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LAW ENFORCEMENT ASSISTANCE ADMINISTRATION (LEAA)

POLICE TECHNICAL ASSISTANCE REPORT

TEMPE (AZ) - POLICE DEPT -

SUBJECT: System Design and Specification Development for Improved Communications

PROJECT NUMBER: 76-162/088

FOR: Tempe, Arizona, Police Department

Population	:	49,919
Police Strength - Sworn		124
Civilian		37
Total	:	161
Square Mile Area	:	33

CONTRACTOR: Public Administration Service
1776 Massachusetts Avenue, N.W.
Washington, D.C. 20036

CONSULTANT: James R. Evans

CONTRACT NUMBER: J-LEAA-002-76

DATE: October 18, 1976

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SECTION I. INTRODUCTION

The City of Tempe is located in the geographic center of the State of Arizona and is a part of the Phoenix metropolitan area. The population of the total metropolitan area is about one million persons and Tempe claims about one tenth of the area's residents. The Arizona State University lies in the north central part of the City of Tempe with an enrollment of 37,200 students. The City's total land area is about 33 square miles.

The City's Police Department has 124 uniformed police officers and 37 civilians. The annual police budget is $3,200,000.00. The Department maintains 67 radio equipped vehicles and provides 24-hour dispatching service.

Nature of Study

The City of Tempe, Arizona requested technical assistance from LEAA because the City's Police Department needed specialized assistance in renovating its communication system. Generally, the Department's plan was to begin operation on a new radio channel and install a suitable satellite receiver system in order to improve communication in poor reception areas of the City. Specifically, the Department requested assistance in the following three areas:

a) Assistance to correct any interference problems that may arise with other Communities as the result of the operation of a new radio channel.

b) Assistance in the design of a suitable satellite communications system.

c) Assistance in the preparation of procurement specifications for communications equipment needed for the new system.

The Department's present radio communications consist of portable radio units that are used both by the foot beat officer and in the patrol vehicle. These portable radios are amplified through a base station repeater system placed on Tempe Butte located on the north edge of the City. The base station also is connected to the control console in police headquarters.

Study Methods

The on-site technical assistance was provided over a three-day time period between September 7 and September 10, 1976. During this period the consultant performed the following tasks:

1) Toured the "poor" communications' areas of the City.

2) Reviewed FCC license problems in connection with the new radio channel.

3) Met with Police Department employees and State Planning Agency personnel relative to possible radio interference problems.

4) Reviewed the present radio dispatch center operations.

5) Assisted in the design of a suitable satellite receiver system capable of future expansion.

6) Established system design criteria and prepared equipment specifications.

Persons interviewed during the assignment were:

Arthur Fairbanks, Chief of Police

Terry Stewart, Captain

Robert Enright, Lieutenant

John Crego, Planner

Stan Conner, Radio Technician

John Morrow, Arizona Criminal Justice Planning

SECTION II. UNDERSTANDING THE PROBLEM

The primary objectives of the assignment were the design of a satellite radio receiver system and equipment specification development. The satellite system design was to incorporate a second radio channel, which had been assigned to the Tempe Police Department about 2 years earlier.

The Radio Frequency Problem

The Department saw the need of a second radio channel several years ago and applied to the State of Arizona Frequency Committee for a pair of very high frequency (VHF) radio channels. The Committee approved the Department's request and assigned the frequencies of 154,800 MHZ for base operation and 155.835 MHZ for mobile operation. The Department then requested a license from the FCC in Washington, D.C. The license was granted on May 23, 1975.

The potential problem of interference was not realized until after the Arizona State Justice Planning Agency requested a review of the Tempe Police grant application by technical employees of the Arizona Department of Public Safety (DPS). At that time reference was made to a possible interference problem between Tempe and radio systems in the Cities of Mesa and Scottsdale (adjacent to Tempe) and the DPS. DPS contended that the close proximity of the above departments could result in radio interference.

Satellite Receiver System Design

A previous grant request submitted by the City of Tempe for Federal funds outlined the need for improved radio communications, especially in the southern area of the City. One of the improvements included in the grant plan was the placement of a satellite type station near the "poor" signal area. The message would be relayed via telephone lines, back to the control center and the base station repeater.

After reviewing the proposed plans the consultant made a visit to the south area of the City in order to establish the proper requirements and recommend a precise system design. The consultant's visit to the area determined, among other things, that the terrain was generally flat and contained mostly one story housing (see Figure 1). Other technical requirements examined included the following:

		Yes	No
a)	Was enough suitable land available?	X	
b)	Was a suitable building available to house radio equipment?	X	
c)	Was the roadway adequate to allow for regular and emergency equipment maintenance?	X	
d)	Was commercial power available?	X	
e)	Was space available for erection of a radio tower?	X	
f)	Was telephone service available?	X	
g)	Would emergency power be available?		X

In addition to the site requirements the satellite receiver system design had to meet three criteria:

1) It had to provide adequate communications to the "poor" original areas.

2) It had to have expansion capability for the future.

3) It had to be installed within present budget limitations.

With these objectives in mind a system was laid out in preliminary form and discussed with local technical personnel (see Figure 2). All agreed the design selected to be a workable system. The only problem was that the LEAA funded portion of grant was based upon equipment prices of one or two years ago and it probably did not accurately reflect today's costs.

The new system design places two satellite receivers on different frequencies in the south section of the City of Tempe. The two receivers and their frequencies correspond to two identical frequencies used in satellite receivers covering the north section of the City. These four receivers are connected to two signal comparators that determine the strongest and best signal from the portable radio unit operating anywhere in the City. This arrangement provides flexibility in the assignment of particular groups of cars on either pair of frequencies. It also allows for future growth since the two radio channels can handle communications for approximately 100 vehicles (from estimates in FCC Rules and Regulations, Part 89).

Other new equipment items shown in the system design configuration in the south section are a radio tower, antenna, coaxial cable, and receiver multi-coupler.

Specification Development

Radio equipment specification development was undertaken after the communication system design was completed. Discussions were held with staff personnel to determine some of the necessary equipment modifications and the desired results to be obtained. Since time was a factor, basic criteria was established to expedite the task.

Figure 1

MAP ILLUSTRATING POOR COMMUNICATION SIGNAL AREAS

Tempe, Arizona

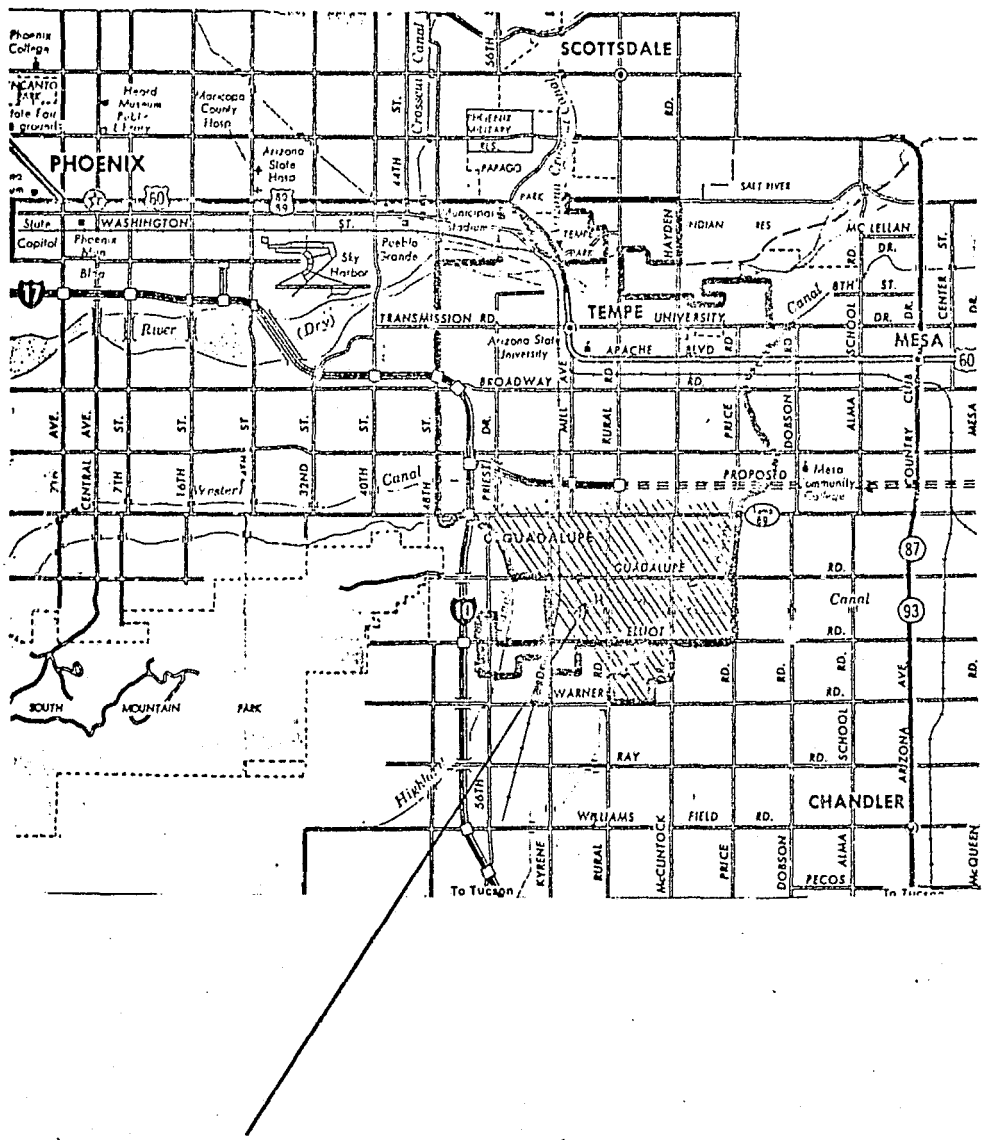
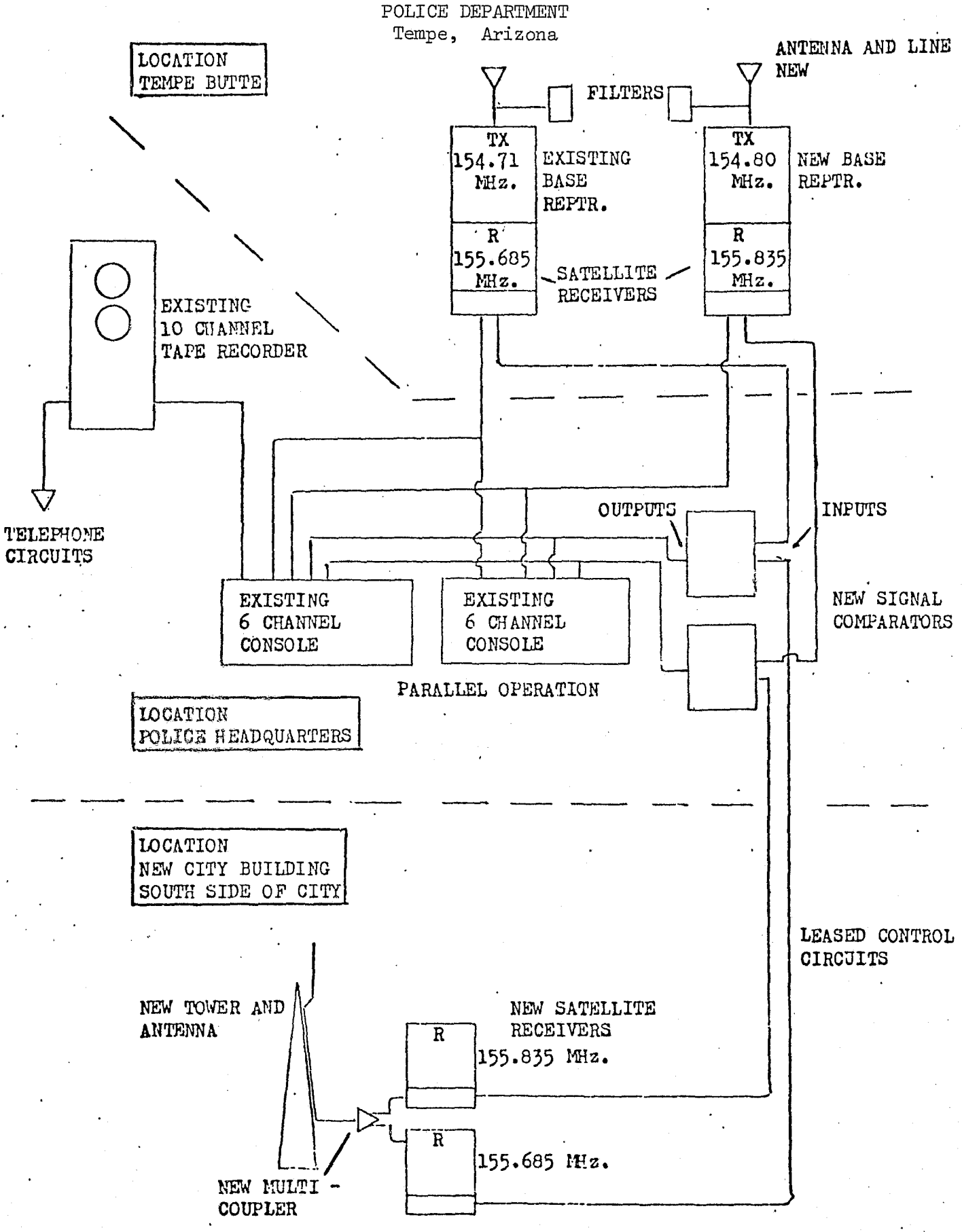


Figure 2

PROPOSED RADIO SYSTEM DESIGN



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SECTION III. ANALYSIS OF THE PROBLEM

The Departments of Mesa, Scottsdale, and the DPS operate radio equipment 15 KHZ removed from the newly licensed Tempe frequencies. These are termed adjacent channels by the FCC. The distance between base antennas are: Tempe to Mesa, 5 miles; Tempe to Scottsdale, 5 miles; Tempe to DPS, 10 miles.

The State Committee had foreseen a possible interference problem before it approved the Tempe application. Thus, it had asked the Tempe Police Department to conduct frequency tests with the other agencies (DPS at that time was not included in the adjacent channel list). The tests were conducted, and no interference problems were detected. The Departments of Mesa and Scottsdale submitted letters to the Frequency Committee which confirmed the test's results. The Committee, in turn, granted Tempe the use of the frequencies.

The above points were thoroughly discussed at a meeting between the consultant, Police Department officials, and Mr. Morrow of the State Planning Agency. After considerable discussion, a decision was reached whereby Tempe would install its new equipment on the new frequencies. Significant to this determination was the fact that no other acceptable VHF channels were available in the Phoenix area. If an interference problem were to eventually occur the Tempe Police Department could purchase filters or change frequencies to minimize or eliminate the problem.

Specification Development

The radio equipment specifications are based upon the new system design. The specifications are non-restrictive in order to attract a minimum of three vendors. Some of the standard LEAA guidelines have been incorporated into the functional section of the specifications. In addition, the specifications reflect the latest in satellite receiver and signal comparator equipment. Equipment specifications appear in the Appendix.

IV. FINDINGS AND CONCLUSIONS

The findings and conclusions are based upon the three original areas of concern, namely:

a) Potential problems arising from the assignment of a new radio channel.

b) Correcting communication deficiencies in poor reception areas.

c) Developing procurement specifications for the purchase of new equipment.

Findings	Remarks
a) The City presently is licensed by the FCC for an additional radio channel.	a) The City should continue its original plans since it is doubtful that any radio interference will develop and the new channel will provide more dependable service to officers and citizens.
b) The "poor" reception areas of the City are probably caused by deficiencies in the original system design which depend on 5-watt portable units.	b) The new system concept will completely eliminate the poor reception areas and provide the officer with dependable communications.
c) The Department had not prepared procurement specifications for new radio equipment.	c) Specifications for the proposed communication system design have been prepared and are set forth in the Appendix of this report.

V. RECOMMENDATIONS

The most feasible approach for Tempe to pursue is to continue with its original plan to use the new channel assigned by the State Frequency Committee and install a new satellite receiver station. Another alternative, of course, is to continue with the present system, but this could be dangerous to the officers who must rely upon radio communications. Another alternative would be to install high power mobile units in all police vehicles in place of the existing low power portables. This alternative would be costly, however, and it still would not improve communications for the officer on foot in the "poor" signal areas.

General Recommendation

The general recommendation is to proceed with present plans for a revised and updated radio system.

Specific Recommendations

1. Continue with present planning to install a second radio channel to improve City-wide communications.

2. Adopt the approved system design while keeping in mind future additional improvements in the data field.

3. Acquire recommended radio equipment as soon as possible after final specification approval by the City and the State Planning Agency.

A p p e n d i x

RADIO EQUIPMENT SPECIFICATIONS

Tempe, Arizona, Police Department

SPECIFICATION INDEX

1.0 GENERAL

These specifications set forth minimum equipment standards required for the purchase of a repeater base station, radio tower, comparators, satellite receivers, and associated items for the Police Department in Tempe, Arizona.

All equipment items bid must be of current design and in production by the company that the vendor represents. It is the prerogative of the Police Department to request field tests and/or equipment samples if new designs are bid that have not been field tested.

The specifications are intended to be of non-restrictive nature that will provide open and free competition among vendors. Only high quality radio equipment with proven field performance records will be acceptable. Parts availability, equipment delivery, and other factors will be considered in awarding the bid.

1 A.1 SCOPE OF PROJECT

This project and the enclosed specification are designed to allow the purchase, installation, testing, and warrantee of certain radio equipment items.

The following items are to be purchased:

ITEM and EXPLANATION

Base Station - VHF Repeater
Filters or Duplexers as required.
Existing Receiver Modification or Replacement.
Two Satellite Receivers with Antenna Coupler.
Two Signal Comparators.
One Multi-Channel Tape Recorder Modification.
Radio Tower - 50 foot, S.S. Type
Antennas - 5 to 6 DB Gain.
Coaxial Cable - 140 Ft. with Fittings
Other items required for system implementation but not on this RFP are portable modifications, installation of base, receivers, comparator, and leased control lines.

1 A.2 INSTRUCTIONS TO BIDDERS

Sealed bids will be received at the office of _____ on _____ to supply radio communications equipment and/or system for Tempe, Arizona. Bids shall be in a sealed envelope.

Prices on bids will be firm for 120 days. A minimum of thirty days will be allowed between the time that the bid request is sent to the vendors and the date that the bids are to be received.

Contracts shall be made only with responsible contractors who possess the potential ability to perform successfully under the terms and conditions of this proposed procurement. Consideration shall be given to such matters as contractor integrity, record of past performance, financial and technical resources, or accessibility to other necessary resources (from Federal Guideline Manual M1700.6, page 3-5).

Bids will be made in accordance with local bidding procedures and information contained in the Federal Guideline Manual Number M 7100.1A dated April 30, 1973 as amended. (Note: vendors not familiar with these guidelines may review the document at the Arizona Justice Planning Agency, located in Phoenix, Arizona.) All vendors will comply with the Federal Guidelines.

The Federal Guidelines address the matter of competitive bidding as follows:

> Adequate competition. All procurement transactions regardless of whether negotiated or advertised shall be conducted in a manner so as to provide maximum, open and free competition. (Contractors that develop or draft specification requirements, statements of work, and/or RFP's for a proposed procurement shall be excluded from bidding or submitting a proposal to compete for the award of such procurement.)

Any vendor who plans to bid on a project may obtain by written request to the Tempe, Arizona Police Department, an interpretation on any part of the system design or specifications. The written request must be received by the City at least two weeks prior to the bid opening date. The Police Department's answers to the request will be to the best of its ability and the Department will not be held responsible for the vendor's interpretation of the specifications.

1 A.3 ALTERNATE PROPOSALS

An alternate bid may be submitted and will be evaluated upon its contents and merit. The prime bid will be the one that meets the specifications. The alternate bid or proposal will indicate in complete detail how it will benefit or be superior to a prime bid meeting the specifications.

1 A.4 PAYMENTS TO VENDORS

Payments will be made to the vendors or contractors by the fiscal officer on the project.

The first payment will be made after the equipment has been received at the designated location. The amount of the first payment will be determined by the fiscal officer and usually is 90 per cent of the invoice amount. These payments shall in no way constitute acceptance of the installation or operation of the equipment.

The final payment of all sums due the vendor or contractor shall be made within 30 days after complete installation and acceptance by the City of Tempe Police Department.

1 A.5 BID BONDS AND BID SECURITY

Federal guidelines require bid bonds or bid security in certain contracts over $100,000.00. The local purchasing agent or fiscal officer may, because of local regulations, require a bid security on contracts less than $100,000.00.

Excerpts from federal guideline manual M1700.6, page 4-30-1 are as follows:

1. All bids shall be accompanied by one of the following forms of bidder's security:

a. Cash.

b. Cashier check made payable to purchaser.

c. A certified check made payable to the purchaser.

d. A bidder's bond executed by a surety company authorized to do business in this State, made payable to the purchaser.

2. The security shall be in an amount equal to at least 5% of the amount bid.

3. If the contract is not awarded to the bidder, the security will be refunded within 3 days of the announcement of the award.

4. The bid bond will be returned to the successful bidder on receipt of the payment and performance bond. If the successful bidder fails to execute the contract, the amount of his security shall be forfeited to the purchaser.

1 A.6 PERFORMANCE BONDS

Federal guidelines require performance bonds on certain contracts over $100,000.00. The local purchasing agent or fiscal officer may, because of local policies or regulations, require a performance bond on contracts less than $100,000.00.

The equipment must operate after installation in accordance to the specifications of the manufacturer.

Excerpts from federal guideline manual M1700.6, page 4-31 are as follows:

1. The Contractor agrees to furnish to the governmental unit at his own expense a performance bond and a payment bond which shall become binding upon the award of the contract to the Contractor.

2. The performance bond shall be 100% of the contract amount, conditioned upon the faithful performance of the contract in accordance with the plans, specifications and terms thereof. The bond shall be solely for the purchaser.

3. The payment bond shall be fixed at 100% of the contract amount solely for the protection of the claimants, as defined in paragraph 6 of this clause, supplying labor or materials to the principal Contractor or his sub-contractors in the prosecution of the work provided for in the contract.

4. The bond shall be executed by a surety company authorized to do business in this State. The purchaser shall be the payee.

5. The bonds shall be filed in the purchaser's office within 7 days of the notification of the award of the contract.

6. A "Claimant" means a person having furnished labor, material, or both, used or reasonably required for use in the performance of the contract.

1 A.7 INSURANCE

Any successful bidder to this project shall have approved insurance. The bidder or contractor and all sub-contractors shall maintain for the life of the contract; Workman's Compensation, Public Liability, and Property Damage Insurance that will protect him from all claims which might result from operations under this contract either by his own employees or those of any sub-contractor.

1 A.8 CONTRACT DISPUTES AND APPEALS

The federal procurement manual M1700.6, page 6-21 covers adequately the matter of disputes that may arise during the course of a contract. It states as follows:

1. Responsibility of grantee. The grantee is the responsible authority, without recourse to LEAA regarding the settlement and satisfaction of all contractual and administrative issues arising out of procurements entered into, in support of a grant. This includes but is not limited to: disputes, claims, protests of award, source evaluation, or other matters of a contractual nature.

2. Preferred method of resolution.

   a. Most procurements are completed as planned. However, disagreements do arise from time to time. To avoid delays, the disputes procedures have been developed to adjust disagreements while work continues. This is an administrative method for resolving contract issues and is preferred over resorting directly to legal action. The preferred administrative method encourages the parties to agree to handle disputes by direct discussion or negotiation and thus avoid a consuming and costly legal proceeding. In the event that a dispute cannot be resolved by the parties directly involved, the administrative procedure normally includes provisions for the contractor to appeal directly to a local

jurisdictional body such as an Appeal Board, Arbitration Board, or a Hearing Panel established in accordance with State or local policies, rules or regulations.

b. The recourse for a contractor to settle disputes should be spelled out in a general provision in the grantee's contract.

1 A.9 PERMITS AND REGULATIONS

STATE AND LOCAL

The subgrantee (Police Department) shall obtain all permits and licenses for use of permanent structures or roadways and rite of ways for radio tower access. The contractor shall obtain all temporary permits or licenses necessary for his operation and shall comply with all laws, ordinances, rules, and regulations concerning the work assignment.

1 A.10 COMPLIANCE WITH FCC, FAA, EIA, IEEE, AND RETMA STANDARDS AND REGULATIONS

All contractors and their work, construction, and equipment must meet or exceed current standards and regulations as published by the Commissions or Associations:

A. Federal Communications Commission (FCC)

B. Federal Aviation Agency (FAA)

C. Electronic Industries Association (EIA)

D. Institute of Electrical and Electronic Engineers, Inc. (IEEE)

E. Radio-Electronics-Television Manufacturing Association (RETMA)

F. Environmental Protection Agency (EPA)

1 A.11 CONTRACTOR WORK HOURS AND SAFETY STANDARDS ACT

All contractors shall abide by the Federal Act (40 USC 327-330) as stated below:

Where applicable, all contracts awarded by grantees and subgrantees in excess of $2,000 for construction contracts and in excess of $2,500 for other contracts which involve the employment of mechanics or laborers shall include a provision for compliance with Sections 103 and 107 of the Contract Work Hours and Safety Standards Act (40 USC 327-330) as supplemented by Department of Labor Regulations (29 CFR, Part 5). Under Section 103 of the Act, each contractor shall be required to compute the wages of every mechanic and laborer on the basis of a standard work day of eight (8) hours and a standard work week of 40 hours. Work in excess of the standard work day or

work week is permissible, provided that the worker is compensated at a rate of not less than 1 1/2 times the basic rate of pay of all hours worked in excess of eight (8) hours in any calendar day or 40 hours in the work week. Section 107 of the Act is applicable to construction work and provides that no laborer or mechanic shall be required to work in surroundings or under working conditions which are unsanitary, hazardous, or dangerous to his health and safety as determined under construction, safety, and health standards promulgated by the Secretary of Labor. These requirements do not apply to the purchases of supplies, materials, or articles ordinarily available on the open market, or contracts for transportation or transmission of intelligence.

1 A.12 EQUAL OPPORTUNITY

All vendors bidding upon these specifications shall abide with the Federal Equal Opportunity Act.

All contracts in excess of $10,000 shall contain provisions to insure "Equal Employment Opportunity" for compliance with Executive Order No. 11246, as supplemented in the Department of Labor regulations (41 CFR, Part 60). Each contractor shall be required to have an affirmative action plan which declares that it does not discriminate on the basis of race, color, religion, creed, national origin, sex, or age; and which specifies goals and target dates to insure implementation of the plan. The sub-grantee shall establish procedures to insure compliance with this requirement by contractors and to insure that suspected or reported violations are promptly investigated.

1 A.13 ANTI-KICK-BACK ACT

All vendors bidding upon these specifications shall abide with the Copeland "Anti-Kick-Back" Act.

A brief explanation of the Act is as follows:

This Act provides that any contractor shall be prohibited from including, by any means, any person employed in the construction, completion, or repair of public work to give up any part of the compensation to which he is entitled. The sub-grantee shall report any suspected or reported violations to the Agency.

1 A.14 EXAMINATION OF CONTRACTUAL RECORDS

Any successful vendor for this communications project shall agree to comply with provisions of the federal guideline manual M1700.6, Chapter 4, Section 4, page 4-38 relative to examination of contractual records if required. The following is an excerpt from the federal guidelines:

All contracts awarded by grantees shall include a provision to the effect that the grantee, LEAA, and the Comptroller General of the United States, or any of their duly authorized representatives, shall have access for purpose of audit and examination to any books, documents, papers, and records of the contractor that are pertinent to the grants received under Title I.

1 A.15 ENVIRONMENTAL POLICY ACT

The contractor and the sub-grantee must comply with guidelines as set forth in the National Environmental Policy Act of 1969 if applicable to the project. Excerpts from federal guideline manual M4100.1E dated January 16, 1976 states as follows:

The National Environmental Policy Act of 1969, Section 102(2) (C), (P.L. 91-190) and Guidelines issued by the Council on Environmental Quality (CEQ) require that prior to "major federal actions" significantly affecting the quality of the human environment an assessment of environmental consequences shall be made in the form of a (draft) environmental statement, which shall be circulated for comment by the federal agency to federal, state, and local agencies and the public as provided in CEQ Guidelines and then revised as needed. A final environmental statement must accompany the proposed action through LEAA's review and decision-making processes. Failure to comply with environmental clearance procedures at the time a grant application is being processed exposes LEAA and the State Planning Agency to litigation. See Guideline Manual M 4061.5, Environmental Procedures.

Actions on Which Environmental Evaluations or Environmental Impact Statements are Required:

(1) New construction projects.

(2) The renovation or modification of a facility which leads to an increased occupancy of more than 25 persons.

(3) The implementation of programs involving the use of pesticides and other harmful chemicals.

(4) The implementation of programs involving the use of microwaves or radiation.

(5) Research and technology whose anticipated or intended future application could be expected to have a potential effect on the environment.

(6) Other actions which require the substantial commitment of resources or trigger such a substantial commitment by another as determined by the responsible LEAA official to possibly have a significant effect on the quality of the environment.

1 A.16 EQUIPMENT WARRANTEE

All communications equipment supplied by the vendor shall have a warrantee period to be stipulated in the vendor's bid. This period will be considered during the bid evaluation. The warrantee shall include all parts, sub-assemblies and complete assemblies, and labor for repair during the period of warrantee.

The system and all equipment must function properly and be completely installed before final acceptance.

If during the first year of operation there are excessive or repeated failures of equipment or components, the vendor shall correct the defect or replace the entire unit at no cost to the user agency.

The contractor or vendor shall warrant to the agency that all equipment supplied will meet the technical specifications, and shall be free of defects in materials and workmanship.

1 A.17 FCC LICENSE REQUIREMENT

It will be the vendor's responsibility to provide radio equipment on the proper designated frequencies that are to be used by the agency. The frequencies have been licensed by the Police Department and are designated in other sections of the specifications.

1 A.18 EVALUATION OF BIDS

The evaluation of bids will be made by the sub-grantee personnel, which normally consists of a police representative and the purchasing agent.

Communications project bids will include evaluation factors such as delivery date, bid price, bid consistent with bid request, compliance with equipment specifications, past record of vendor's company, and other factors that may be considered important by the project director or the purchasing director.

The following is an excerpt from the federal guidelines manual M1700.6, Page 3-10 relative to bid evaluation:

The fourth step is the evaluation of bids, which is the process of determining whether each offer has been submitted in conformance with the requirements of the invitation--what is offered and the contractual terms. Ordinarily, any bid that deviates in any way from the essential requirements of the invitation will be rejected. The basic rules applied in determining deviations are whether the bidder's variance from the parameters of the invitation affects the price, quantity, delivery period, quality of the item, or the grantee's specific contract terms. Should any of these variances exist the bid must be rejected and the bidder cannot be permitted to remedy the defect in his offer. Particularly evident in this step is that no flexibility

is permitted either the purchasing official or the bidder in the procurement method. Responsiveness to an IFB is an objective decision. In the evaluation step the grantee also determines the responsibility of the prospective contractor. If deemed desirable, the responsibility of a prospective contractor may be determined by a pre-award survey.

1 A.19 FREIGHT AND DELIVERY

The best and fastest delivery schedule shall be quoted in the vendor's bid. Each bid will reflect the point of delivery and the price indicated either as a separate item or included in equipment cost. It shall be the responsibility of the successful bidder to see that the equipment is delivered as per schedule at the designated point.

1 A.20 INSTALLATION

The installation of all equipment in this project will be performed by City technical personnel, except the radio tower, antenna, coaxial cable, and modification parts and wiring.

The agency desires to use their own technical personnel for installation, the contractor shall furnish the agency with full information relative to every phase of the specific item to be installed.

When the agency installs any equipment the contractor will not be responsible for the installation; however, he will retain an equipment warrantee responsibility.

If special tools are required for certain installations, the vendor will advise the agency where the tools are available.

When installing base station equipment, comparators, satellite receivers, tape recorders, and etc. the agency will supply 120/240 VAC electrical power to the site or area of installation. The agency will be responsible for radio control lines or circuits to the area of installation. The agency will obtain property, rite of way, and FAA and FCC permits and licenses.

The contractor or vendor will assist in the performance of equipment tests.

Frequency and modulation measurements will be made on all transmitters by the City and a copy of the written record will be filed in the agency at the time of equipment tests.

1 A.21 EQUIPMENT TESTS

The Police Department's radio technician will perform all equipment tests. New equipment that fails to perform to specifications will be tested on site by the vendor's technical staff and repaired or replaced. All equipment tests on transmitters will be performed by a radio technician holding a second class radio telephone license or higher.

Examples of work in testing and adjusting may include:

1. Level adjustments for proper dB level on consoles, receivers, and base station equipment.

2. Adjustment of level controls on tape recording equipment to provide proper audio delivery without cross-talk on telephone circuits.

The vendor will supply all technical information that is required to meet factory specifications and FCC rules and regulations.

The contractor will recommend the make, model, and price of any special test equipment that is required to perform the necessary adjustments and tests.

1 A.22 WORK INSPECTION

The contractor and the Police Department technician will jointly inspect the completed portions of the system.

Final inspection will be carried out in the same manner. The inspection by either party does not indicate system acceptance.

1 A.23 INSTRUCTION MANUALS

The vendor will furnish prior to installation of the system or equipment complete and final instruction manuals. They will include all latest revisions in the equipment.

Quantity of Manuals Required	
Base station	1
Satellite Receivers	2
Receiver Decoupler	1
Signal Comparators	1
Tape Recorders	1

The manuals shall be 8 1/2 x 11 inches and all pages fastened securely together. They will include complete service data and theory of operation. Information for ordering of all parts, transistors, sub-assemblies, as well as cables.

The manuals shall contain all current revisions. All equipment manufactured by sub-contractors will have manuals of equal quality and completeness.

All parts will have an identification number for ordering and will be kept in stock by the equipment manufacturer for a period to ten (10) years.

As a minimum, the instruction manual shall include:

1. Table of contents.

2. Complete parts description of each part and/or electrical sub-assembly.

3. Technical voltages, resistance, capacity of all electrical items.

4. Complete mounting instructions.

5. Schematic diagrams of all circuits.

6. Tuning instructions of all equipment capable of this action.

7. Operational block diagram and pictorial of parts location.

1 A.24 TEST EQUIPMENT

The vendor or contractor shall recommend any special test equipment or tools required for maintenance of his equipment. Any special cables, plug-in electronic boards, extender boards for modules that are not supplied as a standard item with the equipment will be recommended. One spare module shall be supplied with the signal comparators.

1 A.25 TRAINING

The vendor will provide factory training for a period of one week if the agency has their own technicians and is desirous of this need.

The training will include as a minimum basic two-way service training on the companies base stations, mobile units, portable units and control consoles, signal comparators, and satellite receivers. The training will include as a minimum the principles of operation, alignment and tuning special circuits, and use of special test equipment.

The term factory training is defined as either at the vendor's plant or at a field training session in the southwest.

1 A.26 RADIO SYSTEM DESIGN DIAGRAM

Figure 1 A.26 indicates a brief system design that will aid vendors when bidding upon the specifications. The diagram identifies the location of equipment items such as the base stations, control consoles, signal comparators, satellite receivers, and the new radio tower.

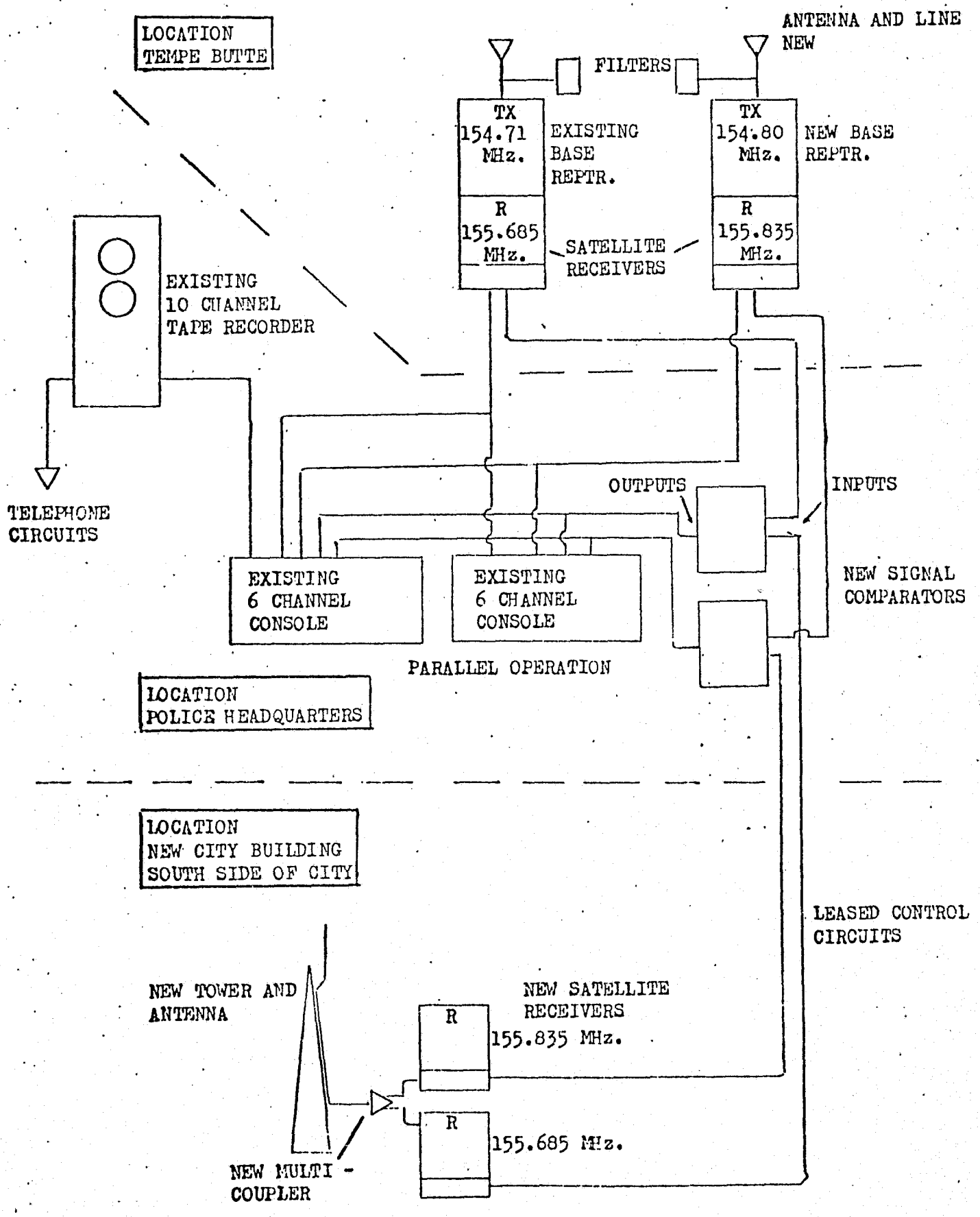
All technical questions relative to wiring circuits, installations, and operating criteria will be answered by the technical (radio) staff of the Tempe Police Department.

Please note that the basic diagram does not necessarily indicate the exact wiring between all components nor all of the control wiring in the control consoles and base station repeaters.

Figure 1 A.26

PROPOSED RADIO SYSTEM DESIGN

POLICE DEPARTMENT
Tempe, Arizona



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2.0 BASE STATIONS VHF

The base station radio specifications are prepared for the Tempe, Arizona Police Department for procurement of one VHF base unit radio to operate as a repeater unit and the receiver to be operated as one satellite into a signal comparator.

The base station radio equipment must be, "off the shelf", meeting all FCC and EIA requirements. The past performance record will be considered in the evaluation of bids by the sub-grantee.

All upright base stations will have test meters for proper testing of major circuits in the transmitter and receiver.

Technical manuals, test microphone, and speaker will be included with each base unit.

2 A.1 GENERAL

Primary power	-------	115 V AC, 60 Hz., single phase
Duty cycle	-------	Continuous for 110 Watts and below
Circuitry	-------	Completely solid state
Cabinet style	-------	Indoor upright style, 19" rack space. Height not to exceed 84 inches. Front and rear doors to be locked and keyed alike.
Type of Modulation	-------	FM
Type of control	-------	Remote. 600 ohm termination.
Ambient temperature	-------	- 30 to + 60 degrees C.
Environmental	-------	10,000 feet.
Operating Frequencies	-------	Transmitter 154.800 MH_z. Receiver 155.835 MH_z.
Tone squelch	-------	No

2 A.2 SPECIFIC DATA, Transmitter

Output impedance	--------	50 ohms.
Output power	--------	100 watts minimum.
FM noise	--------	- 55 db.
Modulation	--------	16F3, +/-5 kHz.
Frequency stability	--------	+/-.0005%.
Output distortion	--------	Less than 5%, 300 to 3000 Hz.
Audio response	--------	Within +1 and -3 db of 6 db per octave pre-emphasis 300 to 3000 Hz.
Spurious emission	--------	- 70 db down

2 A.3 SPECIFIC DATA, Receiver

Input impedance	--------	50 ohms
Modulation acceptance	--------	+/- 7 kHz.
Frequency stability	--------	+/- .0005%
Sensitivity	--------	.35 uv. EIA 12 db SINAD.
Selectivity	--------	- 90 db, @ +/- 30 kHz.
Intermodulation	--------	- 80 db. Min.
Spruious and Image Rejection -		- 90 db. Min.
Audio output	--------	5 watts.
Audio distortion	--------	5% or less.
Audio response	--------	Within +1 and -8db per octave deemphasis 300 to 3000 Hz.
Hum and noise	--------	- 40db down.
Number of receivers	- ------	One per one frequency station, Remote, 600 ohm termination.
Receiver mode	--------	Satellite operation, compatible with signal comparator.

2 A.4 ISOLATION EQUIPMENT

The vendor shall supply and install isolation equipment if determined necessary for interference free operation at this site.

Some isolation may be accrued from vertical antenna separation; however, both antennas must remain as high as possible to achieve maximum gain. To realize minimum receiver desensitization and minimum transmitter intermodulation a filter and duplexer combination shall be considered.

3.0 RADIO TOWER

The radio tower purchased by this specification shall meet FAA and FCC regulations and EIA standards. The tower furnished must have a minimum 30 pound wind load factor with the required antenna installed.

3 A.1 REQUIREMENTS

1. Tower to be 50 feet in height, self-supporting type.
2. One 6.0 db gain antenna will be placed at the top of the tower.
3. Loading factor shall include 7/8 inch coaxial cable.
4. A warrantee shall be furnished by the vendor that defines the period of warrantee time with the indicated loading, not less than 12 months warrantee period will be accepted.
5. Routine maintenance instructions shall be supplied by the vendor. A manual shall also be supplied setting forth the drawings of the footings, guy anchors, and other construction details.
6. All tower members and sections shall be hot dipped galvanized finish.
7. A ground system shall be installed by the vendor consisting of a minimum of a 10 foot copper rod, clamps, and lead wire of No. 8 size or larger.
8. Concrete footings, if required, must have as a minimum a compression strength of 3000 lbs PSF at 28 days.
9. The vendors price shall include complete erection and installation of tower and removal of rubble after completion. Installation prices will cover lighting and painting if needed and antenna work. (Antenna installation may be an option with the customer.)

4.0 ANTENNA SYSTEMS

4 A.1 GENERAL

Two antenna systems are to be supplied and installed. They will be located at the Tempe Butte site and the new South Tower site. A system consists of the antenna, coaxial cable, fittings, and accessories. The vendor will be responsible for quality work by all sub-contractors.

4 A.2 SPECIFIC DATA, Electrical

Operating frequency	155 mHz.
Bandwidth	10 mHz.
Gain	5 or more.
Vertical pattern beamwidth	16 degrees at 1/2 power points.
V.S.W.R.	1.5:1 or less.
Maximum power input	500 watts.

4 A.3 SPECIFIC DATA, Mechanical

Type desired	4 element folded dipole mast mounted or approved equal.
Mounting location	One at top of new 50 ft. tower; one on existing structure at Tempe Butte.
Mounting hardware	To be furnished by vendor.
Approximate length	21 feet.
Windload	Not more than $(3.2 \text{ ft.})^2$ flat area equivalent.

4 A.4 SPECIFIC DATA, Transmission Line

Quantity in feet	140 (40 ft. at Butte) (100 ft. on new location)
Type	Coaxial, foam dielectric.
Impedance	50 ohms.
Conductors, Outer and Inner	Copper.
Size	7/8 inch.

Attenuation	----------	0.6 dB/100 feet or less.
Outer cover	----------	Polyethylene.
Connectors	----------	One end antenna, other base station.
Mounting hardware	----------	To be furnished by vendor. (All line to be securely fastened to tower by stainless wraplock.)

4 A.5 INSTALLATION

The term installation includes all antenna mounting, coaxial cable erection, cable termination to base equipment area, testing, proper grounding of the outer shield, and other tasks normally required.

5.0 SATELLITE RECEIVERS

5 A.1 GENERAL

The satellite receivers to be purchased on this bid will be divided into three categories (Note: refer to system diagram figure 1 A.26). One existing radio receiver located in the repeater station at Tempe Butte will require modification for satellite operation into the signal comparator or must be replaced with a new receiver if the vendor is unable to modify the existing unit.

A second satellite receiver will be required in the new base station that is being purchased for operation of the second pair of radio channels.

The third and fourth satellite receivers will be placed at the new tower location in the south section of the City. These receivers may be mounted in a single cabinet.

All receivers must be compatible with the signal comparators being purchased.

Each receiver must have its own power supply and a tone encoder or generator.

A receiver multicoupler shall be supplied for two-receiver operation at the south site.

Receiver frequencies are as follows:

Location		Frequency
#1 Existing (butte)	----------	155.685 mHz.
#2 New (at base on butte)	----------	155.835 mHz.
#3 New (at south location)	----------	155.835 mHz.
#4 New (at south location)	----------	155.685 mHz.

5 A.2 SPECIFIC DATA, Receiver

Channel spacing	------- 30 KHz.
Sensitivity	------- 0.35 uv. (12 dB SINAD)
Selectivity	------- -90 dB
Frequency stability	------- ± .0005%
Spurious and image rejection	— -100 dB
Modulation acceptance	------- 7 KHz.
Intermodulation	------- - 80 dB
Audio Output	------- + 11 dB @600 ohms.
Audio distortion	------- 3% or less
R. F. impedance	------- 50 ohms.
Impulse noise rejection	------- Required on 2 south receivers
Audio response	------- EIA specifications.

5 A.3 INSTALLATION

The installation of all receivers will be completed by the Tempe Police Department.

6.0 SIGNAL COMPARATORS (VOTERS)

6 A.1 GENERAL

Two signal comparators are required on the procurement. They must be compatible with the four satellite receivers. Each comparator shall have two inputs with a future expansion to four or more.

A spare input module shall be supplied with the two comparators to assist in maintenance and reduce "down" time. Other modules or test equipment necessary for maintenance will be bid by the vendor as an option for purchase by the City.

The comparators shall be housed in a suitable cabinet. They are to be mounted in the communications center.

6 A.2 TECHNICAL

Power supply	------ 115 V. AC, 60 Hz., 1 phase.
Input impedance	------ 600 ohms.
Line sensitivity	------ -20 to -30 dBm
Output impedance	------ 600 ohms.
Output level	------ +11 dBm or more (adjustable)
Output audio response	------ $\pm$ 1 dB from 300 - 3000 Hz.
Output audio distortion	------ 5% or less.
Unselected channel rejection	- -40 dB or more.
Initial response timing	------ 50 ms. or less.

6 A.3 INSTALLATION

The installation of the two comparators will be completed by the technical staff of the Tempe Police Department.

The successful vendor shall provide instruction manuals for installation and maintenance of the equipment. These are to be shipped with the comparator units.

Leased telephone circuits from the satellite receivers to the comparators will be the responsibility of the Police Department.

Any special tools or test equipment required for installation or maintenance of the comparators will be bid as an option by the vendor.

7.0 RECORDER MODIFICATION

7 A.1 GENERAL

Modification is required of the existing multi-channel tape recorder. The modification will consist of changing an existing 10 channel recorder to a maximum of 30 channels.

The existing recorder is a Dictaphone model 4000 series. The technical specifications of the recorder are on file at the Police Department.

After modification the recorder unit must meet or exceed original specifications. The workmanship on all cables shall be neat and all parts supplied and installed per factory specifications and quality control.

The circuit modifications and technical manuals shall be supplied to the technical staff of the Police Department.

The vendor will be required to connect all radio and telephone circuits to the recorder and adjust and test for proper operation.

This modification may be bid by the original equipment vendor or by vendors of radio equipment as an option.

New tapes for the modified recorder are being purchased on a separate order.

8.0 CONTROL CONSOLE MODIFICATIONS

8 A.1 GENERAL

Modification of two existing radio control consoles will be required for operation of the expanded system.

This modification may be bid by the original equipment vendor as an option or by other radio equipment vendors.

The conversion will basically be the addition of two transmit and receive channels or modules. The control consoles were manufactured by the General Electric Company. Technical data and exact modifications may be obtained from the technical staff of the Police Department.

The modifications will include all parts or assemblies. Wiring shall be in a workmanship manner. The units must be tested after completion and must meet or exceed original manufacturer's specifications.

8 A.2

Other modifications in the revised radio system will include the addition of a second frequency to the mobiles and portable units. Labor for these modifications will be provided by the Police Department.

END

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