NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MISSION H-2 / APOLLO 13
SCIENTIFIC EXPERIMENTS
REQUIREMENTS

MANNED SPACECRAFT CENTER
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MISSION H-2/APOLLO 13 SCIENTIFIC EXPERIMENTS REQUIREMENTS

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Preface

This document contains data and information applicable to the operation and performance of the Lunar Surface Scientific and Geology Experiments.

Comments or questions concerning the contents of this document should be directed to the Lunar Surface Operations Planning Office (LSOPO), TD, telephone: HU3-2055.

REFERENCES

1. Apollo Lunar Surface Experiments Operational Requirements. MSC-TA-D-68-1 (December 1968).

2. Measurements Requirements Document. ALSEP-SE-03, Revision H (8 April 1969).

3. Apollo Lunar Geology Definitive Experiment Plan (April 1968).

4. Apollo Lunar Geology Experiment Operational Requirements (December 1968).

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1.0 INTRODUCTION

1.1 PURPOSE

This document defines the scientific operations for ALSEP Array B, the lunar geology traverse, and the crew activities during the lunar surface operation phases. The information contained in this Plan includes data on ALSEP Array B, its limitations and constraints. This data is necessary for mission management, mission planning and the formulation of mission documentation based on hardware limitations.

1.2 SCOPE

This scientific experiments document contains a statement of mission objectives, mission descriptions, and an operational timeline for the lunar surface operations.

The operational timeline consists of four phases which are defined as follows:

Phase I, Lunar Surface EVA Phase, covers the period during which the astronauts are available for specific deployment, back-up operations, and field geology investigations. For further information regarding astronaut activity, refer to the Apollo 13 Flight Plan.

Phase II, Lunar Surface Operation Checkout Phase, covers the period from LM ascent through the checkout and calibration of all systems.

Phase III, Forty-Five Day Phase, covers the period from experiment checkout through the first 45 days of ALSEP operation.

Phase IV, One-Year Phase, covers the period from day 45 through the first year of ALSEP operational life.

A block diagram of events is presented in Figure 1-1 to identify the different phases of the mission.

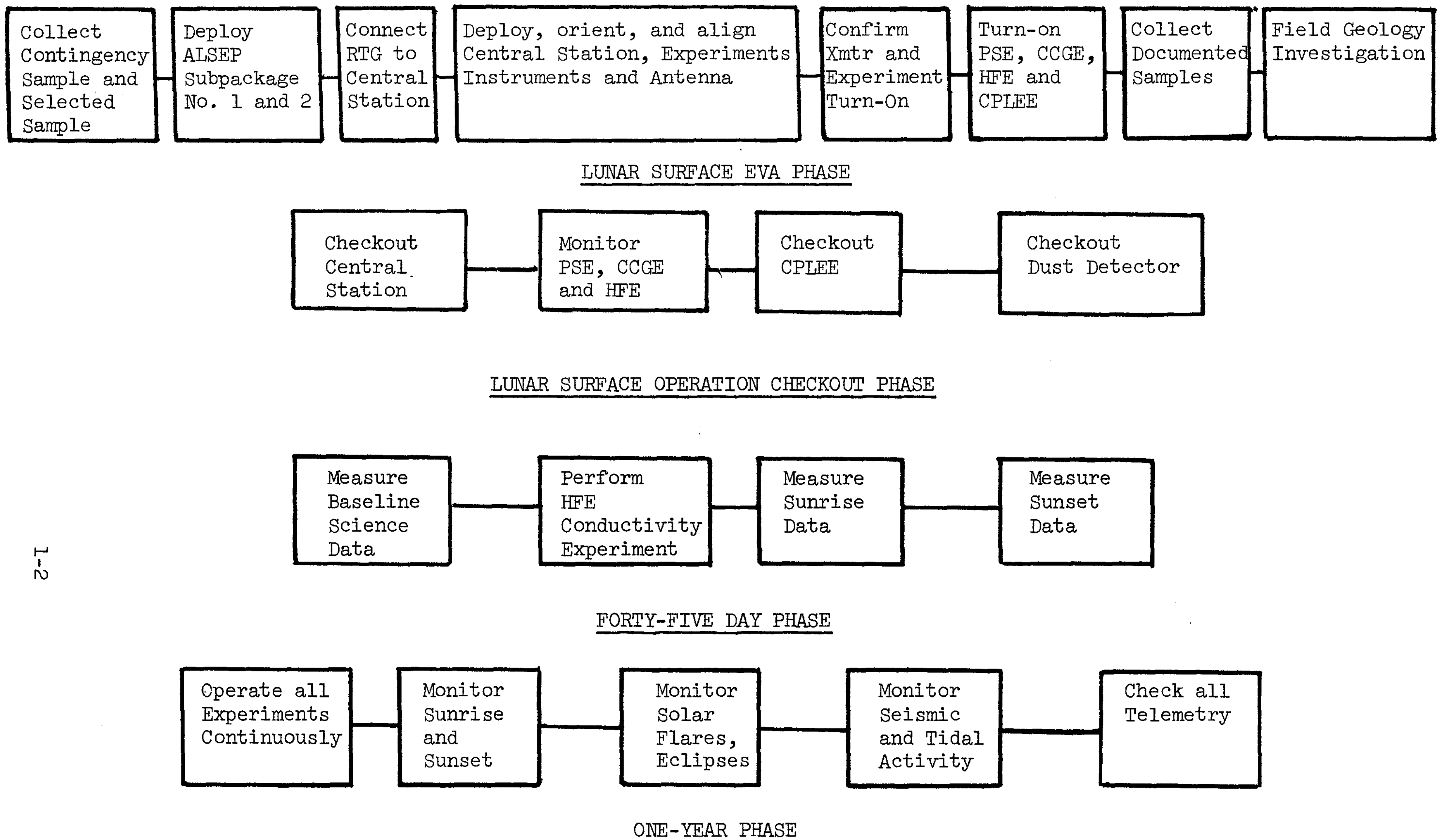


FIGURE 1-1. LUNAR SURFACE OPERATION PHASES

1.3 PRINCIPAL INVESTIGATORS

1. Passive Seismic Experiment - Dr. Gary V. Latham, Lamont-Doherty Geological Observatory, Columbia University, Palisades, New York.

2. Cold Cathode Gauge Experiment - Dr. Francis S. Johnson, University of Texas at Dallas, Post Office Box 30365.

3. Heat Flow Experiment - Dr. Marcus G. Langseth, Lamont-Doherty Geological Observatory, Columbia University, Palisades, New York.

4. Charged Particle Lunar Environment Experiment - Dr. B. J. O'Brien, University of Sydney, Australia.

5. Lunar Geology Experiment - Dr. Eugene M. Shoemaker, United States Geological Survey, 601 East Cedar Ave., Flagstaff, Arizona.

6. Lunar Soil Mechanics Experiment - Dr. William D. Carrier, Manned Spacecraft Center, Houston, Texas.

7. Lunar Dust Detector - Dr. S. Freden, Manned Spacecraft Center, Houston, Texas

8. Solar Wind Composition - Dr. Johannes Geiss, University of Berne, Physikalisches Institut, Sidlerstrasse 5, Berne, Switzerland.

The P.I.'s and their co-investigators for the above experiments will assist and advise the Flight Controller during the deployment and activation of their respective experiments. Operational methods, modes, real-time commands, and calibration procedures will be controlled by each P.I. for his experiment until a steady-state, operational equilibrium has been reached. Thereafter, the Flight Controller may contact the Science and Applications Directorate for advice or assistance.

1.4 ABBREVIATIONS AND ACRONYMS

ABBREVIATIONS	DEFINITION
AMPS	Amperes
ALSEP	Apollo Lunar Surface Experiments Package
AUTO	Automatic
CAAD	Computation and Analysis Division
CAL	Calibrate
CCGE	Cold Cathode Gauge Experiment
CPLEE	Charged Particle Lunar Environment Experiment
db	decibels
dbm	decibels with reference to one milliwatt
F	Fahrenheit
FOD	Flight Operations Directorate
FCSD	Flight Crew Support Division
HFE	Heat Flow Experiment
kHz	kiloHertz
kv	kilovolts
kw	kilowatts
LGE	Lunar Geology Experiment
LM	Lunar Module
LP	Long Period
LSOP	Lunar Surface Operatings and Planning
ma	milliamperes
MCC	Mission Control Center
MESA	Modularized Equipment Stowage Assembly
MHz	MegaHertz
MSFN	Manned Space Flight Network
mv	millivolts
PCU	Power Conditioning Unit
PDR	Power Dissipation Resistor
PDU	Power Distribution Unit
PI	Principal Investigator
PSE	Passive Seismic Experiment
RTG	Radioisotope Thermoelectric Generator
S&AD	Science and Applications Directorate
SEQ	Scientific Equipment Bay
SP	Short Period
SWC	Solar Wind Composition
USGS	United States Geological Survey
Vdc	Volts direct current
XMTR	Transmitter

2.0 MISSION OBJECTIVES

2.1 ALSEP MISSION OBJECTIVES

The prime purpose of the ALSEP is to measure lunar physical and environmental characteristics and transmit the data to receiving stations on Earth, for a minimum period of one year.

2.2 LUNAR DUST DETECTOR MISSION OBJECTIVE

The objective is to investigate lunar dust deposition on each deployed ALSEP and lunar solar cell degradation radiation environment on each deployed ALSEP, by measurements.

2.3 CONTINGENCY SAMPLE COLLECTION MISSION OBJECTIVE

The purpose is to collect a small sample of loose material (approximately two pounds) in the immediate vicinity of the LM during the early part of the EVA.

2.4 SELECTED SAMPLE COLLECTION MISSION OBJECTIVE

The purpose is to collect geologically interesting samples of lunar material including individual rock samples and fine grained fragmental material during the lunar surface EVA. The emphasis is on collecting selected samples rather than only a large quantity of lunar material. However, the maximum volume of samples possible is to be returned.

2.5 LGE MISSION OBJECTIVES

The major objective of the LGE is to correlate carefully collected samples with a variety of observational data at the LM landing site.

The LGE functional objectives are as follows:

1. Examine, photograph, and collect lunar geologic samples for return to earth and analysis in the Lunar Receiving Laboratory.
2. Obtain data on field relations such as shape, size, range, pattern of alignment or distribution of all accessible types of lunar topographic features.
3. Collect core samples of lunar surface material.
4. Collect a gas analysis sample of lunar surface material.
5. Collect a special environmental sample of lunar surface material.
6. Collect a magnetic sample of lunar surface material.
7. Collect lunar surface drill stem samples.

2.6 LUNAR SOIL MECHANICS MISSION OBJECTIVES

The objective is to obtain data on the lunar soil mechanical behavior and on the surface and sub-surface characteristics.

2.7 SOLAR WIND COMPOSITION MISSION OBJECTIVE

The purpose is to determine the elemental and isotopic composition of the noble gases and other selected elements in the solar wind by measurement of particle entrapment on an exposed aluminum foil sheet.

3.0 MISSION DESCRIPTION

3.1 ALSEP MISSION DESCRIPTION

ALSEP Array B (Figures 3-1 and 3-2), is comprised of a central station to act as a power and communication center for gathering information from the scientific experiments, a data subsystem for transmitting data to and from Earth, and four scientific experiments defined as follows:

1. Passive Seismic Experiment (PSE) to monitor seismic activity.

2. A Cold Cathode Gauge Experiment (CCGE) to provide data pertaining to the density of the lunar ambient atmosphere, including temporal variations, and the rate of loss of contamination left in the landing area by the astronauts and the LM.

3. A Heat Flow Experiment (HFE) to provide data pertaining to the temperatures and heat production of the lunar interior by measuring the net outward flux at the surface. The heat budget of the lunar subsurface to a depth of ten feet will be measured for a period of at least one year. This data will provide information on the thermal properties and structure of the subsurface.

4. A Charged Particle Lunar Environment Experiment (CPLEE) to provide data pertaining to the solar wind, solar cosmic rays, and other particle phenomena by measuring the energy distribution and time variations of the proton and electron fluxes at the lunar surface.

The ALSEP will be transported to the lunar surface in the Scientific Equipment Bay (SEQ) of the lunar module (LM) descent stage.

ALSEP deployment procedures will be performed at a time when the sun angle from the lunar horizon is from 7 to 22 degrees. However, ALSEP design allows deployment at a maximum sun angle of 45 degrees and a relative lunar surface temperature of approximately +165 degrees F. The requirements, constraints, and limitations on the physical deployment arrangement for the ALSEP are presented in Tables 3.1-1 through 3.1-8.

The 300-foot distance to the emplacement area is the result of a trade-off in comparing the necessity of ALSEP deployment out of the LM ascent stage blast area with the constraints of keeping the astronaut within the time and distance limitations dictated by the PLSS oxygen curve to assure a safe return to the LM. The walk to the deployment area is timed to prevent excess RTG warmup and thereby avoid potential thermal problems for the astronaut.

The ALSEP may be removed from the LM when the bottom of the SEQ Bay is from 18 to 60 inches from the lunar surface and with a $\pm 15^{\circ}$ tilt in any direction.

The ALSEP will be self-sufficient during operation, using a radioisotopic thermoelectric generator for electrical power, and will collect, format, and transmit scientific and engineering data to the receiving sites on earth for a minimum period of 1 year, possibly 2 years. This data will be used to derive information of the composition and structure of the lunar body, magnetic field, atmosphere, and the solar wind.

Downlink telemetry communications from the ALSEP are received at one or more of the remote sites of the Manned Space Flight Network (MSFN) and forwarded to the Mission Control Center (MCC). All uplink commands to ALSEP are executed by MCC for transmission by the remote sites. Up to 100 different commands allow selection of redundant components plus control of individual experiment ranges, operational modes, and calibration cycles.

3.2 LUNAR DUST DETECTOR MISSION DESCRIPTION

Data received from the dust detector which is composed of solar cells situated horizontally on the ALSEP Central Station and covered with different thickness of glass-shielding will be used in analyzing the effects of dust accumulated on the surface of the solar cells as a result of either natural deposition or from the effects of LM lift-off.

3.3 CONTINGENCY SAMPLE COLLECTION MISSION DESCRIPTION

The crewman will descend from the LM with the contingency sample container and quickly scoop up a loose sample of lunar soil. Sequence photographs will be made showing the astronaut collecting the sample. The sample container will be sealed and stowed in a pocket of the EMU until return to the LM.

3.4 SELECTED SAMPLE COLLECTION MISSION DESCRIPTION

Selected samples of rock fragments with varied texture or mineralogy will be collected and the remainder of the sample collection will be completed with loose materials representative of the landing area. The samples may be collected by the Astronauts in sample weigh bags provided in the Lunar Equipment Transfer Bag and in the Sample Return Container or individual bags from a dispenser.

In addition, the following samples will be collected during the selected collection mission.

1. One bagged sample taken when the SRC is opened will be designated for use by the Organic Principal Investigators.

2. One bagged sample taken under the LM will be designated the fuel contamination sample.

3. Core samples will be collected using the Apollo Lunar Surface Drill and drill core stems.

Upon completion of the sample gathering, samples will be sealed in the sample return container and prepared for transfer to the LM. Photographs of the immediate sample gathering area will be obtained although there is no prime photography requirements for the selected samples.

3.5 LGE MISSION DESCRIPTION

The fundamental requirements of lunar field geology procedures are observation, description, documented sampling, and photography. In the general case, these operations are combined to form a series of stops or stations that constitute a geologic traverse. The specific combinations of operations at a given station and the sequence of stations are controlled by three factors:

1. The nature of the geologic terrain.
2. The equipment available.
3. The time available.

The nature of the geologic terrain can rarely be fully anticipated and therefore some degree of flexibility in procedures is always required.

The geological sampling tools are presented in Figures 3-3 and 3-4.

The real-time planning of each traverse prior to egress from the Lunar Module will consist of the linking of procedures and the known geology of the site with the actual geologic setting observed by the crew. With the aid of the data and personnel in the Scientific Support Facility, the crew will make the final plans for a geologic traverse.

Samples to provide a more detailed and selective variety of lunar material will be collected in the following manner:

1. Samples will be collected using the carrier and tools stowed in the MESA and will be documented by photographs. Samples will be placed individually in pre-numbered bags and the bags placed in the sample return container. Additional loose samples judged by the crew to be of particular interest will be collected and stowed loose in the Sample Return Container weigh bag.

2. Features and relationship such as shape, size, range, and patterns of alignment or distribution will be described and photographed.

3. Core samples will be collected with drive tubes provided in the sample return container.

4. A gas analysis sample of lunar surface material will be collected and sealed in the gas analysis sample container and placed in the sample return container.

5. A special environment sample of lunar surface material will be collected, sealed in the special environmental sample container and placed in the sample return container.

6. A magnetic sample of lunar material will be collected, placed in the magnetic shield sample container and placed in the sample return container.

7. Drill stem samples will be collected utilizing the Apollo lunar surface drill and placed in the sample return container.

3.6 LUNAR SOIL MECHANICS MISSION DESCRIPTION

The crewmen will obtain data on the mechanical behavior of the lunar surface material including texture, consistency, compressibility, cohesion, adhesion, density and color.

3.7 SOLAR WIND COMPOSITION MISSION DESCRIPTION

The Solar Wind Composition Experiment (SWC) consists of a panel of very thin aluminum foil rolled and assembled into a combination handling and deployment container. The SWC is designed to entrap noble gas constituents of the Solar Wind, such as helium, neon, argon, krypton and xenon.

The crewmen will remove the SWC experiment from the LM Modularized Equipment Stowage Assembly (MESA) and deploy it on the lunar surface. The experiment will remain deployed until after completion of all EVA tasks and will then be disassembled. The reel and foil will be placed in a teflon bag and stored in a sample return container for return to earth.

The requirements, constraints, and limitations on the physical deployment arrangement for the SWC experiment are presented in Table 3.1-9.

TABLE 3.1-1 RTG DEPLOYMENT CONSTRAINTS

PARAMETER	CONSTRAINT
Separation Between RTG and Central Station	9 to 13 feet. Limited by 13-foot cable. Hot RTG should be away from Central Station to avoid contact with astronaut, and to provide maximum heat radiation to free space.
RTG Orientation from Central Station	$\pm$ 20° East or West of Central Station as visually determined by astronaut to minimize thermal load on Central Station.
RTG Deployment Site	Horizontal site. Pallet must be horizontal $\pm$ 10°, as visually determined by astronaut. No mechanical provisions for astronaut to level RTG. Astronaut will avoid craters and slopes which impede dissipation of heat from RTG.
RTG Alignment	No critical constraints. Astronaut will align so as to favor RTG cable exit toward Central Station.
Interrelation	RTG requires maximum view of space to maximize heat radiation. Astronaut will read ammeter on shorting switch box, connect RTG to Central Station, actuate switch.

TABLE 3.1-2 ANTENNA DEPLOYMENT CONSTRAINTS

PARAMETER	CONSTRAINT
Site Selection	Attached to Central Station
Antenna Leveling	$\pm 0.55^\circ$ of vertical. Astronaut will use bubble level to adjust. Level adjustment interacts with alignment.
Antenna Alignment	$\pm 0.50^\circ$ of East-West line, with reference to sun line. Astronaut will use sun dial to align.
Antenna Azimuth Setting	Astronaut will set dial to value indicated on Antenna Aiming Tables for landing site chosen.
Antenna Elevation Setting	Astronaut will set dial to value indicated on Antenna Aiming Tables for landing site chosen.
Special Requirements	1. Maximum Allowable Errors for Astronaut Alignment: A. Scale Setting: 0.25° B. Leveling: 0.50° C. Shadow Alignment: 0.70° D. Overall Mean: 1.16°

TABLE 3.1-3 CENTRAL STATION DEPLOYMENT CONSTRAINTS

PARAMETER	CONSTRAINT
Central Station-to-LM Separation	300 ft. minimum. This distance is required to keep ALSEP out of the LM ascent blast area.
Central Station Orientation from LM	Due West or East of LM, preferably West. Must not be deployed in shadow of LM.
Central Station Deployment Site	Approximately horizontal, as visually determined by astronaut to provide stable base for antenna. Astronaut must avoid craters and slopes which would degrade thermal control of unit.
Central Station Leveling	$\pm 2.5^{\circ}$ of vertical as noted by astronaut on bubble level. Leveling procedure interacts with alignment procedure; accuracy of leveling must be maintained to assure accurate antenna aiming.
Central Station Alignment	$\pm 1^{\circ}$ of East-West as aligned by astronaut using partial compass rose. Alignment affects thermal control capability of Central Station. Closed or curtained sides of Central Station must face East-West.
Interrelation	Central Station, as with most ALSEP subsystems, requires clear field-of-view for both thermal control and scientific data reasons. Central Station must not be shaded from the sun on the lunar surface prior to deployment. ALSEP design allows deployment when sun angle is between 7 and 45 degrees. ALSEP may be removed from LM when bottom of SEQ Bay is from 18 to 60 inches from lunar surface and with a 15 degree tilt in any direction.

TABLE 3.1-4 PSE DEPLOYMENT CONSTRAINTS

PARAMETER	CONSTRAINT
PSE-to-Central Station Separation	8 to 10 feet. Limited by 10-foot cable. 8 feet minimum separation due to thermal heat from RTG.
PSE Orientation from Central Station	Due East or West of Central Station as visually determined by astronaut. Must be out of field-of-view of Central Station radiator.
PSE Deployment Site	Approximately level spot, free from loose material.
PSE Leveling	Must be coarse leveled by astronaut within ± 5 degrees of vertical. Five degrees is the limit of the automatic, fine-leveling gimbal system.
PSE Alignment	Astronaut must rough align within ± 20 degrees of lunar East, before opening PSE shroud, by pointing arrow on the sensor girdle towards the sun. Fine alignment will be performed by the astronaut after removing girdle and spreading the thermal shroud. Astronaut will read and record, to the nearest degree, the intersection of the shadow of the gnomon on the compass rose. Final azimuth alignment must be known within ± 5 degrees accuracy with reference to lunar North or South.
Interrelation	PSE must be no less than 10 feet from other units to minimize pickup of stray vibrations by PSE.

TABLE 3.1-5 CCGE DEPLOYMENT CONSTRAINTS

PARAMETER	CONSTRAINT
CCGE - Central Station Separation	50 to 60 feet from Central Station. Limited by 60-foot cable.
CCGE Orientation from Central Station	Parallel to Central Station as visually determined by the astronaut.
CCGE Deployment Site	Approximately level spot, free from loose material. Unobstructed view in front of orifice.
CCGE Leveling	Must be leveled within ± 3 degrees of vertical by use of bubble level.
CCGE Alignment	Astronaut must align CCGE within ± 15 degrees of lunar East.
Interrelation	CCGE must be no less than 100 feet from the LM ascent stage.
Special Requirements	The CCGE gauge nozzle must point away from the LM and other subsystems.

TABLE 3.1-6 HFE DEPLOYMENT CONSTRAINTS

PARAMETER	CONSTRAINT
Separation between HFE electronics package and Central Station	25-30 feet. Limited by 30-foot cable.
HFE electronics package orientation from Central Station	Southeast of the Central Station. See Figure 3-5
HFE Electronics Package Deployment Site	Approximately level area, removed from any surface irregularities or rocks that might reflect sunlight directly onto the sunshield reflector of the electronics package.
HFE Electronics Package	Leveled to ± 12 degrees of vertical for maximum utilization of the thermal sunshield.
HFE Electronics Package Alignment	Aligned to within ±5 degrees of the plane of the ecliptic or lunar equator.
Electronics Package to Probe Separation	16-20 feet. Limited by length of cable.
Electronics package to Probe Orientation	See Figure 3-5.
Probe Deployment Site	See Table 3.1-7.
Probe Alignment	Within 15 degrees of vertical.
Probe to Probe Separation	Approximately 34-36 feet, as shown in Figure 3-5.
Interrelation	The HFE should be at least 10 feet from all other experiments and at least 20 feet from the PSE.

TABLE 3.1-7 PROBE DEPLOYMENT CONSTRAINTS

PARAMETER	CONSTRAINTS
Probe Deployment Site	At least 10 diameters from fresh craters with strew fields of stones.
	At least 5 diameters from large isolated blocks (boulders) exposed at the surface.
	Try to avoid topographic features greater than a meter in diameter such as craters or hummocks that have an aspect ratio greater than 1 to 10, (slopes of 10^{o}).
	On the scale of 10's of meters topographic highs should be avoided and depressions preferred to assure the thickest possible regolith.

TABLE 3.1-8 CPLEE DEPLOYMENT CONSTRAINTS

PARAMETER	CONSTRAINT
CPLEE-to-Central Station Separation	9 to 11 feet, limited by 11-foot cable.
CPLEE Orientation from Central Station	Generally South of Central Station. Minimum 10 feet, preferably 20 feet from RTG. Must avoid field-of-view of Central Station radiator. Orientation visually determined by astronaut.
CPLEE Deployment Site	Approximately level area, free of gross surface irregularities and rocks or boulders. Bottom of experiment should not touch the surface.
CPLEE Leveling	Within ± 2.5 degrees of vertical. Astronaut will level the CPLEE using bubble level. Leveling interacts with alignment.
CPLEE Alignment	Within ± 2 degrees of East-West sun line. Astronaut will align so that arrow on top of unit points East, then report, within ± 1 degree, the reading of the shadow of the handling tool on the partial compass rose.
Interrelation	Radioactive contaminants caused by other ALSEP Subsystems must be less than 0.1 count per second in all channels of CPLEE.

TABLE 3.1-9 SWC DEPLOYMENT CONSTRAINTS

PARAMETER	CONSTRAINTS
SWC Deployment Site	60 to 100 feet from the LM to prevent dust (due to crew activity) or residue from vented gases from settling on the aluminum foil. Perform no activity within 15 to 20 feet of the deployed SWC. Astronaut will avoid craters or slopes during SWC deployment.
SWC Leveling	Must be emplaced on the lunar surface in a vertical position and facing the sun.
SWC Alignment	Alignment will be performed by the Astronaut within ± 30 degrees of the sun line.

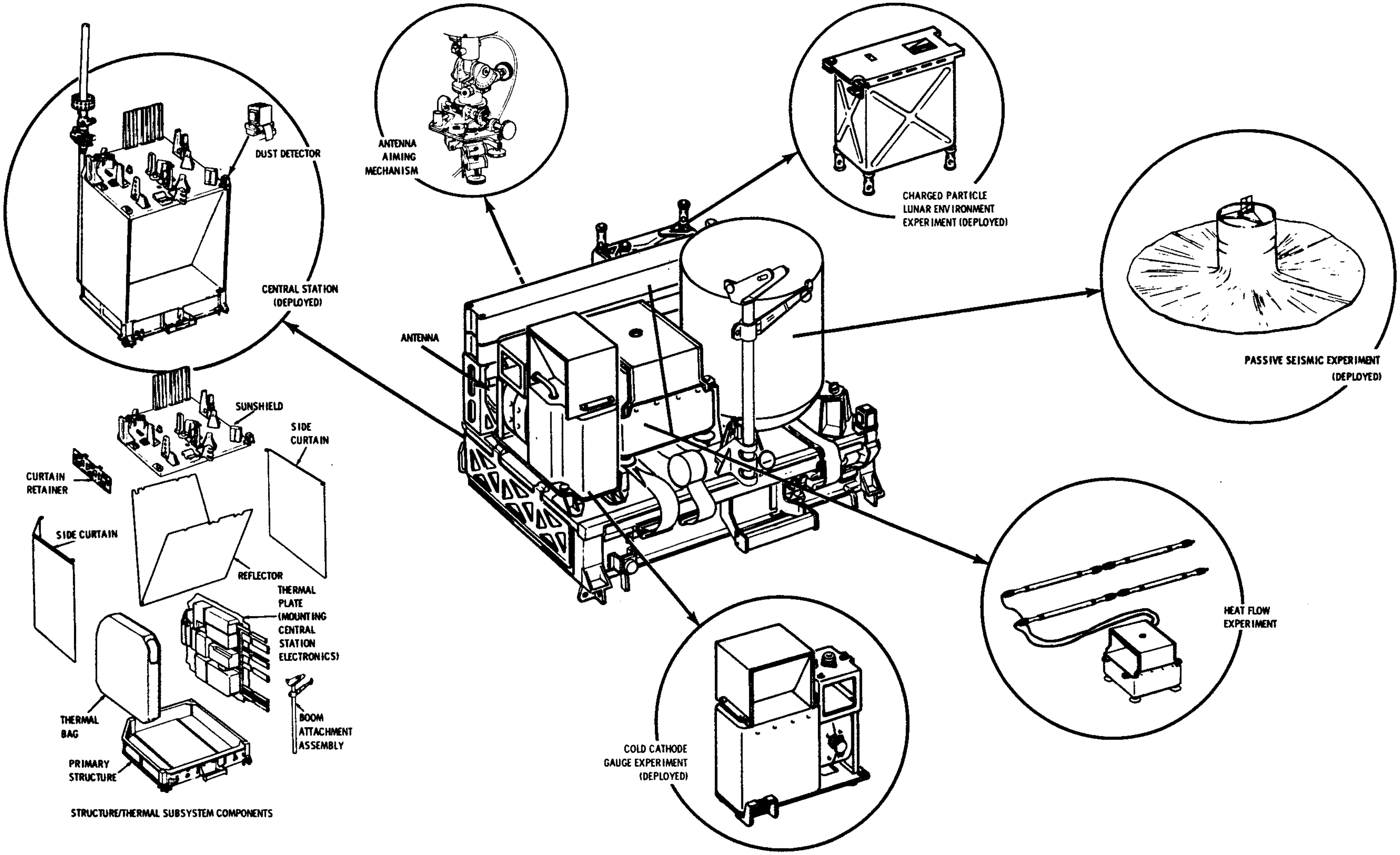


Figure 3-1 ALSEP Subpackage No. 1 (Array B)

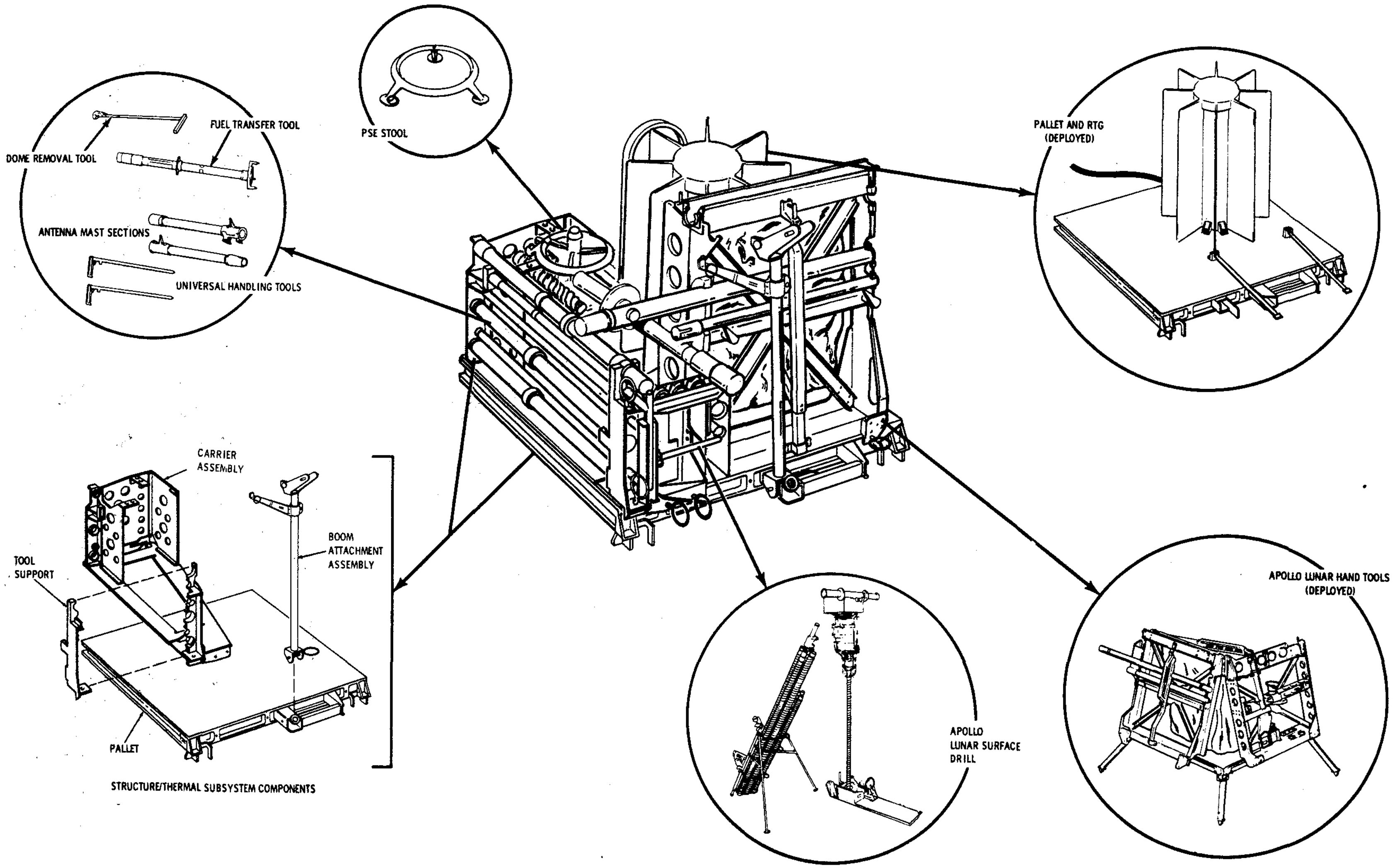


Figure 3-2 ALSEP Subpackage No. 2 (Array B)

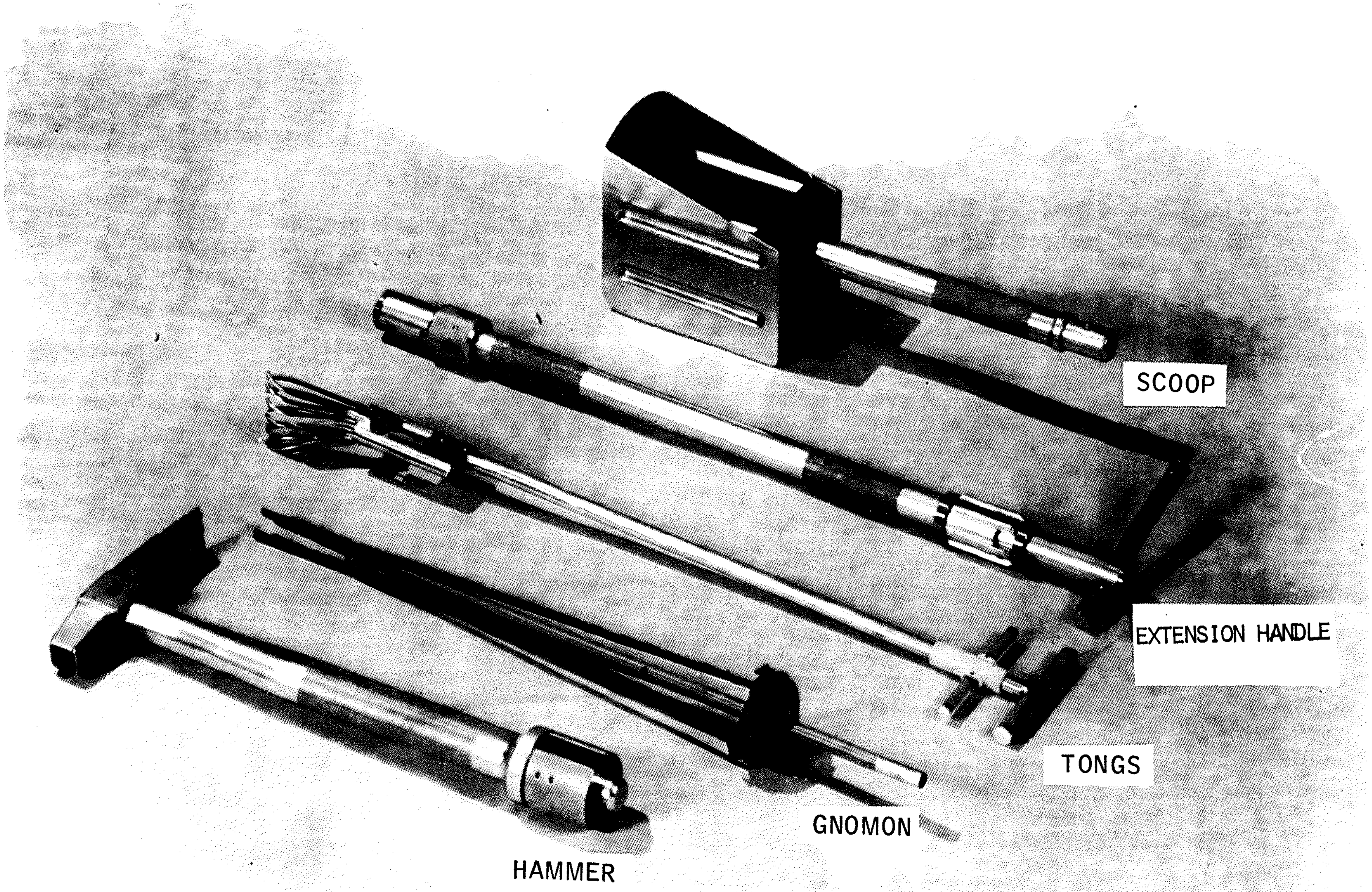


FIGURE 3-3 GEOLOGICAL SAMPLING TOOLS

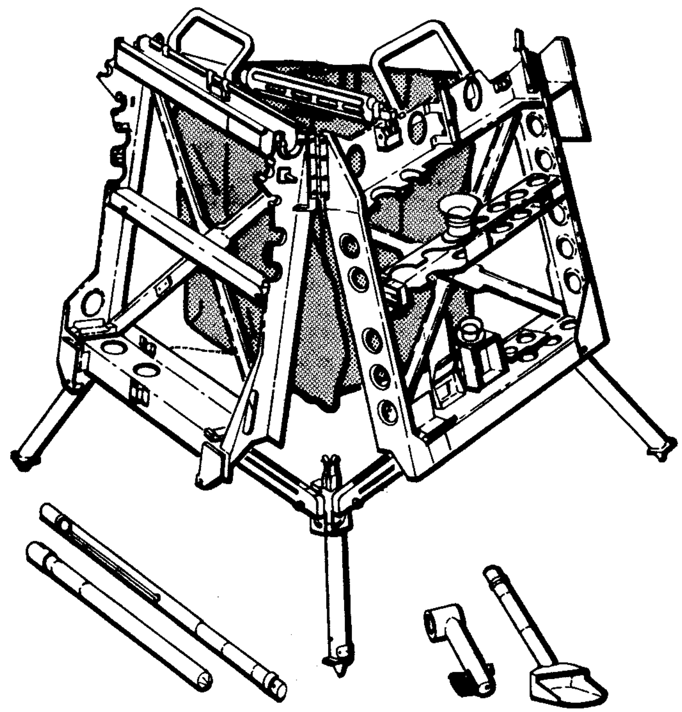


FIGURE 3-4 APOLLO LUNAR HAND TOOLS

Prime ALSEP deployment location is due west of LM.
Backup location is due East of LM.

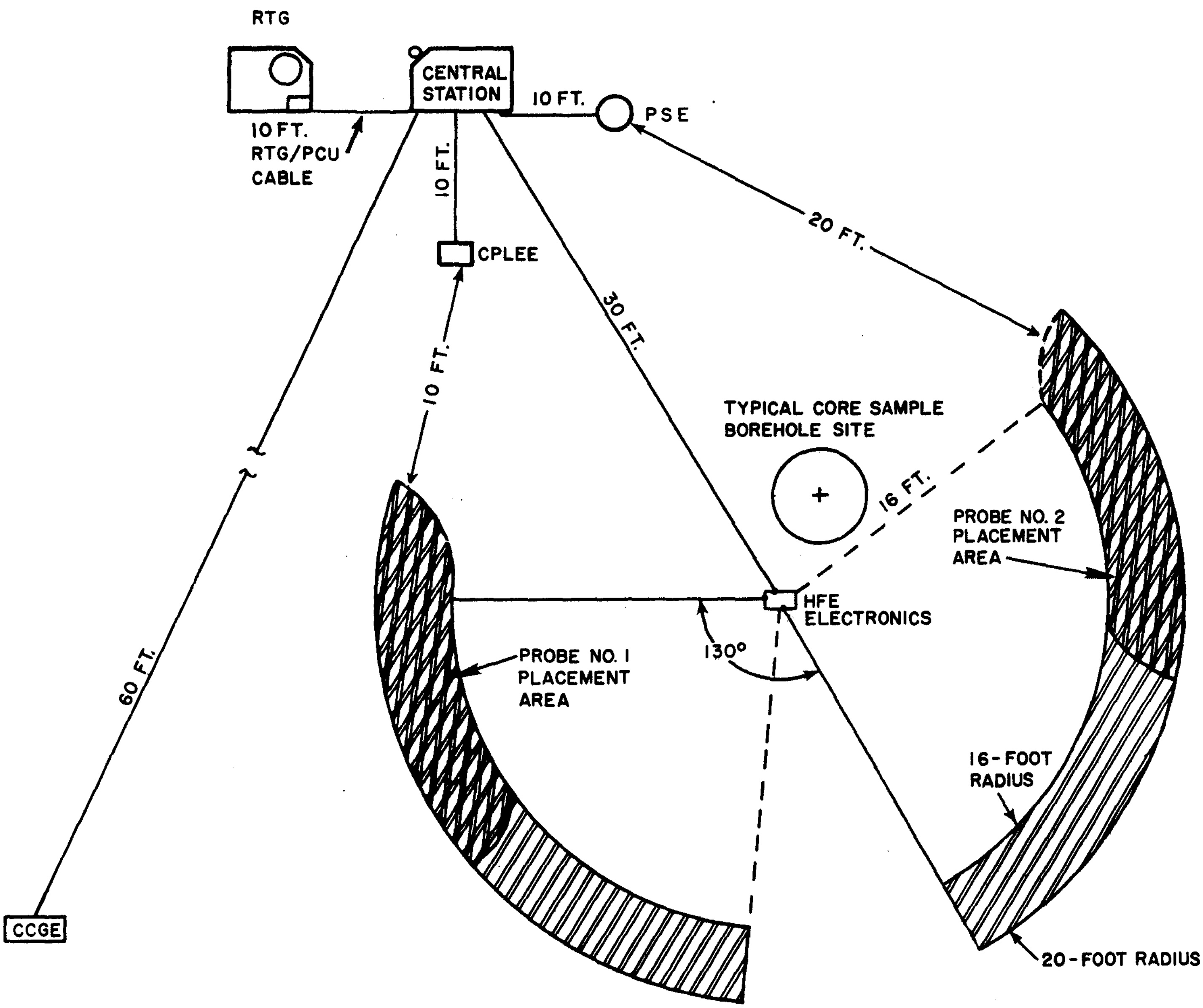


Figure 3-5 TYPICAL ARRAY B DEPLOYMENT ARRANGEMENT

4.0 PHASE I (LUNAR SURFACE EVA PHASE)

Phase I is outlined in Table 4-1 and covers the period during which the astronauts are available for specific deployment and field geology investigations. Refer to Apollo 13 Flight Plan for further information involving astronaut activities during this phase.

TABLE 4-1 PHASE I (LUNAR SURFACE PHASE)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	NOMINAL VALUE	REMARKS
1. Contingency Sample Collection	Collect a contingency sample.			
2. Solar Wind Composition	Deploy and orient the SWC instruments.			Retrieve the SWC experiment after completion of all other EVA tasks.
3. Selected Sample Collection	Collect samples of lunar material.			
4. Orient Central Station	Unload experiments. Orient and level CS Assembly and erect antenna and sunshield.			
5. Deploy Experiment Instrument	Deploy, orient and level			
	PSE Instrument			Preset condition: Standby On
	CCGE Instrument			Preset condition: Power Off
	HFE Instrument			Preset condition: Power Off
	CPLEE Instrument			Preset condition: Standby On
	Drill two holes and install probes. Recheck alignment and leveling of HFE electronics package.			
6. Align Central Station Antenna	Level CS, orient antenna base, and enter prescribed offsets.	Verify antenna settings chosen by astronaut.		
	Astronaut will actuate Switch S-1 and notify MCC of readiness status via voice link.	Acknowledge readiness message via voice link.		

TABLE 4-1 PHASE I (LUNAR SURFACE PHASE)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	NOMINAL VALUE	REMARKS
7. Turn On ALSEP Transmitter		Initiate command CD-2 (octal 013) "Transmitter On."		If ALSEP does not respond, actuate switches SW-2 and SW-3.
		Verify execution of command by reception of RF signal from ALSEP.		
		Start data recorders and verify transmission of 1060 bps telemetry.		
		Advise astronaut via voice link that ALSEP transmitter is functioning.		
	Acknowledge MCC receipt of RF signal and useful data via voice link.			
8. Passive Seismic Experiment Turn-On		A. Check experiment status telemetry, AB-4 (channel 12, octal 264-314), for correct indication.		PSE Standby On
		B. Check reserve power status telemetry, AE-5 (channel 8), for indication lower than octal 267.		
		C. Initiate command CD-13 (octal 036), PSE Operational Power On.		If telemetry data is interrupted for more than 5 minutes, command PSE to Standby.

TABLE 4-1 PHASE I (LUNAR SURFACE PHASE)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	NOMINAL VALUE	REMARKS
8. Passive Seismic Experiment Turn-On (Continued)		D. Check telemetry Word 46 for verification of command reception and parity check.		
		E. Check experiment status telemetry, AB-4 (channel 12, octal 171-215), for correct indication.		PSE Power On HFE Power Off
		F. Check experiment status telemetry, AB-5 (channel 14, octal 206-306), for correct indication.		CCGE Power Off CPLEE Standby On
		G. Check reserve power status telemetry, AE-5 (channel 8), for indication lower than octal 264.		
		H. Housekeeping Data Check (Word 33).		
		1. Long period gain (X and Y) channel 23.	3.0 volts	Preset condition: -30db
		2. Long period (Z) amplifier gain, channel 38.	3.0 volts	Preset condition: -30db
		3. Level direction and speed, channel 53.	0 volts	Preset condition: + low

TABLE 4-1 PHASE I (LUNAR SURFACE PHASE)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	NOMINAL VALUE	REMARKS
8. Passive Seismic Experiment Turn-On (Continued)		H. (Continued)		
		4. Short period amplifier gain, channel 68.	3.0 volts	Preset condition: -30db
		5. Leveling mode and coarse sensor mode, channel 24.	0 volts	Auto, Coarse Sensor Out.
		6. Thermal control status, channel 39.	0 volts	Auto, On
		7. Calibration status (L.P. and S.P.) channel 54.	3.0 volts	All Off
		8. Uncage status, channel 69.		Caged
		I. Uncage Passive Seismometer		
		1. Initiate command CL-9 (octal 073) to Uncage PSE Sensor Assembly.		
		2. Verify command reception and acceptance (word 46).		

TABLE 4-1 PHASE I (LUNAR SURFACE PHASE)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	NOMINAL VALUE	REMARKS
8. Passive Seismic Experiment Turn-On (Continued)		I. (Continued)		
		3. Verify change in uncage status telemetry, word 33 channel 69.		Uncage/ARM
		4. Repeat steps I.1 and I.2.		Wait 30 seconds between Step I.1 and I.4.
		5. Verify change in uncage status telemetry, word 33, channel 69.		Uncage/Fire
		6. Observe short period scientific data on drum recorder for evidence of physical uncaging.		Consult P.I. before adjusting any gains. Adjust gain to visible signal.
		J. Level Passive Seismometer		
		1. Verify that feedback filter is switched OUT (preset position) by comparing LP Seismic and LP Tidal data on recorders.		During initial leveling or whenever all LP components are Off level, verify feedback position during Step J.10. If filter is In, execute command CL-13 (octal 101) and note response.

TABLE 4-1 PHASE I (LUNAR SURFACE PHASE)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	NOMINAL VALUE	REMARKS
8. Passive Seismic Experiment Turn-On (Continued)		J. (Continued)		
		2. Initiate command COARSE LEVEL SENSOR. CL-14 (octal 102).		
		3. Verify reception and acceptance of command (word 46).		
		4. Check telemetry channel 24 for change in status of COARSE LEVEL SENSOR and verification of AUTO leveling mode.		Switch as required to obtain COARSE LEVEL SENSOR and AUTO status by commands CL-14 (octal 102) and CL-15 (octal 103).
		5. Initiate and verify command CL-12 (octal 076) THERMAL CONTROL MODE SELECT		
		6. Check telemetry channel 39 for confirmation that heaters are Off.	1 volt	Off
		7. Check shunt regulator current channel 8. Adjust PDRs if necessary.	1.1 amps	

TABLE 4-1 PHASE I (LUNAR SURFACE PHASE)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	NOMINAL VALUE	REMARKS
8. Passive Seismic Experiment Turn-On (Continued)		J. (Continued)		
		8. Initiate command LEVELING POWER X MOTOR ON CL-6 (octal 070).		
		9. Verify decrease of shunt regulator current channel 8 (or 13).	1.1 amps	
		10. Observe recorder of long period, Tidal X-axis data as leveling proceeds.	$\Delta t \approx 0$	During initial leveling, verify that feedback filter is switched out. This can be done by verifying the time lag between tidal and seismic data. If filter is in, execute command CL-13 (octal 101) and note response.
		11. Observe S.P. Seismic data on recorder		Observe S.P. Channel
		12. When X tidal output reaches a value of 0.5V or less, initiate command CL-6 (octal 070) LEVELING POWER X MOTOR OFF.		If tidal outputs are not within $\pm$ 0.5 volts, repeat steps J.1 to J.14 deleting steps J.2 and J.3.

TABLE 4-1 PHASE I (LUNAR SURFACE PHASE)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	NOMINAL VALUE	REMARKS
8. Passive Seismic Experiment Turn-On (Continued)		J. (Continued) 13. Verify reception and acceptance of command (word 46).		
		14. Verify that shunt regulator current has returned to approximately the value measured in Event 7, Step J.7.	1.1 amps	
		15. Repeat Event 7, step J.8 through J.14, for Y-axis, initiating and verifying command CL-7 (octal 071) LEVELING POWER Y MOTOR while monitoring appropriate recorder.		
		16. Initiate and verify command CL-14 (octal 102) COARSE LEVEL SENSOR		
		17. Check channel 24 for change of status.	0 volts	Auto, Coarse Sensor OUT
		18. Verify that X & Y tidal outputs are within $\pm$ 0.5 volts.		

TABLE 4-1 PHASE I (LUNAR SURFACE PHASE)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	NOMINAL VALUE	REMARKS
8. Passive Seismic Experiment Turn-On (Continued)		J. (Continued) 19. Initiate and verify command CL-8 (octal 072) LEVELING POWER Z MOTOR ON.		Initial centering of Z-axis requires following command settings: leveling command mode, high speed and + direction. Turn Z power ON.
		20. Verify decrease of shunt regulator current (HK-8)	1.1 amps	
		21. Monitor Z-axis Tidal data as centering progresses.	Mean lunar gravity at site of ALSEP.	
		22. When a zero crossing is observed on Z tidal output, select "Leveling AUTO" mode.		
		23. When Z tidal output reaches a value of 0.5 volt or less, initiate and verify command CL-8 (octal 072) LEVELING POWER Z MOTOR OFF.		
		24. Verify that shunt regulator current has increased to approximately the value measured in Event 7, Step J.7.		

TABLE 4-1 PHASE I (LUNAR SURFACE PHASE)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	NOMINAL VALUE	REMARKS
8. Passive Seismic Experiment Turn-On (Continued)		J. (Continued) 25. Verify that all tidal outputs (X, Y and Z) are within ± 0.5 volts.		If tidal outputs are not within ± 0.5 volts, repeat steps J.1 to J.24, deleting steps J.2, J.3, J.16 and J.17.
		26. Initiate and verify command PSE FILTER IN CL-13 (octal 101).		
		27. Verify that filter has been switched IN by comparison of L.P. Seismic and L.P. Tidal data on recorders.		
		28. Execute command CL-12 (octal 076) THERMAL CONTROL MODE SELECT as required to keep within limits.		
		29. Check telemetry of thermal control status (channel 39).	0 volts	
		K. Passive Seismometer Calibration		
		1. Initiate and verify command CL-4 (octal 066) CALIBRATION LP ON/OFF		

TABLE 4-1 PHASE I (LUNAR SURFACE PHASE)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	NOMINAL VALUE	REMARKS
8. Passive Seismic Experiment Turn-On (Continued)		K. (Continued)		
		2. Check for response in Tidal data and in L.P. Seismic data on drum recorders.		
		3. Check for status change in channel 54.	1.0 volts	L.P. On S.P. Off
		4. Initiate and verify command CL-4 (octal 066) CALIBRATION L.P. ON/OFF		
		5. Check for status change in channel 54.	3.0 volts	All Off
		6. Initiate and verify command CL-3 (octal 065) CALIBRATION SP ON/OFF.		
		7. Check for response in SP Seismic data on recorder.		
		8. Check for status change in channel 54.	2.0 volts	L.P. Off S.P. On
		9. Initiate and verify command CL-3 (octal 065) CALIBRATION SP ON/OFF		

TABLE 4-1 PHASE I (LUNAR SURFACE PHASE)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	NOMINAL VALUE	REMARKS
8. Passive Seismic Experiment Turn-On (Continued)		K. (Continued)		
		10. Check for status change in channel 54.	3.0 volts	All Off
		L. Thermal Stabilization of Passive Seismometer		
		1. Monitor sensor unit temperature and verify that trend is toward 125°F, determine gradient.	125°F	Relevel as required per event 7, step J, deleting step J.2, J.3, J.16 and J.17.
		2. Continue to monitor temperature until equilibrium is reached.		
		M. Collection of Baseline Passive Seismic Data		
		1. Record data, without further transmission of command for determination of background noise level, frequency and magnitude of detectable seismic events.		
		2. Fix gains at levels determined from Step M.1 above.		

TABLE 4-1 PHASE I (LUNAR SURFACE PHASE)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	NOMINAL VALUE	REMARKS
9. Cold Cathode Gauge Experiment		A. Check CCGE reserve power status telemetry, channel 8.		CCGE in survival mode. Do not initiate any commands without consulting the PI.
		B. Monitor the experiment supply voltage, channel 20.	29.0 volts	
		C. As soon as possible after ALSEP deployment and power has been applied to CCGE, initiate command 5 (Automatic Operate Mode).		Turn all power on to CCGE. Record Power increase from central system.
		D. Record data on high-speed printer continuously.		
		E. One (1) hour after power turn-on, initiate command 2 followed by command 4 (CCGE break seal). Record data continuous (1 page data/min.) on high speed printer for up to 3 hours after LM lift-off, and then followed by one page data every 5 minutes. Also record gauge data, electrometer range, gauge, and electronic temperature on analog recorder up to 3 hours after LM lift-off.		Opens the break seal.

TABLE 4-1 PHASE I (LUNAR SURFACE PHASE)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	NOMINAL VALUE	REMARKS
9. Cold Cathode Gauge Experiment (Continued)		F. Telemetry checks:		
		1. Examine telemetry data and ensure that decommutation is being properly executed.		
		2. Check power consumption.		
		3. Check the following engineering voltages:		Subcommutated into CCGE word 5 (8 bits each) during 5 successive ALSEP frames. Subcommutation repeats itself after 4 complete ALSEP frames.
		ID: CCGE Word 1, ALSEP Word 15 — Symbol	PCM Count	Engineering Data: CCGE Word 5, ALSEP Word 63
		0 — DG10	220 +35 -30	+4.5 KVDC
		1 — DG11	127 +6	+15 VDC
		2 — DG12	122 +27 -33	-15 VDC
		3 — DG13	127 + 4	+10 VDC

TABLE 4-1 PHASE I (LUNAR SURFACE PHASE)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY			NOMINAL VALUE	REMARKS
9. Cold Cathode Gauge Experiment (Continued)		F. (Continued)				
		4. Check the following temperatures:				
		ID	Parameter	CCGE Word	ALSEP Word	PCM Count
		DG-8	Gauge Temperature	3	47	40 - 250
		DG-9	Electronics Temperature	4	56	127 - 200
		5. Check the following calibration voltages in CCGE. Calibrate voltages selected by command 1. Range change is initiated by command 3. Range direction is selected by command 4 (down) and command 2 (up).				
		Range ID DG-6		CCGE Word	ALSEP Word	PCM Count DG-7
		0		2	31	128 ± 26
		1		2	31	128 ± 26
		2		2	31	128 ± 26

TABLE 4-1 PHASE I (LUNAR SURFACE PHASE)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY		NOMINAL VALUE	REMARKS
9. Cold Cathode Gauge Experiment (Continued)		F. (Continued) 5. (Continued)			
		Range ID DG-6	CCGE Word	ALSEP Word	PCM count DG-7
		3	2	31	128 $\pm$ 26
		4	2	31	128 $\pm$ 26
		5	2	31	128 $\pm$ 26
		6	2	31	128 $\pm$ 26
		6. Check PCM count against the analog word 1 channel, AG-1 and the range ID against the analogue word 2 channel AG-2.			
		7. Check telemetry associated with CCGE performance in CCGE word 2. ALSEP word 31 with CCGE in automatic-operate mode (command 5).			
		CCGE Output	DG-7		
		CCGE Range	DG-6		

TABLE 4-1 PHASE I (LUNAR SURFACE PHASE)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	NOMINAL VALUE	REMARKS
9. Cold Cathode Gauge Experiment (Continued)		G. Cold Cathode Gauge Experiment Break Seal 1. Initiate and verify command 2. 2. Initiate and verify command 4. 3. Check CCGE output data for increase attributable to seal break. H. Collection of Baseline CCGE data: 1. Record data, without further transmission of commands.		

ID	Parameter	Limits
DG-10	4.5 KVDC	± 200 V
DG-11	+15 VDC	± 1V
DG-12	-15 VDC	± 1V
DG-13	+10 VDC	±0.1V (critical)
DG-8	Gauge Temp.	+250°F -275°F
DG-9	Elec. Temp.	+185°F - 50°F

TABLE 4-1 PHASE I (LUNAR SURFACE PHASE)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	NOMINAL VALUE	REMARKS
10. Heat Flow Experiment Turn-On		A. Check Heat Flow reserve power status telemetry, channel 8.	29.0 volts	
		B. Initiate command CD-19 HFE Operational Power On		
		C. Check experiment status (channels 12 and 14) for correct indications.		PSE Power On HFE Power On, Mode 1 CPLEE Standby On CCGE Power On
		D. Confirm operations of HFE by appearance of data in telemetry word 21.		
		E. Check HFE data channels as shown below:		
		1. +5V supply (channel 30)	+5V	
		2. -5V supply (channel 45)	-5V	
		3. +15V supply (channel 56)	+15V	
		4. -15V supply (channel 74)	-15V	
		5. Low Conductivity Heater (Frame 57)	0V	Frames 57 and 75 should be zero except during the conductivity experiments.

TABLE 4-1 PHASE I (LUNAR SURFACE PHASE)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	NOMINAL VALUE	REMARKS
10. Heat Flow Experiment Turn-On (Continued)		E. (Continued)		
		6. High conductivity Heater (frame 75)	OV	
		F. Thermal check of HFE:		Should turn-on in Mode 1
		1. Check telemetry data word 21 for sub-system mode indica-tions (bit 3, 4, 5, of frames 3 and 11).	100 mode 1 010 mode 2 001 mode 3	Gradient Mode Low Conductivity Mode High Conductivity Mode
		2. If system is not in mode 1, initiate and verify command CH-1 (octal 135), mode 1.		Refer to HFE command description
		3. Initiate and verify commands HF-8 and HF-9 in that order.		This sequence of commands selects an operating subse-quence which includes ambient temperatures at both probes and at the electronic package.
		4. Check telemetry indication of HFE thermocouple refer-ence and probe cable temperature (word 21 subcommutated).		

TABLE 4-1 PHASE I (LUNAR SURFACE PHASE)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	NOMINAL VALUE	REMARKS
10. Heat Flow Experiment Turn-On (Continued)		F. (Continued) 5. Continue to monitor until stabilization of temperatures has been confirmed.		
		G. Collection of Baseline HFE Data:		
11. Charged Particle Lunar Environment Experiment		A. Check CPLEE reserve power status telemetry, Channel 8.	9.0 watts min.	CPLEE should be in the Automatic mode.
		B. Monitor the experiment supply voltage, channel 20.	29 volts	
		C. Initiate command CD-22 (octal 052) Operational Power On		
		D. Verify change of status (channels 12 and 14)		PSE Power On CCGE Power On HFE Power On, Mode 1 CPLEE Power On
		E. Check level of experiment supply voltage, channel 20.		
		F. Verify CPLEE Channeltron Voltage increase - OFF		Check housekeeping words 2 and 3 for variation in reading. If CPLEE Channeltron is On, execute Command 121 to turn Off.

TABLE 4-1 PHASE I (LUNAR SURFACE EVA PHASE)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	NOMINAL VALUE	REMARKS
11. Charged Particle Lunar Environment Experiment (Continued)		G. Verify that CPLEE is still in Automatic mode and is stepping		Voltage step, odd frames, word 39, bit 1 and even frame, word 7, bit 1. Remain in this step for approximately 30 minutes to look at data. Send Command 114 if not in automatic mode.
		H. Initiate Command CC-6 (octal 117) Automatic Voltage Sequence - Off		CPLEE in manual mode.
		I. Initiate Command CC-5 (octal 115) 8 times.		After each execution, verify CPLEE has stepped by looking at the high speed printer. Remain in each step for approximately 20 minutes.
		J. Initiate Command 114 Automatic Sequence - ON		
		K. Initiate and verify Command CC-7 (octal 120) CPLEE Channeltron Voltage - ON		Need approximately 30 minutes of data for Steps K and L.
		L. Initiate and verify Command CC-8 (octal 121) CPLEE Channeltron Voltage - OFF		CPLEE Operational Power - ON. (Automatic mode) Leave in Automatic mode until PI request CPLEE be placed in Standby mode. NOTE: Put CPLEE in Standby Power ON mode during LM ascent.

TABLE 4-1 PHASE I (LUNAR SURFACE EVA PHASE)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	NOMINAL VALUE	REMARKS
12. Experiments Turn-On Verification	Acknowledge Report	A. Advise crewmen that the PSE, HFE, CPLEE, and CCGE experiments have been turned On. B. Monitor PSE data. C. Monitor CCGE data. D. Monitor HFE data. E. Monitor CPLEE data.		Put CPLEE in Standby Power before LM ascent.
13. Field Geology Investigation		The MSC activity consists of managing the incoming geologic information in various ways.		

TABLE 4-1 PHASE I (LUNAR SURFACE PHASE)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	NOMINAL VALUE	REMARKS
13. Field Geology Investigation (Continued)		1. Encode data for imput into computer. 2. Make real-time notes and sketches of descriptions to transmit over closed circuit TV. 3. Make hard copy of Apollo TV images. 4. Annotate large scale versions of the astronaut data package maps. 5. Keep track of photos taken as a check on photo coverage. 6. Prepare specific questions to ask if and when appropriate.		
	A. Sample and describe the morphological features of small but predominant craters in the near area of the landing site.			Photograph sample site in stereo.
	B. Take scoop samples at scattered points along traverse.			Describe texture and composition; compare to other areas; photograph each sample site in stereo.

TABLE 4-1 PHASE I (LUNAR SURFACE PHASE)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	NOMINAL VALUE	REMARKS
13. Field Geology Investigation (Continued)	C. Dig several trenches parallel to sun's rays at different points along traverse			Photograph trench in stereo and show details of wall texture such as: Color Change Chemical Alterations Textural Changes Compositional Changes Fragment Type and Concentration
	D. Collect fragments of rocky material which appears to be representative types.			Try to move the large objects or pry beneath them after photographing their original positions.
	E. Take core tube samples, preferably where layering is known to exist.			Check for layering with chisel end of hammer along traverse. Take one photograph of surface before driving tube, then stereo photographs with tube and extension handle in place. Give brief statement of impressions on: Origin of Material How Emplaced How Distributed or Affected Since Emplacement Mechanical Properties

TABLE 4-1 PHASE I (LUNAR SURFACE PHASE)

EVENT	ASTRONAUT ACTIVITY	MCC ACTIVITY	NOMINAL VALUE	REMARKS
13. Field Geology Investigation (Continued)	F. Observe Morphologic type craters on horizon (Sharp-rimmed to subdued, pan-craters, funnel-shaped, dimple craters, chain and loop craters, secondary craters, etc.)			Briefly identify Morphologic type, then photograph general shape in stereo with baselines approximately 1/3 to 1/2 distance to points of interest, such as far wall. Give impressions or origin and mechanism of the craters' formation (impact, volcanic, other); relative age of crater. Activities A through F will be performed consistent with the Apollo 13 Flight Plan. These activities are not necessarily listed in order or priorities.

PHASE I (LUNAR SURFACE PHASE)

ACTIVITY CHART

Event (Geologic features to be studied)	Astronaut Activity			MSC Activity
	SAMPLING	PHOTOGRAPHY	DESCRIPTION	MONITORING
1. OUTCROP 2. Blocky Rimmed Crater 3. Blocks 4. Bright Halo Crater 5. Regolith 6. Sharp Rimmed Crater 7. Elongate Crater 8. Crater Chain 9. Mare Ridge 10. Scarp 11. Crater Cluster 12. Dimple Crater 13. Lineament 14. Subdued Crater	of ● Outcrop ● Blocks ● Regolith using ● hammer ● tongs ● scoop ● core tubes	of ● Outcrop ● Blocks ● regolith ● geologic features ● topographic features using ● monoscopic ● stereoscopic ● panoramic with ● Hasselblad ● Apollo TV ● Time-Sequence	of ● Rock Material and Geologic features with respect to ● Color, texture, composition, structure weathering or alteration. ● variations-horizontal and vertical ● relationships to adjacent features ● comparisons with similar features ● integrations of: - origins of features - sources of materials - processes	of ● Sample #s ● Photo #s ● Descriptions and ● encoding data ● annotating maps and photos ● prepare questions ● answer questions ● advise astronauts

The astronaut activity will consist of observation, photography, description, and sampling of certain geologic features conducted along the traverse. At the same time MSC will be monitoring and documenting the astronaut activity.

5.0 PHASE II (LUNAR SURFACE OPERATION CHECKOUT PHASE)

Phase II is outlined in Table 5-1 and covers the period from LM ascent through the checkout of all subsystems.

TABLE 5-1 PHASE II, (LUNAR SURFACE OPERATION CHECKOUT PHASE)

EVENT	MCC ACTIVITY	NOMINAL VALUE	REMARKS
1. LM Ascent	A. Monitor all scientific and engineering telemetry during and after launch noting any changes attributable to LM activity.		Note significant trends.

TABLE 5-1 PHASE II, (LUNAR SURFACE OPERATION CHECKOUT PHASE)

EVENT	MCC ACTIVITY	NOMINAL VALUE	REMARKS
2. Power Supply Check	A. Check the following parameters:		When telemetry indicates the need for adjustment of the DC load, the necessary control can be accomplished by switching power dumps in or out through use of the following commands: CD-5 (PDM Load #1 On) CD-6 (PDM Load #1 Off) CD-7 (PDM Load #2 On) CD-8 (PDM Load #2 Off)
	1. 0.25 Vdc Calibration (on Channel 2)	0.25 volts	
	2. 4.75 Vdc Calibration (on Channel 3)	4.75 volts	
	3. Converter Input Voltage (on Channel 1)	16.2 volts	
	4. Converter input current (on Channel 5)	4.2 amps	
	B. Verify that system is operating on PCU #1 by checking Channel 8 of telemetry word No. 33 (Shunt Regulator #1 Current)	1.1 amps	
	C. Check PCU temperatures as follows:		
	1. Power Oscillator #1 (on Channel 64)	+ 94°F	
	2. Regulator #1 (on Channel 77)	+103°F	

TABLE 5-1 PHASE II, (LUNAR SURFACE OPERATION CHECKOUT PHASE)

EVENT	MCC ACTIVITY	NOMINAL VALUE	REMARKS
2. Power Supply Check (Continued)	D. Check PCU operating parameters as follows:		If either the temperatures of Event 2, Step C or the parameters of Event 2, Step D, are out of limits, switch to PCU 2 by transmission of Octal Command 062 (Power Conditioning Unit Reset).
	1. +29V (on Channel 20)	+ 29.0 Volts	
	2. +15V (on Channel 35)	+ 15.0 Volts	
	3. +12V (on Channel 50)	+ 12.0 Volts	
	4. + 5V (on Channel 65)	+ 5.0 Volts	
	5. -12V (on Channel 79)	- 12.0 Volts	
	6. - 6V (on Channel 80)	- 6.0 Volts	
	E. Check RTG Temperatures as follows:		
	1. Hot Frame #1 (Channel 6)	1054°F	
	2. Hot Frame #2 (Channel 37)	1025°F	
	3. Hot Frame #3 (Channel 52)	1107°F	
	4. Cold Frame #1 (Channel 7)	478°F	
	5. Cold Frame #2 (Channel 67)	426°F	
	6. Cold Frame #3 (Channel 82)	511°F	
	F. Initiate command CX-01 (octal 027) DUST DETECTOR ON.		
	G. Monitor Cell Voltage of Dust Accretion Units		
	1. Dust Cell 2 Output (Channel 26)	52 mv	

TABLE 5-1 PHASE II, (LUNAR SURFACE OPERATION CHECKOUT PHASE)

EVENT	MCC ACTIVITY	NOMINAL VALUE	REMARKS
	G. (Continued)		
2. Power Supply Check (Continued)	2. Dust Cell 3 Output (Channel 41)	52 mv	
	3. Dust Cell 1 Output (Channel 84)	52 mv	
	H. Initiate Command CX-02 (Octal 031) DUST DETECTOR OFF.		
3. Temperature Checks and Thermal Control	A. Check telemetry channels as indicated below for pertinent temperature measurements:		If either the temperature or power levels are outside limits, switch to back-up transmitter by initiating command CD-4 (Octal 015) or command CD-1 (Octal 012).
	Location — **Channels**		
	1. Sunshield — 27, 42	- 80° F	If necessary turn Central Station Back-Up Heater On and Off by initiation and verification of following commands: CD-9 (Heater On) CD-10 (Heater Off)
	2. Thermal Plate — 4, 28, 43, 58, 71	+ 83° F	
	3. Structure Sides — 59, 87	0° F	
	4. Structure Bottom and Back — 15, 88	+6° F, +28° F	
	5. Inner Multilayer Insulation — 60	+ 64° F	
	6. Outer Multilayer Insulation — 72	+ 26° F	

TABLE 5-1 PHASE II, (LUNAR SURFACE OPERATION CHECKOUT PHASE)

EVENT	MCC ACTIVITY		NOMINAL VALUE	REMARKS
3. Temperature Check and Thermal Control (Continued)	A. (Continued) Location	Channel		
	7. Analog Data Processor Base	33	$+ 83^{\circ}F$	
	8. Analog Data Processor Internal	34	$+ 90^{\circ}F$	
	9. Digital Data Processor Base	46	$+ 83^{\circ}F$	
	10. Digital Data Processor Internal	47	$+ 87^{\circ}F$	
	11. Command Decoder Base	48	$+ 83^{\circ}F$	
	12. Command Decoder Internal	49	$+ 86^{\circ}F$	
	13. Command Demodulation VCO	61	$+ 86^{\circ}F$	
	14. Power Distribution Unit Base	62	$+ 83^{\circ}F$	
	15. Power Distribution Unit Internal	63	$+100^{\circ}F$	
	B. Check Shunt Regulator Current (Channel 8)		1.1 amps	

TABLE 5-1 PHASE II, (LUNAR SURFACE OPERATION CHECKOUT PHASE)

EVENT	MCC ACTIVITY	NOMINAL VALUE	REMARKS
3. Temperature Check and Thermal Control (Continued)	C. Optimize Central Station thermal environment by dumping reserve power into the external power dissipation resistors. Initiate commands in accordance with the following table: If AE-5 Shunt Current is: — Command PDR 0.6 to 1.1A — CD-5 (Octal 017) PDR #1 ON 1.1 to 1.5A — CD-7 (Octal 022) PDR #2 ON > 1.5A — CD-5 & 7 Both PDR #1 & #2 ON < 0.6A — Both PDR #1& #2 OFF D. Check Verification of any commands transmitted per Event 3, Step C above (Word 46).		

TABLE 5-1 PHASE II, (LUNAR SURFACE OPERATION CHECKOUT PHASE)

EVENT	MCC ACTIVITY	NOMINAL VALUE	REMARKS
3. Temperature Check and Thermal Control (Continued)	E. Check for appropriate change in shunt current for any command transmitted in Event 3, Step C (AE-5)		
	F. Initiate command CX-01 (Octal 027) DUST DETECTOR ON.		
	G. Check Dust Accretion Unit		
	1. Dust Cell 2 Temp (Channel 30)	+ 136° F	
	2. Dust Cell 3 Temp (Channel 56)	+ 136° F	
	3. Dust Cell 1 Temp (Channel 83)	+ 136° F	
	H. Initiate command CX-02 (Octal 031) DUST DETECTOR OFF.		

TABLE 5-1 PHASE II, (LUNAR SURFACE OPERATION CHECKOUT PHASE)

EVENT	MCC ACTIVITY	NOMINAL VALUE	REMARKS
4. Transmitter Checks	A. Monitor the following transmitter temperatures:		If either the temperature or power levels are outside limits, switch to back-up transmitter by transmission of command CD-4 (or CD-1).
	1. Transmitter A Crystal Temperature, Channel 18	+ 75° F	
	2. Transmitter A Heat Temperature Sink, Channel 19	+ 75° F	
	B. Check transmitter A AGC voltage, Channel 51	1.10 V @ +75° F	
	C. Check transmitter A Power Doubler Current, Channel 81	162 ma @ +75° F	
	D. Request MSFN check of ALSEP transmitter frequency. Log frequency and verify that it is within 11.5 kHz of nominal. (2275.5 MHz for Array B).	2275.5 MHz	
	E. Request MSFN check level of signal from ALSEP. Log level and verify that it exceeds the minimum receiver input power.	30' dish - 125.2 dbm 85' dish -118.2 dbm	

TABLE 5-1 PHASE II, (LUNAR SURFACE OPERATION CHECKOUT PHASE)

EVENT	MCC ACTIVITY	NOMINAL VALUE	REMARKS
4. Transmitter Checks (Continued)	F. Initiate Command CD-4 (Octal 015), XMTR B Select		Consult LSPO before initiating this command.
	G. Repeat Event 4, Steps A-E above, checking channels 31, 32, 66 and 22.	$+75^{\circ}F$, $+75^{\circ}F$, 0.61V @ $+75^{\circ}F$, 157 ma @ $+75^{\circ}F$	
	H. Initiate and verify Command CD-1 (Octal 012) Transmitter A Select.		
5. Diagnostic Checks	A. Monitor local oscillator crystal temperature A (Channel 16).	$+144^{\circ}F$	
	B. Monitor Channel 36 for RF level of ALSEP receiver local oscillator.	6.1 dbm	
	C. With MSFN ground transmitter radiating at rated power level, Monitor ALSEP Channel 21 for prelimiting signal level of command receiver.	-88 dbm	

TABLE 5-1 PHASE II, (LUNAR SURFACE OPERATION CHECKOUT PHASE)

EVENT	MCC ACTIVITY	NOMINAL VALUE	REMARKS
5. Diagnostic Checks (Continued)	D. Check for subcarrier indication, Channel 9	No modulation present. Octal 57	
	E. Check Channel 9 for indication of availability at the command decoder of 1 KHz subcarrier when it is transmitted from MSFN.	Modulation present. Octal 275	
	F. Determine ALSEP receiver center frequency by plotting MSFN transmitter frequency vs. ALSEP prelimiting signal level as transmitter is tuned across band. Log center frequency (nominally 2119 MHz ± 21 kHz).	2119 MHz	
6. Passive Seismic Experiment Checkout	A. Monitor all science data measurements on a continuous basis.		Note significant trends, especially during the turn-on period for the other experiments. During LM ascent, PSE Scientific data must be monitored continuously so as to measure any seismic disturbance due to ascent engine blast.
	B. Monitor the experiment supply voltage, Channel 20.	29.0 volts	Note significant trends.

TABLE 5-1 PHASE II, (LUNAR SURFACE OPERATION CHECKOUT PHASE)

EVENT	MCC ACTIVITY	NOMINAL VALUE	REMARKS
6. Passive Seismic Experiment Checkout (Continued)	C. Monitor the thermal plate temperatures, Channel 43.		Note significant trends and compare temperatures against other thermal plate temperatures on Channel 4, 28, 58 and 71.
	D. Check need for leveling as indicated by the Tidal output recordings.		

TABLE 5-1 PHASE II, (LUNAR SURFACE OPERATION CHECKOUT PHASE)

EVENT	MCC ACTIVITY	NOMINAL VALUE	REMARKS
7. Cold Cathode Gauge Experiment	A. Check experiment status (Channel 14) for correct indications		PSE Power On HFE Power On CPLEE Standby On CCGE Power On
	B. Record CCGE data on the high speed printer.		Record data continuous (1 page data/min) for up to 3 hours after LM lift-off, and then followed by one page data every 5 minutes.
	C. Record CCGE data on the analog recorder.		Record gauge data, electrometer range, gauge, and electronic temperature up to 3 hours after LM lift-off.

TABLE 5-1 PHASE II, (LUNAR SURFACE OPERATION CHECKOUT PHASE)

EVENT	MCC ACTIVITY	NOMINAL VALUE	REMARKS
8. Heat Flow Experiment Checkout	A. Check HFE data on a continuous basis		Note significant trends, especially during the turn-on period for the other experiments.
	B. Monitor the experiment supply voltage, Channel 20	29.0 volts	Note significant trends
	C. Check need for leveling of the HFE electronics package.		
	D. Initiate and verify octal command 152 twice.		To insure command link is operating properly.
	E. Monitor HFE Engineering channels as shown below:		Note significant trends.
	Telemetry word 33		
	1. +5 v supply (Frame 29)	+ 5.0 volts	
	2. -5 v supply (Frame 45)	- 5.0 volts	
	3. +15 v supply (Frame 55)	+15.0 volts	
	4. -15 v supply (Frame 74)	-15.0 volts	
	5. Low conductivity heater (Frame 57)	0	Frames 57 and 75 should be zero except during the conductivity experiment.
	6. High conductivity heater (Frame 75)	0	

TABLE 5-1 PHASE II, (LUNAR SURFACE OPERATION CHECKOUT PHASE)

EVENT	MCC ACTIVITY	NOMINAL VALUE	REMARKS
9. Charged Particle Lunar Environment Experiment	A. Check engineering data as follows:		CPLEE in automatic Mode - ON
	1. Temperature Sensor #1, Channel 11 (AC-5)		
	2. Temperature Sensor #2, Channel 90 (AC-6)		
	3. DC-DC converter voltage, Channel 10. (AC-4)		
	4. Switchable Power Supply Voltage, Channel 25. (AC-1)		
	5. Channeltron #1 Power Supply Voltage, Channel 89. (AC-2).		
	6. Channeltron #1 Power Supply Voltage, Channel 40. (AC-3)		
	B. Monitor telemetry for scientific data outputs (words 7, 17, 19, 23, 39, 55), comparing against results of ground tests.		

TABLE 5-1 PHASE II, (LUNAR SURFACE OPERATION CHECKOUT PHASE)

EVENT	MCC ACTIVITY	NOMINAL VALUE	REMARKS
9. Charged Particle Lunar Environment Experiment (Continued)	C. Note following status flag in scientific data: 1. Sensor Assembly, odd frames, word 7, bit 1 2. Deflection voltage polarity, odd frames, word 19, bit 1. 3. Voltage Step, odd frames, word 39, bit 1 and even frames, word 7, bit 1.		
	D. Verify that CPLEE is automatically stepping and that sequence is proper.		(see DC-97, DC-98, DC-99 sequences below)

DC-97	DC-98	DC-99	
1	1	1	1
0	1	1	1
1	1	1	0
0	1	1	0
1	1	0	1
0	1	0	1
1	1	0	0
0	1	0	0
1	0	1	1
0	0	1	1
1	0	1	0
0	0	1	0
1	0	0	1
0	0	0	1
1	0	0	0
0	0	0	0

Sequence Repeats

TABLE 5-1 PHASE II, (LUNAR SURFACE OPERATION CHECKOUT PHASE)

EVENT	MCC ACTIVITY	NOMINAL VALUE	REMARKS
9. Charged Particle Lunar Environment Experiment (Continued)	E. Voltage Step Comm Check		
	1. Initiate and verify command CC-6 (octal 117) CPLEE automatic voltage sequence - OFF		CPLEE auto sequence stops.
	2. Initiate and verify at 5 minute intervals, eight (8) command CC-5 (octal 115) CPLEE step voltage level.		CPLEE steps through sequence upon commands.
	3. Verify from printout, proper values for test oscillator readout (DC-85 through and including DC-96)		
	4. Initiate and verify command CC-4 (octal 114) CPLEE automatic voltage sequence - ON		CPLEE auto sequence begins.
	F. Beta Source Check		
	1. Check CPLEE science data for proper beta source counts (verify with PI).		Accumulate data for approximately 30 minutes.
	2. Initiate Command 120 Channeltron Voltage - ON		Accumulate data for approximately 30 minutes.
	3. Initiate Command 121 Channeltron Voltage - OFF		

TABLE 5-1 PHASE II, (LUNAR SURFACE OPERATION CHECKOUT PHASE)

EVENT	MCC ACTIVITY	NOMINAL VALUE	REMARKS
9. Charged Particle Lunar Environment Experiment (Continued)	G. Turn CPLEE - OFF		Turn CPLEE - OFF during LM Ascent
	H. Turn CPLEE - ON		Turn CPLEE - ON approximately 15 minutes after LM Ascent. Consult PI before executing this command.
	I. Dust Cover Removal		
	1. Check with PI or PI representative prior to dust cover removal.		
	2. Check for availability of adequate reserve power, HK-8. Adjust PDRs if necessary		
	3. Initiate and verify command CC-3 (octal 113) CPLEE dust cover removal.		Dust cover removed.
	4. Check science data for confirmation of dust cover removal.		
	J. Scientific Data Check		
	1. Send Command 120		Analyze data for 30 minutes.
	2. Send Command 121		Analyze data for 30 minutes.

TABLE 5-1 PHASE II, (LUNAR SURFACE OPERATION CHECKOUT PHASE)

EVENT	MCC ACTIVITY	NOMINAL VALUE	REMARKS
10. Dust Detector Checks	A. Check redundant decoder by initiation of command CX-1 (Octal 027) DUST DETECTOR ON with the alternate command address.		
	B. Verify reception and acceptance of command (Word 46).		
	C. Check temperatures of dust detector cells in Channels 30, 56 and 83.	+ 136° F	
	D. Check shunt regulator current, Channel 8 (Adjust PDRs if necessary).	1.1 amps	
	E. Check Channels 26, 41 and 84 for cell voltages of Dust Accretion units.	52 mv	
	F. Initiate Command CS-02 (Octal 031) DUST DETECTOR OFF.		

6.0 PHASE III (FORTY-FIVE DAY PHASE)

Phase III is outlined in Table 6-1 and covers the period from power turn-on and experiment checkout, through the following 45 calendar days.

TABLE 6-1 PHASE III, (FORTY-FIVE DAY PHASE)

EVENT	MCC ACTIVITY	NOMINAL VALUE	REMARKS
1. Central Station	A. Temperature Monitor		
	1. Monitor critical Central Station temperatures. (Word 33)		Note any out-of-limit readings and significant trends toward limits.
	B. Power Monitor		
	1. Check RTG temperatures on a continuous basis. (Word 33)		Continuously check the telemetry of the electrical parameters associated with the power supply.
	2. Log RTG temperatures every 24 hours and identify significant trends. (Word 33)		
	3. Log input power, voltage, and current and output voltages every 24 hours and identify significant trends.		
	C. Thermal Control		
	1. Initiate and verify commands. CD-06 (Octal 021) PDR #1 OFF CD-08 (Octal 023) PDR #2 OFF		

TABLE 6-1 PHASE III, (FORTY-FIVE DAY PHASE)

EVENT	MCC ACTIVITY	NOMINAL VALUE	REMARKS
1. Central Station (Continued)	C. (Continued) 2. Check reserve power as indicated by shunt regulator current, Channel 8. 3. Utilize reserve power for thermal control by initiating and verifying commands in accordance with the following table:		

Day Lunar Cycle	Commands
Day	CD-5 (Octal 017) PDR #1 ON
Day	CD-7 (Octal 022) PDR #2 ON
Day	CD-5 (Octal 017) PDR #1 ON
Day	CD-7 (Octal 022) PDR #2 ON

Night Lunar Cycle	Commands
Night	CD-26 (Octal 056) Heater 2 ON

TABLE 6-1 PHASE III, (FORTY-FIVE DAY PHASE)

EVENT	MCC ACTIVITY	NOMINAL VALUE	REMARKS
1. Central Station (Continued)	C. (Continued) Night Lunar Cycle — Commands Night — CD-25 (Octal 055) Heater 1 OP Pwr ON Night — CD-26 (Octal 056) Heater 2 OP Pwr ON and CD-9 (Octal 024) Heater 3 ON Night — CD-25 (Octal 055) Heater 1 OP Pwr ON and CD-9 (Octal 024) Heater 3 ON 4. Confirm an appropriate change in Channel 8 (Event 1, Step C.2) for each command executed in Event 1, step C.3. 5. If CD-26 is executed, confirm change in status telemetry Channel 14. Otherwise confirm no change in Channel 12 and Channel 14.		

TABLE 6-1 PHASE III, (FORTY-FIVE DAY PHASE)

EVENT	MCC ACTIVITY	NOMINAL VALUE	REMARKS
1. Central Station (Continued)	D. Transmitter Monitor		
	1. Check transmitter frequency at each "hand-over" from one MSFN station to the next. Log results and note any significant trend. Frequency should be: 2275.5 MHz (±11.5 KHz) for ALSEP Array B̄.	2275.5 MHz	
	2. Approximately once per day preferably at a fixed evaluation angle at a single MSFN station, measure and record receiver input level of the signal received from ALSEP. Log results and note trend daily.		
	3. Monitor and log daily the electrical parameters associated with the ALSEP transmitter:		

Parameter	Channel
Trans. A, AGC Voltage	51
Trans. B, AGC Voltage	66
Trans. A, DC, Power Doubler	81
Trans. B, DC, Power Doubler	22

TABLE 6-1 PHASE III, (FORTY-FIVE DAY PHASE)

EVENT	MCC ACTIVITY	NOMINAL VALUE	REMARKS
1. Central Station (Continued)	E. Downlink Bit Error Check		
	1. Approximately once per hour obtain results of bit error check (against the predictable first words of each ALSEP frame).		
	2. Log results and note significant trends.		
	F. Receiver Monitor		
	1. Log daily readings of electrical parameters associated with ALSEP receiver.		
	<u>Parameter</u> — <u>Channel</u>		
	RCVR, Local OSC Level — 36 RCVR, Pre-limiting level — 21		Note any significant trends.
	2. Once per day recheck ALSEP receiver center frequency as in Phase II, Event 5, Step F. Log results and note any significant trend.	2119 MHz	Reading taken with known output from ground transmitter, e.g., 10 kW.

TABLE 6-1 PHASE III, (FORTY-FIVE DAY PHASE)

EVENT	MCC ACTIVITY	NOMINAL VALUE	REMARKS
2. Passive Seismic Experiment	A. Monitor all science data measurements continuously on drum recorders.		
	B. Once per day record and log the following housekeeping data.		
	1. Experiment supply voltage Channel 20.	+ 29.0 Volts	
	2. Thermal plate temperature, Channel 43.		Note any significant trends and compare temperature against other thermal plate temperatures Channels 4, 28, 58 and 71.
	C. Once per day, check need for leveling as indicated by Tidal output recordings. Relevel (automatic) as in Phase I, Event 8, Step J when required (deleting steps J.2, J.3, J.16 and J.17). CL-06 (Octal 070) X-axis CL-07 (Octal 071) Y-axis CL-08 (Octal 072) Z-axis		NOTE: Check experiment status Channel 14 for evidence of "ripple off" during leveling.
	D. Check for evidence of automatic calibration of short period sensor at 12-hour intervals.		
	E. Once per day, calibrate long period circuitry as in Phase I, Event 8, Step K, Calibration (CL-04, Octal 066).		

TABLE 6-1 PHASE III, (FORTY-FIVE DAY PHASE)

EVENT	MCC ACTIVITY	NOMINAL VALUE	REMARKS
3. Cold Cathode Gauge Experiment	A. Monitor CCGE Engineering and Scientific data.		Note any significant trends. Print out CCGE format on high speed printer once every 30 minutes.
	B. Once per day, log power supply voltages and equipment temperatures.		Note any significant trends.
	C. Monitor input voltage to the experiment, Channel 20.	29.0 volts	Once per day, record and log.

TABLE 6-1 PHASE III, (FORTY-FIVE DAY PHASE)

EVENT	MCC ACTIVITY	NOMINAL VALUE	REMARKS
4. Heat Flow Experiment	A. Monitor the HFE Engineering and Scientific Data.		Monitor temperature trends at each sensor. Monitor mode, heater, and programmer states and note abnormal readings.
	B. Heat Flow Conductivity Experiment		Consult PI prior to performing conductivity experiment. During the conductivity experiment consult the PI before making any mode changes or data interruptions. The time interval for hard copy printouts will be a real-time decision by the PI.
	1. Check HFE data telemetry word 21, bits 3, 4, 5, 6 of HF word 5 for correct heater state.	0000	
	2. If bits 3, 4, 5, 6 of HF word 5 are not 0000, send octal command 152 (Heater Advance) until the bits are in the proper state. Reference HF heater sequence - Page 6-10.		Octal command 152 advances the heater switch one state for each command sent. The heater sequence is equivalent to that of a rotary switch. Ex. In order to go from heater 12 OFF to heater 11 OFF, four heater advance commands must be sent. The next state after Heater 23 ON is Heater 12 OFF.

Heater Sequence

State	H4	H3	H2	H1	Heater	Function	Bridge Energized
1	0	0	0	0	12	OFF	DTR 11
2	0	0	0	1	12	ON	DTR 11
3	0	0	1	0	14	OFF	DTR 12
4	0	0	1	1	14	ON	DTR 12
5	0	1	0	0	11	OFF	DTR 11
6	0	1	0	1	11	ON	DTR 11
7	0	1	1	0	13	OFF	DTR 12
8	0	1	1	1	13	ON	DTR 12
9	1	0	0	0	22	OFF	DTR 21
10	1	0	0	1	22	ON	DTR 21
11	1	0	1	0	24	OFF	DTR 22
12	1	0	1	1	24	ON	DTR 22
13	1	1	0	0	21	OFF	DTR 21
14	1	1	0	1	21	ON	DTR 21
15	1	1	1	0	23	OFF	DTR 22
16	1	1	1	1	23	ON	DTR 22

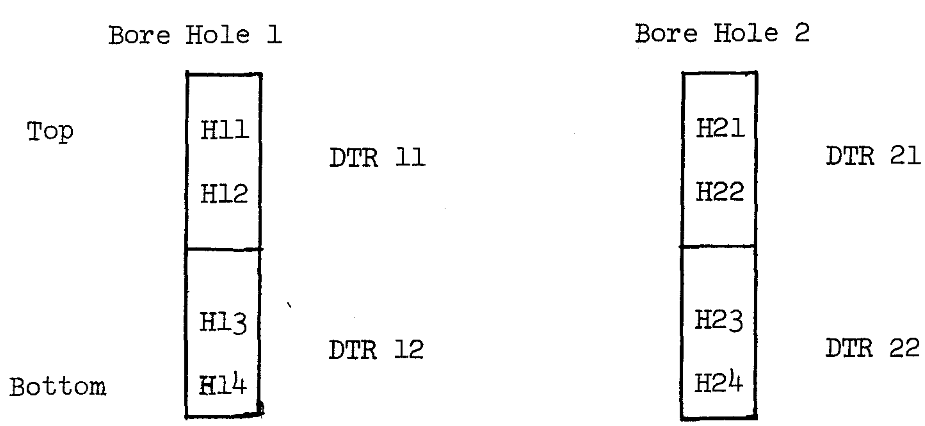


TABLE 6-1 PHASE III, (FORTY-FIVE DAY PHASE)

EVENT	MCC ACTIVITY	NOMINAL VALUE	REMARKS	
4. Heat Flow Experiment (Continued)			Heat Flow Cond. Experiment	Heater Energized
			1	H12
			2	H14
			3	H22
			4	H24
			5	H11
			6	H13
			7	H21
			8	H23
5. Heat Flow Conductivity Experiment 1 Mode 2 Operation H12	Command Sequence (Initiate and verify)		Bridge Measurement	Heater State
A) Initation	Monitor for 2 hours		DTH 11	0000
B) Heating Phase (a) PI will determine, after 1 hour, to continue in Mode 2 or switch to Mode 3 operation	152, 136		DTH 11	0001
			If PI elects to stay in Mode 2 the heating phase will be from 15 to 36 hours.	
			(a) The heater advance Command 152, in Mode 2 operation, can be sent during the 2 hour initiation period.	

TABLE 6-1 PHASE III, (FORTY-FIVE DAY PHASE)

EVENT	MCC ACTIVITY	NOMINAL VALUE	REMARKS Bridge Measurement	 Heater State
6. Heat Flow Conductivity Experiment 1 Mode 3 Operation	Command Sequence (Initiate and Verify)			
A) Heating Phase 10 hrs. Terminate on approval of PI.	140, 144		DTR 11, TR 11	0001
B) Monitor lower section ring bridge for 15 minutes.	152		DTR 12, TR 12	0010
C) Monitor upper section ring bridge for 15 minutes. (a)	135, 152, 152, 140, 144		DTR 11, TR 11	0100
D) Monitor Probe 1 gradient bridge for 15 minutes. (b)	135, 142, 152 (14 times)		DTH (11, 12) T (11, 12)	0010
E) Monitor Lower section ring bridge for 15 minutes.	140, 144		DTR 12, TR 12	0010

(a) For ring bridge, Mode 3 measurements, the 15 minute period starts when the last command has been initiated and verified.

(b) For gradient bridge measurements, the 15 minute period starts when command 135 has been initiated and verified.

TABLE 6-1 PHASE III, (FORTY-FIVE DAY PHASE)

EVENT	MCC ACTIVITY	NOMINAL VALUE	REMARKS	
6. (Continued)				
F) Return to Step 3 and repeat steps (C-E) for a minimum of 6 hours.				
G) Return to Mode 1 operation, full sequence.	135, 141			
7. Heat Flow Conductivity Experiment 2 Mode 2 Operation H 14			Bridge Measurement	Heater State
A) Initiation	Monitor for 2 hours		DTH 12	0010
B) Heating Phase	152, 136		DTH 12	0011
PI will determine, after 1 hour, to continue in Mode 2 or switch to Mode 3 operation.				

TABLE 6-1 PHASE III, (FORTY-FIVE DAY PHASE)

EVENT	MCC ACTIVITY	NOMINAL VALUE	REMARKS	
			Bridge Measurement	Heater State
8. Heat Flow Conductivity Experiment 2 Mode 3 Operation	Command Sequence (Initiate and Verify)			
A) Heating Phase 10 hours Terminate on approval of PI.	140, 144		DTR 12, TR 12	0011
B) Monitor lower section ring bridge for 15 minutes.	135, 152, 152, 152, 140, 144		DTR 12, TR 12	0110
C) Monitor Probe 1 gradient bridge for 15 minutes	135, 142		DTH (11, 12) T (11, 12)	0110
D) Monitor lower section ring bridge for 15 minutes.				
E) Return to Step C and repeat steps (C and D) for a minimum of 6 hrs.				
F) Return to Mode 1 operation, full sequence	135, 141			

TABLE 6-1 PHASE III, (FORTY-FIVE DAY PHASE)

EVENT	MCC ACTIVITY	NOMINAL VALUE	REMARKS	
			Bridge Measurement	Heater State
9. Heat Flow Conductivity Experiment 3 Mode 2 Operation H 22	Command Sequence (Initiate and verify)			
A) Initiation	Monitor for 2 hours		DTH 21	0110
B) Heating Phase	152, 152, 152, 136		DTH 21	1001
PI will determine after one hour, to continue in Mode 2 or switch to Mode 3 operation.				

TABLE 6-1 PHASE III, (FORTY-FIVE DAY PHASE)

EVENT	MCC ACTIVITY	NOMINAL VALUE	REMARKS	
10. Heat Flow Conductivity Experiment 3 Mode 3 operation	Command Sequence (Initiate and Verify)		Bridge Measurement	Heater State
A) Heating Phase 10 hr. Terminate on approval of PI.	140, 144		DTR 21, TR 21	1001
B) Monitor lower section ring bridge for 15 minutes	152		DTR 22, TR 22	1010
C) Monitor upper section ring bridge for 15 minutes	135, 152, 152, 140, 144		DTR 21, TR 21	1100
D) Monitor Probe 2 gradient bridge for 15 minutes	135, 143, 152 (14 times)		DTH (21, 22) T (21, 22)	1010
E) Monitor lower section ring bridge for 15 minutes.	140, 144		DTR 22, TR 22	1010
F) Return to Step C and repeat steps (C-E) for a minimum of 6 hours.				

TABLE 6-1 PHASE III, (FORTY-FIVE DAY PHASE)

EVENT	MCC ACTIVITY	NOMINAL VALUE	REMARKS	
10. (Continued) G) Return to Mode 1 operation, full sequence	135, 141			
11. Heat Flow Conductivity Experiment 4 Mode 2 Operation H 24	Command Sequence (Initiate and Verify)		Bridge Measurement	Heater State
A) Initiation	Monitor for 2 hours		DTH 22	1010
B) Heating Phase	152, 136		DTH 22	1011
PI will determine, after 1 hour to continue in Mode 2 or switch to Mode 3 operation.				
12. Heat Flow Conductivity Experiment 4 Mode 3 operation	Command Sequence (Initiate and Verify)		Bridge Measurement	Heater State
A) Heating Phase 10 hours Terminate on approval of PI	140, 144		DTR 22, TR 22	1011
B) Monitor lower section ring bridge for 15 minutes	135, 152, 152, 152, 140, 144		DTR 22, TR 22	1110

TABLE 6-1 PHASE III, (FORTY-FIVE DAY PHASE)

EVENT	MCC ACTIVITY	NOMINAL VALUE	REMARKS	
12. (Continued)				
C) Monitor Probe 2 gradient bridge for 15 minutes.	135, 143		DTH (21, 22) T (21, 22)	1110
D) Monitor lower section ring bridge for 15 minutes.	140, 144		DTR 22, TR 22	1110
E) Return to Step C and repeat steps (C thru D) for a minimum of 6 hrs.				
F) Return to Mode 1 operation, full sequence.				
13. Heat Flow Conductivity Experiment 5 Mode 2 operation H 11	Command Sequence (Initiate and Verify)		Bridge Measurement	Heater State
A) Initiation	Monitor for 2 hours		DTH 11	1110
B) Heating Phase	152 (7 times), 136		DTH 11	0101
PI will determine after 1 hour, to continue in Mode 2 or switch to Mode 3 operation.				

TABLE 6-1 PHASE III, (FORTY-FIVE DAY PHASE)

EVENT	MCC ACTIVITY	NOMINAL VALUE	REMARKS	
			Bridge Measurement	Heater State
14. Heat Flow Conductivity Experiment 5 Mode 3 Operation	Command Sequence (Initiate and Verify)			
A) Heating Phase - 10 hrs. Terminate on approval of PI.	140, 144		DTR 11, TR 11	0101
B) Monitor upper section ring bridge for 15 minutes.	135, 152 (11 times) 140, 144		DTH 11, TR 11	0000
C) Monitor Probe 1 gradient bridge for 15 minutes.	135, 142		DTH (11, 12) T (11, 12)	0000
D) Monitor upper section ring bridge for 15 minutes.	140, 144		DTR 11, TR 11	0000
E) Return to Step 3 and repeat steps (C-D) for a minimum of 6 hours.				
F) Return to Mode 1 operation full sequence	135, 141			

TABLE 6-1 PHASE III, (FORTY-FIVE DAY PHASE)

EVENT	MCC ACTIVITY	NOMINAL VALUE	REMARKS	
15. Heat Flow Conductivity Experiment 6 Mode 2 Operation H 13	Command Sequence (Initiate and Verify)		Bridge Measurement	Heater State
A) Initiation	Monitor for 2 hours		DTH 12	0000
B) Heating Phase	152 (7 times), 136		DTH 12	0111
PI will determine after 1 hour, to continue in Mode 2 or switch to Mode 3 operation.				
16. Heat Flow Conductivity Experiment 6 Mode 3 Operation	Command Sequence (Initiate and Verify)		Bridge Measurement	Heater State
A) Heating Phase 10 hrs. Terminate on approval of PI.	140, 144		DTR 12, TR 12	0111
B) Monitor upper section ring bridge for 15 minutes.	135, 152 (9 times), 140, 144		DTR 11, TR 11	0000
C) Monitor lower section ring bridge for 15 minutes.	135, 152, 152, 140, 144		DTR 12, TR 12	0010

TABLE 6-1 PHASE III, (FORTY-FIVE DAY PHASE)

EVENT	MCC ACTIVITY	NOMINAL VALUE	REMARKS	
16. (Continued)				
D) Monitor Probe 1 gradient bridge for 15 minutes	135, 142, 152 (14 times)		DTH (11, 12) T (11, 12)	0000
E) Monitor upper section ring bridge for 15 minutes.	140, 144		DTR 11, TR 11	0000
F) Return to Step C and repeat steps (C thru E) for a minimum of 6 hrs.				
G) Return to Mode 1 operation, full sequence.	135, 141			
17. Heat Flow Conductivity Experiment 7 Mode 2 operation H 21	Command Sequence (Initiate and Verify)		Bridge Measurement	Heater State
A) Initiation	Monitor for 2 hours		DTH 21	0000
B) Heating Phase	152 (13 times), 136		DTH 21	1101
PI will determine after 1 hour, to continue in Mode 2 or switch to Mode 3 operation.				

TABLE 6-1 PHASE III, (FORTY-FIVE DAY PHASE)

EVENT	MCC ACTIVITY	NOMINAL VALUE	REMARKS	
18. Heat Flow Conductivity Experiment 7 Mode 3 operation	Command Sequence (Initiate and Verify)		Bridge Measurement	Heater State
A) Heating Phase - 10 hrs. Terminate on approval of P.I.	140, 144		DTR 21, TR 21	1101
B) Monitor upper section ring bridge for 15 minutes.	135, 152 (11 times), 140, 144		DTR 21, TR 21	1000
C) Monitor Probe 2 gradient bridge for 15 minutes.	135, 143		DTH (21, 22) T (21, 22)	1000
D) Monitor upper section ring bridge for 15 minutes.	140, 144		DTR 21, TR 21	1000
E) Return to Step C and repeat steps (C thru D) for a minimum of 6 hr.				
F) Return to Mode 1 operation, full sequence	135, 141			

TABLE 6-1 PHASE III, (FORTY-FIVE DAY PHASE)

EVENT	MCC ACTIVITY	NOMINAL VALUE	REMARKS	
19. Heat Flow Conductivity Experiment 8 Mode 2 operation H 23	Command Sequence (Initiate and Verify)		Bridge Measurement	Heater State
A) Initiation	Monitor for 2 hours		DTH 22	1000
B) Heating Phase	152 (7 times), 136		DTH 22	1111
PI will determine after 1 hour, to continue in Mode 2 or switch to Mode 3 operation.				
20. Heat Flow Conductivity Experiment 8 Mode 3 operation	Command Sequence (Initiate and Verify)		Bridge Measurement	Heater State
A) Heating Phase 10 hrs.	140, 144		DTR 22, TR 22	1111
Terminate on approval of PI.				
B) Monitor upper section ring bridge for 15 minutes.	135, 152 (9 times), 140, 144		DTR 21, TR 21	1000
C) Monitor lower section ring bridge for 15 minutes.	135, 152, 152, 140, 144		DTR 22, TR 22	1010

TABLE 6-1 PHASE III, (FORTY-FIVE DAY PHASE)

EVENT	MCC ACTIVITY	NOMINAL VALUE	REMARKS
20. (Continued)			
D) Monitor Probe 2 gradient bridge for 15 minutes.	135, 143, 152 (14 times)		DTH (21, 22) T (21, 22) 1000
E) Monitor upper section ring bridge for 15 minutes.	140, 144		DTR 21, TR 21 1000
F) Return to Step C and repeat Steps (C thru E) for a minimum of 6 hours.			
G) Return to Mode 1 operation, full sequence	135, 141		

TABLE 6-1 PHASE III, (FORTY-FIVE DAY PHASE)

EVENT	MCC ACTIVITY	NOMINAL VALUE	REMARKS
21. Charged Particle Environment Experiment	A. Monitor science data continuously with CPLEE in automatic voltage sequence mode.		Report abnormal activity to PI.
	B. Once per day monitor and record CPLEE housekeeping parameters listed below. AC-2 Channeltron PS #1 AC-3 Channeltron PS #2 AC-4 DC-DC Conv. Volts AC-5 Temp. of phy. anal. AC-6 Temp. of Swt. P.S.		If any housekeeping parameters exceed the red-line limits initiate contingency action.
	C. At discretion of the PI, utilize CPLEE voltage step command to concentrate on particular range of particle energy.		
22. Dust Detector	A. Lunar Day		
	1. Initiate and verify command CX-01 (Octal 027) DUST DETECTOR ON.		
	2. Once per day, log outputs of dust detector cells, AX-4, AX-5 and AX-6 (HK channels 84, 26 and 41), corrected for temperature per AX-1, AX-2 and AX-3 (Channels 83, 30 and 56), and supply voltages (plus and minus 12 volts, Channel 50 and 79.)		Note any significant trends.

TABLE 6-1 PHASE III, (FORTY-FIVE DAY PHASE)

EVENT	MCC ACTIVITY	NOMINAL VALUE	REMARKS
22. Dust Detector (Continued)	B. Lunar Night 1. After terminator has passed ALSEP site, initiate and verify command CX-02 (Octal 031) DUST DETECTOR OFF 2. Confirm small increase in reserve power (Channel 8) when command is executed.		

7.0 PHASE IV (ONE-YEAR PHASE)

Phase IV as outlined in Table 7-1 covers the period from forty-five (45) days through the first year of operational life for ALSEP.

TABLE 7-1 PHASE IV, (ONE-YEAR PHASE)

EVENT	MCC ACTIVITY	NOMINAL VALUE	REMARKS
1. Central Station	A. Check Central Station temperatures as in Phase III, Event 1, Step A, and initiate any contingency action indicated. Log critical parameters for trend identification.		Check temperatures early in each access period, and every day during continuous coverage.
	B. Check and log RTG temperatures as in Phase III, Event 1, Step B.1.		Every 24 hours
	C. Check telemetry of power supply parameters as in Phase III, Event 1, Step B.3. Log for trend identification. Initiate contingency action if required (e.g., switch PCUs).		Check telemetry early in each access period. and every day during continuous coverage.
	D. Check transmitter performance as in Phase III, Event 1, Step D. Log data and initiate contingency action (e.g., switch transmitters), if necessary.		Check transmitter early in each access period, and every day during continuous coverage.

TABLE 7-1 PHASE IV, (ONE-YEAR PHASE)

EVENT	MCC ACTIVITY	NOMINAL VALUE	REMARKS
1. Central Station (Continued)	E. Check receiver performance as in Phase III, Event 1, Step F. Log results.		Check receiver every day and near the end of each access period.
	F. Check the bit error rate of the downlink as in Phase III, Event 1, Step E. Log results.		Check downlink bit error every day and near the end of each access period.
	G. Optimize the Central Station thermal environment for the next 24-hour period as in Phase III, Event 1, Step C.		Optimize thermal control every day and near the end of each access period.
2. Passive Seismic Experiment	A. Early in the access period and every day during continuous coverage, check sensor temperature, DL-7, and initiate contingency action if out-of-limits.		
	B. Early in the access period and again near end of access, check Tidal X, Y and Z data, DL-4, DL-5 and DL-6, respectively, for excessive drift of sensor and relevel, if necessary, in accordance with Phase I, Event 8, Step J (deleting steps J.2, J.3, J.16 and J.17).		

TABLE 7-1 PHASE IV, (ONE-YEAR PHASE)

EVENT	MCC ACTIVITY	NOMINAL VALUE	REMARKS
2. Passive Seismic Experiment (Continued)	C. During each continuous coverage access period, check for evidence of automatic calibration in short period data, DL-8, and initiate contingency action if necessary. Adjust gain, if necessary, per Phase I, Event 8, Step H.		
	D. During each access period, calibrate long period circuitry as in Phase I, Event 8, Step K.		
	E. Near the end of each access period, examine science data for evidence of unusual developments.		
3. Cold Cathode Gauge Experiment	A. Monitor the CCGE Engineering and Scientific data.		Log abnormal activity. During the 2 hour period of real-time monitoring print out CCGE data with high speed printer once every 15 minutes.
	B. Monitor the experiment supply voltage, Channel 20.	29.0 volts	

TABLE 7-1 PHASE IV, (ONE-YEAR PHASE)

EVENT	MCC ACTIVITY	NOMINAL VALUE	REMARKS	
4. Heat Flow Experiment	Command Sequence:		Bridge Measurement:	Heater State:
A. Check HFE data for 2 hr. periods	(Initiate and Verify)		Monitor temperature trends at each sensor. Monitor mode, heater, and programmer states and note abnormal readings.	
1. Initiation			Ensure heater state is 0000. If not, send command 152 until state 000 is reached.	
2. M 3 operation - 15 min.	140, 144		DTR11	0000
3. M 1 operation - 15 min.	135, 152, 152		Full Sequence	0010
4. M 3 operation - 15 min.	140, 144		DTR12	0010
5. M 1 operation - 15 min.	135, 152 (6 times)		Full Sequence	1000
6. M 3 operation - 15 min.	140, 144		DTR21	1000
7. M 1 operation - 15 min.	135, 152, 152		Full Sequence	1010
8. M 3 operation - 15 min.	140, 144		DTR22	1010
9. M 3 operation - 15 min.	135, 152 (6 times)		Full Sequence	0000
			The PI will perform a second set of conductivity experiments during the final two months of the lunar year.	

TABLE 7-1 PHASE IV, (ONE-YEAR PHASE)

EVENT	MCC ACTIVITY	NOMINAL VALUE	REMARKS
5. Charged Particle Lunar Environment Experiment	A. Early in each access period check status of CPLEE housekeeping.		Log abnormal activity and initiate contingency action if required.
	B. Monitor CPLEE science data and adjust voltage stepper mode, at the discretion of the PI, to optimize data.		
6. Dust Detector	A. At access just prior to lunar sunrise, turn on dust detector by initiating and verifying command CX-01 (Octal 027) DUST DETECTOR ON.		
	B. Once per day during lunar day check and log dust detector data as in Phase III, Event 22, Step A.2. Compare against previously obtained data for same point in lunar cycle.		
	C. At first access after lunar sunset, turn dust detector off by initiating and verifying command CS-02 (Octal 031) DUST DETECTOR OFF.		

8.0 EXPERIMENT CONSUMABLES

The following graphs of the experiment consumables are enclosed.

The RTG Power Profile is presented in Figure 8-1.

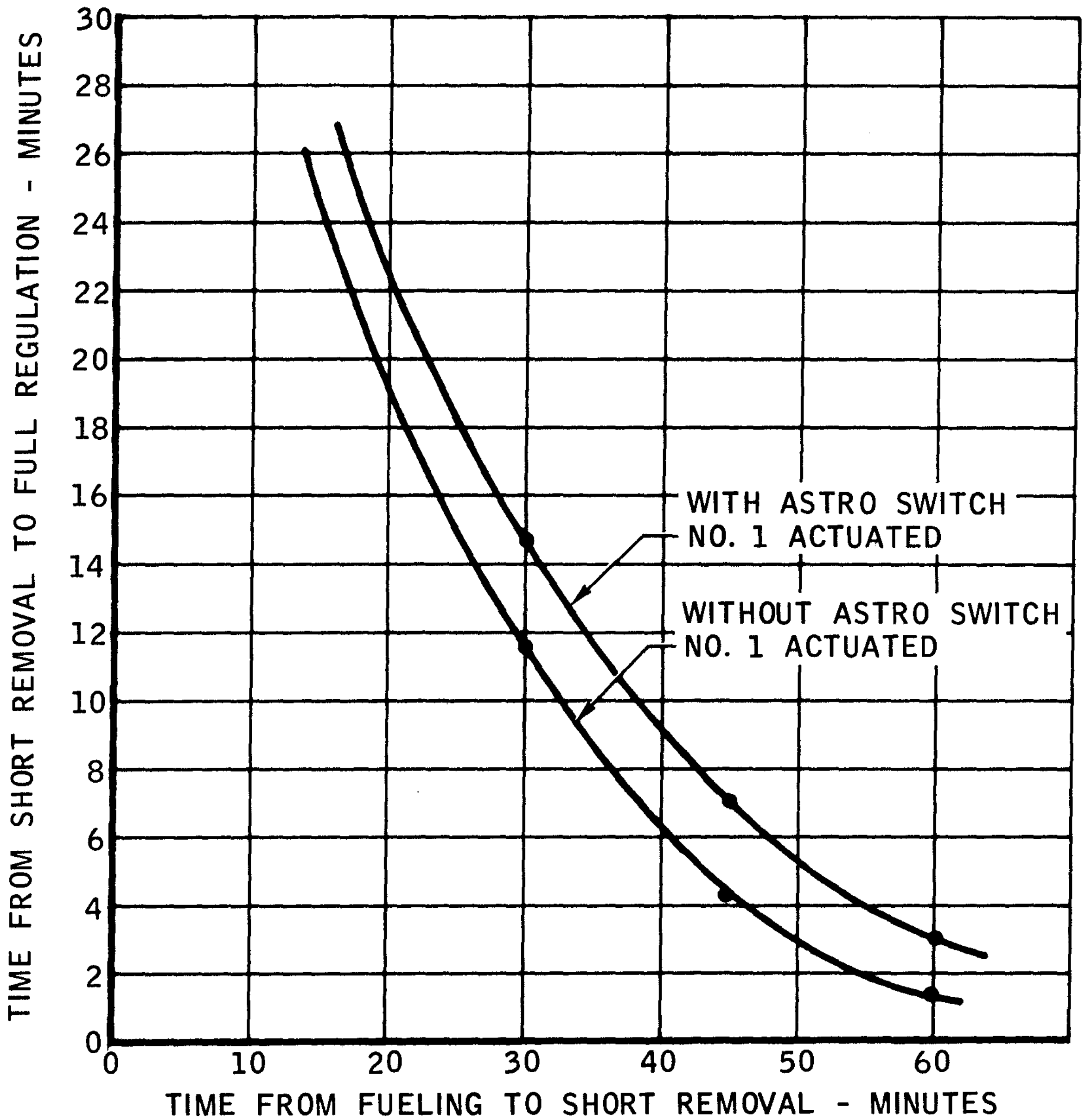
The PCU Power output vs. Central Station Dissipation is presented in Figure 8-2.

The Power Profile for the PSE is presented in Figure 8-3.

The Power Profile for the CCGE is presented in Figure 8-4.

The Power Profile for the HFE is presented in Figure 8-5.

The Power Profile for the CPLEE is presented in Figure 8-6.



NOTES:

1. FULL REGULATION IS 36 WATTS @ 16 VOLTS.
2. A VARIATION OF ± 3 MINUTES MUST BE ALLOWED DUE TO VARIABLES AFFECTING RTG LUNAR SURFACE OPERATION.

Figure 8-1 RTG POWER PROFILE

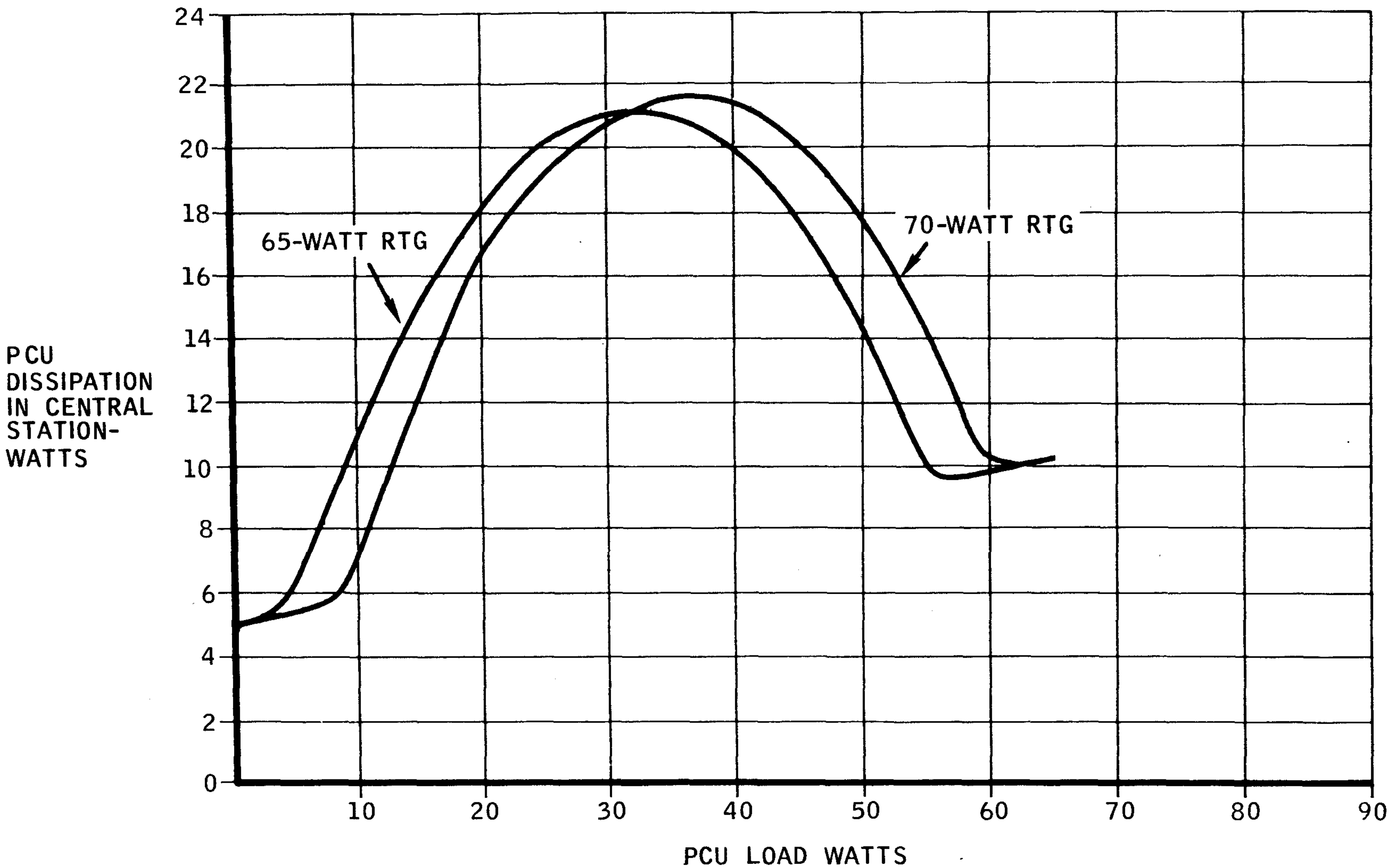


Figure 8-2 PCU POWER OUTPUT VS CENTRAL STATION DISSIPATION

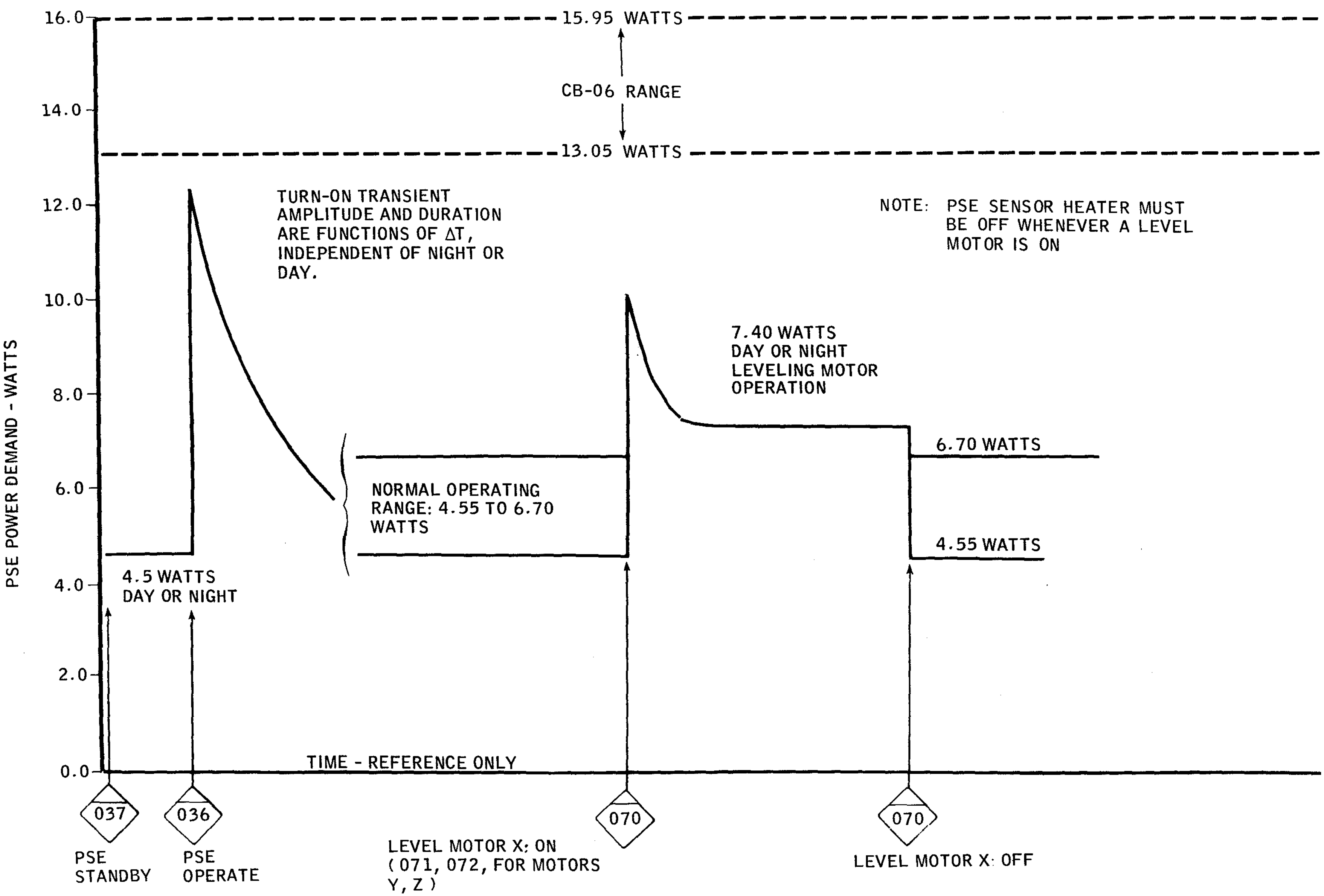


Figure 8-3 PSE POWER PROFILE

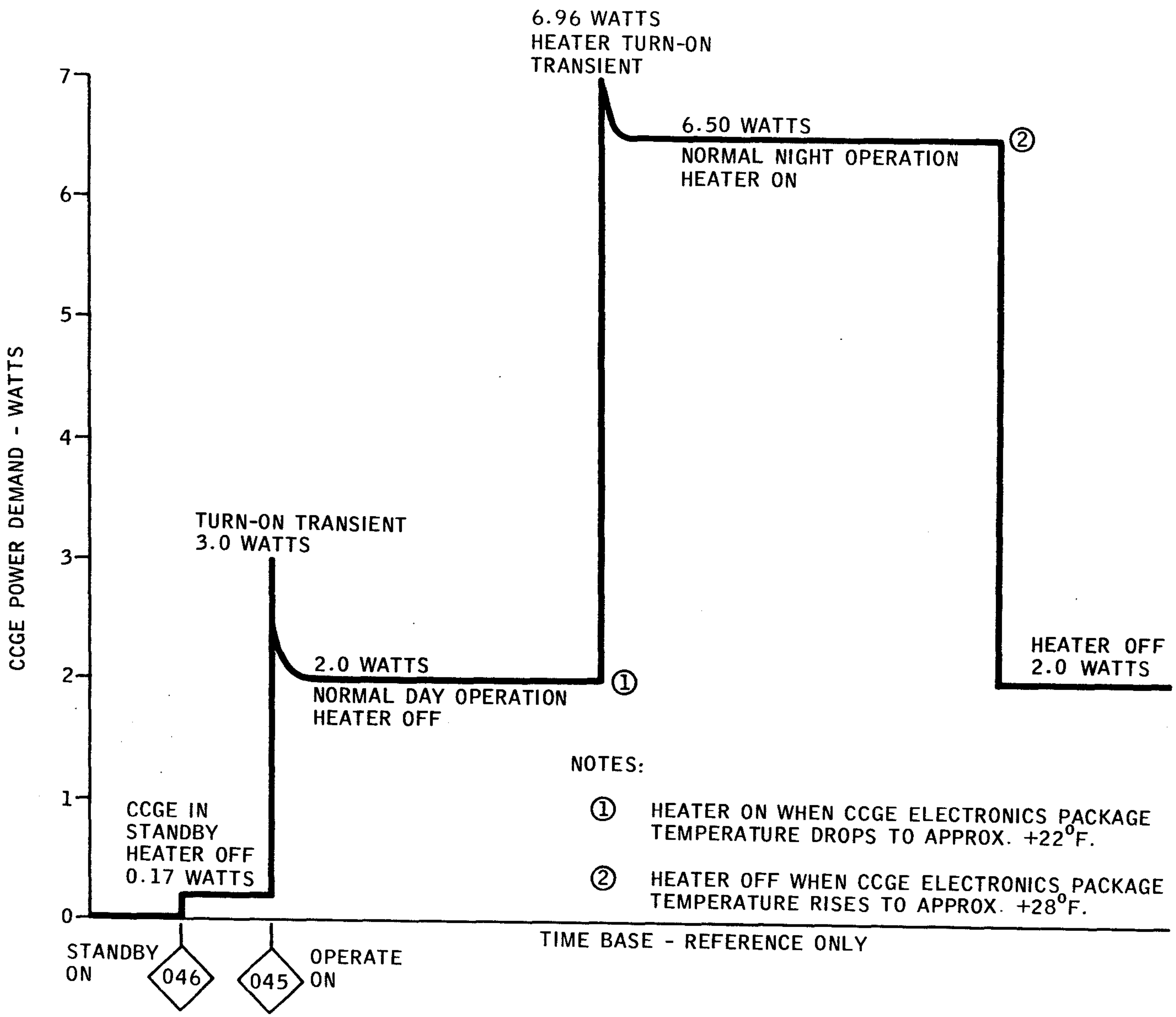


FIGURE 8-4 CCGE POWER PROFILE

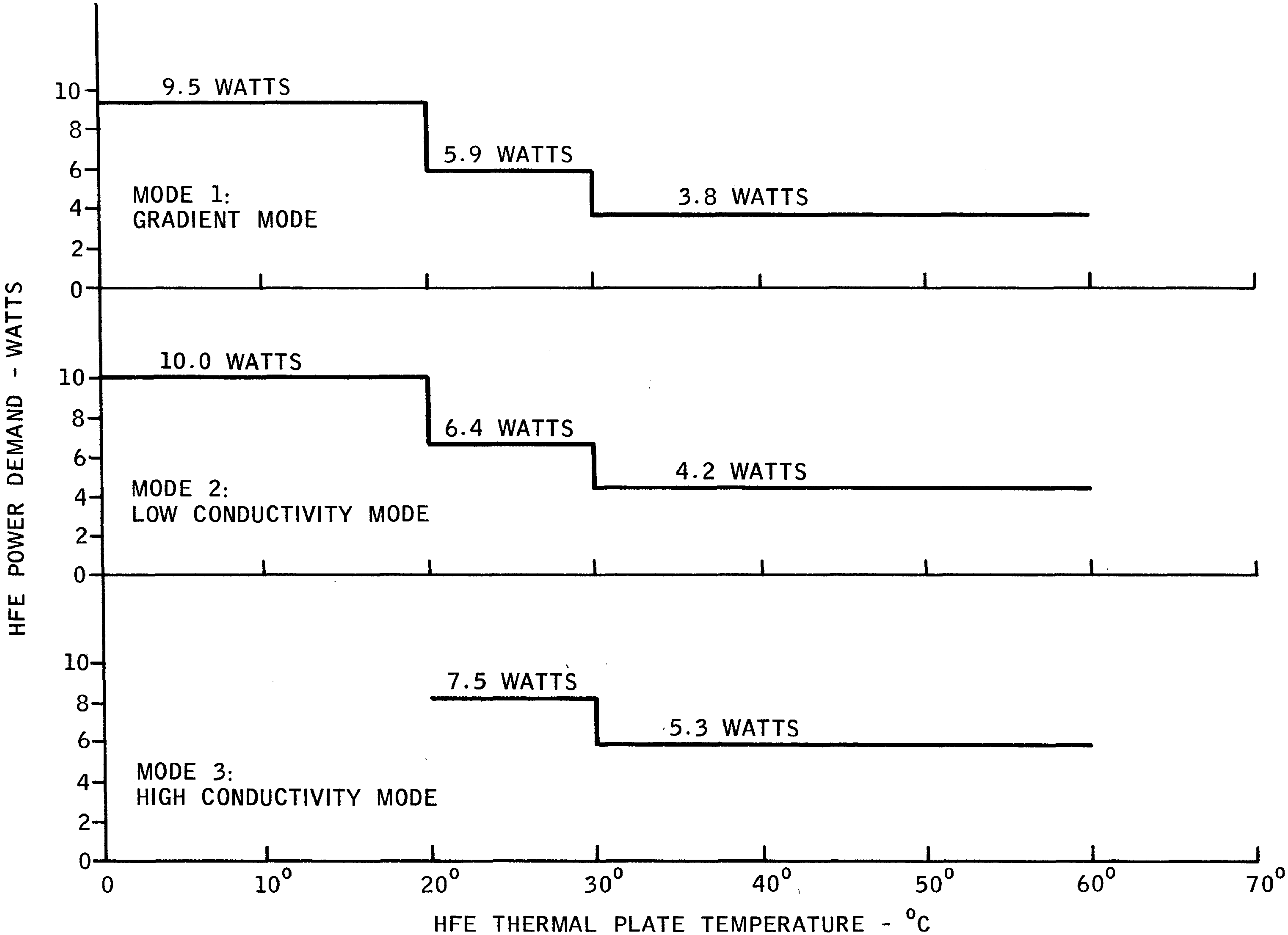


Figure 8-5 HFE POWER PROFILE

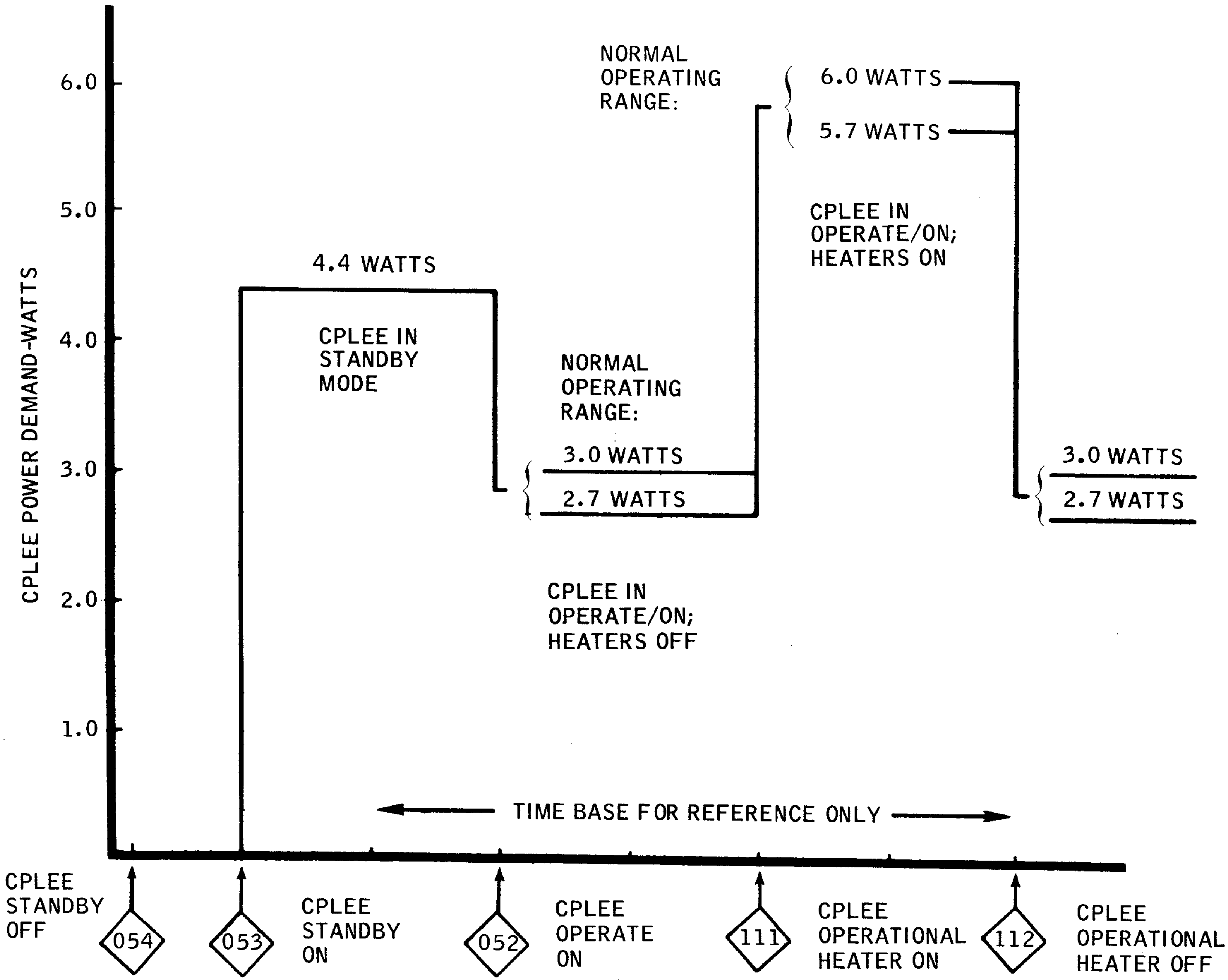


FIGURE 8-6 CPLEE POWER PROFILE