M. C. Miller

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

(FOR ALL LAUNCH DATES)

APOLLO 16

PRELIMINARY

LUNAR SURFACE PROCEDURES

PREPARED BY

LUNAR SURFACE PROCEDURES SECTION

EVA/IVA PROCEDURES BRANCH

CREW PROCEDURES DIVISION

MANNED SPACECRAFT CENTER

HOUSTON, TEXAS

DECEMBER 15, 1971

PRELIMINARY

APOLLO 16

LUNAR SURFACE PROCEDURES

DECEMBER 15, 1971

Approved By: R. G. Zedekar

R. G. Zedekar
Chief, Lunar Surface Procedures Section

D. C. Schultz

D. C. Schultz
Chief, EVA/IVA Branch

APOLLO 16

LUNAR SURFACE PROCEDURES

PRELIMINARY

PREFACE

This document has been prepared by the Crew Procedures Division, Flight Crew Operations Directorate, Manned Spacecraft Center, Houston, Texas and by General Electric, Apollo and Ground Systems, Houston Programs. The information contained herein represents the preliminary Lunar Surface Procedures for Apollo 16, Mission J-2, the sixth manned lunar landing mission. This document will not be updated via errata pages, rather a completely revised edition will be published approximately one month prior to the Apollo 16 launch date.

Prepared By: R R Kain

R. R. Kain
Lunar Surface Procedures Section

R. J. Koppa

R. J. Koppa
General Electric Co.

J. G. Olmsted

J. G. Olmsted
General Electric Co.

T. O. Montgomery

T. O. Montgomery
General Electric Co.

CONTENTS

SECTION 1.0

INTRODUCTION

1.0 INTRODUCTION

This Preliminary Apollo 16 Lunar Surface Procedures document is used to document the planning for lunar surface EVA operations on Mission J-2, to describe the crew equipment interface, and to document the manner in which the lunar surface mission requirements are to be implemented.

The nominal plan includes three two-man EVA periods during the 73 hour stay of the LM vehicle on the lunar surface. The first, second and third EVA's are planned for seven hours each of activity from depressurization to repressurization of the LM. Several alternate operation plans will be included in the final edition of this document to cover such off-nominal cases as higher-than-anticipated workloads which result in shorter PLSS time-to-consumables-redline, difficulties in placement or deployment of experiments resulting in time loss, and malfunction of an EMU or PLSS before or during an EVA which occasions subsequent single-man EVA contingency operation.

EMU operations and procedures (including contingency) are covered in the EMU AOH, Reference 7

Detailed photographic and TV camera operations are covered in Reference 6, but are integrated herein in a summary manner.

This document contains summary and detailed timeline and procedures data. The voice data plan and copies of the crew's cuff checklist will be included in the final edition. The summary timelines are essentially a task flow analysis along a time base showing coincident activities and points of interaction between crewmen. The detailed timeline procedures simply list in the sequence of performance, the steps required to carry out each of the tasks identified in the summary timeline. It is in the detailed timeline procedures that the crew/equipment interfaces are revealed. Both the summary and detailed timeline procedures present the CDR's and the LMP's task side-by-side to minimize the confusion as to which crewman is doing what and to show how they cooperate in the lunar surface operations. The voice data plan will be provided coincident with the detailed timeline procedures as a device by which capcom (capsule communicator) is able to keep abreast of the crew's activities and to provide cap-com with cues, data and data recording points with which to provide realtime assistance to the lunar surface crew during the EVA activities. The crew's cuff checklists will be included for information only, showing the procedural cues the crew have at their fingertips.

The procedures herein are responsive to the Mission Requirements for SA-511/CSM-113/LM-11 J-2 Type Mission currently in effect as of the date of this document.

SECTION 2.0

MISSION PLAN

2.0 MISSION DESCRIPTION

The following information is taken from the "Mission Requirements, SA-511/CSM-113/LM-11 J-2 Type Mission, Lunar Landing," Change C, dated November 2, 1971, and its approved revisions.

2.1 MISSION OBJECTIVES

The following primary mission objectives have been assigned to this mission by the Office of Manned Space Flight (OMSF) in the Mission Implementation Plan (Reference 1):

1) Perform selenological inspection, survey, and sampling of materials and surface features in a pre-selected area of the Descartes region.

2) Emplace and activate surface experiments.

3) Conduct in-flight experiments and photographic tasks from lunar orbit.

Detailed objectives have been derived from the OMSF-assigned primary objectives, placed in order of priority, and detailed to the extent necessary for mission planning.

2.2 LUNAR SURFACE PRIORITIES

The detailed objectives and experiments are listed below in their order of priority. Accomplishment of the detailed objectives and detailed experiments planned for the lunar surface will not be jeopardized for the sake of those planned for lunar orbit or coasting flight.

Priority	Detailed Objectives and Experiments
	Lunar Surface
1	Documented Sample Collection at highest priority traverse station (Part of Lunar Geology Investigation)
2	Heat Flow (S-037) (Part of Apollo 16 ALSEP)
3	Lunar Surface Magnetometer (S-034) (Part of Apollo 16 ALSEP)
4	Passive Seismic (S-031) (Part of Apollo 16 ALSEP)
5	Active Seismic (S-033) (Part of Apollo 16 ALSEP)
6	Drill Core Sample Collection (Part of Lunar Geology Investigation)
7	Lunar Geology Investigation (S-059) (Portions other than priority items 1 and 6 above)
8	Far UV Camera/Spectroscope (S-201)
9	Solar Wind Composition
10	Soil Mechanics (S-200)
11	Portable Magnetometer (S-198)
12	Cosmic Ray Detector (Sheets) (S-152)

2.3 EVA REQUIREMENTS

The stay time on the lunar surface is open-ended and the planned maximum will not exceed approximately 73 hours. After checkout of the LM to assess its launch capability, the LM will be depressurized to allow egress of astronauts to the surface. The nominal plan will provide for three periods of simultaneous EVA by both astronauts. The first EVA period will be up to approximately 7 hours in duration and will be constrained by a maximum of 18 hours between the time of crew wake up on the day of landing to the time of repressurization after the first EVA period. The second and third EVA periods will be approximately 7 hours each in duration.

Traverse planning will provide for returning the crew to the LM under each of the following single-failure conditions.

> Use of the buddy-secondary life support system due to an inoperative PLSS anytime during a riding traverse (based on the assumption that the LRV will operate properly during the return to the LM).
>
> Use of two PLSS's for a walking return to the LM from an inoperative LRV anytime during a riding traverse (based on the assumption that both PLSS's will operate properly during the return to the LM).

Traverse planning will not be provided for dual failure conditions such as two PLSS failures or an LRV failure combined with a PLSS failure. ALSEP deployment operations will be accomplished during the first EVA as defined in the CSM/LM Spacecraft Operational Data Book, SNA-8-D-027, Vol. V, ALSEP Data Book, as revised by Appendix TBD for Apollo 16 ALSEP.

Television transmission will be provided as early as practicable during the EVA period. Television coverage will include an astronaut descending to the lunar surface, an external view of the landed LM, a panorama of distant terrain features and an astronaut conducting lunar surface activities. Television coverage will be provided by the GCTA during each science stop when using the LRV.

Photography will be employed throughout the EVA to document the activities and observations.

Figure 2.3-1 gives sun elevation and azimuth at the Descartes site as a function of date, GMT and GET. Table 2.3-1 gives earth and sun elevations and azimuths at the nominal EVA start times for this mission.

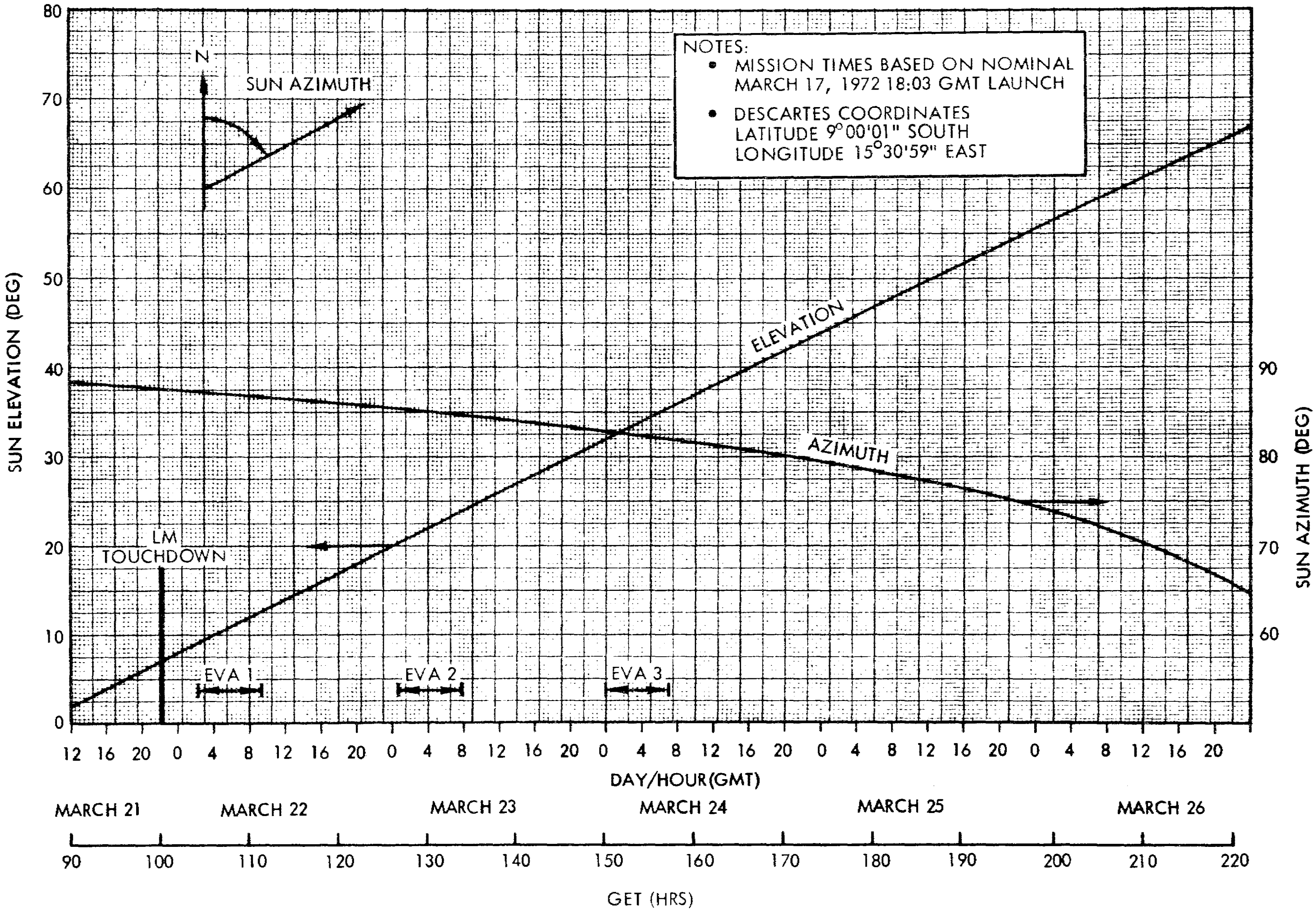


FIGURE 2.3-1: SUN ELEVATION AND AZIMUTH AT DESCARTES

START EVA	AZIMUTH		ELEVATION		EARTH CRESCENT SIZE
	EARTH	SUN	EARTH	SUN	
1	-59.5^{0}	87^{0}	79.5^{0}	8.5^{0}	49.5%
2	-52.5^{0}	85^{0}	78.5^{0}	20.5^{0}	38.5%
3	-47.5^{0}	82.5^{0}	77.5^{0}	32^{0}	29.0%

TABLE 2.3-1: EARTH/SUN AZIMUTH AND ELEVATIONS AT NOMINAL EVA START TIMES FOR DESCARTES

2.4 LANDING SITE DESCRIPTION

Descartes, the J-2 Mission landing area, is located in a highlands region lying in the southeastern portion of the moon. The landing area of interest lies to the southwest of the Mare Tranquillitatis, north of the Descartes Crater, and several hundred kilometers west northwest of the Theophilus Crater. The landing coordinates are 8°59'55" S latitude, 15°31'12" E longitude based upon preliminary Apollo 14 triangulation measurements.

The Descartes area is characterized by hilly, grooved, and furrowed terrain (Descartes Mountains) which appears to be morphologically similar to many terrestrial areas of volcanism. This area is also the site of an extensive development of highland plains material (Cayley formation), a geological unit of widespread occurrence in the lunar highlands.

This region is important to the lunar geologist since knowledge of the composition, age, and extent of magmatic differentiation in a highland volcanic complex is particularly important in understanding lunar volcanism and its contribution to the evolution of the lunar highlands. A comparison with similar mare complexes provides an evaluation of wide spectrum of lunar volcanic activity. An understanding of the composition and age of the highland plains material also adds to the knowledge of the processes which modify large areas of the lunar highlands.

2.5 DETAILED SCIENTIFIC OBJECTIVES OF THE DESCARTES REGION

The landing site for the J-2 Mission is the Descartes area of the moon. The relationship between the Descartes region and previous Apollo landing sites is shown in Figure 2.5-1. A more detailed view of the Descartes region is shown in Figure 2.5-2. The Descartes region lies in the lunar southern highlands and is unique in that it is the highest topographic region on the near side of the moon. Since no recognizable gravity anomalies are associated with this region, this mountainous plateau apparently must extend to a great depth to be isostatic.

The portion of the Descartes region which has been selected for the LM touchdown point and the synthesis of candidate traverse routes and activities is shown in Figure 2.5-3. This figure shows two other candidate landing points that were considered in the selection process. The selected landing point, Point 2, provides for the accomplishment of objectives associated with the Descartes landing site and is located at the coordinates of 15°31'12" E and 8°59'55" S based on preliminary triangulation measurements. The geological rationale for selection of this landing site is presented in the following paragraphs.

The lunar highlands appear to consist of three major types of deposits: (1) undivided pre-Imbrian materials and older degraded crater materials, (2) ejecta blankets composed of material ejected by the major basin-forming events, (e.g., Mare Imbrium formation) that are typified by the Apollo 14 Fra Mauro and Apollo 15 Apennine Mountains highland areas,and (3) volcanic constructional materials that are exemplified by the Descartes highland region, the Apollo 16 lunar landing site.

The Descartes area is an outstanding location to sample and study the petrochemistry of two volcanic constructional units of the lunar highlands: the Cayley formation unit* and the Kant Planteau unit, of which two separate and distinct portions are present.

Fresh craters of various sizes, also present within the candidate landing area, allow sampling of these highland units to varying depths. The mounded floors of craters within this landing area, up to 1 kilometer in diameter, suggest that a lower layer of unknown origin has been penetrated.

The Cayley formation unit is highland plains material consisting mostly of smooth to undulating terrain probably resulting from fluid volcanic flow rock and pyroclastic detritus. This unit is the largest single identifiable rock unit on the near side of the moon (covers 7 percent of near side surface) except for mare

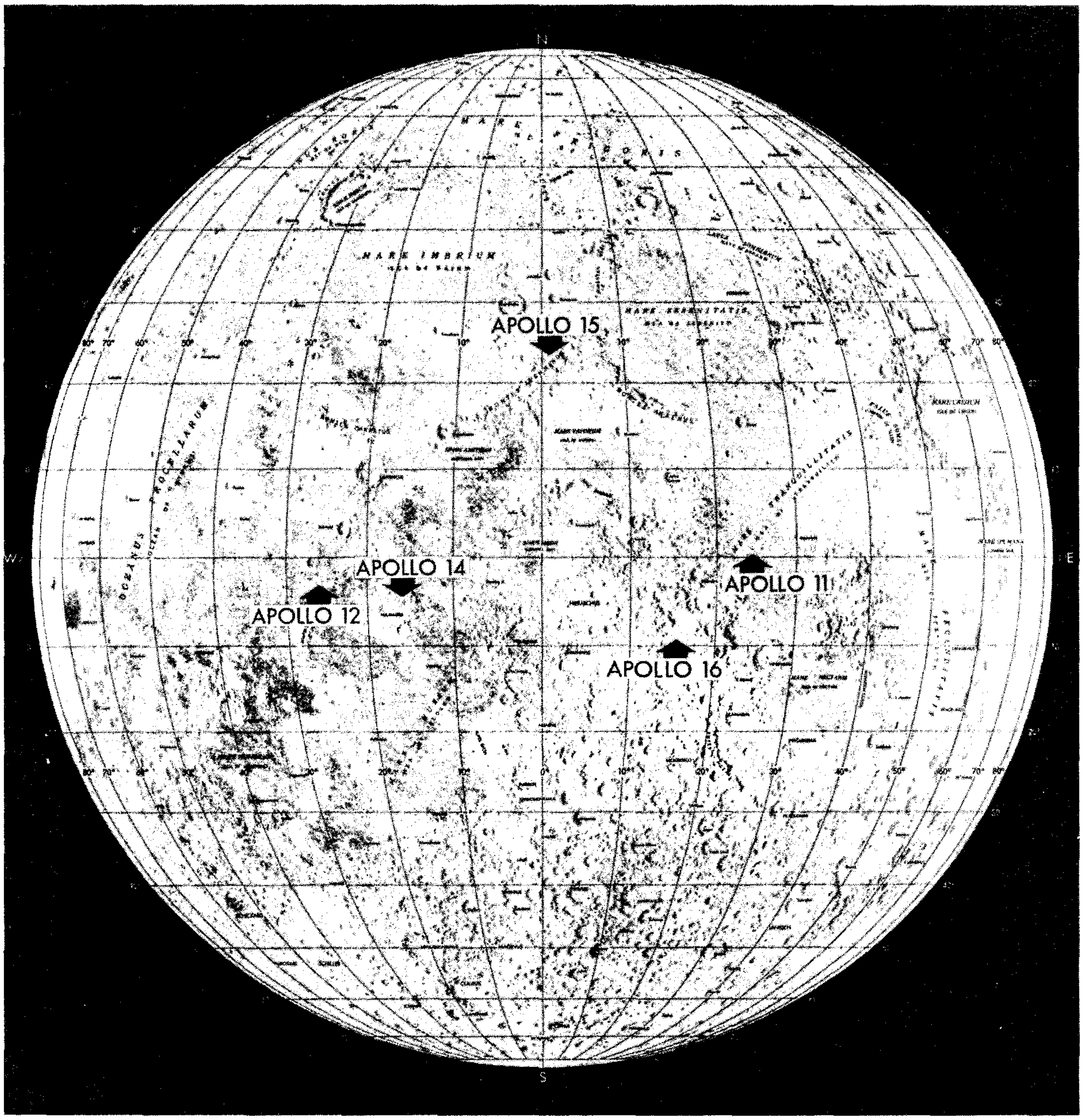


FIGURE 2.5-1 APOLLO 16 LANDING SITE

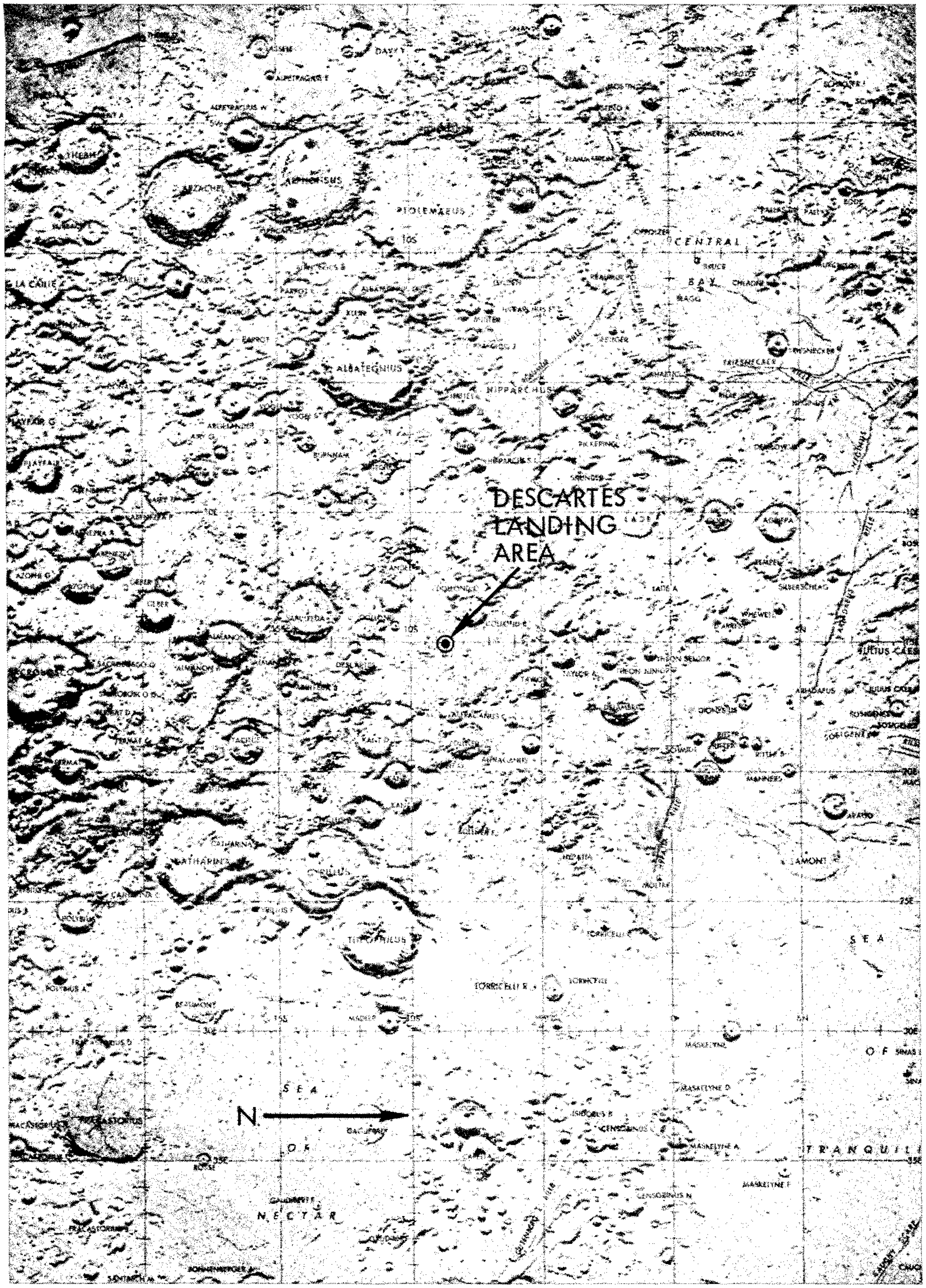


FIGURE 2.5-2 LM LANDING SITE IN THE DESCARTES AREA

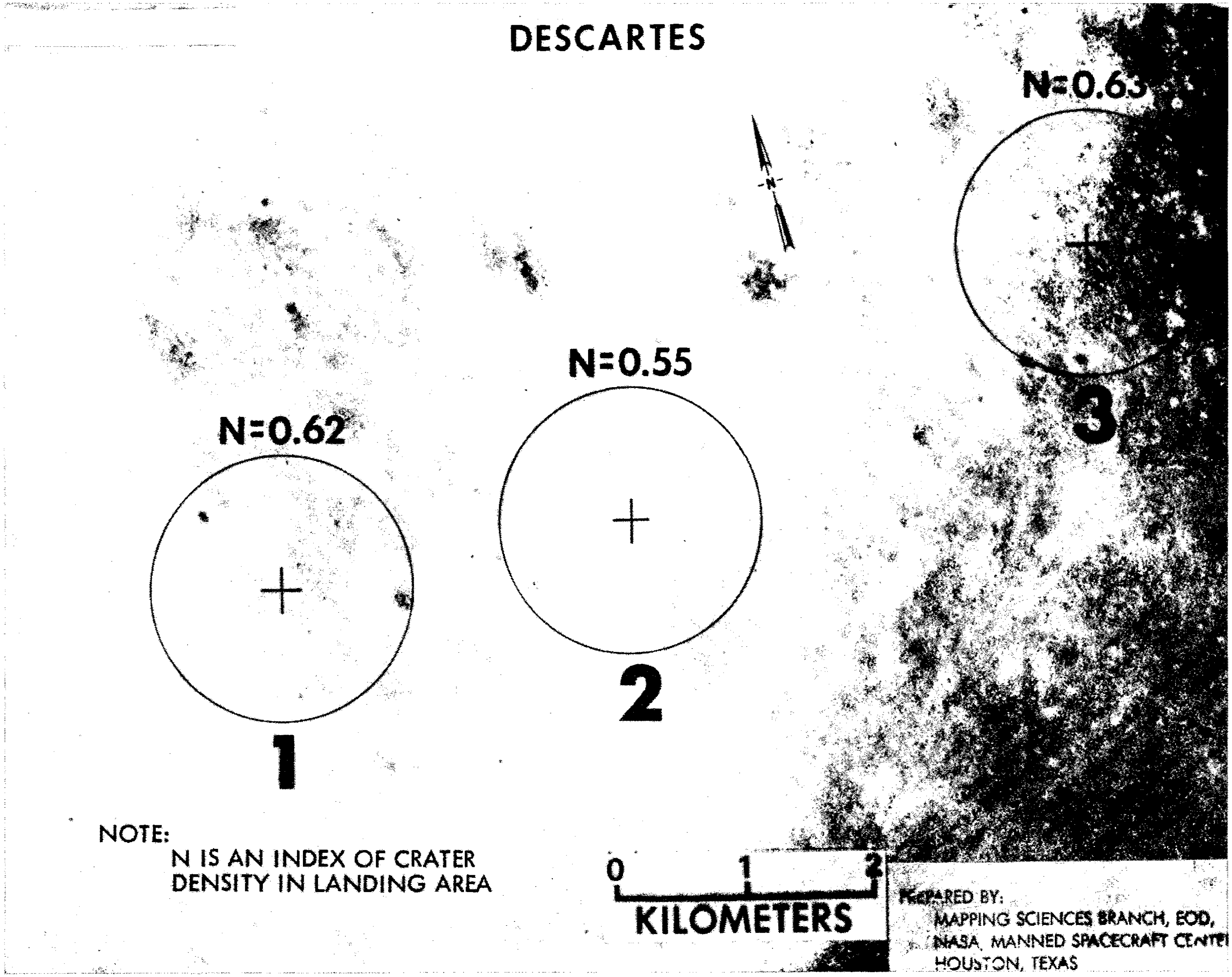


FIGURE 2.5-3 CANDIDATE LANDING POINTS IN DESCARTES REGION

regions. The Descartes Mountains (edge of Kant Plateau unit) are composed of hilly and furrowed highland plateau material that is probably the product of more viscous volcanic flow rock, pyroclastics, and their associated cones. This type of unit covers 4.3 percent of the near side of the moon. This landing site provides a unique opportunity to accomplish dating and other studies of the morphological evolution of young, bright-rayed craters. The geological information obtained can be applied to infer ages of other visible craters of apparently similar construction.

The specified geological features recommended for sampling in the proposed landing area (Figure 2.5-3) are as follows:

a) Cayley Plains which include young, bright-rayed craters (North Ray, South Ray)

b) South Descartes Mountains (Stone Mountain)

c) North Descartes Mountains (Smokey Mountains)

d) Subdued craters and crater chains

*The Cayley formation unit and Cayley Plains are used as interchangeable terms in this section. Cayley formation is a general geological term whereas Cayley Plains is associated with the Cayley formation unit peculiar to the Descartes landing site.

2.5.1 Cayley Plains (North Ray, South Ray)

Since the proposed landing area is on the smooth phase of this unit, LM vicinity samples will provide material of this unit. Bright-rayed craters of sizes up to 1 kilometer in diameter penetrate this unit, and would permit selective sampling to a depth of about 200 meters.

Exposed in the east wall of the bright-rayed North Ray Crater (Figure 2.5-4) and recognizable as a scarp-forming unit to the south and east of the crater is the youngest stratigraphic unit of the Cayley formation. In addition, a lower stratigraphic layer lying approximately 150 to 200 meters below the present surface is indicated by mounds in the floors of all craters of about 1 kilometer in diameter. Speculations as to the origin of this lower layer include: another type of Cayley constructional unit; Imbrium basin ejecta; Nectaris basin ejecta; or pre-Imbrium local source material. Detailed sampling should provide the correct answer. Crater rim sampling alone should determine if pre-Imbrium material is present or not.

Excellent samples of the Cayley Plains would be provided by radial sampling of the bright rays emanating from North Ray and South Ray Craters (Figure 2.5-4). Investigations should also be made of the seemingly rimless craters in this area and of the one very dark crater west of the selected landing point.

2.5.2 South Descartes Mountains (Stone Mountain)

These hills form the north edge of a bright, hilly, and furrowed unit that extends southward 100 kilometers to the crater Descartes and eastward 50 kilometers across the Kant Plateau. The Kant Plateau unit is recognizable at several highland areas on the near side of the moon and becomes more prevalent on the far side. This unit appears to have been formed of very viscous lava, morphologically the opposite of mare lava. Samples from these hills will provide material from a large regional highland volcanic unit, the Kant Plateau.

2.5.3 North Descartes Mountains (Smokey Mountains)

This feature might be a pre-Imbrium crater wall although it is more probably a volcanic constructional form. Sampling would establish whether ancient breccias are present from a different region of the moon or if these hills are just another area of highland volcanics. Samples supporting either hypothesis would

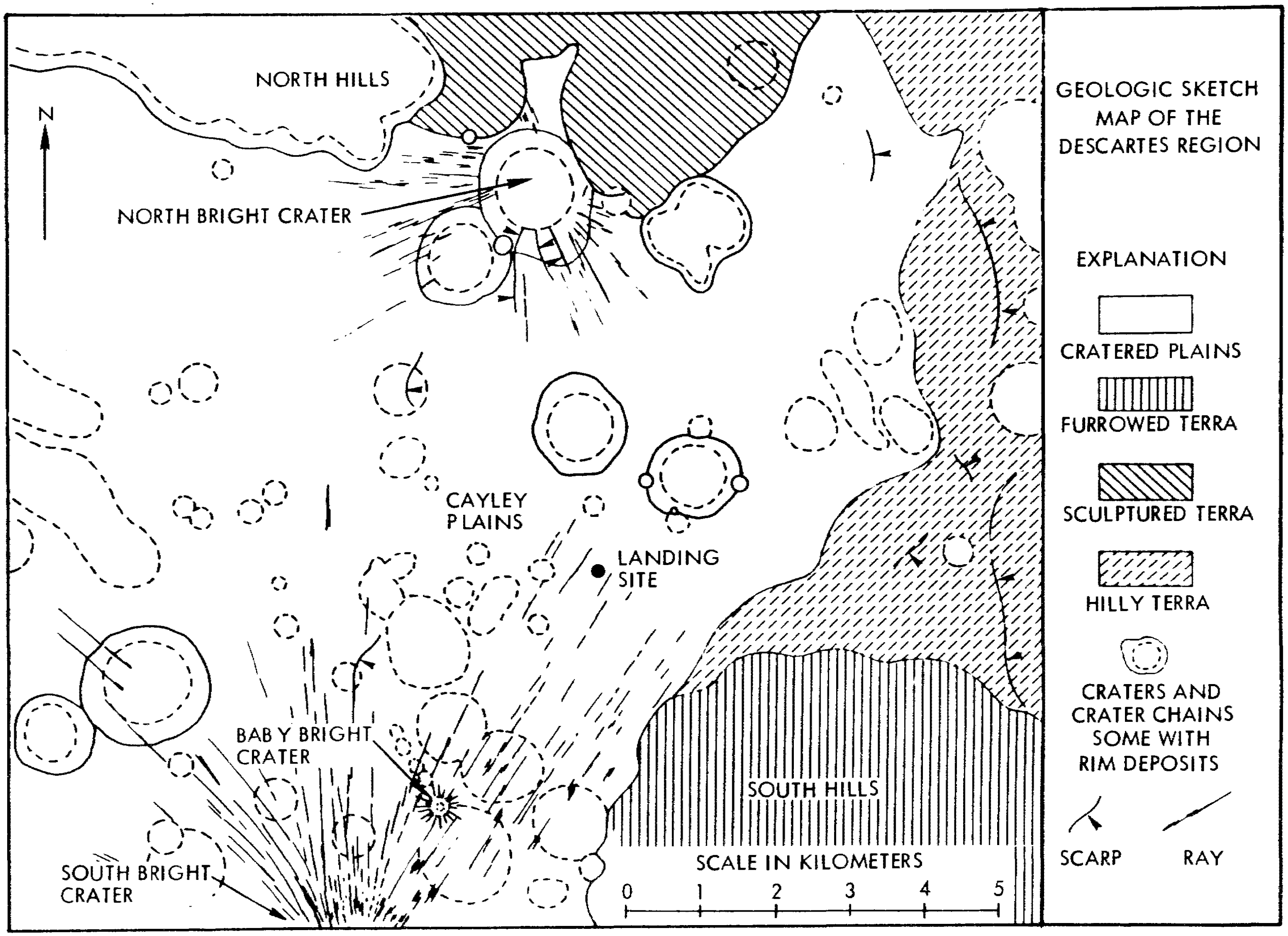


FIGURE 2.5-4 GEOLOGIC UNITS IN DESCARTES LANDING AREA

afford valuable data. A desirable area to sample this unit would be a large crater at the south base of these hills.

2.5.4 Subdued Craters and Crater Chains

A number of craters and crater chains, marginally accessible from the proposed landing area, appear to be the result of ejecta from the crater Theophilus (or possibly Cryillus). The largest group close to the landing area is west of the North Hills. The morphology of this crater type will aid in understanding the details of formation of large secondary craters and their rate of degradation. The deepest samples of Cayley formation might be collected from the rim.

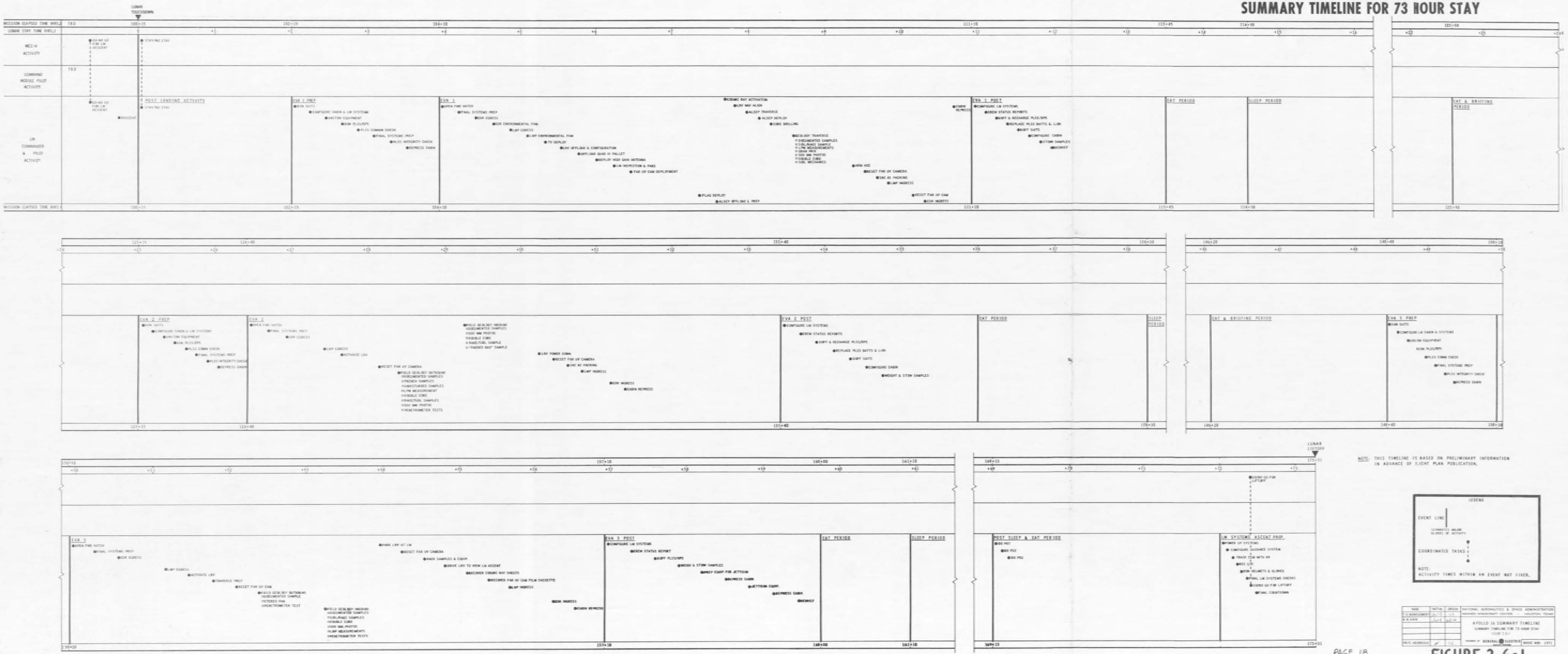
A small group of irregular craters east of North Ray Crater and against the base of North Hills are either primary impact craters or a secondary crater chain similar to those farther west. It is desirable that these craters be observed and sampled, although the three previous units are more important from the standpoint of lunar geology studies.

2.6 LUNAR SURFACE ACTIVITY FOR 73 HOUR STAY

The nominal plan is for the Commander and the Lunar Module Pilot to remain on the lunar surface for approximately 73 hours. A summary time-line for the lunar surface stay is presented in Figure 2.6-1.

Table 2.6-1 lists the loose equipment which the Apollo 16 crew will leave behind on the lunar surface, divided as to EVA in which this gear is abandoned. Table 2.6-2 lists the gear which is transferred by the crew between the ascent and the descent stage of the LM during lunar surface operations. The data of Table 2.6-2 is supplemented by explanatory diagrams in Section 3.5 of this document.

APOLLO 16 LUNAR SURFACE ACTIVITY SUMMARY TIMELINE FOR 73 HOUR STAY



NOTE: THIS TIMELINE IS BASED ON PRELIMINARY INFORMATION IN ADVANCE OF FLIGHT PLAN PUBLICATION.

LEGEND

EVENT LINE — SEPARATES MAJOR BLOCKS OF ACTIVITY

COORDINATED TASKS

NOTE: ACTIVITY TIMES WITHIN AN EVENT NOT FIXED.

NATIONAL AERONAUTICS & SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER — HOUSTON, TEXAS

APOLLO 16 SUMMARY TIMELINE
SUMMARY TIMELINE FOR 73 HOUR STAY

PREPARED BY GENERAL ELECTRIC

BASIC NOV. 1971

FIGURE 2.6-1

TABLE 2.6-1 LOOSE EQUIPMENT LEFT ON LUNAR SURFACE

1. Jettison During EVA-1: (In a Jettison Bag)
   2 OPS Pallets
   3 Arm rests
   Camera Bag & padding
   500 mm Cam Reseau Cover

2. Discarded On Lunar Surface During EVA-1
   Misc Pip Pins and Fastenings
   Thermal Covers
   TV Camera Bracket
   ALSEP RTG Dome Removal Tool and Fuel Transfer Tool
   PSE Girdle
   ALSEP Subpallet
   Lunar Surface Drill, Treadle and Rack
   LEC Bag
   TV Tripod
   LCRU/GTCA Pallet
   Pallet 1
   SRC Dust Skirt and Seal Protector
   Bore/Core stems bag

3. Operational Equipment Deployed and Left On EVA-1
   Flag
   TV Camera
   LRV
   ALSEP: PSE, LSM, HFE, ASE
   SWC
   UV Camera

4. Jettison During EVA-2 (In BSLSS Bag)
   1 LM ECS LiOH Cartridge and Canister

   2 PLSS Batteries
   2 PLSS LiOH Cartridges and Canisters

5. Discarded on Lunar Surface During EVA-2
   EVA-2 Pallet
   1 Core Tube Cap Dispenser
   SRC Dust Skirt and Seal Protector

6. Jettisoned During EVA-3 (In Jettison Bag)
   2 PLSS Batteries
   2 PLSS LiOH Cartridges and Canisters
   1 LM LiOH Canister and Canister
   2 LCG

7. <u>Discarded on Lunar Surface During EVA-3</u>

LRV w/GCTA, LCRU, QUAD III Pallet, 2-LCRU Batteries
Hand Tool Carrier w/tools
Penetrometer (less drum)
Lunar Hand Tools
Gnomon
Polarizing Filter
2 70mm Data Camera w/Bracket, Handle, Trigger
16mm Lunar Data Acquisition Camera Assy w/staff
Lunar Equipment Conveyor
500mm lens Camera
SWC Staff
2 lens Brushes
BSLSS
Dust Brush
Unused Documented Sample Bags
Reseau Plate Cover

8. <u>Jettisoned to Lunar Surface After EVA-3 (In Jettison Bag)</u>

2 pr Lunar Boots
2 PLSS
2 ICG
2 Hammocks
Sleep Restraint
2 RCU
Waste Receptacle
Helmet/EVA Int. Stow.
ETB
2 LCG Adapters
Retractable Tethers
ISS
1 Armrest

TABLE 2.6-2 EQUIPMENT TRANSFERRED BETWEEN ASCENT STAGE/SURFACE/ASCENT STAGE

1. Transferred to Surface EVA-1
   - ETB and contents
   - Map holder w/lunar surface maps, LRV cklist and Sun Compass
   - 3-70mm mags
   - 3-16mm mags
   - 500mm lens camera w/lens and Mag
   - 1-70mm camera w/mag
   - BSLSS
   - Bag Dispenser Brkt
   - 2 Lens Brush

   Empty EVA-1 Pallet

2. Transferred into Ascent Stage EVA-1
   - EVA-1 pallet
   - SCB
   - SCB
   - SRC #1
   - ETB and contents
     - Lunar surface maps
     - 2-70mm mags
     - 3-16mm mags
     - Mag from 500mm lens camera
     - 2-70mm cameras w/mags

3. Transferred to surface EVA-2
   - ETB and contents
     - Lunar surface maps
     - 2-70mm mags
     - 3-16mm mags
     - Mag for 500mm lens camera
     - 2-70mm cameras w/mags

   Empty EVA-2 pallet

4. Transferred into Ascent Stage EVA-2
   - EVA 2 pallet w/ECS LiOH canister
   - SCB
   - SCB
   - SRC #2
   - ETB and contents
     - Lunar surface maps
     - 2-70mm mags
     - 3-16mm mags
     - Mag from 500mm lens camera
     - 2-70mm cameras w/mags

5. <u>Transferred to surface EVA-3</u>
ETB and contents
Lunar surface maps
2-70mm mags
2-16mm mags (or all unused)
Mag for 500mm lens camera
2-70mm cameras w/mags (Polarizing Filter on CDR Camers)

6. <u>Transferred into Ascent Stage EVA-3</u>
SCB
SCB
BSLSS Sample Bag (Big Rock Bag)
ETB and contents
Lunar surface maps
4-70mm mags
2-16mm mags
Mag from 500mm lens camera
Solar Wind Composition (bagged)
1-70mm mag
Cosmic Ray Sheets (in bag)
UV Camera film cassette

SECTION 3.0

NOMINAL LUNAR EVA

3.0 NOMINAL LUNAR SURFACE EVA

3.1 EVA GENERAL DESCRIPTION

On Apollo 16, the CDR and LMP will spend 73 hours on the lunar surface at the Descartes site, of which as many as 21 hours will be spent in actual EVA activities. There will be three 7-hour EVA's, scheduled as shown in Figure 2.6-1. ,the summary timeline for the 73 hour total stay period. The EVA periods are separated by periods of LM cabin activity for housekeeping, nutrition, and sleeping.

Figure 3.1-1 gives the summary timeline for EVA 1, Figure 3.1-5 for EVA 2, and Figure 3.1-6 for EVA 3.

3.1.1 EVA 1

EVA 1 commences a little more than four hours after touchdown at Descartes. The crew has described the general lunar scene as they see it from the windows of the LM (the nominal landing yaw orientation is +Z axis pointing due west), gone through systems checks, had a light snack, and are prepared to embark on their first EVA, equipped with their Extravehicular Mobility Units comprising their spacesuits, life support, communications, sun visors, and boots.

EVA 1 features ALSEP deployment, and a modicum of geological - geophysical investigation, westerly to Spook and Flag Craters.

The CDR egresses first, bringing out a jettison bag filled with expended gear. This he drops, then pulls a lanyard to deploy the MESA (Modularized Equipment Stowage Assembly), Figure 3.1-3, and descends to the lunar surface. He has a bag of cameras and film magazines with him as he descends.

After a brief time of familiarization to the surface conditions, the CDR proceeds to place the color TV (which has been viewing him from the MESA) on a tripod some distance away (see Figure 3.1-4).

The LMP egresses soon after the CDR. He also spends some time acclimating to lunar 1/6 G conditions, then unloads the lunar drill and its boring and coring equipment from the MESA.

The two crewmen then tackle LRV (Lunar Roving Vehicle) unloading and set up. This process is shown in Figure 3.1-2. The LRV comes out of the side (Quad I) of the LM like a folding bed. The two crewmen complete the unfolding and preparation of the LRV, following which the CDR does a system checkout,

APOLLO 16 SUMMARY TIME LINE

LUNAR SURFACE NOMINAL EVA 1

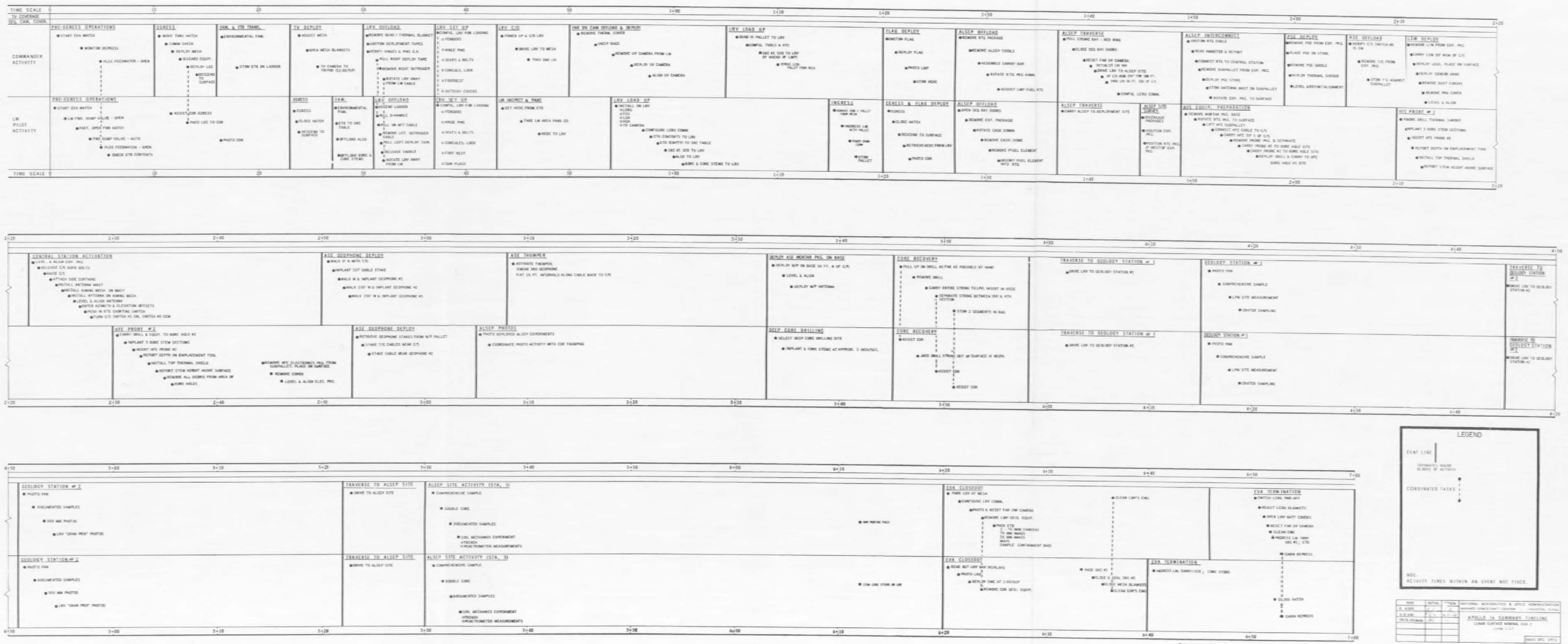
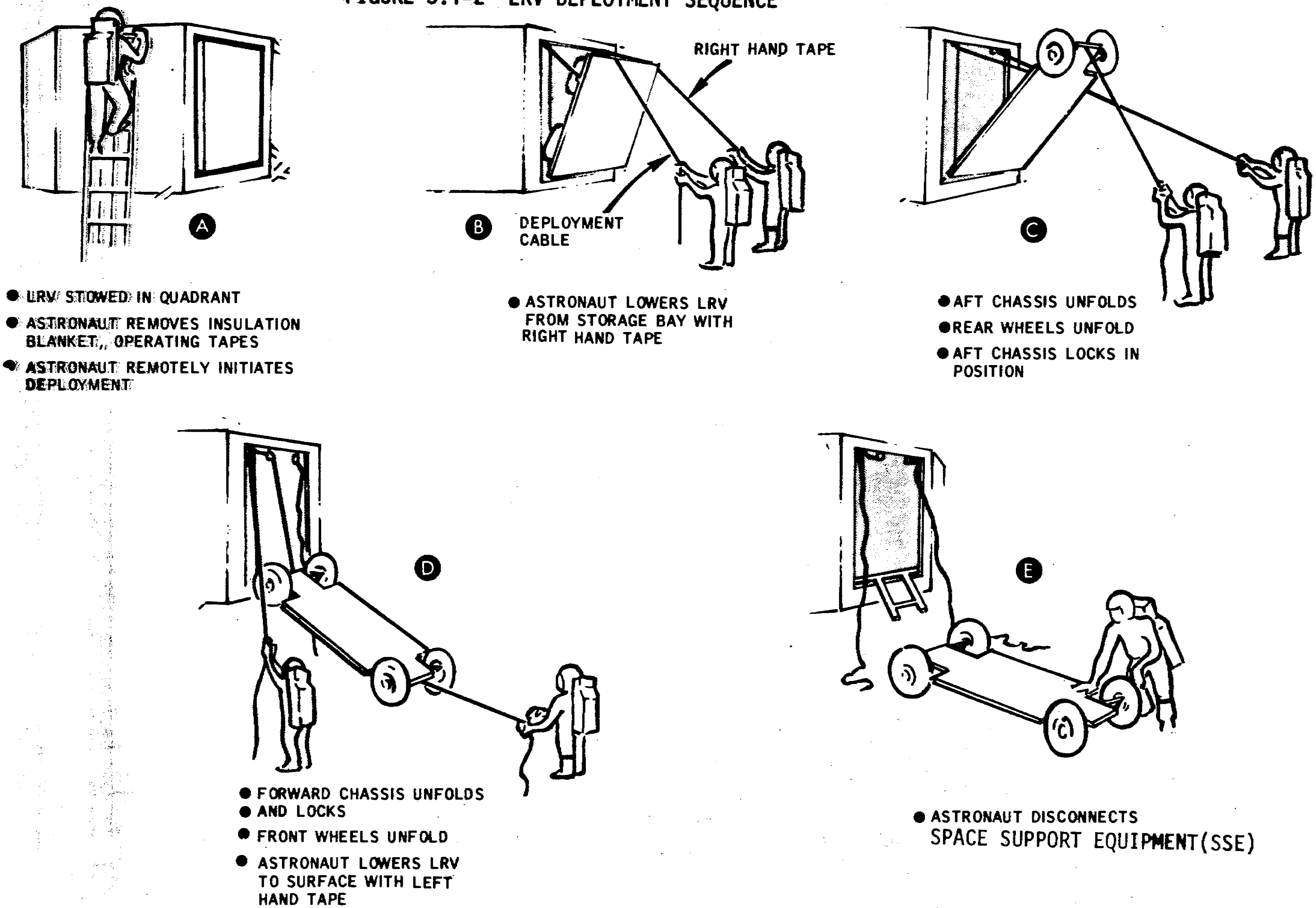


FIGURE 3.1-1

FIGURE 3.1-2 LRV DEPLOYMENT SEQUENCE



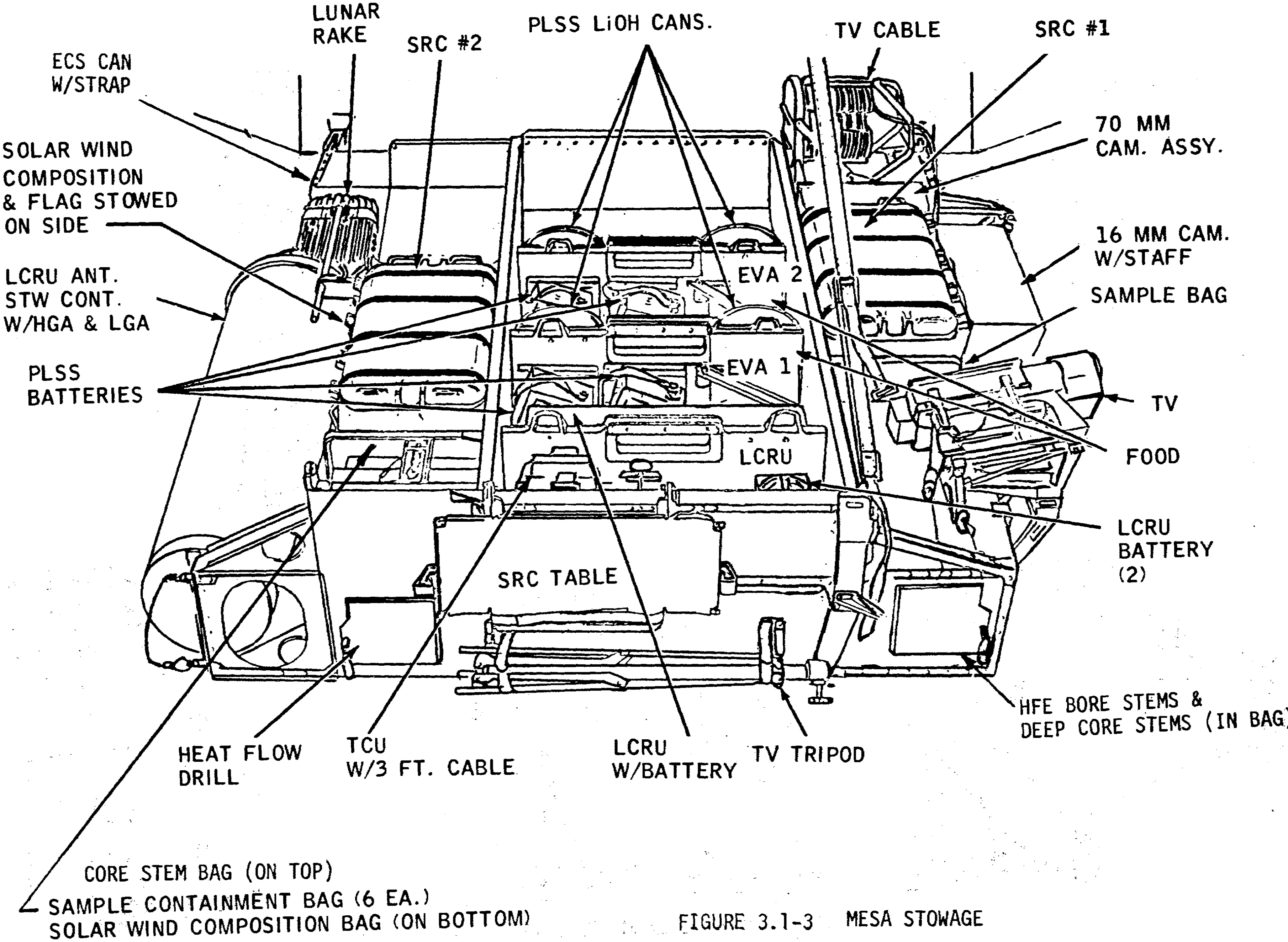


FIGURE 3.1-3 MESA STOWAGE

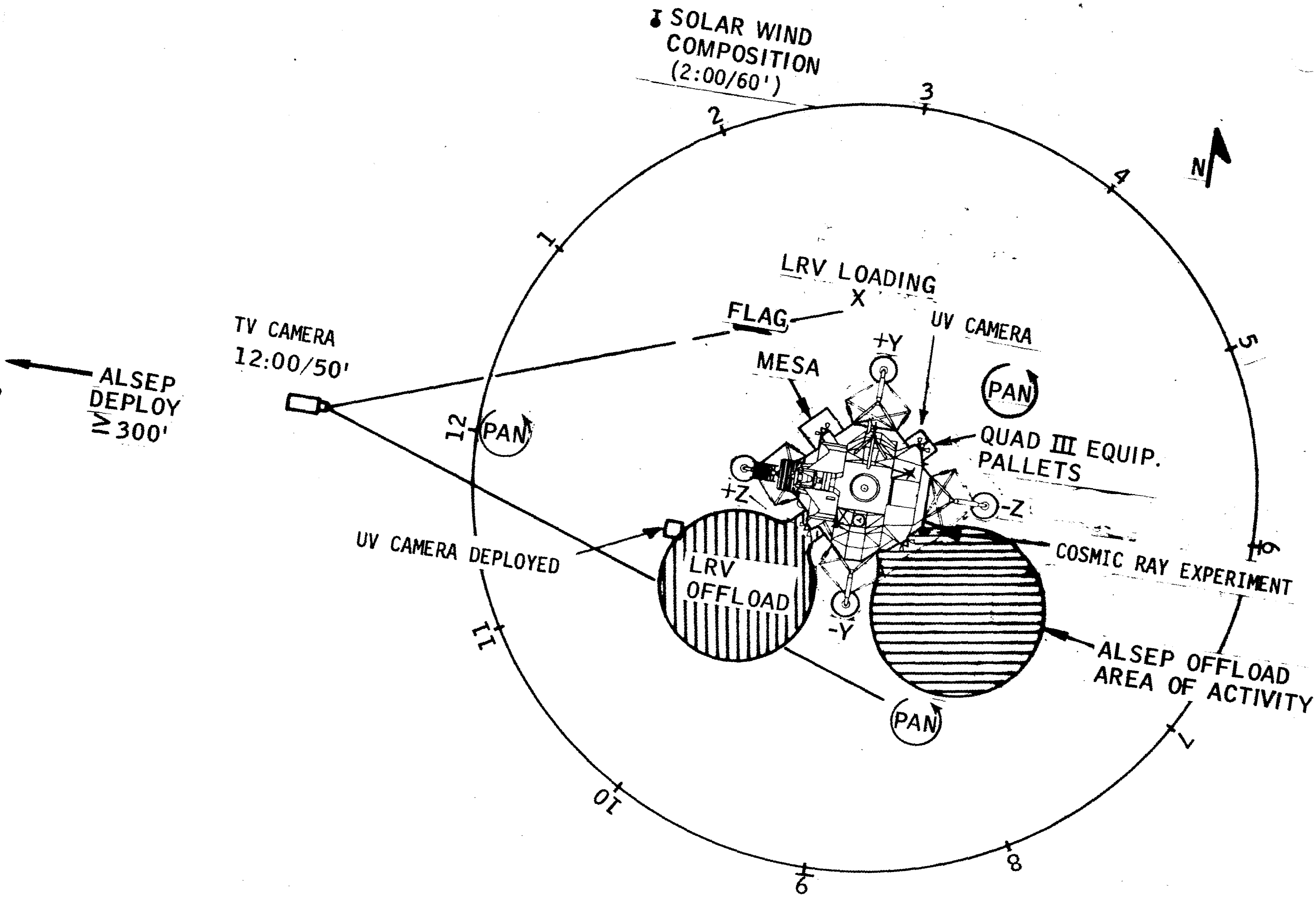


FIGURE 3.1-4 PROBABLE AREAS FOR NEAR LM LUNAR SURFACE ACTIVIT

and takes a short spin around the LM to the vicinity of the MESA. The LMP performs a LM walkaround and photographic documentation of the spacecraft as it is situated.

As soon as the CDR has satisfied himself that all is in order with the LRV, and has parked it by the MESA, he goes to the side of the spacecraft known as Quad III (see figure 3.1-2) and takes out the Far UV (Lyman-Alpha) Camera, a miniature astronomical observatory. See Figure 3.4-22 through -24 for a description of this experiment. The camera, essentially a Schmidt camera and spectrograph, is set up on tripod legs in the shadow of the LM not far from where the LRV was deployed. At appropriate times during the next 20 hours of surface EVA time, the CDR will return to this camera to select a new, pre-designated target.

The LMP has been busy during this period setting up the LRV communication and TV system. This comprises the LCRU (Lunar Communications Relay Unit), the GCTA (Ground Controlled Television Assembly), the color TV itself, which is moved from its tripod to a post atop the GCTA in the front of the LRV, and the two antennas, the helical low gain antenna, and the dish-shaped high gain antenna. This communications array is shown in Figure 3.5-1. The LMP gets all of the requisite components out of their stowage on the MESA, installs and interconnects them.

From this point on, the TV system is controlled by MCC.

The LMP then unloads the magazines and maps, other gear out of the bag the CDR brought down to the surface with him. He also takes two cameras off the MESA, one the CDR's 70mm data camera, and the other the 16mm motion picture camera.

Finally, he takes a metal sample stowage container, a SRC (Sample Return Container) from the MESA, opens it, and takes out a bag of sampling supplies. The details of this bag and its contents, as well as the other bags' contents can be found in Section 3.5 of this document.

The CDR participates in LRV load up by taking a pallet full of tools and geological supplies from Quad III and placing it on the aft end of the LRV. He then assists the LMP in completing the MESA and bag unloading chores.

The LMP takes a supply pallet out of the MESA, re-enters the ascent stage to switch the LM communications system to low power (now the LRV system is functional) and regains the surface.

Following a flag deployment ceremony, the crew proceeds around the LM to Quad II and ALSEP offload. This process is depicted in Figures 3.4-1 through -8. The 2 packages are taken out of the quad, and the LMP transfers a radio active fuel capsule to the radio-isothermal generator unit on one of the packages that will ultimately power the entire ALSEP.

The LMP picks up the two packages bar-bell fashion, and moves out to the designated ALSEP deployment area, some 100 meters west of the LM. The CDR retargets the Far UV camera and shifts some sheets inside a cosmic ray experiment being on the side of Quad II. (See Figure 3.4-25.)

He mounts the LRV and drives out to the ALSEP site.

On arriving at the site, he receives an MCC advisal on the correct direction in which to lay out the geophone line (part of ALSEP). This line is nominally West or down-sun (azimuth of the sun is about 85-1/2° at this time), but the line must be set up so as to facilitate pick up of LM ascent, and avoid the possibility of the grenades' (also part of ALSEP) firing into large craters, since the mortar box is set up to fix parallel to the geophone line of deployment. The CDR drives 100 meters along the required heading using the navigation system (see Section 3.7) to lay out a track to follow in deploying the geophone line.

He returns to the ALSEP site, where the LMP is beginning to set up the ALSEP packages, and parks 60 feet south of the central station of ALSEP and on a heading NNE, or about 015°, for good TV coverage.

He dusts the communication system, and joins the LMP to deploy ALSEP.

In general, the CDR is responsible for deploying all experiments in ALSEP, except the HFE (Heat Flow Experiment). The LMP takes charge of the HFE and the drilling operations that are required to emplace the HFE.

The CDR deploys the PSE (Passive Seismic Experiment), the ASE (Active Seismic Experiment) and the LSM (Lunar Surface Magnetometer). The PSE is a sombrero-shaped package of seismographs which has been carried on all lunar landings to date. Refer to Section 3.4 for more data on these experiments.

The ASE comprises three distinct parts: a mortar package which contains 4 grenades which are planned to be fired long after the crew leaves the surface; a thumper device which has 19 charges (like dynamite caps) to induce artificial local "quakes," and (on the same frame as the thumper) an array of three geophones to be implanted along a 100 meter distance, at spaces of 50 meters. The ASE was flown on Apollo 14.

The LSM is an array of magnetometers also flown on Apollo 12 and 15. Some more details of these experiments can be found in Section 3.4.

The deployment layout is given in Figures 3.4-2 and -3.

The LMP takes a subpallet containing the HFE south 30 feet from the ALSEP central station, after connecting the experiment to the station. He goes through a preliminary layout and then readies the ALSD (Apollo Lunar Surface Drill) for implantation of the two 2.5 meter bore strings required.

The ALSD is an improved version of the system that was used on Apollo 15. Each string consists of 3 sections, an initial 1.37 meter section, and two 0.71 meter sections. These screw together, and the drill is decoupled to add additional sections by using a special wrench.

After each hole is drilled and the bore stems are in the ground, a set of HFE thermocouple heater probes are emplaced using a special long tool. The final configuration of this experiment is shown in Figures 3.4-19 and 20.

The CDR, by this time, has completed laying out the PSE, the LSM, readying the ASE, and unfolding as well as activating the Central Station. The ALSEP is on the air. As a team, then, the CDR and LMP deploy the geophones. The CDR walks along the line he previously laid out with the LRV, and carries the spool-laden thumper. He unreels the geophone line, plus a power line back to the central station. The LMP follows along behind, stakes the lines down, and implants two of the three geophones as they unroll out of the thumper. The CDR takes care of the third and last geophone.

The LMP takes a series of documentation photos of ALSEP (see Figure 3.3.1) during the thumping experiment.

The CDR performs the thumping experiment. Every 15 feet he pauses at a white mark on the geophone line, and fires a charge, which is picked up and transmitted by the ALSEP geophones and system to earth. This yields valuable seismologic information to the ASE scientific investigations.

Following this experiment, the CDR deploys the mortar package on a special base nearly 17 meters distant to the NNE. The LMP gets ready to drill a core sample.

The core sample utilizes the same drill system as the HFE, and is very similar to that used on Apollo 15. The chief addition to the system is a jack, or core extractor to save time and energy in removing the core once the sample is taken. The LMP couples titanium fluted core stems together, to take a sample 2.5 meters deep.

Both crewmen get the core out of the lunar surface, then break the core in two sections, cap, and stow the sections nearby for later pickup.

With this operation, the ALSEP and related procedures are closed out, and the crew gets ready for geological investigation. They don some tools and sample bags (they have special tool carriers on their life support packs (PLSS's for this). They then mount the LRV and make for Station 1, "Flag" Crater.

The reader is referred to Section 3.6 for details on crew objectives and activities at Station 1, and all other traverse stations on the three EVA's. Suffice it to say here that they spend 30 minutes at Station 1 doing sampling, taking a comprehensive sample (rake and soil) and a Lunar Portable Magnetometer reading. This last device was carried on Apollo 14. It measures local magnetic fluxes, and is more fully described in Section 3.5. The experiment consists of a tripod - mounted sensor, a reel with cable, and an electronics/ readout device, all mounted or stowed on the LRV geopallet (see Figure 3.5-1).

At Station 2, the crew does more sampling, takes some telephoto photographs with their 500mm lens camera, and performs an LRV experiment dubbed the "Gran Prix," the Gran Prix consists of one crewman driving the LRV in a series of stops, starts, and acceleration runs, in road test fashion, while the other man makes a four-minute movie of the proceedings. Station 2 consumes 31 minutes.

The two crewmen return to a spot roughly half-way between ALSEP and LM to do a soil mechanics experiment, as well as take a double core sample, also a comprehensive sample. This final station, Station 3, takes 50 minutes. At the conclusion of this station, the crew picks up the drill core sample, and arms the mortar package.

The crew returns to the LM at six hours and twenty minutes into the EVA. The LRV is parked in the sun headed north (for thermal reasons) and powered down. The communications gear and batteries are dusted, then the CDR resets the Far UV Camera for its next target.

The LMP deploys the Solar Composition Experiment, which has flown on all Apollo missions. This is an aluminum and platinum window shade on a pole.

The two men unpack the tools and sample bags from each other's PLSS carriers, then pack up the cameras and film magazines. They leave the telephoto camera and the motion picture camera on the LRV between EVA's. The SRC is packed with the bag that came out of it, now filled with samples, filled core tubes, and rocks.

The LMP and CDR dust each other off, and the LMP takes a sample bag and the core stems up to the ascent stage. He ingresses the LM. The CDR retargets the Far UV camera for its between-LM pictures, and shuts down the LRV communication system. He transfers the SRC and the bag of cameras and magazines up to the LM "porch," hands them in to the LMP, and finally ingresses the spacecraft.

The hatch is closed and repressurization initiated to end the first EVA.

3.1.2 EVA 2

EVA 2 (see Figure 3.1-5) begins with depressurization of the cabin, followed by egress of the CDR, who drops the customary bag of discarded gear to the surface. He descends to the surface, bearing the ETB, and activates the television system on the front of the LRV. The LMP follows the CDR soon afterwards, As soon as the TV is up, the CDR resets the FAR UV Camera to a new target for the duration of the pretraverse activities.

Both crewmen load up for the traverse. The LMP gets out the second SRC (Sample Return Container) while the CDR unpacks the cameras and magazines, together with the map package for EVA 2. The LMP is loaded with the hammer, core tube rammer, core caps, and a sample bag. Some of the contents of the SRC bag are relocated to another, similar bag for use in EVA 3; the latter bag is stowed under the LMP seat. The SRC bag with its remaining gear, which comprises core tubes, a special core tube vacuum container, and a smaller vacuum container is stowed on the CDR's PLSS.

Packs of small teflon sample bags from the SRC bag are affixed to each of the crewmen's data cameras.

After a final check that all supplies and tools are in place on the LRV or on the crewmens' back packs, the Far UV Camera is again retargeted. The crew mounts the LRV and initializes the navigation system. Then they depart, some fifty minutes after depressurization, for Station 4, and the excursion to Stone Mountain, "Stubby" and Wreck" Crater.

For details on the EVA 2 traverse, see Section 3.6.

At 20 minutes past the sixth hour of EVA 2, the crew returns to the LM for closeout. The LRV is parked, as it was on EVA 1, cross-sun in the sun facing north, not far from the MESA. As has been done at every stop during the traverse, the communication gear is thoroughly dusted. Also, the LRV battery thermal surfaces are dusted at closeout.

The LMP does this chore while the CDR retargets the Far UV Camera, following which the two men unload their PLSS tool carriers. The SRC bag, now filled with samples, core tube samples, and the two filled vacuum containers, is replaced in the SRC and the SRC made ready for transit into the ascent stage. Other bags with samples are off loaded for later

APOLLO 16 SUMMARY TIMELINE

LUNAR SURFACE NOMINAL EVA 2

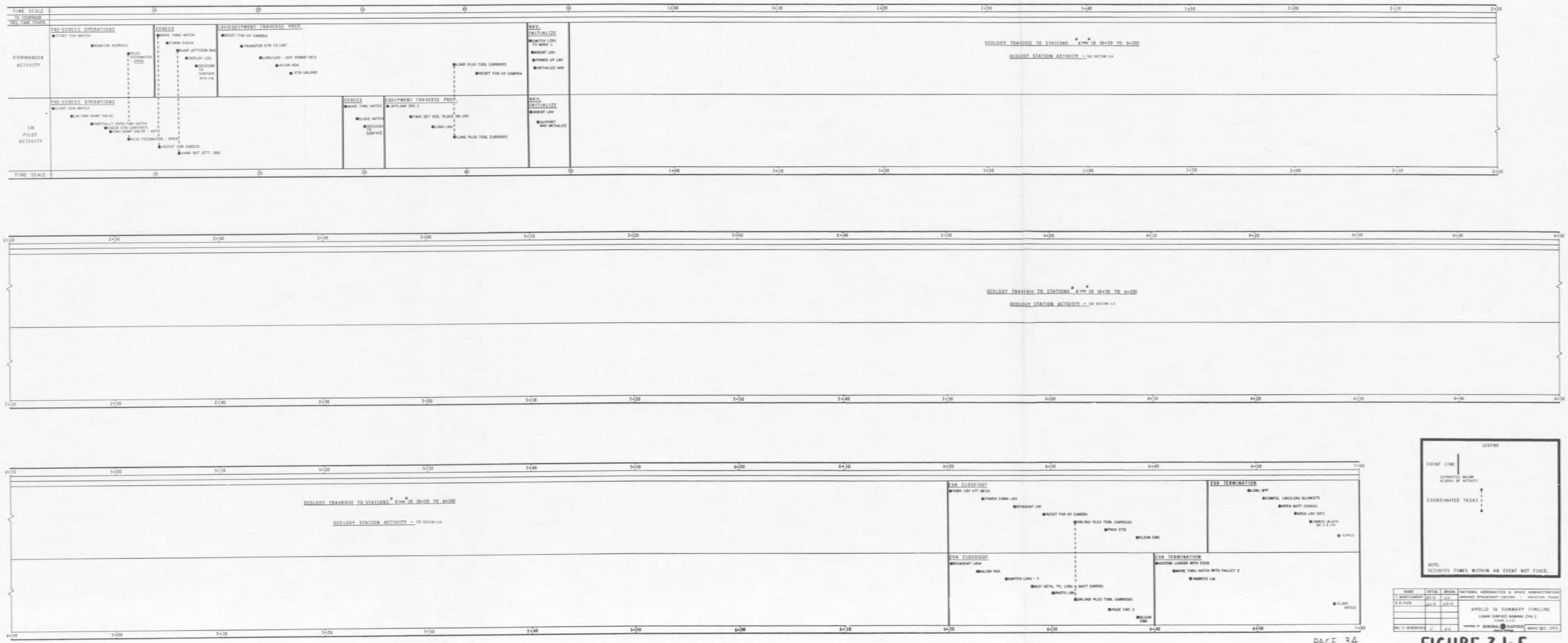


FIGURE 3.1-5

transfer. Finally, the hand tools go back on the hand tool carriers on the back of the LRV.

The BSLSS Sample Return bag ("Big Rock Bag") stays on the LRV. By this time, it might be almost 1/2 full of large rocks which have been documented and collected by the crew.

The CDR and LMP clean each other off, and the LMP ingresses the LM with sample bag(s). He also carries in supply pallet no. 2 from the MESA, in which he has installed the spare spacecraft LiOH canister.

The CDR lingers to retarget the Far UV Camera and turns off the LCRU then climbs the ladder with the SRC in hand. He receives the stripped pallet 2 in exchange for the SRC when he reaches the platform on "porch" of the LM. The pallet is dropped, then the CDR pulls up the cameras and magazines in their bag by means of a short tether he attached while on the surface. This bag he hands in to the LMP, then he moves through the hatch. Repressurization is initiated to terminate EVA 2.

3.1.3 EVA 3

EVA 3 begins with depressurization of the cabin, after which the CDR descends to the surface laden with the camera bag. See Figure 3.5-6 for a general timeline of these activities. He immediately retargets the Far UV Camera, while the LMP egresses and descends to the surface, the LMP unpacks the camera/magazine bag as his next task, as the CDR brings the communications systems to life. As part of this task, he changes the LCRU battery. Then the crewmen load each other's PLSS tool harnesses. The CDR places the "spare" sample collection bag (stowed with geological supplies under the LMP seat on EVA 2) on the LMP, together with the usual tools from the LRV. The LMP in turn, puts an extra sample collection bag on the CDR.

The LRV is checked to ensure that all the requisite tools and equipment are in place. Then the CDR selects a new target on the Far UV Camera, and both men mount the LRV. The navigational system is initialized, and the crewmen depart at about 45 minutes into the EVA timeline for their northerly sortie to North Ray Crater and Smoky Mountains.

Please refer to Section 3.6 for specific details on the crewmen activities on the EVA 3 traverse.

The crew returns to the LM to begin final closeout at ten minutes after six hours into the timeline.

Once again, the LRV is parked close to the MESA, but in sunlight. The radiating surfaces are dusted by the LMP while the CDR selects the final target of the Far UV Camera. The LMP packs up all the film magazines and clears the LRV of all returnable items and samples. The CDR walks around the spacecraft and takes the Cosmic Ray Experiment off the side of Quad II. He folds the experiment up (See Figure 3.4-25) and, with the LMP's help, bags it for return to earth. The LMP takes the motion picture camera off the LRV, while the CDR mounts the vehicle for the final time. The CDR powers up the LRV, and goes through a short "Gran Prix" exercise while the LMP films the procedure.

The CDR resets the navigation system at the LM and heads east 100 meters for the final resting spot for the LRV. He parks it pointing down sun at the LM, thoroughly cleans all radiation surfaces, and configures the system such that the LRV batteries power the communication system. He then walks back to the LM.

APOLLO 16 SUMMARY TIMELINE

LUNAR SURFACE NOMINAL EVA 3

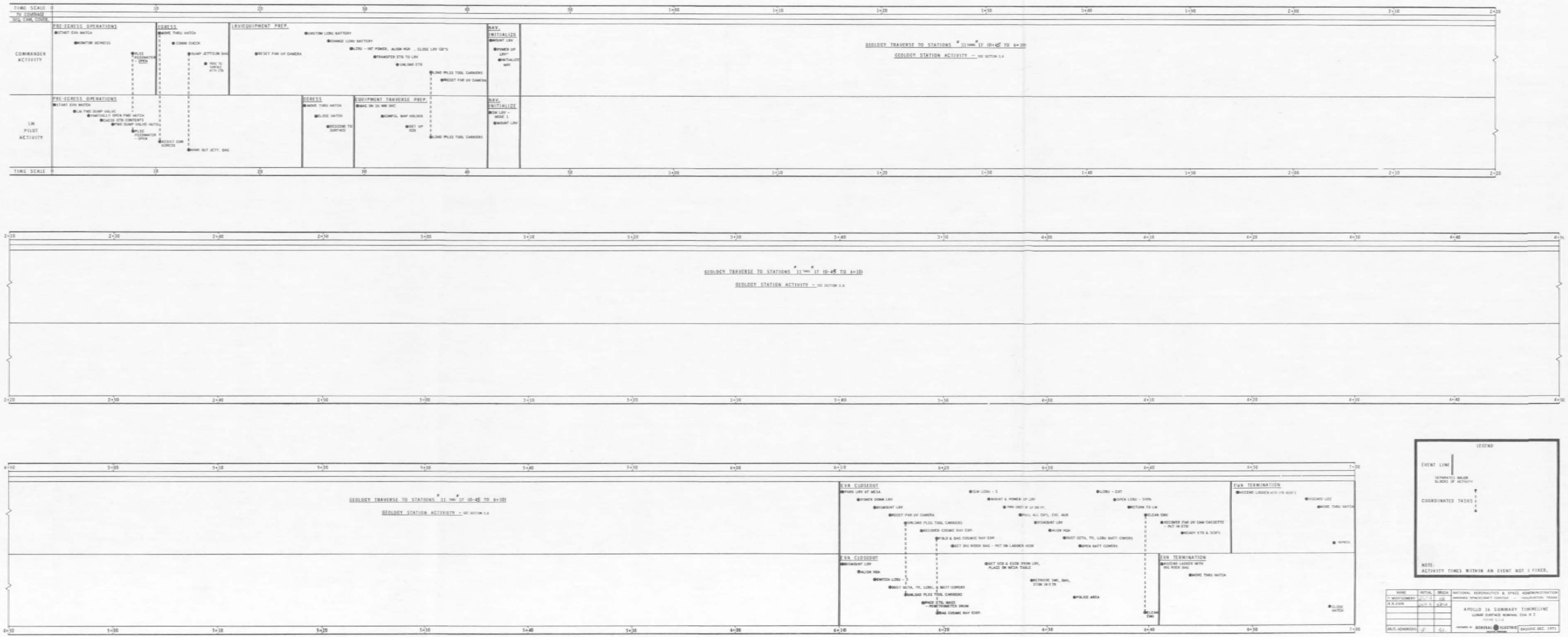


FIGURE 3.1-6

Meanwhile the LMP collects the Solar Wind Composition Experiment foil, bags, and places it in the camera magazine bag. He polices the area around the LM, especially in the direction of the ALSEP, to minimize the possibility that any loose equipment might be blown by the ascent stage engine into the experiments as the crew lifts off.

The crew then cleans each other off, and make ready for EVA termination. The final experimental procedure is to remove the film cassette from the Far UV Camera and place the camera under the LM. The cassette joins the other magazines in the equipment bag.

The LMP ingresses first with the Big Rock Bag and a sample bag. The CDR follows soon after with the magazine and equipment bag and several sample bags which he hands in to the LMP. He moves through the hatch, and repressurization is initiated after hatch closure to end the final EVA.

3.2 DETAILED EVA TIMELINE PROCEDURES

3.2.1 EVA-1

The detailed procedures for EVA-1 are shown on the following vertical format pages. In the final edition of this document, the crew cuff checklist pages which correspond approximately to the timeline will be shown on the far left-hand facing sheets along with the Voice Data Plan with which capcom can assure that the required information is given by the crew to MCC-H and which assists capcom in essential communications with the crew. The crew's cuff checklist does not necessarily correspond to the vertical timeline in content or verbiage as this is a crew preference item and contains those cues the crew feels they need to accomplish the required tasks.

MISSION: APOLLO 16 DATE: 15 DECEMBER 1971
EVA: 1 REVISION: D

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES
<u>DEPRESSURIZE CABIN</u> OPEN HATCH		<u>DEPRESSURIZE CABIN</u> START EVA WATCH (CALL'MARK')**
	0+00	
	0+01	
	0+02	
	0+03	
	0+04	
	0+05	
	0+05	
	0+06	
	0+07	
	0+08	
	0+09	
	0+10	**NOTE;DETAILED PROCEDURES ARE PRESENTED IN 'LUNARSURFACE CHECKLIST',EQUIP PREP EVA 1 SECTION

MISSION: APOLLO 16 DATE: 15 DECEMBER 1971

EVA: 1 REVISION: D

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES
EGRESS (CDR 1)		EGRESS (CDR 1)
PLACE JETTISON BAG IN HATCH		MOVE THROUGH HATCH
PULL LEC FROM BAG, ATTACH TO ETB		
PASS LEC WITH ETB TO CDR	0+10	
VERIFY CB CONFIGURATION		
	0+11	
		DESCEND LADDER TO MESA DEPLOY HEIGHT
	0+12	
		PULL HANDLE (L SIDE PLAT) TO DEPLOY
		SECURE AND TOSS JETTISON BAG
	0+13	TO QUAD 1 AREA
		DEPLOY LEC (DANGLE OFF PLATFORM NEAR MESA)
	0+14	DESCEND LADDER TO PAD
	0+15	
	0+15	GAIN SURFACE
		HANG ETB OFF LADDER HOOK
		FAMILIARIZATION (CDR)
		CHECK MOBILITY AND
	0+16	STABILITY-REPORT
EGRESS (LMP 1)		
MOVE THROUGH HATCH		
	0+17	
	0+18	
CLOSE HATCH	0+19	
DESCEND LADDER TO PAD		
	0+20	

MISSION: APOLLO 16 DATE: 15 DECEMBER 1971

EVA: 1 REVISION: D

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES
GAIN SURFACE __FAMILIARIZATION (LMP)__		KICK ANY DISCARDS UNDER LM
CHECK MOBILITY AND STABILITY		
	0+20	
		__DEPLOY TV CAMERA__ ADJUST MESA HEIGHT
	0+21	LOOSEN MESA BLANKET AROUND TV OPEN AND FOLD BACK MESA BLANKETS
		UNSTOW TV TRIPOD, BOTTOM FRONT
DEPLOY SRC TABLE PULL PIN,OFFLOAD ALSD,PLACE ON +Y PAD	0+22	DEPLOY TV TRIPOD PULL LANYARDS FROM CLIPS, PULL TO RELEASE 4 BAL-LOKS LIFT CAMERA FROM BRACKET
PULL PIN(S),OFFLOAD BORE/CORE PKG,PLACE ON +Y PAD	0+23	MOUNT CAMERA ON TV TRIPOD PULL 20 FT OF CABLE FROM MESA CARRY TV TO 12:00/50 FT & SET UP(COORD WITH MCC FOR SETTINGS)
DISCONNECT & HANG UP LEC	0+24	
HANG ETB OFF SRC TABLE		
	0+25	
	0+25	
	0+26	
		REMOVE AND DISCARD TV STOWAGE BRACKET
	0+27	
		CLOSE RH THERMAL BLANKET
	0+28	__OFFLOAD LRV__ REMOVE THERMAL BLANKETS UNSTOW DEPLOYMENT CABLE L SIDE LRV
	0+29	DRAPE CABLE ON SEC STRUT DEPLOY REEL OPERATING DRAPE TAPE ON SEC STRUT VERIFY WALKING HINGE LATCHES
	0+30	

MSC/CPD-1691 NASA — MSC

MISSION: APOLLO 16 DATE: 15 DECEMBER 1971

EVA: 1 REVISION: D

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES
		VERIFY FWD/AFT CHASSIS
OFFLOAD LRV		VER L,R OUTRIG CABLES TAUT
ASCEND LADDER		DEPLOY REEL TAPE,RIGHT
		BACK AWAY FROM LM,HOLDING REEL
PULL D-HANDLE	0+30	REQUEST LMP TO PULL D-HANDLE
DESCEND LADDER		VER PINS RELEASED,LRV ROTATES
PICK UP DEPLOYMENT CABLE,APPLY STEADY PULL OUTWARD FROM QUAD I (20 LBS FORCE)UNTIL REAR WHEELS ON GROUND••	0+31	PULL DOWN ON RIGHT SIDE REEL TAPE UNTIL FWD AND AFT CHASSIS PINS RELEASE••
	0+32	RESUME PULLING TAPE UNTIL AFT WHEELS ON SURFACE, FWD CHASSIS LOCKED, AND OUTRIGGER CABLES ARE SLACK
		PULL PIN RH SIDE OUTRIG CABLE
PULL PIN LH SIDE OUTRIG CABLE	0+33	DISCARD TAPE & CABLE- UNDER LM••
DISCARD TAPE &CABLE - UNDER LM		
PULL DOWN ON LEFT SIDE REEL TAPE UNTIL FWD WHEELS REST ON SURFACE AND CABLE IS SLACK	0+34	PULL PINS HOLDING DEPLOY CABLE & D-LATCH PINS TO LRV;MOVE CABLE & WHEEL LOCK STRUTS AWAY FROM LRV
DISCARD TAPE UNDER LM		
PULL SADDLE REL CABLE		
	0+35	
	0+35	
	0+36	
	0+37	
	0+38	
	0+39	
SET UP LRV		SET UP LRV
	0+40	
••PULL ON CABLE TO SLIDE WHEELS AFT IF REQD		••CHASSIS+AFT WHLS DEPLOY-LOCK STRUTS RETAINED BY TETHERS
		••PULL ON DEPLOYMENT CABLE TO SLIDE AFT WHEELS IF REQUIRED

MISSION: APOLLO 16 DATE: 15 DECEMBER 1971

EVA: 1 REVISION: D

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES
DEPLOY LEFT REAR FENDER		DEPLOY RT R FEND EXT
VERIFY LEFT REAR HINGE PINS		VERIFY RT RHINGE PIN-ENG,
ERECT LEFT SEAT		ERECT RIGHT SEAT
UNSTOW SEAT BELT, HANG IT UP		UNSTOW SEAT BELT, HANG IT UP
RELEASE HANDHOLD TIE-DOWN	0+40	LOWER ARM REST
PULL T:HANDLE,LOWER CONSOLE		PULL T-HANDLE,LOWER CONSOLE
		LOCK HANDHOLD/CONSOLE
LOCK HANDHOLD/CONSOLE		REMOVE TRIPOD APEX (3 PINS)
PLACE STRAP OVER T HNDL	0+41	REMOVE PIN, INSTALL TOEHOLD
REMOVE TRIPOD APEX (3 PINS -		ERECT FOOTREST
DISCARD)		VER RT FR HINGE PIN-ENG
REMOVE PIN, INSTALL TOEHOLD		DEPL RT FR FEND EXT
ERECT FOOTREST	0+42	VER BATT COVERS CLOSED
VER L FRT HINGE PIN-ENG		PLACE CONTINGENCY TOOL ON L PAN
DEPLOY LEFT FRONT FENDER		CONTING ALLOT
PULL ATT IND,C/W PINS		
CONTING ALLOT	0+43	
	0+44	
	0+45	
	0+45	
	0+46	
	0+47	
	0+48	
	0+49	CHECK OUT LRV
		VERIFY:PARKING BRAKE-ON,
LM INSPECTION AND PANS		ENTER LRV-LEFT HAND SEAT
RETRIEVE AND DON 70 MM CAMERA**		
	0+50	

MISSION: APOLLO 16 DATE: 15 DECEMBER 1971
EVA: 1 REVISION: D

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES
		CLOSE CB BUSSES A,B,C,D
		REPORT AMP-HR, AMPS, VOLTS
MOVE TO 20 FT OFF +Z GEAR		CLOSE CB 15V PR & SEC
	0+50	CLOSE CB STEER FWD & R
		CLOSE CB DR PWR LF,RF,LR,RR
		POS DR EN SW LF+RF-PWM 1
		POS DR SW LR+RR-PWM 2
TAKE PHOTO PAN	0+51	POS PWM SEL SW-BOTH
		POS 15 VDC SW - SEC
		POS STEER FWD SW-BUS A
		POS STEERING REAR SW - BUS D
	0+52	POS DR PWR LF+RF-BUS A
		POS DR PWR LR+RR-BUS D
		RELEASE PARKING BRAKE
		DRIVE AROUND LM TO MESA
	0+53	VICINITY
MOVE TO 20 FT OFF SEQ BAY		
	0+54	
TAKE PHOTO PAN		
	0+55	
		STOP LRV AND SET BRAKE
		POS 15 VDC SW -OFF
	0+55	
		OFFLOAD FAR UV CAMERA
		UNSTOW ZIPPER LANYARD ON BAG
TAKE PHOTO COSMIC RAY, 7 FT	0+56	STAND AWAY FROM BAG,PULL DOWN
MOVE TO 20 FT OFF QUAD III		ON ZIPPER UNTIL OVER TOP
		UNSTOW INNER LANYARD,UNZIP
		FOLD BAG BACK AWAY FROM CAMERA**
	0+57	
		PULL LOWER PIP PIN,L SIDE,
TAKE PHOTO PAN		PULL LOWER PIP PIN,R SIDE,
		GRASP CAM BY HANDLE AND LEG
	0+58	LIFT CAM UP AND OUT TO CLEAR
		TURN CAM UPRIGHT AND PROCEED
		TO VICINITY OF LRV STOWAGE
		AREA - QUAD I
	0+59	
	1+00	
**COMMENT ON DPS EROSION,		**USE CONTINGENCY TOOL IF
STRUTS, PAD PENETRATION SOIL		NECESSARY
PATTERNS, ANY LM ANOMALIES		

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES
DOFF CAMERA ONTO LRV FLOORPAN	"	
LOAD LRV (EVA 1)-LMP	1+00	
LIFT LCRU SUPPORT POST LOCKS		
UNSTOW LCRU FROM MESA,DISCARD		
INSTALL LCRU ON LRV, LOCK IN		
DISCONNECT LCRU POWER CABLE	1+01	
CONNECTOR FROM STOW ADAPTER,		
DISCONNECT GCTA CABLE		
DISCARD STOWAGE ADAPTERS		
REMOVE TCU FROM MESA	1+02	
INSTALL TCU RT SIDE		
LRV,CONNECTORS INBD.		
	1+03	
ROTATE TCU STAFF TO ENGAGE		
ENGAGE, ROTATE STAFF COLLAR TO	1+04	DEPLOY AND INITIALIZE FAR UV CAM
DISCONNECT TV CONN FROM TCU		HOLD UPRIGHT ON SURFACE, PULL
CONNECT TCU CABLE TO TCU		ELEVATE CAMERA UNTIL LEGS
UNSTOW RAKE, PLACE UP IN MESA		LATCH (VERIFY LATCH)
DETACH & DISCARD RAKE BRACKET	1+05	
OPEN ANTENNA STOWAGE CONTAINER		POINT CAM BARREL DOWNSUN
		PUSH LEGS INTO GND, STEP ON
TAKE OUT LO GAIN ANTENNA		COLLARS
INSTALL LO GAIN ANTENNA IN L	1+05	REMOVE BATTERY BOX, DEPLOY
SIDE HANDHOLD LRV		CABLE AND PLACE BOX IN SUN
POINT ANT AT EARTH		(OFF -Y FOOTPAD)
ROUTE AND CONNECT LO GAIN ANT		
CABLE TO LCRU	1+06	
		LEVEL CAMERA-BACK OFF KNOB 2
VELCRO DOWN CABLE		CCW UNTIL CLEAR THEN BUBBLE
REMOVE HI GAIN ANTENNA FROM		LEVEL WITH KNOBS 1 & 3, WHEN
STOWAGE CONTAINER	1+07	LEVEL LOCK DOWN KNOB 2 (CDR
		STANDS UPSUN TO LEVEL)**
INSTALL ON L SIDE LRV,ROTATE	1+08	
STAFF TO ENGAGE		
ENGAGE, ROTATE STAFF COLLAR TO		PULL AZIMUTH PIP PIN, THEN
CONNECT HI GAIN ANT CABLE TO		PULL OTHER SIDE ELEVATION PIP
ERECT HI GAIN ANT-PUSH OUT AND	1+09	RELEASE AZIMUTH, POINT CAM
UP UNTIL ANT LOCKS IN PLACE		EXACTLY DOWNSUN
		LOCK AZIMUTH
		SLACK OFF AZIMUTH SCALE LOCK,
	1+10	
		**OR DIG LEGS IN GROUND TO LEVEL

MISSION: APOLLO 16 DATE: 15 DECEMBER 1971

EVA: 1 REVISION: D

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES
		ZERO SCALE, TIGHTEN SCALE LOCK
PUSH ANT STAFF UP UNTIL POINT		REMOVE PROTECTIVE COVER, FRONT
POINT ANT TO EARTH		UNLOCK AND SET AZIMUTH =34 DEG
DEPLOY AND LOCK ANT DISH		
	1+10	SET ELEVATION = 79 DEG
TELESCOPE ANT STAFF UP TO		
GO TO TV CAMERA		CENTER EARTH IN SIGHT
		GLASS-REPORT AZ &EL TO MCC
TV CAMERA POWER SW =	1+11	
TAKE TV CAM OFF TRIPOD AND		
INSTALL TV CAM ON TCU		
		SET CAMERA TO FIRST
CONNECT GCTA/TV CABLE TO TV	1+12	TARGET;COORD WITH MCC IF DELTA
CHECK LCRU CONTROLS:		SETTINGS REQUIRED
	1+13	LOCK AZIMUTH
POS PWR SW-EXT		THROW POWER SW = ON**
AGC,TEMP,POWER-REPORT TO MCC		LOAD LRV (EVA 1)-CDR
POS MODE SW-2 (FM/TV)**		RELEASE STRAP ON ADAPTER POST
VERIFY AGC GREATER THAN 2	1+14	SWING POST UP AND TO RIGHT
OPEN LCRU BLANKETS 100 PER		GO TO QUAD III
CENT		PULL LANYARD ON LEFT HANDRAIL
REMOVE,DISCARD ANT		GRASP HANDRAILS AND MOVE
CONTAINER,BRACKETS	1+15	BOTTOM OF PALLET OUT, UP, THEN
MESA,ETB OFFLOAD TO LRV		LOWER PALLET TO DISENGAGE FROM LM
UNSTOW BIG ROCK BAG,PLACE ON L		TURN PALLET ON ITS SIDE
SIDE GEOPALLET		MATCH UP STOWAGE INTERFACES,
	1+15	GUIDE PALLET ONTO INTERFACES
		HOLD UPPER RAIL, PULL LANYARD
UNSTOW 16 MM CAMERA R SIDE		PULL L END OF RAIL OUTWARD
MESA,INSTALL MAG (ETB) AND		UNTIL DISENGAGED
PLACE ON R HANDHOLD LRV	1+16	HOLD LOWER RAIL, PULL LANYARD
		PULL L END OF RAIL OUTWARD
		PREPARE AFT PALLET FOR GEOLOGY
UNSTOW 70 MM CAM FROM R SIDE		PULL LOOSE AND DISCARD ALL STRAPS
MESA,INSTALL MAG (REPORT NO)	1+17	UNSTOW AND PLACE PENETROMETER
AND BAG SHOE(20DSBD)		IN PALLET HOLE
STOW 2-70 MM MAGS, 3-16 MM		PULL PINS,REMOVE RETAINERS, ON
MAGS	1+18	PLACE XT HANDLE,TONGS IN HTC
		PUT SCOOP ON XT HANDLE,STOW IN HTC
		UNSTOW GNOMON,DEPLOY
		LEGS,PLACE IN QUIVER
INSTALL MAP HOLDER & MAPS	1+19	
		TAKE COVER OFF PENETROMETER
		TAKE OUT DUST BRUSH, STOW ON LCRU
HANG BSLSS FROM LMP SEAT		
	1+20	
**INITIAL POS MODE SW IS PMI/NB		**NOTE FILM ADVANCE IN WINDOW

MISSION: APOLLO 16 DATE: 15 DECEMBER 1971
EVA: 1 REVISION: D

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES
RETURN ETB TO SRC TABLE FOLD BACK BLANKET OVER SRC 1		UNSTOW AND HANG EXTRA SCB
UNSTOW SRC 1, PLACE AND CLAMP OPEN SRC 1, REMOVE SCB, TEMP		
STOW CLOSE CONTROL SAMPLE	1+20	
TAKE SCB TO LRV, HANG ON HTC		
	1+21	
STOW ALSD ON LRV UNDER R SEAT		
INGRESS (LMP 1)		INGRESS (LMP 1)
TAKE PALLET 1 OUT OF MESA		MONITOR LMP, UNSTOW & DISCARD
MOVE TO FOOTPAD ASCEND LADDER	1+22	LCRU PALLET
	1+23	
OPEN HATCH PUT PALLET THRU HATCH, OR DRAG		INITIATE NAV SYSTEM – NAV CB IN
MOVE THRU HATCH	1+24	MONITOR LMP AND PHOTO INGRESS
	1+25	
SWITCH TO LOW POWER		
POWER AMP SWITCH – OFF		
BIT RATE SWITCH – LOW TV CB – 'OPEN'	1+25	
MODULATION SW – PM		
	1+26	
EGRESS (LMP 2)		EGRESS (LMP 2)
STRIP PALLET 1, STOW CONTENTS EGRESS WITH PALLET 1		ASSIST LMP (WATCH, ALSO PHOTO)
BACK OUT HATCH ONTO PLATFORM	1+27	
	1+28	
	1+29	
MOVE ONTO LADDER, PULL HATCH TO		DEPLOY FLAG PULL TWO STOWAGE PIP PINS +
	1+30	

MISSION: APOLLO 16		DATE: 15 DECEMBER 1971
EVA: I		REVISION: D
LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES
DESCEND LADDER TO PAD		WALK TO DEPLOYMENT SITE
		DRIVE LOWER SHAFT INTO SURFACE
	1+30	DEPLOY HORIZ SHAFT BY FIRST EXTENDING THEN ROTATING SHAFT
TOSS PALLET UNDER LM		EXTEND VERTICAL SHAFT,PULL INSERT UPPER SHAFT INTO LOWER
DEPLOY FLAG PHOTO CDR BY FLAG,GIVE CAM TO→	1+31	PHOTO LMP BY FLAG STOW CAMERA UNDER LRV SEAT
OPEN SEQ BAY DOOR REMOVE THERMAL COVER FROM DOOR		UNLOAD ALSEP PACKAGE 2
REMOVE LOWER VELCRO STRAP AND BACK AWAY TO POSITION CLEAR	1+32	MOVE TO PACKAGE 2 PULL LANYARD TO UNLOCK PACKAGE
PULL WHITE PART OF LANYARD TO RAISE DOOR**		GRASP HANDLE, STEADY WITH OTHER HAND
TEMPORARILY STOW LANYARD ON LM STRUT**	1+33	PULL PACKAGE OUT OF SEQ BAY AS PKG CLEARS BAY,SHIFT TO STEADY
UNLOAD ALSEP PACKAGE 1 UNLOAD ALSEP PACKAGE 1(SAME AS PKG 2)		UNDER PKG SWING PACKAGE TO GROUND HANDLE UP
	1+34	PULL PIN,DISCARD HOCKEY STICK UNDER LM
	1+35	
		TAKE TOOLS OFF PKG 2
FUEL RTG REMOVE CASK ROTATION LANYARD	1+35	REMOVE SUBPALLET PULL PIN - REMOVE 2 TOOL RESTRAINT PULL
HOLD FABRIC PART OF LANYARD ROTATE CASK TO NEAR-HORIZONTAL		PULL OUT ON TOOL BRACKET ASSY TAKE OUT 2 UHT'S- INSTALL 1 IN
PULL CASK LANYARD OUT OF WAY RECEIVE DRT FROM CREWMAN	1+36	PKG 2 SOCKET AND OTHER IN PKG 1 REMOVE 2 HALVES OF ANTENNA
INSERT DRT ON DOME NUT AND ROTATE DRT 90 DEG CW TO		MAST-JOIN MASTS ARROW TO ARROW INSERT MAST END (TRIGGER DN)
REMOVE DOME AND DISCARD RECEIVE FUEL TRANSFER TOOL	1+37	TAKE OUT HANDLING TOOLS -FTT + DRT HAND DRT TO LMP,THEN FTT WHEN
INSERT FTT INTO FUEL CAPSULE ROTATE FTT TO ENGAGE CAPSULE		TILT PKG 2 TO FLAT ON SURFACE TO FUEL RTG
WITH DRAW TOOL AND CAPSULE MOVE TO PACKAGE NO.2	1+38	
INSERT CAPSULE INTO RTG RELEASE FTT BY COUNTERROTATING		
DISCARD FTT UNDER LM TIME ALLOTMENT FOR CONTINGENCY	1+39	PULL COVER OFF RTG CONTINGENCY ALLOTMENT
	1+40	
**VERIFY DOOR FULLY OPEN AND FOLDED UP OVER SEQ BAY.VERIFY LANYARD UNTANGLED		
**SECURE DOORS WITH VELCRO STRAP IF QUAD II IS LOW		

CREW EVA CHECKLIST

VOICE DATA

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES
	1+40	
JOIN ALSEP PACKAGES (BARBELL)		
RETURN PKG 2 TO UPRIGHT		
MOVE PKG 2 OVER TO PKG 1,	1+41	
SOCKET ON BOTTOM TO FREE END		
INSERT MAST IN PKG 1 SOCKET		
	1+42	
ALSEP CARRY		
PICK UP JOINED ALSEP PKGS,		
WALK OUT TO ALSEP SITE		
	1+43	
		CLOSE SEQ BAY DOOR
	1+44	
		RETRIEVE DOOR LANYARD FROM LM
		MOVE TO POSITION CLEAR OF DOOR
		PULL BLACK + WHITE STRIPED
	1+45	PORTION OF LANYARD UNTIL DOOR CLOSED
	2	TOSS LANYARD UNDER LM
		RESET FAR UV CAMERA
		PUSH RESET SW - CHECK FILM
	1+45	UNLOCK AND SET AZIMUTH - TBD
		DEG, RELOCK AZIMUTH
		SET ELEVATION -TBD DEG
	1+46	
		PUSH RESET SW - CHECK FILM
		SHIFT COSMIC RAY EXPERIMENT
		REMOVE THERMAL PROTECTOR
	1+47	ENSURE LMP WITH ALSEP OUT OF SIGHT
		PULL RED RING DOWN UNTIL IT'S LOOSE
		INITIALIZE NAV SYSTEM
		MANEUVER TO POINT LRV DNSUN, ON
	1+48	LEVEL GND
		DEPLOY AND READ SUN SHADOW
	1+49	DEVICE TO MCC
		READ PITCH AND ROLL TO MCC
	1+50	

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES
		INPUT HEADING INTO NAV SYSTEM (TORQUE SW)
	1+50	
	1+51	INITIALIZE COMPUTER-VERIFY ALL DIGITS ZERO
	1+52	**LRV TRAVERSE**
		ENTER LRV-LEFT HAND SEAT, POS 15 VDC SW-PRIM RELEASE PARKING BRAKE
	1+53	DRIVE TO ALSEP SITE-THEN SCOUT DOWNSUN 300+ FT TO ENSURE GOOD LAYOUT FOR ASE LINE
	1+54	
	1+55	
	1+55	
	1+56	
	1+57	
SURVEY ALSEP SITE		**SURVEY ALSEP SITE**
DESCRIBE AREA	1+58	PARK LRV 60 FT S C/S ,POINT LRV 015°
		POWER DOWN LRV
	1+59	DISMOUNT LRV
POSITION ALSEP AT SITE		DUST TV,GCTA,LCRU
DISCONNECT PKG 2 FROM ANT		
MOVE PKG 2 8 FT WEST PKG 1,	2+00	ALIGN HI GAIN ANTENNA

MISSION: APOLLO 16 | DATE: 15 DECEMBER 1971
EVA: 1 | REVISION: D

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES
TURN SO UHT HANDLE POINTS NORTH		
TURN PKG 1 SO UHT HANDLE POINTS NORTH		SET LCRU MODE-FM/TV
TAKE UHT OUT OF SOCKET, PKG 2	2+00	
REMOVE HFE SUBPALLET		
RELEASE 1ST VELCROED HFE PULL RING TO PULL HFE CONN PIN		
DO SAME WITH 2ND PULL RING AND PULL M/P BASE PIN	2+01	CONNECT RTG
REMOVE M/P BASE ASSY, PLACE TO SIDE ROTATE PKG 2 TO GND, EYEBALL		TAKE UHT FROM PKG 1
RELEASE HFE SUBP CARRY HANDLE USE UHT, RELEASE 2 BOYD BOLTS	2+02	
ON HFE SUBPALLET LIFT HFE SUBPALLET OFF PKG 2.		READ TEMP LABEL ON RTG CABLE
DEPOSIT TO ONE SIDE	2+03	RELEASE 3 BOYDBOLTS ON RTG CABLE REEL
CONNECT HFE		
VERIFY HFE CABLE REEL DEPLOYED PROCEED TO C/S WITH HFE		ENGAGE UHT, PULL RTG REEL FROM PKG 2 WALK TO PKG 1, DEPLOYING CABLE
REMOVE HFE CONNECTOR AND C/S CONNECT HFE CONNECTOR TO C/S.	2+04	RELEASE SHORT SW PULL REMOVE SHORT PLUG PULL PIN
TIME ALLOTMENT FOR CONTINGENCY		REMOVE SHORT PLUG BRACKET LAY ASIDE REEL AND UHT
	2+05	READ AMMETER AND REPORT PULL SHORTSW CONN DUST COVER
DEPLOY HFE ELECT + LAYOUT PROBES		PULL RTG CONN DUST COVER CONNECT SHORT SW TO C/S
PICK UP HFE PALLET, CARRY 30 FT COLLAPSE HFE PALLET STRUT	2+05	TIME ALLOTMENT FOR CONTINGENCY
PLACE PALLET ON SURFACE RELEASE 4 BOYDBOLTS ON PROBE		
PKG	2+06	REMOVE SUBPALLET, AIM MECH
REMOVE PROBE PKG FROM HFE		RELEASE 2 BB ON SUBPLT 2,2 ON AIM MECH
REMOVE 2 VELCRO CLOSURE STRAPS SPLIT BOX, LEAN RAMMER HALF	2+07	ENGAGE UHT IN CARRY SOCKET, PICK UP AIM MECH
MOVE TO 1ST BORE HOLE, DEPLOYING CABLE OUT OF PROBE		CARRY PALLET/AIM MECH NE DEP AIM MECH ON SUBPALLET
BOX HALF (WATCH FOR MARK ON CABLE)	2+08	DEPLOY PSE STOOL RELEASE PSE STOOL BOYDBOLT
PLACE BOX ON SURFACE		TAKE OFF PSE STOOL (UHT OR BY HAND GOUGE HOLE WITH BOOT 8 FT SE
GO BACK TO SUBPALLET, PICK UP MOVE TO 2ND BORE HOLE,	2+09	REMOVE BRACKET & JETTISON PLACE STOOL OVER HOLE
DEPLOYING CABLE OUT OF PROBE BOX HALF (WATCH FOR MARK ON		TIP PACKAGE 1 AND ALIGN REMOVE ANT MAST FROM PKG 1
	2+10	

CREW EVA CHECKLIST

VOICE DATA

MISSION: APOLLO 16 DATE: 15 DECEMBER 1971
EVA: 1 REVISION: D

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES
CABLE)		STOW MAST ON SUBPALLET TAPER
		RELEASE DUST COVER
PREPARE DRILL		WITH UHT OR HAND, ROTATE PKG 1
UNSTOW DRILL FROM LRV		REMOVE DUST COVER
	2+10	ALIGN PKG 1 BY EYEBALL
PLACE DRILL, TREADLE DOWN		
PRESS POWER SW - VERIFY MOTOR		DEPLOY PSE
PULL PIN 2 (L SIDE - PULL)		USE UHT, RELEASE 4 BOYD BOLTS
ROTATE RACK CAMLOC 90 DEG CCW	2+11	USE UHT, ENGAGE SOCKET, LIFT PSE
TURN DRILL PKG, ROTATE BATT		TRANSPORT PSE TO PSE STOOL
REMOVE HANDLE ASSY FROM CLIPS		SHAKE BOYDBOLTS OFF PSE
FIT UPPER PIN INTO BATT		HOVER PSE OVER STOOL, ALIGN
PULL UP ON HANDLE, SLAP LOWER	2+12	ARROW EAST, REMOVE GIRDLE
VERIFY HANDLE LOCKED SECURELY		PLACE PSE ON STOOL
ROTATE RACK CAMLOC AND BRACKET		REMOVE GIRDLE AND
LIFT RACK OFF TREADLE, DEPLOY		USE UHT TO DEPLOY PSE SKIRT
LEGS	2+13	
VERIFY ALL LEGS EXTENDED AND		
PLACE RACK ON SURFACE OUT OF WAY		
UNSTOW BORE/CORE STEMS FROM		
CONTAINER	2+14	USE UHT TO LEVEL PSE WITH
		BUBBLE LEVEL AS REF
PEEL DOWN BAG, PLACE STEMS IN	2+15	
RACK		
	2+15	
PULL PIN 5 AND MOVE BRACKET UP		
LIFT DRILL OFF TREADLE		READ SUN COMPASS, REPORT
CARRY DRILL AND RACK TO BORE		OFFLOAD ASE THUMPER/GEOPHONE
DRILL BORE HOLE 1	2+16	VERIFY SW NO 5 - CW
PLACE DRILL-BATT DOWN-ON SURFACE		RELEASE BOYD BOLT ON T/G
INSERT 54 INCH BIT STEM IN		GRASP T/G RESTRAINING ARM WITH
DRILL		ONE HAND AND UPPER END OF T/G
PICK UP DRILL, PUSH BIT IN	2+17	UNFOLD T/G, POSITION AND LOCK
PULL RING, TAKE OFF THERMAL SHD.		SLEEVES
ENERGIZE DRILL BY SLIDING		LEAN T/G ON SUBPALLET
GLOVES TOGETHER ON HANDLE.		TIME ALLOTMENT FOR CONTINGENCY
GET WRENCH, ENGAGE ON STEM AND	2+18	
TWIST DRILL CCW OFF STEM END		
PLACE DRILL ON SURFACE		
DISENGAGE WRENCH, STOW	2+19	
SELECT A 30 IN STEM AND INSERT		
PICK UP DRILL		
PLACE DRILL OVER STEM**		
	2+20	

**ENSURE INSERTION

CREW EVA CHECKLIST

VOICE DATA

MISSION: APOLLO 16 DATE: 15 DECEMBER 1971
EVA: 1 REVISION: D

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES
ENERGIZE DRILL, DRILL UNTIL STEM END 16IN.OUT		
RELEASE DRILL FROM STEM		
	2+20	
PLACE DRILL ON SURFACE		
DISENGAGE WRENCH,STOW		
SELECT LAST 30 IN STEM INSERT		
PICK UP DRILL	2+21	
PLACE DRILL OVER STEM**		
ENERGIZE DRILL, DRILL UNTIL STEM END 11IN.OUT		
RELEASE DRILL FROM STEM	2+22	
PLACE DRILL TO ONE SIDE		DEPLOY MORTAR PACKAGE
DISENGAGE WRENCH, STOW	2+23	PLACE UHT IN CARRY SOCKET
CONTINGENCY ALLOTMENT TIME		GRASP UHT AND LIFT M/P FROM PKG 1
		WHILE HOLDING UHT PULL M/P PIN
		MANUALLY ROTATE M/P ON UHT
	2+24	DEPLOY SECOND M/P LEG AND LOCK
		GRASP END OF COLLAPSED FLAG
		FREE MAST OF CLIP,ERECT 1ST
		PLACE M/P DOWN NE OF
	2+25	C/S,POINTED NW
	2+25	DEPLOY REMAINING 3 SECT OF
		REMOVE LSM
		RELEASE LSM BOYDBOLTS (2)
		PULL HANDLE OF UPPER SUPPORT
	2+26	LIFT BRACKET OFF LSM, DISCARD
		GRASP LIFTOFF HANDLE, REMOVE
		VERIFY CABLE FREE OF C/S TOP
		DEPLOY LSM
	2+27	CARRY LSM TO DEPLOY SITE
	2+28	REMOVE STOWAGE BRACKET
		DEPLOY LEGS, ROTATE LSM SO COLORED LEG TO EAST
	2+29	DEPOSIT LSM**
		USE UHT TO REMOVE FOAM PACKAGING
		DEPLOY 3 SENSOR ARMS- ROTATE +
	2+30	
**ENSURE INSERTION		**VERIFY CABLE IS OUTSIDE LEGS

MISSION: APOLLO 16 DATE: 15 DECEMBER 1971

EVA: 1 REVISION: D

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES
		LOCK EACH UPPER ARM SECTION - LOWER ARM INTO DEPLOYED POSITION**
		REMOVE SENSOR DUST COVERS
	2+30	
		HOUSECLEAN TOP OF LSM
		USE UHT TO TURN LEVEL SCREWS ON LEGS
	2+31	USE PRA REMOVAL LANYARD
		ALIGN LSM USING SUN COMPASS
		RECHECK LEVEL, ADJUST ALIGN
	2+32	,LEVEL AS REQD
	2+33	TIME ALLOTMENT FOR CONTINGENCY
<u>EMPLACE HFE PROBE 1</u>		
PICK UP PROBE BOX, PULL OUT DEPLOY RAMMER, LEAN ON RACK		
	2+34	
PULL PROBE OUT OF BOX, DANGLE BY CORD**		
	2+35	
ENGAGE RAMMER CROWFOOT ABOVE THERMAL SHIELD		
INSERT AND DROP PROBE INTO	2+35	
PUSH SHIELD DOWN HOLE, PUSH PROBES TO BOTTOM VERIFY BY MARK ON RAMMER, REPORT DEPTH MARK IF NOT AT MARK	2+36	
	2+37	
SLIDE EXTERNAL SUNSHIELD OVER		
MEASURE AND REPORT STEM HT	2+38	<u>ERECT CENTRAL STATION</u>
<u>DRILL BORE HOLE 2</u>		ALIGN PKG 1 BY SUN COMPASS, BUBBLE LEVEL
TAKE RACK AND RAMMER TO 2ND		
TAKE DRILL TO SITE,PLACE ON SURFACE	2+39	
		STAND ON E SIDE
		USE UHT TO RELEASE 5 BOYDBOLTS S SIDE C/S
	2+40	
**CAUTION-HANDLE ONLY AT MIDDLE OF SECTIONS		**CENTER ARM FIRST, INSURE ELBOW COVERS POP OFF.

MISSION: APOLLO 16 DATE: 15 DECEMBER 1971

EVA: 1 REVISION: D

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES
REPEAT PROCEDURE FOR BORE HOLE DRILLING AS ON BORE HOLE 1		
		RELEASE 4 BOYDBOLTS E SIDE C/S + ANT BB
	2+40	
		ENGAGE UHT REAR THERMAL SOCKET, SEPARATE FROM
	2+41	PULL LANYARD TO RELEASE 2 PINS,TO BEGIN COVER
		ALLOW SLACK IN CABLE TO LOWER REAR CURTAIN TO SURFACE
	2+42	USE UHT TO SEPARATE ANT CABLE PULL LANYARD TO DEPLOY CABLE
		USE UHT TO RELEASE 3 BOYDBOLTS ON N SIDE OF C/S
	2+43	RELEASE 4 BOYDBOLTS W SIDE C/S + ANT BB
	2+44	VER SUNSHLD ROOF RELEASED FROM VERIFY C/S STILL ALIGNED AND
		LEVEL,CORRECT IF NOT RELEASE 2 NORTH SIDE INTERIOR
	2+45	RELEASE CENTER BOYDBOLT (TOP USE UHT OR GLOVE TO GUIDE
		CHECK SIDE CURTAINS DEPLOYED, DISCARD COVERS
	2+45	ATTACH REAR AND FRONT OF SIDE CURTAIN, BOTH SIDES TO C/S
CONTINGENCY ALLOTMENT TIME		
	2+46	ATTACH REAR THERMAL CURTAIN TO SIDES
		TIME ALLOTMENT FOR CONTINGENCY
	2+47	
	2+48	
	2+49	
	2+50	

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES
	2+50	
	2+51	
		SET UP AND ALIGN ALSEP ANTENNA
		RETRIEVE ANTENNA MAST
	2+52	REMOVE AIMING MECHANISM
		RETURN TO PACKAGE NO.1
		INSTALL ANTENNA MAST ON PKG 1
EMPLACE HFE PROBE 2		REMOVE DUST COVER (LANYARD)
PICK UP PROBE BOX	2+53	INSTALL AIMING MECHANISM ON MAST
PULL PROBE OUT OF BOX, DANGLE BY CORD**		REMOVE AIMING MECH PKG-DISCARD
		GRASP ANTENNA AND INSTALL ON AIMING MECHANISM
	2+54	VERIFY HELIX SECURE
		ADJUST LEVELING KNOBS, USING BUBBLE LEVEL
		OBSERVE SUN COMPASS,ADJUST
	2+55	ENTER AZIMUTH - 24.58
ENGAGE RAMMER CROWFOOT ABOVE THERMAL SHIELD		
INSERT AND DROP PROBE INTO		ENTER ELEVATION -16.59
PUSH SHIELD DOWN HOLE, PUSH	2+55	
PROBES TO BOTTOM VERIFY BY MARK ON RAMMER. REPORT DEPTH		RECHECK LEVEL
		ACTIVATE CENTRAL STATION
MARK IF NOT AT MARK		PUSH IN SHORT SW, VERIFY AMPS
	2+56	USE UHT, TURN ON SW 1(CW),SW 5(CCW)
		RECEIVE CONFIRMATION OF GOOD RF AND DATA TRANS- MISSION IF
	2+57	REQUIRED**
SLIDE EXTERNAL SUNSHIELD OVER		
MEASURE AND REPORT STEM HT		
REMOVE ALL DEBRIS FROM AREA (16 FT OR MORE)	2+58	
TAKE RACK AND DRILL TO CORE SITE	2+59	
ALIGN HFE ELECT		
USE UHT TO RELEASE 4 BOUDBOLTS ON HFE ELECT		
	3+00	
**CAUTION HANDLE ONLY AT MIDDLE OF SECTIONS		**SW [2] TURNS ON CENTRAL POWER
		SW [3] TURNS EXP. [SEQ] TO OPERATE SW [4] TURNS EXP. TO HIGH BIT RATE

MISSION: APOLLO 16 | DATE: 15 DECEMBER 1971
EVA: 1 | REVISION: D

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES
ENGAGE AND USE UHT TO REMOVE HFE ELECT FROM SUBPALLET		
KICK SUBPALLET OUT FROM UNDER PLACE HFE ON OPEN SIDE SOUTH,		
BUBBLE LEVEL HFE	3+00	
ALIGN TO TBD MARK, UHT DEPLOY GEOPHONES		DEPLOY GEOPHONES
PICK UP HAMMER FROM LRV, 2 STAKES FROM M/P BASE	3+01	PICK UP THUMPER/GEOPHONE. WALK 8 FT NORTH UNREELING CABLES FROM T/G
PUT ON 70MM CAMERA	3+02	STOP BY LOOPS IN BOTH CABLES
DRIVE STAKE THRU LOOPS BOTH CABLES		PROCEED TO DEPLOY CABLE TO REMOVE GEOPHONE SPRING CLIP
	3+03	REMOVE GEOPHONE REEL OFF 150 FT OF CABLE AND WATCH FOR FLAG ON CABLE THEN WATCH FOR CABLE TO GEOPHONE
EMPLACE GEOPHONE, CK ALIGN 7° WALK WITH CDR	3+04	
	3+05	
	3+05	REMOVE GEOPHONE SPRING CLIP REMOVE GEOPHONE
STAKE GEOPHONE LINE	3+06	
EMPLACE GEOPHONE, CK ALIGN 7° STAY AT GEOPHONE 2, ASSIST CDR IN KEEPING STRAIGHT LINE ONSUN. PHOTO HIM WHEN HE IS AT	3+07	REEL OFF 150 FT OF CABLE AND WATCH FOR FLAG REMOVE GEOPHONE SPRING CLIP
3RD GEOPHONE POSITION DURING ALSEP PHOTO RETURN TO VICINITY C/S	3+08	
	3+09	
	3+10	REMOVE GEOPHONE EMPLACE GEOPHONE, CK ALIGN 7°

MISSION: APOLLO 16 DATE: 15 DECEMBER 1971

EVA: 1 REVISION: D

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES
PHOTO ALSEP		
PHOTO BORE STEM,DSUN, 11 FT		
PHOTO BORE STEM, STEREO PR, XSUN, 7 FT,C/S	3+10	
PHOTO ELECT,XSUN, 7 FT, C/S		
PHOTO W BORE STEM,D SUN,11 FT	3+11	
PHOTO BORE STEM,STEREO		CONDUCT THUMPER EXPERIMENT
WALK TO LSM		TAKE UP POS BY MARK FOR EACH SHOT
		NOTIFY CREWMAN EACH SHOT-ALL
	3+12	MOTION CEASE FOR 15 SEC.
		SELECT ASI-CALL NUMBER TO MCC
		ROTATE ARM SW,WAIT 4, PRESS IN
PHOTO LSM SUNCOMPASS,3FT		REPEAT ABOVE AT EACH MARKER 9
	3+13	TIMES**
PULL LANYARD,DEPLOY		
PHOTO LSM 7 FT, C/S IN FIELD, SENSOR HEADS		
PHOTO RTG 7 FT, C/S IN FIELD	3+14	
	3+15	
PHOTO C/S, XSUN,7FT, LOOKING S		
PHOTO PSE XSUN,3FT,		
PHOTO PSE DSUN,7FT, C/S IN		
PHOTO C/S, XSUN,7FT, SWITCHES	3+15	
PHOTO PAN, 10 FT S C/S (FOCUS 74)		
	3+16	
	3+17	
SAMPLE OR STANDBY FOR THUMPER	3+18	
	3+19	
	3+20	
		**WATCH FOR 30 FT SKIP VICINITY GEOPH 2
		PAUSE 10 SEC AFTER EACH SHOT

MISSION: APOLLO 16 — DATE: 15 DECEMBER 1971

EVA: 1 — REVISION: D

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES
	3+20	
	3+21	
		REPEAT ABOVE AT EACH MARKER 9 TIMES
	3+22	
	3+23	
	3+24	
	3+25	
	3+25	
	3+26	
	3+27	
<u>PREPARE DRILL FOR CORING</u> PLACE DRILL ON SURFACE TAKE OUT BIT STEM STRING PICK UP DRILL, INSERT STEM BIT	3+28	
SLACKTIME TASK INSERTED	3+29	
	3+30	

MISSION: APOLLO 16		DATE: 15 DECEMBER 1971
EVA: 1		REVISION: D
LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES
	3+30	
	3+31	
	3+32	
	3+33	
	3+34	
	3+35	RETURN TO C/S
		TURN ASTRO SW 5 - CW
	3+35	THUMPER FINISHED
THUMPER FINISHED		ADVISE LMP THUMPER FINISHED
PROCEED TO NEXT ACTIVITY		
DRILL CORE		DEPLOY MORTAR PACKAGE BASE
ENERGIZE DRILL AND DRILL DOWN	3+36	CARRY M/P AND BASE 50 FT NE
PLACE WRENCH ON STEM		
TWIST DRILL CCW UNTIL FREE		
FROM STEM		PLACE M/P ON SURFACE
REMOVE WRENCH	3+37	PULL PIN, UNFOLD AND LOCK BASE
TAKE OUT 2ND STRING, THREAD ON		
PLACE DRILL ON STEM, ENSURE		PULL PINS TO DEPLOY STAKES (4)
ENERGIZE DRILL AND DRILL DOWN		PLACE BASE ON SURFACE, ROUGH
PAST STEM JOINT	3+38	WITH UHT, ALIGN BASE TO DOWNSUN
PLACE WRENCH ON STEM		LINE**
TWIST DRILL CCW UNTIL FREE		TIME ALLOTMENT FOR OFF-NOMINAL
REMOVE WRENCH		DEPLOY OF T/G ALONG OTHER
TAKE OUT LAST STRING, THREAD	3+39	THAN DOWNSUN LINE
PLACE DRILL ON STEM, ENSURE		
ENERGIZE DRILL AND DRILL DOWN		
PAST STEM JOINT		
	3+40	
		** OR TO ANGLE-OFF OF T/G LINE IF NOT DOWNSUN DEPLOYED WITHIN ACC OF 5 DEG

MISSION: APOLLO 16 — DATE: 15 DECEMBER 1971
EVA: 1 — REVISION: D

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES
TIME ALLOTMENT FOR CONTINGENCY	-	
	3+40	
	3+41	
	3+42	
	3+43	
		WITH UHT OR BOOT PUSH BASE LEVEL INTO SURFACE
	3+44	SET UP MORTAR PACKAGE PICK UP M/P, WALK TO W SIDE OF ENGAGE PINS,FRONT OF M/P,INTO HOLES IN BASE
	3+45	SWING M/P REAR ONTO POSTS BUBBLE LEVEL M/P
	3+45	<u>PHOTO MORTAR PACKAGE</u> PHOTO M/P XSUN,15 FT,C/S IN PHOTO M/P DNSUN,7
	3+46	
	3+47	
	3+48	
	3+49	
	3+50	

MISSION: APOLLO 16 — DATE: 15 DECEMBER 1971

EVA: 1 — REVISION: D

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES
RECOVER CORE		
RUN DRILL FOR 10-15 SEC		
PULL UP ON DRILL UNTIL AT MAX HANDLE HEIGHT**		
	3+50	RECOVER CORE
ENGAGE WRENCH ON TOP STEM		PULL UP ON DRILL
TWIST OFF DRILL CCW; DISCARD		ASSIST LMP
CAP TOP OF STEM		
GRASP STEM STRING AND PULL UP	3+51	GET CAP ASSY FROM RACK
		PULL UP STEM AS REQUIRED
IF NO GO, INSTALL JACK		
	3+52	INSTALL JACK
	3+53	
JACK STEM UP OUT OF SURFACE	3+54	
		ASSIST LMP
	3+55	
	3+55	
	3+56	
	3+57	
	3+58	
PULL STEM OUT OF JACK	3+59	
		PULL STEM OUT OF SURFACE (WITH LMP)
CAP BIT END		
TAKE STRING OVER TO LRV VISE		
	4+00	

**INSTALL JACK AT THIS POINT IF NO GO

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES
POSITION STRING IN VISE(MIDDLE JOINT)ENGAGE WRENCH		HOLD CAP ASSY HOLD STEMS IN VISE
BREAK AND SEPARATE JOINT 3		HOLD CAP ASSY
CAP BOTH ENDS	4+00	
STOW THE TWO SECTIONS IN RACK		
STOW EQUIPMENT ON LRV		STOW EQUIPMENT ON LRV
STOW GNOMON ON LRV STOW EXTENSION HDL/SCOOP IN HTC	4+01	STOW BAGS (IF ANY) ON LRV (HTC) LCRU MODE - 1
	4+02	
	4+03	ENTER LRV ENSURE PARKING BRAKE ENGAGED ENTER LRV
ENTER LRV	4+04	SECURE SAFETY BELT
ENTER LRV SECURE SAFETY BELT READ OUT LRV DISPLAYS		
	4+05	
TRAVERSE TO STATION 1 NAVIGATE TO STATION 1		TRAVERSE TO STATION 1 DRIVE TO STATION 1
	4+05	
	4+06	
	4+07	
	4+08	
	4+09	
	4+10	

MISSION: APOLLO 16 DATE: 15 DECEMBER 1971
EVA: 1 REVISION: D

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES
	4+10	
	4+11	
	4+12	
	4+13	
	4+14	
	4+15	
	4+15	
	4+16	
	4+17	
	4+18	
	4+19	
		EXIT LRV
		SET HANDBRAKE
EXIT LRV		POWER DOWN LRV
	4+20	

MISSION: APOLLO 16 DATE: 15 DECEMBER 1971
EVA: 1 REVISION: D

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES
READ OUT ALL NAV DISPLAYS RELEASE SAFETY BELT EXIT LRV		RELEASE SAFETY BELT EXIT LRV DUST ALL RADIATOR SURFACES GCTA & LCRU
	4+20	
	4+21	POINT HGA TO EARTH, SW LCRU TO 2 MODE(FM/TV)
STATION 1		STATION 1
STATION 1 TASKS	4+22	STATION 1 TIME: 30 MINUTES TASKS: PAN
	4+23	RAKE/SOIL SAMPLE CRATER RIM SAMPLING
	4+24	LPM SITE MEASUREMENT PERFORM TASKS
	4+25	
	4+25	
	4+26	
	4+27	
	4+28	
	4+29	
	4+30	

MISSION: APOLLO 16 DATE: 15 DECEMBER 1971
EVA: I REVISION: D

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES
	4+30	
	4+31	
	4+32	
	4+33	
	4+34	
	4+35	
STATION 1 (CONT'D) STATION 1 TASKS		STATION 1 (CONT'D) STATION 1 TIME: 30 MINUTES TASKS: PAN
	4+35	RAKE/SOIL SAMPLE AWAY CRATER RIM SAMPLING
	4+36	LPM SITE MEASUREMENT PERFORM TASKS
	4+37	
	4+38	
	4+39	
	4+40	

MISSION: APOLLO 16 | DATE: 15 DECEMBER 1971
EVA: 1 | REVISION: D

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES
	4+40	
	4+41	
	4+42	
	4+43	
	4+44	
	4+45	
	4+45	
	4+46	
	4+47	LCRU MODE: 1
		ENTER LRV
ENTER LRV	4+48	ENSURE PARKING BRAKE ENGAGED
ENTER LRV		ENTER LRV
SECURE SAFETY BELT		SECURE SAFETY BELT
READ OUT LRV DISPLAYS		SLACKTIME TASK INSERTED
	4+49	
TRAVERSE TO STATION 2		TRAVERSE TO STATION 2
NAVIGATE TO STATION 2		DRIVE TO STATION 2
	4+50	

MISSION: APOLLO 16 DATE: 15 DECEMBER 1971
EVA: 1 REVISION: D

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES
	4+50	
	4+51	
	4+52	
	4+53	
	4+54	
	4+55	
		EXIT LRV
	4+55	SET HANDBRAKE
EXIT LRV		POWER DOWN LRV
READ OUT ALL NAV DISPLAYS		RELEASE SAFETY BELT
RELEASE SAFETY BELT		EXIT LRV
EXIT LRV	4+56	DUST ALL RADIATOR SURFACES GCTA & LCRU
SLACKTIME TASK INSERTED		
	4+57	
		POINT HGA TO EARTH, SW LCRU TO 2 MODE(FM/TV)
	4+58	
STATION 2		STATION 2
STATION 1 TASKS		STATION 2 TIME: 31 MINUTES
		TASKS: PAN
	4+59	
		SAMPLING OF CRATER AREA
	5+00	

MISSION: APOLLO 16 DATE: 15 DECEMBER 1971
EVA: 1 REVISION: D

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES
		GRAND PRIX 500 MM PHOTOS OF OUTLYING AREAS PERFORM TASKS
	5+00	
	5+01	
	5+02	
	5+03	
	5+04	
	5+05	
	5+05	
	5+06	
	5+07	
	5+08	
	5+09	
	5+10	

MISSION: APOLLO 16 DATE: 15 DECEMBER 1971

EVA: 1 REVISION: D

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES
	5+10	
SLACKTIME TASK INSERTED		
STATION 2 (CONT'D) STATION 1 TASKS	5+11	STATION 2 (CONT'D) STATION 2 TIME: 31 MINUTES TASKS: PAN
	5+12	SAMPLING OF CRATER AREA
	5+13	GRAND PRIX 500 MM PHOTOS OF OUTLYING AREAS PERFORM TASKS
	5+14	
	5+15	
	5+15	
	5+16	
	5+17	
	5+18	
	5+19	
	5+20	

MISSION: APOLLO 16 | DATE: 15 DECEMBER 1971
EVA: 1 | REVISION: D

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES
	5+20	
	5+21	
	5+22	
	5+23	
	5+24	LCRU MODE: <u>1</u>
	5+25	<u>ENTER LRV</u>
<u>ENTER LRV</u>		ENSURE PARKING BRAKE ENGAGED
ENTER LRV		ENTER LRV
SECURE SAFETY BELT		SECURE SAFETY BELT
READ OUT LRV DISPLAYS	5+25	
<u>RETURN TO ALSEP SITE (STA 3)</u>		<u>RETURN TO ALSEP SITE (STA 3)</u>
NAVIGATE TO ALSEP SITE	5+26	DRIVE TO ALSEP SITE
	5+27	
	5+28	
	5+29	
	5+30	

MISSION: APOLLO 16 DATE: 15 DECEMBER 1971

EVA: 1 REVISION: D

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES
	5+30	
	5+31	
	5+32	
	5+33	
	5+34	
		<u>EXIT LRV</u> SET HANDBRAKE
<u>EXIT LRV</u> READ OUT ALL NAV DISPLAYS RELEASE SAFETY BELT EXIT LRV	5+35	POWER DOWN LRV RELEASE SAFETY BELT EXIT LRV DUST ALL RADIATOR SURFACES GCTA & LCRU
	5+35	
	5+36	POINT HGA TO EARTH,SW LCRU TO 2 MODE(FM/TV)
<u>SOIL MECHANICS</u> DO DOUBLE CORE PENETROMETER TESTS COMPREHENSIVE SAMPLING	5+37	<u>SOIL MECHANICS</u> STATION TIME: 50 MINUTES DO TRENCH DIGGING AND DOCUMENTATION DOCUMENTED SAMPLING
SOIL MECH	5+38	COMPREHENSIVE SAMPLING SOIL MECH
	5+39	
	5+40	

MISSION: APOLLO 16 | DATE: 15 DECEMBER 1971
EVA: 1 | REVISION: D

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES
	5+40	
	5+41	
	5+42	
	5+43	
	5+44	
	5+45	
	5+45	
	5+46	
	5+47	
	5+48	
	5+49	
	5+50	

MISSION: APOLLO 16 | DATE: 15 DECEMBER 1971
EVA: 1 | REVISION: D

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES
<u>SOIL MECHANICS</u> (CONT'D)		<u>SOIL MECHANICS</u> (CONT'D)
DO DOUBLE CORE		STATION TIME: 50 MINUTES
PENETROMETER TESTS		DO TRENCH DIGGING AND
COMPREHENSIVE SAMPLING	5+50	DOCUMENTATION
		DOCUMENTED SAMPLING
SOIL MECH		COMPREHENSIVE SAMPLING
	5+51	SOIL MECH
	5+52	
	5+53	
	5+54	
	5+55	
	5+55	
	5+56	
	5+57	
	5+58	
	5+59	
	6+00	

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES
	6+00	
	6+01	
	6+02	
SOIL MECHANICS (CONT'D)		SOIL MECHANICS (CONT'D)
DO DOUBLE CORE PENETROMETER TESTS COMPREHENSIVE SAMPLING	6+03	STATION TIME: 50 MINUTES DO TRENCH DIGGING AND DOCUMENTATION DOCUMENTED SAMPLING
SOIL MECH	6+04	COMPREHENSIVE SAMPLING
		SOIL MECH
	6+05	
	6+05	
	6+06	
	6+07	
	6+08	
	6+09	
	6+10	

MISSION: APOLLO 16 DATE: 15 DECEMBER 1971

EVA: 1 REVISION: D

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES
	6+10	
	6+11	
	6+12	
	6+13	
	6+14	
	6+15	
PICK UP CORE STEMS	6+15	
<u>ARM MORTAR PACKAGE</u> ENGAGE UHT IN LATCH ON SAFETY TRY TO REMOVE UHT WITHOUT RETRIEVE SAFETY PIN LANYARD USE UHT AND ROTATE 2 SAFE/ARM RECHECK ALIGNMENT AND LEVEL	6+16	
	6+17	
	6+18	
WALK TO C/S, TURN ASTRO SW 5 CCW.		
	6+19	
	6+20	

MISSION: APOLLO 16 DATE: 15 DECEMBER 1971
EVA: 1 REVISION: D

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES
	6+20	
	6+21	LCRU - MODE 1
	6+22	<u>ENTER LRV</u> ENSURE PARKING BRAKE ENGAGED ENTER LRV SECURE SAFETY BELT
<u>ENTER LRV</u> ENTER LRV SECURE SAFETY BELT READ OUT LRV DISPLAYS	6+23	
<u>RET TO LM</u> RET TO LM	6+24	<u>RET TO LM</u> RET TO LM
	6+25	
	6+25	
	6+26	
	6+27	
	6+28	
<u>PARK LRV</u> READ OUT ALL NAV & SYSTEM DISPLAYS, EXIT	6+29	<u>PARK LRV</u> PARK LRV AT MESA IN SUN, XSUN, HEADING N(MCC ADVISE)
	6+30	POWER DOWN

CREW EVA CHECKLIST

VOICE DATA

MISSION: APOLLO 16 DATE: 15 DECEMBER 1971

EVA: 1 REVISION: D

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES
PHOTO LRV XSUN, DNSUN,		PULL ALL CB'S EXCEPT AUX, BUS A & C
BEFORE/AFTER DUSTING		EXIT LRV
	6+30	
		POINT HGA TO EARTH
	6+31	SET LCRU MODE SW - 3 (TV/RMT) DUST OFF SURFACES--LCRU, GCTA, TV MIRRORS LRV BATTERIES, LENS BRUSH
	6+32	FOR TV LENS — CONFIGURE LCRU COVERS AS MCC ADVISES
	6+33	
	6+34	
	6+35	
	6+35	
	6+36	
STOW 70 MM CAM ON LRV		OPEN LRV RADIATORS DUST BATTERIES (if req'd)
<u>DEPLOY SOLAR WIND (SWC)</u> RELEASE 2 SWC TIE-DOWN SNAP CLOSE MESA BLANKETS	6+37	
CARRY SWC TO DEPLOYMENT SITE 60 FT FROM LM OFF QUAD I	6+38	<u>PHOTO FAR UV CAMERA</u> PHOTO CAMERA XSUN 20 FT, F5.6 1/60 PHOTO CAMERA AZ CIRCLE, 3 FT, DNSUN
EXTEND EACH SECTION OF STAFF UNTIL IT LOCKS (REDBAND) APPLY COMPRESSING FORCE TO EXTEND SHADE CYLINDER AND EXTEND FOIL SHADE AND HOOK TO LOWER PORTION OF STAFF	6+39	<u>RESET FAR UV CAMERA</u> PUSH RESET SW - CHECK FILM UNLOCK AND SET AZIMUTH - TBD DEG, RELOCK AZIMUTH
PRESS STAFF INTO SURFACE WITH FOIL NORMAL TO SUN (SIDE MARKED 'SUN' TO SUN)	6+40	SET ELEVATION - TBD DEG

MISSION: APOLLO 16 DATE: 15 DECEMBER 1971
EVA: 1 REVISION: D

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES
UNLOAD PLSS TOOL CARRIERS		UNLOAD PLSS TOOL CARRIERS
HOLD STILL FOR OFFLOAD		OFFLOAD SCB FROM LMP, TEMP STOW
		OFFLOAD & DISCARD CAP
		OFFLOAD HAMMER AND STOW ON HTC
	6+40	
OFFLOAD SCB FROM CDR, TEMP STOW		OFFLOAD RAMMER AND STOW ON HTC
STOW PLSS ANTENNA (CDR)		STOW PLSS ANTENNA (LMP)
PACK SRC 1		HOLD STILL FOR OFFLOAD
TAKE SRC COLL BAG OFF HTC AND	6+41	
PLACE SRC BAG IN SRC-TUCK IN		PACK ETB
ALL WAY AROUND		TAKE OFF 70MM CAM AND PLACE ON
PLACE EXTRA ROCKS IN BAGS IN		GET ETB FROM MESA, PLACE ON LRV
SRC IF ROOM	6+42	FLOORPAN
		PLACE CDR CAM IN ETB
PULL SKIRT OFF SRC AND DISCARD		OFFLOAD MAGS- 2-70 AND 2-16
CLOSE SRC AND LATCH BOTH SIDES		FROM LRV INTO ETB
	6+43	
		TAKE MAG L OFF 500 MM CAM, PUT
TIDY MESA BLANKETS		MAG IN ETB AND REPLACE CAM
	6+44	UNDER SEAT
		TAKE 16 MM MAG OFF DAC, PLACE
	6+45	MAG IN ETB
		PUT MAP(S) IN ETB
		TAKE ETB TO MESA, PLACE 6
	6+45	CONTAINMENT BAGS IN ETB
INGRESS (LMP 2)		
		INGRESS (LMP 2)
CLEAN OFF CDR		GET BRUSH, CLEAN OFF LMP
	6+46	
GRAB SCB(S) AND CORE STEMS	6+47	
MOVE TO FOOT OF LADDER		
REMOVE TONGS, OTHER GEAR(IF		
ANY)		RESET FAR UV CAMERA
MOVE TO TOP OF LADDER	6+48	PUSH RESET SW - CHECK FILM
		UNLOCK AND SET AZIMUTH - TBD
		DEG, RELOCK AZIMUTH
		SET ELEVATION -TBD DEG
	6+49	
OPEN LM HATCH		
		PUSH RESET SW - CHECK FILM
	6+50	

CREW EVA CHECKLIST

VOICE DATA

MISSION: APOLLO 16 | DATE: 15 DECEMBER 1971
EVA: 1 | REVISION: D

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES
MOVE THROUGH HATCH	6+50	
	6+50	
	6+51	
	6+52	
	6+53	
INGRESS (CDR 1)		INGRESS (CDR 1)
RECEIVE SRC 1,STOW;DETACH LEC		
ASSIST CDR- STOW PLSS ANT		TURN OFF LCRU PWR SW
	6+54	DANGLE ETB FROM LEC
		DUST OFF EMU,VERIFY TOOLS OFF
	6+55	GRAB SRC 1
		ASCEND LADDER TO PLATFORM
	6+55	
		PASS SRC 1 INSIDE
	6+56	PULL UP ETB,PASS INTO A/S
		DROP LEC HOOKS BACK TO SURFACE
		MOVE THRU HATCH
	6+57	
REPRESSURIZE CABIN		REPRESSURIZE CABIN
INITIATE REPRESS**	6+58	CLOSE HATCH
	6+59	
	7+00	

**DETAIL PROCEDURES IN'LUNAR SURFACE CHECKLIST' FOR REPRESSURIZATION

3.2.2 EVA-2

The detailed timeline procedures for EVA-2 are shown on the following vertical format pages.

The detailed sampling and related procedures during the traverse are given in Section 3.2.5 along with those pages of the crew cuff checklist which serve as a guide for the crew while doing these procedures.

APOLLO 16

NOMINAL TIMELINE

LUNAR SURFACE EVA 2

DECEMBER 1971

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES	LCRU TV	TASK FUNCTION LMP	TASK FUNCTION CDR
Start EVA watch	0	Start EVA watch (Call "MARK")		PRE-EGRESS OPERATIONS	PRE-EGRESS OPERATIONS
		NOTE: detailed procedures are presented in "Lunar Surface Checklist" Equipment Prep-EVA 2 Section.			
Open hatch	0+10	EGRESS			

MSC/CPD-1691 NASA — MSC

MISSION: APOLLO 16 DATE: DEC. 1971
EVA: 2

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES	SEQ CAM.	TASK FUNCTION LMP	TASK FUNCTION CDR
Hand jettison bag to CDR	0+10	Move thru hatch			
		Toss jettison bag to surface (-y strut)			
Hook up LEC to ETB		Pass in LEC hooks			
Hand ETB to CDR					
Recorder - OFF		Lower ETB to surface			
Verify - VOX Sens - MAX - CB config - Utility, floodlights - OFF		Descend to surface			
		Gain surface			
EGRESS					
Move thru hatch		RESET FAR UV CAMERA			
Close hatch		Punch "reset", verify target with MCC			
Descend to surface		Enter new azimuth, elevation			
	0+20	TV Close LRV CB's			
Gain Surface		Close battery covers (verify closure mated)			
Get out SRC 2, clamp on SRC table		LCRU SW - EXT			
Open SRC 2, take out SCB 2. Interim stow on MESA, close control sample.		Align HGA LCRU Covers 100% OPEN Place brush on LCRU TRAVERSE LOADUP Get ETB and place on LRV Floor pan (Left)			
Take SCB 2 to LRV, place on HTC (left side)		Place LMP HEDC on LMP seat			
		Place 1-16mm mag & maps on LMP seat			
Take out SCB (3 or 4) place on HTC (right side)		Install mag L on 500 mm cam			
Take 2-20 bag dispensers from SCB 2 & place on seats		Place 2-70mm mags and 2-16mm mags under seat			
Transfer equipment from SCB 2 to SCB 3 or 4	0+40				

MSC/CPD-1691 NASA — MSC

MISSION: APOLLO 16
EVA: 2

DATE: DEC. 1971

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES	SEQ. CAM.	TASK FUNCTION LMP	TASK FUNCTION CDR
• core tubes - 1U, 1L • 2-20 Bag dispensers • 1-core tube cap assy	0+40	Return ETB to SRC table			
Put SCB 3 or 4 on floor board		Tidy MESA Blankets			
Put 16mm mag or DAC ✓ operation		LMP LOADUP			
Put maps in holder Put SCB under seat		Get extra SCB (NO's 5-8) from pallet, place on LMP			
CDR LOADUP (Hold Still as CDR requests)		Get core tube cap assy & place on LMP Get hammer & place in pocket or on LMP			
Get SCB & place on CDR Erect CDR PLSS antenna		Erect LMP PLSS antenna Hold Still			
Verify hand tools, etc. secure		RESET FAR UV CAMERA			
LRV PREP		Punch "reset", verify target with MCC Enter new azimuth, elevation			
Don HEDC and bags Mount LRV Initialize Nav System	0+50	LRV PREP Don HEDC & Bags Switch LCRU Mode - 1 Mount LRV Power up			
DRIVE TO STA 4 - 1.2 KM					
	1+00				

MISSION: APOLLO 16 DATE: DEC. 1971
EVA: 2

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES	SEQ CAM.	TASK FUNCTION LMP	TASK FUNCTION CDR
Arrive Sta 4 Readout NAV displays Dismount LRV	1+00	Arrive Sta 4 Power down & dismount LRV			
NOTE: this overhead applies at each step		Align HGA Sw LCRU Mode - 2 Dust off TV, GCTA, LCRU Batt Covers			
STATION 4: 15 MINUTES ● Panorama ● Documented Sample					
	1+10				
NOTE: this overhead applies at each stop					
Mount LRV Read out LRV displays		Sw LCRU Mode - 1 Mount LRV			
DRIVE TO STATION 5 - 2.3 KM					
	1+30				

MISSION: APOLLO 16
EVA: 2

DATE: DEC. 1971

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES	SEQ CAM.	TASK FUNCTION LMP	TASK FUNCTION CDR
	1+30				
ARRIVE STA 5		ARRIVE STA 5			
O.H.		O.H.			

STATION 5: 30 MINUTES

1+40

- Panorama
- Surface Samples
- Core Sample (in vacuum container)
- Documented Samples

1+50

MISSION: APOLLO 16
EVA: 2

DATE: DEC. 1971

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES	SEQ CAM.	TASK FUNCTION LMP	TASK FUNCTION CDR
	1+50				
	2+00				
O.H.		O.H.			
DRIVE TO STATION 6 - 1.1 KM					
	2+10				

MISSION: APOLLO 16 DATE: DEC. 1971
EVA: 2

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES	SEQ CAM.	TASK FUNCTION LMP	TASK FUNCTION CDR

2+10

STONE MOUNTAIN

ARRIVE STA 6 — ARRIVE STA 6

O.H. — O.H.

STATION 6 - 1 HOUR

- Panorama
- 500 mm Photography
- Double Cove

2+20

- Comprehensive Sample
- Documented Samples
- Panorama

2+30

MISSION: APOLLO 16
EVA: 2

DATE: DEC. 1971

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES	SEQ. CAM.	TASK FUNCTION LMP	TASK FUNCTION CDR
	2+30				
	Station 6 - Cont'd				
	2+40				
	2+50				

MISSION: APOLLO 16
EVA: 2

DATE: DEC. 1971

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES	SEQ. CAM.	TASK FUNCTION LMP	TASK FUNCTION CDR
	2+50				
	Station 6 - Cont'd				
	3+00				
	3+10				

MISSION: APOLLO 16
EVA: 2

DATE: DEC. 1971

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES	SEQ CAM.	TASK FUNCTION LMP	TASK FUNCTION CDR
	3+10				
Close out Sta. 6		Close out Sta. 6			
O.H.		O.H.			
DRIVE TO STA. 7 - 0.3 KM					
ARRIVE STA 7		ARRIVE STA 7			
O.H.		O.H.			
STATION 7 - 45 MINUTES					
	3+20				
● Panorama ● Documented Samples ● Panorama					
	3+30				

MISSION: APOLLO 16
EVA: 2

DATE: DEC. 1971

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES	SEQ CAM	TASK FUNCTION LMP	TASK FUNCTION CDR
	3+30				
	Station 7 - Cont'd				
	3+40				
	3+50				

MISSION: APOLLO 16
EVA: 2

DATE: DEC. 1971

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES	SEQ CAM	TASK FUNCTION LMP	TASK FUNCTION CDR
	3+50				
	Station 7 - Cont'd				
O.H.		O.H.			
	4+00				
	DRIVE TO STATION 8 - 1.5 KM				
	4+10				

MISSION: APOLLO 16
EVA: 2

DATE: DEC. 1971

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES	SEQ CAM.	TASK FUNCTION LMP	TASK FUNCTION CDR
	4+10				
	"STUBBY" CRATER				
ARRIVE STA. 8		ARRIVE STA. 8			
	STATION 8 - 20 MINUTES				
	● Panorama ● 500 mm photography (across Stubby) ● Documented Samples				
	4+20				
	4+30				

MISSION: APOLLO 16
EVA: 2

DATE: DEC. 1971

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES	SEQ CAM.	TASK FUNCTION LMP	TASK FUNCTION CDR
	4+30				
O.H.		O.H.			
DRIVE TO STA 9 - 0.9 KM					
BETWEEN "WRECK" & "STUBBY"					
ARRIVE STA. 9	4+40	ARRIVE STA. 9			
STATION 9 - 55 MINUTES ● Panorama ● Double Core ● Comprehensive Sample ● Documented Sample					
	4+50				

MISSION: APOLLO 16

EVA: 2

DATE: DEC. 1971

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES	SEQ. CAM.	TASK FUNCTION LMP	TASK FUNCTION CDR
	4+50				
	Station 9 - Cont'd				
	5+00				
	5+10				

MSC/CPD-1691 NASA — MSC

MISSION: APOLLO 16
EVA: 2

DATE: DEC. 1971

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES	SEQ. CAM.	TASK FUNCTION LMP	TASK FUNCTION CDR
	5+10				
	Station 9 - Cont'd				
	5+20				
	5+30				

MISSION: APOLLO 16
EVA: 2

DATE: DEC. 1971

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES	SEQ CAM.	TASK FUNCTION LMP	TASK FUNCTION CDR
	5+30				
O.H.		O.H.			
DRIVE TO STATION 10 - 1.6 KM					
	5+40				
ARRIVE STA. 10		ARRIVE STA. 10			
O.H.		O.H.			
	5+50				

MISSION: APOLLO 16
EVA: 2

DATE: DEC. 1971

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES	SEQ CAM	TASK FUNCTION LMP	TASK FUNCTION CDR
	5+50				
	STATION 10 - 20 MINUTES				
	• Panorama • Radial Sample				
	6+00				
O.H.		O.H.			
	DRIVE TO LM - 1.4 KM				
	6+10				

MISSION: APOLLO 16 DATE: DEC. 1971
EVA: 2

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES	SEQ CAM.	TASK FUNCTION LMP	TASK FUNCTION CDR
	6+10				
	RETURN TO LM				
ARRIVE AT LM	6+20	ARRIVE AT LM			
LRV PARK		LRV PARK			
Read out all LRV Displays		Park LRV at MESA in Sun X Sun (heading - TBD)			
Pull LRV CB's (BUS A, B, C & D)		POWER DOWN LRV(±15 VDC SW-OFF)			
Dismount LRV		Dismount LRV			
TV		RESET FAR UV CAMERA			
Align HGA		Punch "reset", verify target with MCC			
Switch LCRU Mode - 3					
Dust TV, GCTA, LCRU & LRV batt covers		Enter new azimuth, elevation			
Photo LRV - X Sun Stereo & Dn Sun					
UNLOAD PLSS		UNLOAD PLSS			
		Remove SCB & Stow on HTC			
Hold Still		Remove core cap disp. & discard			
	6+30				

MISSION: APOLLO 16 DATE: DEC. 1971
EVA: 2

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES	SEQ CAM	TASK FUNCTION LMP	TASK FUNCTION CDR
	6+30	Place rammer in HTC			
		Place hammer in HTC & dress carrier			
Place 70 mm HEDC on seat		Stow LMP PLSS Antenna			
Remove SCB & place on HTC.		Hold Still			
Dress carrier Stow CDR PLSS antenna					
PACK SRC 2		PACK ETB			
Get SCB 2 from HTC		Get ETB from MESA			
Place pouches side up in SRC 2		Place in ETB: 2 - HEDC			
Remove skirt & seal prot.		2 - 70 mm mags 2 - 16 mm mags			
Close & seal SRC 2 Place SRC 2 by ladder on Pad		1 - mag from 500 camera (restow cam under seat)			
Off load pallet 2, pack LiOH can in pallet pocket		1 - 16 mm mag from DAC			
Verify 2 cans green - report	6+40	1 - Set maps			
Get brush from LCRU					
EMU CLEAN		EMU CLEAN			
Clean CDR EMU		Hold Still			
Hand Brush to CDR		Clean LMP EMU			
Get extra SCB from HTC		Carry ETB to SRC table & hang up			
INGRESS		SRC 2 TRANSFER			
Climb ladder with SCB and Pallet		Climb ladder with SRC 2 or attach hooks LEC toSRC 2 & haul up SRC 2			
Open hatch					
Move thru hatch		Hand SRC 2 into A/S to LMP			
Receive & stow SRC 2					
Strip pallet 2		RESET FAR UV CAMERA			
	6+50				

MISSION: APOLLO 16 DATE: DEC. 1971
EVA: 2

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES	SEQ CAM.	TASK FUNCTION LMP	TASK FUNCTION CDR
	6+50	Punch "reset" verify target with MCC			
		Enter new azimuth, elevation			
		LRV CONFIGURE			
		LCRU - OFF			
		Blankets - MCC advise			
		Open battery covers DUST ALL LRV MIRRORS IF REQ. Grab ETB, hook up LEC			
		INGRESS			
		Climb ladder			
		Hand up ETB			
Receive ETB, Stow		Hand into A/S to LMP			
Return hooks to CDR Return Pallet 2 to CDR		Drop hooks to surface			
		Jettison pallet			
Close hatch		Move thru hatch			
REPRESS		REPRESS			
	7+00				

3.2.3 EVA-3

The detailed timeline procedures for EVA-3 are shown in the following vertical format pages.

The detailed sampling and related procedures during the traverse are given in Section 3.2.5 along with those pages of the crew cuff checklist which serve as a guide for the crew doing these procedures.

NOMINAL TIMELINE

LUNAR SURFACE EVA 3

DECEMBER 1971

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES	LCRU TV	TASK FUNCTION LMP	TASK FUNCTION CDR
Start EVA Watch	0+00	Start EVA Watch (Call "MARK")		PRE-EGRESS OPERATIONS	PRE-EGRESS OPERATIONS
		NOTE: detailed procedures are presented in "Lunar Surface Checklist" Equipment Prep-EVA 3 Section			
Open hatch	0+10	EGRESS			

MISSION: APOLLO 16 DATE: DEC. 1971
EVA: 3

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES	SEQ CAM	TASK FUNCTION LMP	TASK FUNCTION CDR
Hand jettison bag to CDR	0+10	Move thru hatch			
		Toss jettison bag to surface (-y strut)			
Hook up LEC to ETB		Pass in LEC hooks			
Hand ETB to CDR		Lower ETB to surface			
Recorder - OFF					
Verify - VOX Sens - MAX - CB Config - Utility, flood lights-OFF		Descend to surface			
		Gain Surface			
EGRESS		RESET FAR UV CAMERA			
Move thru hatch		Punch "reset", verify target with MCC			
Close hatch		Enter new azimuth, elevation			
Descend to surface					
	0+20	TV			
		Get new battery from MESA for LCRU			
Gain Surface					
ETB UNPACK					
Get ETB and place on L floor pan LRV		Change LCRU Batt - Toss old under LM			
Place LMP HEDC, 1-16 mm mag, maps on R seat		Align HGA			
		LCRU Mode Sw - INT			
		Push in LRV CB's			
Install mag L on 500 mm cam, restow					
Place 2-70 mm mags & 2-16 mm mags under seat		Close batt covers Open LCRU covers Put Dust Brush on LCRU			
		Place 16 mm mag on DAC			
Place CDR HEDC on seat		Put maps in holder			
Return ETB to SRC table		Get SCB out from under seat - lay out 2-20 bag dispensers & core tube cap assy.			
Tidy MESA blankets					
	0+30				

MISSION: APOLLO 16 DATE: DEC. 1971
EVA: 3

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES	SEQ. CAM.	TASK FUNCTION LMP	TASK FUNCTION CDR
PLSS LOADUP	0+30	PLSS LOADUP			
Hold Still		Put hammer on LMP (a place in pocket)			
		Put rammer on LMP			
		Place core tube cap assy on LMP			
		Get out extra SCB and place on LMP			
		Erect LMP PLSS antenna			
Place SCB on CDR		Hold Still			
Erect CDR PLSS Antenna					
LRV PREP		RESET FAR UV CAMERA			
		Punch "reset" verify target with MCC			
Switch LCRU Mode - 1		Enter new azimuth, elevation			
Mount LRV					
		LRV PREP			
	0+40	Mount LRV			
		Power up LRV			
		Initialize Nav			
DRIVE TO STA 11 - 2.7 KM					
	1+00				

CREW EVA CHECKLIST

VOICE DATA

MISSION: APOLLO 16
EVA: 3

DATE: DEC. 1971

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES	SEQ CAM.	TASK FUNCTION LMP	TASK FUNCTION CDR
	1+00				
ARRIVE AT STA 11		ARRIVE AT STA 11			
Read out Nav displays Dismount LRV		Power down LRV Dismount LRV			
NOTE: overhead is applicable to all stops		Dust TV, GCTA, LCRU and LRV batt covers Align HGA			
	1+10	Sw LCRU Mode - 2			
		NOTE: overhead is applicable to all stops			

STATION 11 TIME - 10 MINUTES

- Panorama
- LPM
- Rock/Soil Samples

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES
Mount LRV Read out all LRV Displays		Sw LCRU Mode - 1 Mount LRV Power up LRV

DRIVE TO STA 12 - 1.85 KM

1+30

MISSION: APOLLO 16
EVA: 3

DATE: DEC. 1971

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES	SEQ CAM.	TASK FUNCTION LMP	TASK FUNCTION CDR
	1+30				
ARRIVE AT STA. 12		ARRIVE AT STA. 12			
O.H.		O.H.			
STATION 12 TIME: 10 MINUTES • Panorama • Rock/Soil Samples					
	1+40				
O.H.		O.H.			
DRIVE TO STA. 13 - 0.4 KM CLIMB UP NORTH RAY					
ARRIVE STA. 13		ARRIVE STA. 13			
O.H.		O.H.			
	1+50				

MISSION: APOLLO 16

EVA: 3

DATE: DEC. 1971

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES	SEQ CAM.	TASK FUNCTION LMP	TASK FUNCTION CDR
	1+50				

STATION 13 TIME: 56 MINUTES

- Panorama
- 500 mm photography (N. Ray other side)
- Far Polarimetric Photos

(Move 50 ft. N.E.)

- Far Polarimetric Photos
- 500 mm photography (N. Ray, Smoky Mt.)
- Documented Samples
- Panorama

2+00

2+10

MISSION: APOLLO 16
EVA: 3

DATE: DEC. 1971

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES	SEQ. CAM.	TASK FUNCTION LMP	TASK FUNCTION CDR
	2+10				
	STATION 13 - Cont'd				
	2+20				
	2+30				

MISSION: APOLLO 16

EVA: 3

DATE: DEC. 1971

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES	SEQ CAM.	TASK FUNCTION LMP	TASK FUNCTION CDR
	2+30				
	2+40				
O.H.		O.H.			
DRIVE TO STA 14 - 0.65 KM					
ANOTHER SPOT ON N. RAY CRATER					
ARRIVE AT STA. 14		ARRIVE AT STA. 14			
O.H.		O.H.			
	2+50				

STC/CPD-0681 NASA — MSC

MISSION: APOLLO 16
EVA: 3

DATE: DEC. 1971

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES	SEQ CAM.	TASK FUNCTION LMP	TASK FUNCTION CDR
	2+50				

STATION 14 - TIME: 65 MINUTES

- Panorama
- 500 mm Photography (crater)
- Comprehensive Sample
- Documented Samples

3+00

3+10

MISSION: APOLLO 16
EVA: 3

DATE: DEC. 1971

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES	SEQ CAM.	TASK FUNCTION LMP	TASK FUNCTION CDR
	3+10				
	STATION 14 - Cont'd				
	3+20				
	3+30				

MISSION: APOLLO 16
EVA: 3

DATE: DEC. 1971

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES	SEQ CAM.	TASK FUNCTION LMP	TASK FUNCTION CDR
	3+30				
	STATION 14 - Cont'd				
	3+40				
	3+50				

MISSION: APOLLO 16
EVA: 3

DATE: DEC. 1971

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES	SEQ. CAM.	TASK FUNCTION LMP	TASK FUNCTION CDR
	3+50				
O.H.		O.H.			
DRIVE TO STATION 15 - 1.7 KM					
TO SMOKY MOUNTAIN					
	4+00				
ARRIVE STA. 15		ARRIVE STA. 15			
O.H.		O.H.			
	4+10				

CREW EVA CHECKLIST

VOICE DATA

MISSION: APOLLO 16
EVA: 3

DATE: DEC. 1971

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES	SEQ CAM.	TASK FUNCTION LMP	TASK FUNCTION CDR
	4+10				

STATION 15 - 40 MINUTES

- Panorama
- 500 mm Photography - (Smoky)
- Double Core
- Documented Sample

4+20

4+30

MISSION: APOLLO 16
EVA: 3

DATE: DEC. 1971

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES	SEQ CAM.	TASK FUNCTION LMP	TASK FUNCTION CDR
	4+30				
	STATION 15 - Cont'd				
	4+40				
O.H.		O.H.			
	DRIVE TO STA. 16 - 2.5 KM				
	5+00				

MISSION: APOLLO 16

EVA: 3

DATE: DEC. 1971

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES	SEQ CAM	TASK FUNCTION LMP	TASK FUNCTION CDR
	5+00				
ARRIVE AT STA. 16		ARRIVE AT STA. 16			
O.H.	STATION 16 - TIME: 36 MINUTES	O.H.			
	5+10				

- Panorama
- LPM
- Comprehensive Sample
- Documented Samples

5+20

MISSION: APOLLO 16
EVA: 3

DATE: DEC. 1971

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES	SEQ. CAM.	TASK FUNCTION LMP	TASK FUNCTION CDR
	5+20				
	STATION 16 - Cont'd				
	5+30				
	5+40				

CREW EVA CHECKLIST

VOICE DATA

MISSION: APOLLO 16
EVA: 3

DATE: DEC. 1971

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES
	5+40	
O.H.		O.H.
DRIVE TO STA. 17 - 0.6 KM		
ARRIVE AT STA. 17		ARRIVE AT STA. 17
O.H.		O.H.
	5+50	
STATION 17 - 10 MINUTES • Panorama • LPM • Rock/Soil Samples		
O.H.		O.H.
RETURN TO LM - 1.5 KM		
	6+00	

CREW EVA CHECKLIST

VOICE DATA

MISSION: APOLLO 16
EVA: 3

DATE: DEC. 1971

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES	SEQ CAM.	TASK FUNCTION LMP	TASK FUNCTION CDR
	6+00				
ARRIVE AT LM	6+10	ARRIVE AT LM			
LRV PARK		LRV PARK			
Read out all LRV Displays		Park LRV at MESA in sun heading 000			
		Power down LRV			
Dismount LRV		Dismount LRV			
Doff HEDC onto seat		Doff HEDC onto seat			
TV		RESET FAR UV CAMERA			
Align HGA		Punch "reset", verify target with MCC			
Switch LCRU Mode - 3 Dust TV, GCTA, LCRU, & LRV batt covers		Enter new azimuth, elevation			
UNLOAD PLSS		UNLOAD PLSS			
Hold Still		Remove LMP extra SCB & place on HTC			
		Pull tool carrier QD's and let carrier fall			
		Kick under LM			
	6+20	Stow LMP PLSS Antenna			

MISSION: APOLLO 16 DATE: DEC. 1971

EVA: 3

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES	SEQ CAM.	TASK FUNCTION LMP	TASK FUNCTION CDR
Remove CDR SCB and place on HTC	6+20	Hold Still			
Pull tool carrier QD's and let carrier fall					
Kick tool carrier under LM					
Stow CDR PLSS antenna					
PACK ETB		COSMIC RAY			
Get ETB from MESA, place on L floor pan LRV		Walk around to SEQ Bay			
Place in ETB: (L Side)		Pull white ring and pip pin to release frame			
• Mag from CDR HEDC		Carry cosmic ray exp back to MESA, rest it on SRC table			
• Mag from 500 mm cam					
• 2-70 mm mags under seat					
• 2-3 16 mm mags under seat		Pull blue ring, slide out panels (report temp labels as they appear) & fold them up			
Take ETB around to R floor pan LRV					
		Take out cosmic ray bag			
COSMIC RAY	6+30				
Assist CDR bag Cosmic Ray Panels		Bag cosmic Ray Panels			
PACK ETB: (R Side)		Leave panels on SRC table			
Place in ETB:		Discard frame under LM			
• Mag from LMP HEDC					
• Maps		ROCK BAG			
Pull pin, remove penetrometer drum, bag drum, stow in ETB		Get Big Rock Bag (BRB) from geo pallet			
Close ETB, take to SRC table, hang it up		Hang BRB on ladder hook			
		LRV			
Take off DAC from LRV for Gran Prix		Switch LCRU Mode - 1			
Get SCB's from LRV, place on MESA		Mount LRV			
		Power up LRV			
Film Gran Prix		Perform Gran Prix			
	6+40				

CREW EVA CHECKLIST

VOICE DATA

MISSION: APOLLO 16 DATE: DEC. 1971

EVA: 3

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES	SEQ CAM.	TASK FUNCTION LMP	TASK FUNCTION CDR
	6+40				
Place DAC mag in ETB SWC Retrieve SWC foil Place SWC in bag from MESA Place bagged SWC in ETB		Drive LRV 100 m E (heading from MCC) Park LRV on an MCC - supplied heading (∿ 270°) POWER DOWN LRV (±15 VDC SW - OFF) PULL CB'S: BUS B, BUS D, NAV, ±15 VDC CLOSE CB'S: AUX, BUS A, BUS C			
POLICE AREA Clean & tidy area, ensure every-thing well under LM		Dismount LRV AUX Bypass SW - ON LCRU Mode SW - 2 Power SW - EXT			
(allowance here for any special activities)		Align HGA (use AGC) Dust GCTA, TV, LCRU & LRV batt covers Open LCRU & batt covers DUST ALL LRV MIRRORS IF REQ. Take dust brush, return to LM			
CLEAN EMU'S	6+50	CLEAN EMU'S			
Hold Still		Clean LMP EMU			
Clean CDR EMU		Hold Still			
INGRESS Grab BRB & 1 SCB Climb ladder Open hatch, put in bags Move thru hatch Stow BRB & SCB		Far UV CAMERA Press "reset" 4 times - SW OFF Pull pin, remove cassette Put camera under LM Place cassette in ETB Hook ETB & SCB to LEC, dangle under platform INGRESS Climb ladder			
Unhook ETB & SCB, stow		Pass ETB & SCB to LMP			
Pass LEC out		Drop LEC			
Close hatch		Move thru hatch			
REPRESS		REPRESS			
	7+00				

3.2.4 Sampling And Related Procedures

The techniques utilized in obtaining and documenting the lunar surface samples and in performing the Lunar Field Geology and Soil Mechanics objectives are presented in the following pages and are shown on a vertical timeline format. The task times indicated in the format are approximate and are used primarily for reference.

MISSION: APOLLO 16 DATE: DEC. 15, 1971

EVA:

CORE TUBE SAMPLE

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES	SEQ CAM	TASK FUNCTION LMP	TASK FUNCTION CDR
Remove core tube from CDR's sample bag	0	Place gnomon nearby			
Assemble core tube/ext handle - report number		Remove hammer from LMP PLSS tool carrier			
Hold core tube upright on surface and press into surface by hand		Take stereo pair X-sun f8,1/250,7 ft			
Drive tube into surface (comment on difficulty)					
Remove core from surface		Photo tube & LRV X-sun f8,1/250,15 ft			
		Obtain core tube cap from LMP PLSS & cap tube			
Assist CDR		Remove core tube from ext hndl			
Get extension handle from CDR & install scoop		Get core tube tool from LMP PLSS & seat core follower against core			
		Stow core in collection bag and core tube tool & hammer on LMP PLSS			
Proceed to next sample	5	Pick up gnomon Proceed to next sample			

NOTE: Double and triple core tube procedures are similar to the above except that the cap of the lower tube must be removed to mate the lower tube to the upper tube. The caps are replaced when the tubes are disassembled and the follower on each tube is seated with tool. The double core requires an additional 2 minutes and the triple an additional 4 minutes.

MISSION: APOLLO 16 DATE: DEC. 15, 1971
EVA:

SINGLE SAMPLE DOCUMENTATION

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES	SEQ CAM	TASK FUNCTION LMP	TASK FUNCTION CDR
Describe sample	0	Describe sample & place gnomon down-sun with pointer leg at sample & color chart at 45° to sun			
Take down-sun photo at f11,1/250,11 ft		Take stereo pair X-sun at f8,1/250,7 ft			
Prepare sample bag (if reqd) & report bag number		Collect sample			
Add soil to sample (scoop) if desired.					
Seal sample bag and place in collection bag		Take X-sun after photo f8,1/250,7 ft			
*Take locator photo using LRV in background X-sun at f8,1/250,15 ft		Describe area of sample			
NOTE: Locator photo may be taken before sampling		Pick up gnomon			
Proceed to next sample	5	Proceed to next sample			
* This locator photo procedure assumes that a panorama is taken at each sampling site, showing the position of the LRV.					

MISSION: APOLLO 16 DATE: DEC. 15, 1971
EVA:

COMPREHENSIVE SAMPLE

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES	SEQ CAM	TASK FUNCTION LMP	TASK FUNCTION CDR
Remove rake from pallet	1	Select area for optimum rock distribution & place gnomon			
Assemble rake/ext hndl					
Describe sample area		Describe area, relate to surrounding terrain.			
		Mark off area to be sampled			
Take before photo down-sun f11,1/250,11 ft		Take X-sun stereo pair f8,1/250,7 ft			
Get sample bag, report number & hold for CDR to fill		Use rake, collect 1 Kg of rocks 3/8" - 1 1/2" (approx one sample bag)			
Close sample bag, seal & stow in collection bag		Get sample bag, report number & hold for LMP to fill			
Use scoop, collect 1 Kg of fines (approx one sample bag)	5				
Take locator photo using LRV in background X-sun f8,1/250, 15 ft		Close sample bag, seal & stow in collection bag			
		Take after photo X-sun f8,1/250,7 ft			
Disassemble rake/ext hndl		Complete area description			
Stow rake on pallet					
Tether ext hndl/scoop					
Proceed to next sample	10				

MISSION: APOLLO 16 DATE: DEC. 15, 1971

EVA:

PHOTO POLARIMETRIC SURVEY (Far & Near)

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES	SEQ CAM	TASK FUNCTION LMP	TASK FUNCTION CDR
	0	Install polar filter on camera			
		Assume a position X-sun from distant feature to be photographed (approx 1 Km away)			
		Reset camera f5.6,1/125,74 ft			
		Take 3 photos: f5.6,1/125,74 ft, Filter L* f5.6,1/125,74 ft, Filter C f5.6,1/125,74 ft, Filter R			
		Report filter positions Move up-sun ∿ 50 meters from first position Take 3 photos: f5.6,1/125,74 ft, Filter R* f5.6,1/125,74 ft, Filter C f5.6,1/125,74 ft, Filter L			
** Take before photo down-sun f11,1/250,11 ft		Select site for near polar series & place gnomon			
	5	Assume position 7 ft from area			
		Take 3 photos each at: 90° phase Filter L, C, R* 110° phase Filter R, C, L* 130° phase Filter L, C, R*			
** Take locator photo using LRV in background feature X-sun f8,1/250,15 ft					
Get sample bags, report number & hold for CDR.		Collect minimum of 4 rock samples from area in documented sample bags			
Close bags, seal & stow in collection bags					
* L=left, C=center, R=right for filter position which can be used in any order but must be reported to MCC		Retrieve gnomon			
**Can be taken by CDR if required	10	Proceed to next sample			

MISSION: APOLLO 16 DATE: DEC. 15, 1971

EVA:

RADIAL SAMPLING

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES	SEQ CAM.	TASK FUNCTION LMP	TASK FUNCTION CDR
Describe area to be sampled radially	0	Select ∿ 10m crater on smooth surface & place gnomon			
		Take partial pan from opposite sides of crater			
Get sample bags, report numbers & hold for CDR to fill		Select soil/rock samples (on a ray if possible): 1 - one crater dia from rim 1 - 1/2 crater dia from rim 1 - on rim 1 - center of crater (if poss) 1 - 1/2 crater dia from rim 1 - one crater dia from rim			
Close bags, real & stow in collection bags					
		Retrieve gnomon			
Proceed to next sample	10	Proceed to next sample			

[C/CPD-0681 NASA — MSC

MISSION: APOLLO 16

DATE: DEC. 15, 1971

EVA:

SMALL TRENCH SAMPLE (EXPLORATORY)

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES	SEQ CAM	TASK FUNCTION LMP	TASK FUNCTION CDR
Take locator photo using LRV in background feature X-sun f8,1/250,15 ft	0	Select area to be sampled & place gnomon			
Use scoop, dig trench 3-8 inches deep 10° off sunline					
Take after photo down-sun f11,1/250,11 ft		Take after photos, stereo pair X-sun f8,1/250,7 ft			
If samples taken, using scoop collect soil samples from inside trench and surface *		If samples taken, get sample bags, report number & hold for LMP to fill			
		Close bags, seal & stow in collection bag			
		Retrieve gnomon			
Proceed to next sample	5	Proceed to next sample			
*If buried rock found in trench and shadowed soil not found, consider collecting rock & some soil into SESC					

MISSION: APOLLO 16 **DATE:** 15 DECEMBER 197

EVA: LUNAR PORTABLE MAGNETOMETER(LPM)-"SITE"

ACTIVITIES	EVA TIME	ACTIVITIES	SEQ CAM	TASK FUNCTION LMP	TASK FUNCTION CDR
0 Unstow tripod,spread &place on surface Pull pins, unstow sensor and reel Discard stowage bracketry Unreel 5 ft of cable install sensor on tripod, "sun" to "sun", position 1 Walk 45 feet to R of LRV carrying sensor/tripod(relieve strain on cable) Watch for white indicator mark on cable when 47 ft extension reached Place tripod, "sun" arrow to sun Align and bubble level sensor/tripod Return to LRV Raise hood on LPM electronics pkg (do this every time operate pkg) Sw elect power ON (MARK 60 sec) Take photo of deployed sensor/tripod Report tempilabel reading on elect. READ Sw-ON--Report reading 5 READ Sw-OFF READ Sw-ON--Report reading READ Sw-OFF READ Sw-ON--Report reading READ Sw-OFF Return to Sensor/tripod Turn sensor to Position 2 and reclamp Relevel and re-align tripod (MARK 60 sec) Return to LRV READ Sw-ON--Report reading READ Sw OFF (Repeat 2 times Return to sensor/tripod Turn sensor to Position 3 and reclamp Relevel and re-align tripod (MARK 60 sec) 10	10 15	Return to LRV READ Sw-ON--Report reading READ Sw OFF (Repeat 2 times) Power Sw- OFF Return to sensor/tripod Pick up sensor/tripod, carry back to LRV Stow sensor/tripod in bag Reel up cable Stow reel in bag and secure CAUTION: ensure cable does not foul LRV suspension or running gear			

MISSION: APOLLO 16 **DATE:** 15 December 1971
EVA: LUNAR PORTABLE MAGNETOMETER (LPM)

EVA TIME	ACTIVITIES	SEQ CAM	TASK FUNCTION LMP	TASK FUNCTION CDR
0	Unstow tripod with sensor			
	Unbag reel, pull out sufficient cable to clear LRV			
	Let reel fall, walk 45 feet to R of LRV carrying sensor/tripod (relieve strain on cable)			
	Watch for white indicator mark on cable when 47 ft extension reached			
	Place tripod, sun arrow to sun			
	Align and bubble level tripod			
	Return to LRV			
	Sw power -ON(MARK 60 sec)			
	Take photo of sensor/tripod			
	Report tempilabel reading-elect.			
	READ Sw-ON--Report reading			
	READ Sw OFF (Repeat 2 times)			
	Power Sw-OFF			
	Return to sensor/tripod			
5	Pick up sensor/tripod, carry back to LRV			
	Stow sensor/tripod in bag			
	Reel up cable			
	Stow reel in bag and secure			
	CAUTION-Ensure cable does not foul LRV suspension or running gear			
	NOTE: After final reading with LPM, take photo (3 ft) of LPM electronics to show dust accumulation			

MISSION: APOLLO 16

DATE: DEC. 15, 1971

EVA:

SOIL MECHANICS TRENCH

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES	SEQ CAM.	TASK FUNCTION LMP	TASK FUNCTION CDR
TBD		TBD			

MISSION: APOLLO 16

DATE: DEC. 15, 1971

EVA:

PENETROMETER TESTS

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES	SEQ CAM.	TASK FUNCTION LMP	TASK FUNCTION CDR
TBD		TBD			

3.3 PHOTOGRAPHY DATA

Figure 3.3-1 summarizes the various kinds of photographic routines the crew goes through in the course of their lunar surface operations. The illustrations are taken from the crew's cuff checklist.

The photographic techniques utilized for documented samples and for documenting core tube samples is very similar to those used in Apollo 15. That is, for a documented sample, the CDR takes a cross-sun stereo pair from 7 feet before sampling while the LMP takes a down-sun photo from 11 feet. The CDR then takes an after photo cross-sun from 7 feet and the LMP takes a cross-sun location photo from 15 feet with the LRV in the background. This procedure assumes that a photo panorama is taken at each sampling area, showing the position of the LRV. To document a core tube sample, the CDR takes a stereo pair cross-sun with core tube in contact with the surface, before driving. The CDR then takes a single cross-sun locator photo with core tube fully inserted. After removal of the core tube, the CDR usually takes a photograph cross-sun of the hole left in the surface.

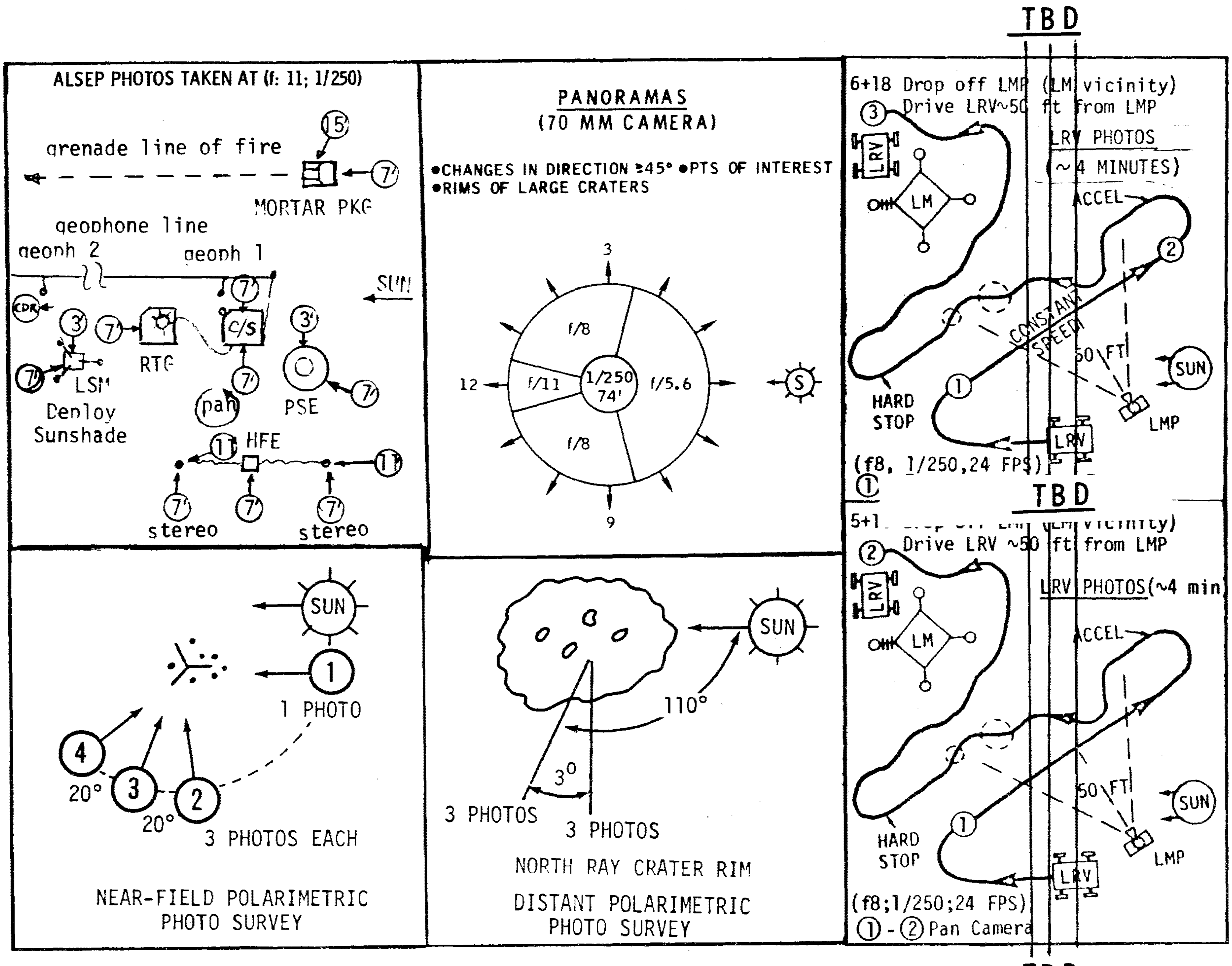
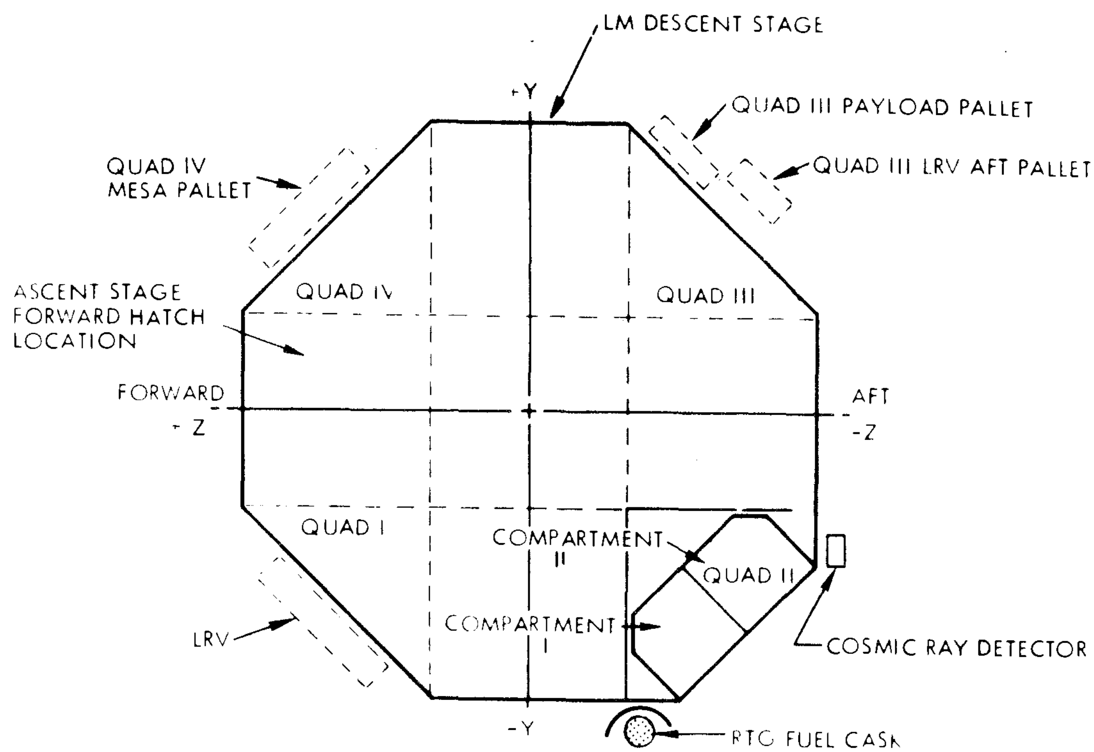


Figure 3.3-1 Lunar Surface Photography Data

3.4 LUNAR SURFACE EXPERIMENTS - DEPLOYMENT & EQUIPMENT DATA

Figure 3.4-1 illustrates the LM Descent Stage stowage locations for the lunar surface scientific equipment. Detailed data on ALSEP experiments is contained in Section 3.4.1. The astrophysical experiments(UV Camera, Cosmic Ray and Solar Wind) and the geophysical experiments (Portable Magnetometer and Soil Mechanics) are shown in figure 3.4-4



QUAD I
- LUNAR ROVING VEHICLE

QUAD II SEQ BAY
- APOLLO 16 ALSEP
  - SUBPACKAGE NO. 1
  - SUBPACKAGE NO. 2

QUAD III PAYLOAD PALLET
- FAR UV CAMERA SPECTROSCOPE

QUAD III NO. 3 PALLET
- UNUSED

QUAD IV MESA PALLET
- LUNAR SURFACE DRILL ASSEMBLY
- 16-MM DATA ACQUISITION CAMERA AND STAFF
- LUNAR SURFACE HASSELBLAD ELECTRIC CAMERA
- CAMERA ACCESSORIES
- GROUND-COMMANDED TV CAMERA, CONTROL UNIT, AND ACCESSORIES
- SAMPLE RETURN CONTAINERS (2)
- LUNAR SURFACE RAKE
- RETURN BAG FOR COSMIC RAY DETECTOR
- SOLAR WIND COMPOSITION *
- SAMPLE RETURN BAG**
- SAMPLE CONTAINMENT BAGS (6)

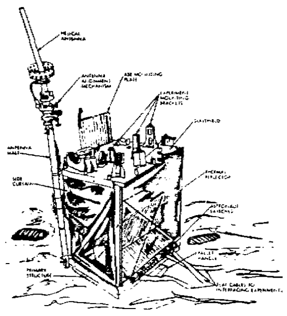
QUAD III LRV AFT PALLET
- ADJUSTABLE SAMPLING SCOOP
- APOLLO LUNAR HAND TOOL CARRIER
- GNOMON PHOTOMETRIC CHART
- SELF-RECORDING PENETROMETER
- HAMMER
- 32-INCH TONGS (2)
- TOOL EXTENSION HANDLE (2)
- LUNAR PORTABLE MAGNETOMETER
- SAMPLE COLLECTION BAGS (2)
- EXTRA SAMPLE COLLECTION BAGS (4)

FIGURE 3.4-1 LM DESCENT STAGE STOWAGE OF SURFACE SCIENCE EQUIPMENT

3.4.1 ALSEP Deployment And Equipment Data

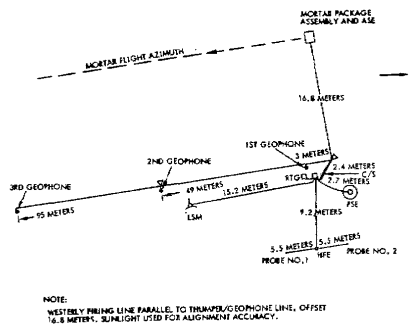
The ALSEP deployment site is selected in a location not less than 100 meters due West of the LM such that the LM ascent engine blast will not create a dust cloud or otherwise disturb the deployed experiments. The ALSEP site should be fairly level and relatively free of boulders and craters which may interface with nominal deployment procedures or thermal characteristics. The experiments and central station should not be deployed in a shadow, near a large boulder nor in a crater. Pertinent ALSEP experiment deployment data is summarized in Figure 3.4-2 Included also in this figure is an ALSEP layout which depicts the relative positions of the experiments with respect to C/S after deployment is complete.

CENTRAL STATION (C/S)

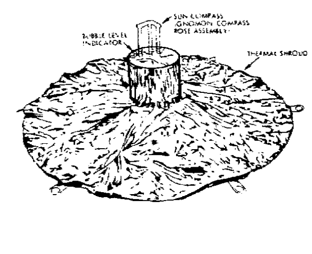


The Central Station is deployed East of the RTG, leveled within 5° of vertical using bubble level and aligned within ±5° of East-West using a gnomon and partial compass rose on the C/S. When sunshield is deployed the sides face East, West.

The ALSEP Antenna is attached to C/S and must be leveled to within 0.5° of vertical using the bubble level and aligned within ±.5° of the sun line as determined by the sun shadow reference line. The crewman then sets the Azimuth and Elevation dials to the predetermined settings in his cuff checklist.

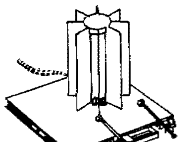


PASSIVE SEISMIC EXPERIMENT (PSE)



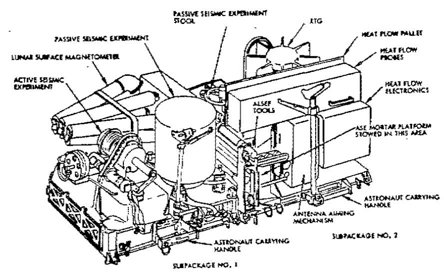
The PSE is deployed approximately 3 meters East of C/S on a stool designed to provide good mechanical contact and thermal insulation with the lunar surface. The PSE must be out of the field-of-view of the C/S radiator (South) and leveled within 5° of vertical on the bubble level. Initial alignment is within ±20° of East before removing PSE girdle. Fine alignment is reported within ±5° using the compass rose after the thermal shroud deployment.

RADIOISOTOPE THERMOELECTRIC GENERATOR (RTG)



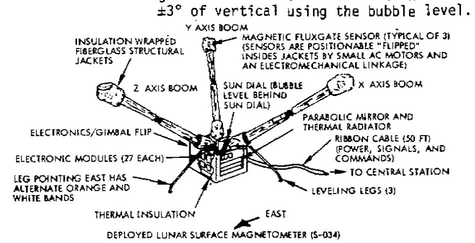
The RTG is located approximately 3 to 3.5 meters away from and within ±20° West of C/S. The RTG should be approximately level and not located in a depression as a maximum view of space is required for heat radiation

The astronaut will read the shorting switch ammeter, connect it to C/S and actuate the switch at the proper time.

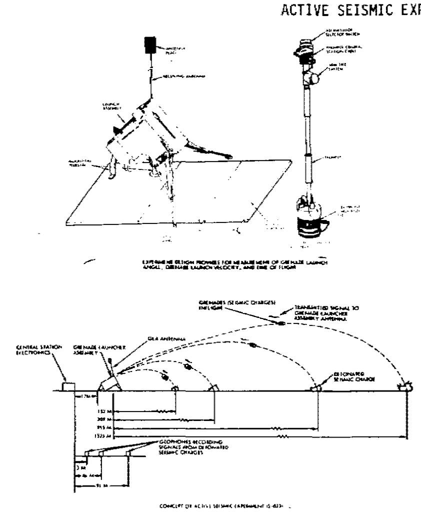


LUNAR SURFACE MAGNETOMETER (LSM)

The LSM is deployed approximately 14 meters WSW of C/S and aligned within ±3° of the sun line using the sun shadow device provided. The crewman will report final alignment to within ±1° by reading the shadowgrath. The LSM is leveled within ±3° of vertical using the bubble level.



ACTIVE SEISMIC EXPERIMENT (ASE)

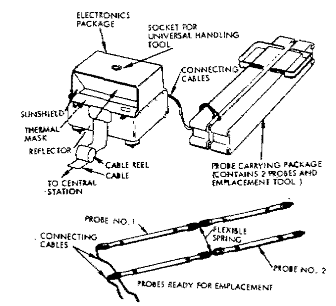


The ASE consists of two major subsystems:

MORTAR BOX ASSEMBLY Deployed on a base and bubble leveled to (5°) and aligned by the astronaut as shown North of Central Station 58 ft. away. Contains 4 grenades remotely fired by ground control 1 year after crew returns to earth. Astronaut readies by removing safety rod and actuating safety switches to remove short across arm/fire circuits.

THUMPER/GEOPHONE ASSEMBLY - Astronaut unfolds thumper and walks WSW unreeling geophone line. Geophones emplaced at 12, 162, and 312 ft. from Central Station. Alignment of phones along line ±3° ref. to Mortar Box and Flag at 162' geophone, each leveled to 7°. Astronaut returns to Central Station along geophone line firing thumper charge every 15 ft. to excite geophones (21 charges in all).

HEAT FLOW EXPERIMENT (HFE)



The HFE is deployed 8 to 10 meters South of C/S, aligned within ±5° of the plane of the ecliptic using the UHT as a gnomon and leveled within 5° using a bubble level. The HFE probes are deployed 5 to 6 meters from the electronics package and a minimum of 12 meters from the RTG. The HFE probe holes are drilled with the ALSD within 15° of vertical and should be located 60 meters from fresh craters and at least 5 diameters away from boulders greater than 2/3 meter across at the surface.

FIGURE 3.4-2 ALSEP DEPLOYMENT AND EQUIPMENT DATA

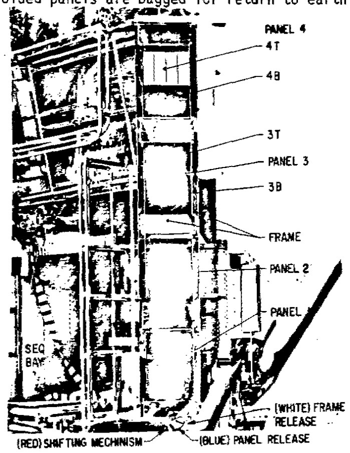
TBD

APOLLO LUNAR SURFACE DRILL (ALSD) USED TO DRILL
PROBE EMPLACEMENT HOLES FOR HEAT FLOW EXPERIMENT (S-037)

FIGURE 3.4-3 APOLLO LUNAR SURFACE DRILL & BORE STEMS

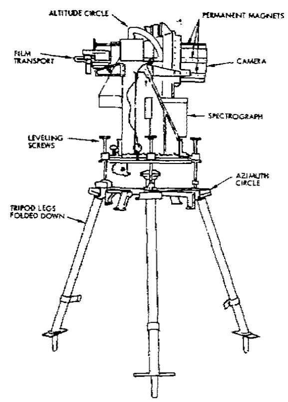
COSMIC RAY DETECTOR (SHEETS) EXPERIMENT

The Cosmic Ray Experiment comprises three separate but related investigations. Data will be obtained from analyses of the various sheets of materials (plastics and metals) which make up the four-panel array. The Cosmic Ray Experiment collects data on the outbound trip as well as on the lunar surface. To provide a discrete "mark" for the transition from orbital to lunar surface data, the crew, near the beginning of EVA 1, pulls a lanyard to shift some sheets which respect to others in the array. The crew also documents the amount of dust on the experiment in this EVA. The shift must be accomplished after the RTG for ALSEP is out of sight, since the radiation from the RTG capsule affects the data.
At the close of EVA 3, the Cosmic Ray Experiment is taken down from the spacecraft (SEQ Bay), removed from its frame, and folded. The crew must report the readings on tempilabels as they appear during the folding process. The folded panels are bagged for return to earth.



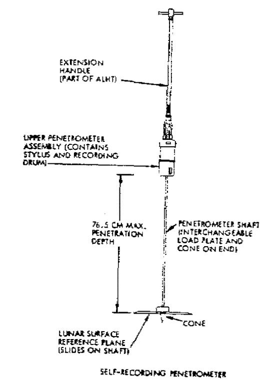
LUNAR SURFACE ULTRAVIOLET CAMERA (LSUC)

The LSUC is a miniature observatory which provides imagery and spectroscopy in the far ultraviolet range (Lyman-alpha). The LSUC is a modified Scmidt camera with a field of 20 degrees, and a spectral resolution of 4 angstroms. The crew deploys the LSUC on its own tripod to within 5 degrees of vertical. The camera is set up in the shade of the LM off the Quad I side near the ladder. The camera mounting is of the alt-azimuth type, with a setting accuracy of 1 degree. Crew operation consists of initial setup, turnon, and periodic retargeting. A crewman removes the film cassette at the top of the camera for return to earth.



SELF-RECORDING PENETROMETER

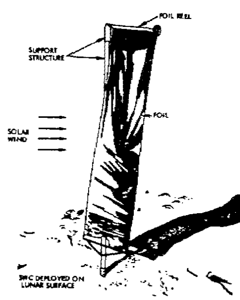
The Penetrometer is the principal Soil Mechanics instrument used on Apollo 16. It is used to obtain penetration and plate-load-sinkage characteristics of the lunar soil, through the use of three different cross-section penetration tips (cones), and a plate attachment. The crewman must push down on the penetrometer top handle (which is the Extension handle) with a smooth, even downstroke until full penetration is achieved, or no further travel is possible. Photographic documentation is TBD. Plate load measurements are accomplished in the same manner, except loading is exerted until the handle seats on the top of the drum housing, which requires 40 lbs pressure. Each measurement is indexed by turning the recording drum, the only part of the penetrometer which is returned to earth.



SOLAR WIND COMPOSITION (SWC) EXPERIMENT

The SWC is an aluminum-platinum foil collector of particles from the Solar Wind which provides data on the elemental and isotopic composition of the noble gasses and other selected elements that comprise the Solar Wind. The SWC is deployed 60 to 100 feet away from the LM in direct sun, with the surface of the foil within 30 degrees of the sun line. The SWC foil deployment is photographed to localize its position with respect to the LM as well as its orientation.

The SWC foil is removed from its pole, rolled, and bagged for return to earth at the end of the 3rd EVA.



LUNAR PORTABLE MAGNETOMETER (LPM)

Instrument measures local magnetic flux. Sensor head (on tripod) must be deployed 47 feet from LRV and from electronics/readout device mounted on the LRV geopallet. Sensor must be leveled (by bubble) to within 5 degrees of vertical, and aligned by sun shadow to within 3 degrees. Sixty seconds must elapse between sensor placement and reading. The readout on the LPM is digital via solid-state devices. Since the magnetic flux varies as a function of time, the crewman takes three readings in sequence for each measurement. The cable is then reeled up and the tripod/sensor restowed on the LRV.

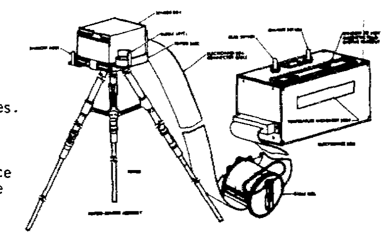
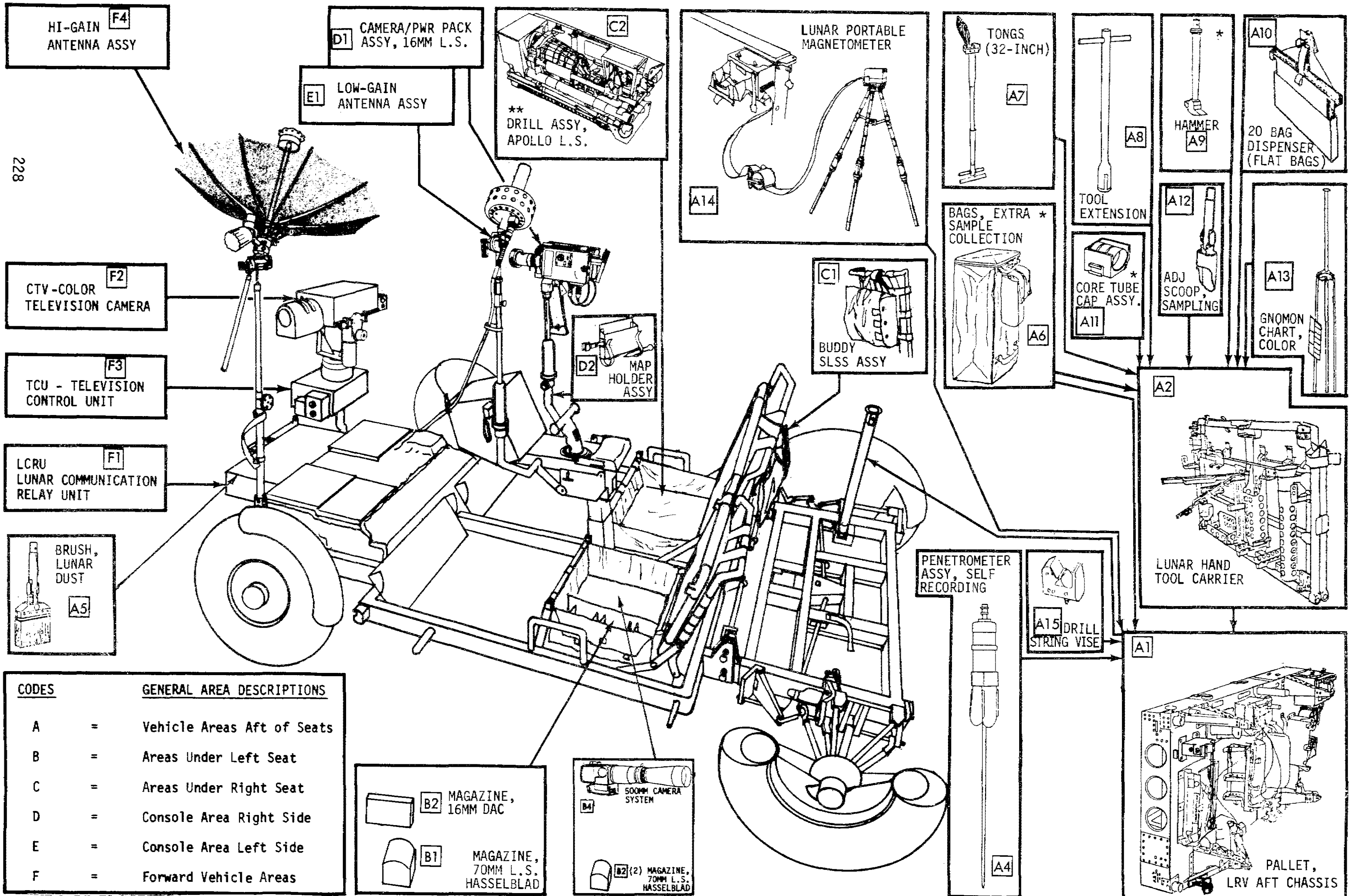


FIGURE 3.4-4 ASTROPHYSICAL AND GEOPHYSICAL EXPERIMENTS DATA

3.5 GEOLOGY EQUIPMENT AND DATA

The illustration in Figure 3.5-1 summarizes the lunar surface geology equipment and traverse support equipment as stowed on the LRV and PLSS tool carrier in support of the astronauts field geology activities. Those items marked (*) are normally stowed on the LMP's PLSS tool harness although they can also be stowed in the areas indicated.

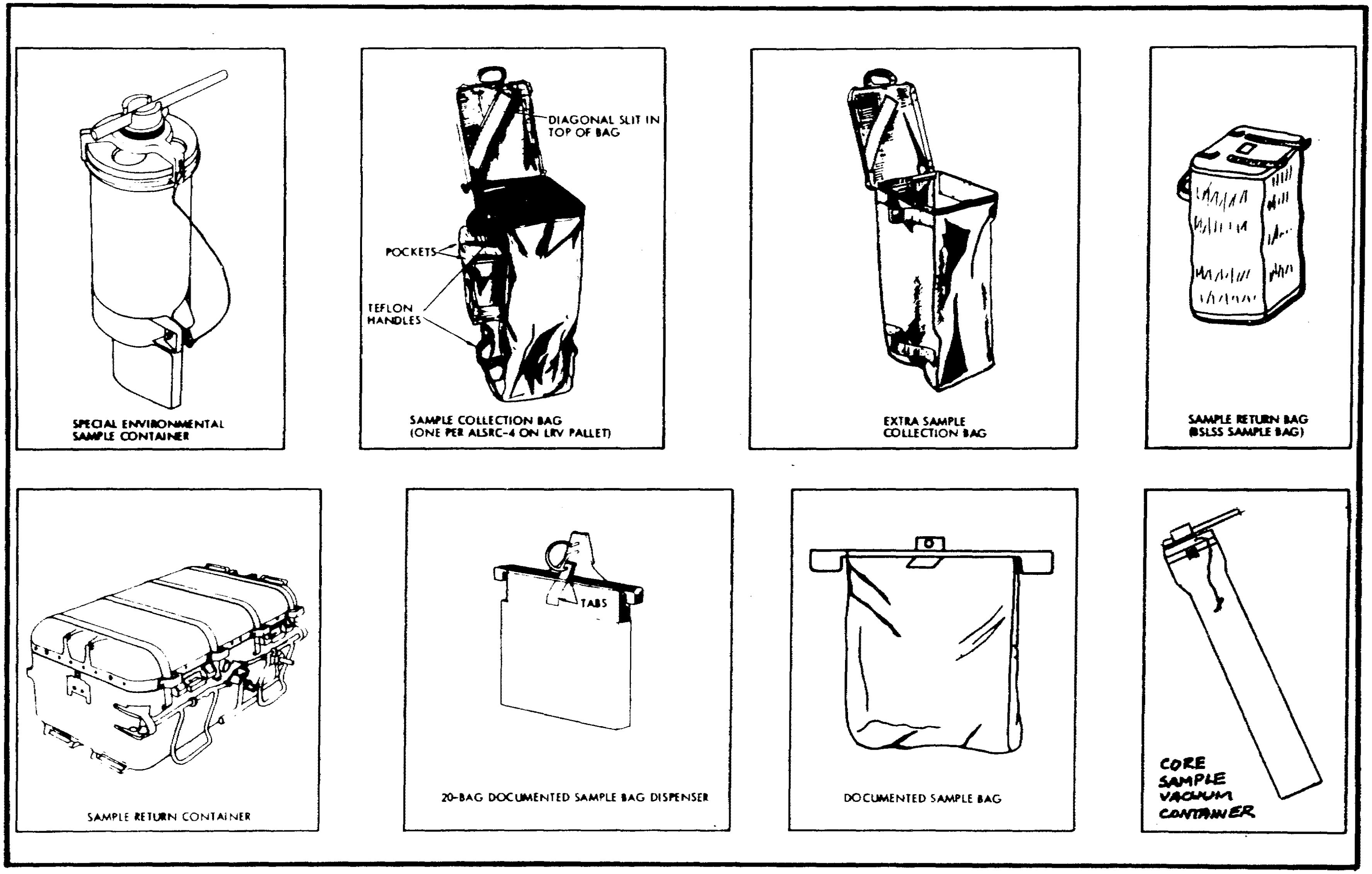
Figures 3.5-7, 3.5- 8, and 3.5- 9 provide a pictorial sequence for Lunar Surface Geology Equipment and Sample Management for EVA's 1, 2 & 3. These diagrams provide a means for tracking the movement of the various items of equipment utilized on the lunar surface, including equipment transfers from and to the Ascent Stage.



CODES		GENERAL AREA DESCRIPTIONS
A	=	Vehicle Areas Aft of Seats
B	=	Areas Under Left Seat
C	=	Areas Under Right Seat
D	=	Console Area Right Side
E	=	Console Area Left Side
F	=	Forward Vehicle Areas

*Normally carried on the LMP PLSS tool carrier
**Only carried from LM to ALSEP site

FIGURE 3.5-1 LUNAR FIELD GEOLOGY EQUIP. STOWAGE ON LRV



NOTE: 3 "PADDED" DOCUMENTED SAMPLE BAGS WILL ALSO BE USED.

FIGURE 3.5-2 LUNAR GEOLOGY SAMPLE CONTAINERS

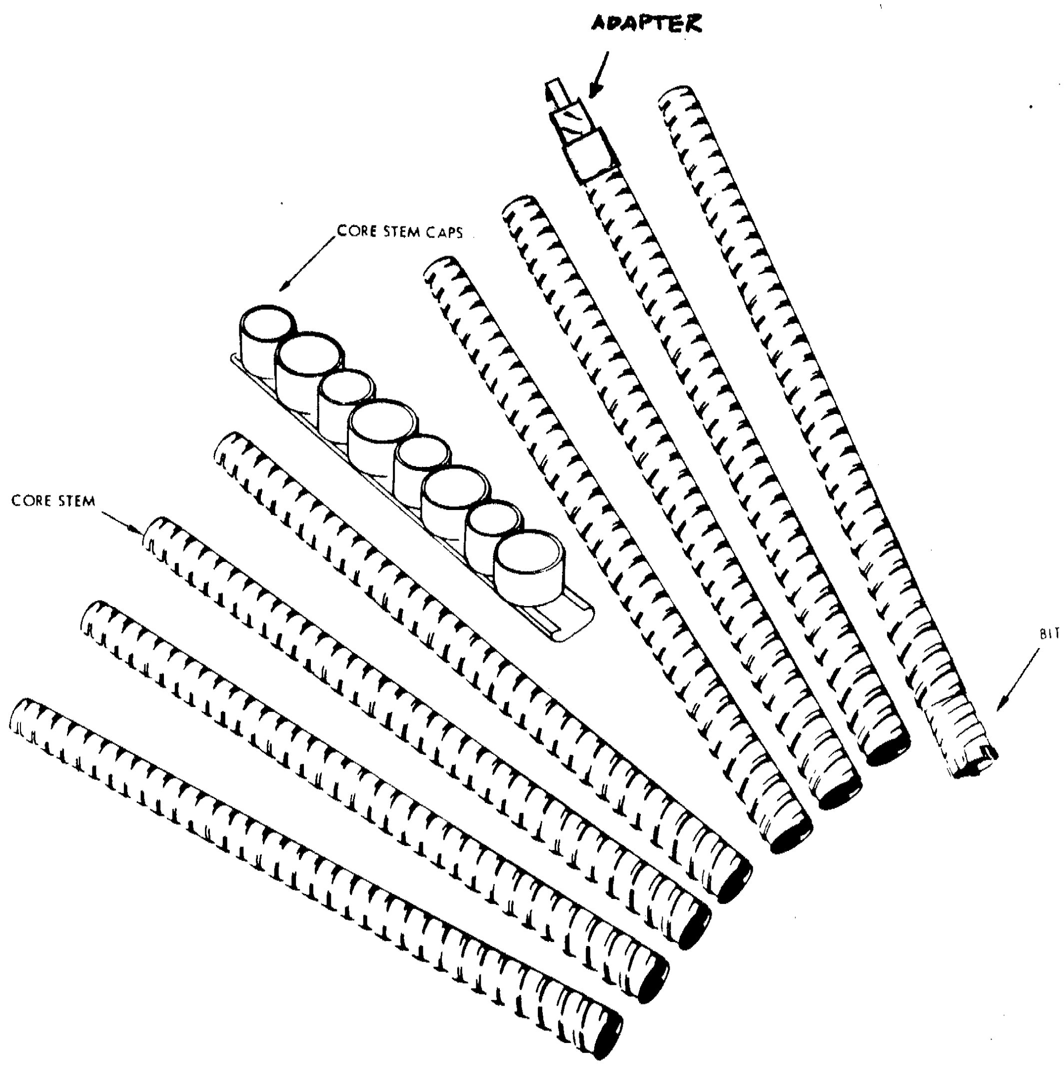


FIGURE 3.5-3 LUNAR SURFACE DRILL CORE STEMS & CAPS

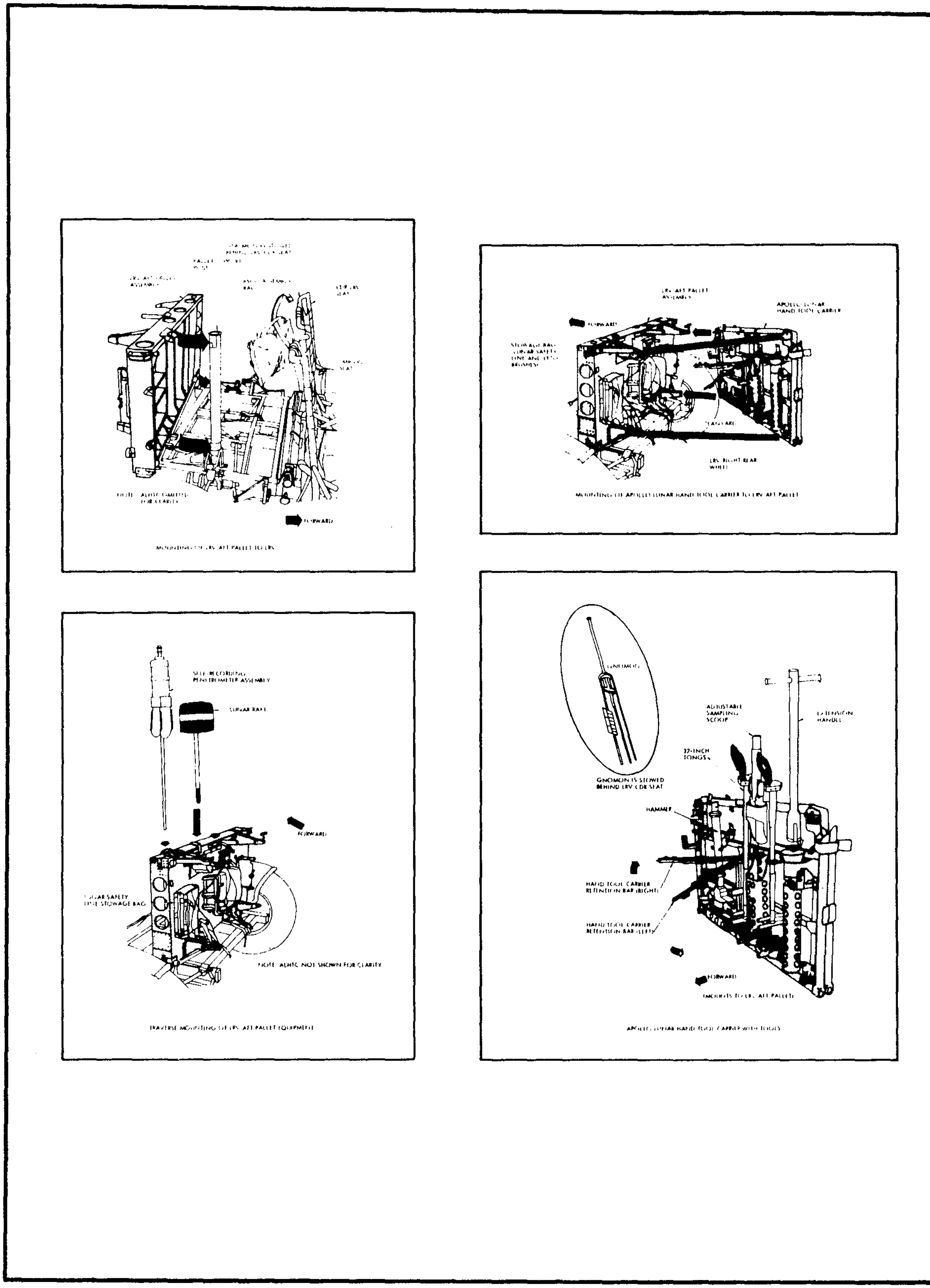
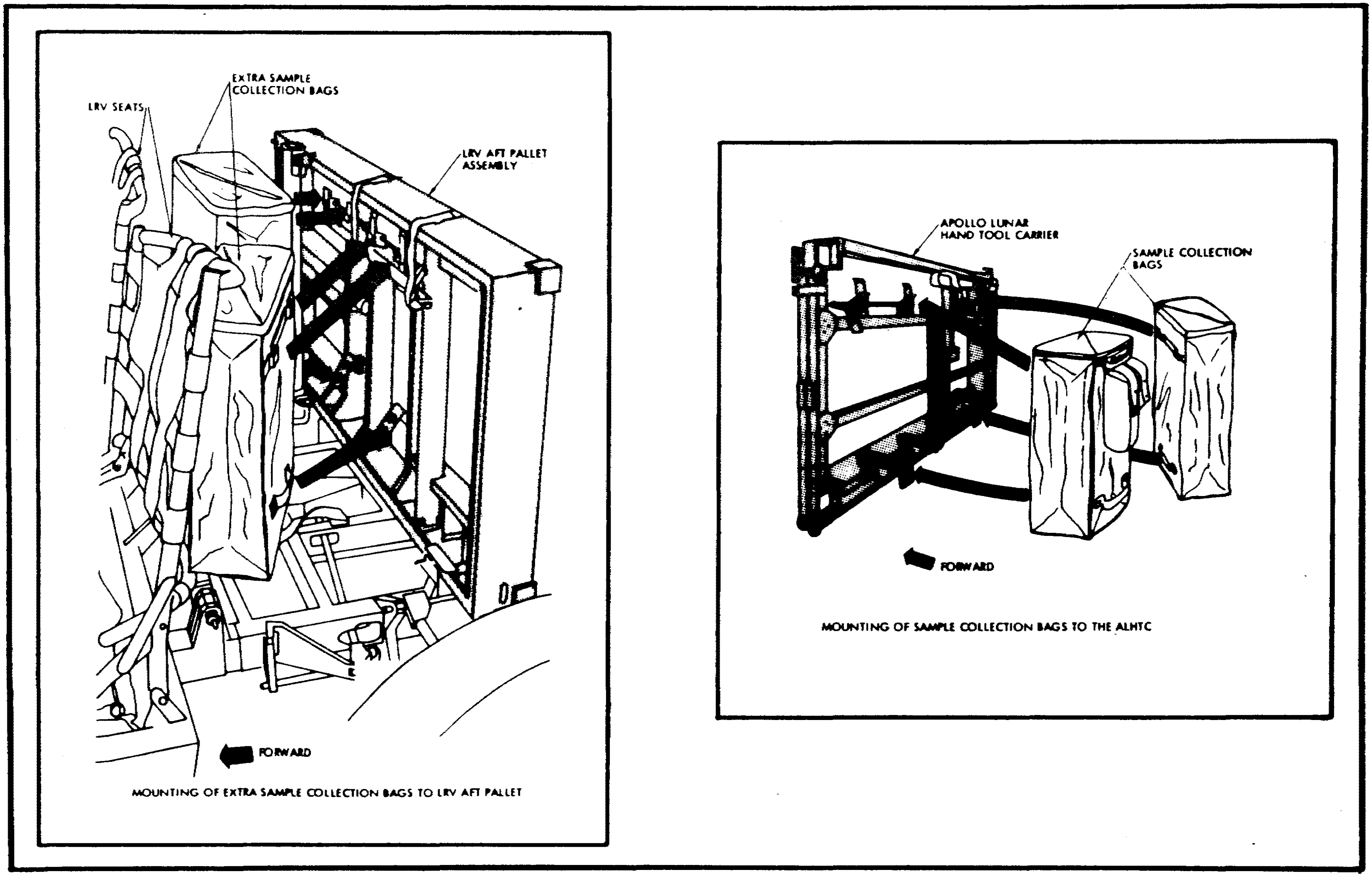


FIGURE 3.5-4 SURFACE SCIENCE EQUIP. STOWAGE ON LRV



MOUNTING OF EXTRA SAMPLE COLLECTION BAGS TO LRV AFT PALLET

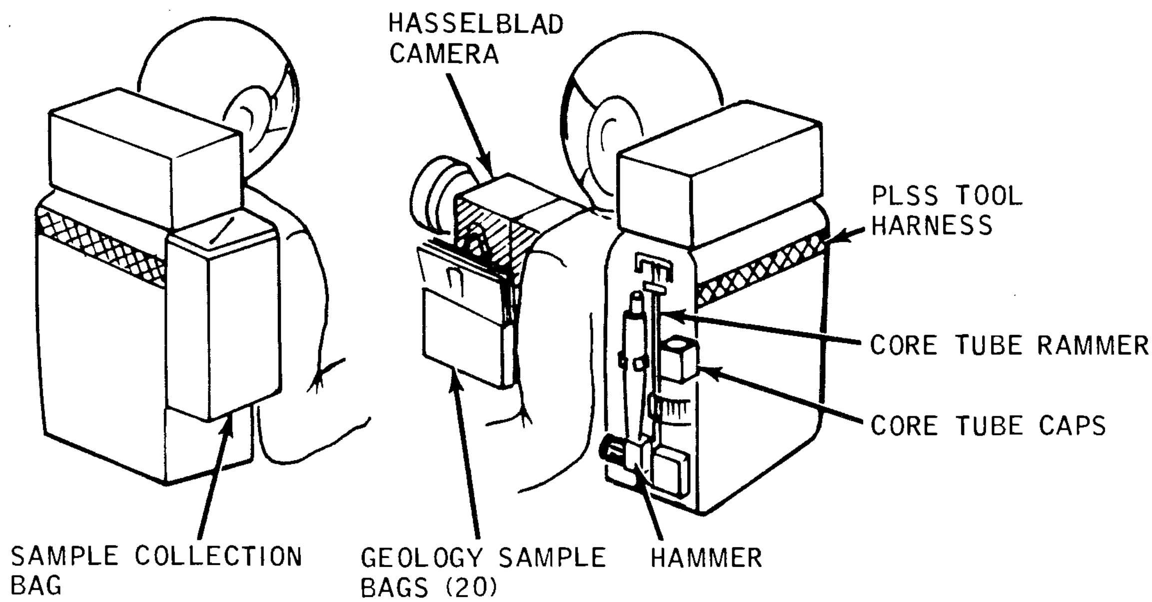
MOUNTING OF SAMPLE COLLECTION BAGS TO THE ALHTC

FIGURE 3.5-5 SAMPLE COLLECTION BAG STOWAGE ON LRV

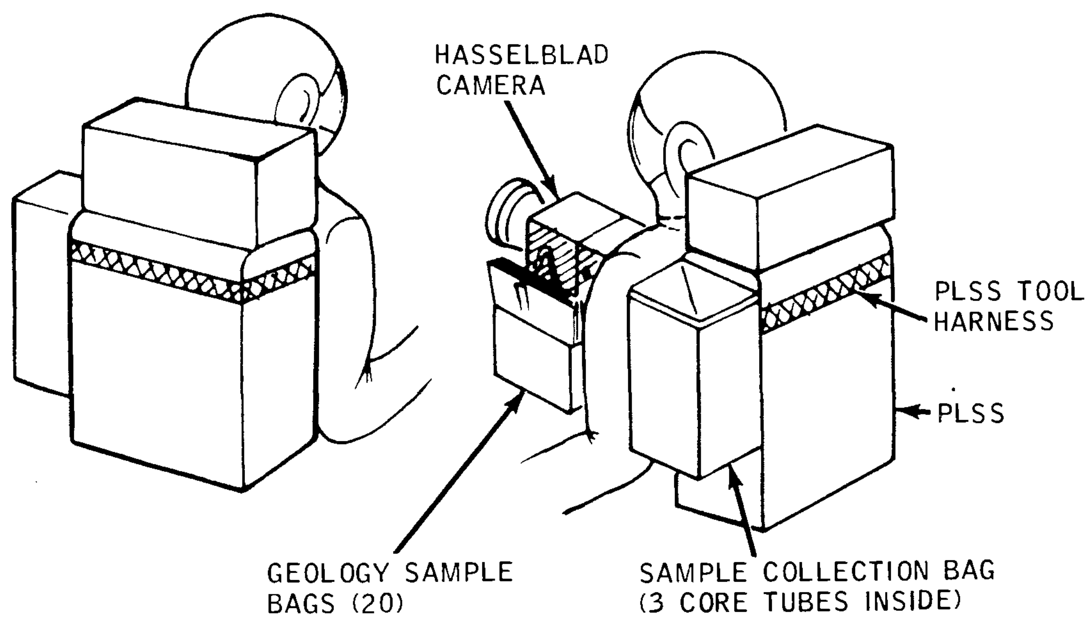
FIGURE 3.5-6 PLSS/GEOLOGY TOOL STOWAGE

LUNAR HANDTOOL STOWAGE ON THE EXTRAVEHICULAR MOBILITY UNIT

LMP PLSS



CDR PLSS



NOTES: 1. TOOL CARRIER DESIGNED FOR EMERGENCY SELF-DOFFING VIA QUICK-DISCONNECT LANYARDS ACCESSIBLE TO WEARER.

SESC	-	Special Environmental Sample Container
U 03, L 10	-	Core tubes (ex. Upper tube -#03, Lower tube -#10)
C A	-	Core tube cap assy (w/3 caps)
R	-	Core tube tool assy
S S S S S S	-	Set of 6 core stems
C A	-	Core stem cap assy
	-	Lunar surface rake
	-	Penetrometer
	-	Penetrometer (Data recording section only)
LS	-	Large Samples
S	-	Small Samples
ALSD	-	Apollo Lunar Surface Drill
	-	Dust brush
CUFF ✓LIST	-	Crew cuff checklist
MAPS EVA-1	-	Lunar surface maps (EVA specified)
HOLDER	-	LRV mapholder
LRV ✓ LIST	-	LRV checklist
BSLSS	-	Buddy Secondary Life Support System
	-	Gnomon
ORG. CONT. SAMP.	-	Organic Control Sample
	-	Hammer
	-	Tongs
	-	Extension Handle
	-	Extension Handle/Scoop Assy
20-DSBD 1001	-	20-Documented Sample Bag Dispenser
MAG HBW LMP 70 CAM	-	LMP 70mm camera w/mag
MAG HBW CDR 70 CAM	-	CDR 70mm camera w/mag
MAG HBW LL70 CAM	-	500mm Lens Camera w/mag
70 HBW	-	70mm Magazine w/HBW film
70 HCEX	-	70mm Magazine w/HCEX film
16	-	16mm Magazine w/CEX film
LCRU BAT	-	LCRU Battery
F	-	**Polarizing Filter**

Table 3.5-1 LEGEND FOR LUNAR FIELD GEOLOGY EQUIPMENT & SAMPLE MANAGEMENT

FIGURE 3.5-7a EVA 1 PRE-ALSEP DEPLOYMENT

(MESA AND ETB TRANSFERS TO LRV)

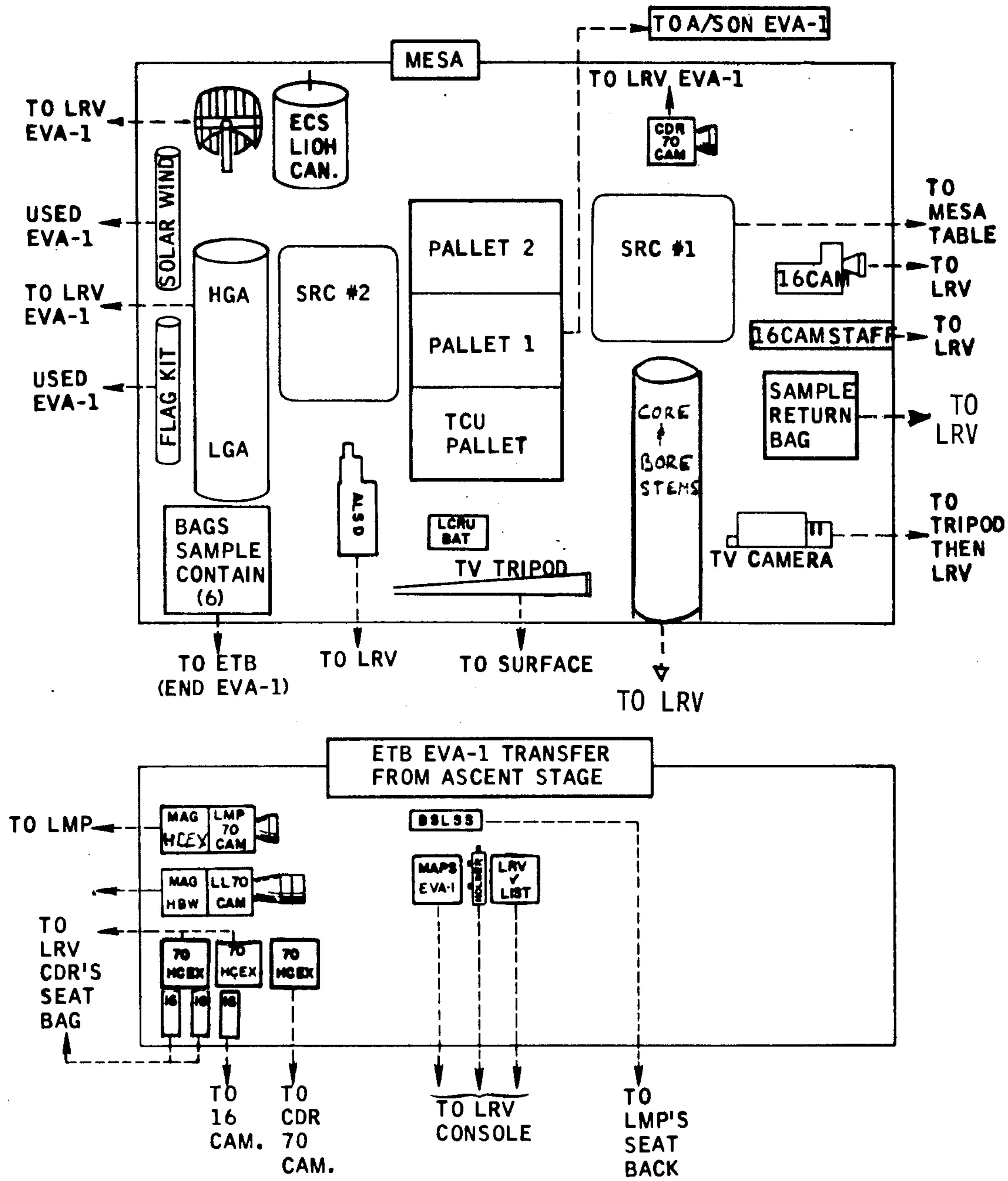
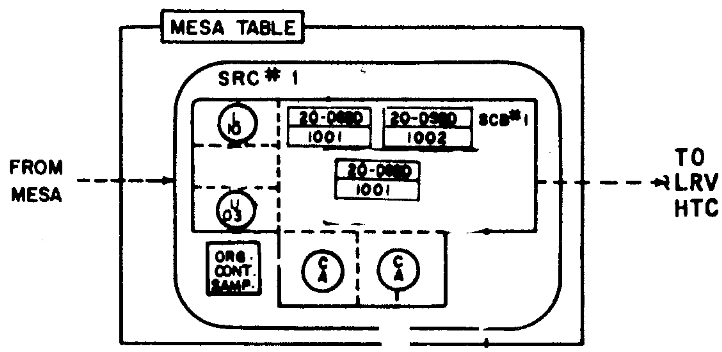


FIGURE 3.5-7b EVA 1 PRE ALSEP DEPLOYMENT (MESA TABLE LOADING AND TRANSFER TO LRV)



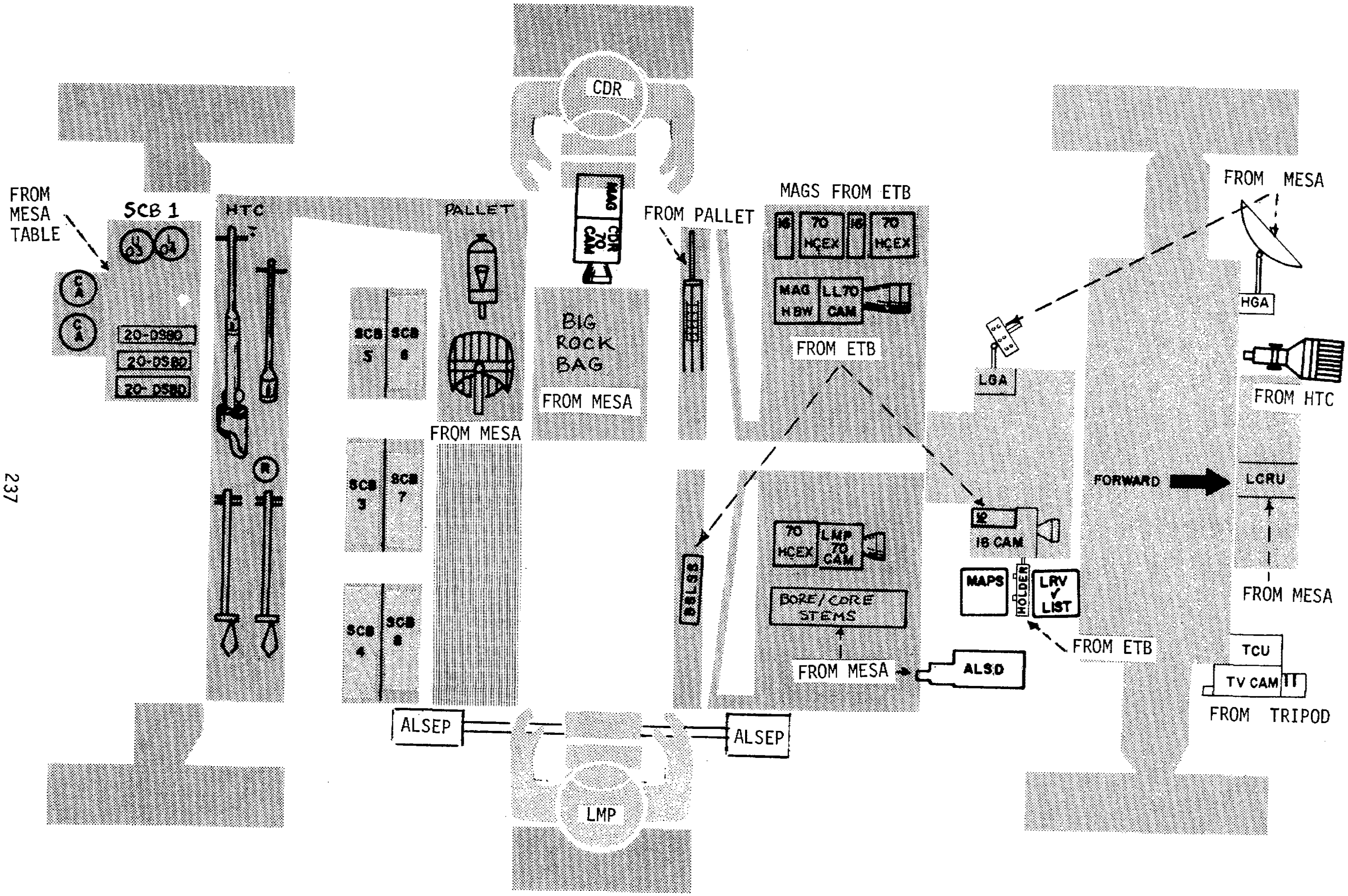


FIGURE 3.5-7c EVA 1 PRE-ALSEP DEPLOYMENT

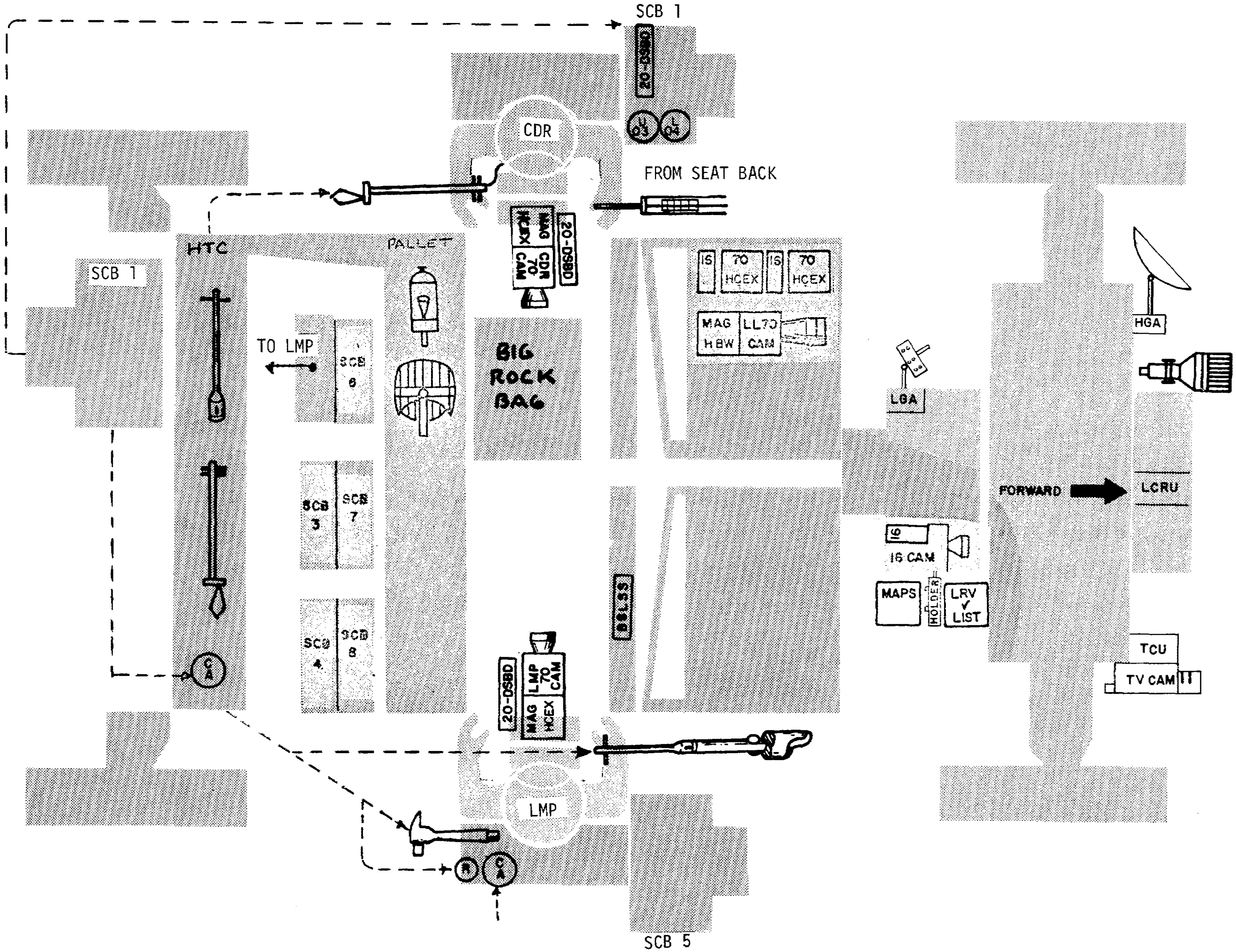


FIGURE 3.5-7d EVA 1 PRE-GEOLOGY TRAVERSE

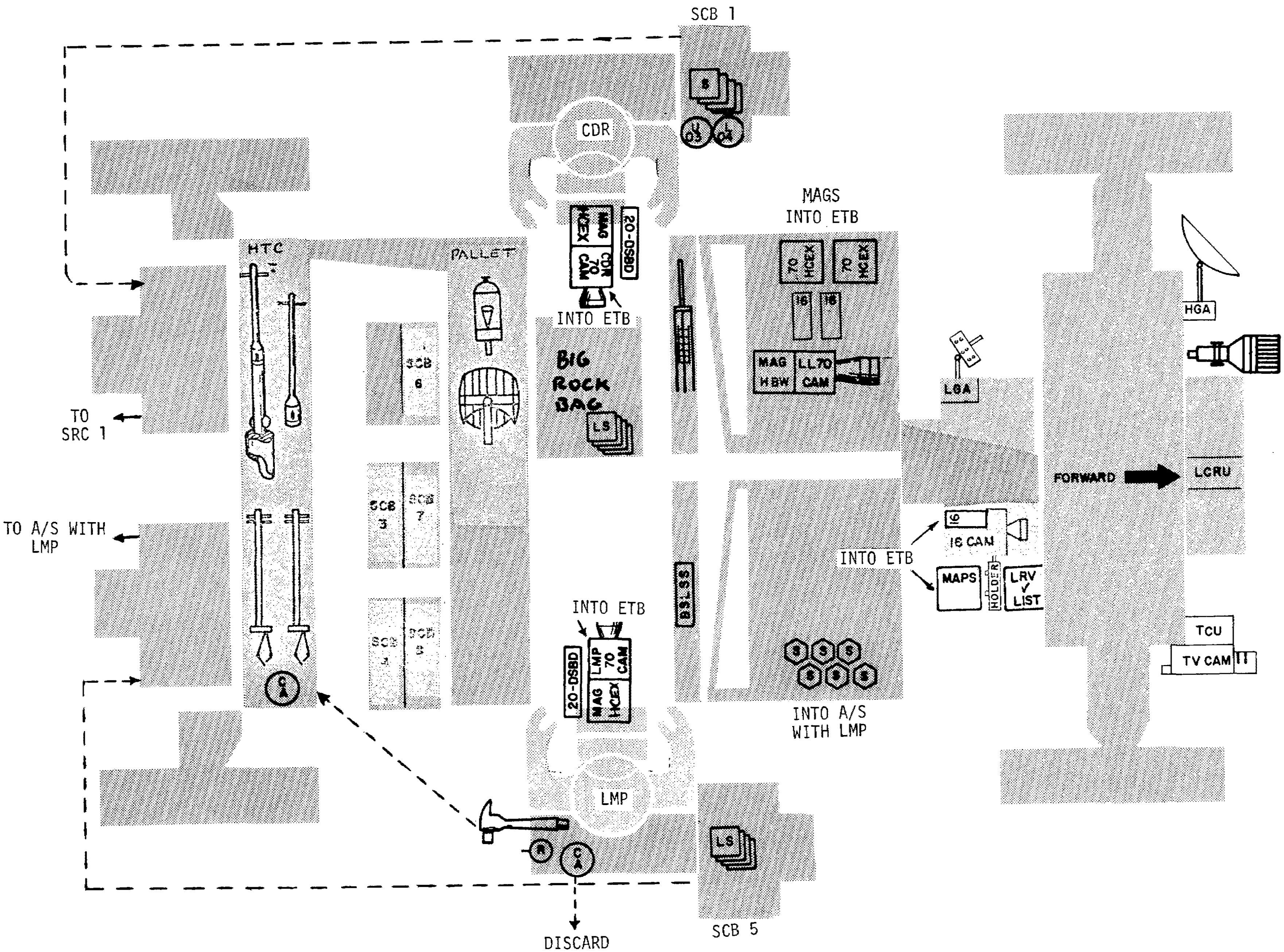


FIGURE 3.5-7e EVA 1 ARRIVAL BACK AT LM

FIGURE 3.5-7f **EVA-1 LRV TRANSFERS TO MESA AND LM**

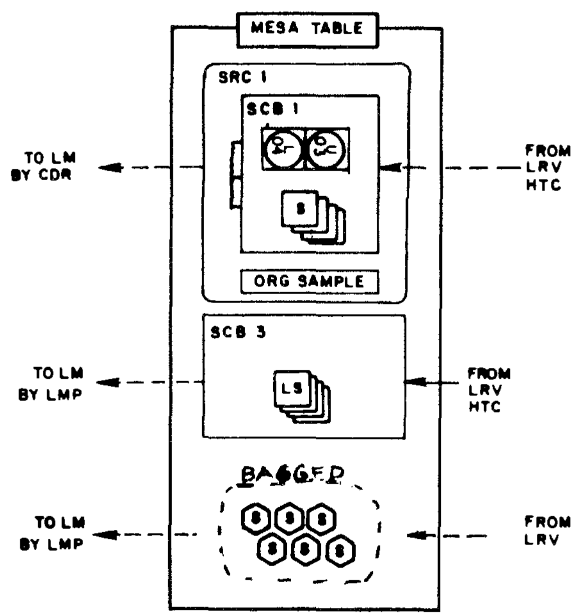
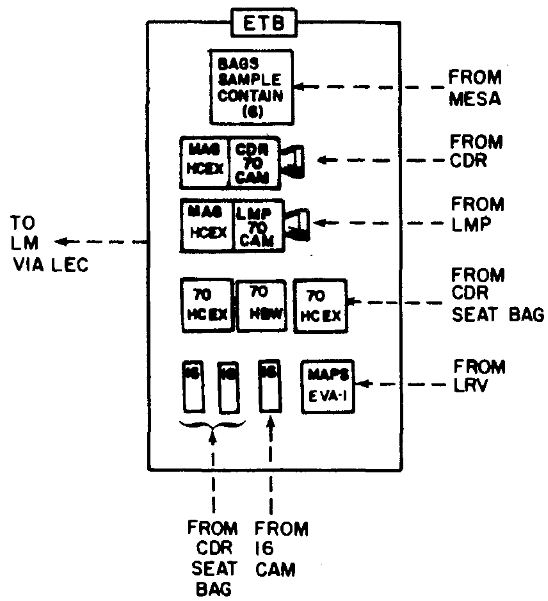


FIGURE 3.5-7g EVA-1 ON LMP INGRESS (ETB TRANSFER TO LM)



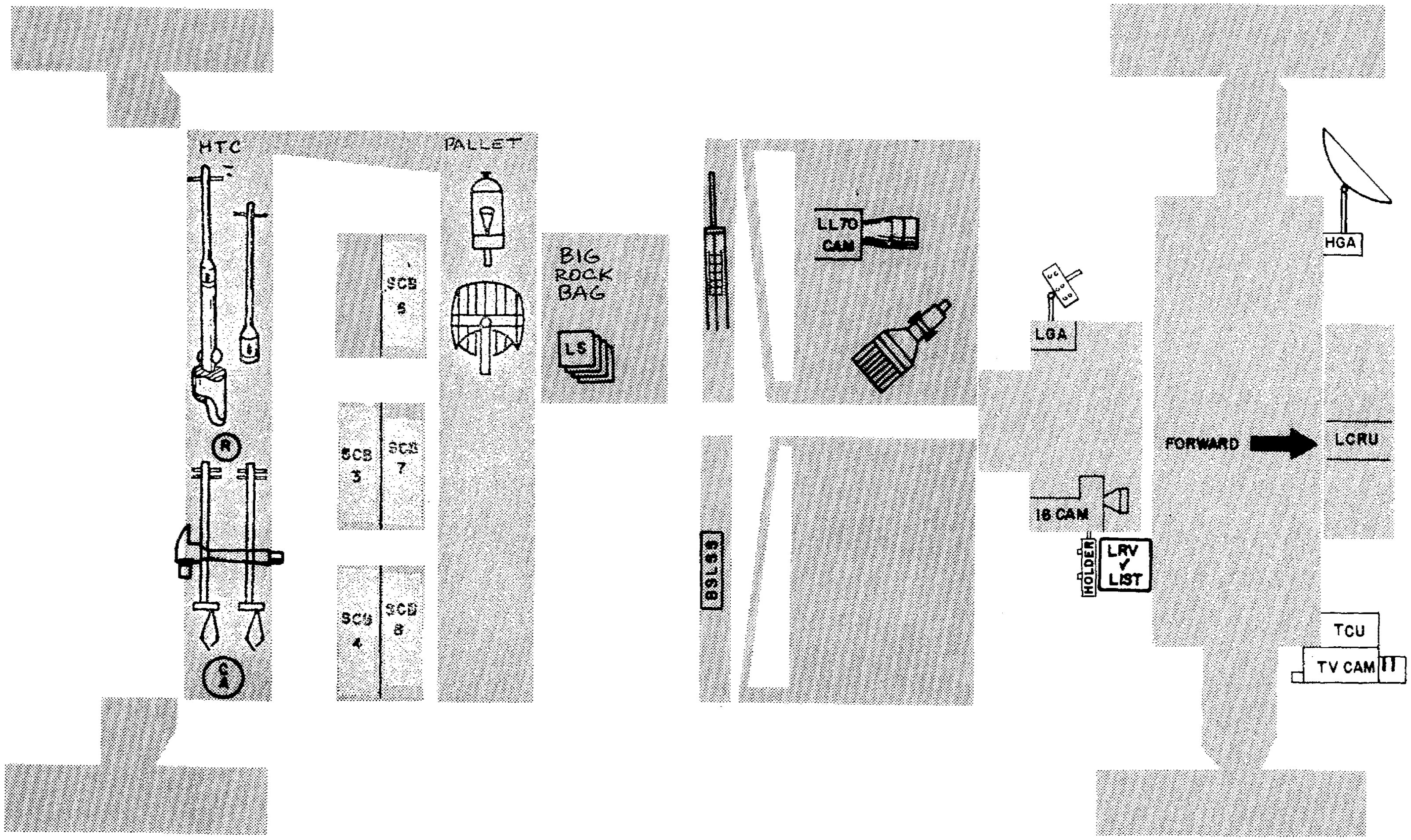


FIGURE 3.5-7h EVA 1 FINAL LRV CONFIGURATION

FIGURE 3.5-8a : **EVA-2 PRE-GEOLOGY TRAVERSE**
(MESA AND ETB TRANSFERS TO LRV)

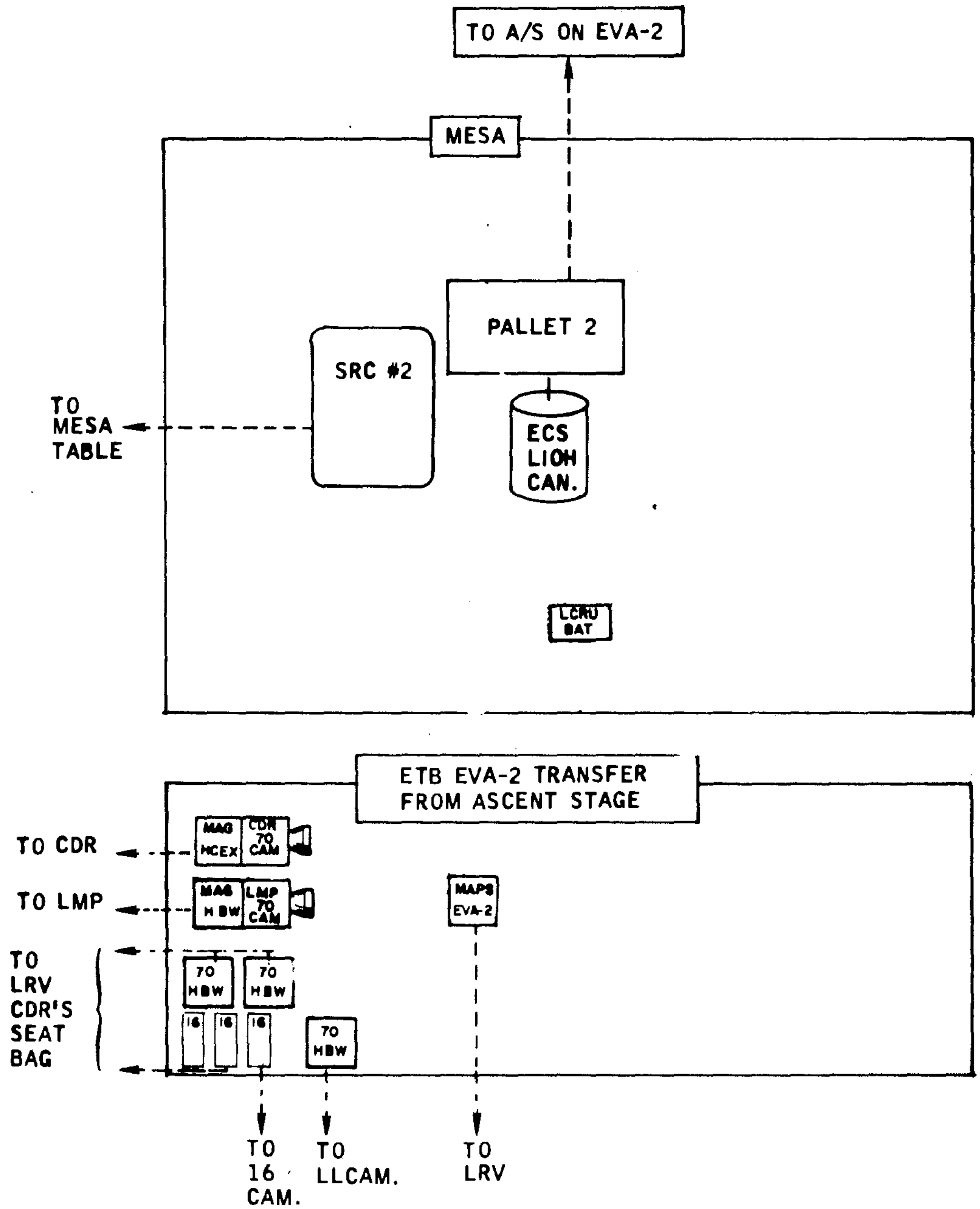
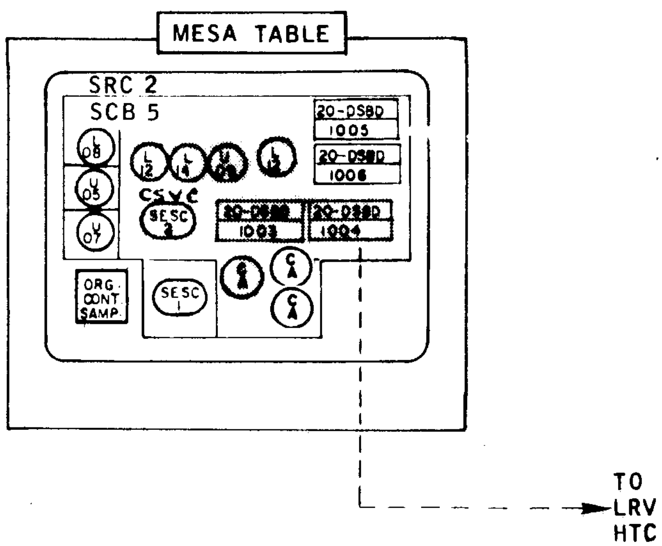


FIGURE 3.5-8b **EVA-2 PRE-GEOLOGY TRAVERSE**

(MESA TABLE LOADING AND TRANSFER TO LRV)



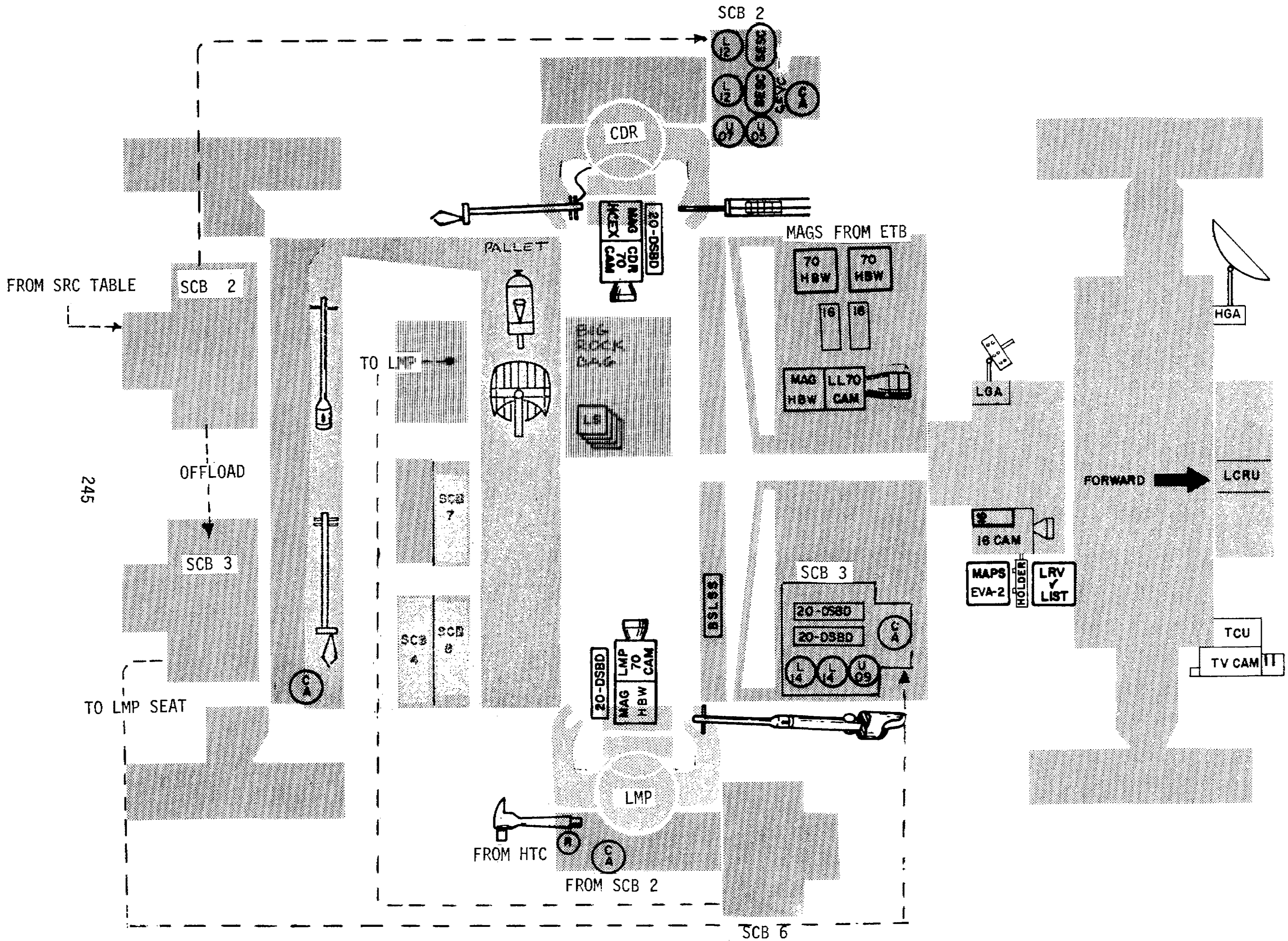


FIGURE 3.5-8c EVA 2 PRE-GEOLOGY TRAVERSE

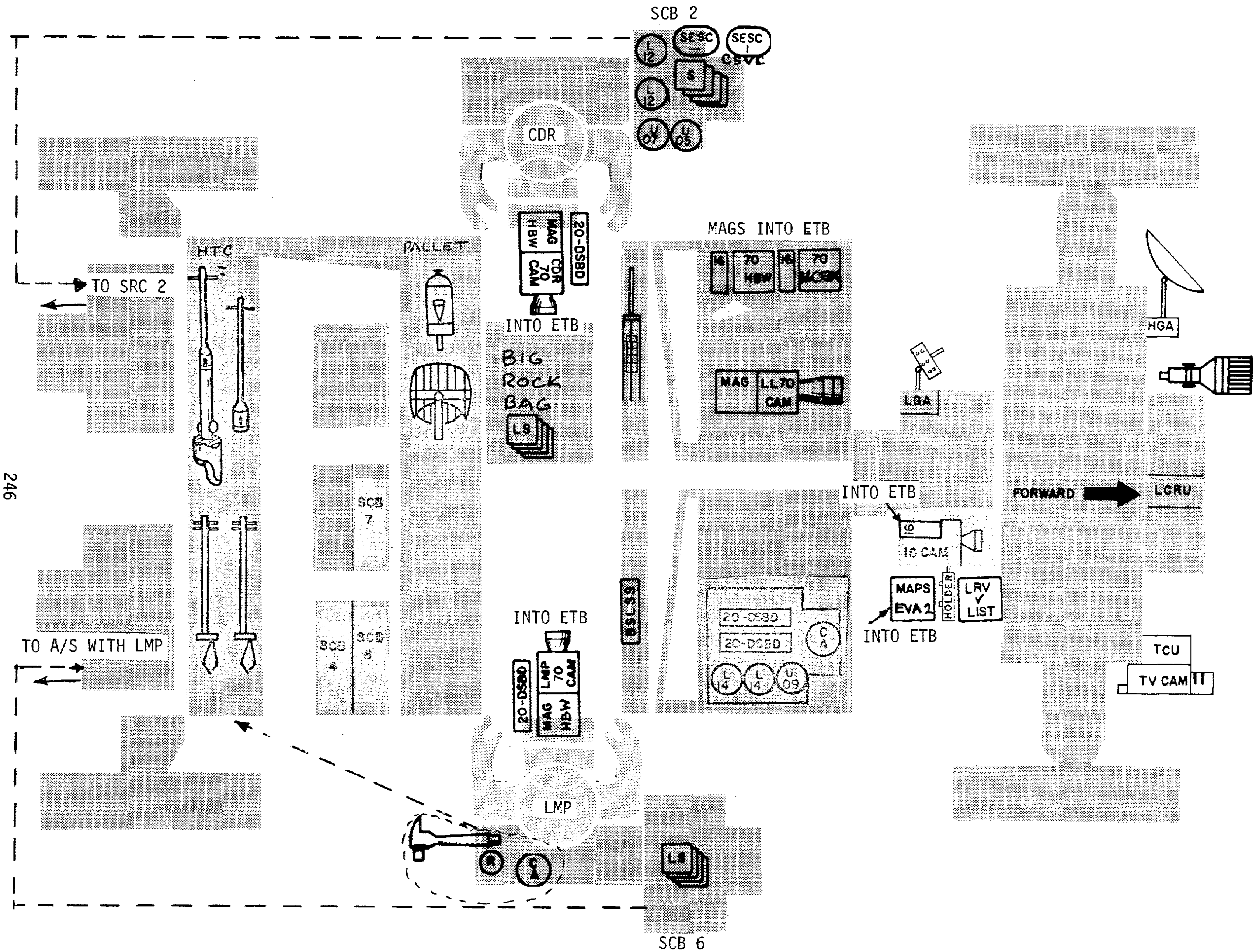


FIGURE 3.5-8d EVA 2 ARRIVAL BACK AT LM

FIGURE 3.5-8e : EVA-2 ON ARRIVAL BACK AT LM (LRV TRANSFERS TO MESA AND LM)

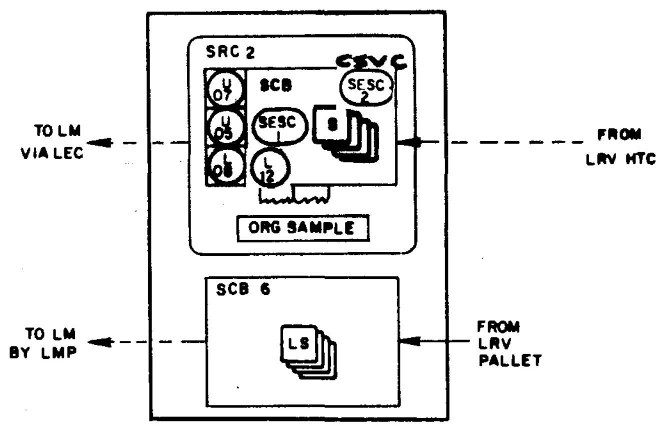
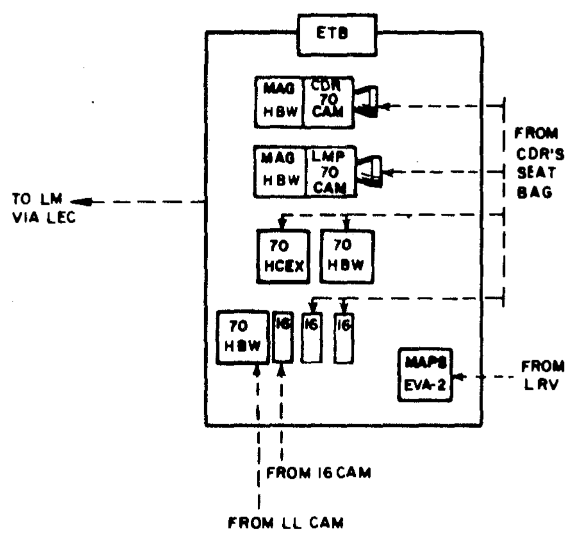


FIGURE 3.5-8f **EVA-2 ON LMP INGRESS**
(ETB TRANSFER TO LM)



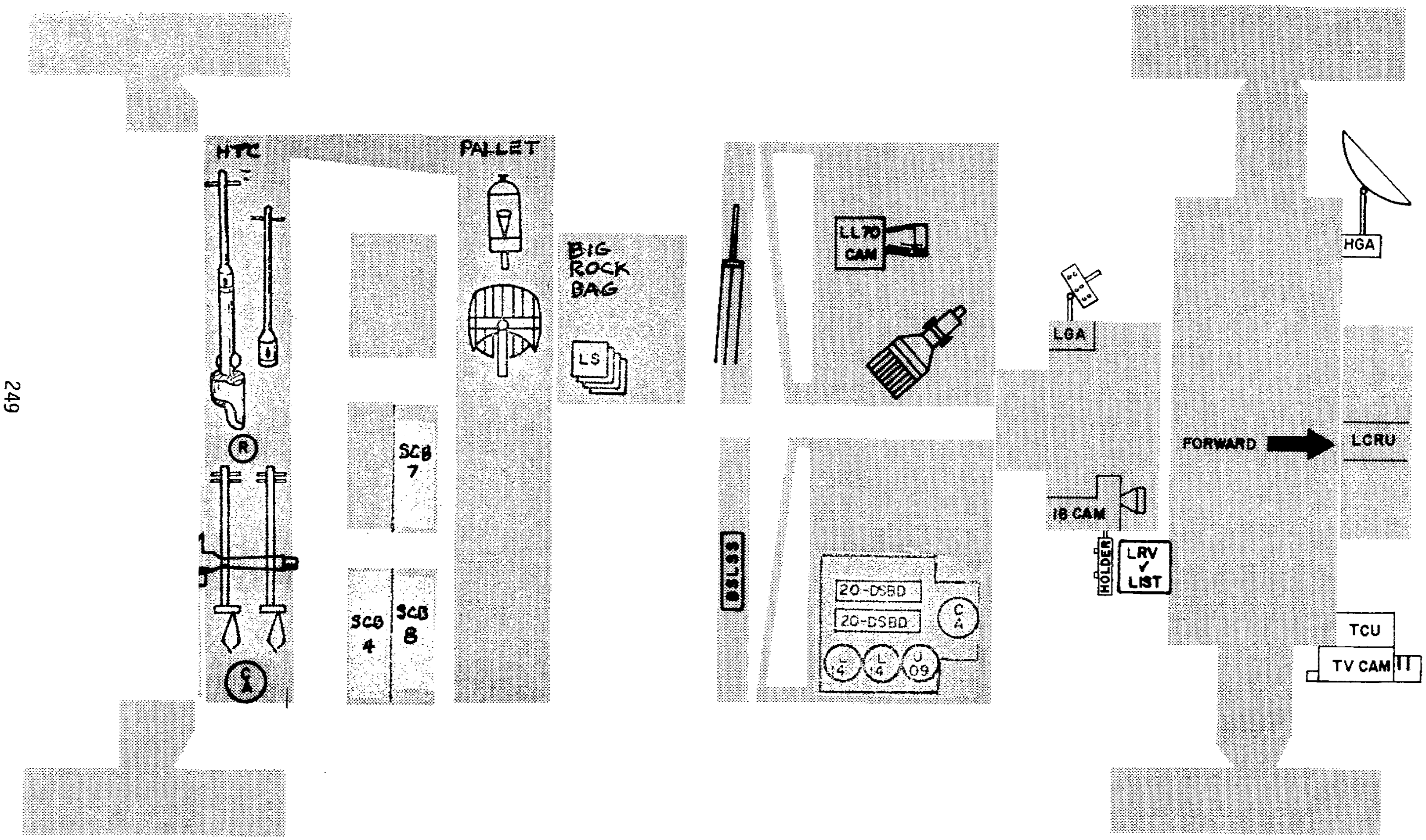
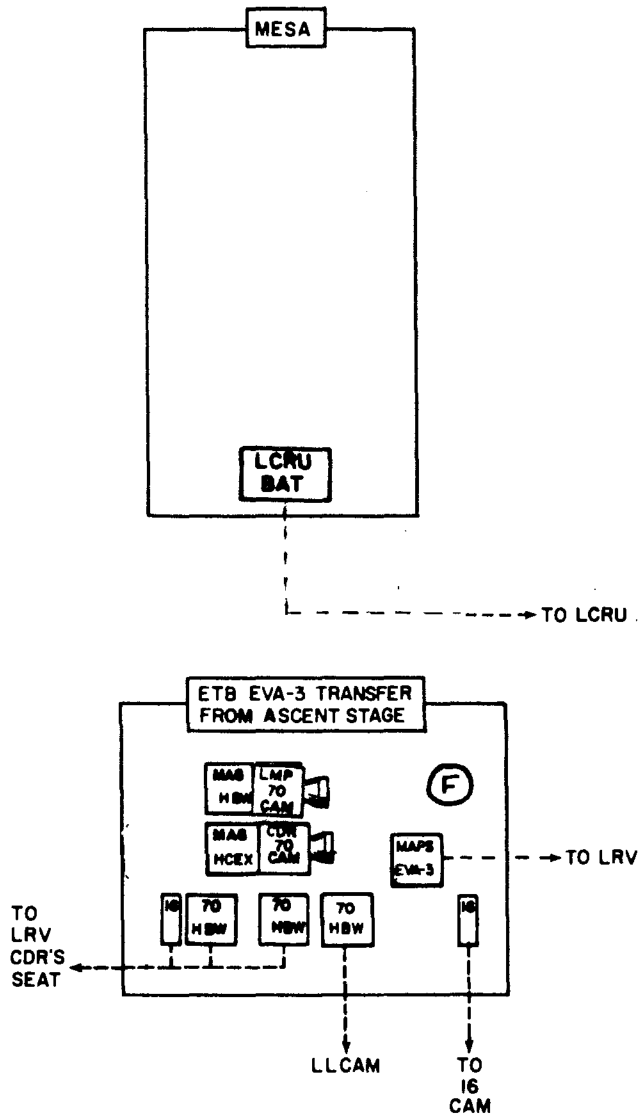


FIGURE 3.5-8g EVA 2 FINAL LRV CONFIGURATION

FIGURE 3.5-9a : **EVA-3 PRE-GEOLOGY TRAVERSE**

(MESA AND ETB TRANSFERS TO LRV)



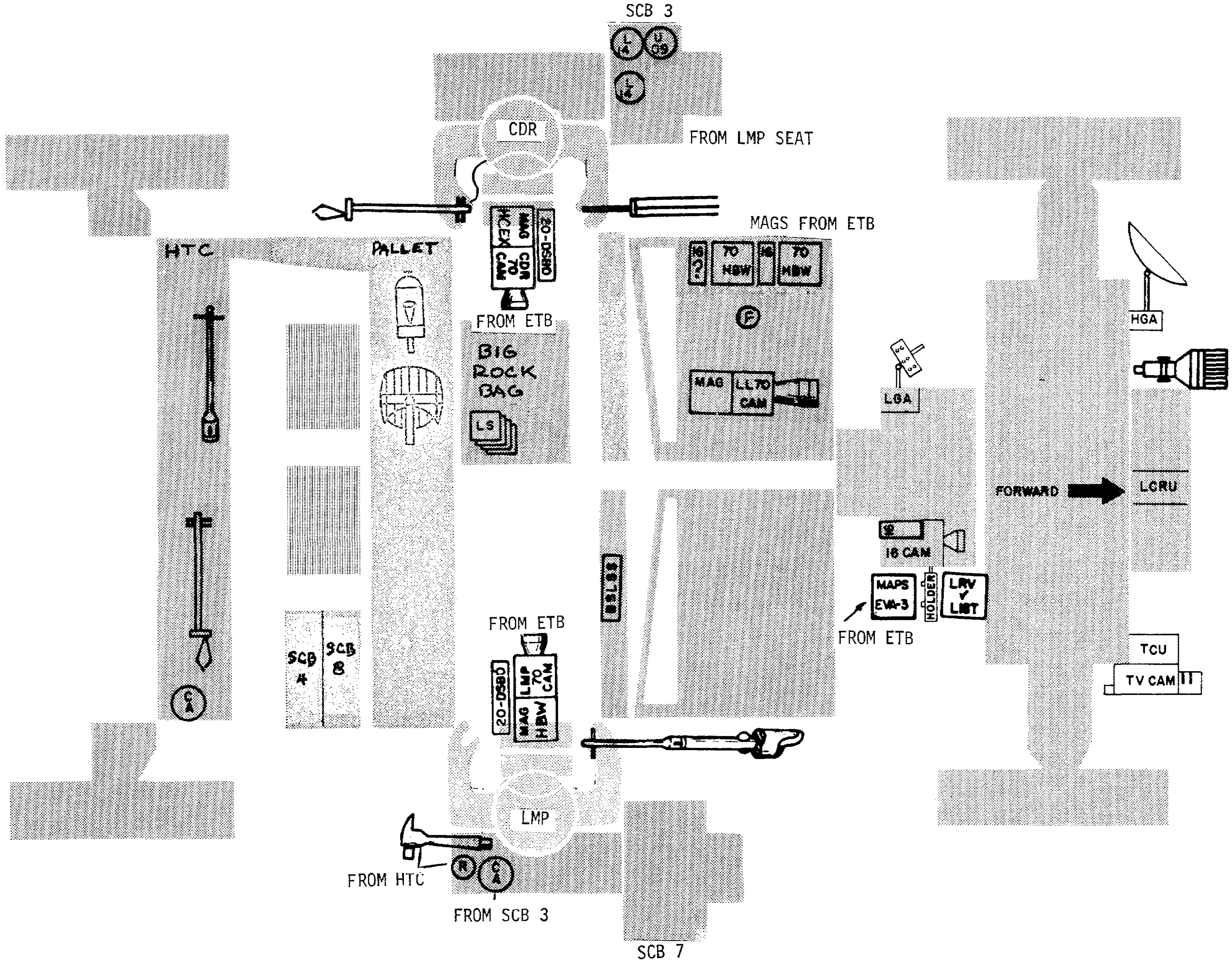


FIGURE 3.5-9b : EVA 3 PRE-GEOLOGY TRAVERSE

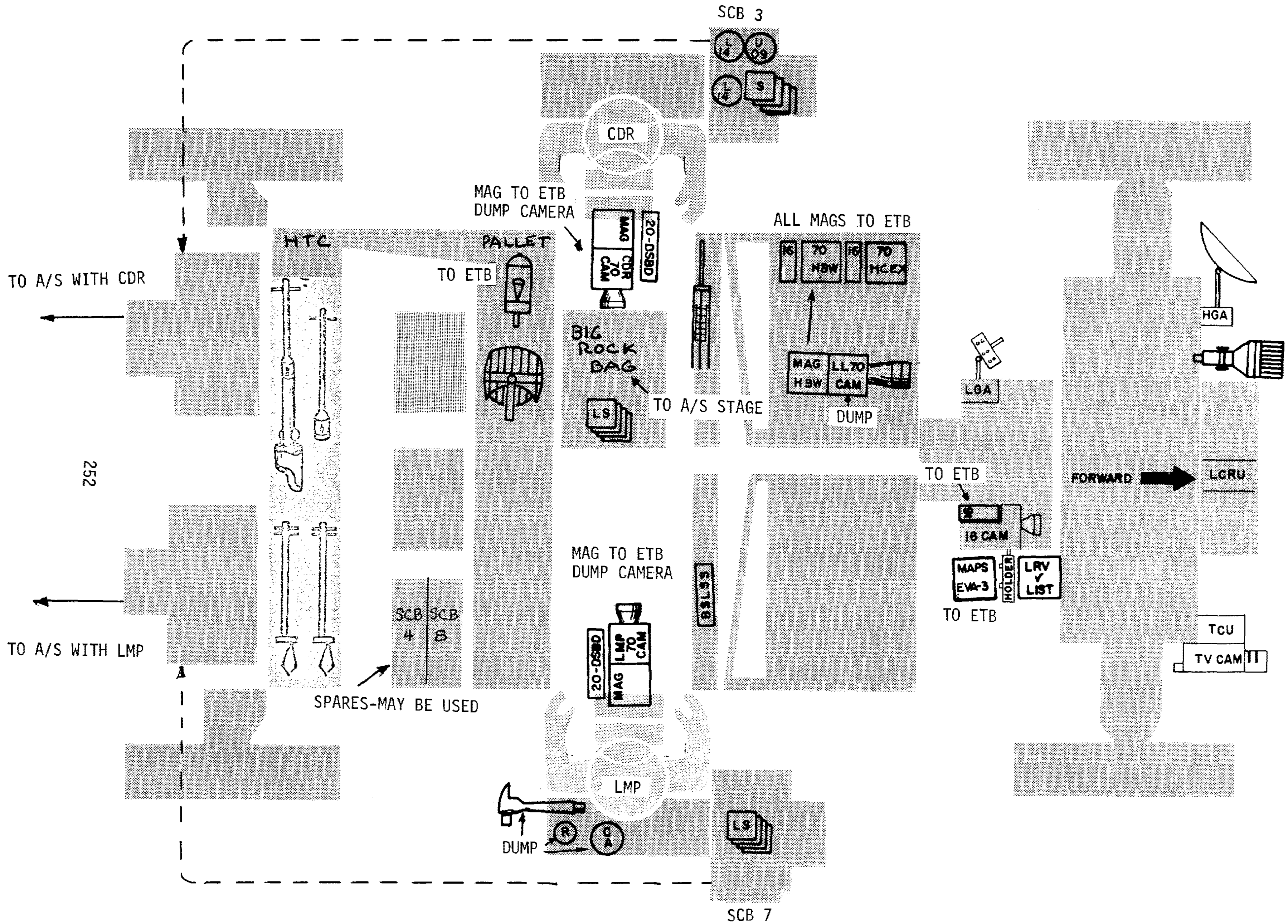
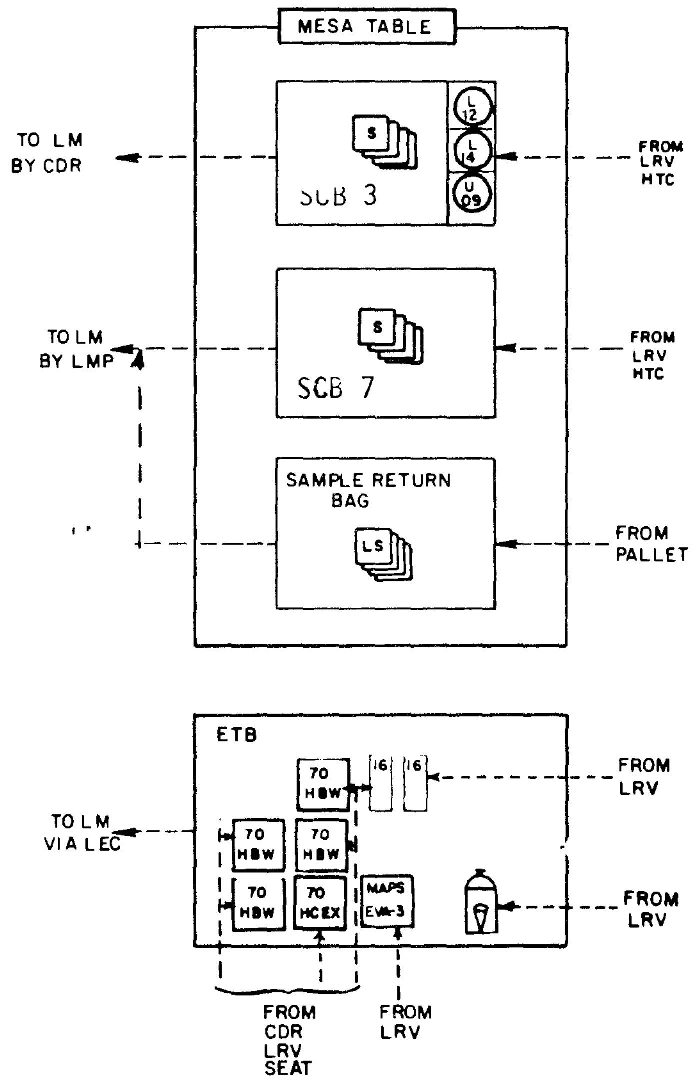


FIGURE 3.5-9c EVA 3 ARRIVAL BACK AT LM

FIGURE 3.5-9d **EVA-3 ON ARRIVAL BACK AT LM**
(LRV TRANSFER TO MESA AND LM)



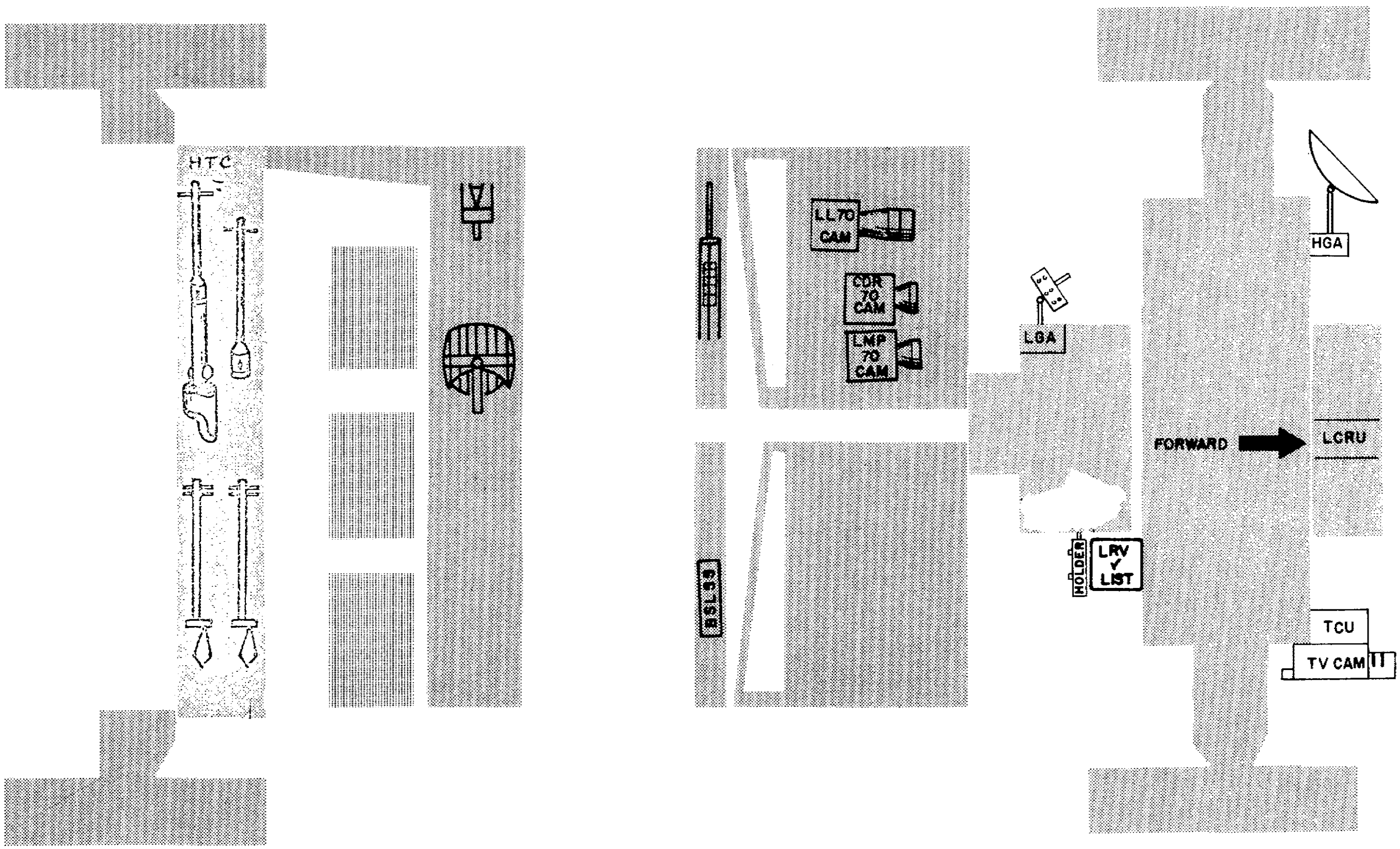


FIGURE 3.5-9e EVA 3 FINAL LRV CONFIGURATION (R.I.P.)

3.6 EVA TRAVERSES

Section 3.6 was prepared with the cooperation of the Lunar Surface Procedures Section, Crew Procedures Division by the Operations Analysis Branch of Systems Engineering Division, Apollo Spacecraft Program Office, for inclusion in this document.

3.6 EVA TRAVERSES

Descartes Landing Site

The regional setting of the Descartes landing site is shown in figure 3.6-1. The arrow points to the landing area, the coordinates of which are $9^{\circ}00'01''$S and $15^{\circ}30'59''$E. The names of major craters are indicated on the figure for purposes of orientation.

Figure 3.6-2 is a detailed view of that portion of the Descartes area which will be under investigation during the Apollo 16 LRV traverses. The photo covers about 13 km north to south and 15 km east to west. The landing point is marked by an "X" and the bright-rayed crater in the center of the southern margin is South Ray. On the previous figure (3.6-1), South Ray is the bright dot just under the arrow.

Crater names and names of other topographic features in the area of interest to the traverses are shown in figure 3.6-3 superimposed on the photograph of the landing area.

EMU Consumables Data for Traverse Planning

The initial quantities of PLSS consumables (water, oxygen, and electrical power) and the rate at which they are depleted (metabolic rate, heat leak, suit leak, etc.) have a direct influence on the nominal traverse design. In addition, the traverse must always accommodate two contingencies: walkback from any point in the traverse after an LRV failure and driveback from any point in the traverse after one crewman's PLSS failure (using the Buddy-SLSS mode). Tables 1-4 present the basic EMU data used in Apollo 16 traverse planning. Details of the particular traverse evaluation relative to the consumables margin for the nominal and contingency cases are shown in a later section.

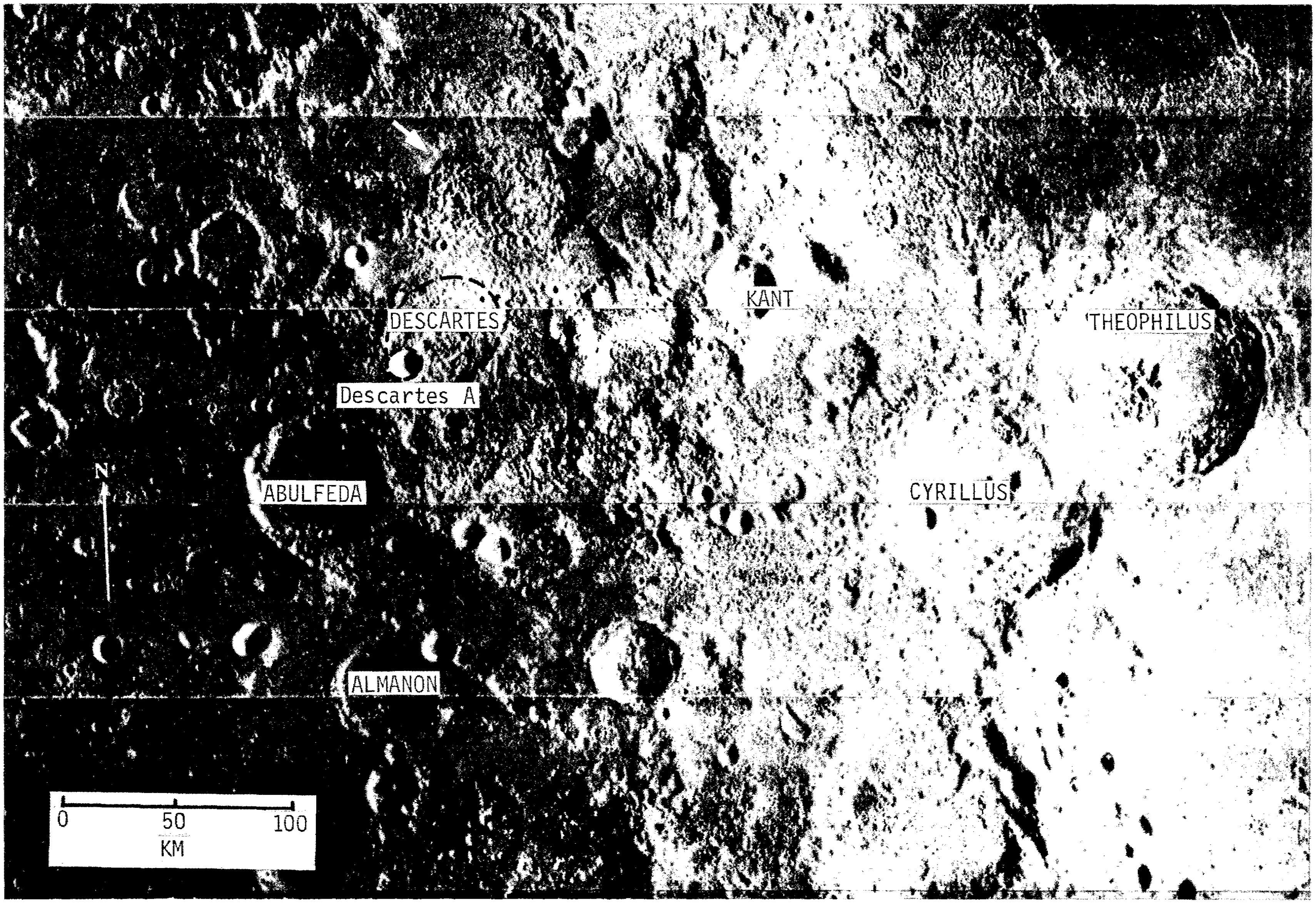


Figure 3.6-1. - Regional setting of the Descartes area.
Arrow points to the landing site.

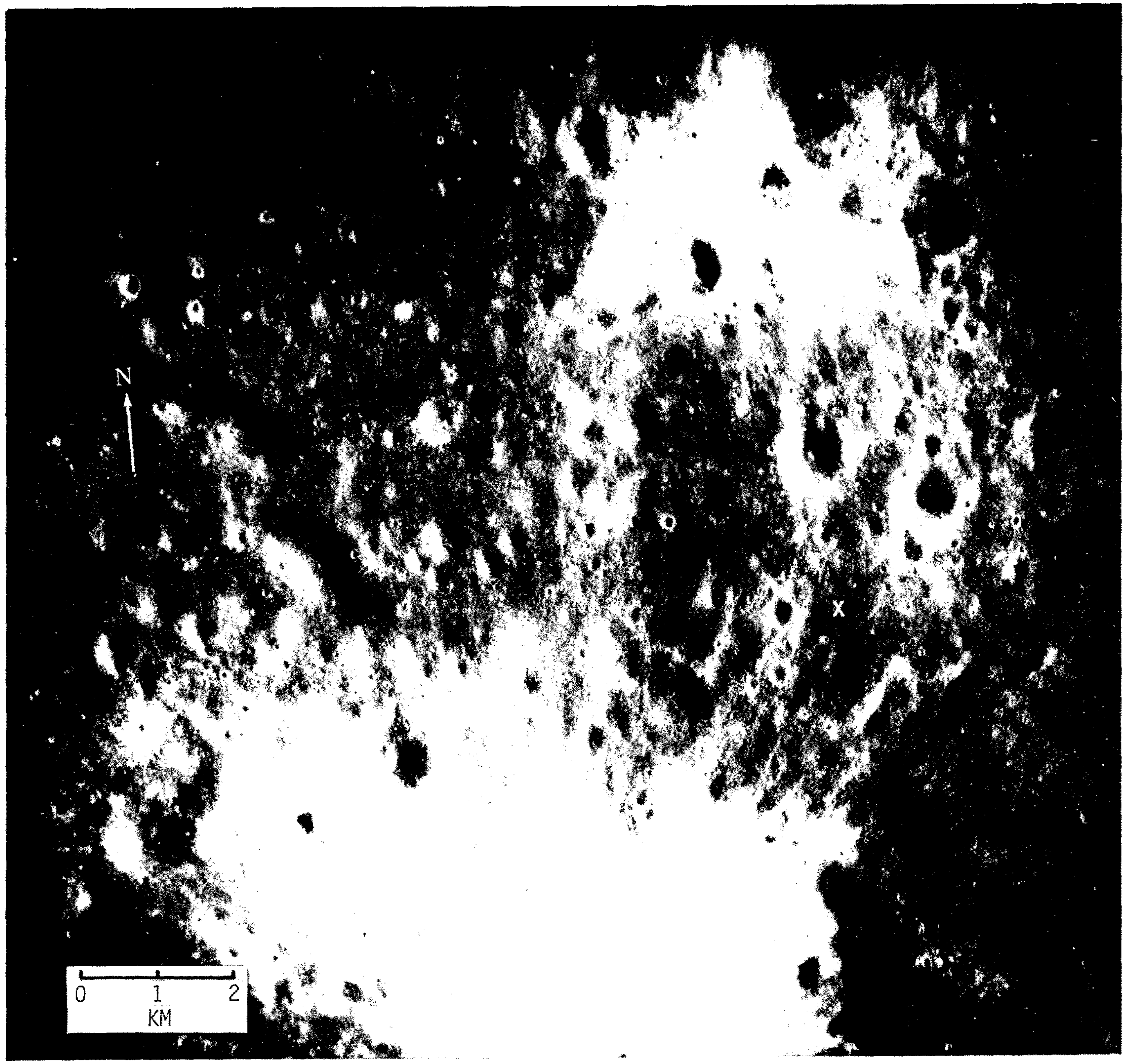


Figure 3.6-2. - Detailed view of the Descartes area.

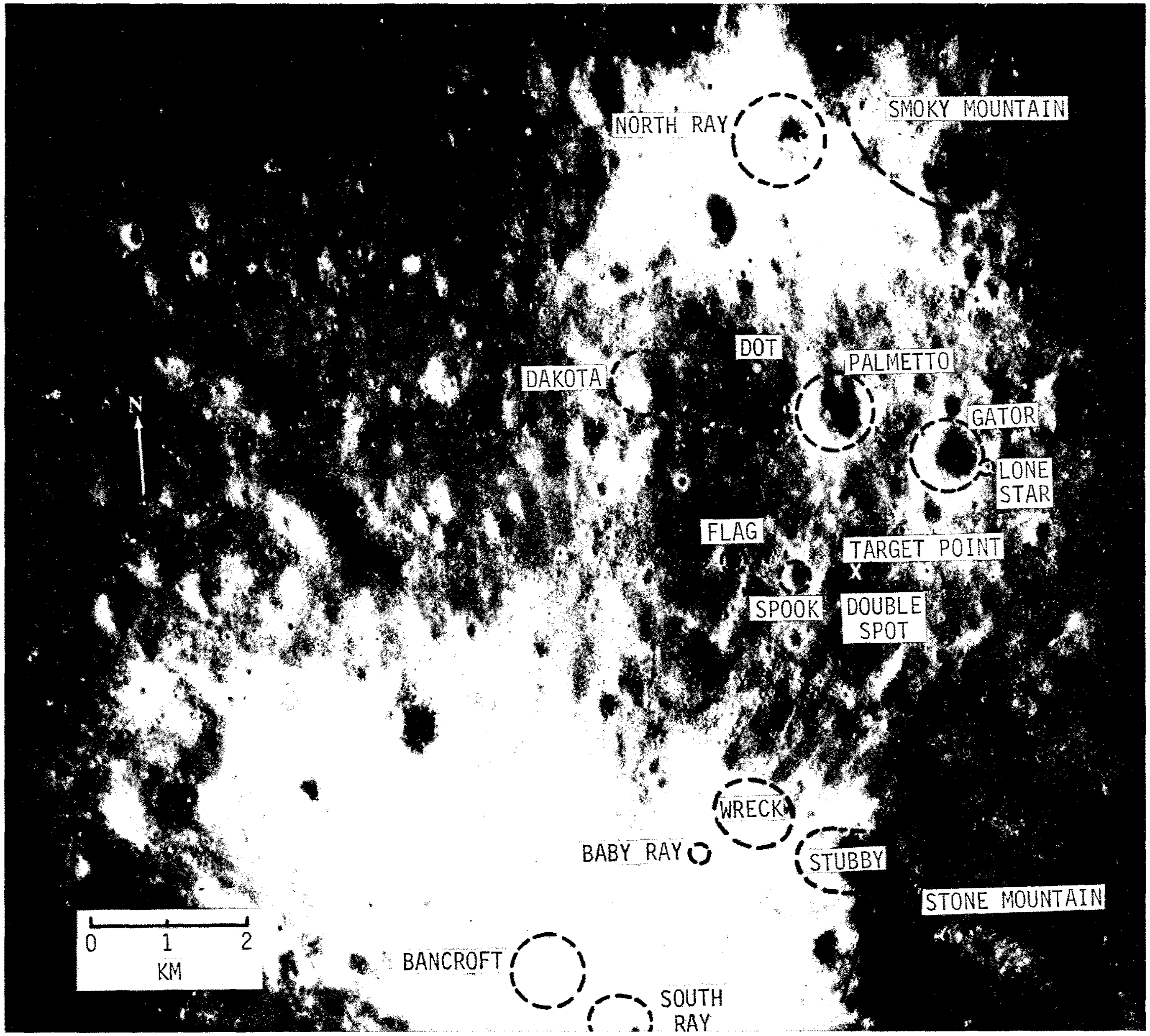


Figure 3.6-3. - Photograph of Descartes area with major feature names.

TABLE 3.6-1

PLSS CONSUMABLES

PRIMARY OXYGEN

Total Usable:	EVA I -	1.426 lb.
	EVA II & III -	1.345 lb.

$$O_2 \text{ usage rate (lb/hr)} = 1.627 \times 10^{-4} \times \text{metabolic rate (BTU/hr)} + \text{EMU leak rate (lb/hr)}$$

FEEDWATER

Total Usable:	EVA I -	11.21 lb.
	EVA II & III -	11.64 lb.

$$\text{Feedwater usage rate (lb/hr)} = \frac{1.26}{1038} \times \text{metabolic rate (BTU/hr)} + \frac{\text{EMU Heat Leak (BTU/Hr)}}{1038} + \frac{153}{1038}$$

ELECTRICAL POWER

Total Usable: 21.37 Amp/hrs.

Usage Rate: 2.6 amps.

TABLE 3.6-2

Oxygen Purge System Capability

Usable:	High Flow Purge -	5.07 lb.
	Low Flow Purge -	5.37 lb.
	Make-up Mode -	5.67 lb.
Lifetime:	High Flow Purge -	39 minutes
	Low Flow Purge -	80.5 minutes

Operational Allowances:

Buddy-SLSS Hookup Time -	5 minutes
LM Ingress Time -	13 minutes
Time limit for walkback to LRV (OPS low purge) for B-SLSS hook-up -	10 minutes

TABLE 3.6-3
Consumables Leak Rates

EMU O_2 Leak

EVA I	:	.020 lb/hr
EVA II	:	.028 lb/hr
EVA III	:	.035 lb/hr

EMU Heat Leak

EVA I	:	-100 BTU/Hr
EVA II	:	+75 BTU/Hr
EVA III	:	+160 BTU/Hr

TABLE 3.6-4
Metabolic Rates

Activity -

LRV Riding: 550 BTU/Hr

LM Overhead & ALSEP activity: 1050 BTU/Hr

Traverse Station Activity: 950 BTU/Hr

Contingency Walkback:

(a) Up to 1 hr return time: 1560* BTU/Hr
(3.6 km/hr walking rate)

(b) Over 1 hr return time: 1290* BTU/Hr
(2.7 km/hr walking rate)

*Includes 20 percent uncertainty over estimated metabolic rate.

3.6.1 LRV Traverses

The LRV traverses are designed to concentrate on two major geologic objectives: The Cayley formation typified by the landing area itself, and the Descartes Mountains typified by Stone Mountain to the south of the landing area and Smoky Mountain to the north. Figure 3.6.1-1 shows the planned LRV traverses superimposed on a photograph of the Descartes site. A topographic map of the area is shown in figure 3.6.1-2. The EVA I traverse is relatively short since a significant portion of the EVA is spent in performing tasks in the LM vicinity including ALSEP deployment. It is devoted entirely to sampling the Cayley Formation. The traverses on EVA II and III divide the time between the Cayley Formation and the Descartes Mountains.

Details of the station time allotments, the station activities, PLSS consumables margins (for both the nominal and contingency walk-back cases) appear in the following sections. It should be understood that the station times available and the list of activities at each station represent a highly success-oriented estimate of achievement. This approach is taken consciously in order that training of the crew and ground support elements will encompass the most optimistic estimate of accomplishment. Achieving the pre-planned EVA durations will depend to a large extent on accurately estimating PLSS consumables usage rates; achieving the pre-planned times for the traverse will depend upon the other EVA activities such as LRV deployment and ALSEP deployment going precisely as planned; achieving the pre-planned station times depend directly on making good the pre-mission estimates of LRV speed; and finally achieving the many pre-planned station tasks will depend on a rather complex set of interrelated activities meshing exactly as planned; moreover, on the scene observations by the crew (in consultation with the science support team on the ground) will probably result in reordering of scientific tasks and reapportionment of times. In order to be able to respond to the various non-nominal situations, priorities of traverse stations and priorities of station tasks are established beforehand to serve as guidelines when the situations occur during the mission. These guidelines appear in section 3.6.3.

Details of the three LRV traverses appear in sections 3.6.1.1, 3.6.1.2, and 3.6.1.3. For each EVA, a narrative description is presented followed by a station timeline in which the individual activities of the two crewmen are presented in a simplified bar chart form. The actual division and interrelationship of the crew's activities will be more complex than it is practical to show in this type format. Finally, details relative to EMU consumables are presented for both the nominal case and for the traverse contingency cases (walkback from failed LRV and driveback using Buddy-SLSS). The calculated data for each traverse is presented and is followed by the input data on which the calculations were based. The figure at the end of each section shows graphically the walkback distance as a function of EVA time relative to the oxygen margin, the most critical of the PLSS consumables.

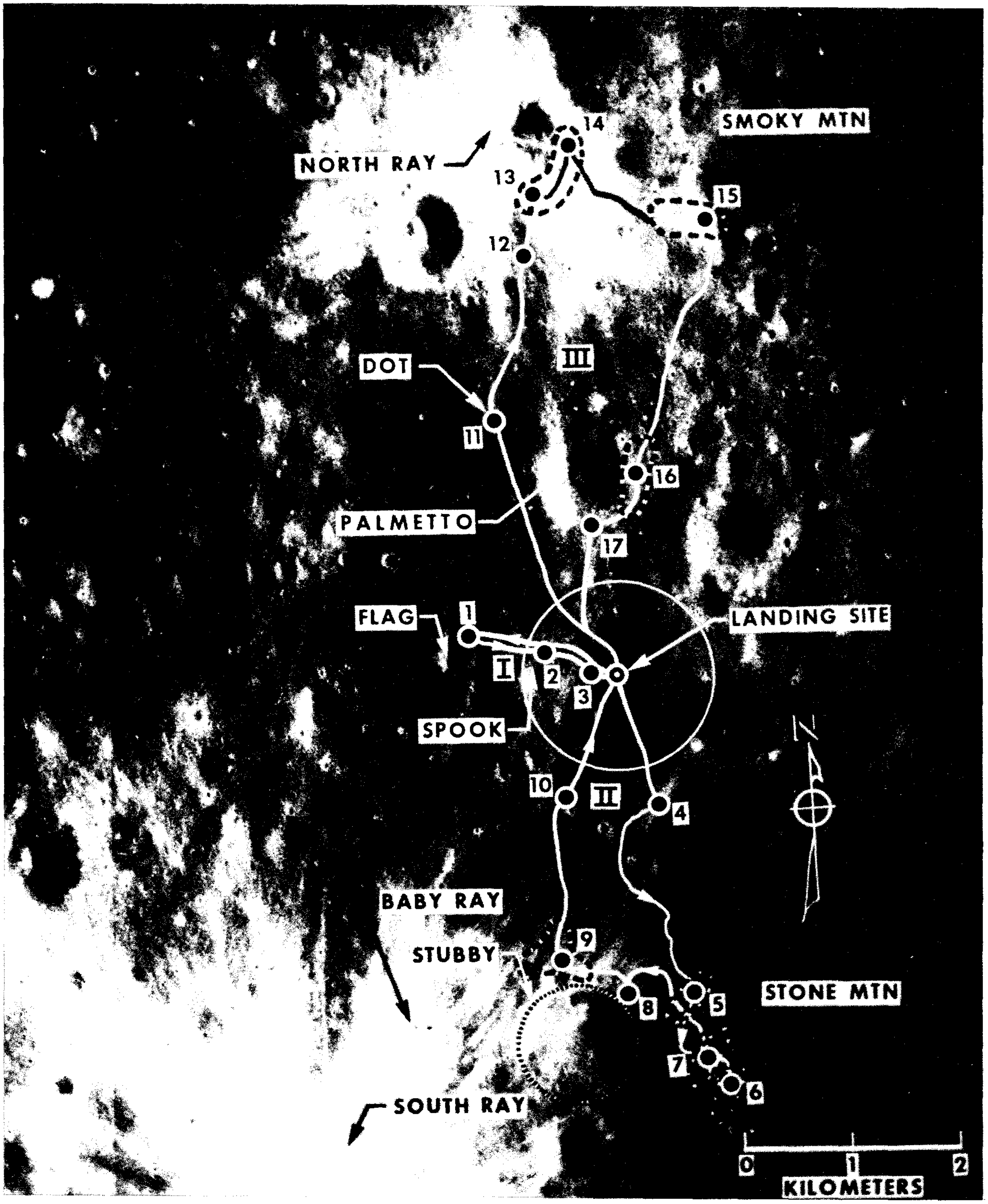


Figure 3.6.1-1. - LRV Traverses.

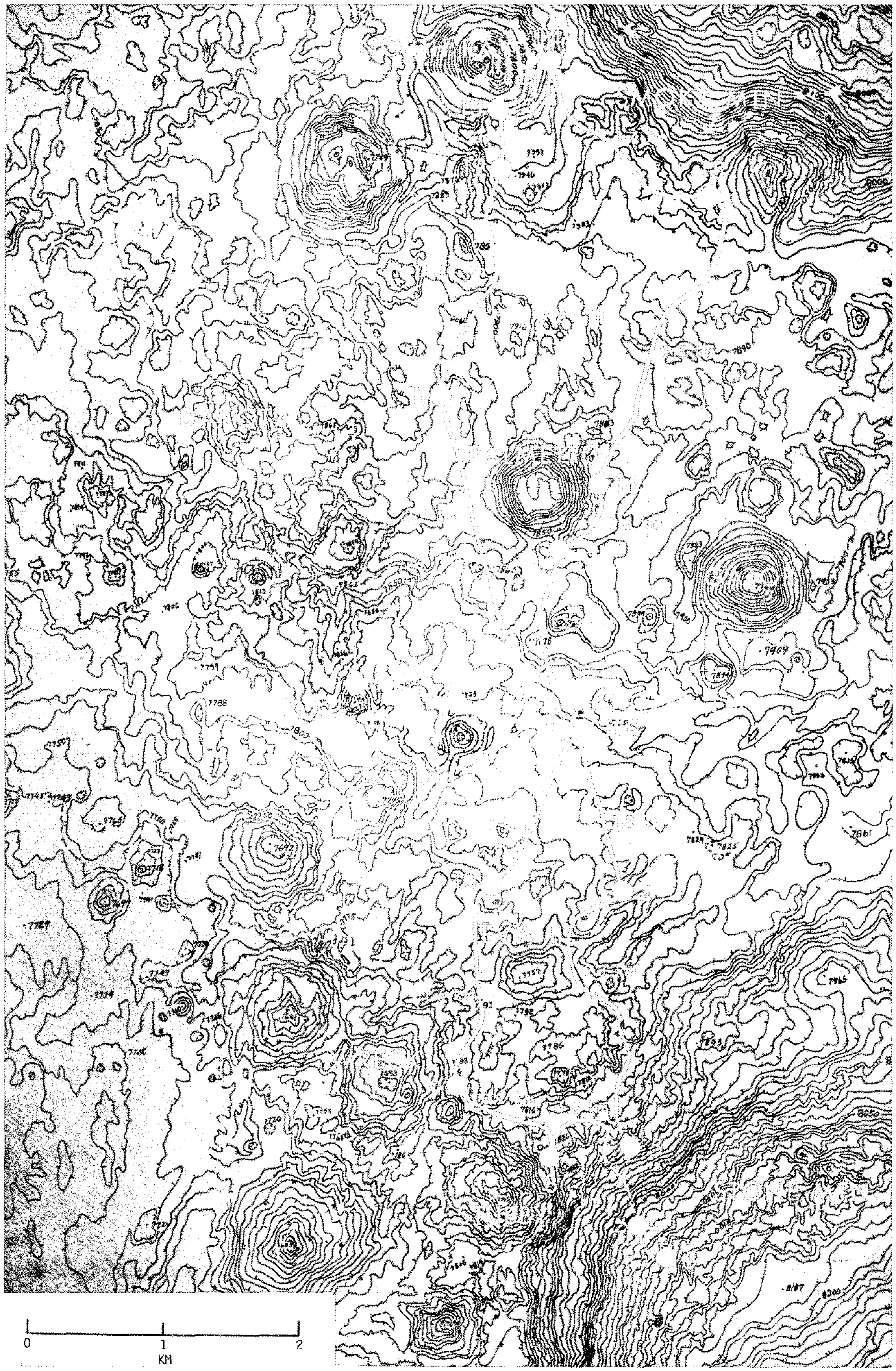


Figure 3.6.1-2. - Topographic map of the Descartes area with LRV traverses superimposed. Contour Interval is 10 meters.

3.6.1.1 EVA I

Traverse Description

On EVA I, the initial period of activity in the LM vicinity occupies about 1-1/2 hours during which time the LRV is deployed and equipment is loaded on the LRV in preparation for the traverse. In addition, the far UV camera is set up near the LM and the first of several exposures of various astronomical targets is accomplished. Near the end of this period, the ALSEP is off-loaded and transported to its deployment site about 100 m west of the LM. For approximately the next 2-1/2 hours, the crewmen are occupied at the ALSEP site setting up and activating the various ALSEP experiments. Activity at the ALSEP site is concluded with the drilling of the 2.6 m core and its recovery. The drill stems from the core are separated into their two sections and are left at the site for retrieval later in the EVA. The LRV navigation system is initialized, and the geology traverse begins at 4 hours 01 minute into the EVA.

Approximately 2-1/2 hours is available on EVA I for the geology traverse. This time is spent in investigating and sampling the Cayley plains in the area west of the landing site and near the landing site itself. Three stations are planned: the first at Flag crater about 1.7 km west of the landing site; the second near Spook crater about 1.1 km west of the landing site; and the third back in the LM/ALSEP area. Details of the station activities appear in the following section. Activities at and in the vicinity of Spook and Flag craters are designed to gain a better understanding of the Cayley areally, as well as with depth. Material ejected from these craters may have been derived from depths as great as 60 m. Observations of any stratigraphy in the crater walls coupled with samples from the excavated materials will also be important in the interpretation of the Active Seismic, Magnetometer and Heat Flow Experiment data.

At the completion of Station 2 activities the crewmen return to the vicinity of the LM, 5-1/2 hours into the EVA. A location is selected between the ALSEP area and the LM where about 50 minutes is spent in performing sampling activities and accomplishing the major portion of the Soil Mechanics experiment.

The EVA I closeout begins at 6 hours 20 minutes and cabin repressurization occurs 40 minutes later, ending the 7-hour EVA.

EVA I

STATION	STATION TIME (HR:MIN)	TRAVEL TIME (MIN)	GEOLOGICAL FEATURES	OBSERVATIONS AND ACTIVITIES
LM	1:37	--	CAYLEY PLAINS	EGRESS AND EVA PREPARATION
ALSEP	2:24	--	CAYLEY PLAINS	ALSEP DEPLOYMENT
TRAVEL	--	14	ACROSS CAYLEY PLAINS AND RAYS	OBSERVE STATION 2 AREA AND DISTRIBUTION OF RAY MATERIAL
1 FLAG CRATER	0:30	--	FLAG CRATER, ABOUT 300 METERS IN DIAMETER IN CAYLEY PLAINS; ADJACENT RAY FROM SOUTH RAY CRATER.	EXPLORATION OF CONE CRATER SIZE CRATER EXCAVATING CAYLEY AND OBSERVATIONS OF ADJACENT RAY: PAN CRATER SAMPLING (USE PADDED BAGS HERE IF CONVENIENT) LPM SITE MEASUREMENT RAKE/SOIL SAMPLE
TRAVEL	--	06	ACROSS CAYLEY PLAINS AND RAYS	ASSESS STATION 2 REGION FOR BEST SAMPLING AREA

STATION	STATION TIME (HR:MIN)	TRAVEL TIME (MIN)	GEOLOGICAL FEATURES	OBSERVATIONS AND ACTIVITIES
2 SPOOK CRATER VICINITY	0:31	--	SPOOK CRATER (ABOUT 300 METERS IN DIAMETER) AND SMALL BLOCKY CRATER TO THE NORTH	ASSESS SITE GEOLOGY AND BASED ON THIS AND RESULTS FROM FLAG DIVIDE TIME BETWEEN SPOOK AND BLOCKY CRATER: PAN DOCUMENTED SAMPLING - SPOOK CRATER RIM - BLOCKS ASSOCIATED WITH SMALL CRATER 500 MM PHOTOGRAPHY OF OUTLYING AREAS LPM READING GRAND PRIX
TRAVEL	--	08	CAYLEY PLAINS	OBSERVE RAY PATTERNS: AREA OF EVA II ROUTE TO STONE MOUNTAIN
3 LM/ALSEP AREA	0:50	--	CAYLEY PLAINS BETWEEN LM AND ALSEP	PAN SOIL/RAKE SAMPLE DOUBLE CORE TUBE DOCUMENTED SAMPLING SOIL MECHANICS ACTIVITIES TRENCH SOIL SAMPLES (IF TRENCH IS DUG FOR SOIL MECHANICS)
LM	0:40	--	CAYLEY PLAINS	CLOSEOUT

TRAVERSE STATION TIMELINES - EVA I

STATION 1 - FLAG CRATER (:30)

CDR	OVER-HEAD		DESCRIPTION	LPM SITE MEASUREMENT	RAKE/SOIL SAMPLE	O/H
	:03		:02	:15	:08	:02
LMP	O/H	PAN	DESCRIPTION	SAMPLING*	RAKE/SOIL SAMPLE	O/H

NOTES:

O/H = OVERHEAD

* = CONSIDER 2nd PAN NEAR END OF STATION IF TIME PERMITS.

STATION 2 - SPOOK CRATER (:31)

CDR	O/H		LPM MEAS.	SAMPLING	GRAND PRIX	O/H
	:03		:05	:15	:06	:02
LMP	O/H	PAN	500mm PHOTOS	SAMPLING*	GRAND PRIX	O/H

STATION 3 - ALSEP/LM AREA (:50)

CDR	O/H		TRENCH	TRENCH SAMPLES	RAKE/SOIL SAMPLE	SAMPLING*		O/H
	:03		:08	:03	:08	:20	:06	:02
LMP	O/H	PAN	DOUBLE CORE	TRENCH SAMPLES	RAKE/SOIL SAMPLE	PENETROMETER READINGS, ARM MP, RETRIEVE 2.6m CORE	SAMPLING	O/H

EVA I

APOLLO 16-DESCARTES TRAVERSES CALCULATED DATA

STATION NO.	SEG. DIST. (KM)	LRV MOBILITY RATE (KM/HR)	RIDE TIME (MIN)	TOTAL TRAVEL DIST. (KM)	ARRIVE STATION EVA TIME (H+MIN)	STATION STOP TIME (H+MIN)	DEPART STATION EVA TIME (H+MIN)
LM				0.00	0+ 0	1+37	1+37
ALSEP				0.00	1+37	2+24	4+ 1
RIDE	1.70	7.30	14				
1				1.70	4+15	0+30	4+45
RIDE	0.75	7.30	6				
2				2.45	4+51	0+31	5+22
RIDE	0.95	7.30	8				
3				3.40	5+30	0+50	6+20
LM				3.40	6+20	0+40	7+ 0
TOTALS			28			6+32	7+ 0

STATION	RETURN DIST (KM)	TRAVERSE CONTINGENCIES: LRV FAILURE				TRAVERSE CONTINGENCIES: PLSS FAILURE		EVA AV MET RATE (BTU/HR)
		WALK-BACK TIME TO LM (H+MIN)	STATION MARGIN ABOVE WALKBACK REQT 1, 4			MIN LRV RIDE BACK SPEED REQ 3		
			F/W (H+MIN)	O_2 (H+MIN)	AMP HR (H+MIN)	0 MIN (KM/HR)	10 MIN (KM/HR)	
LM	0.00	0+ 0	****	****	****	0.00	0.00	1050.00
ALSEP	0.00	0+ 0	4+40	3+34	3+58	0.00	0.00	1050.00
1	1.70	0+28	3+ 6	2+ 1	2+36	1.63	1.94	1014.95
2	0.95	0+16	2+51	1+45	2+11	0.91	1.09	999.31
3	0.00	0+ 0	2+32	1+25	1+39	0.00	0.00	984.01
LM	0.00	0+ 0	2+ 1	0+55	1+12	0.00	0.00	990.30

FOOTNOTES TO 'CALCULATED DATA'

1. 30 MINUTES RESERVES MAINTAINED ON ALL PLSS CONSUMABLES AT STATION METABOLIC RATE

2. ALL DISTANCES AND SPEEDS ARE MAP DISTANCES AND MAP SPEEDS (MOBILITY RATES)

3. REQUIRED RATE = RETURN DISTANCE/AVAILABLE OPS TIME
   TOTAL OPS TIME 80.5 MINUTES
   5 MIN BSLSS HOOKUP
   13 MIN LM INGRESS
   62.5 MIN AVAILABLE FOR RIDEBACK
   52.5 MINUTES REMAINING FOR RIDEBACK (10 MINUTES ALLOWED AT STATION FOR RETURN TO LRV AND RIDEBACK PREPARATION)

4. TIME MARGIN AT STATION METABOLIC RATE

   STATION / FINAL LM O/H } MARGIN = TIME REMAINING AFTER ALLOWANCE FOR 10 MINUTES AT LRV, WALKBACK, AND 13 MINUTES INGRESS

5. RESPIRATORY EXCHANGE QUOTIENT = .90

6 FEED WATER HEAT OF VAPORIZATION 1038 $\frac{\text{BTU}}{\text{LB.}}$

EVA I

APOLLO 16-DESCARTES TRAVERSES
INPUT DATA

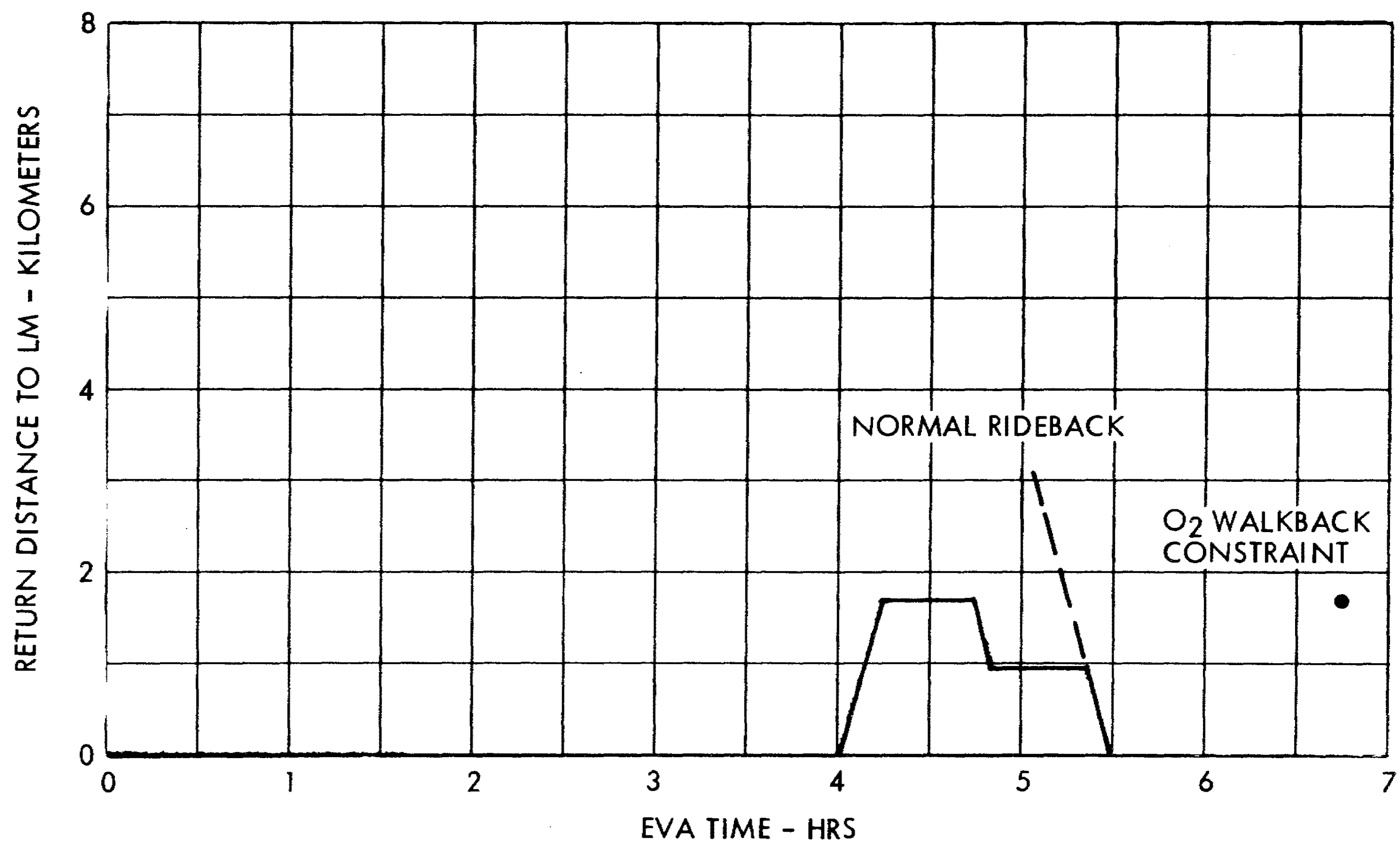
STATION NO.	STATION STOP TIME (H + MIN)	SEG. DIST (KM)	RET. DIST (KM)	HEAT LEAK (BTU/HR)	MOBILITY RATE WALK (KM/HR)	MOBILITY RATE RIDE (KM/HR)	MET WALK (BTU/HR)
LM	1+37	0.00	0.00	-99.	3.60	7.30	1560.0
ALSEP	2+24	0.00	0.00	-99.	3.60	7.30	1560.0
1	0+30	1.70	1.70	-99.	3.60	7.30	1560.0
2	0+31	0.75	.95	-99.	3.60	7.30	1560 0
3	0+50	0.95	0.00	-99.	3.60	7.30	1560.0
LM	0+40	0.00	0.00	-99.	3.60	7.30	1560.0

MET ALSEP (BTU/HR)	MET RIDING (BTU/HR)	MET STATION (BTU/HR)	MET LM O/H (BTU/HR)	LEAK RATE O_2 (LB/HR)	EVA START (F/W LB)	EVA START (O_2 LB)
1050.00	550.00	950.00	1050.00	.020	11.21	1.426

APOLLO 16

RIDING TRAVERSE - DISTANCE

EVA 1



3.6.1.2 EVA II

Traverse Description

On EVA II, approximately the initial three-quarter hour involves egress and preparation for the traverse activities. Investigation of three areas occupies the 5-1/2 hours of traverse time. This time is spent in investigating the Descartes Formation (the Stone Mountain region), doing additional sampling of the Cayley Formation, and sampling blocks and blocky rays originating from South Ray Crater. Details of the station activities for EVA II appear in the following section. Stations 4 and 10 occur in the Cayley Formation and samples from these stations combined with Cayley samples from other EVA's should provide data on the areal variation of this unit and possible gradational relationships with the Descartes Formation. Samples of ray material from South Ray may be collected at Station 4. The relatively fresh sharp-rimmed, 50-meter crater at Station 10 should provide good samples of local bedrock.

Stations 5, 6, 7 and 8 will investigate the Descartes Formation (Stone Mountain) and its relation to the Cayley. About 1-3/4 hours are spent at Stations 5 and 6 which will be located on the slopes of Stone Mountain depending on the crew's analysis of the local geology and trafficability. Activities there are designed to collect a wide variety of sample data using various collecting techniques. Existing craters and changes in slope will be areas of specific interest on the mountain front. A total of 50 minutes will be spent near the base of the Descartes Formation (Stone Mountain) and in addition to sampling, observations will be made on the relationships between the Cayley and Descartes formations.

One hour will be spent at Station 9 investigating boulders and ray material from South Ray Crater. A large boulder will be selected for detailed sampling according to procedures outlined in the Field Geology experiment. Sampling of this region will not only provide material derived from below the surface several kilometers away but study of the length of exposure of these materials and materials from North Ray Crater will help to establish the rate of ray disappearance.

The remaining 40 minutes of the EVA is spent at the LM stowing samples and equipment and ingressing.

EVA II

STATION	STATION TIME (HR:MIN)	TRAVEL TIME (MIN)	GEOLOGICAL FEATURES	OBSERVATIONS AND ACTIVITIES
LM	0:50	--	CAYLEY PLAINS	EGRESS AND EVA PREPARATION
TRAVEL	--	10	ACROSS CAYLEY PLAINS AND RAYS FROM SOUTH RAY	OBSERVE DISTRIBUTION OF RAYS, ABUNDANCE OF BLOCKS, AND SECONDARY CRATERS
4	0:15	--	IN CAYLEY PLAINS ADJACENT TO SOUTH RAY DEPOSITS	EXAMINE AND SAMPLE CAYLEY/RAY AREA: PAN DOCUMENTED SAMPLING SURFACE SOIL SAMPLE SHALLOW TRENCH SOIL SAMPLE
TRAVEL	--	19	ACROSS CAYLEY PLAINS TO BASE OF STONE MOUNTAIN	OBSERVE ANY CHANGES OF REGOLITH CHARACTERISTICS UPON APPROACH TO STONE MOUNTAIN. NOTE SLOPE CHARACTERISTICS ON STONE MOUNTAIN
5 STONE MOUNTAIN	0:30	--	IN DESCARTES FORMATION AT BASE OF STONE MOUNTAIN	NOTE CHARACTERISTICS OF DESCARTES FORMATION AND LOCAL GEOLOGY AND COMPARE TO ADJACENT CAYLEY: ASSESS UPSLOPE TERRACES: PAN DOCUMENTED SAMPLING - SURFACE SAMPLER SAMPLES (ONE ON UNDISTURBED SOIL, ONE ON TOP OF ROCK; RETURN ROCK) - CSVC (SINGLE CORE)

STATION	STATION TIME (HR:MIN)	TRAVEL TIME (MIN)	GEOLOGICAL FEATURES	OBSERVATIONS AND ACTIVITIES
TRAVEL	--	09	DESCARTES FORMATION	OBSERVE TERRACES AND ANY BEDROCK-REGOLITH CHANGES
6 STONE MOUNTAIN	1:00	--	SMALL CRATERS AT BASE OF TERRACE IN DESCARTES FORMATION. THE HIGHEST POINT REACHED IN THE DESCARTES FORMATION ON STONE MOUNTAIN.	OBSERVATION AND SAMPLING OF DESCARTES FORMATION: PAN - (TAKE ONE AT BEGINNING AND A SECOND AT THE MOST DISTANT POINT FROM THE LRV DURING SAMPLING DOCUMENTED SAMPLING - RAKE/SOIL SAMPLE - DOUBLE CORE (CONSIDER TRIPLE) 500 MM PHOTOGRAPHY UPSLOPE AND OTHER TARGETS PENETROMETER MEASUREMENTS
TRAVEL	--	02	DESCARTES FORMATION	OBSERVE TERRACES AND ANY BEDROCK-REGOLITH CHANGES
7 STONE MOUNTAIN	0:45	--	INTERMEDIATE AREA IN CRATERED AND TERRACED REGION OF DESCARTES FORMATION	STATION TO BE SELECTED AT SOME INTERMEDIATE POINT ON THE WAY DOWN STONE MOUNTAIN BASED ON THE ASSESSMENT FROM STATION 6 PAN DOCUMENTED SAMPLING 500 MM PHOTOGRAPHY OF SOUTH RAY CRATER (IF NOT TAKEN AT STATION 6)

STATION	STATION TIME (HR:MIN)	TRAVEL TIME (MIN)	GEOLOGICAL FEATURES	OBSERVATIONS AND ACTIVITIES
TRAVEL	--	12	DESCARTES FORMATION	OBSERVE CRATERS, BLOCKS
8 STONE MOUNTAIN-STUBBY CRATER AREA	0:20	--	IN DESCARTES FORMATION AT BASE OF STONE MT. NEAR STUBBY	OBSERVE RELATIONS BETWEEN CAYLEY AND DESCARTES FORMATION IN STUBBY AREA: PAN DOCUMENTED SAMPLING - STUBBY RIM 500 MM PHOTOGRAPHY OF - SOUTH WALL OF STUBBY - OTHER TARGETS
TRAVEL	--	07	ACROSS CAYLEY FORMATION TO RAYS FROM SOUTH RAY CRATER	OBSERVE CHANGES IN REGOLITH AND NOTE CHARACTERISTICS OF RAYS
9 RAYS FROM SOUTH RAY CRATER	0:55	--	IN RAYS FROM SOUTH RAY CRATER OVERLYING CAYLEY	IN BLOCKY RAY AREA: PAN DOUBLE CORE RAKE/SOIL SAMPLE (REMOTE FROM LOCAL BOULDERS) DOCUMENTED SAMPLES - POSSIBLE BOULDER/PERMANENT SHADOW SESC SAMPLE - SELECT LARGE BOULDER FOR BOULDER SAMPLING - RAY SAMPLES

STATION	STATION TIME (HR:MIN)	TRAVEL TIME (MIN)	GEOLOGICAL FEATURES	OBSERVATIONS AND ACTIVITIES
TRAVEL	--	13	ACROSS CAYLEY	OBSERVE RAY AND BLOCK DISTRIBUTION, COMPARE TO OTHER RAYS AND REGOLITH
10	0:20	--	FRESH 50 M CRATER IN CAYLEY	PAN RADIAL SAMPLING OF SMALL FRESH CRATER: OBSERVE INTERIOR FOR COMPARISON WITH DOT CRATER ON EVA III.
TRAVEL	--	12	CAYLEY PLAINS	CHARACTERISTICS OF CAYLEY AND RAYS
LM	0:40	--	CAYLEY PLAINS	CLOSEOUT

TRAVERSE STATION TIMELINES - EVA II

STATION 4 - CAYLEY PLAINS (:15)

CDR	O/H		SAMPLING	O/H
	:03		:10	:02
LMP	O/H	PAN	SAMPLING	O/H

NOTES:

O/H = OVERHEAD

* = CONSIDER 2nd PAN NEAR END OF STATION IF TIME PERMITS.

STATION 5 - BASE OF STONE MOUNTAIN (:30)

CDR	O/H		SAMPLE FOR CSVC	SAMPLING		O/H
	:03		:06	:08	:11	:02
LMP	O/H	PAN	SAMPLE FOR CSVC	SURFACE SAMPLER	SAMPLING	O/H

STATION 6 - STONE MOUNTAIN (:60)

CDR	O/H		DESCRIPTION AND 500mm PHOTOS	DOUBLE CORE	RAKE/SOIL SAMPLE	SAMPLING	O/H
	:03		:08	:08	:08	:31	:02
LMP	O/H	PAN	PENETROMETER MEASUREMENTS	DOUBLE CORE	RAKE/SOIL SAMPLE	SAMPLING *	O/H

STATION 7 - STONE MOUNTAIN (:45)

CDR	O/H		DESCRIPTION AND SAMPLING	O/H
	:03		:40	:02
LMP	O/H	PAN	DESCRIPTION AND SAMPLING *	O/H

TRAVERSE STATION TIMELINES - EVA II (CONT)

STATION 8 - STUBBY CRATER (:20)

CDR	O/H		DESCRIP-TION	SAMPLING	O/H
	:03		:03	:12	:02
LMP	O/H	PAN	500mm PHOTOS	SAMPLING	O/H

NOTES:

O/H = OVERHEAD

* = CONSIDER 2nd PAN NEAR END OF STATION IF TIME PERMITS.

STATION 9 - SOUTH RAY EJECTA BLANKET (:55)

CDR	O/H		DOUBLE CORE	RAKE/SOIL SAMPLE	RAY SAMPLING	BOULDER SAMPLING	O/H
	:03		:08	:08	:09	:25	:02
LMP	O/H	PAN	DOUBLE CORE	RAKE/SOIL SAMPLE	RAY SAMPLING	BOULDER SAMPLING*	O/H

STATION 10 - CAYLEY PLAIN (:20)

CDR	O/H		RADIAL SAMPLING	O/H
	:03		:15	:02
LMP	O/H	PAN	RADIAL SAMPLING	O/H

EVA II

APOLLO 16-DESCARTES TRAVERSES CALCULATED DATA

STATION NO.	SEG. DIST. (KM)	LRV MOB-ILITY RATE (KM/HR)	RIDE TIME (MIN)	TOTAL TRAVEL DIST. (KM)	ARRIVE STATION EVA TIME (H+MIN)	STATION STOP TIME (H+MIN)	DEPART STATION EVA TIME (H+MIN)
LM				0.00	0+ 0	0+50	0+50
RIDE	1.20	7.30	10				
4				1.20	1+ 0	0+15	1+15
RIDE	2.30	7.30	19				
5				3.50	1+34	0+30	2+ 4
RIDE	1.10	7.30	9				
6				4.60	2+13	1+ 0	3+13
RIDE	0.30	7.30	2				
7				4.90	3+15	0+45	4+ 0
RIDE	1.50	7.30	12				
8				6.40	4+13	0+20	4+33
RIDE	0.90	7.30	7				
9				7.30	4+40	0+55	5+35
RIDE	1.60	7.30	13				
10				8.90	5+48	0+20	6+ 8
RIDE	1.40	7.30	12				
LM				10.30	6+20	0+40	7+ 0
TOTALS			84			5+35	7+ 0

STATION	RETURN DIST (KM)	TRAVERSE CONTINGENCIES: LRV FAILURE: WALK-BACK TIME TO LM (H+MIN)	LRV FAILURE: STATION MARGIN ABOVE WALKBACK REQT 1, 4: F/W (H+MIN)	O_2 (H+MIN)	AMP HR (H+MIN)	PLSS FAILURE: MIN LRV RIDE BACK SPEED REQ 3: 0 MIN (KM/HR)	10 MIN (KM/HR)	EVA AV MET RATE (BTU/HR)
LM	0.00	0+ 0	****	****	****	0.00	0.00	1050.00
4	1.20	0+20	6+19	5+13	6+14	1.15	1.37	964.09
5	3.50	0+58	4+38	3+31	4+47	3.36	4.00	897.43
6	4.60	1+42	2+49	1+42	2+54	4.42	5.26	897.50
7	4.30	1+36	2+11	1+ 4	2+13	4.13	4.91	903.76
8	3.70	1+22	2+ 0	0+54	1+54	3.55	4.23	891.16
9	3.00	0+50	1+31	0+24	1+24	2.88	3.43	893.28
10	1.40	0+23	1+43	0+37	1+18	1.34	1.60	884.10
LM	0.00	0+ 0	1+51	0+45	1+12	0.00	0.00	890.75

FOOTNOTES TO 'CALCULATED DATA'

1. 30 MINUTES RESERVES MAINTAINED ON ALL PLSS CONSUMABLES
   AT STATION METABOLIC RATE

2. ALL DISTANCES AND SPEEDS ARE MAP DISTANCES AND MAP SPEEDS
   (MOBILITY RATES)

3. REQUIRED RATE = RETURN DISTANCE/AVAILABLE OPS TIME
   TOTAL OPS TIME 80.5 MINUTES
   5 MIN BSLSS HOOKUP
   13 MIN LM INGRESS
   62.5 MIN AVAILABLE FOR RIDEBACK
   52.5 MINUTES REMAINING FOR RIDEBACK (10 MINUTES ALLOWED AT STATION FOR RETURN TO LRV AND RIDEBACK PREPARATION)

4. TIME MARGIN AT STATION METABOLIC RATE

$$\left.\begin{array}{l}\text{STATION}\\ \text{FINAL LM O/H}\end{array}\right\}\ \text{MARGIN} = \begin{array}{l}\text{TIME REMAINING AFTER ALLOWANCE}\\ \text{FOR 10 MINUTES AT LRV,}\\ \text{WALKBACK, AND 13 MINUTES}\\ \text{INGRESS}\end{array}$$

5. RESPIRATORY EXCHANGE QUOTIENT = .90

6 FEED WATER HEAT OF VAPORIZATION $1038 \frac{\text{BTU}}{\text{LB.}}$

EVA II

APOLLO 16-DESCARTES TRAVERSES
INPUT DATA

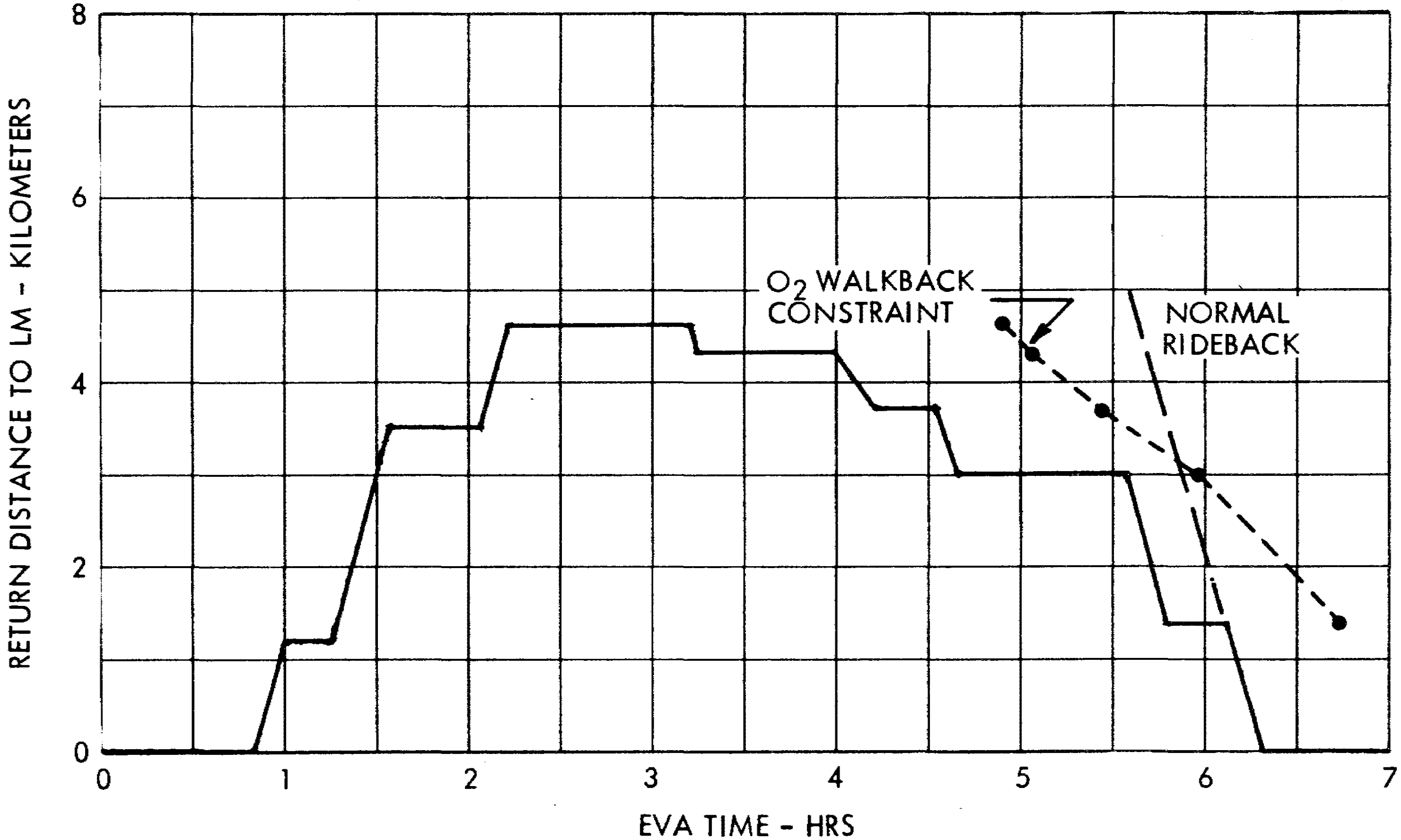
STATION NO.	STATION STOP TIME (H + MIN)	SEG. DIST (KM)	RET. DIST (KM)	HEAT LEAK (BTU/HR)	MOBILITY RATE WALK (KM/HR)	MOBILITY RATE RIDE (KM/HR)	MET WALK (BTU/HR)
LM	0+50	0.00	0.00	75.	3.60	7.30	1560.0
4	0+15	1.20	1.20	75.	3.60	7.30	1560.0
5	0+30	2.30	3.50	75.	3.60	7.30	1560.0
6	1+00	1.10	4.60	75.	2.70	7.30	1290.0
7	0+45	0.30	4.30	75.	2.70	7.30	1290.0
8	0+20	1.50	3.70	75.	2.70	7.30	1290.0
9	0+55	0.90	3.00	75.	3.60	7.30	1560.0
10	0+20	1.60	1.40	75.	3.60	7.30	1560.0
LM	0+40	1.40	0.00	75.	3.60	7.30	1560.0

MET ALSEP (BTU/HR)	MET RIDING (BTU/HR)	MET STATION (BTU/HR)	MET LM O/H (BTU/HR)	LEAK RATE O_2 (LB/HR)	EVA START (F/W LB)	EVA START (O_2 LB)
1050.00	550.00	950.00	1050.00	.028	11.64	1.345

APOLLO 16

RIDING TRAVERSE - DISTANCE

EVA II



3.6.1.3 EVA III

Traverse Description

Egress and preparation for the traverse will consume the first 3/4 hour of EVA III. The 5-1/2 hour traverse time will be used to investigate three broad points of interest; Smoky Mountain (Descartes Formation), and North Ray Crater and other areas in the Cayley Plains (Cayley Formation). Over two hours are spent in the vicinity of North Ray Crater (Stations 13 and 14) because of its importance in revealing the characteristics of the Cayley with depth. A crater of this size ($\sim$1 km) should have brought material up from a depth of 200 meters. Indeed, examination of the photography of the crater rim suggests that large blocks there may be correlated with different albedo banding seen in the crater wall. Extensive block sampling is planned there and 500 mm photography of the crater interior may not only document internal structures and stratigraphy but may also allow correlation of collected samples back into the crater stratigraphy.

Approximately one additional hour station time will be spent sampling the Cayley at four other stations (11, 12, 16 and 17) spread over the traverse route. Stops will include small craters less than 100 m diameter, such as Dot, and a larger crater, Palmetto, which while approaching North Ray in size, is much more subdued.

A second sampling of the Descartes Formation will involve investigation of the Smoky Mountain region. Approximately 3/4 hour is spent in extensively sampling that feature at a station whose exact location will be selected by the crew in real time.

Two portable magnetometer measurements will be taken on the traverse. After return to the LM, the last 3/4 hour will be spent stowing samples and equipment and ingressing.

EVA III

STATION	STATION TIME (HR:MIN)	TRAVEL TIME (MIN)	GEOLOGICAL FEATURES	OBSERVATIONS AND ACTIVITIES
LM	0:45	--	CAYLEY PLAINS	EGRESS AND PREPARE FOR TRAVERSE
TRAVEL	--	22	ACROSS CAYLEY TOWARD NORTH RAY	OBSERVE CAYLEY AND RAYS FROM NORTH RAY
11	0:10	--	DOT CRATER; BLOCKY RIMMED POSSIBLY CONCENTRIC CRATER	PAN SOIL SAMPLE ROCK SAMPLE LPM READING
TRAVEL	--	15	TOWARD OUTER EJECTA BLANKET OF NORTH RAY CRATER	OBSERVE RAYS AND APPROACH TO EJECTA BLANKET
12	0:10	--	AREA NEAR OUTER EJECTA BLANKET OF NORTH RAY	SOIL SAMPLE ROCK SAMPLE
TRAVEL	--	03	UP ONTO RIM OF NORTH RAY	OBSERVE BLOCK DISTRIBUTION, VARIETY
13 NORTH RAY CRATER	0:56	--	SOUTH RIM OF NORTH RAY CRATER	EXAMINE EJECTA AND VIEW CRATER INTERIOR STEREO PAN DOCUMENTED SAMPLING 500 MM PHOTOGRAPHY OF CRATER RIM AND INTERIOR POLARAMETRIC PHOTOGRAPHIC AND SAMPLING

EVA III

STATION	STATION TIME (HR:MIN)	TRAVEL TIME (MIN)	GEOLOGICAL FEATURES	OBSERVATIONS AND ACTIVITIES
TRAVEL	--	05	AROUND NORTH RAY RIM	NOTE BLOCK VARIETY AND DISTRIBUTION
14 NORTH RAY CRATER	1:05	--	AREA OF VERY LARGE BLOCKS ON SOUTHEAST RIM OF NORTH RAY CRATER	BLOCK FIELD WITH LARGE BLOCKS OF DIFFERENT ALBEDO: PAN 500 MM PHOTOGRAPHY OF INTERIOR OF NORTH RAY DOCUMENTED SAMPLING BOULDER SAMPLING RAKE/SOIL (REMOTE FROM LOCAL BOULDERS)
TRAVEL	--	14	FROM NORTH RAY TO BASE OF SMOKY MOUNTAIN (DESCARTES FORMATION)	OBSERVE TRANSITION WITH SMOKY MOUNTAIN
15 SMOKY MOUNTAIN	0:40	--	CRATER CLUSTER AT BASE OF SMOKY MOUNTAIN	IN DESCARTES FORMATION: PAN DOCUMENTED SAMPLING OF SMOKY MOUNTAIN - DOUBLE CORE (SINGLE, IF TRIPLE TAKEN ON STONE MT.) - RAKE SOIL 500 MM PHOTOGRAPHY OF SMOKY MT. PENETROMETER
TRAVEL	--	21	SOUTH ACROSS CAYLEY PLAINS TO PALMETTO CRATER	OBSERVE SMOKY MOUNTAINS/CAYLEY CHARACTERISTICS AND CHANGES
16 PALMETTO CRATER	0:36	--	RIM OF SUBDUED 1 KM CRATER IN CAYLEY PLAINS	PAN DOCUMENTED SAMPLING OF PALMETTO RIM SOIL/RAKE LPM READING

EVA III (CONT)

STATION	STATION TIME (HR:MIN)	TRAVEL TIME (MIN)	GEOLOGICAL FEATURES	OBSERVATIONS AND ACTIVITIES
TRAVEL	--	05	ACROSS CAYLEY PLAINS SOUTH OF PALMETTO TOWARD LM	OBSERVE LATERAL CHANGES IN CAYLEY CHARACTERISTICS
17	0:10	--	SOUTH RIM OF PALMETTO	DOCUMENTED SAMPLING SOIL/ROCK SAMPLE LPM READING
TRAVEL	--	13	ACROSS CAYLEY PLAINS TOWARD LM	OBSERVE CHARACTERISTICS OF CAYLEY PLAINS
LM	0:50	--	CAYLEY PLAINS	GRAND PRIX #2 CLOSEOUT

TRAVERSE STATION TIMELINE - EVA III

STATION 11 - DOT CRATER (:10)

CDR	O/H	LPM MEAS.	O/H
	:03	:05	:02
LMP	O/H PAN	ROCK/SOIL SAMPLE	O/H

NOTES:

O/H = OVERHEAD

* = CONSIDER 2nd PAN NEAR END OF STATION IF TIME PERMITS.

STATION 12 - NORTH RAY EJECTA BLANKET (:10)

CDR	O/H	ROCK/SOIL SAMPLE	O/H
	:03	:05	:02
LMP	O/H PAN	ROCK/SOIL SAMPLE	O/H

STATION 13 - NORTH RAY RIM (:56)

CDR	O/H	DESCRIP-TION	500mm PHOTOS	NEAR FIELD POLARIMETRY	500mm PHOTOS NO.2		SAMPLING	O/H
	:03	:03	:04	:10	:02	:04	:28	:02
LMP	O/H PAN	DESCRIP-TION	FAR FIELD POLAR.	NEAR FIELD POLARIMETRY (INCLUDES 4 SAMPLES)	PAN NO.2	FAR FIELD POLAR. NO.2	SAMPLING*	O/H

STATION 14 - NORTH RAY RIM (1:05)

CDR	O/H	DESCRIP-TION	RAKE/SOIL SAMPLE	SAMPLING	O/H
	:03	:05	:08	:47	:02
LMP	O/H PAN	500mm PHOTOS	RAKE/SOIL SAMPLE	SAMPLING*	O/H

TRAVERSE STATION TIMELINE - EVA III (CONT)

STATION 15 - BASE OF SMOKY MOUNTAIN (:40)

CDR	O/H		DESCRIP-TION	DOUBLE CORE	RAKE/SOIL SAMPLE	SAMPLING		O/H
	:03		:04	:08	:08	:15		:02
LMP	O/H	PAN	500mm PHOTOS	DOUBLE CORE	RAKE/SOIL SAMPLE	SAMPLING		O/H

STATION 16 - PALMETTO CRATER (:36)

CDR	O/H		RAKE/SOIL SAMPLE	LPM MEAS.	SAMPLING		O/H
	:03		:08	:05	:18		:02
LMP	O/H	PAN	RAKE/SOIL SAMPLE	SAMPLING*			O/H

STATION 17 - SOUTH OF PALMETTO (:10)

CDR	O/H		LPM MEAS.	O/H
	:03		:05	:02
LMP	O/H	PAN	ROCK/SOIL SAMPLE	O/H

NOTES:

O/H = OVERHEAD

* = CONSIDER 2nd PAN NEAR END OF STATION IF TIME PERMITS.

EVA III

APOLLO 16-DESCARTES TRAVERSES CALCULATED DATA

STATION NO.	SEG. DIST. (KM)	LRV MOB-ILITY RATE (KM/HR)	RIDE TIME (MIN)	TOTAL TRAVEL DIST. (KM)	ARRIVE STATION EVA TIME (H+MIN)	STATION STOP TIME (H+MIN)	DEPART STATION EVA TIME (H+MIN)
LM				0.00	0+ 0	0+45	0+45
RIDE	2.70	7.30	22				
11				2.70	1+ 7	0+10	1+17
RIDE	1.85	7.30	15				
12				4.55	1+32	0+10	1+42
RIDE	0.40	7.30	3				
13				4.95	1+46	0+56	2+42
RIDE	0.65	7.30	5				
14				5.60	2+47	1+ 5	3+52
RIDE	1.70	7.30	14				
15				7.30	4+ 6	0+40	4+46
RIDE	2.50	7.30	21				
16				9.80	5+ 7	0+36	5+43
RIDE	0.60	7.30	5				
17				10.40	5+47	0+10	5+57
RIDE	1.55	7.30	13				
LM				11.95	6+10	0+50	7+ 0
TOTALS			98			5+22	7+ 0

STATION	RETURN DIST (KM)	TRAVERSE CONTINGENCIES						EVA AV MET RATE (BTU/HR)
		LRV FAILURE				PLSS FAILURE		
		WALK-BACK TIME TO LM (H+MIN)	STATION MARGIN ABOVE WALKBACK REQT 1, 4			MIN LRV RIDE BACK SPEED REQ 3		
			F/W (H+MIN)	O_2 (H+MIN)	AMP HR (H+MIN)	0 MIN (KM/HR)	10 MIN (KM/HR)	
LM	0.00	0+ 0	****	****	****	0.00	0.00	1050.00
11	2.70	0+45	5+16	4+21	5+47	2.59	3.09	893.30
12	4.60	1+42	3+52	2+57	4+24	4.42	5.26	847.86
13	5.00	1+51	2+43	1+48	3+16	4.80	5.71	877.18
14	5.50	2+ 2	1+20	0+25	1+55	5.28	6.29	890.05
15	4.65	1+43	0+55	0+ 0	1+20	4.46	5.31	881.82
16	2.15	0+36	1+24	0+30	1+31	2.06	2.46	869.08
17	1.55	0+26	1+25	0+32	1+26	1.49	1.77	866.94
LM	0.00	0+ 0	1+25	0+31	1+12	0.00	0.00	879.11

FOOTNOTES TO 'CALCULATED DATA'

1. 30 MINUTES RESERVES MAINTAINED ON ALL PLSS CONSUMABLES
   AT STATION METABOLIC RATE

2. ALL DISTANCES AND SPEEDS ARE MAP DISTANCES AND MAP SPEEDS
   (MOBILITY RATES)

3. REQUIRED RATE = RETURN DISTANCE/AVAILABLE OPS TIME
   TOTAL OPS TIME <u>80.5 MINUTES</u>
   5 MIN BSLSS HOOKUP
   13 MIN LM INGRESS
   62.5 MIN AVAILABLE FOR RIDEBACK
   52.5 MINUTES REMAINING FOR RIDEBACK (10 MINUTES ALLOWED AT STATION FOR RETURN TO LRV AND RIDEBACK PREPARATION)

4. TIME MARGIN AT STATION METABOLIC RATE
   $\left.\begin{array}{l}\text{STATION} \\ \text{FINAL LM O/H}\end{array}\right\}$ MARGIN = TIME REMAINING AFTER ALLOWANCE FOR 10 MINUTES AT LRV, WALKBACK, AND 13 MINUTES INGRESS

5. RESPIRATORY EXCHANGE QUOTIENT = .90

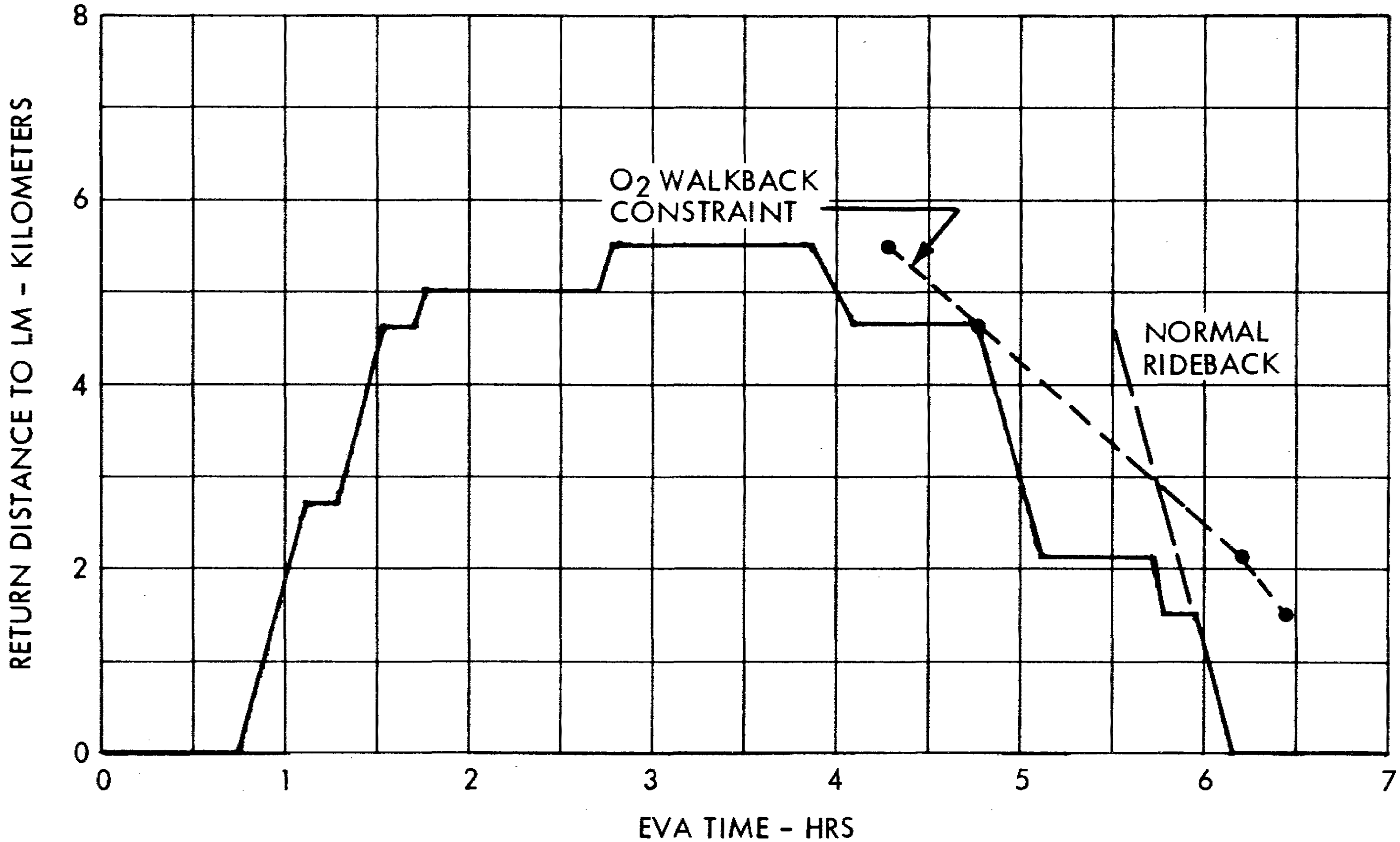
6 FEED WATER HEAT OF VAPORIZATION 1038 $\frac{\text{BTU}}{\text{LB.}}$

EVA III
APOLLO 16-DESCARTES TRAVERSES INPUT DATA

STATION NO.	STATION STOP TIME (H + MIN)	SEG. DIST (KM)	RET. DIST (KM)	HEAT LEAK (BTU/HR)	MOBILITY RATE WALK (KM/HR)	MOBILITY RATE RIDE (KM/HR)	MET WALK (BTU/HR)
LM	0+45	0.00	0.00	160.	3.60	7.30	1560.0
11	0+10	2.70	2.70	160.	3.60	7.30	1560.0
12	0+10	1.85	4.60	160.	2.70	7.30	1290.0
13	0+56	0.40	5.00	160.	2.70	7.30	1290.0
14	1+05	0.65	5.50	160.	2.70	7.30	1290.0
15	0+40	1.70	4.65	160.	2.70	7.30	1290.0
16	0+36	2.50	2.15	160.	3.60	7.30	1560.0
17	0+10	0.60	1.55	160.	3.60	7.30	1560.0
LM	0+50	1.55	0.00	160.	3.60	7.30	1560.0

MET ALSEP (BTU/HR)	MET RIDING (BTU/HR)	MET STATION (BTU/HR)	MET LM O/H (BTU/HR)	LEAK RATE O_2 (LB/HR)	EVA START (F/W LB)	EVA START (O_2 LB)
1050.00	550.00	950.00	1050.00	.035	11.64	1.345

APOLLO 16
RIDING TRAVERSE - DISTANCE
EVA III



3.7 LUNAR ROVER VEHICLE

The Apollo 16, J-2, mission is the second to use a vehicle to transport the crew and equipment on extended geology traverses. The benefits derived from using the LRV during the geology traverses include:

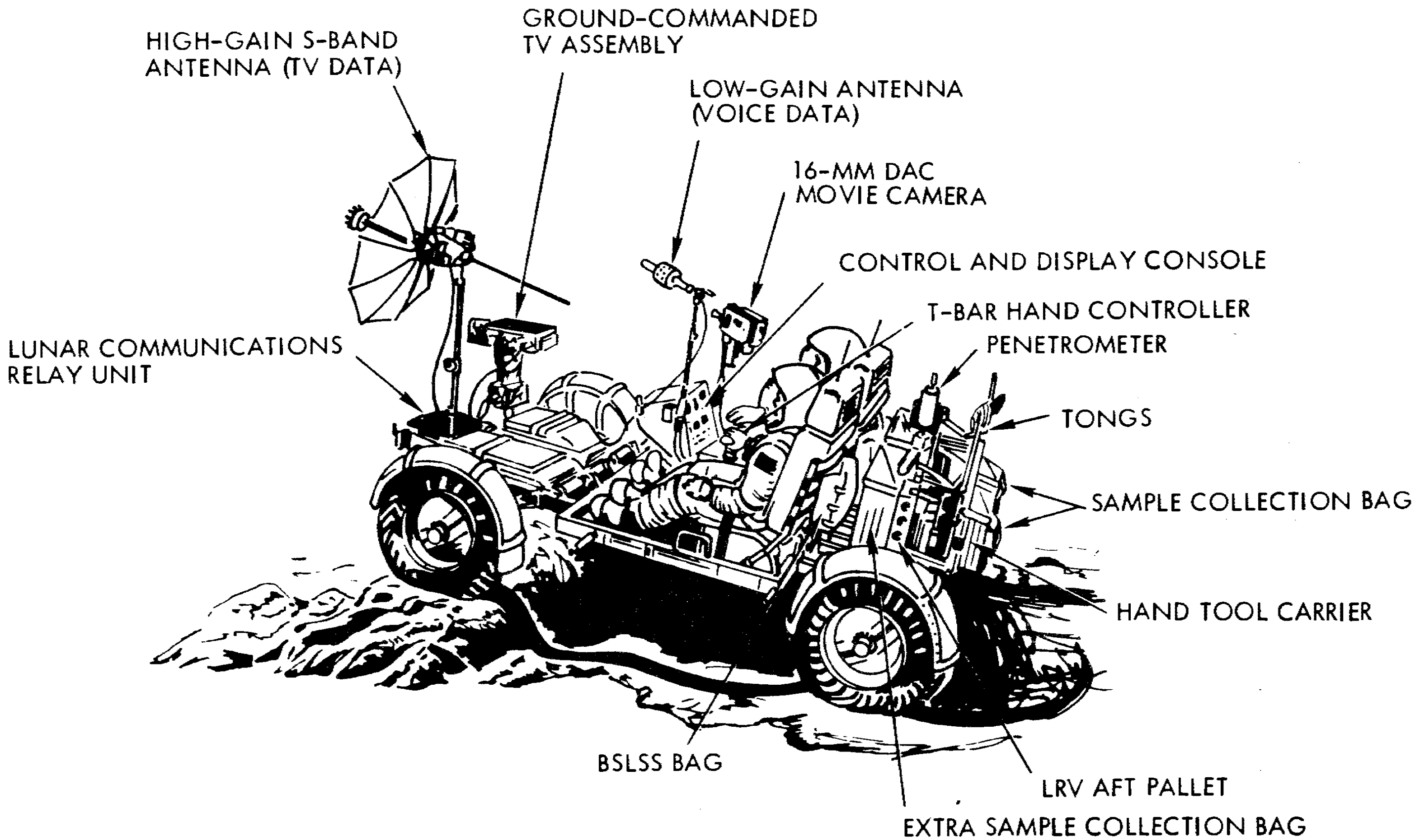
1) Decreased metabolic rates while driving,
2) Decreased traverse time between geology sites and,
3) Increased communications capability.

The intent of this section is to provide operational data relative to the LRV systems, operations, performance and constraints. In addition, a section is provided showing the decal and checklist used in operating the vehicle on the lunar surface.

3.7.1 Systems

The LRV (see figure 3.7-1) is a four wheel, electrically powered, crew controlled, vehicle designed to accommodate two crewmen and stowed ancillary equipment (see figure 3.5-1 LRV stowage) for lunar surface traverses. Control of the LRV during the traverse is effected by either of the two crewmen operating the hand controller located between them. The functions of the hand controller are shown in figure 3.7-3. The crewman in the left seat nominally has a control advantage since the "T" handle is biased in his direction.

Selection of power sources for the steering motors (2) and the drive motors (4), monitoring of parameters and operation of the navigation system is possible by either crewman using the control and display console. The functions of the control and display console which are not intuitively obvious are briefly described in figure 3.7-4. For a complete description of the LRV systems refer to the Lunar Roving Vehicle Operations Handbook.



GEOLOGY TRAVERSES WITH USE OF LRV

FIGURE 3.7-1 LUNAR ROVING VEHICLE (LRV)

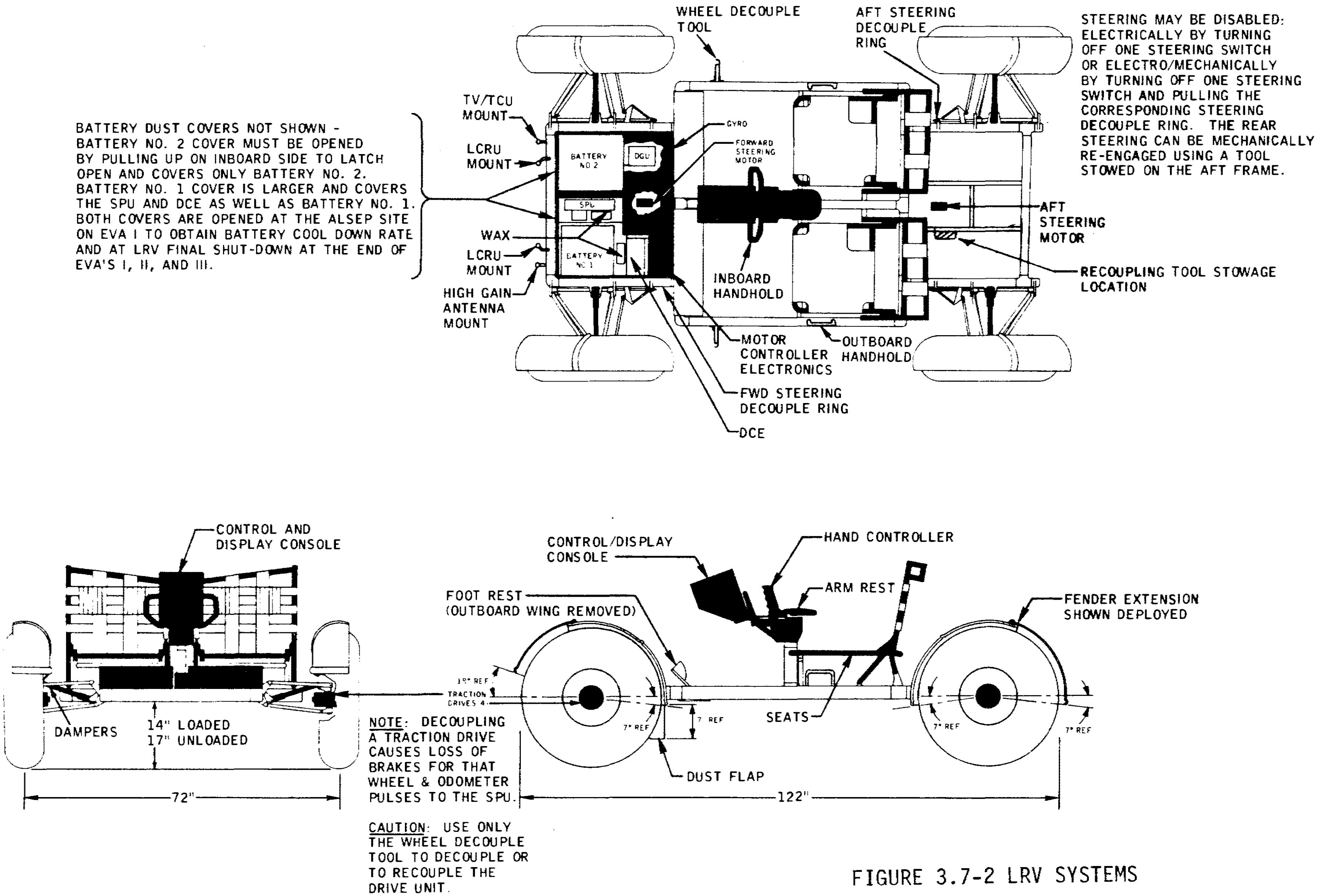


FIGURE 3.7-2 LRV SYSTEMS

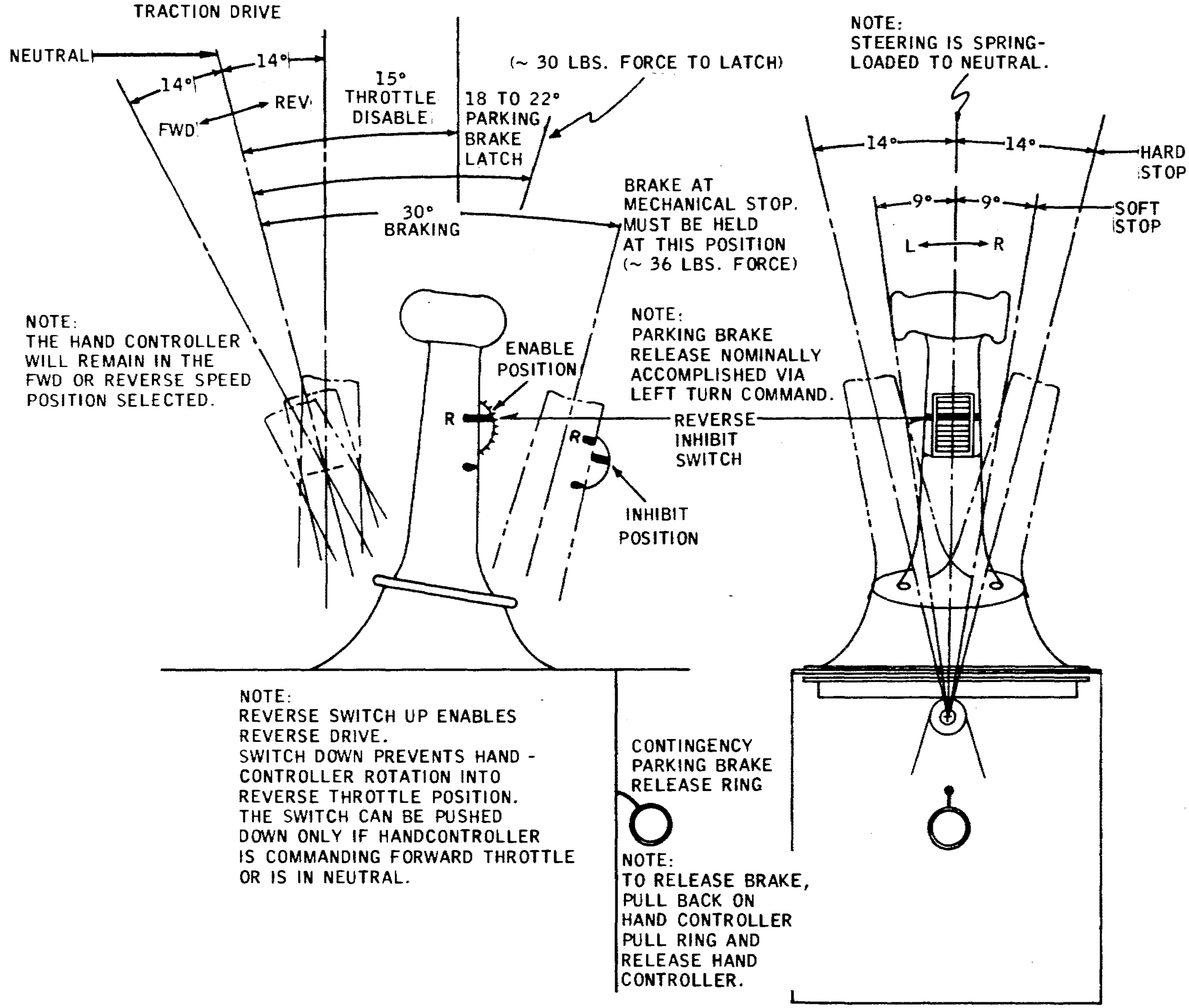
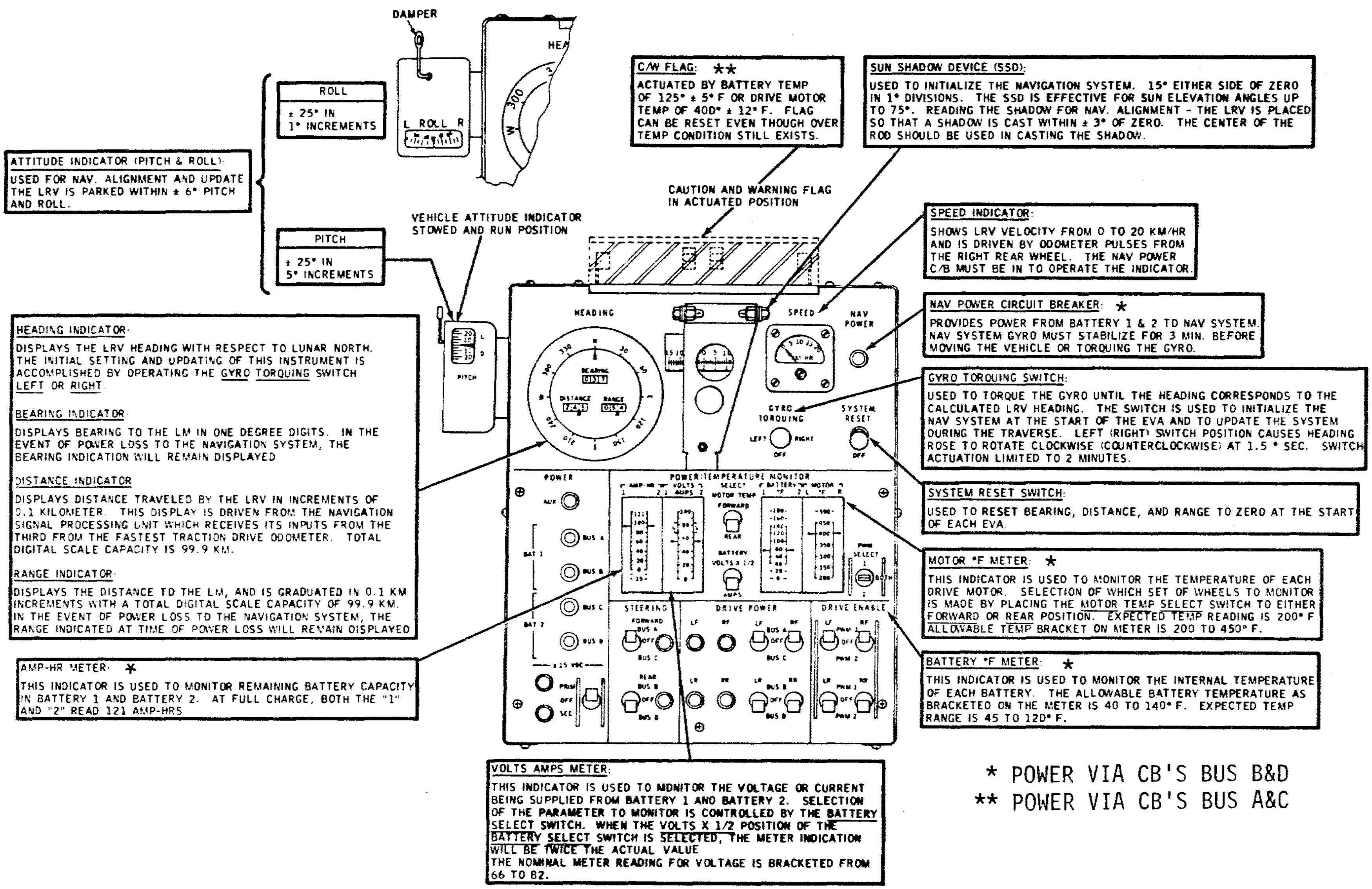


FIGURE 3.7-3 LRV HANDCONTROLLER FUNCTIONS

FIGURE 3.7-4 LRV CONTROL AND DISPLAY FUNCTIONS



* POWER VIA CB'S BUS B&D

** POWER VIA CB'S BUS A&C

3.7.2 Operations

The following table is a compendium of the functions performed on and with the LRV during the lunar surface EVA operations. As such, it is designed to supplement data on LRV operations as specified in the integrated EVA vertical timelines, by providing detail procedures. The delineation of these functions is by EVA and the procedures referenced within each function are given in chronological order.

TABLE 3.7-1

LRV OPERATIONAL FUNCTIONS

	FUNCTION	PROCEDURE
EVA-1		
	Deploy and set-up	Table 3.7-2
	LRV Power-up	Table 3.7-3.A
	Navigation Alignment	Table 3.7-4
	Geology/Science Sites	
	A) Nominal	Table 3.7-5.A
	B) Nav update	Table 3.7-5.B
	LRV close-out	Table 3.7-5.A
EVA-2		
	LRV power-up	Table 3.7-3.B
	Navigation Alignment	Table 3.7-4
	Geology/Science Sites	
	A) Nominal	Table 3.7-5.A
	B) Nav Update	Table 3.7-5.B
	LRV close-out	Table 3.7-6.B
EVA-3		
	Navigation Alignment	Table 3.7-4
	Geology/Science Sites	
	A) Nominal	Table 3.7-5.A
	B) Nav Update	Table 3.7-5.B
	LRV close-out	Table 3.7-6.C

TABLE 3.7-2

LRV OFF-LOAD FROM LM AND LRV SET-UP

1. Release LRV insulation blanket, verify outrigger cables taut and chassis parallel.

2. Inspect right and left walking hinge latches to verify indicator marks aligned.

2A. Release contingency deployment tool velcro. Remove and stow tool.

3. Release left hand deployment tape stowed in nylon bag attached to lower left support arm by velcro tapes.

4. Stow left hand deployment tape by draping it over a LM landing strut for convenient future access.

5. Release deployment cable from teflon clips on left side of LRV center chassis and deploy cable.

6. Release right hand deployment tape stowed in nylon bag attached to lower right support arm by velcro tape. Hold tape and move away from LRV deployment area.

7. Ascend LM ladder and pull LRV deployment D-handle. Verify LRV moves outward from LM about 4 degrees.

8. Descend LM ladder. Grasp deployment cable, monitor deployment activity and maintain tension on deployment cable.

9. Pull right hand deployment tape. Verify LRV rotates outward from LM.

10. Continue to pull right hand tape. When the tape marks appear (the vehicle is outboard at about 45 degrees) verify that:

    (a) Tension on aft cable is released.
    (b) Aft chassis unfolds and locks in position.
    (c) Rear wheels unfold and tethered rear wheel struts fall free.
    (d) Forward chassis is released from console post and returns to 35 degree position. (Rotates in toward LM)

11. Continue to pull right hand tape. Verify that:

    (a) Center/aft chassis rotates until rear wheels contact lunar surface.
    (b) Rear wheels slide on surface permitting center/aft chassis to move away from LM.

    NOTE: If wheels fail to slide, deployment cable may be pulled to permit center/aft chassis to move away from LM.

12. Continue to pull right hand tape. Verify that:

    (a) Rear wheels are on the surface.
    (b) Forward chassis continues to unfold and locks in position.
    (c) Forward wheels unfold.

13. Release right hand tape and at chassis RR grasp outer braked reel cable and remove cable pin and discard cable and pin outside work area.

14. At chassis LR grasp outer braked reel cable and remove cable pin and discard cable and pin outside work area.

15. Pull left hand tape. Verify that forward chassis lowers until all wheels contact lunar surface and support vehicle weight and 45° cable is slack.

    NOTE: If wheels fail to slide, deployment cable may be pulled to move LRV away from LM.

16. Coil deployment cable and remove cable release pin and chassis delatch fitting pin. Discard cable and deployment hardware outside of work area (right).

17. Pull saddle release cable verify telescoping rod drop free (left).

18. Erect LRV geology pallet mounting post (right).

19. Deploy rear fender extension (right and left).

20. Check rear hinge pins engaged (right and left).

21. Check rear steering decouple ring sealed (right).

22. Release inboard hand hold tie down (left).

23. Erect seats (right and left).

24. Attach seat support leg velcro strap to outboard handhold (right and left).

25. Lower arm rest (right).

26. Pull console "T" handle and rotate 90°; lower console while raising inboard handhold (right and left).

27. Lock console/handhold inplace, T handle 90°, velcro T handle strap (right and left).

28. Remove tripod and stow toehold (wheel decouple tool) (right and left).

29. Release velcro tiedowns and erect footrest and velcro in place (right and left).

30. Check front hinge pins engaged (right and left).

31. Deploy front fender extension (right and left).

32. Verify battery covers closed (right and left).

33. Pull attitude indicator and C&W pins and discard (left).

    NOTE: The vehicle may be picked up by both crewmen and turned away from the LM prior to vehcile set-up (i.e., prior to step 19).

TABLE 3.7-3.A
POWER-UP (EVA-1)

1. Check hand controller operation.
2. Set parking brake and Verify Reverse INHIBIT Switch - DOWN.
3. BUS A, BUS B, BUS C, BUS D Circuit Breakers - Close.
4. $\pm$ 15 VDC PRIM and SEC Circuit Breakers - Close.
5. STEERING FORWARD AND REAR Circuit Breakers - Close.
6. DRIVE POWER LF, RF, LR, RR Circuit Breakers - Close.
7. Report BAT 1 and BAT 2 AMPS indications.
8. BATTERY Switch - VOLTS x 1/2.
9. Report BAT 1 and BAT 2 VOLTS indications.
10. BATTERY Switch - AMPS.
11. Report BAT 1 and BAT 2 temp (°F) indications.
12. Report BAT 1 and BAT 2 AMP-HR indications.
13. PWM SELECT Switch - BOTH. (Verify)
14. DRIVE ENABLE LF and RF Switches - PWM 1.
15. DRIVE ENABLE LR and RR Switches - PWM 2.
16. $\pm$ 15 VDC Switch - SEC.
17. STEERING FORWARD Switch - BUS A.
18. STEERING REAR Switch - BUS D.

CAUTION

The hand controller should be in park brake position and the drive enable switches must be set to an <u>active</u> PWM prior to setting any drive power switch to an energized bus. If the drive power switch is turned on and the corresponding drive enable switch is not selected to an active PWM, then full power will be applied to the corresponding drive motor when the hand controller is released from brake position. Should this condition occur, the hand controller should be immediately returned to park brake position.

19. DRIVE POWER LF AND RF Switches - BUS A.

20. DRIVE POWER LR AND RR Switches - BUS D.

*21. Release parking brake and place reverse INHIBIT switch - UP position.

NOTE: The LRV driver may now back away from LM. LRV driver should request other crewman to direct and monitor any backing operations from an off-vehicle position.

*22. Stop LRV and set parking brake. Reset Reverse INHIBIT Switch (push switch DOWN).

23. Release parking brake and drive to MESA area for equipment loading.

*Omit Steps 21 & 22 if the LRV has been picked up and turn facing away from the LM.

TABLE 3.7-3.B
POWER-UP (EVA-2&3)

1. Check hand controller set parking brake and Verify Reverse INHIBIT Switch - DOWN.
2. BUS A, BUS B, BUS C, BUS D Circuit Breakers - Close.
3. NAV POWER CB - CLOSE (Do not Torque gyro or move LRV for 1-1/2 min.)
4. Report BAT 1 and BAT 2 AMP-HR indications.
5. Report BAT 1 and BAT 2 VOLTS indications.
6. Report BAT 1 and BAT 2 AMPS indications.
7. Report BAT 1 and BAT 2 temp (°F) indications.
8. Verify PWM SELECT Switch - BOTH.
9. Verify DRIVE ENABLE LF and RF Switches - PWM 1.
10. Verify DRIVE ENABLE LR and RR Switches - PWM 2.
11. $\pm$ 15 VDC Switch - PRIM
12. Release parking brake and Drive to nav alignment site.

TABLE 3.7-4

NAVIGATION ALIGNMENT

1. Drive LRV to area level within $\pm$ 6° of zero for pitch and roll.
2. Deploy Sun Shadow Device (SSD).
3. Park heading down sun within $\pm$ 3° SSD.

   Hand controller to parking brake position
   Power down switches
4. Report SSD, pitch and roll readings.
5. Stow SSD and attitude indicator.
6. Move SYSTEM RESET switch momentarily to RESET and return to OFF position.
7. Verify bearing, distance & range indicators zero.
8. Operate GYRO TORQUING switch to LEFT or RIGHT position to correct HEADING indicator as required.
9. Power-up LRV.

TABLE 3.7-5.A
GEOLOGY/SCIENCE SITE NOMINAL

1. Stop LRV and set hand controller in parking brake position; Neutral throttle, reverse inhibit switch - down.

2. Power down as follows:

   (a) $\pm$ 15 VDC Switch - OFF.

3. Report LRV readings in the following ORDER:

   (a) Heading
   (b) Bearing
   (c) Distance
   (d) Range
   (e) Amp-Hr Batt 1
   (f) Amp-Hr Batt 2
   (g) Temp Batt 1
   (h) Temp Batt 2
   (i) Temp LF motor
   (j) Temp RF motor
   (k) Temp LR motor
   (l) Temp RR motor

4. Align HGA via AGC meter and sight.

5. LCRU mode switch:

   (a) TV RMT (near the LM) or,
   (b) FM/TV (on the traverse)

6. Dust CTV, TCU and LCRU.

7. Perform science requirements.

8. Return to LRV.

9. Stow Gnomon.

10. LCRU mode switch to PM1/WB.

11. Mount LRV and fasten seat belt.

12. Verify handcontroller in parking brake position and reverse inhibit switch down.

13. $\pm$ 15 VDC switch - PRIM.

14. Release parking brake.

TABLE 3.7-5.B

GEOLOGY/SCIENCE SITE-NAV UPDATE

1. Drive to area level within ± 6° of zero for pitch and roll.

2. Deploy SSD and head down sun within ± 3° SSD.

3. Stop LRV and set hand controller in parking brake position. Reverse inhibit switch - down.

4. Report SSD, pitch and roll readings.

5. Stow SSD and attitude indicator.

6. Power down as follows:

   (a) ± 15 VDC Switch - OFF.

7. Report LRV readings in the following ORDER:

   (a) Heading
   (b) Bearing
   (c) Distance
   (d) Range
   (e) Amp-Hr Batt 1
   (f) Amp-Hr Batt 2
   (g) Temp Batt 1
   (h) Temp Batt 2
   (i) Temp LF motor
   (j) Temp RF motor
   (k) Temp LR motor
   (l) Temp RR motor

8. Align HGA via AGC meter and SIGHT.

9. LCRU mode Switch:

   (a) TV RMT (near the LM)
   (b) FM/TV (on the traverse)

10. Dust CTV, TCU and LCRU.

11. Perform stop science requirements.

12. Return to LRV.

13. Stow Gnomon.

14. LCRU mode switch to PM1/WB.

15. Mount LRV and fasten seat belt.

16. Verify handcontroller in parking brake position and reverse inhibit switch down.

17. Report heading and Torque Gyro to Houston update as required.

18. $\pm$ 15 VDC switch - PRIM.

19. Release parking brake.

TABLE 3.7-6.A

EVA-1 Closeout HEADING = TBD °,

1. Position LRV near MESA - Cross sun, set parking brake and verify REVERSE INHIBIT switch - DOWN.

2. Report bearing distance & range.

3. ± 15 VDC switch - OFF.

4. NAV power CB - OPEN.

5. Report LRV readings in following order:

   (a) AMP-Hr Batt 1
   (b) Amp-Hr Batt 2
   (c) Temp Batt 1
   (d) Temp Batt 2
   (e) Temp LF motor
   (f) Temp RF motor
   (g) Temp LR motor
   (h) Temp RR motor

6. Egress LRV align Hi-gain Ant.

7. LCRU mode sw - TV RMT.

8. Prior to LM ingress.

   (a) LCRU power switch - OFF
   (b) LCRU thermal blanket - place TBD % blanket over mirrors.
   (c) LRV battery covers - dusted then OPEN & dust LRV mirrors as required.
   (d) BUS A, BUS B, BUS C, & BUS D CB's - OPEN

TABLE 3.7-6.B

EVA-2 Closeout

1. Position LRV near MESA - Cross sun, Heading - _____°, set parking brake and verify REVERSE INHIBIT switch - DOWN.

2. Report BEARING, DISTANCE and RANGE.

3. $\pm$ 15 VDC switch - OFF.

4. NAV POWER circuit breaker - OPEN.

5. Report LRV readings in following order:

   (a) Amp-Hr Batt 1
   (b) Amp-Hr Batt 2
   (c) Temp Batt 1
   (d) Temp Batt 2
   (e) Temp LF motor
   (f) Temp RF motor
   (g) Temp LR motor
   (h) Temp RR motor

6. Egress LRV align H-gain Ant.

7. LCRU mode sw - TV RMT.

8. Prior to LM ingress:

   (a) LCRU power switch - OFF
   (b) LCRU thermal blanket - Place TBD % blanket over mirrors.
   (c) LRV covers dusted, then opened and LRV mirrors dusted as required
   (d) BUS A, BUS B, BUS C, & BUS D CB's - OPEN

TABLE 3.7-6.C

EVA-3 Closeout

1. Position LRV near MESA - Set parking brake and verify REVERSE INHIBIT switch - DOWN.

2. Report BEARING, DISTANCE and RANGE.

3. ± 15 VDC switch - OFF.

4. Report LRV readings in following order:

   (a) Amp-Hr Batt 1
   (b) Amp-Hr Batt 2
   (c) Temp Batt 1
   (d) Temp Batt 2
   (e) Temp LF motor
   (f) Temp RF motor
   (g) Temp LR motor
   (h) Temp RR motor

5. Egress LRV and align Hi-gain Ant.

6. LCRU mode switch - TV RMT.

   NOTE: Off-load equipment and then drive to final LRV parking site.

7. LCRU mode switch - PM1/WB.

8. Ingress LRV verify parking brake, reverse inhibit switch - DOWN.

9. ± 15 VDC switch - PRIM.

10. NAV RESET switch to RESET momentarily then to - OFF.

11. Verify BEARING, DISTANCE and RANGE - ZERO.

12. Drive on a HEADING of TBD° until the DISTANCE indicator reads 0.1 km; BEARING indicator should read TBD°. Turn left to a HEADING of TBD° and stop at outbound tracks.

13. Set parking brake.

14. ± 15 VDC switch - OFF.

15. NAV POWER CB - OPEN.

16. BUS B and BUS D CB's - OPEN (Note BUS A & BUS C CB's remain closed).

17. AUX power CB - CLOSED.

18. AUX power by pass sw - ON.

19. Egress LRV align Hi-gain Ant and LCRU mode switch - TV RMT.

20. LRV battery covers - OPEN.

21. Dust LRV mirrors as required.

3.7.3 Performance and Constraints

The purpose of this section is to provide LRV performance, constraints and operating limitations which are of general interest.

Detailed performance and constraint characteristics may be found in the LRV Operations Handbook, Appendix A.

Velocity, steering and braking capabilities and limitations are shown in figures 3.7-5 , 3.7-6 and 3.7-7 , respectively.

Slopes, positive or negative, significantly effect the LRV characteristic. An observation that can be made from these figures is that increasing slopes decrease speed, improve steering and dynamic stability, and stopping distance as compared to a 0° slope. Figure 3.7-8 is intended to further refine the data provided in figure 3.7-7 to include the effects of various hand controller braking positions on stopping distance vs slopes for 8 km/hour.

Table 3.7-7 is compendium of LRV operating limits, constraints, and requirements of crew operation. These are generally presented without comment.

APOLLO 16 LRV VELOCITY
CONSTRAINTS (KPH)

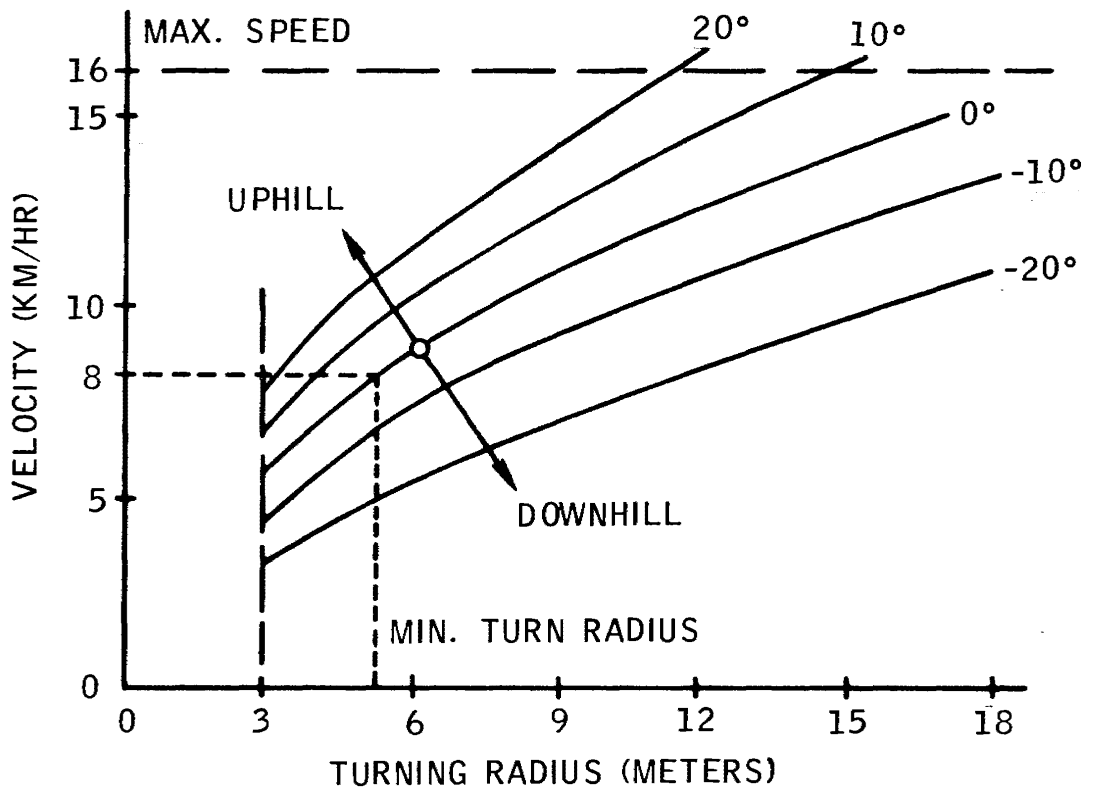
CONSTRAINTS	SLOPE	SMOOTH MARE	ROUGH MARE
SPEED CAPABILITY TORQUE LIMITED	0°	11.2	10.5
	5°	9.2	8.8
	10°	8.0	7.6
SUSPENSION LIMIT LOADS		16	10
		12" BUMP AT 14 KPH	
CONTROLLABILITY 13° SIDE SLIP ANGLE		6m TURN AT 5.5 KPH	
		12m TURN AT 10 KPH	

NOTE: LOW RANGE P.S.D.
1.5 FACTOR OF SAFETY ON SUSPENSION LOAD
AVERAGE SLOPE J-1 2 DEGREES

Figure 3.7 - 5

FIGURE 3.7-6

DYNAMIC STABILITY - STEERING STABILITY



COEFFICIENT OF FRICTION: $\mu = 0.6$

EXAMPLE: ON LEVEL GROUND AT 8 KM/HR, SLIDING BEGINS AT A TURN RADIUS OF 5.2 METERS.

FIGURE 3.7-7

STOPPING DISTANCE VERSUS INITIAL VELOCITY FOR VARIOUS SLOPES

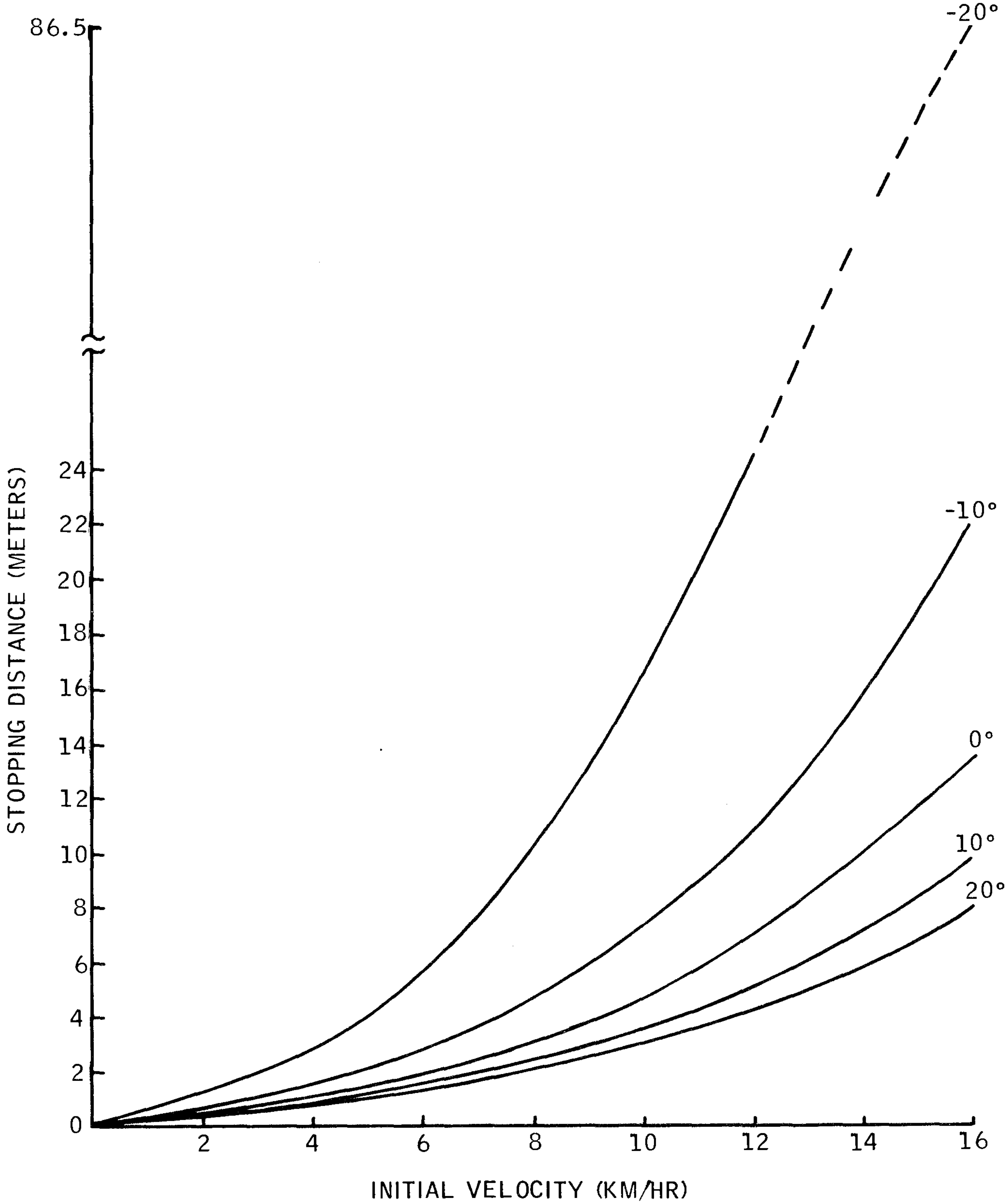


FIGURE 3.7-8

LRV STOPPING DISTANCE VS. HANDCONTROLLER PULL FORCE FOR 8 KM/HR

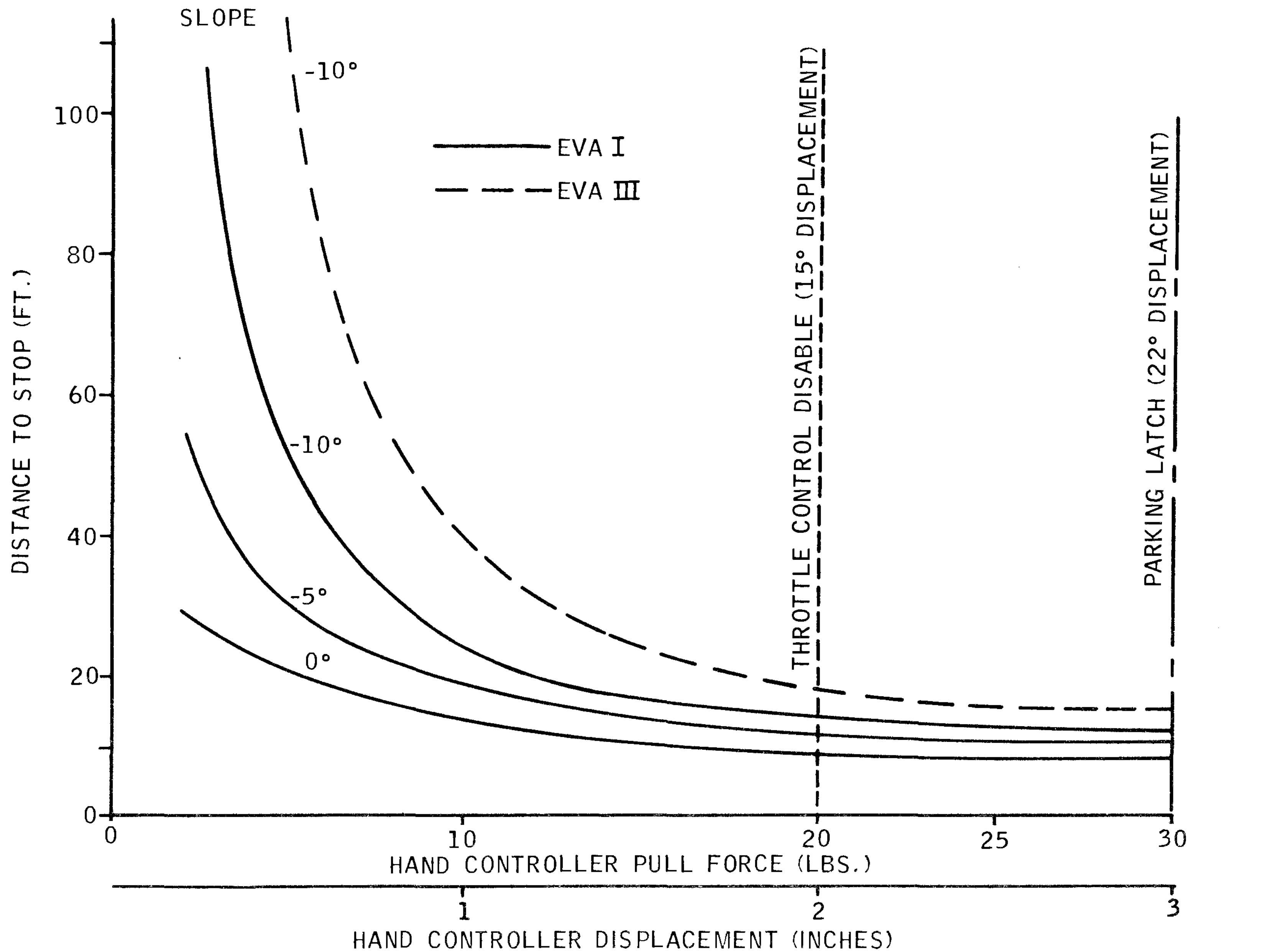


TABLE 3.7-7

LRV Operating Limits, Constraints & Requirements

1. The LRV velocity should not exceed 5 km/hour while traversing to the ALSEP site with the ALSD on the LMP seat.

2. The NAV power circuit breaker must be closed for at least 1-1/2 minutes before torquing the gyro or repositioning the LRV.

3. The navigation system gyro must not be torqued continuously for more than two (2) minutes.

   NOTE: Since the heading indicator torques at a rate of 1.5°/sec the heading could be torqued 180° in 2 minutes.

4. To minimize heading errors for navigation system initial alignment and updates, the LRV should be parked such that the pitch and roll is within ± 6° of zero, (roll being the most critical) and the Sun Shadow Devices (SSD) within ± 3°.

5. The attitude indicator and the SSD should be read to MCC within the tolerances noted below to minimize heading errors:
   Pitch within 2-1/2°, Roll within 1° and SSD within 1°.
   Further the shadow cast on the SSD scale should be read from the center of the rod.

6. Park the LRV cross sun heading North between EVA's in the sun light:

   (a) END of EVA-1 - HEADING = TBD °
   (b) END of EVA-2 - HEADING = TBD °

7. Open the LRV battery covers at the end of each EVA.

8. The LCRU thermal blankets will be open (i.e. % of mirror showing) as per the following schedule:

   (a) EVA-1, EVA-2 & EVA-3 - 100%
   (b) Between EVA's 1&2 - TBD%
   (c) Between EVA's 2&3 - TBD%
   (d) Subsequent to EVA-3 - 100%

9. The LRV will be parked at the conclusion of EVA 3 as per the following parameters:

   (a) Distance 300 ft + 25 ft
   (b) LRV to LM Bearing TBD°
   (c) LRV Heading TBD°

10. Caution: While driving, an open-operating corridor shall be maintained on either side of the LRV. For a velocity of 8 km/hour the driving corridor should be 17 feet. Possible condition: guard against steering failures.

11. Caution: The drive enable switches must be set to an active PWM prior to setting any drive power switch to an energized bus. If the drive power switch is turned on and the corresponding drive enable switch is not selected to an active PWM, then full power will be applied to the corresponding drive motor when the hand controller is released from brake position.

12. Warning: The EMU should not brush against the LRV wire wheels at any time. This constraint is to protect the man and the suit not the LRV. Possible condition: Wire breakage on wheel.

13. Warning: The gloved hand is not to be used to decouple or recouple a traction drive unit. The decouple tool is specifically provided for this operation. Possible condition: Overtemp drive unit.

3.7.4 Decals and Checklists

The LRV Operations Decal which is located on the console immediately ahead of the LRV handcontroller is shown in figure 3.7-9. The LRV/LCRU Malfunction Procedures Checklist shown in figure 3.7-10 is included as part of the onboard Flight Data File and is stowed in the LRV mapholder.

POWER-UP

Check Hand Controller

Brake - On, Rev - Down

CB: All Closed
(Ex. Aux + Nav)

Hou: Amp Hr, Amps,
Volts, Temps

PWM Select - Both

Drive Enable:
Fwd - PWM 1
Aft - PWM 2

±15 VDC - SEC

Steering: Fwd - BUS A
Aft - BUS D

Drive Power:
Fwd - BUS A
Aft - BUS D

STOP

Brake - On, Rev - Down

±15 VDC - OFF

Hou: Nav, Amp Hrs,
Temps

LCRU: LM - 3 (TV RMT)
TRAV - 2 (FM/TV)

NAV ALIGN

* STOP, 3° SSD, 6° R & P

CB: Nav - Close (1-1/2 min)

Sys Reset - Reset & Off

Brng, Dist, Rng - Zero

* Hou: Roll, Pitch, SSD,
Heading

* Gyro Torq To Hou Update

* SSD - Stow

* = NAV UPDATE

START

GNOMON - GNOMON

LCRU - 1 (PM1/WB)

±15 VDC - PRIM

CLOSE OUT

STOP At LM, Hou Heading

CB: Bus A, B, C, D, &
Nav - Open

Hou: LCRU Covers

LCRU Power - Off

Batt Covers Open

EVA 3 - CB: All Open Ex
Aux, Bus A & C - Closed

Aux CB By Pass - On

LCRU: Power - Ext
Mode - 3 (TV RMT)

Figuure 3.7-9 LRV Operations Decal

Figure 3.7-10 LRV/LCRU Malfunction Procedures Checklist

LRV:

AMPS NOT BALANCED

Procedure	Result
1. DRIVE POWER Sw (4) - OFF (individually)	Drive Motor Short
	DRIVE POWER - OFF DRIVE ENABLE - OFF
2. DRIVE ENABLE Sw (4) - PWM 1	PWM 2 Failure
	PWM SELECT Sw - PWM 1
3. DRIVE ENABLE Sw (4) - PWM 2	PWM 1 Failure
	PWM SELECT Sw - PWM 2
4. DRIVE POWER Sw (4) - alt. pos.	Drive Motor Power Circuit Open For One Bus
5. DRIVE POWER Sw (4) - OFF (individually) Isolate motor not drawing current	Open Circuit in Motor Not Drawing Current
	DRIVE POWER - OFF DRIVE ENABLE - OFF
6. Monitor AH meter. Reconfig. to load share as required	Cause Not Determined

LOSS OF DRIVE FROM ALL WHEELS

Procedure	Result
1. ±15 VDC Sw - alt. pos.	±15 VDC Circuitry
2. Set Parking Brake DRIVE ENABLE Sw (4) - PWM 2 PWM SELECT Sw - PWM 2 ±15 VDC CB (2) - close	PWM 1 Shorted
3. Set Parking Brake DRIVE ENABLE Sw (4) - PWM 1 PWM SELECT Sw - PWM 1 ±15 VDC CB (2) - close	PWM 2 Shorted
4. DRIVE POWER Sw (4) - OFF (individually) ±15 VDC CB (2) - close	DCE Shorted
5. STEERING POWER Sw (2) - OFF (individually) ±15 VDC CB (2) - close	Steering Shorted

Figure 3.7- 10 (Cont'd)

LOSS OF VOICE COMM with MSFN (LCRU)

LCRU:

LGA: AGC <2

MODE - FM/TV (HGA) - - - - - - - - - - - - - - - - - LGA or Rcvr 1
CB LRV AUX - Close
POWER - EXT - 16.8V Batt Power

AGC >2 & POWER >1

MODE-PM1/NB (LGA) - - - - - - - - - - - - - - - - - Downlink Sig Proc

MODE-FM/TV (HGA) - - - - - - - - - - - - - - - - - - S-B Xmtr or Rcvr 1 Audio

Traverse Mode: Swap Ant Connectors
MODE-PM2/NB (LGA)

AGC >2 & POWER <1

CB LCRU - CLOSE - - - - - - - - - - - - - - - - - - 28V Overload

If CB opens: MODE-FM/TV (HGA)
CB LCRU - Close - - - - - - - - - - - S-Band Xmtr Short

Traverse Mode: Swap Ant Connectors
MODE-PM2/NB (LGA)

CB LRV AUX - Close
POWER - EXT - 28V Batt Power

HGA: AGC <2.5

MODE-PM1/WB (LGA) - - - - - - - - - - - - - - - - - HGA or Rcvr 2
CB LRV AUX - Close
POWER - EXT - 16.8V Batt Power

AGC >2.5 & POWER >1

MODE - PM2/NB (HGA) - - - - - - - - - - - - - - - - Downlink Sig Proc

MODE - PM1/WB (LGA) - - - - - - - - - - - - - - - - S-B Xmtr or Rcvr 2 Audio

AGC >2.5 & POWER <1

CB LCRU - Close - - - - - - - - - - - - - - - - - - 28V Overload

If CB Opens: MODE - PM1/WB(LGA)
CB LCRU - Close - - - - - - - - - - - S-Band Xmtr Short

CB LRV AUX - Close
POWER - EXT - 28V Batt Power

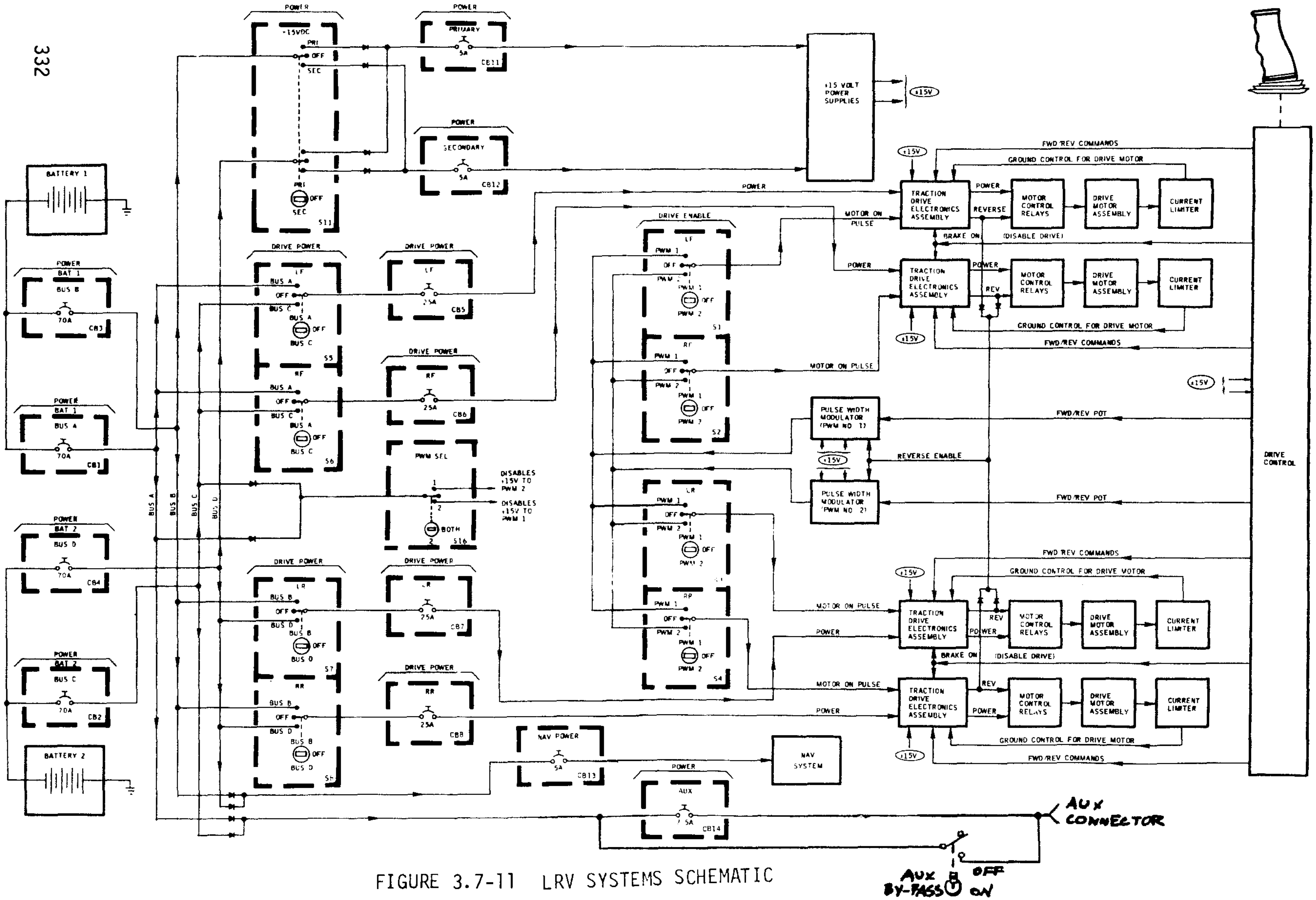


FIGURE 3.7-11 LRV SYSTEMS SCHEMATIC

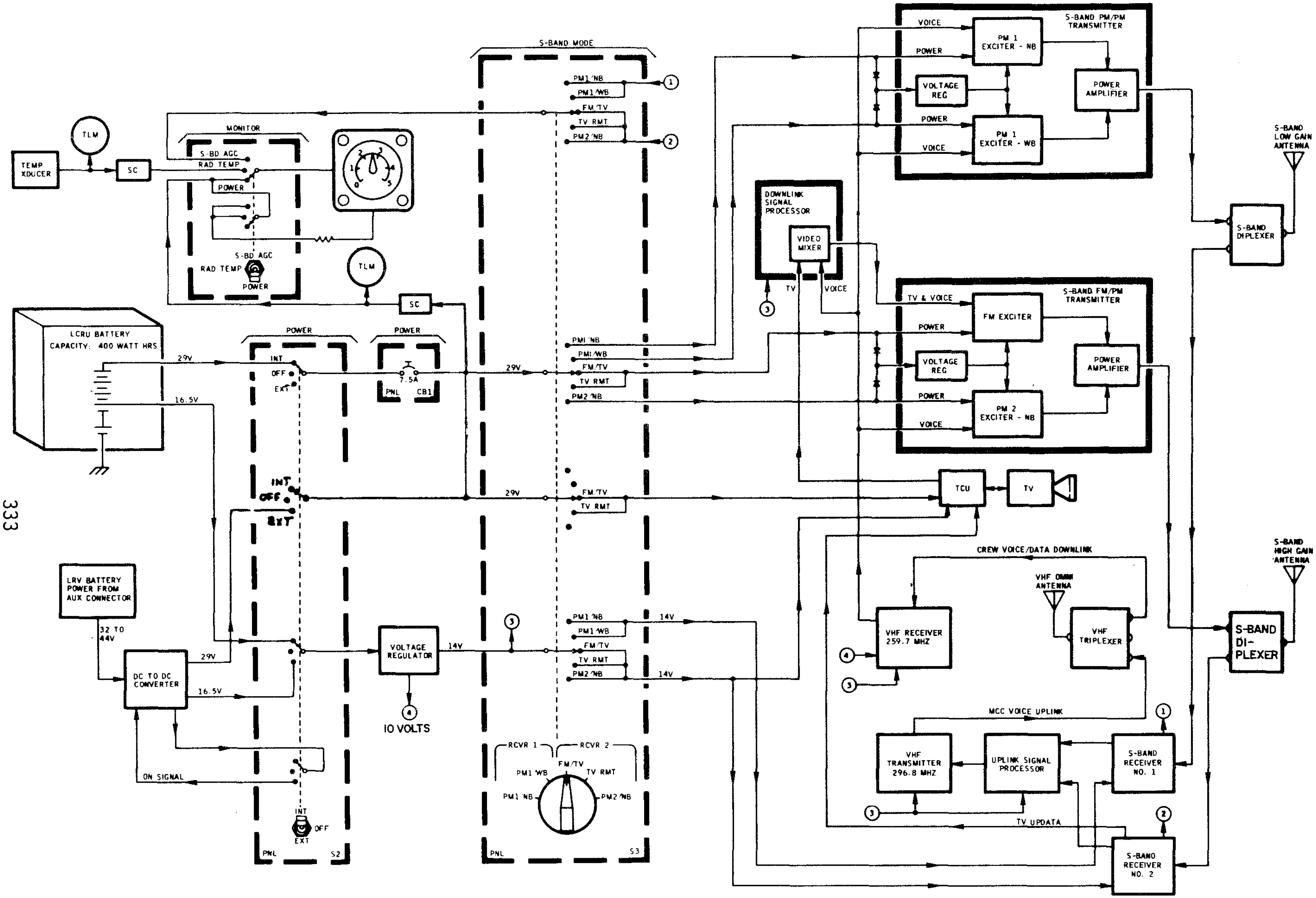


FIGURE 3.7-12 LCRU SYSTEMS SCHEMATIC

SECTION 4.0

CONTINGENT PLANS

4.0 CONTINGENT PLANS

4.0 CONTINGENT PLANS

TBD

SECTION 5.0

APPENDIX

5.0 APPENDIX

5.1 ABBREVIATIONS

ALSD - Apollo Lunar Surface Drill
ALSEP - Apollo Lunar Surface Experiments Package
A/S - Ascent Stage
ASE - Active Seismic Experiment

BSLSS - Buddy Secondary Life Support System

CDR - Commander
C/S - Central Station
CTV - Color Television Camera

DC - Data Camera
DSBD - Documented Sample Bag Dispenser

ECS - Environmental Control System
EMU - Extravehicular Mobility Unit
EVA - Extra Vehicular Activity
GCTA - Ground Controlled Television Assembly
HCEX - Hi-speed Colar Exterior
HFE - Heat Flow Experiment
HGA - High Gain Antenna
HTC - Hand Tool Carrier

LCRU - Lunar Communication Relay Unit
LEC - Lunar Equipment Conveyor
LGA - Low Gain Antenna
LiOH - Lithium Hydroxide
LM - Lunar Module
LMP - Lunar Module Pilot
LPM - Lunar Portable Magnetometer
LRV - Lunar Roving Vehicle
LSM - Lunar Surface Magnetometer

MCC-HOU - Mission Control Center - Houston
MESA - Modularized Equipment Stowage Assembly
MSFN - Manned Space Flight Network

PLSS - Primary Life Support System
PRA - Parabolic Reflector Assembly
PSE - Passive Seismic Experiment

RCU - Remote Control Unit
RHSC - Right Hand Side Console (LM)
RTG - Radio-isotope Thermoelectric Generator

SCB	-	Sample Collection Bag
SESC	-	Special Environmental Sample Container
SRC	-	Sample Return Container
SWC	-	Solar Wind Composition
SSD	-	Sun Shadow Device
TCU	-	Television Control Unit
TD	-	Touchdown
UHT	-	Universal Handling Tool

5.2 LUNAR SURFACE OPERATIONAL CONSTRAINTS

TBD

5.3 EQUIPMENT DECALS

TBD

5.4 References

(1) Office of Manned Space Flight; Apollo Flight Mission Assignments, Document M-D MA5000-11, SE010-000-1; 11 July 1969

(2) Lunar Surface Project Office: Flight System Familiarization Manual The Bendix Corp., Aerospace Systems Division, 1 August 1967 (Revised 15 April 1969; chg 1 Dec 15, 1970)

(3) ALSEP Familiarization Course Handout The Bendix Corp., Aerospace Systems Division, 1 May 1970

(4) Systems Engineering Division, Apollo Spacecraft Program Office: Mission Requirements SA-511/CSM-113/LM-11, J-2 Type Mission, MSC-03974, Change B, 2 November 1971

(5) Science Mission Support Division, Science and Applications Directorate: Mission Science Planning Document, AS-511/CSM-113/LM-11 (Apollo 16) MSC-04143, 18 October 1971.

(6) Science Missions Support Division, Science and Applications Directorate: Lunar Surface Experiments Deployment Criteria, Mission J-2/Apollo 16, MSC-04998, 15 October 1971.

(7) Apollo Operation Handbook MSC 01372-1 Vol I Rev V March 1971 and MSC 01372-2 Vol II Rev III June 1971.

NASA — MSC — Coml., Houston, Texas