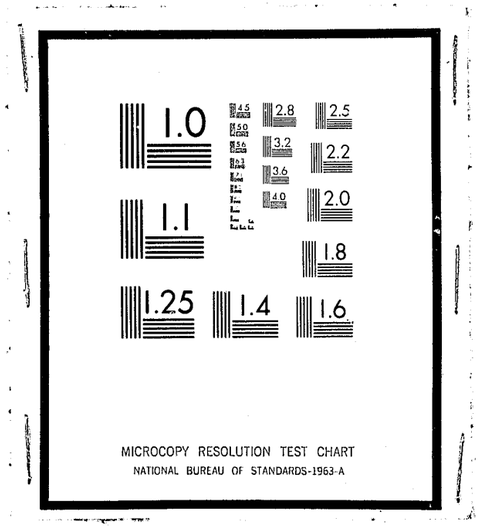

THE MITRE CORPORATION
WASHINGTON OPERATIONS

WORKING PAPER

WP- 8672 ___ ___ ___ ___ ___
No. Vol. Series Rev. Supp. Corr.

CONTROLLED DISTRIBUTION

Subject: Total Monitoring System -
Phase I Procurement Specifications

To: W. E. Holden

From: J. H. Parness

Dept.: D-33

Date: 3 March 1972

Contract No.: 72141

Sponsor: Washington D. C.
Metropolitan Police Dept.

Project No.: 1760

Approved for MITRE Distribution: Charles M. Landecker
for W. E. Holden

ABSTRACT:

This report discusses the Total Monitoring System to be incorporated into the Washington, D. C. Metropolitan Police Department. Detailed equipment specifications for Phase I (Street to Command Center Television System) procurement are presented.

THIS INFORMAL PAPER PRESENTS TENTATIVE INFORMATION FOR LIMITED DISTRIBUTION.

ACKNOWLEDGEMENTS

The author wishes to express his thanks and appreciation to John Bell and George Wicker who aided in the preparation of this paper.

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

1.0 TOTAL MONITORING SYSTEM

The fundamental purpose of a Total Monitoring System (TMS) is to provide a system which can broadcast live TV pictures from a hovering helicopter, fixed camera locations and from limited ground mobile configurations. This system will allow MPD officials to augment their viewing and controlling of civil disturbances in the District of Columbia.

2.0 OPERATIONAL REQUIREMENTS

The overall operational requirements for the TMS are to provide live television coverage (relayed to the Headquarters Command Post) of the "popular" gathering areas (i.e., Mall, Lafayette Park, Capitol grounds, Pennsylvania Avenue, Dupont Circle and bridges).

Television coverage should be provided by airborne, fixed and portable (backpack with a relay) camera systems. Video taping capability at the Command Post using present equipment is necessary. A one-way TV link from the Command Post to the Street Command Bus is also desirable.

Additional operational constraints require the use of an optical stabilizer in the helicopter to provide a stable image under 10:1 zoom operation, duplicate cabling in all three MPD helicopters, rapid reconfiguration capability of the fixed site operation, and flexibility in the portable backpack equipment for use in a vehicle or at a fixed location.

3.0 TMS SYSTEM DESIGN

The complete TMS system is shown in Figure 1. As shown, there is a single helicopter link, two relay inputs from fixed cameras or backpacks, and a TV link from Headquarters to the Command Bus via a third relay package. Also, indicated in Figure 1 are some of the many possible relay locations. In practice, the exact location of the portable relays are determined before an actual operation.*

Another feature of this system concept is that it utilizes a building block approach which allows for a two-phased procurement. Figure 2 is a diagram of a suggested Phase I configuration (called Street to Command Center Television System) containing a single relay, backpack and helicopter TV link. This concept will provide not only the two independent systems, but can be easily altered (by utilizing an additional camera and monitor) to operate as three independent systems. As shown in Figure 3, the backpack would be utilized in a direct line-of-sight (LOS) with the Command Post, the relay would be utilized as a fixed camera site, and the helicopter would operate in a normal mode. Another possible combination

*Direct cabling to several locations was rejected due to greater cost estimates (2:1) for cable as compared to microwave one-way paths plus a loss in operating flexibility.

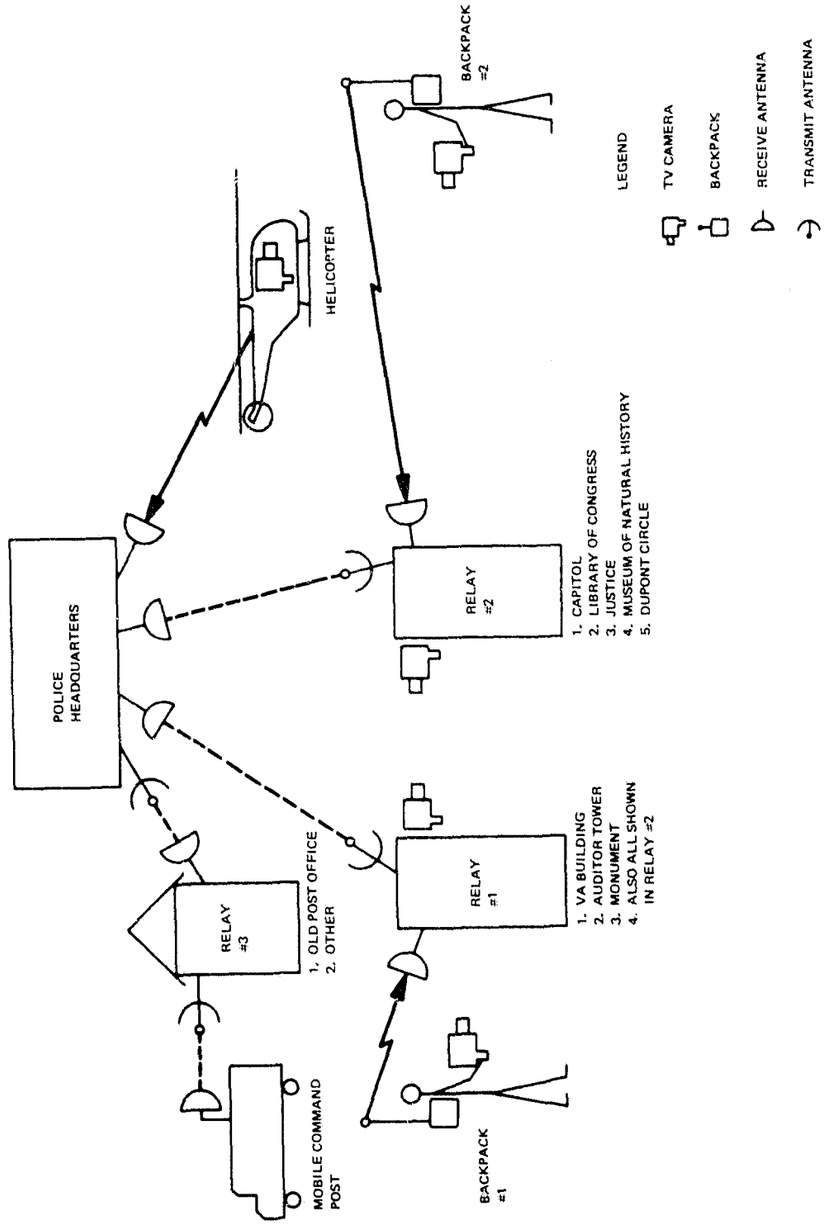

FIGURE 1. TOTAL MONITORING SYSTEM

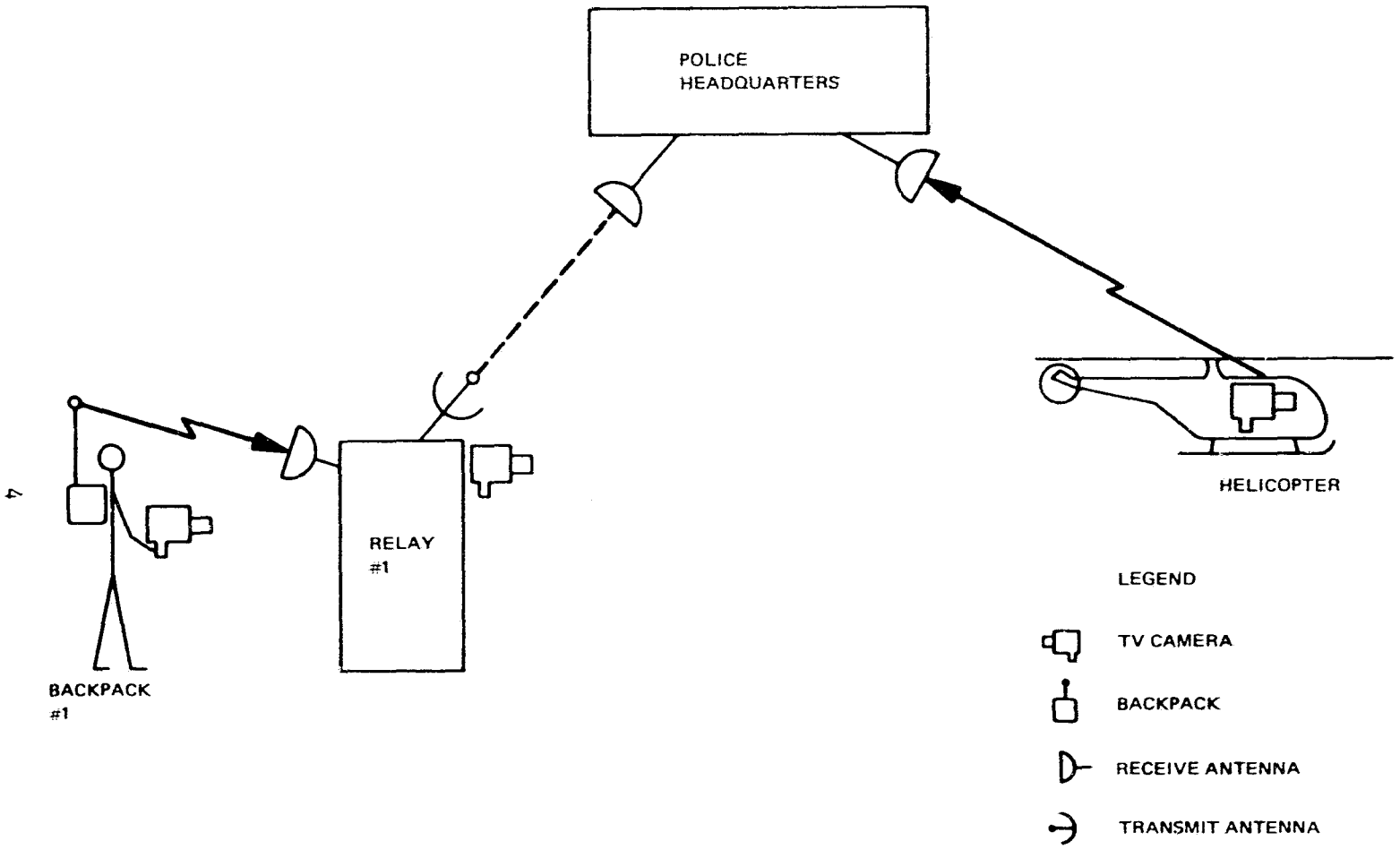

FIGURE 2. PHASE I CONCEPT

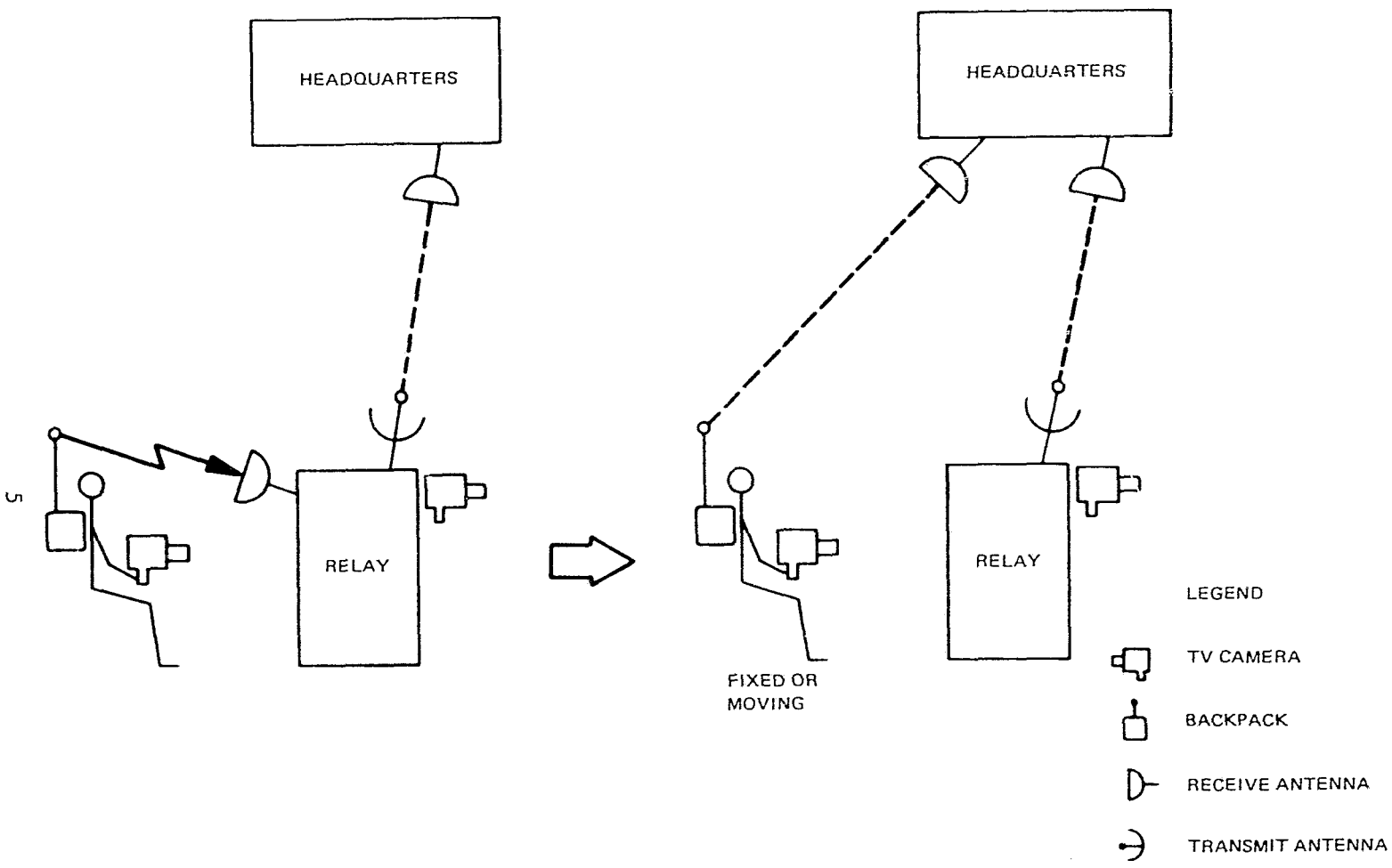

FIGURE 3. EQUIVALENT CAPABILITY

(Figure 4) would be to operate the relay equipment on a second helicopter (without a stabilizer), the backpack direct LOS, and the prime helicopter in its normal mode.

An additional advantage of the above concept is built-in equipment redundancy which allows the relay equipment to be utilized as a spare for the prime helicopter system.

The Phase I design also calls for similar cabling and transmitter mounting plates to be installed in all three MPD helicopters for additional redundancy.* Total change-over time between helicopters should be a matter of minutes.

A suggested Phase II procurement would address a second backpack and relay plus the Command Post to Command Bus link (see Figure 5).

3.1 Phase I Specifications

Figures 6 and 7 present all of the system elements for the Phase I section of the TMS. The following pages present the detailed equipment specifications for these elements.

*This will allow any one of the MPD helicopters to be used as a prime or secondary broadcast platform.

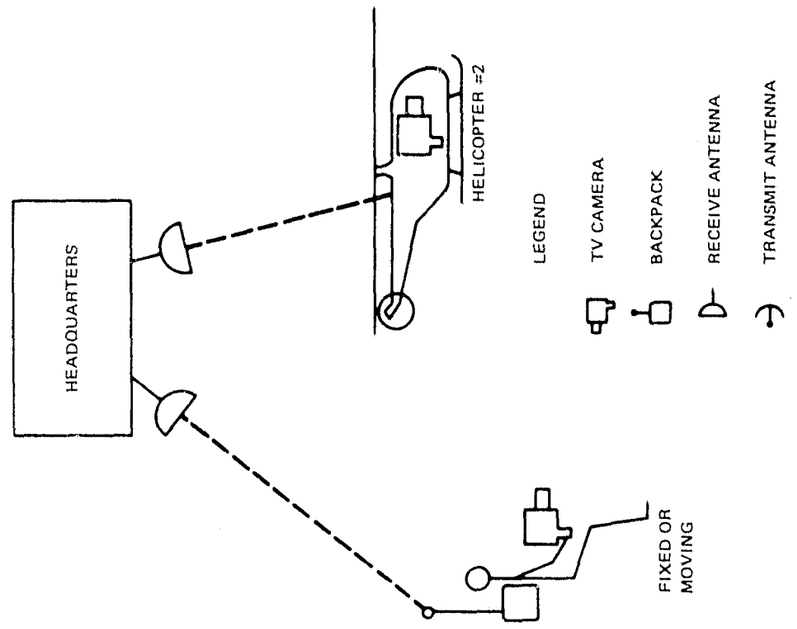

FIGURE 4. EQUIVALENT CAPABILITY

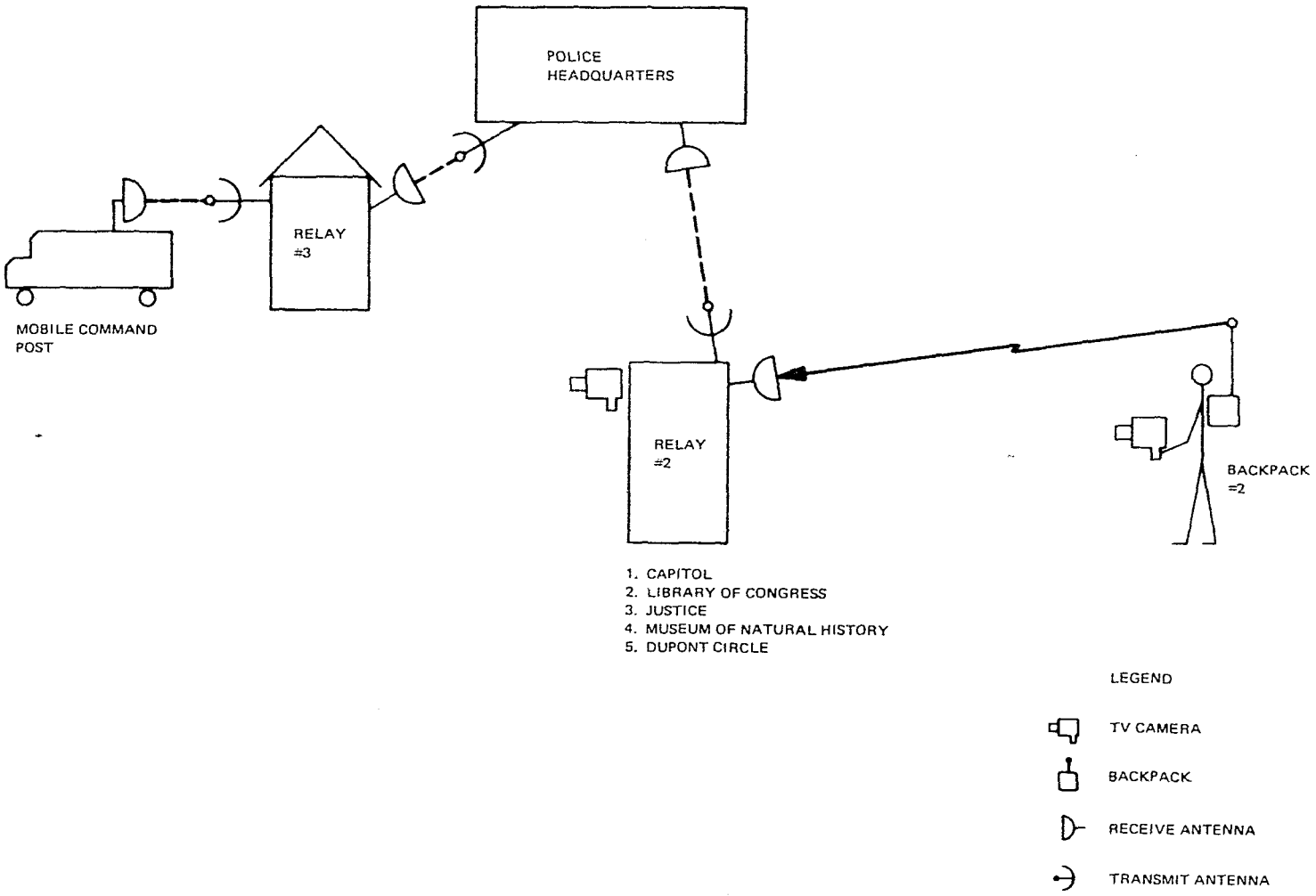

FIGURE 5. PHASE II CONCEPT

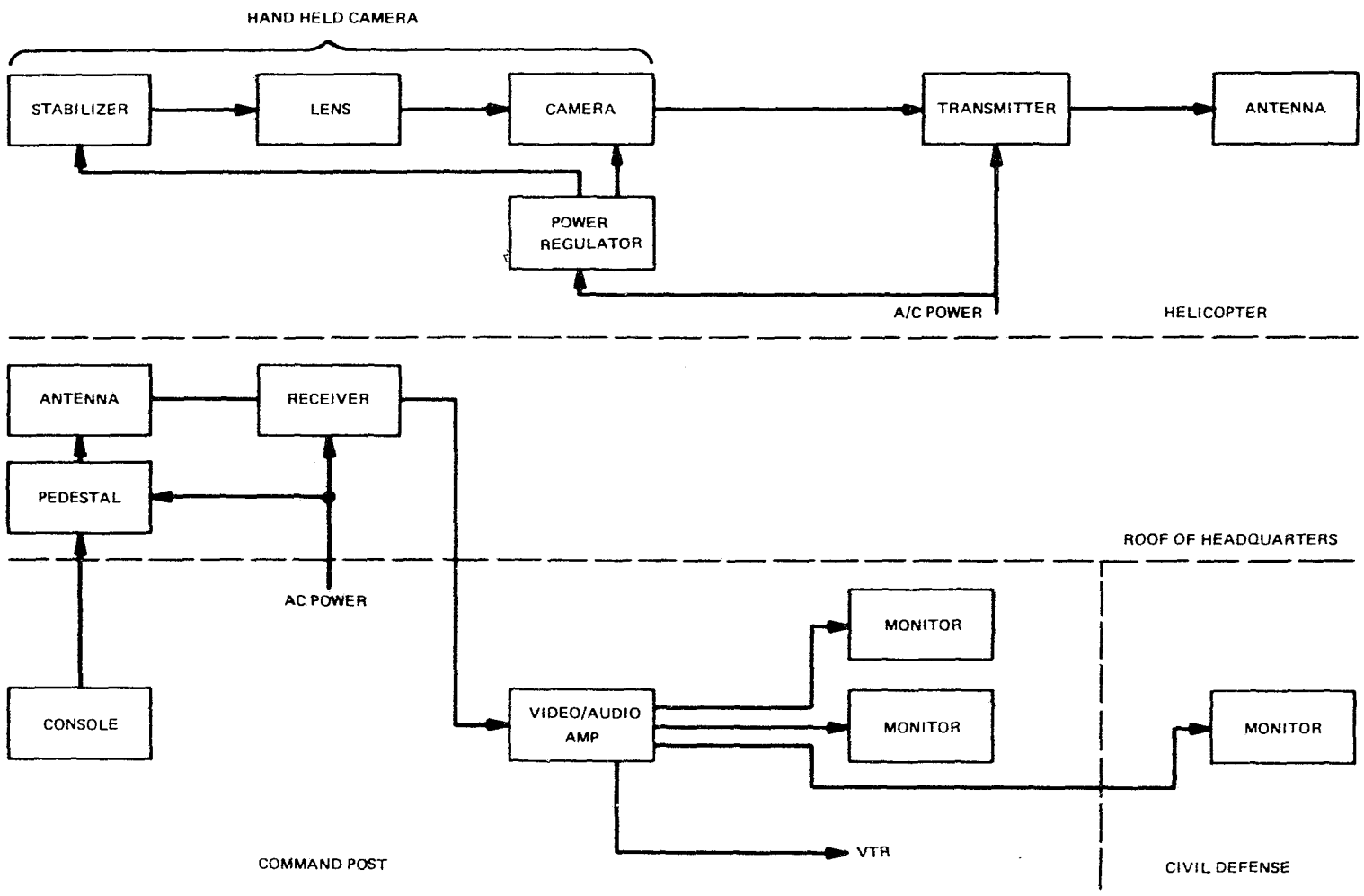

FIGURE 6 – HELICOPTER SYSTEM

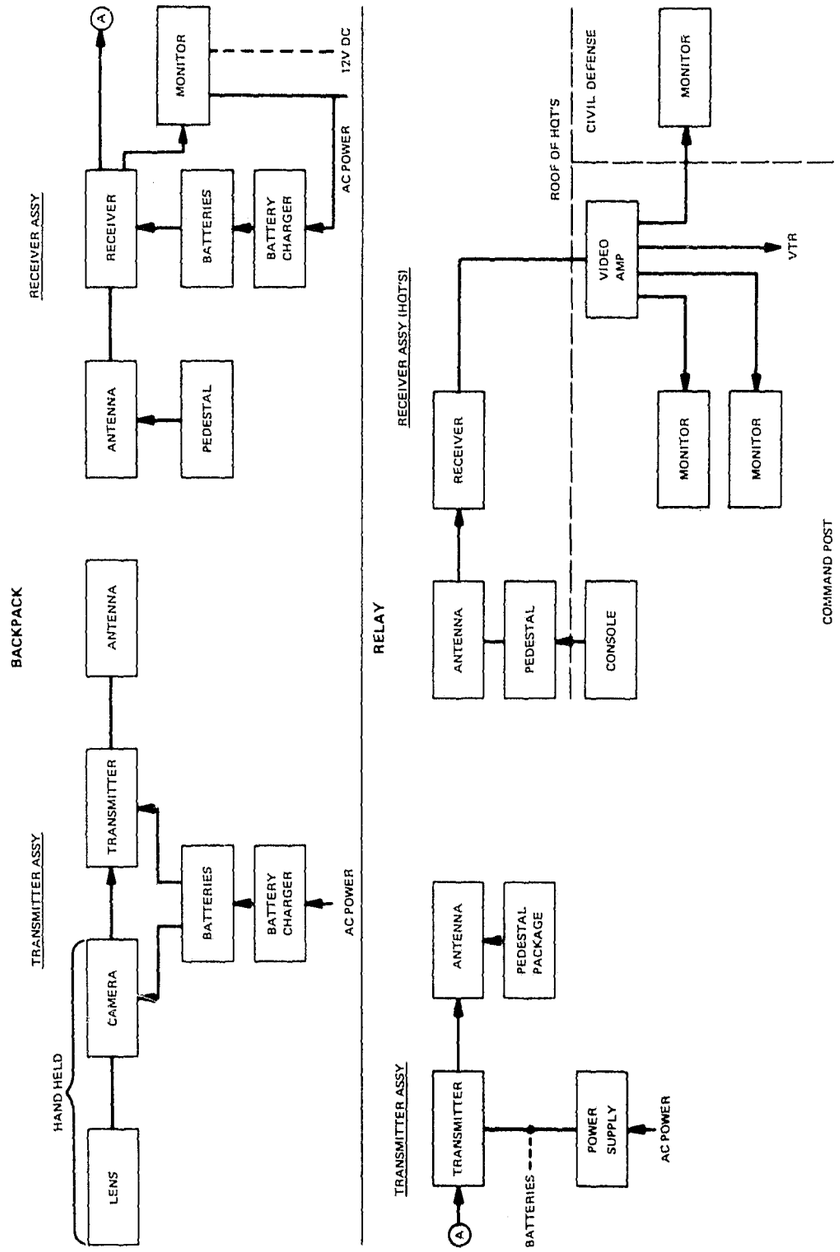

FIGURE 7 – BACKPACK/RELAY SYSTEM

GENERAL REQUIREMENTS FOR BOTH SYSTEMS

1. All helicopter-mounted equipment must meet FAA material and installation specifications.

2. All outdoor equipment must meet the following environmental requirements except where noted;

   (a) temperature - operating -30°C to +50°C;

   (b) humidity - 100% relative;

   (c) complete waterproofing - one inch/hour for three hours;

   (d) vibration - 2G 10-500 Hz;

   (e) shock - 15G all directions;

   (f) altitude - sea level to 10,000 feet.

3. The helicopter and relay link transmitters and receiver must be identical in both mechanical and electrical performance and must be easily interchangeable.

4. All system connectors should be compatible, with the following recommendations:

   (a) RF cables - type TNC connectors;

   (b) video cables - type BNC connectors:

   (c) power/audio - manufacturer's suggested type.

5. All equipment and installations on headquarters roof must meet all applicable electrical and mechanical requirements as outlined by Bureau of Building Management, Department of General Services, District government.

6. Overload protection provisions should be system engineered and specified in the proposals.

7. Indicate warranty and service provisions in the proposals.

HELICOPTER TV LINK PROCUREMENT LIST

A. Helicopter

1 - transmitter

1 - antenna

1 - regulator/ps

1 - camera

1 - stabilizer

1 - lens

3 - sets of cables/mounting plates

Installation in helicopter

B. Headquarters

1 - receiver

1 - antenna

1 - antenna pedestal/control console

1 - video/audio amplifier

2 - CCTV monitors

1 - set of cables

Installation at Headquarters

HELICOPTER TRANSMITTER

Output frequency:	2475 and 2490 MHz; one frequency at a time
Output power:	10 watts nominal; 8 watts over temperature and supply voltage ranges specified into load VSWR 1.5:1
Input power:	28 ± 4 VDC; 4.5 amps (maximum) reverse polarity protection
Output frequency stability:	± 0.03% under all conditions of environmental and voltage
Output impedance:	50 ohms
Modulation characteristics:	
Type:	True FM
Input impedance:	75 ohms resistive, ± 5%
Frequency response:	Per EIA RS-250-A
Deviation sensitivity:	± 4 MHz/Vpp
Maximum deviation:	± 5 MHz
Deviation sense:	Positive
Deviation linearity:	2% of best straight line for maximum deviation
Harmonic distortion:	3% maximum for modulation frequencies from 6 Hz to 4 MHz deviated 4 MHz
Antenna conducted spurious emissions:	IRIG 106-69
Pre-emphasis:	CCIR Rec 405
Environmental conditions:	As per General Requirements
Altitude:	10,000 feet
Humidity:	Up to 100% relative humidity

Physical characteristics:

Size:	6 x 5 x 2 inches, excluding heat sink
Weight:	40 ounces maximum
Must have FCC Type Acceptance	
Audio subcarrier frequency:	6.8 MHz
Audio signal channel (other):	Per RS-250-A recommendations p.11, except audio response
Heat sink:	As required

ANTENNA (HELICOPTER)

Frequency band:	2450-2500 MHz
Polarization:	Vertical
Gain:	6 dB
Horizontal pattern:	Omnidirectional
Vertical pattern:	40° from +15° upward to -25° downward
Input VSWR:	1.5:1 maximum
Input impedance:	50 ohms
Mounting:	Quick disconnect for switching to other MPD Bell 47G helicopters

REGULATED POWER SUPPLY (HELICOPTER)

Input voltage:	28 VDC ± 15%
Output voltage:	12 VDC ± 5% @ 13 VA
Size:	30 cu. inches maximum
Weight:	2 pounds maximum
Environmental conditions:	As per General Requirements

Overload protection shall be provided.

CAMERA (HELICOPTER)

Electronic

Power:	12 VDC ± 5% (applies to all following specifications)
Power consumption:	10W or less (including viewfinder)
Scan system:	2:1 interlace, 525 line as per EIA Specification RS-170
Horizontal frequency:	15.750 KHz ± 0.3 KHz, internally generated
Vertical frequency:	60 Hz ± 0.5%, internally generated
Video output:	Composite video > 1V p-p; < 2V p-p; 75 ohms, sync negative
Video SNR:	≥ 43 dB
Horizontal resolution:	> 350 lines center; > 220 lines at edge
Auto. light compensation:	> 300X for 3 dB change in video level
Vidicon:	2/3" or 1" vidicon, equivalent to or better than 8823 or 7735A vidicons
RF output:	Not required

Viewfinder (electronic)

Picutre tube:	3/4" to 1-1/2" with pre-focused eyepiece (diagonal)
Resolution:	≥ 220 lines center
Mount:	Viewfinder must either be in integral part of the camera or mount securely to the camera so as to not make camera operation awkward or difficult

(Optical, in lieu of electronic viewfinder)

Viewing system:	Should present a view area ± 10% of area viewed on a monitor and should be capable of following zoom operation within this specification

Physical

Size:	Camera plus viewfinder dimensions should not exceed 4"(W) x 8"(H) x 18"(D) including the lens
Weight:	Camera plus viewfinder, less than 7.5 pounds; lens weight must be included
Accessories:	(a) Handgrip with integral camera control switch (b) An integral cable harness (video and power) to the helicopter
Mount:	C-mount

Environmental:

Temperature:	0° to +40°C
Vibration:	2G 10-500 Hz
Shock:	15G all directions

OPTICAL STABILIZER (HELICOPTER)

Optical freedom:	± 4°
Angular compensation:	Better than 90% from 0.6-20 cycles/sec
Clear aperature:	2.3 inches (58 mm)
Transmissibility:	Visible (0.45 to 0.7 microns) - greater than 95%
Input power:	12 VDC ± 5%
Power consumption:	3 watts or less
Warm-up time:	30 seconds
Weight:	Less than 3 pounds
Width:	≤ 6.5 inches
Height:	≤ 5.5 inches
Depth:	≤ 4 inches
Self-contained batteries:	Optional

ZOOM LENS (HELICOPTER)

Range of focal length:	10:1
Speed:	$f4$ or better
Lens mount:	Compatible with camera (C-mount)
Lens front diameter:	Compatible with stabilizer mounting
Zoom control:	Electric remote
Focus:	Constant over zoom range
Input power:	12 VDC ± 5%
Weight:	See camera specifications
Mechanical:	Must support the optical stabilizer

CABLE SETS/MOUNTING BRACKETS (HELICOPTER)

3 - sets of interconnecting cables between

(a) transmitter;

(b) regulator;

(c) antenna;

for use with the MPD Bell 47G helicopters; equipment mounted outside must contain weatherproof connectors plus plugs for sealing when not in use.

3 - sets of mounting brackets for use in mounting

(a) transmitter;

(b) regulator;

(c) antenna;

all brackets must contain quick disconnect capability and operate in outdoor helicopter environment.

RECEIVER (HEADQUARTERS)

Electrical

Frequency:	Remotely tuneable to 2460, 2475, or 2490 MHz; operating on one frequency at a time
Noise figure at antenna port:	12 dB maximum
Local oscillator stability:	AFC
Intermediate frequency:	Not critical, preferably between 70-250 MHz
Intermediate frequency bandwidth:	20 MHz (3 dB); 60 MHz (60 dB)
Image rejection:	60 dB
Threshold sensitivity:	-75 dBm for 10 dB $\frac{C+N}{N}$
Maximum RF input at antenna port:	+10 dBm
Input impedance:	50 ohms (1.5:1 max. VSWR)
FM discriminator output:	Negative video (black negative)
Signal conditioning:	(a) De-emphasis per CCIR 405 (b) Subcarrier discriminator per EIA RS-250-A, p.11 recommendations
Audio subcarrier frequency:	6-7 MHz (matched to transmitters)
Video baseband:	6 Hz to 4 MHz minimum
Video output impedance:	75 ohms with 20 dB return loss
Video output:	0-2 volts p-p
Video characteristics (other):	Per EIA RS-250-A
Audio characteristics:	Per RS-250-A recommendations, Section 4.

Electrical (Continued)

Signal strength monitoring:	External signal strength monitoring shall be provided for antenna alignment
Input power:	115 VAC ± 15%, 60 Hz

Mechanical

Size (maximum):	10" x 10" x 5"
Weight:	10 lbs. maximum
Weatherproofing:	Capable of operating within specifications when exposed to outdoor weather conditions in Wash. D. C. area
Environmental:	As per General Requirements
Mounting:	Back end of antenna

ANTENNA (HEADQUARTERS)

Size:	30 inch diameter
Type:	Parabolic
Frequency band:	2450-2500 MHz
Gain:	25 dB
Sidelobe level:	Greater than 20 dB down from mainlobe
Polarization:	Vertical
Weatherproofing:	For continuous outdoor use

ANTENNA PEDESTAL/CONTROL CONSOLE (HEADQUARTERS)

Parabolic dish size:	30 inch diameter
Slewing rate:	Azimuth 10°/sec Elevation 5°/sec
Rotation limits:	Protection shall be provided to limit antenna rotation to one full revolution
Readout accuracy:	1°
Remoting capability:	
Control:	Up to 300 feet from pedestal; separate controls for azimuth and elevation
Readout:	Up to 300 feet from pedestal
Input power:	115 VAC ± 15% 60 Hz
Environmental conditions:	Per General Requirements
Antenna Pointing readout display:	Either digital or dial display is satisfactory, separate readouts for azimuth and elevation
Display accuracy:	± 1°
Antenna control:	Separate controls shall be provided for azimuth and elevation unless joystick controls are provided
Signal strength monitor:	Provided on same panel as antenna pointing display
Physical characteristics:	
Antenna readout display:	Signal strength monitor and antenna control shall be capable of being mounted on horizontal surface of a desk type console

VIDEO/AUDIO AMPLIFIER (HEADQUARTERS)

Video input impedance:	75 ohms
Video input signal level:	0-2 volts p-p
Video baseband:	6 Hz to 4.3 MHz
Video distortion:	Per EIA RS-170
Number of video outputs:	Four (4)
Video gain:	0 to +6 dB
Isolation between outputs:	20 dB minimum
Output impedance:	75 ohms
Audio input impedance:	5,000 ohms, unbalanced
Audio input signal level:	+43 dBm
Audio input baseband:	20-5000 Hz
Number of audio outputs:	Four (4)
Audio output impedance:	600 ohm balanced
Audio gain:	0 to +6 dB
Isolation between audio outputs:	20 dB minimum
Input power:	115 VAC ± 15% 50/60 cycles
Size:	Not critical
Weight:	Not critical

NOTE: Separate audio and video amplifiers can be supplied.

MONITORS (HEADQUARTERS)

General

Screen size:	21 inch to 25 inch measured diagonally
Tuner:	Not required
System:	EIA RS-375 standard, 525 lines, 60 field/sec, monochrome

Electrical

Input power:	115 VAC ± 15%, 60 Hz, 200W or less
Video signal:	Composite video per EIA Specification RS-250-A
External sync:	Not required
Audio signal:	As per RS-250-A
Audio output:	One 8 watt pushpull output amplifier with master volume control driving two 8 ohm internal speakers (6 inch or 8 inch speakers)
Monitor performance:	As per EIA RS-375

Mechanical

Size (maximum):	30"(W) x 34"(H) x 20"(D)
Weight (maximum):	85 pounds

CABLE SET (HEADQUARTERS)

Length:	300 feet approximately
Number:	All necessary audio, video, control plus one spare video
Location:	They will be installed between the west side of headquarters roof and the Command Post (5th floor north side)
Weatherproofing:	All cables, connectors must be fully weatherproofed for continuous outdoor use
AC power connection:	AC cables can be wired to nearest fused junction box which is convenient to the roof location

BACKPACK/RELAY LINK PROCUREMENT LIST

Backpack

1 - camera/lens

1 - battery package

1 - transmitter/antenna

1 - receiver antenna/support

1 - receiver/power supply

1 - monitor

1 - console audio-video switching system

Relay

1 - transmitter

1 - antenna/support

1 - receiver

1 - receiver antenna/pedestal

1 - cable set (Headquarters)

1 - video/audio amp

2 - monitors

1 - console control

Installation

BACKPACK CAMERA/LENS

Electronic

Power:	12 VDC or 24 VDC ± 5% (applies to all following specifications)
Power consumption:	10W or less (including viewfinder)
Scan System:	2:1 interlace, 525 line as per EIA Specification RS 170
Horizontal frequency:	15.750 KHz ± 0.3 KHz, internally generated
Vertical frequency:	60 Hz ± 0.5%, internally generated
Video Output:	Composite video >1V p-p; <2V p-p; 75 ohms, sync negative
Video SNR:	≥ 43 dB
Horizontal resolution:	> 350 lines center; >220 lines at edge
Auto. Light Compensation:	> 300X for 3 dB change in video level
Vidicon:	2/3" or 1" vidicon, equivalent to or better than 8823 or 7735A vidicons
RF Output:	Not required

Viewfinder (Electronic)

Picture tube:	3/4" to 1-1/2" with prefocused eyepiece lens (diagonal)
Resolution:	≥ 220 lines center
Mount:	Viewfinder must either be an integral part of the camera or mount securely to the camera so as to not make camera operation awkward or difficult

(Optical, in lieu of electronic viewfinder)

Viewing system:	Should present a view area ± 10% of area viewed on a monitor and should be capable of following zoom operation within this specification

Physical

Size:	Camera plus viewfinder dimensions should not exceed 4"(W) x 8"(H) x 18"(D) including the lens
Weight:	Camera plus viewfinder, less than 7.5 lbs.
Accessories:	(a) Handgrip with integral camera control switch (b) An integral cable harness (video and power) to the backpack unit
Lens:	At least a 4:1 zoom lens is required covering the range of 16mm to 50mm or more, f:2.8 or better (22-60 mm if 1" vidicon used)
Mount:	C-mount
Weight (lens):	Weight of the lens must be included in the camera weight

Environmental

Temperature:	0° to +40°C

BACKPACK BATTERY PACKAGE (CAMERA/TX POWER SUPPLY)

Electrical

Battery voltage:	12 VDC or 24 VDC ± 20% to suit transmitter-camera requirements
Output voltage:	Camera: 12 VDC or 24 VDC; per requirement Transmitter: 12 VDC or 24 VDC; per requirement
Battery capacity:	Suitable for 3 hours of operation at 1.25 times the sum of the nominal transmitter and camera currents at rated voltages
Charge rate:	Maximum recharge time to full charge should be eight hours, after three hours of use
Battery charger/ps:	Supplied with unit as an internal feature or as a compatible external unit; must also be able to power the system in lieu of batteries

Mechanical

Dimensions:	14(W) x 18(H) x 7(D) maximum
Weight (maximum):	
Batteries:	Either built-in or as a removable package, Ni-Cad cells

Environmental: As per General Requirements

Controls and Indicators

Battery power control:	ON-OFF switch
AC power	Battery-AC switch (if internal charge/ power supply used)
Battery check:	Battery level voltmeter and check switch

Connectors: As per General Requirements

Construction

Harness:	A carry harness must be supplied on the battery housing providing a comfortable means of carrying the equipment on the cameraman's back
Controls:	Controls shall be placed so as to be operable by the cameraman with the backpack in place
Cables:	A cable harness shall be supplied to connect the following units:

From	Function	To	
camera	power	camera power	(BP)
camera	video	video in	(TX)
microphone	audio	audio in	(TX)
TX	power	TX power	(BP)

Battery charger: If an external battery charger/power supply is used the charger shall attach securely to the backpack unit to provide a free standing package

BACKPACK TRANSMITTER/ANTENNA

Electrical

Output frequency:	2460 MHz
Output power:	1 watt nominal, at least 0.9 watts over temperature and supply voltage range specified, VSWR 1.5:1 maximum
Input power:	12 VDC or 28 VDC ± 15% @ one amp or less; reverse polarity protection
Output frequency stability:	± .03% under all environmental and electrical conditions specified
Output impedance:	Nominal 50 ohms; VSWR ≤ 1.5:1
Modulation characteristics:	
Type:	True FM
Input impedance:	75 ohms resistive ± 5%
Frequency response:	Per EIA RS-250-A
Deviation sensitivity:	± 4 MHz/Vpp
Deviation sense:	Positive
Maximum deviation:	± 5 MHz
Deviation linearity:	2% of best straight line for maximum deviation
Harmonic distortion:	3% maximum for modulation frequencies from 6 Hz to 4 MHz deviated 4 MHz
Antenna conducted spurious emissions:	IRIC 106-69
Pre-emphasis:	CCIR Rec 405

Environmental conditions:	As per General Requirements

FCC Type Acceptance is required.

Physical characteristics

Size (maximum):	4(W) x 4(H) x 7(D) inches
Weight:	40 ounces maximum
Audio channel:	
Subcarrier frequency:	6.8 or 7.5 MHz, one channel; per RS-250-A recommendations except audio response, 50-5000 Hz and input level.
Audio input level:	-55 dBm, high impedance
Controls:	ON-OFF power switch
Connectors:	
RF output Video input Audio input	As per General Requirements
Power input:	3 pin, threaded, waterproof connector
Construction:	Transmitter is to be constructed as a module with provision for attachment to the battery pack housing. The transmitter housing should have a provision for antenna attachment
Microphone:	Lapel of headset
Output level:	≥ -55 dBm
Frequency response:	50-7500 Hz
Environment:	-10°C to 50°C; 1"/hour rain operation

Antenna characteristics

Type-frequency:	Blade for 2460 MHz
Pattern:	Omnidirectional
Gain:	Between 2 and 6 dB
Environmental:	As per General Requirements

BACKPACK RECEIVER ANTENNA/SUPPORT

Electrical

Type:	Parabolic reflector
Frequency:	2460 MHz
Gain:	$\geq$ 12 dB at 2460 MHz
Polarization:	Vertical

Mechanical

Size:	$\geq$ 12 inch diameter, but less than 24 inch diameter
Weight:	$\leq$ 2 pounds

Environmental: As per General Requirements

Antenna Support: A collapsable tripod mount shall be provided with the antenna

Size:	Collapsed $\leq$ 24 inches Fully extended $\geq$ 50 inches
Windloading:	Tripod mount with a one foot dish antenna attached shall stand free on a level surface in a 10 knot wind from any direction
Weight:	$\leq$ 8 pounds
Pan-tilt control:	a pan-tilt head shall be provided to allow antenna positioning in a 360° arc at elevation angles of -40° to +60°

Connectors

Antenna feed

BACKPACK RECEIVER/POWER SUPPLY

Receiver Electrical

Type:	FM
Frequency:	2460 MHz; manually tuneable
Noise figure:	$\leq$ 12 dB
Local oscillator stability:	AFC operation
Maximum RF input:	$\geq$ +10 dBm
Intermediate frequency:	Not critical, preferably 70-250 MHz
IF bandwidth:	20 MHz (3 dB), 60 MHz (60 dB)
Image and rejection:	60 dB
Threshold sensitivity:	$\leq$ -75 dBm for 10 dB $\frac{C+N}{N}$
Input impedance:	50 ohms (1.5:1 VSWR)
FM discriminator output:	Black negative video
Signal conditioning:	(a) De-emphasis per CCIR 405 (b) Subcarrier discriminator per EIA RS-250-A, p.11 recommendations
Video signal characteristics:	Compatible with EIA RS-250-A, Sec. 4 recommendations; 2 outputs required
Audio signal characteristics:	Compatible with EIA RS-250-A, Sec. 4 recommendations; 2 outputs required
Input voltage:	12 VDC or 24 VDC ± 15%; reverse polarity protection
Power consumption:	6 watts or less
Battery package:	The receiver will be battery powered using rechargeable Ni-Cad batteries

Mechanical

Size (maximum):	16x16x6 inches
Weight:	Less than 12 pounds (integral batteries and power supply) or less than 5 pounds (external batteries and power supply)

AC Power Supply/Charger — An integral or separate external AC power supply unit is required with the receiver

Input Voltage:	115 VAC ± 15% 60 Hz
Output Rating:	Compatible with receiver requirements
Protection:	Short circuit and over voltage protection

Controls and Indicators

Power Control:	ON-OFF
Tuning Control:	As required
Tuning Meter:	As required with tuning control

BACKPACK RECEIVER MONITOR

Electrical

Input power:	115 VAC ± 15%, 60 Hz, 65 watts or less; 12 VDC battery operation may be supplied as an option
Video input:	Composite video, sync negative, per EIA standard RS-375
Video input impedance:	75 ohms unbalanced, as per RS-375; a high impedance additional input may be optional
Video response:	60 Hz to 4.3 MHz (3 dB) or better
Tuner:	Not required, but may be supplied as an option
External sync:	Not required
General:	Monitor shall be all solid state except for the kinescope
Audio:	Desired but not required

Controls and Indicators

Front controls:	ON-OFF switch, contrast, brightness, (side panel location is optional)
Rear controls:	Horizontal hold, vertical hold (side panel or front panel location is optional)

Mechanical

Dimensions (maximum):	10(W) x 11(H) x 10(D)
Picture size:	Picture size shall be from 7 inches to 9 inches measured diagonally
Weight:	Less than 13 pounds

CONSOLE AUDIO-VIDEO SWITCHING SYSTEM

General

Type:	Manual, passive, multiple input to multiple output operation, self-terminating
Switches:	Push-button
Signal inputs:	5 channels (1 audio and 1 video per channel); audio-balanced line; video-unbalanced line
Multiple units:	Separate or integral audio and video switches may be used; more than one, but not more than three audio-video channel switches may be used to perform the desired functions (3 audio and 3 video switcher units maximum, excluding the Civil Defense control switch)

Electrical

Maximum signal levels:	Audio: +14 dBm into terminated load Video: 4 Vpp composite video into terminated load
Input terminations:	All inputs terminated except those selected; Audio: 600 ohm balanced line Video: 75 ohm unbalanced line No impedance transformation is required between inputs and outputs
Connectors:	Video: all video connectors shall be BNC type Audio: audio connectors shall be consistent throughout the audio distribution system, otherwise selection is at the choice of the vendor
Operation:	It is required to select any 2 (exclusive) of 5 input channels for monitoring; each of the 2 selected channel outputs shall drive a 4 channel output audio-video distribution amplifier. One channel from each distribution amplifier shall be controlled (ON-OFF) by a separate

Operation (continued):	switching module, 2 input straight through to 2 output channels, self-terminating, for distribution to the Civil Defense monitors

Mechanical

Switcher dimensions (max.):	14"(W) x 4"(H) x 8"(D) each unit for desk mount (maximum 3 audio units and 3 video units); or 24"(W) x 12"(H) x 14"(D) for a single unit system
Weight:	Less than 4 pounds per unit for multiple units; or less than 30 pounds for a single unit system

RELAY TRANSMITTER

Output frequency:	2475 and 2490; one frequency at a time
Output power:	10 watts nominal; 8 watts over temperature and supply voltage ranges specified into load VSWR 1.5:1
Input power:	28 ± 4 VDC; 4.5 amps (maximum) reverse polarity protection
Output frequency stability:	± 0.03% under all conditions of environmental and voltage
Output impedance:	50 ohms
Modulation characteristics:	
Type:	True FM
Input impedance:	75 ohms resistive, ± 5%
Frequency response:	Per EIA RS-250-A
Deviation sensitivity:	± 4 MHz/Vpp
Maximum deviation:	± 5 MHz
Deviation sense:	Positive
Deviation linearity:	2% of best straight line for maximum deviation
Harmonic distortion:	3% maximum for modulation frequencies from 6 Hz to 4 MHz deviated 4 MHz
Antenna conducted spurious emissions:	IRIG 106-69
Pre-emphasis:	CCIR Rec 405
Environmental conditions:	As per General Requirements

Physical characteristics:	
Size:	6 x 5 x 2 inches, excluding heat sink
Weight:	40 ounces maximum
Must have FCC Type Acceptance.	
Audio subcarrier frequency:	6.8 MHz
Audio signal channel (other):	Per RS-250-A recommendations p.11, except audio response
Heat sink:	As required
AC power supply:	A separate external AC power supply unit is required with the transmitter
Input voltage:	115 VAC ± 15%, 60 Hz
Output rating:	28 VDC ± 4 VDC, at 5 amps, less than 0.5% ripple
Protection:	Short circuit and over-voltage protection shall be incorporated in the power supply
Construction:	The transmitter shall be constructed to mount behind the parabolic dish antenna

RELAY TRANSMITTER ANTENNA/SUPPORT

Size:	30-inch diameter minimum, 48 inches maximum
Type:	Parabolic
Frequency band:	2450-2500 MHz
Gain:	20 dB or greater
Sidelobe level:	Greater than 20 dB down from mainlobe
Polarization:	Vertical
Weatherproofing:	As per General Environmental specification
Construction:	A suitable bracket shall be provided to facilitate mounting the transmitter behind the antenna
Support mount:	A tripod mount shall be provided to support the antenna/transmitter package
Wind:	Free-standing in 10 knot wind; provide hold-down brackets for use if desirable, in higher winds

RELAY RECEIVER

Electrical

Frequency:	Remotely tuneable to 2460, 2475, or 2490 MHz; operating on one frequency at a time
Noise figure at antenna port:	12 dB maximum
Local oscillator stability:	AFC
Intermediate frequency:	Not critical, preferably between 70-250 MHz
Intermediate frequency bandwidth:	20 MHz (3 dB), 60 MHz (60 dB)
Image rejection:	60 dB
Threshold sensitivity:	-75 dBm for 10 dB $\frac{C+N}{N}$
Maximum RF input at antenna port:	+10 dBm
Input impedance:	50 ohms (1.5:1 maximum VSWR)
FM discriminator output:	Negative video (black negative)
Signal conditioning:	(a) De-emphasis per CCIR 405 (b) Subcarrier discriminator per EIA RS-250-A, p.11 recommendations
Audio subcarrier frequency:	6.8 MHz
Video baseband:	6 Hz to 4 MHz minimum
Video output impedance:	75 ohms with 20 dB return loss
Video output:	0-2 volts p-p
Video characteristics (other):	Per EIA RS-250-A
Audio characteristics:	Per RS-250-A recommendations, Sec. 4

Signal strength monitoring:	External signal strength monitoring shall be provided for antenna alignment
Input power:	115 VAC ± 15%, 60 Hz

Mechanical

Size (maximum):	10" x10" x5"
Weight:	10 pounds maximum
Environmental:	As per General Requirements
Mounting:	Back end of relay receiver antenna

RELAY RECEIVER ANTENNA/PEDESTAL

Parabolic dish:	30 inch diameter minimum, 48 inches maximum
Pedestal:	Identical to helicopter antenna pedestal (HQ)
Slewing rate:	Azimuth 10°/sec Elevation not required
Readout display:	Digital or dial display for azimuth only
Readout accuracy:	2°
Rotation limits:	Protection shall be provided to limit antenna rotation to one full revolution
Remoting capability:	
Control:	Up to 300 ft from pedestal
Readout:	Up to 300 ft from pedestal
Input power:	115 VAC ± 15%, 60 Hz
Environmental conditions:	Per General Requirements
Wind:	Capable of withstanding wind up to 75 knots and operations in 20 knot wind
Construction:	Provision shall be made to mount the relay receiver behind the antenna

RELAY CABLE SET (HEADQUARTERS)

Length:	300 feet approximately
Number:	All necessary audio, video, and control plus one spare video
Location:	They will be installed between the west side of Headquarters roof and the command post (5th floor north side)
Weatherproofing:	All cables and connectors exposed to outdoors must be fully weather-proofed
AC power connection:	AC power cables will be wired to a fused junction box with adequate current carrying capability convenient to the roof location

RELAY VIDEO/AUDIO AMPLIFIER

Video input impedance:	75 ohms
Video input signal level:	0-2 volts p-p
Video baseband:	6 Hz to 4.3 MHz
Video distortion:	As per EIA RS-170
Number of video outputs	4 to 6
Video gain:	0 to 6 dB or better
Isolation between outputs:	20 dB minimum
Output impedance:	75 ohms
Audio input impedance:	5000 ohms, unbalanced
Audio input signal level:	+43 dBm
Audio input baseband:	20-5000 Hz
Number of audio outputs:	4
Audio output impedance:	600 ohm balanced
Audio gain:	0 to +6 dB
Isolation between audio outputs:	20 dB minimum
Input power:	115 VAC ± 15%, 50/60 cycles
Size:	Not critical
Weight:	Not critical

NOTE: Separate audio and video amplifiers can be supplied.

COMMAND POST RELAY MONITOR

General

Screen size:	21" to 25" measured diagonally
Tuner:	Not required
System:	EIA RS-375 standard, 525 lines, 60 field/sec, monochrome

Electrical

Input power:	115 VAC ± 15%, 60 Hz, 200W or less
Video signal:	Composite video per EIA specification RS-250-A
External sync:	Not required
Audio signal:	As per RS-250-A
Audio output:	One 8 watt pushpull output amplifier with master volume control driving two 8 ohm internal speakers (6" or 8" speakers)
Monitor performance:	As per EIA RS-375

Mechanical

Size (maximum):	30"(W) x 34"(H) x 20"(D)
Weight (maximum):	85 pounds

RELAY CONSOLE CONTROL

Relay antenna pointing readout display:	Either digital or dial display is satisfactory
Display accuracy:	±2°
Relay antenna control:	A dial type control shall be provided for azimuth
Relay signal strength monitor:	Provided on same panel as antenna pointing display
Physical characteristics:	
Antenna readout display:	Signal strength monitor and antenna control shall be capable of being mounted on horizontal surface of a desk type console

SUGGESTED VENDORS

Ampex Corporation

COHU

Concord Communication Systems

Conic Corporation

Dyna-Rep Corporation

Dyna Sciences

GBC

GTE Lenkurt

International Microwave Corporation

Jansky and Bailey

Jerrold Electronics

Kaiser CATV Division

Laser Link Corporation

Microwave Associates

Motorola

Multimedia

Philips Broadcasting Equipment Corp.

Professional Products

RCA

RHG

Scientific Atlanta

Sylvania

Telcom

Theta Communications

Varian Associates

Video Engineering

Vikoa, Inc.

Westinghouse

DISTRIBUTION LIST

MITRE

D-12

C. C. Grandy
C. A. Zraket

D-30

J. Dominitz
H. D. Frankel
E. L. Rabben
W. F. Yondorf

D-24

S. H. Roth

D-21

S. Polk

D-33

J. O. Bell
D. R. Greenlee
W. E. Holden
D. Jaffe
W. O. Mehuron
J. H. Parness (15)
G. E. Wicker
J. S. Yocum

END