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TECHNICAL REPORT NO. 74-63

AIRBORNE TV SYSTEM

by

Curtis L. Paxton
Communications & Electronics Branch

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Final Report

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report describes the development and test of 10 and 100 watt television transmission systems carried by helicopter. The purpose of the project was to determine whether the system meets the support-mission requirements of PSYOP warfare, and whether it can provide communications in the event of civil disaster. Transmission of both color and black-white programming material was successfully demonstrated. Test results also indicate that the 6-mile radius of ground coverage satisfied the range requirements associated with civil disaster activity.

INTRODUCTION

In 1971, the 8th PYSOP Battalion, Ft Bragg, expressed a need for a TV transmission system carried by helicopter to provide black and white transmission in support of their mission. The US Army Land Warfare Laboratory (USALWL) began the development and test of such a system. To minimize development time and cost, maximum use of commercially available broadcast TV equipment was considered.

A contract #DAAD05-73-C-0022, was awarded to the Acrodyne Corp, Montgomery, PA to provide the required hardware and the engineering support to conduct a feasibility test program.

The first generation of equipment was a modified 10-watt commercial television translator system (Figure 1). The modification involved a redesign of the single-side-band modulator to accept standard video and audio signals from live camera or video recorder/reproducer (VTR) units.

In response to modified requirements by the 8th PYSOP Bn to increase the transmission range and provide for color broadcasts, the 10-watt system was converted to a 100-watt system through the addition of a 100-watt linear amplifier.

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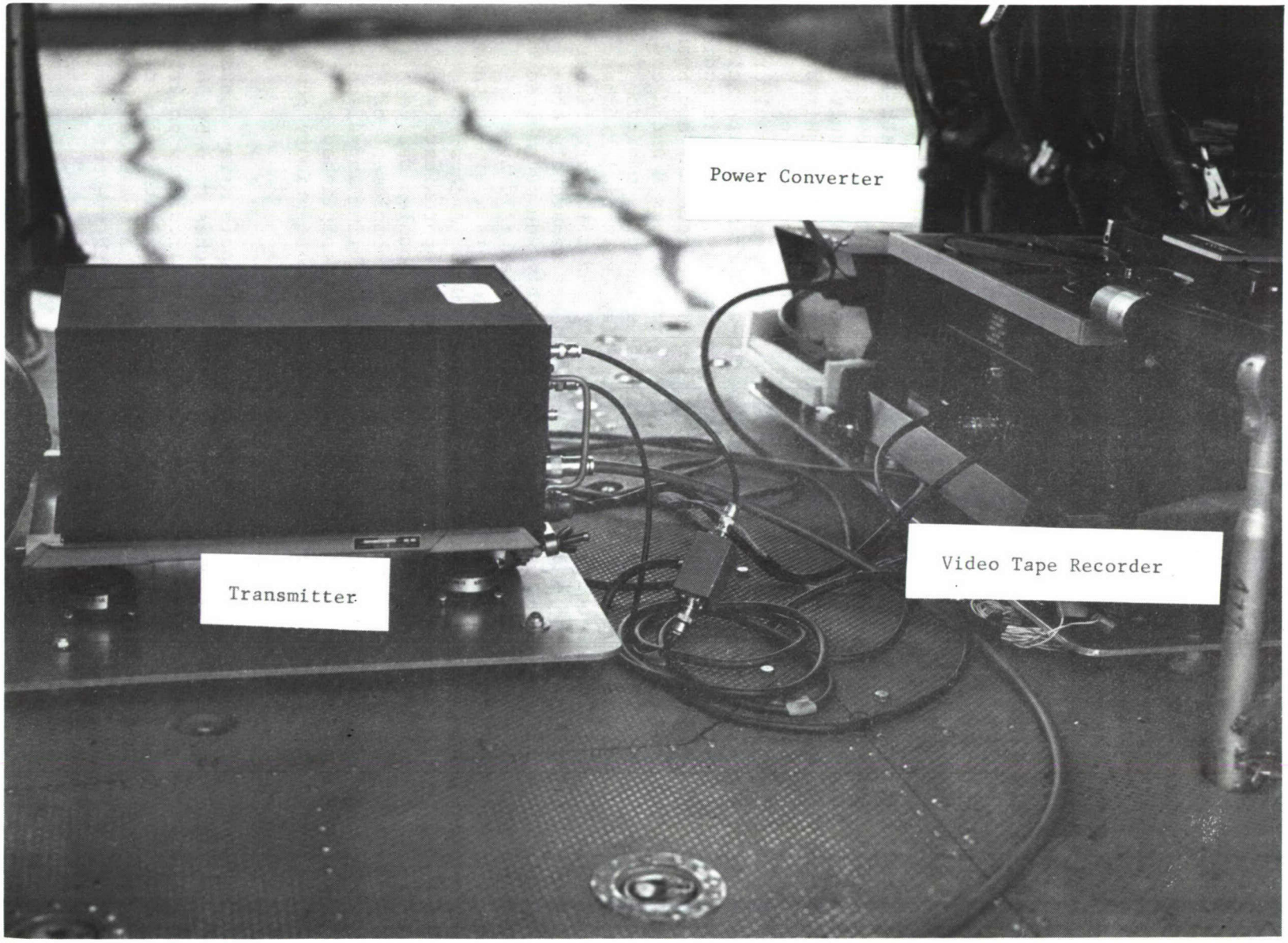

Figure 1. 10-Watt Airborne TV System

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DESCRIPTION

The 100-Watt Airborne TV System was designed for installation and operation in the UH-1H helicopter. The system consists of two electronic equipment racks (Figure 2) mounted within the cargo section of the aircraft and an antenna (Figure 3) externally mounted under the cargo area of the aircraft.

One rack contains a 115 volt 60 Hz power converter to provide input power to the camera control unit and the Sony 8600 video tape recorder/reproducer modules. The system is also adaptable to the VO1600 Sony video cassette recorder. Also included are video, audio, and AC distribution and monitoring panels. Total weight is approximately 125 pounds. The 28 volt, heater blanket, DC power source within the aircraft is used to supply the required 5 ampere load current to operate this portion of the system.

The second rack contains the 10-watt transmitter/driver, the 100-watt linear amplifier, and the companion high/low power supply to operate the overall system. Its total weight is 150 pounds. A separate 50 ampere circuit breaker wired to the essential bus of the aircraft supplies the required input operating power of 45 amperes @ 28 volt DC. Either the main or auxiliary aircraft generators have adequate capacity to operate the aircraft equipment and the TV system simultaneously. The 10-watt transmitter/exciter is totally self-contained. It will accept any commercially available audio and video inputs (B/W or color) from camera or video tape recorder equipment for system formats compatible with American Television Systems M and N and European Television System B. The transmitter module includes a video predistortion network to compensate for envelope delay, vestigial sideband modulator (VSB), an FM modulator, an amplifier-mixer, and a 10-watt linear amplifier. The baseband video and audio information are separately converted to the two IF frequencies, processed independently and recombined to form the desired RF signal. The 100-watt linear amplifier is driven directly by the transmitter/exciter unit. This amplifier is a single tube ultra-linear amplifier with a minimum gain factor of 10db. A ceramic triode tube is used. Average input power dissipation is approximately 600-watts. Both transmitter/exciter and 100-watt amplifier modules derive power from the power supply module which contains a full complement of monitoring devices and necessary sequencing logic for enabling and disabling of the transmitter. Cooling of each of the modules is accomplished by blowers which operate from the 100 volt, 400 Hz single phase primary power supply.

The antenna is a specially designed, hybrid fed, cross-dipole array contained within a plastic cylinder and ground-plane assembly 10 inches deep by 30 inches in diameter. The antenna radiation is left hand circularly polarized in a symmetric conic pattern. The 3db beam width is approximately 120 degrees at a gain of 5db above a circular isotropic reference. The measured front-to-back ratio is 17db with no significant side lobes, which prevents the effects of air-frame and rotor blade perturbation.

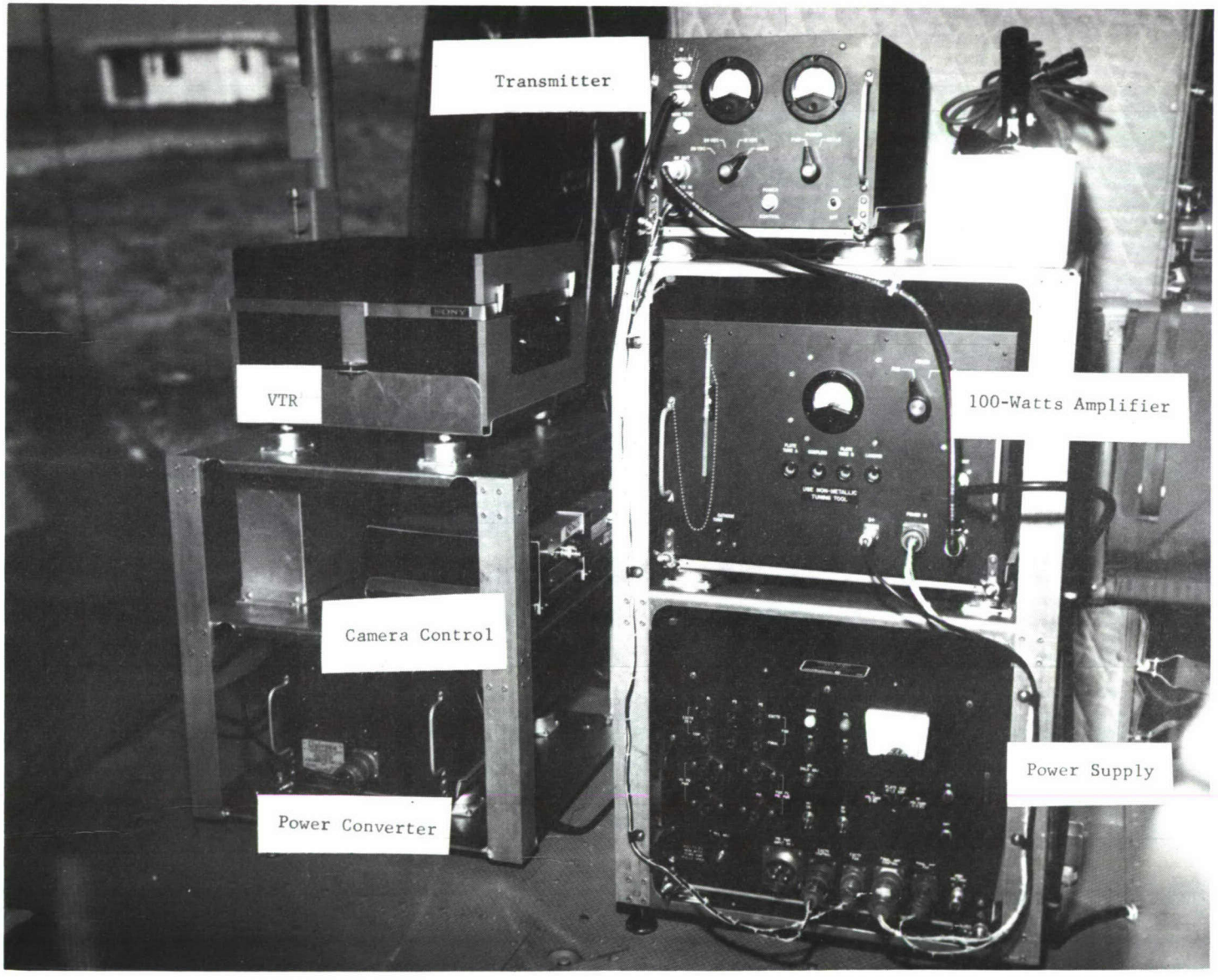

Figure 2. 100-Watt Airborne TV System

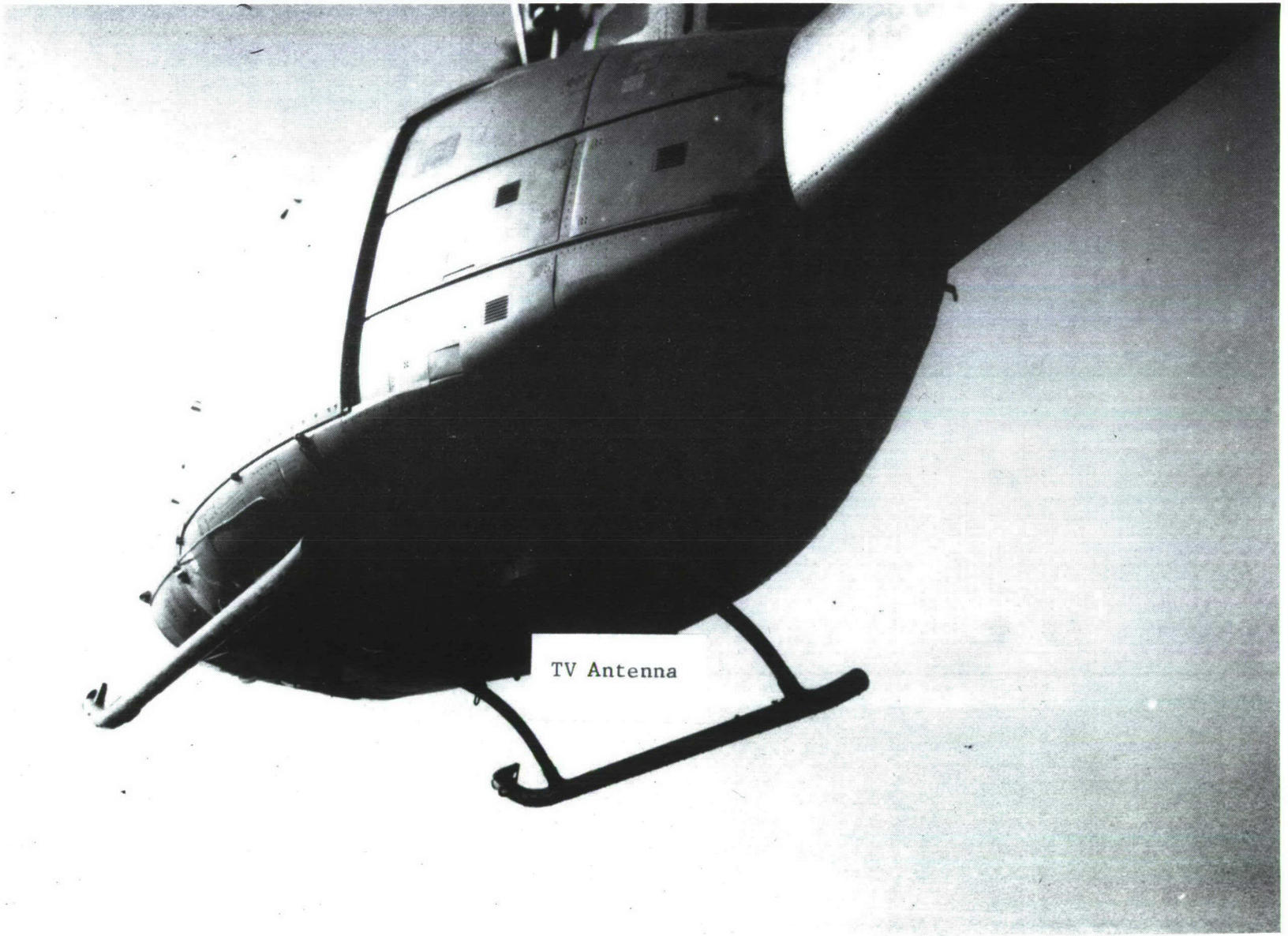

Figure 3. Airborne TV Antenna System

Electrical Characteristics

1. The transmitter is compatible with the following modulation formats:

	American System (M)	American System (N)	European System (B)
Number of Lines	525	625	625
Channel Width (MHz)	6	6	7
Video Bandwidth (MHz)	4.2	4.2	5
Video Sound Separation (MHz)	+4.5	+4.5	+5.5
Vestigial SB (MHz)	0.75	0.75	0.75
Video Modulation	Neg	Neg	Neg
Sound Modulation	FM	FM	FM

2.	Type of Emission	Visual A5, Aural F3
3.	Power Output	100 Watts Peak Sync.
4.	Video/Aural Power Ratio	10db
5.	RF Output Channels	American Channel No. 12 (204-210-MHz) European Channel No. 9 (202-209-MHz)
6.	Output Freq Stability	0.005%
7.	Spurious Output	50db below Peak Sync.
8.	Carrier Harmonic Suppression	60db below Peak Sync.
9.	Output Impedance	50 ohms
10.	Input Video	1.0 Volt Peak to Peak (75 ohms)
11.	Input Audio	odBm (600 ohms)

Performance Characteristics

1. System will accept both video and audio (B/W or color) inputs from camera or video tape recorder equipment for American System M and N and European System B.

2. Both recording and playback capabilities are provided within the aircraft.

3. System is compatible with standard NTSC color recorder systems.

4. A 6-mile radius ground coverage for color transmissions is attainable at an aircraft altitude of 4000 feet (AGL). Black/white transmissions will produce a ground coverage of 10 mile radius.

5. The system is easily transportable by aircraft. It will withstand the airborne environment, including shock and vibration, and a wide operating temperature range between -40°C and +60°C.

6. Aircraft installation and checkout can be accomplished in approximately 1.5 hours by 2 personnel.

7. Provisions are made to use an external 10 inch TV receiver to monitor the RF transmission.

TEST PROCEDURES AND RESULTS

During the period 22-26 January 1973, a feasibility test of the proposed PSYOP Airborne Television System was conducted at Ft. Bragg. The 10-watt television system broadcasting in the black and white mode was used to conduct the test. The aircraft flew at altitudes of 2000, 4000, and 5000 feet within a 3-mile (required range) radius of the JFK Center. Standard monitoring receivers were set up at various locations throughout the JFK Center, SAAF, and the on-post quarters of the USIA advisor. No attempt was made to use sophisticated antenna systems for reception because it was decided that the test should be conducted under the worst conditions that would normally be present in a "real world" situation. Consequently, all receiving antennas were of the rabbit-ear design. All transmissions were made on channel 12 (204-210-MHz). The instability of the 110 volt, 60 Hz power output of the power converter used with the recorder system caused a poor quality transmission from the onboard video tape recorder. There was also a slight amount of adjacent channel interference. Otherwise, the tests produced successful results and demonstrated that the concept of the airborne TV system was indeed feasible. It was also determined that adddi tional RF power output of 100 watts is necessary to broadcast reliably to a target audience located in an area of approximately a 6-mile radius.

A follow-on test of the 10 watt system was conducted at Ft. Bragg in February 1973 using the Sony AV-3400 black and white recorder/reproducer and the Sony AVC-3400 camera as input video sources. Faithful reproduction of the broadcast was obtained out to the required range of 3 miles at an altitude of 2500 feet (AGL). At this time the advisory personnel at Ft. Bragg determined that they required a system which had a color transmission capability.

On May 1973, tests were conducted at Aberdeen Proving Ground, MD on the 10-watt Airborne TV System equipped with the AKAI CVC-150 color camera and Sony AV-5000A video taping system. All tests were conducted in color. Test results were generally unacceptable. The conclusions drawn were that the power output of the transmitter for color was insufficient and the camera used was not capable of providing the quality of picture desired. Substitution of a color Magnavox Camera System produced a good quality picture during follow-up tests conducted at Aberdeen Proving Ground.

During February 1974 the 100-watt version of the Airborne Television System was demonstrated to the 4th PSYOP Group at Fort Bragg. All transmissions were in color on channel 12. A 4000 foot altitude appeared to be optimum to get the required 6 mile ground radius coverage. Otherwise, the method of conducting the test was similar to that used during the January 1973 feasibility test. It was concluded that this system met all requirements for color transmission over the required area.

CONCLUSIONS

1. The feasibility of transmitting both color and black/white video from UH-1H aircraft was successfully demonstrated to the Ft. Bragg PSYOP Group.

2. The 100-watt system is capable of providing a 6-mile ground coverage when broadcasting color from an aircraft altitude of 4000 feet.

3. A good quality power source should be used to power the camera and VTR equipment.

4. Optimum orientation of the rabbit-ear receiver antenna system is 45 degrees with respect to the horizontal plane.

5. The TV system does not interfere with the aircraft electronics equipment.

6. The flight characteristics of the aircraft do not degrade the performance of the system except when banking exceeds 10^{o}.

7. No interference effects from the air-frame or rotor modulation were observed.

8. Either the main or auxiliary aircraft generator has adequate power capacity to simultaneously operate the aircraft equipment and the TV system.

RECOMMENDATIONS

1. It is recommended that the Airborne Television System be considered for use in tactical combat applications.

2. In any follow-on development program, consideration should be given to the design of a stable camera platform and an improved color camera system.

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