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INDIVIDUAL TECHNICAL ASSISTANCE REPORT

In Response to a Request for Technical Assistance

by the

Virginia Division of Justice
and
Crime Prevention

July 16, 1973

NCJRS

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ACQUISITION

Prepared by:

Public Administration Service
1313 East 60th Street
Chicago, Illinois 60637

(Per Contract J-LEAA-015-72)

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I. PRELIMINARY INFORMATION

A. **Consultant Assigned:**

A. Robert Patzlaff
Radio Communications Consultant

B. **Date Assignment Received:**

June 8, 1973

C. **Date of Contact with LEAA Regional Coordinator:**

June 8, 1973

D. **Dates of On-Site Consultation:**

June 21-22, 1973

E. **Individuals Contacted:**

Mr. Joseph N. Tucker
Police Systems Coordinator
Division of Justice and Crime Prevention

Mr. Dean Jennings
Associate Police Systems Coordinator

Mr. Ron Neely
Police Estimate Specialist

Mr. R. N. Smith
Assistant Director
Department of Purchases and Supplies

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II. STATEMENT OF THE PROBLEM

A. **Problem as per Request for Technical Assistance:**

Technical assistance in reviewing the specifications for equipment to be purchased in connection with the Statewide Police Radio Plan.

B. **Problem Actually Observed:**

As stated.

III. FACTS BEARING ON THE PROBLEM

See attached Consultant's Report.

IV. DISCUSSION OF POSSIBLE COURSES OF ACTION

See attached Consultant's Report.

V. RECOMMENDED COURSES OF ACTION

See attached Consultant's Report.

CONSULTANT'S REPORT

Information Background on the Sheriff's Radio Network

Sheriffs' police departments in Virginia are responsible for transporting prisoners across the State when required, as well as other regular police activities when there is no other local police unit having jurisdiction over a local area. As such, sheriff's police require local mobile-to-base and mobile-to-mobile communication within their own county as well as for point-to-point communication among counties and mobile-to-base communication from a vehicle to any other county when in transit with a prisoner which may cover a route crossing several counties.

Over the years the frequency 39.5 MHz has primarily been the sole frequency in use for this purpose with most departments using single frequency radios with carrier squelch operation. In some rural areas volunteer aid organizations work in cooperation with the sheriff's police and have their own equipment operating on 39.5 MHz carrier squelch.

With all counties sharing this one frequency for all activities and with external interference from "skip signals," congestion and interference have been at a high level. However, the many departments and volunteer organizations now having equipment operating on 39.5 MHz make it impractical to completely abandon use of this frequency from an economical point of view; and from a practical point of view, the State recognized that to abandon the 39.5 MHz channel for a high band UHF frequency for local area use would require the use of two radios in a vehicle if they were to retain the ability to travel across the State and communicate to any county base station.

The County Sheriff's Radio Plan

For reasons stated above, the State has embarked on a sheriff's radio network (Statewide Police Radio Plan) which:

1. Retains 39.5 MHz as a point-to-point and "cross-state" frequency for coordination. (Carrier Squelch)
2. Has been assigning a second, individual frequency normally within 1 percent of the 39.5 MHz frequency for use by each county for their local operations. (Tone Coded Squelch Operation)

There are 26 radio channels licensable for base and mobile use in the F.C.C. listing of available channels from 39.12 to 39.90 MHz. Therefore, the plan provides for individual county frequencies with a minimal amount of sharing. Some of the frequencies are, however, on a shared basis between police radio services and local government radio services by F.C.C. rules. However, the State has been coordinating with other users and has worked out frequency coordination and cooperative arrangements to the extent that they expect little interference from co-channel users. In this coordination effort they are also finding that many users are leaving the 39 MHz band in favor of 150 or 450 MHz. Thus the exodus from what has been an interference-laden frequency range by other users is leaving a relatively lightly loaded group of frequencies in some cases.

To provide protection from co-channel users or skip signals, each individual county frequency will operate in the EIA Continuous Carrier Tone Coded Squelch (CCTCS) mode. However, initial operation on 39.5 MHz will be on carrier squelch only to simplify intrazone communication requirements and communication with volunteer group equipment.

Summary of Discussions and Recommendations

Tone Coded Squelch Frequencies

Presently the vendors have been assigning different tone coded squelch frequencies for each county frequency. However, since the radio frequency plan furnished the consultant by the Requesting Agency illustrates that R.F. frequencies are providing the necessary protection against co-channel interference among the counties, it was suggested that the State try to find a common CCTCS frequency for use in all sheriffs' systems. Reasons for this are:

1. As older equipment is gradually replaced and new equipment is purchased with tone coded squelch, it will be possible gradually to achieve the protection from outside interference on 39.5 MHz also.
2. Ordering and coordination of equipment are simplified and a "third" channel, if added in the future on mobile units for some specific coordination purpose, would find all sheriffs' units on the same CCTCS frequency and simplify intracommunication on any future channel added to the network while affording the nuisance interference protection inherent in CCTCS operation.

It was recommended that the Division of Justice and Crime Coordination Activities begin a record tabulation of CCTCS frequencies assigned already in use and request from equipment suppliers either a listing of CCTCS frequencies used on 39.5 throughout the U.S.A. or else ask for a recommendation of the most suitable code on 39.5 MHz. Equipment suppliers have the best records of CCTCS assignments since the F.C.C. has maintained no record of tone codes used on these frequencies.

Frequency Switching on Mobile and Portable Equipment

Because initial operation on 39.5 will be carrier squelch and the individual county frequency will be tone coded squelch, it was recommended that equipment be purchased and wording be placed in the specifications that clearly define that operation of the frequency control switch will simultaneously and automatically cause the 39.5 MHz position to operate as standard squelch both in the transmit and receiver mode. This is to eliminate the need for an officer to remember to operate a second switch to disable tone coding when operating on 39.5. In this way, one eliminates the possibility of being in the wrong squelch mode when on 39.5 MHz.

While it can be argued that the transmitter could send the squelch tone and still be heard on a carrier squelch receiver, this mode of operation would probably result in the tone modulation being heard on older equipment not equipped with proper filtering, and the annoyance of the "hum" may generate operator complaints.

Thus it is recommended that transmitters not send the tone on 39.5 MHz.

It should be remembered, however, that the eventual goal for the State should be a common squelch tone and its eventual use on 39.5, too. Equipment would be modified to full standard coded squelch operation on all radio frequencies at that time in the progress of the program.

Hand-Held Portable Radio Equipment Considerations

Due to declining market demands, many manufacturers do not offer some of their latest equipment designs in the 30-50 MHz frequency range. This is particularly true in hand-held portable products. Due to antenna radiating efficiency at the lower frequency, it was recommended that the State specify and try to obtain portables with:

1. Maximum available power output. In this regard it was pointed out that power outputs up to four watts are available in the low-band portable units.
2. A telescoping antenna at least one-sixth wavelength long (about four feet) as a practical compromise between a length which can be used with convenience against improved radiation resistance of the antenna system. A loading coil must be provided to cancel out all antenna reactive component when antenna is fully extended. A loading coil should preferably be externally adjustable for precise adjustment by a service technician.
3. Units that use a separate, built-in microphone element instead of a common speaker/microphone for maximum transmission clarity.

Table 1 shows a tabulation comparing specifications of the higher quality, low-band portable radios available from manufacturers.

Mobile Radio Equipment

Based on previous experience in operation and the desire to achieve maximum talk-back range to a single station within the county, the State has decided to use 100 w mobile units in all cases.

It should be recognized that a 100 w unit provides only 3 db more input signal at a receiver than a 50 w transmitter but requires almost twice the current from the battery in the vehicle when transmitting. In a given system the talk-back range from a 50 w unit would be approximately three to five miles less for the same quality signal. However, the 100 w radio provides 3 db more in tolerable system degradation margin, which may prove helpful in rural areas where it may be difficult to keep radios at peak operating efficiency at all times due to less frequent visits by a serviceman.

TABLE 1

LOW-BAND HAND-HELP PORTABLE RADIOS

MANUFACTURER	TRANSMITTER				RECEIVER					
	Weight And Size (in inches)	Transmitter Power (Watts)	Spurious Level (Decibels)	Stability (Percent)	Sensitivity (Microvolts)		Selectivity (Decibels)	Audio Power (Watts)	Intermodulation Protection (Decibels)	Spurious Response (Decibels)
					20 Decibels Quieting	12 Decibels, SINAD ^{a/}				
GENERAL ELECTRIC "P.E." SERIES	21 Ounces 7.39x 2.62x 1.58	2.0	-47	.002	.35	.25	-80	.5	-70	-70
MOTOROLA MHLO HANDI-COM	32 Ounces 8x3.35 .x1.90	1.5 ^{b/} 1.2 ^{c/}	-46	.005	.5	.35	-55	.5	?	-50
R.C.A. PERSONAL FONE OR * REPCO ^{d/} 10-8	36 Ounces 8.06x3.38 x 1.75	2.04 and 4.0	-47	.002	.25	.35	-80	.75	-55	-70

^{a/} Signal plus noise and distortion.

^{b/} Nicocadnium Battery.

^{c/} Mercury Battery.

^{d/} Sold through distributors: Aerotron, Comco, Canadian Marconi, Federal Sign and Signal, Karr.

Due to market demand the availability of high-quality, low-band, high-power mobile radios is also somewhat limited. Again, since frequent service calls may be difficult in some areas, a radio with .0005 percent frequency stability would maintain the transmitter more precisely on frequency and retain better the clarity of transmission quality which can suffer when a transmitter gets slightly off frequency. A tabulation of available 50 and 100 w radios is tabulated in Appendix I.

Base Station, Control Console, Desk Set Specifications

In reviewing a specification the State was preparing to issue for base stations, it was noted that it required "tone or D.C. control." The exact type of control—"tone" or "D.C."—must be advised to the bidders so they can determine which model of equipment to bid.

Also, if the Control Consoles are to have "Desk-Set" units operating into them from dispatch points, the control console must be provided with the necessary control point provisions to comply with F.C.C. Rule, Paragraph 89.113(E).

The specification for desk set should clarify how it will be used. Two general types are available—one, with compression amplifier and necessary "current generation" circuitry for use on a two-wire line, or another, with handset, speaker, and switch provision, which is normally connected to a control console or base station with a multiconductor cable.

Monitor Receiver Specifications

The state specification should be more explicit to insure receipt of the type of receiver desired.

In this respect, and for cost savings where more than one frequency is to be monitored at some sheriffs' departments, it is recommended that an investigation into the "scanner-type" receiver be made. Scanner receivers are available for combining low-band (30-50 MHz), high-band (150-174 MHz), and UHF (450-470 MHz) in a single receiver. In locations where the sheriff must coordinate with other governmental subdivisions or agencies operating in other bands, the three-band scanner receiver offers a simple method of coordination and permits each agency to operate on his assigned transmit channel. It is recommended that the use of a high quality receiver of this type be evaluated, particularly in areas near large metropolitan districts.

Conclusion

The points covered in this report are essentially those discussed in the on-site interview with the individuals listed in the beginning of this report.

Based on discussions and technical points clarified, State Personnel felt they could write and correct their specifications as needed.

APPENDIX I
LOW-BAND MOBILE RADIOS

Model and Manufacturer	Number of Frequencies	Power Output		Spurious and Harmonics (Decibels)	Stability (Percent)	F.M. Hum and Noise (Decibels)	Audio Distortion (Percent)	Front or Rear	Sensitivity		Selectivity (20 Decibels)	Intermodulation Protection (Decibels)	Spurious (Decibels)	Audio Power (Watts)	Total Weight (Pounds)
		Maximum (Watts)	Continuous Duty						20 Decibels Quieting	12 Decibels (SINAD) ^{1/2}					
Motorola Vicer (all States)	4	100 90 55	40	-85	.0005	-65	less than 3	Rear	.35	.25	-100	-80	-100	10	4.25/2.6/1.5
Motorola Econ 70 (all States)	4	100 50		-65	.002	-80	3	Rear Front/ Rear	.30	.20	-80	-60	-90	5	4.7/2.6/1.5
EMA Series 100 (all States)	4	100		-85	.0005	-80	3	Trunk Front Dash	.35	.25	-85	-65	-100	5	
EMA Series 100 (all States)		55W		-65	.002 .0005 option	-70	2	Trunk Front Dash	.35	.25	-85	-65	-100	5	1.55
Johnson 501	4	Max. 50W		-65	.002	-70	3	Front	.35	.25	-80	-70	-90	5	.35/1.6/1.3
General Electric Model 11	2-8	100 50		-85 -85	.0005		2	Rear	.35	.25	-100	-80	-95	12	2.25/1.1/1.5

^{1/2} Signal plus noise and distortion.
² Primary Receive/Transmit.
³ Transmit.

END

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