MSC-06724
(COPY 1)

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

LUNAR SURFACE TELEVISION OPERATIONS PLAN

APOLLO 16

FEBRUARY 18, 1972

PREPARED BY
APOLLO COMMUNICATION SYSTEMS SECTION
FLIGHT CONTROL OPERATIONS BRANCH
FLIGHT CONTROL DIVISION

MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

*

LUNAR SURFACE TELEVISION

OPERATIONS PLAN

APOLLO 16

FEBRUARY 18, 1972

SUBMITTED BY:

GARY B. SCOTT
APOLLO COMMUNICATIONS SYSTEMS SECTION

EDWARD I. FENDELL
HEAD, APOLLO COMMUNICATIONS SYSTEMS SECTION

CHARLES S. HARLAN
CHIEF, FLIGHT CONTROL OPERATIONS BRANCH

APPROVED BY:

EUGENE F. KRANZ
CHIEF, FLIGHT CONTROL DIVISION

SIGURD A. SJOBERG
ACTING DIRECTOR OF FLIGHT OPERATIONS

CONCURRED BY:

JAMES A. McDIVITT
MANAGER, APOLLO SPACECRAFT PROGRAM

*

LUNAR SURFACE TELEVISION
OPERATIONS PLAN
APOLLO 16

PREFACE

This document has been prepared by the Apollo Communication Systems Section, Flight Control Operations Branch, Flight Control Division, Manned Spacecraft Center, Houston, Texas with technical assistance by Service Technology Corporation. The information contained within this document represents Lunar Surface Television requirements and planned operations for Apollo 16, as of February 18, 1972.

Any questions or comments concerning this document should be directed to FC2/Gary B. Scott, Flight Control Operations Branch, Apollo Communications Systems Section, at 713-483-2267.

*

LUNAR SURFACE TELEVISION OPERATIONS PLAN

I. INTRODUCTION

The Apollo 16 Lunar Surface Television Operations Plan is used to document the Lunar Surface TV operations plan, to provide TV operating procedures, and to document all Lunar Surface TV requirements to be implemented.

This document includes TV operating procedures and operational TV requirements. The tasks to be observed at each stop are based on current lunar surface planning and therefore are subject to change. The listings for each stop are representative of the type of items that we will observe at that stop.

II. REQUIREMENTS AND PRIORITIES

The lunar surface television requirements as documented in this publication, are considered as highly desirable and not mandatory; however, certain items to be viewed at a given stop do take precedence over other items. The television coverage does not supersede or delete in any way the photographic requirements specified in the Mission Requirements Document (MRD). The following comprises a list of the Lunar Surface television viewing requirements for the Apollo 16 mission.

A. Requirements for Individual ALSEP Experiments

1. Experiments
   a. Passive Seismic (PSE)
   b. Lunar Surface Magnetometer (LSM)
   c. Active Seismic (ASE)
   d. Heat Flow (HFE)
   e. Central Station (CS)

2. General Requirements
   a. Monitor ALSEP offloading, RTG fuel cask removal and RTG fueling.

b. Pan area prior to ALSEP deployment operations and after all experiments are deployed.
c. Attempt to relate each experiment with an identifiable nearfield object (such as another experiment).
d. Obtain a close-up view of each experiment during and after emplacement.
e. Observe general activity around each experiment.

3. Specific Requirements
   a. Central Station
      (1) Obtain a panoramic view of the deployed ALSEP in relation to the CS.
      (2) Obtain a close-up view of the central station during deployment and when fully deployed.
      (3) Obtain a close-up view of the RTG after deployment.
      (4) Obtain a close-up view of the antenna alignment.
   b. Passive Seismic Experiment
      Obtain a close-up view of the PSE thermal shroud contact with the lunar surface (to determine if gaps exist).
   c. Lunar Surface Magnetometer
      (1) Obtain a close-up view of the LSM sensor heads and tripod after deployment.
      (2) Obtain a view of the LSM cable after deployment.
      (3) Observe the unfolding of the arms on the magnetometer during deployment.
   d. Active Seismic Experiment
      (1) Observe the deployment and mounting of the launch assembly onto the mortar platform and its final orientation.

(2) Obtain a close-up view of the platform leveling procedure.

(3) Observe the deployment the geophone line and the implantment of the geophones.

(4) Observe the astronaut during the thumper firings.

e. Heat Flow Experiment

(1) Observe at close-up range, as much of the drilling of the probe holes as possible.

(2) During drilling, observe deviation of drill from vertical position.

(3) Observe insertion and final orientation of probes in holes and deployment of cables and electronics package.

B. Non-ALSEP Experiments

1. Experiments

a. Soil Mechanics Experiment

b. Lunar Portable Magnetometer (LPM)

c. Solar Wind Composition

d. Lunar Geology

e. Far UV Camera

2. Requirements

a. Soil Mechanics

(1) View the core tube sampling operation and penetrometer tests at each core tube site.

(2) View the trenching operation and penetrometer test.

(3) View the rover wheel tracks, where possible.

b. Lunar Portable Magnetometer (LPM)

(1) WAP of each LPM deployment site.

(2) Obtain close-up view of LPM tripod and sensor box during and after each deployment.

(3) Observe the reeling in and reeling out of cable assembly at each LPM stop.

(4) Relate deployed LPM with some identifiable object, if possible.

c. Solar Wind Composition

(1) Obtain PAN view of SWC deployment area.

(2) Obtain close-up view of SWC during and after deployment.

(3) Relate SWC location to LM or other identifiable object.

d. Lunar Geology

(1) Lunar Geology - Lunar Module

(a) Pan 360° with horizon near top of frame and widest field of view.

(b) Sight on LM with maximum and minimum zoom positions to permit scale calibrations on MCC SSR D/TV monitors for later traverse measurements from LRV.

(2) Lunar Geology - LRV

(a) 360° pan at all stops, wide angle, horizon near top of frame. This should not be a continuous pan, but a pan-stop, etc. Stops should be 2-4 seconds long (for Polaroid camera photos) and pans should have a minimum of 10° overlap.

(b) On request from the Experiments Officer, zoom from wide angle to telescopic view at sampling localities or local landmarks as defined from the 360° pan.

(c) During traverse, and at each science stop if surface conditions deem necessary, look at the LRV tracks, fenders, and wheels for excessive dust, or extreme differences in wheel penetration (determined by astronaut).

e. FAR UV Camera

(1) Observe unloading of camera (QUAD III Payload Pallet) if possible.

(2) Observe deployment of tripod and mounting of camera. Relate camera location to LM.

(3) Observe battery and cable deployment.

(4) Obtain close-up view of camera when fully deployed.

(5) Obtain close-up view of camera during a reset operation by the crewman in order to see the mode change.

f. Other Requirements

(1) Establish a grid and calibration scheme for range and heading determinations.

(2) View LRV deployment, checkout, and equipment stowage on the LRV.

(3) View LRV operation during checkout period (especially observe braking).

(4) View ALSEP offloading from LM and deployment in the field.

(5) View equipment jettison from LM after EVA III.

(6) View LM descent stage and ALSEP after EVA III. Details to be defined later.

(7) View LM ascent.

(8) View LM impact.

*

(9) Obtain surveys of the lunar terrain at varying sun angles.

(10) View various astronomical objects, that is the earth, planets, stars, et cetera.

III. OPERATIONAL AND EQUIPMENT CONSTRAINTS

A. The Lunar Communications Relay Unit (LCRU) will operate in the voice/data mode only with the LRV moving. The S-Band low-gain antenna and a MSFN 85-foot dish are required for moving modes. No television can be transmitted in these modes.

B. The LRV must be stopped for transmission of television due to S-Band antenna pointing.

Television requires the high-gain antenna and an 85-foot or 210-foot dish (see Figure III-1 for site coverage).

C. The crewman must dismount the LRV to operate any LCRU controls (modes, power, telemetry monitor) or to deploy or adjust the high-gain antenna.

D. The Extravehicular Communications System (EVCS) can be operated line-of-sight to the LCRU within 500 meters with no degradation in VOICE or data. Degraded but usable voice and data may be obtained to a range of 800 meters.

E. The delay in transmission of video to MCC from the lunar surface is approximately 1.8 seconds.

F. The amount of time from the execution of Ground Commanded Television Assembly (GCTA) commands until video response at MCC is 3.7 seconds maximum. (That is when TV is received at Honeysuckle Creek, Australia and transmitted to MCC via satellite.)

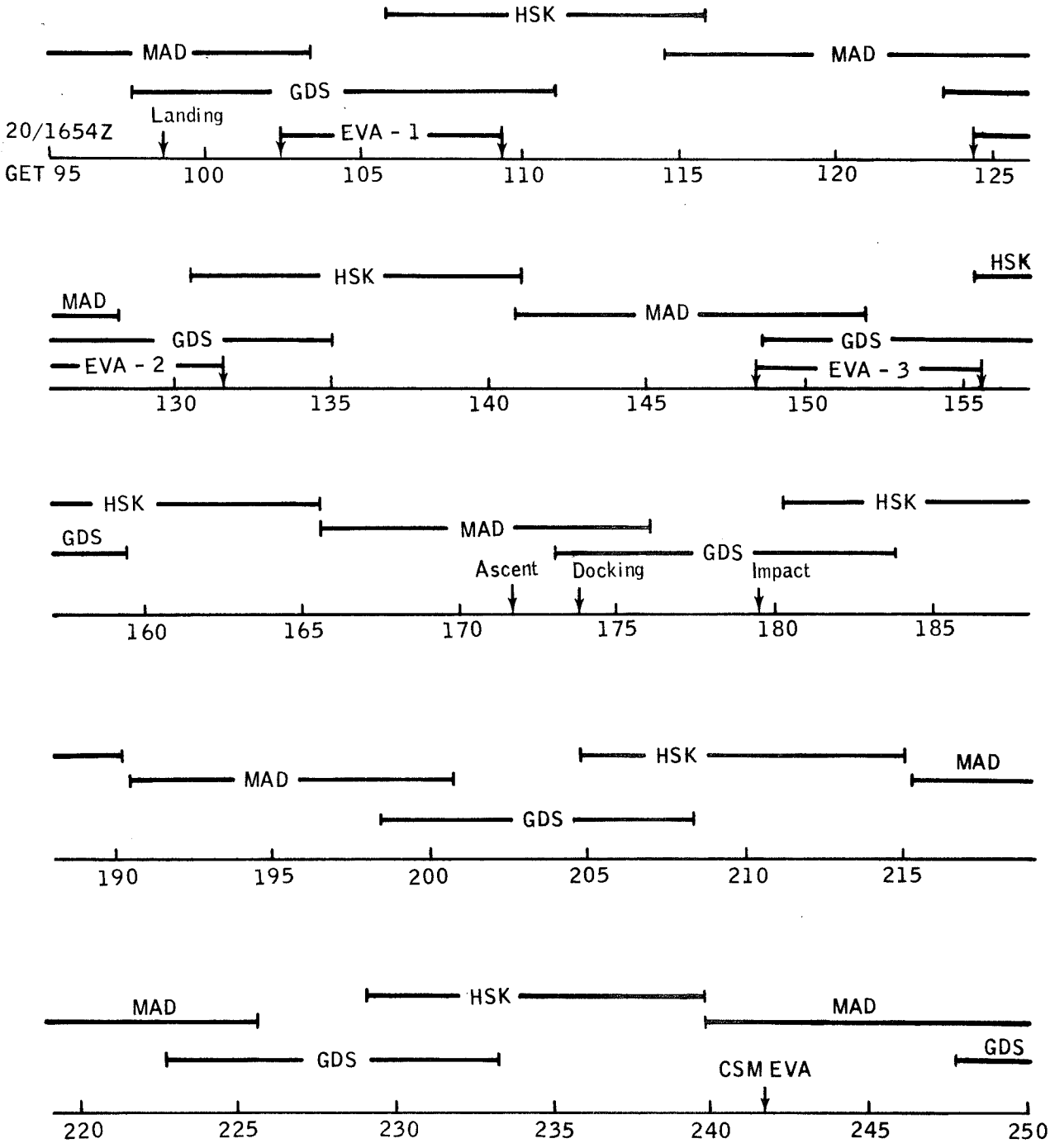


Figure III-1.- MSFN site coverage.

*

IV. TELEVISION MODES

A. General - The Color Television Camera (CTV) has several different modes of operation. At the beginning of Lunar Surface operations, the CTV is mounted on the MESA and video is transmitted via the LM - 100 foot cable and S-Band system to the MSFN. This is the same configuration of the television camera as used on previous missions. Shortly after MESA deploy and the first video is transmitted from the MESA, the crew will mount the CTV on a tripod to view LRV (Lunar Rover) deployment and MESA offloading. The MCC has no command capability while the CTV is connected to the LM via the 100-foot video cable.

After the Lunar Communications Relay Unit (LCRU) and Television Control Unit (TCU) are offloaded and mounted on the LRV, the CTV is turned off, disconnected from LM power, and mounted on the TCU. After LCRU mode checks are made, the CTV will be activated in the LCRU "TV RMT" mode. From this point on, video will be transmitted to the MSFN via the LCRU.

B. Specific Modes - The "TV RMT" and "FM/TV" modes of the LCRU are used for transmission of television. The "FM/TV" mode downlinks 1.25 MHz voice, PLSS data, LCRU data and video to the MSFN on S-Band. Control of the Ground Command Television Assembly is exercised manually by the crew or by ground command from the MCC in this mode.

The "FM/TV" mode will be used for nominal television operations during the traverses.

The "TV RMT" mode of the LCRU has the same capabilities as the "FM/TV" mode but has the additional capability to turn off the LCRU 1.25 MHz VOICE/DATA subcarrier and power down the LCRU FM/PM transmitter. Due to the capability to turn off the 1.25 MHz VOICE/DATA subcarrier, the "TV RMT" mode can downlink video only with an increase in video quality. The capability to turn off the LCRU FM transmitter will be used after EVA III to save power for further CTV operations.

V. INCO INTERFACES AND PROCEDURES

The Instrumentation and Communication System Officer (INCO) is responsible for ground commanding the GCTA and implementation of the Lunar Surface Television Requirements. During real-time mission operations, the INCO will receive additional inputs on operation of the GCTA from the Experiments Officer (EO), and the Flight Director. In addition, the Public Affairs Officer (PAO) will make inputs to the Flight Director who will pass the coordinated input to INCO. The EO is responsible for taking inputs from the lunar field geology Principal Investigators (PI's) and relaying them to INCO. The type of inputs expected in real-time operations are as follows:

A. Narrow-Angle Targets of Opportunity (NATO) of specific geological formations viewed during the wide-angle panorama (WAP) at the beginning of a traverse stop.

B. Certain crew activity not scheduled for television coverage.

VI. SPECIFIC INCO PROCEDURES

A. Wide-Angle Panorama (WAP) - The WAP will occur when the LCRU/GCTA is switched to the "FM/TV" mode at the beginning

of each traverse stop. It will consist of 14 discrete pans of 24 degrees each with stops after each pan of 4 seconds duration. The minimum time to accomplish a WAP is approximately 168 seconds. The WAP will start from one stop and end at the opposite stop. The starting point is determined by the position of the CTV at the time of activation.

B. Narrow-Angle Target of Opportunity (NATO) - The NATO is accomplished by centering the desired object in the television picture with the zoom at minimum (12.5 mm). The centering may require combinations of pan and tilt. When the object is centered in the field-of-view (FOV) of the CTV, the CTV will be zoomed in to the maximum zoom position (75 mm).

C. Medium-Angle View (MAV) - The MAV is accomplished by positioning the object/area to be viewed in the center of the television picture with the zoom at medium ($\sim$30 mm). The MAV will be used when the area around an object is of interest for determining placement or general activity.

D. Typical Traverse Stop Activation - After the CDR dismounts the LRV, he will switch the LCRU to the "FM/TV" mode, which applies power to the GCTA, and point the LCRU High Gain Antenna (HGA) to earth. In addition, if the LCRU was not previously powered up, the CDR would be required to place the LCRU power switch to "INT".

E. Use of the LCRU "TV RMT" mode - The "TV RMT" mode will be used instead of the "FM/TV" mode when the capability is desired of being able to turn off the LCRU 1.25 MHz VOICE/DATA SUBCARRIER and improve the television picture quality. Additionally, the "TM RMT" mode will be used for viewing LM ascent.

*

For the LM ascent command sequence to work the LRV/LCRU/GCTA must be positioned 180° from the LM ascent launch azimuth at approximately 328 feet from the LM. Nominally the LRV will be driven along the derived heading until the odometer clicks .1 km (328 feet). The crewman will then point the LRV on a heading of 170°. The LCRU will be activated on "EXT" power in the "TV RMT" mode and the LCRU HGA pointed toward the earth.

The MCC will then command the CTV so that it is pointing at the LM. If it is impossible to position the LRV as required due to a large crater, rock, et cetera, the LRV will be positioned to the north of the proposed site. The new position will require azimuth correction commands to be added to the ascent command sequence. The nominal ascent command sequence is defined in the detailed timeline, Section VIII.

F. Use of LRV Power - The LCRU has the capability to use LRV power in addition to the LCRU internal battery. This capability will be used for coverage of EVA I, EVA II, the end of EVA III, LM ascent, and it will also provide additional power to increase LCRU/GCTA post-ascent operations time. To use LRV power the LCRU power switch is placed to "EXT" and the LRV power auxiliary circuit breaker is closed.

G. CTV Traverse Stowage - Prior to departure from the Lunar Module or from a science stop, the CTV will be positioned either by ground command or by the crew to 0/360° in azimuth and 0° in elevation. This CTV position is desirable from an operational and thermal standpoint. Operationally, the stowed position will both save time in

*

positioning the CTV for a Wide-Angle Panorama and also provide a known reference for determining the bearing of the crew or an object from the LRV.

VII. EVA LCRU/GCTA Operation

Pages 13 - 15 following are a list of the items to be viewed at each stop during the three scheduled EVA's. There has been no attempt to list by priority the items or actions to be viewed. The order of the observations will be based on the requirements listed in Section II and the real-time evaluations of crew activities.

EVA I

STATION	STATION TIME HR:MIN	ITEMS TO BE VIEWED
LM	1:37	1. LRV DEPLOYMENT AND CHECKOUT 2. MESA OFFLOAD 3. UV CAMERA DEPLOYMENT 4. FLAG DEPLOYMENT 5. RTG FUELING
ALSEP	2:24	1. WAP 2. HFE PROBE - 1 DRILLING OPERATION 3. ASE MORTAR DEPLOYMENT AND ORIENTATION 4. ASE THUMPER OPERATION 5. CENTRAL STATION SETUP AND ANTENNA ALIGNMENT 6. ASE GEOPHONE DEPLOYMENT 7. HFE PROBE - 2 DRILLING OPERATION 8. FINAL HFE PROBE ORIENTATION 9. PSE DEPLOYMENT 10. LSM DEPLOYMENT 11. CORE DRILLING AND EXTRACTION 12. WAP
1 (FLAG CRATER)	0:43	1. WAP 2. NATO FLAG CRATER 3. NATO OF BOULDER BLOCKS 4. OBSERVE STONE MTN AND SMOKEY MTN FOR USE ON EVA II AND III PLANNING 5. LRV TRACKS 6. OBSERVE DOCUMENTED SAMPLING 7. OBSERVE RAKE/SOIL SAMPLING
2 (SPOOK CRATER)	0:56	1. WAP 2. NATO SPOOK CRATER 3. NATO SMALL BLOCKY CRATER 4. OBSERVE DOCUMENTED SAMPLING 5. LPM ACTIVITIES 6. ATTEMPT TO VIEW LM
3 (LM/ALSEP AREA)*	0:14	1. WAP 2. 2.6m CORE RETRIVAL ACTIVITIES 3. ASE MORTAR ARMING 4. VIEW LM 5. GRAND PRIX
LM	0:40	1. WAP 2. NATO OF UV CAMERA TO OBSERVE MODE CHANGING (IF POSSIBLE)

*NO TELEVISION

EVA II

STATION	STATION TIME HR:MIN	ITEMS TO BE VIEWED
LM	0:50	1. OBSERVE ASTRONAUT ACTIVITY
4 (STONE MTN)	0:58	1. WAP 2. MAV/NATO SOUTH RAY 3. NATO BOULDER 4. DOCUMENTED SAMPLING 5. RAKE/SOIL SAMPLING 6. CORE SAMPLING 7. PENETROMETER MEASUREMENTS 8. SPECIALIZED BOULDER SAMPLING 9. 500 MM PHOTOGRAPHY
5 (STONE MTN)	0:40	1. WAP 2. DOCUMENTED SAMPLING 3. BOULDERS 4. LRV TRACKS
6 (BASE OF STONE MTN)	0:20	1. WAP 2. DOCUMENTED SAMPLING
7 (STUBBY CRATER)	0:15	1. WAP 2. BOULDERS 3. NATO STUBBY CRATER 4. NATO BABY RAY CRATER 5. DOCUMENTED SAMPLING 6. 500 MM PHOTOGRAPHY
8 (SOUTH RAY EJECTA BLANKET)	1:00	1. WAP (FOR REAL-TIME PLANNING) 2. NATO WRECK CRATER 3. DOUBLE CORE ACTIVITIES 4. RAKE/SOIL SAMPLING 5. SPECIALIZED BOULDER SAMPLING 6. DOCUMENTED SAMPLING 7. RAY SAMPLING
9	0:25	1. WAP 2. DOCUMENTED SAMPLING 3. SURFACE SAMPLING (STICKY PAPER) 4. CSVS CORE SAMPLE 5. NATO STONE MTN 6. ATTEMPT TO VIEW LM
10 (LM/ALSEP AREA)	0:33	1. WAP 2. DOUBLE CORE ACTIVITIES 3. TRENCH ACTIVITIES 4. PENETROMETER READINGS 5. VIEW LM 6. SOIL MECHANICS ACTIVITIES
LM	0:40	1. LRV OFF LOADING 2. UV CAMERA ACTIVITIES

EVA III

STATION	STATION TIME HR:MIN	ITEMS TO BE VIEWED
LM	0:45	1. ASTRONAUT ACTIVITY
11 (NORTH RAY RIM)	0:55	1. WAP 2. BOULDERS 3. NATO NORTH RAY 4. NATO OF LAYERING INSIDE NORTH RAY 5. NATO OF MOUND IN BOTTOM OF NORTH RAY 6. NATO OF SMOKEY MTN 7. NATO OF STATION 14 AREA 8. DOCUMENTED SAMPLING 9. POLARAMETRIC PHOTOGRAPHY 10. 500 MM PHOTOGRAPHY
12 (NORTH RAY RIM)	0:55	1. WAP 2. BOULDERS 3. SPECIALIZED BOULDER SAMPLING 4. DOCUMENTED SAMPLING 5. RAKE/SOIL SAMPLING 6. NATO SMOKEY MTN 7. NATO NORTH RAY 8. 500 MM PHOTOGRAPHY
13 (NORTH RAY EJECTA BLANKET)*	0:10	1. WAP 2. NATO STATION 14 AREA 3. SOIL AND ROCK SAMPLING
14 (SMOKEY MTN)	0:40	1. WAP 2. DOCUMENTED SAMPLING 3. DOUBLE CORE ACTIVITIES 4. RAKE/SOIL SAMPLING 5. NATO SMOKEY MTN 6. 500 MM PHOTOGRAPHY
15 (DOG LEG CRATER)*	0:10	1. WAP 2. NATO DOG LEG CRATER 3. LPM ACTIVITY 4. SOIL AND ROCK SAMPLING
16 (DOT CRATER)*	0:10	1. WAP 2. ROCK/SOIL SAMPLING 3. LPM ACTIVITY 4. NATO PALMETTO CRATER
17 (PALMETTO CRATER)	0:38	1. WAP 2. DOCUMENTED SAMPLING 3. RAKE/SOIL SAMPLING 4. LPM ACTIVITY 5. NATO PALMETTO CRATER 6. ATTEMPT TO VIEW LM
LM	0:55	1. COSMIC RAY EXPERIMENT RETRIEVAL 2. CLOSEOUT ACTIVITY 3. MOUNTAINS TO THE EAST
FINAL LRV PARKING ORIENTATION		1. WAP 2. LM IMPACT AREA 3. LM

*NO TELEVISION

*

VIII. LIFT-OFF AND POST-LIFT-OFF LCRU/GCTA OPERATION

A. General Description

At the end of EVA III, the LRV/LCRU/GCTA will be positioned 180° from the ascent launch azimuth (265°) at a range of 0.1 kilometer (328 feet) to view ascent with the color television camera (CTV). The LRV will be pointed at a heading of 170°. The CTV will be ground commanded according to a predetermined command sequence to follow the ascent stage (see Page 17).

Post-Lift-Off operation of the LCRU/GCTA from April 22, 1972, until approximately May 4, 1972, at the Descartes site will serve five purposes as follows:

1. Coverage of the LM ascent stage lift-off and initial trajectory.
2. Survey of plume effects near the landing site and on the descent stage.
3. Coverage of the impact for the LM ascent stage.
4. Survey of lunar landscape colors and albedo under changing sun angles.
5. Observations of planets, stars, nebulae, and other astronomical objects.

A complete schedule of camera operations is given in the detailed timeline section. The post-lift-off operations as presented in the detailed timeline will be accomplished based on LRV battery power remaining and thermal considerations. All post EVA activities are time referenced in GMT rather than GET (Ground Elapsed Time) due to the possibility of updates during the mission. GET reference is provided as a flight plan reference only.

*

B. Detailed Timeline

DATE	TIME (GMT) HR:MIN:SEC	SUN		TARGET/GCTA OPERATION	TARGET		MSFN COVER.	ACT Δt(MIN)
		ELEV	AZ		ELEV	AZ		
April 23	21:24:00 (171:30:09)	49°	77°	MCC-Command power ON. Readout LCRU voltage, RAD temperature, and CTV temperature.			MAD	
	21:26:00			MCC-Command 1.25 MHz subcarrier OFF. Attempt to view ALSEP instruments.				
	21:30:00			MCC-Position CTV to view LM ascent. Monitor CTV until LM ascent.	10°	265°		
				ASCENT COMMAND SEQUENCE				
	21:39:09(T+0) (171:45:09)			MCC Command:Tilt UP				
	21:39:11(T+2)			MCC Command:Zoom OUT				
	21:39:19(T+10)			MCC Command:Zoom STOP				
	21:39:21(T+12)			MCC Command:Zoom IN				
	21:39:27(T+18)			MCC Command:Tilt STOP				
	21:39:28(T+19)			MCC Command:Tilt INC DWN				
	21:39:30(T+21)			MCC Command:Tilt INC DWN				
	21:39:32(T+23)			MCC Command:Tilt INC DWN				
	21:39:34(T+25)			MCC Command:Tilt INC DWN				
	21:39:36(T+27)			MCC Command:Tilt INC DWN				
	21:41:00			MAV surface, LM descent stage for plume effects.				
	21:43:00			Attempt to view ALSEP instruments.	10°	265°		
	21:45:00			Pan horizon, MAV				
	21:48:00			MCC-Command power OFF.				24

DATE	TIME (GMT) HR:MIN:SEC	SUN		TARGET/GCTA OPERATION	TARGET		MSFN COVER.	ACT. Δt(MIN)
		ELEV	AZ		ELEV	AZ		
April 24	05:18:00 (179:24:00)	53°	75°	MCC-Command power ON. Readout LCRU voltage, RAD temperature, and CTV temperature.			GDS	
	05:23:00			MCC-Command 1.25 MHz subcarrier OFF. Position CTV to view LM impact.				
	05:33:29 (179:39:29)			LM impact, MAV.	10°	230°		
	05:38:00			View Milky Way and Jupiter.	10°	270°		
	05:40:00			View large Magellanic Cloud, MAV.	10°	135°		
	05:42:00			View Venus, Mars, and Saturn MAV.	10°	45°		
	05:44:00			Pan horizon.				
	05:46:00			MCC-Command 1.25 MHz subcarrier ON. Readout LCRU voltage, RAD temperature, and CTV temperature.				
	05:48:00			MCC-Command 1.25 MHz subcarrier OFF, power OFF.				30

*

DATE	TIME (GMT) HR:MIN:SEC	SUN		TARGET/GCTA OPERATION	TARGET		MSFN COVER.	ACT. Δt(MIN)
		ELEV	AZ		ELEV	AZ		
April 25	07:00:00 (205:06:00)	64°	67°	MCC-Command power ON. Readout LCRU voltage, RAD temperature, and CTV temperature.			GDS	
	07:02:00			MCC-Command 1.25 MHz subcarrier OFF. Pan horizon.				
	07:05:00			MAV/NATO all nearby boulders and hills.				
	07:10:00			View Venus, Mars, and Saturn.	10°	45°		
	07:14:00			View large Magellanic Cloud.	10°	135°		
	07:16:00			View Milky Way. and Jupiter.	10°	270°		
	07:18:00			Pan horizon.				
	07:20:00			MCC-Command 1.25 MHz subcarrier ON. Readout LCRU voltage, RAD temperature, and CTV temperature. Position CTV for thermal management.				
	07:22:00 (205:28:00			MCC-Command 1.25 MHz subcarrier OFF, then command power OFF.				22

*

DATA	TIME (GMT) HR:MIN:SEC	SUN		TARGET/GCTA OPERATION	TARGET		MSFN COVER.	ACT. Δt(MIN)
		ELEV	AZ		ELEV	AZ		
April 26	07:00:00 (229:06:00)	74°	48°	MCC-Command power ON. Readout LCRU voltage, RAD temperature, and CTV temperature.			GDS	
	07:02:00			MCC-Command 1.25 MHz subcarrier OFF.				
	07:03:00			Pan horizon.				
	07:06:00			MAV/NATO all near by boulders and hills.				
	07:12:00			MCC-Command 1.25 MHz subcarrier ON. Read-out LCRU voltage, RAD temperature, and CTV temperature. Position CTV for thermal management.				
	07:15:00 (229:21:00)			MCC-Command 1.25 MHz subcarrier OFF, then command power OFF.				15

DATE	TIME (GMT) HR:MIN:SEC	SUN		TARGET/GCTA OPERATION	TARGET		MSFN COVER.	ACT. Δt(MIN)
		ELEV	AZ		ELEV	AZ		
April 27	07:00:00 (253:06:00)	79°	356°	MCC-Command power ON. Readout LCRU voltage, RAD temperature, and CTV temperature.			GDS	
	07:02:00			MCC-Command 1.25 MHz subcarrier OFF.				
	07:03:00			Pan horizon.				
	07:06:00			MAV/NATO all nearby boulders and hills.				
	07:12:00			MCC-Command 1.25 MHz subcarrier ON. Read-out LCRU voltage, RAD temperature, and CTV temperature. Position CTV for thermal management.				
	07:15:00 (253:21:00)			MCC-Command 1.25 MHz subcarrier OFF, then command power OFF.				15

*

DATE	TIME (GMT) HR:MIN:SEC	SUN ELEV	SUN AZ	TARGET/GCTA OPERATION	TARGET ELEV	TARGET AZ	MSFN COVER.	ACT. Δt(MIN)
April 28	07:00:00 (277:06:00)	73°	309°	MCC-Command power ON. Readout LCRU voltage, RAD temperature, and CTV temperature.			GDS	
	07:02:00			MCC-Command 1.25 MHz subcarrier OFF.				
	07:03:00			Pan horizon.				
	07:06:00			MAV/NATO all nearby boulders and hills.				
	07:12:00			MCC-Command 1.25 MHz subcarrier ON. Readout LCRU voltage, RAD temperature, and CTV temperature. Position CTV for thermal management.				
	07:15:00 (277:21:00)			MCC-Command 1.25 MHz subcarrier OFF, then command power OFF.				15

DATE	TIME (GMT) HR:MIN:SEC	SUN		TARGET/GCTA OPERATION	TARGET		MSFN COVER.	ACT. Δt(MIN)
		ELEV	AZ		ELEV	AZ		
April 29	11:00:00	61°	290°	MCC-Command power ON. Readout LCRU voltage, RAD temperature, and CTV temperature.			GDS	
	11:02:00			MCC-Command 1.25 MHz subcarrier OFF.				
	11:03:00			Pan horizon.				
	11:06:00			MAV/NATO all nearby boulders and hills.				
	11:12:00			MCC-Command 1.25 MHz subcarrier ON. Readout LCRU voltage, RAD temperature, and CTV temperature.				
	11:15:00			MCC-Command 1.25 MHz subcarrier OFF, power OFF.				15

*

DATE	TIME (GMT) HR:MIN:SEC	SUN		TARGET/GCTA OPERATION	TARGET		MSFN COVER.	ACT. Δt(MIN)
		ELEV	AZ		ELEV	AZ		
April 30	11:00:00	50°	283°	MCC-Command power ON. Readout LCRU voltage, RAD temperature, and CTV temperature.			GDS	
	11:02:00			MCC-Command 1.25 MHz subcarrier OFF.				
	11:03:00			Pan horizon.				
	11:06:00			MAV/NATO all nearby boulders and hills.				
	11:12:00			MCC-Command 1.25 MHz subcarrier ON. Readout LCRU voltage, RAD temperature, and CTV temperature.				
	11:15:00			MCC-Command 1.25 MHz subcarrier OFF, power OFF.				15

DATE	TIME (GMT) HR:MIN:SEC	SUN		TARGET/GCTA OPERATION	TARGET		MSFN COVER.	ACT. Δt(MIN)
		ELEV	AZ		ELEV	AZ		
May 1	11:00:00	38°	279°	MCC-Command power ON. Readout LCRU voltage, RAD temperature, and CTV temperature.			GDS	
	11:02:00			MCC-Command 1.25 MHz subcarrier OFF.				
	11:03:00			Pan horizon.				
	11:06:00			MAV/NATO all nearby boulders and hills.				
	11:12:00			MCC-Command 1.25 MHz subcarrier ON. Readout LCRU voltage, RAD temperature, and CTV temperature.				
	11:15:00			MCC-Command 1.25 MHz subcarrier OFF, power OFF.				15

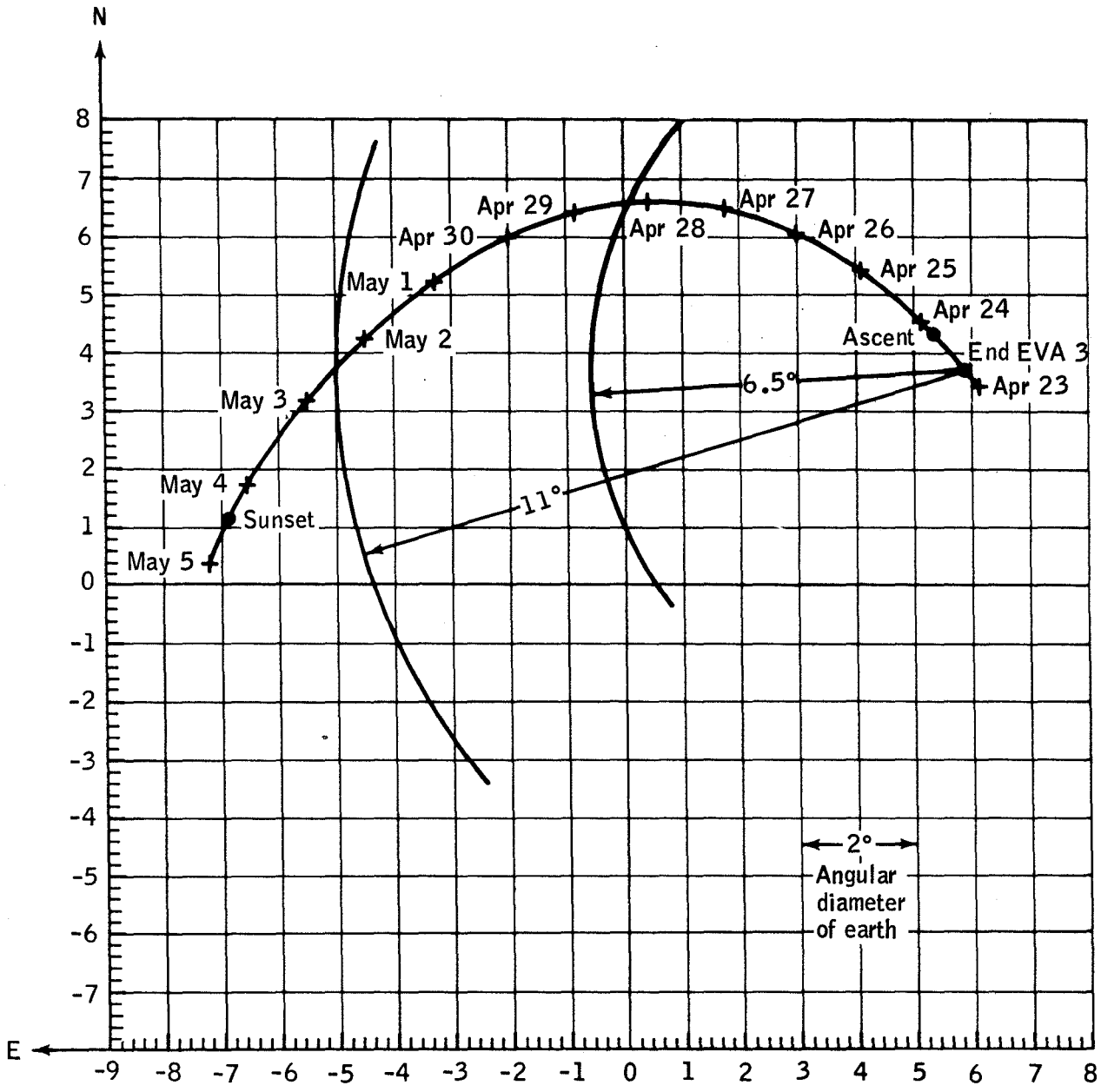
*

DATE	TIME (GMT) HR:MIN:SEC	SUN ELEV	SUN AZ	TARGET/GCTA OPERATION	TARGET ELEV	TARGET AZ	MSFN COVER.	ACT. Δt(MIN)
May 2	11:00:00	26°	276°	MCC-Command power ON. Readout LCRU voltage, RAD temperature, and CTV temperature.			GDS	
	11:02:00			MCC-Command 1.25 MHz subcarrier OFF.				
	11:03:00			Pan horizon.				
	11:06:00			MAV/NATO all nearby boulders and hills.				
	11:12:00			MCC-Command 1.25 MHz subcarrier ON. Readout LCRU voltage, RAD temperature, and CTV temperature.				
	11:15:00			MCC-Command 1.25 MHz subcarrier OFF, power OFF.				15

DATE	TIME (GMT) HR:MIN:SEC	SUN		TARGET/GCTA OPERATION	TARGET		MSFN COVER.	ACT. Δt(MIN)
		ELEV	AZ		ELEV	AZ		
May 3	11:00:00	14°	274°	MCC-Command power ON. Readout LCRU voltage, RAD temperature, and CTV temperature.			GDS	
	11:02:00			MCC-Command 1.25 MHz subcarrier OFF.				
	11:03:00			Pan horizon.				
	11:06:00			MAV/NATO all nearby boulders and hills.				
	11:12:00			MCC-Command 1.25 MHz subcarrier ON. Readout LCRU voltage, RAD temperature, and CTV temperature.				
	11:15:00			MCC-Command 1.25 MHz subcarrier OFF, power OFF.				15

*

DATE	TIME (GMT) HR:MIN:SEC	SUN		TARGET/GCTA OPERATION	TARGET		MSFN COVER.	ACT. Δt(MIN)
		ELEV	AZ		ELEV	AZ		
May 4	13:45:00	40°	272°	MCC-Command power ON. Readout LCRU voltage, RAD temperature, and CTV temperature.			GDS	
	13:47:00			MCC-Command 1.25 MHz subcarrier OFF.				
	13:48:00			Pan horizon.				
	13:51:00			MAV/NATO all nearby boulders and hills.				
	14:12:00			MCC-Command 1.25 MHz subcarrier ON. Readout LCRU voltage, RAD temperature, and CTV temperature.				
	14:15:00			MCC-Command 1.25 MHz subcarrier OFF, power OFF.				30



MSFN 85' antenna reception capability = 6.5°
GDS 210' antenna reception capability = 11°

Figure VIII-I.- Lunar libration - latitude and longitude of the sub-earth point at 00:00:00 GMT on April 23, 1972 to May 5, 1972.

☆ U.S. GOVERNMENT PRINTING OFFICE: 1972—779-262/531

LUNAR SURFACE TELEVISION

OPERATIONS PLAN

APOLLO 16

DISTRIBUTION LIST

AA/C. C. Kraft, Jr.
AB/S. A. Sjoberg
AP/H. Gibbons
AP3/E. L. Worrell
J. McLeaish
M. E. Reim
CA/D. K. Slayton
CB/T. P. Stafford
J. Young
C. Duke
T. Mattingly
A. England
CG241/D. R. Brooks
CG331/R. G. Zedekar
J. H. Roberts
J. G. Olmsted
CG211/M. F. Dement
CG511/T. W. Holloway
DA/R. S. Johnston
DD/W. R. Hawkins, M. D.
EA/M. A. Faget
EA311/R. A. Gardiner
EE/R. S. Sawyer
H. C. Kyle
R. L. Sinderson
EE2/O. L. Graham
W. E. Perry
J. P. Anderson
EE7/J. W. Seyl
PA/J. A. McDivitt
R. W. Kubicki
PD4/J. R. Sevier
W. Jaderlund
PD911/W. M. Speier
PD121/J. M. Peacock
D. Segna
TA/A. J. Calio
TD/J. Zarcaro
R. Fry (5)
R. Baldwin
TF5/M. McEwen (2)
TN/T. L. Page
W. C. Phinney
FA/S. A. Sjoberg
H. W. Tindall
FC/E. F. Kranz
J. W. Roach
M. F. Brooks
G. S. Lunney
G. D. Griffin
M. P. Frank
FC2/C. S. Harlan
C. R. Lewis
E. I. Fendell
G. B. Scott (25)
L. L. D. Armstrong (10)
FC3/A. D. Aldrich
FC4/J. E. Hannigan
FC5/J. C. Bostick
JM2/Document Management (3)
FC6/C. B. Shelley
T. Bruce
P. Klapach
R. G. Britton
FC9/J. E. Saultz
G. D. Griffith
B. L. Sharpe
R. H. Koos
J. H. Cooper
D. Toups
J. F. Moser (2)
FM/J. P. Mayer
FS/J. C. Stokes
J. M. Satterfield (2)
J. E. Mager
F. Wrinkle
C. M. Horstman
J. White
E. A. Tarkington
L. Meyer
FS4/S. D. Sanborn
FS45/H. Smoak (10)
FL/J. B. Hammack

NASA HEADQUARTERS/J. Holcomb (2), MAO
NASA HEADQUARTERS/C. Lee, MAO
NASA HEADQUARTERS/R. J. Shafer/K/IOA
NASA HEADQUARTERS/R. Petrone
NASA HEADQUARTERS/D. A. Beattie/MAL

USGS/Flagstaff
Attn: G. Swan (1)
M. H. Hait (2)
Dr. G. Ulrich

OSMF/MAO/J. McClanahan

MSFC/S&E/CSE/LRV/D. Chandler
MSFC/S&E/AERO/YE/O. Vaughn
MSFC/PM/SAT/LRV/J. M. Sisson

MAS/Bellcomm/J. T. Raleigh

RCA/AED/MS115
P. O. Box 800
Princeton, N. J. 08540
ATTN: L. Weinreb; S. Russell

RCA/Building 13-7-3
Front and Cooper St.
Camden, N. J. 08102
ATTN: H. J. Hamlin

GSFC/BLDG 12/RE120/861.1
ATTN: A.T. Dannessa (40)

Dr. Leon Silver
Division of Geological and Planetary Sciences
California Institute of Technology
Pasadena, California 91109

Dr. William R. Muehlberger
Geology Department
University of Texas
Austin, Texas 78712

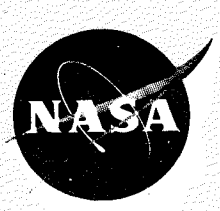
APOLLO

LSTOP

LUNAR SURFACE TELEVISION OPERATIONS PLAN

APOLLO 16

FEBRUARY 18, 1972



FCD
MSC
NASA