MSC-05171

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

SCIENCE CONTINGENCY PROCEDURES

MISSION J-2/APOLLO 16

REVISION A

MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

NOVEMBER 1971

REVISED APRIL 1972

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS 77058

REPLY TO
ATTN OF: TD5-72-4-18

APR 17 1972

MEMORANDUM

TO: Distribution

FROM: TD5/Head, Experiment Operations Section

SUBJECT: Revision B to the Science Contingency Procedures, Mission J-2/Apollo 16

Please remove existing pages 1-12, 2-13, 2-16, and 2-17 from your copy of the Science Contingency Procedures Document (MSC-05171) dated April 1972, and replace with Change B dated April 14, 1972.

James R. Bates

Enclosure

TD5:JRBates:RFry(GE):ej:4-17-72:5851

PREFACE

This document defines the Apollo 16 Mission Science Contingency Guidelines and equipment procedures. This document is a complete reissue which replaces the Science Contingency Procedures, Mission J-2/Apollo 16, dated November 1971. Information contained within this document represents the Science Contingency Procedures for Lunar Surface Operation as of April 3, 1972.

Contingency plans presented in this document apply to various situations where some degree of premission planning is necessary and serve to provide a set of plans and guidelines for use in real time where circumstances might not otherwise permit such planning.

The procedures are to be used by the Surface Science Teams should it become necessary to deviate from the normal experiment deployment and geology traverses specified in the MRD and the LSP documents.

It is obvious that all contingency situations cannot be preplanned and it is understood that real time circumstances can modify those situations which were preplanned. Such modifications, if made, will be with the concurrence of the responsible elements in the Mission Control Center.

MSC-05171

SCIENCE

CONTINGENCY PROCEDURES

MISSION J-2/APOLLO 16

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1.0 GENERAL GUIDELINES FOR LUNAR SURFACE PLANNING

1.1 Time Constraint

A. For any malfunction on a scientific task spend a maximum of 10 minutes on malfunction procedures, then abandon. Additional time may be allocated on certain malfunctions before resulting in total experiment abandonment. These items are as follows: RTG Fueling, ALSEP Package 1 to Package 2 Cable Connections, ALSEP Antenna Erection and Alignment, and moving ALSEP Deployment to a later EVA. This additional time will be a real-time decision based on consumables and timeline constraints.

B. General Guidelines for EVA Operational Time Allotments.

Driving Time. . . . . 30% of EVA Time

Science Time. . . . . 70% of EVA Time

- Primary Objectives. . . . . 30%)
- Secondary Objectives. . . . . . 30%)
- Tertiary and Miscellaneous Objectives. . . . . 40%)

C. A reasonable science stop consists of 10 minutes science time and 5 minutes of overhead time.

D. The accumulative timeline for EVA activity along with the required time for each crewman to complete his assigned task is presented in Tables 1.1, 1.2, and 1.3.

TABLE 1.1 APOLLO 16 EVA 1

EVA Time (Hrs-Min)	Event Time (Min)	CDR	LMP	Event Time (Min)	EVA Time (Hrs-Min)
0 + 00	10	Prep for Egress	Prep for Egress/Aid CDR	22	0 + 00
0 + 10	12	Egress/MESA Deploy/ Environmental Fam.			
0 + 22	8	MESA Set Up/TV Deploy	Egress/Environmental Familiarization	5	0 + 22
			MESA Set Up	6	0 + 27
0 + 30	8	Offload LRV			
			Offload LRV	5	0 + 33
0 + 38	12	Set Up LRV/Checkout	Set up LRV	5	0 + 38
			LM Area Photos	7	0 + 43
0 + 50	15	Offload Far UV Camera	Load LRV/TV/Stow ALSD, Bore/Core Stems on LRV	25	0 + 50
1 + 05	15	Load LRV/Prepare Aft Pallet for Geology/ MESA			
			Ingress/Stow Contents on Pallet 1 in LM	5	1 + 15
1 + 20	7	Flag Deploy/Photo	Egress/Deploy Flag/ Photo	7	1 + 20
1 + 27	7	ALSEP Offload/Attach Antenna Mast Sections to Subpackage #1	ALSEP Offload	5	1 + 27
			Fuel RTG/Prepare Sub-packages for traverse	5	1 + 32
1 + 34	2	Reset Far UV Camera			
1 + 36	1	Shift Cosmic Ray Experiment			
1 + 37	5	Close SEQ Bay Door/LRV Prep/Traverse	ALSEP Traverse	12	1 + 37
1 + 42	7	ALSEP Site Survey/ Geophone Line Deploy-ment reference (290°)			
1 + 49	7	RTG Cable Connect/Re-move Subpallet and Aim Mech. from Sub-package 2.	HFE Offload/Connect to CS	4	1 + 49

TABLE 1.1 APOLLO 16 EVA 1 (Continued)

EVA Time (Hrs-Min)	Event Time (Min)	CDR	LMP	Event Time (Min)	EVA Time (Hrs-Min)
			Deploy HFE Electronics and Layout Probes	7	1 + 53
1 + 56	8	Deploy PSE Stool/PSE			
			Prepare Drill/Bore & Core Stems	10	2 + 00
2 + 04	4	Offload ASE Thumper/ Geophone			
2 + 08	3	Offload Mortar Package			
			Drill Bore Hole 1/ Emplace HFE Probe 1/ Report Probe Depth and Stem Height	20	2 + 10
2 + 11	2	Offload LSM			
2 + 13	17	Erect Central Station			
2 + 30	10	Assemble & Align ALSEP Antenna/Depress Shorting Switch	Drill Bore Hole 2/ Emplace HFE Probe 2/ Report Probe Depth and Stem Height	20	2 + 30
2 + 40	10	Deploy LSM			
2 + 50	18	Deploy Geophones/Flags	Align HFE Electronics/ Deploy Geophones	15	2 + 50
			ALSEP Photos/Sample or Standby for Thumper Activity	28	3 + 05
3 + 08	25	Thumper/Geophone Experiment			
3 + 33	15	Deploy Mortar Package Base/Photo	Deep Drill Core Sample	15	3 + 33
3 + 48	8	Assist in Core Recovery /Pan Photo	Deep Drill Core Recovery	11	3 + 48
3 + 56	7	Prepare for Geology Traverse			
			Prepare for Geology Traverse	4	3 + 59
4 + 03	12	Traverse to Station 1	Traverse to Station 1	12	4 + 03

TABLE 1.1 APOLLO 16 EVA 1 (Concluded)

EVA Time (Hrs-Min)	Event Time (Min)	CDR	LMP	Event Time (Min)	EVA Time (Hrs-Min)
4 + 15	43	Station 1 - Flag Crater	Station 1 - Flag Crater	43	4 + 15
	03	• Overhead (Set Up)	• Overhead (Set Up)	02	
			• Pan Photo	01	
	03	• Description	• Description	03	
	08	• Rake/Soil Sample	• Rake/Soil Sample	08	
	27	• Documented Samples	• Documented Samples	27	
	02	• Overhead (Close Out)	• Overhead (Close Out)	02	
4 + 57	6	Traverse to Station 2	Traverse to Station 2	6	4 + 57
5 + 03	56	Station 2 (Spook Crater)	Station 2 (Spook Crater)	56	5 + 03
	03	• Overhead (Set Up)	• Overhead (Set Up)	02	
			• Pan Photo	01	
	03	• Description	• Description	03	
	18	• LPM Site Measurement	• 500mm Photos	03	
	28	• Documented Samples	• Documented Samples	42	
	03	• Overhead (Close Out)	• Overhead (Close Out)	03	
5 + 58	7	Traverse to Station 3	Traverse to Station 3	7	5 + 58
6 + 05	14	Station 3 (ALSEP Site)	Station 3 (ALSEP Site)	14	6 + 05
	01	• Overhead (Set Up)	• Overhead (Set Up)	01	
	08	• Gran Prix	• Photo Gran Prix	08	
	03	• Retrieve Deep Core	• Arm Mortar Package/ Position CS SW #5 - CCW	04	
	02	• Overhead (Close Out)	• Overhead (Close Out)	01	
6 + 19	5	Return to LM/Park LRV in Sun	Return to LM/Park LRV in Sun	5	6 + 19
6 + 24	6	Photo/Reset Far UV Camera	Deploy SWC/Photo	6	6 + 24
6 + 30	20	EVA Close Out/Pack ETB	EVA Close Out/Pack SRC #1	12	6 + 30
			Ingress/Stow Core Stem	8	6 + 42
6 + 50	10	Transfer SRC 1 into LM/ Ingress	Receive SRC 1/Assist CDR	10	6 + 50
7 + 00		EVA 1 Termination	EVA 1 Termination		7 + 00

TABLE 1.2 APOLLO 16 EVA 2

EVA Time (Hrs-Min)	Event Time (Min)	CDR	LMP	Event Time (Min)	EVA Time (Hrs-Min)
0 + 00	10	Prep. for Egress	Prep. for Egress/Aid CDR	16	0 + 00
0 + 10	5	Egress/Environmental Familiarization			
0 + 16	4	Reset Far UV Camera Camera	Egress/Environmental Familiarization	6	0 + 16
0 + 20	20	TV/Prep. for Geology Traverse			
			Prepare for Geology Traverse	18	0 + 22
0 + 40	4	PLSS Load-Up	PLSS Load-Up	4	0 + 40
0 + 44	2	Reset Får UV Camera	Pan Photo	2	0 + 44
0 + 46	4	LRV Prep.	LRV Prep.	4	0 + 46
0 + 50	35	Traverse to Station 4	Traverse to Station 4	35	0 + 50
1 + 25	58	Station 4 - Stone Mt.	Station 4 - Stone Mt.	58	1 + 25
	03	• Overhead (Set Up)	• Overhead (Set Up)	02	
	05	• Description	• 500mm Photo	05	
	08	• Rake/Soil Sample	• Description	03	
	06	• Solo Sampling	• Rake/Soil Sample	08	
	02	• Panorama 1	• Penetrometer Tests	08	
	08	• Double Core	• Double Core	08	
	24	• General Sampling	• Panorama 2	02	
	02	• Overhead (Close Out)	• General Sampling	22	
			• Overhead (Close Out)		
2 + 25	5	Traverse to Station 5	Traverse to Station 5	5	2 + 25
2 + 30	40	Station 5 (Stone Mt.)	Station 5 (Stone Mt.)	40	2 + 30
	03	• Overhead (Set Up)	• Overhead (Set Up)	02	
	35	• General Sampling	• Panorama	01	
	02	• Overhead (Close Out)	• General Sampling	35	
			• Overhead (Close Out)	02	
3 + 10	2	Traverse to Station 6	Traverse to Station 6	2	3 + 10
3 + 12	20	Station 6 (Stone Mt.)	Station 6 (Stone Mt.)	20	3 + 12
	03	• Overhead (Set Up)	• Overhead (Set Up)	02	
	15	• General Sampling	• Panorama	01	
	02	• Overhead (Close Out)	• General Sampling	15	
			• Overhead (Close Out)	02	

TABLE 1.2 APOLLO 16 EVA 2 (Continued)

EVA Time (Hrs-Min)	Event Time (Min)	CDR	LMP	Event Time (Min)	EVA Time (Hrs-Min)
3 + 32	3	Traverse to Station 7	Traverse to Station 7	3	3 + 32
3 + 35	15 03 03 07 02	Station 7 - Stubby • Overhead (Set Up) • Description • General Sampling • Overhead (Close Out)	Station 7 - Stubby • Overhead (Set Up) • Panorama • 500mm Photo • General Sampling • Overhead (Close Out)	15 02 01 03 07 02	3 + 35
3 + 52	3	Traverse to Station 8	Traverse to Station 8	3	3 + 52
3 + 55	60 03 03 08 08 20 16 02	Station 8 - South Ray • Overhead (Set Up) • Description • Double Core • Rake/Soil Sample • Boulder Protocol • Sampling • Overhead (Close Out)	Station 8 - South Ray • Overhead (Set Up) • Panorama • Description • Double Core • Rake/Soil Sample • Boulder Protocol • Sampling • Overhead (Close Out)	60 02 01 03 08 08 20 16 02	3 + 55
4 + 55	4	Traverse to Station 9	Traverse to Station 9	4	4 + 55

4 + 59	25
	03
	08
	12
	02
		Station 9-Cayley Plains
		• Overhead (Set Up)
		• CSVC
		• Surface Samplers
		• Overhead (Close Out)
			Station 9-Cayley Plains
			• Overhead (Set Up)
			• Panorama
			• CSVC
			• Surface Samplers
			  • Beta Cloth
			  • Velvet
			  • Skim Sample
			  • Scoop Sample
			• Overhead (Close Out)
				25
				02
				01
				08
				12
				
				02
					4 + 59

5 + 24	21	Traverse to Station 10	Traverse to Station 10	21	5 + 24
5 + 45	33 03 08 05 13 02 02	Station 10 - LM/ALSEP • Overhead (Set Up) • Double Core • Trench • Trench Sampling • Panorama • Overhead (Close Out)	Station 10 - LM/ALSEP • Overhead (Set Up) • Double Core • Penetrometer Tests • Overhead (Close Out)	33 03 08 19 03	5 + 45
6 + 18	2	Traverse to LM	Traverse to LM	2	6 + 18
6 + 20	3	Park LRV	LRV Readout/TV	6	6 + 20
6 + 23	3	Reset Far UV Camera			

TABLE 1.2 APOLLO 16 EVA 2 (Concluded)

EVA Time (Hrs-Min)	Event Time (Min)	CDR	LMP	Event Time (Min)	EVA Time (Hrs-Min)
6 + 26	5	Unload PLSS	Unload PLSS	5	6 + 26
6 + 31	7	Pack ETB • 2 - HEDC's (with mag) • 2 - 70mm mags • 2 - 16mm mags • 2 - Padded Bags • 1 -Mag from 500mmCam • 1 -Mag from DAC • 1 -Set of Maps	Pack SRC 1	7	6 + 31
6 + 38	3	EMU Clean Up	EMU Clean Up	3	6 + 38
6 + 41	12	EVA Close Out	EVA Close Out/Ingress Stow SRC/Aid CDR	9 10	6 + 41 6 + 50
6 + 53	3	Reset Far UV Camera			
6 + 56	4	Ingress			
7 + 00		EVA 2 Termination	EVA 2 Termination		7 + 00

TABLE 1.3 APOLLO 16 EVA 3

EVA Time (Hrs-Min)	Event Time (Min)	CDR	LMP	Event Time (Min)	EVA Time (Hrs-Min)
0 + 00	10	Prep. for Egress	Prep. for Egress	17	0 + 00
0 + 10	7	Egress/Environmental Familiarization			
0 + 17	3	Reset Far UV Camera	Egress/Environmental Familiarization	5	0 + 17
0 + 20	12	TV/Prep. for Geology Traverse			
			ETB Unpack/Prep. for Geology Traverse	10	0 + 22
0 + 32	5	PLSS Load-Up	PLSS Load-Up	4	0 + 32
			Pan Photo	4	0 + 36
0 + 37	4	Reset Far UV Camera			
			LRV Prep.	7	0 + 40
0 + 41	6	LRV Prep.			
0 + 47	43	Traverse to Station 11	Traverse to Station 11	43	0 + 47
1 + 30	53 03 04 04 10 26 04 02	Station 11-North RayRim • Overhead (Set Up) • Description • Set Up for Near Field Polarimetric • Sampling for Near Field Polarimetric • General Sampling • Panorama 2 • Overhead (Close Out)	Station 11-North RayRim • Overhead (Set Up) • Panorama 1 • 500mm Photo • Far Field Polarimetric Photos • Near Polarimetric • General Sampling • Far Field Polarimetric Photos • Overhead (Close Out)	53 02 01 04 04 10 26 04 02	1 + 30
2 + 23	3	Traverse to Station 12	Traverse to Station 12	3	2 + 23
2 + 26	56 03 05 08 38 02	Station 12-North RayRim • Overhead (Set Up) • Description • Rake/Soil Sample • General Sampling • Overhead (Close Out)	Station 12-North RayRim • Overhead (Set Up) • Panorama 1 • 500mm Photos • Rake/Soil Sample • General Sampling • Overhead (Close Out)	56 02 01 05 08 38 02	2 + 26
3 + 22	5	Traverse to Station 13	Traverse to Station 13	5	3 + 22

TABLE 1.3 APOLLO 16 EVA 3 (Continued)

EVA Time (Hrs-Min)	Event Time (Min)	CDR	LMP	Event Time (Min)	EVA Time (Hrs-Min)
3 + 27	10	Station 13-North Ray Blanket	Station 13- North Ray Blanket	10	3 + 27
	01	• Overhead (Set Up)	• Overheat (Set Up)	01	
	08	• Rock/Soil Sampling	• Panorama	02	
	01	• Overhead (Close Out)	• Rock/Soil Sampling	06	
			• Overhead (Close Out)	01	
3 + 37	6	Traverse to Station 14	Traverse to Station 14	6	3 + 37
3 + 43	40	Station 14 - Smoky Mt.	Station 14 - Smoky Mt.	40	3 + 43
	03	• Overhead (Set Up)	• Overhead (Set up)	02	
	04	• Description	• Panorama	01	
	08	• Rake/Soil Sample	• 500mm Photos	04	
	08	• Double Core	• Rake/Soil Sample	08	
	02	• Panorama	• Double Core	08	
	13	• General Sampling	• General Sampling	15	
	02	• Overhead (Close Out)	• Overhead (Close Out)	02	
4 + 23	10	Traverse to Station 15	Traverse to Station 15	10	4 + 23
4 + 33	10	Station 15-Dog Leg Crater	Station 15-Dog Leg Crater	10	4 + 33
	01	• Overhead (Set Up)	• Overhead (Set Up)	01	
	08	• LPM Measurement	• Panorama	02	
	01	• Overhead (Close Out)	• Rock/Soil Sample	06	
			• Overhead (Close Out)	01	
4 + 43	11	Traverse to Station 16	Traverse to Station 16	11	4 + 43
4 + 54	10	Station 16-Dot Crater	Station 16-Dot Crater	10	4 + 54
	01	• Overhead (Set Up)	• Overhead (Set Up)	01	
	08	• LPM Measurement	• Panorama	02	
	01	• Overhead (Close Out)	• Rock/Soil Sample	06	
			• Overhead (Close Out)	01	
5 + 04	3	Traverse to Station 17	Traverse to Station 17	3	5 + 04
5 + 07	38	Station 17-Palmetto Crater	Station 17-Palmetto Crater	38	5 + 07
	03	• Overhead (Set Up)	• Overhead (Set Up)	02	
	03	• Description	• Panorama 1	01	
			• Description	03	
	08	• Rake/Soil Sample	• Rake/Soil Sample	08	
	10	• LPM Measurements	• LPM/Rock Measurement (Igneous Rock)	10	
	01	• Panorama 2			
	11	• General Sampling	• General Sampling	12	
	02	• Overhead (Close Out)	• Overhead (Close Out)	02	
5 + 45	20	Traverse to LM	Traverse to LM	20	5 + 45

TABLE 1.3 APOLLO 16 EVA 3 (Concluded)

EVA Time (Hrs-Min)	Event Time (Min)	CDR	LMP	Event Time (Min)	EVA Time (Hrs-Min)
6 + 05	3	LRV Configure	LRV Configure	6	6 + 05
6 + 08	3	Reset Far UV Camera			
6 + 11	3	Unload PLSS	Unload PLSS	3	6 + 11
6 + 14	6	Retrieve Cosmic Ray Experiment	Pack ETB • 500mm Mag. • 3 HEDC Mag. • Mag. R (16mm) • DAC Mag. • Map Package • Penetrometer Drum	11	6 + 14
6 + 20	22	LRV Placement/TV/Gran Prix			
			Photo Gran Prix	5	6 + 25
			Retrieve SWC	3	6 + 30
			EVA Close Out/Complete Packing ETB • Mag. T of DAC • SWC • HEDC Mag.	9	6 + 33
6 + 42	3	DAC Show	DAC Show	3	6 + 42
6 + 45	2	Clean EMU	Clean EMU	3	6 + 45
6 + 47	3	Retrieve Far UV Camera Film			
			Ingress/Aid CDR	12	6 + 48
6 + 50	10	Transfer ETB/SCB into LM/Ingress			
7 + 00		EVA 3 Termination	EVA 3 Termination		7 + 00

1.2 Lunar Surface Activity Guidelines

EVA-1	EVA-2	EVA-3
• A minimum of 55 minutes must be spent on Geology which includes arming the MPA. Do not off-load ALSEP unless a minimum of 1 hour, 30 minutes can be spent on deployment. In the event of EVA time reduction, delete Station 1 (Flag) and do Station 2 (Spook) activity first, then do Station 3 (LM/ALSEP). Perform LPM site calibrations at Station 2 (Spook) or reschedule for EVA-3. ALSEP Deployment not completed, slip to end of EVA-2. In the event the complete ALSEP Deployment is slipped to EVA-2, perform the Deployment Activity at the beginning of EVA-2 and move planned EVA-2 activity to EVA-3. Delete the planned EVA-3 activity.	• A minimum of 1 hour must be spent at Stone Mountain. • A minimum of 30 min. must be spent at South Ray. • A maximum of 10 additional minutes will be spent attempting to get to Station 4 on Stone Mountain. • If Soil Mechanics Experiment not completed, do not reschedule activity.	• A maximum of 30 additional minutes will be spent attempting to reach the rim of North Ray. B • A minimum of 90 minutes must be spent at North Ray. B • A minimum of 20 minutes must be spent at Smoky Mountain.

1.3 EVA/Traverse Planning Criteria

A. 30 minutes reserves maintained on all PLSS consumables at station metabolic rate.

B. All distances and speeds are map distances and map speeds (mobility rates).

C. 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).
These numbers are subject to pre-launch load data.

D. 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

E. Respiratory exchange quotient = .90

F. Feed water heat of vaporization 1038 $\frac{BTU}{LB.}$

G. The LRV will be used at all times even though its rate approaches that of a walking astronaut. This results in lower crew metabolic rates, and provides a tool, sample, and experiment carrier.

H. LRV rates will be computed in real time (a nominal LRV rate is 7.3 KPH) and applied to a plan plot which integrates real time PLSS consumables data and defines the maximum distance which the crew can operate from the LM.

I. Should the planned ALSEP deployment site be unsuitable for deployment, an alternate site >300 feet west of LM should be selected using the following guidelines:

1. ALSEP components should not be placed on slopes >5 degrees.

2. Locate ALSEP components at least 12 feet from a one-foot outcropping, 24 feet from a two-foot outcropping, etc.

3. If outcropping cannot be avoided, orient ALSEP components thermal radiators away from outcropping to achieve a clear view of space.

4. Orient radiators away from direct sunlight.

J. Should the planned ALSEP deployment site be unsuitable for geophone deployment, select the best ALSEP deployment site >300 feet west of LM and deploy the geophone line within 45 degrees of the Central Station/LM line of sight utilizing the following criteria:

1. Ensure that none of the geophones has been pulled out of the lunar surface before firing the ASI's.

2. The geophone line should be positioned to prevent firing grenades into or over a ridge or crater.

3. If geophone deployment cannot be accomplished within 45 degrees of the Central Station/LM line of sight, deploy the geophones cross-sun per Figure 9, page 4-35. Precise deployment direction will be determined in real time.

K. If unable to schedule all 19 thumper ASI firings, the following guidelines should be followed:

1. Schedule a minimum of 5 ASI firings before slipping the thumper activity to EVA-2. (Geophone cable positions 1, 6, 11, 15, 19 with ASI positions 1, 2, 3, 4, 5)

2. If the five geophone calibration "thumps" are obtained on EVA 1, EVA 2 will not be used to obtain the 14 additional "thumps".

3. If no "thumps" are obtained on EVA 1, then the five calibration thumps (and no more) will be obtained on EVA 2.

L. If unable to schedule all planned LPM measurements, the following priority guidelines should be used:

1. a) One measurement near rim of crater.
   b) One measurement approximately one crater diameter away.
   c) One measurement approximately two crater diameters away.
   d) One measurement in the Cayley Formation region.

2. The sensor head must be >250 feet from LM and >35 feet from LRV.

3. One of the measurements performed must be a site survey.

4. All other measurements should be performed with the sensor head in position 3.

1.4 Lunar Surface EVA Hold Points

In the event of a PLSS or operational contingency (i.e., a PLSS malfunction or an imminent consumables red-line due to an inability to complete the deployment tasks within the nominal timeline), the sequence of experiment deployment tasks may be temporarily stopped after the completion of any one of the hold points listed below. In case the ALSEP deployment cannot be completed during EVA 1 and part of the deployment must be deferred to EVA 2, three prime hold points provide the highest return from an ALSEP system viewpoint. (These hold points are following the completion of tasks d, g, and k.) The deployment may be resumed at a later point in time by continuing with the next series of tasks.

A. Offload the (LSUC) Lunar Surface Ultraviolet Camera. Place camera in LM shadow and the battery in the sun.

B. Remove ALSEP packages 1 and 2. Close SEQ Bay door. Emplace ALSEP packages with handles up, with experiments in and facing the sun within $\pm 15^{\circ}$.

C. Remove UHT's and carry bar.

D. Rotate fuel cask. (PRIME EVA 1 HOLD POINT)

E. Remove fuel cask dome.

F. Unstow ALSD, place on LRV.

G. Fuel RTG, close SEQ Bay doors, carry ALSEP to deployment site, remove HFE pallet and MPA pallet from package 2, pull shorting switch lanyard and connect RTG and HFE cables to Central Station, offload aiming mechanism (do not actuate shorting switch if ammeter indicates a non-zero reading). (PRIME EVA 1 HOLD POINT)

H. Remove HFE electronics package from pallet and deploy.

I. Remove PSE, ASE and LSM. Deploy PSE and ASE.

J. Drill first bore hole and insert first probe in bore stem.

K. Align CS, raise sunshield, install antenna mast, aiming mechanism, and antenna. Note: Depress shorting switch and rotate astronaut switch 1 clockwise if hold is imminent. (PRIME EVA 1 HOLD POINT)

L. Remove and deploy LSM.

M. Drill second bore hole and insert second probe into bore stem.

N. Depress shorting switch and rotate astronaut switch 1 clockwise.

O. Turn astronaut switch 5 counterclockwise, deploy ASE, and perform Thumper/Geophone tasks.

1.5 Lunar Surface Experiment Priorities

The following sections provide science priorities for use in replanning EVA activities when circumstances dictate.

1.5.1 Surface Experiments Priorities

(Source: Mission Implementation Plan and Mission Requirements Document)

PRIORITY	EXPERIMENT
1.	Documented Samples at highest priority area. (Part of Lunar Geology Investigation)
2.	Apollo 16 ALSEP • HFE (S-037) • LSM (S-034) • PSE (S-031) • ASE (S-033)
3.	Drill Core Sample (Part of Lunar Geology Investigation).
4.	Lunar Geology Investigation (S-059). (Portions other than priority items 1 and 3 above)
5.	Far UV Camera/Spectroscope (S-201).
6.	Solar Wind Composition (S-080).
7.	Soil Mechanics (S-200).
8.	Lunar Portable Magnetometer (S-198).
9.	Cosmic Ray Detector (Sheets)(S-152).
10.	Lunar Rover Vehicle Evaluation

1.5.2 Overall Priority

(Source: SWP Minutes, March 16-17, 1972.)

PRIORITY	STATION
1	1 and 2
2	3 (ALSEP Activity)
3	4 and 5
4	11 and 12

1.5.3 EVA Station Priorities

(Source: SWP Minutes, March 16-17, 1972.)

EVA 1		EVA 2		EVA 3	
Priority	Station	Priority	Station	Priority	Station
1	2 (Spook)	1	4) Stone	1	11 North Ray
1	1 (Flag)	1	5) Mtn.	1	12 North Ray
2	3 (LM/ALSEP)	2	8 South Ray	2	14 Smoky Mtn.
		5	9 Cayley Plain	3	13 North Ray Blanket
		6	7 Stubby	4	17 Palmetto
		4	10 Cayley Plain	6	15 Dog Leg
		3	6 Base of Stone Mtn.	5	16 Dot

Note: 1) Move the CSVC tasks to station 8 if necessary to drop station 9.

2) The stations indicated above are shown on the Apollo 16 Traverse Planning Map, Figure 2.

1.5.4 EVA Station Task Priorities

(Exclusive of standard tasks such as TV, photographic pan, etc.)

Station	Priority	Tasks
	EVA 1	
1 Flag Crater	1 2	Rake/Soil Sample Sampling
2 Spook Crater	1 2 3	Sampling LPM Measurement 500 mm Photos
3 ALSEP/LM Area	1 2	Retrieve 2.6 m Core Arm Mortar Package
	EVA 2	
4 Stone Mountain	1 3 2 4	Rake/Soil Sample Double Core Sampling SESC/500 mm Photos/Penetrometer Measurements
5 Stone Mountain	1	Description and Sampling
6 Base of Stone Mountain	1	Description and Sampling
7 Stubby Crater	1 2	Sampling 500 mm Photos
8 South Ray	1 3 2	Rake/Soil Sample Double Core Sampling (Including Boulder Operations)
9 Cayley Plains	2 1	CSVC Surface Sampler
10 LM/ALSEP Area	4 1 3 2	Sampling Double Core Trench Samples Penetrometer Measurements

1.5.4 EVA Station Task Priorities (Continued)

EVA 3		
Station	Priority	Tasks
11 North Ray Rim	1 2 3 4	Sampling 500 mm Photos Near Field Polarimetry Far Field Polarimetry
12 North Ray Rim	1 2 3	Rake/Soil Sample Sampling 500 mm Photos
13 North Ray Ejecta Blanket	1	Rock/Soil Sample
14 Smoky Mountain	1 2 3 4	Rake/Soil Sample Sampling Double Core 500 mm Photos
15 Dog Leg Crater	1 2	LPM Measurement Rock/Soil Sample
16 Dot Crater	1 2	LPM Measurement Rock/Soil Sample
17 Palmetto Crater	1 2 3	Rake/Soil Sample Sampling LPM Measurement

1.5.5 Minimum Field Geology Time Line

These times reflect the minimum required at a specific geologic feature in order to justify going to that feature. In the case of EVA-1 a minimum of 55 minutes traverse is required for Cayley Plain sampling.

Feature	Min. Time
Stone Mountain	1 + 00
North Ray	1 + 30
Cayley Plains (EVA-1)	0 + 55
South Ray Crater Req.	0 + 30
Smoky Mountain	0 + 20

1.5.6 Special Sample Priority

(Source: SWP Minutes of February 7-8, 1972).

PRIORITY	SAMPLE
1)	Split Boulder
2)	Giant Boulder (>5 m)
3)	Radial Sample of Fresh Crater
4)	Ultraclean (CSVC)
5)	Surface Sample (Cloth)
6)	Fillet/Dust
7)	Permanent Shadow Soil
8)	E-W Split Boulder

1.5.7 Priority of Samples After Collection

1) SRC #1 (EVA 1)
   - SCB #1
     - Documented Samples from Stations 1 and 2

2) SCB #6 (EVA 2)
   - Documented Samples from Stations 4 through 8 and 10
   - Surface Samples (Beta and Velvet)
   - Drive Core Samples (4 tubes)
   - Trench Samples

3) SCB #3 (EVA 3) Stations 11 through 17
   - Documented Samples
   - Rake/Soil Samples
   - Drive Core Samples

4) Film Magazines
   - EVA 1
     - 70mm - Color A, B and C
- B/W G
     - 500mm - L
   - EVA 2
     - 70mm - Color C and D
- B/W H and I
     - 500mm - L
   - EVA 3
     - 70mm - Color E and F
- B/W J and K
     - 500mm - L and M

5) Deep Core Stems (6 each) EVA 1

6) SRC #2 (EVA 2)
   - SCB #2 (Stations 4 through 8 and 10)
     - Documented Samples
     - Drive Core Samples (Two Tubes)
     - SESC
     - CSVC

7) SCB #5
   - Documented Samples from Stations 1 and 2

8) SCB #7 (EVA 2) Stations 11 through 17
   - Documented Samples
   - Rake/Soil Samples

9) SCB #4

1.5.7 Priority of Samples After Collection (Continued)

10) SCB #8

11) Film Magazines - 35mm Far UV Spectrometer

12) Large Rock Bag from EVA's 1, 2, and 3

13) Solar Wind Composition

14) Penetrometer Drum

15) Cosmic Ray Detectors

16) Film - 16mm Magazines

1.6 Lunar Surface Photographic Contingencies

1.6.1 Contingency: Malfunction of One HEDC

	Camera	Solution
1.	500mm	Do without until EVA 3. Convert CDR's 60mm to 500 for III.
2.	CDR's 60mm	Do without until back in LM and try to fix. If unfixable, convert 500mm to 60mm for CDR on EVA 2 and convert back to 500mm for EVA 3.
3.	LMP's 60mm	Change CDR's camera to B/W and give to LMP to complete EVA. Convert 500mm to 60mm for LMP on EVA 2 and convert back to 500mm for EVA 3.

1.6.2 Contingency: Malfunction of 2 HEDC's

Solution

Convert remaining HEDC to 60mm with B/W magazine at first opportunity for LMP use.

1.6.3 Contingency: Walking Traverse from LRV to North Ray Rim

Case	Solution
LRV doesn't reach Station 11, (North Ray rim) and traverse on foot to crater rim is attempted.	Change to new B/W magazine (mag M) on 500mm and carry in LMP's SCB.

1.7 Map Data for Contingency Planning

1.7.1 Landing Dispersion Ellipses for Apollo 16

Guidance errors are assumed constant for all cases
(3 - Sigma: V = ± 1821 feet, W = ± 3927 feet).

3 - SIGMA ELLIPSES		
Case	Down Range (V)	Cross Range (W)
1. With landmark Tracking With Noun 69	± 3281 feet (± 1000 m)	± 4593 feet (± 1400 m)
2. No Landmark Tracking With Noun 69	± 4922 feet (± 1500 m)	± 8859 feet (± 2800 m)
3. With Landmark Tracking No Noun 69	± 21,327 feet (± 6500 m)	± 4593 feet (± 1400 m)
4. No Landmark Tracking No Noun 69	± 30,444 feet (± 9289 m)	± 8859 feet (± 2800 m)

These ellipses are shown in Figure 1.

1.7.2 Crew Onboard Map Data Pack for Contingency Landing

Quantity	Scale	Grid Size	Comments
1	1:100,000	800 m	• Index photomap: • Contains normal landing ellipse and no optics ellipses for 3-sigma cases.
1	1:50,000	400 m	• Landing area photomap: • Can barely accommodate all 3-sigma landing ellipses.
12	1:25,000	200 m	• Contingency traverse photomap: • Normal 3-sigma landing ellipse.
1	1:12,500	100 m	• Centered over landing site.

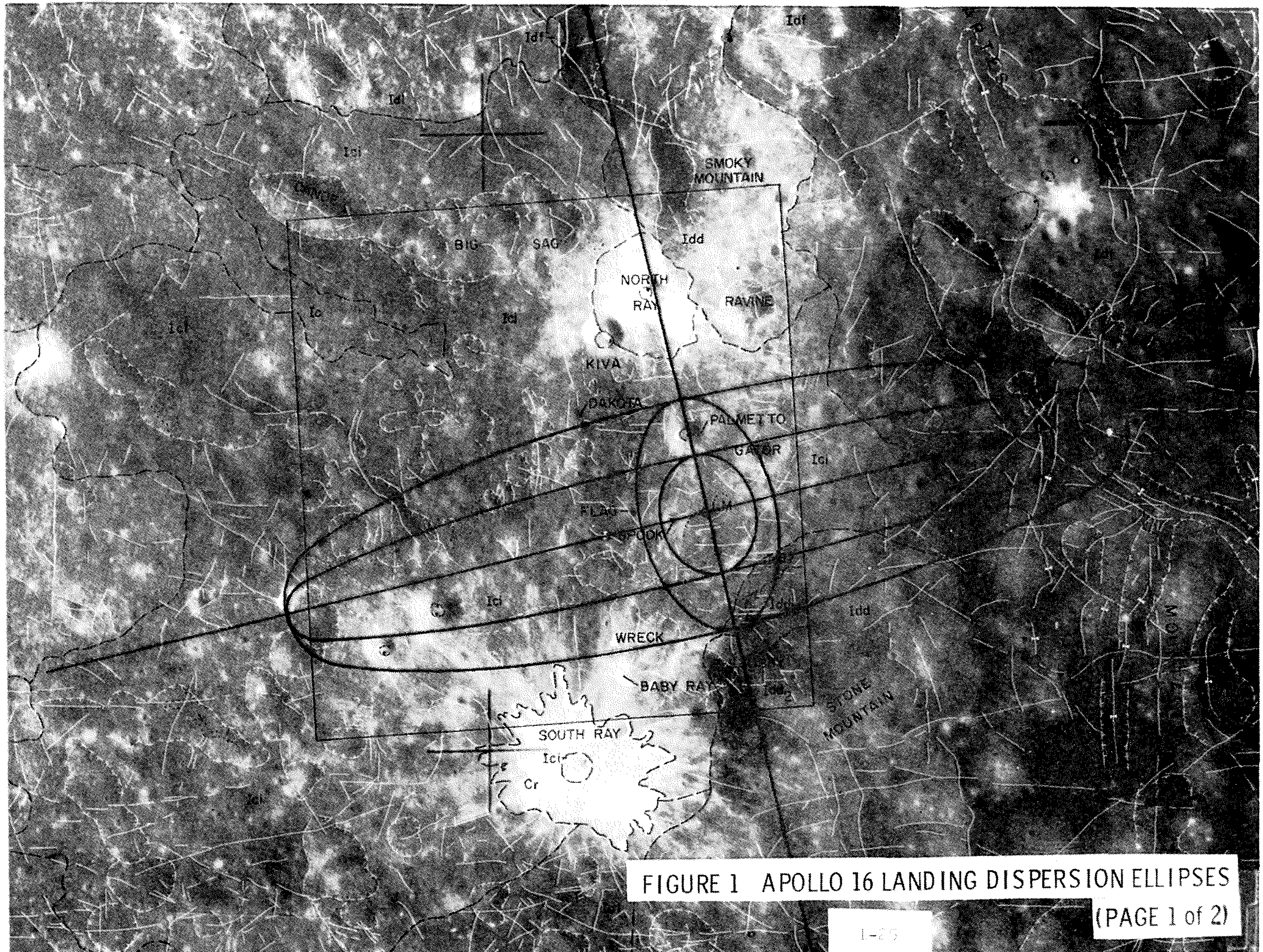


FIGURE 1 APOLLO 16 LANDING DISPERSION ELLIPSES (PAGE 1 of 2)

⊙

Nominal LM site

(Black)

Contact between morphologic units

(Black)

Trace of inferred stratification

(White)

Structural lineament

(White)

Structural lineament in bottom of trough or depression

(White)

Outline of rimless or low-rimmed basin, or of trough

(Black)

Mound

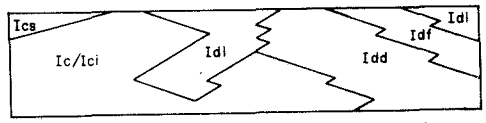
MORPHOLOGIC UNITS

Cr

Rim and ray materials of rayed crater — Copernican

Er

Rim materials of non-rayed crater — Eratos-thenian



Cayley Formation Plains-forming — Descartes materials Mountain- and hill-forming — Imbrian

Ic - undivided
Ici - irregular
Ics - smooth

Idf - hilly and furrowed
Idd - domical
Idl - low hilly

pIh	pIr

Hilly cratered material — Ring structure material — Pre-Imbrian

STRATIGRAPHY

(For area of 1:25,000 scale geologic map)

Ici

CAYLEY FORMATION

Stratified materials, with layers about 10-40 m thick. Underlies rolling, irregular surface. Interpreted to be mafic to intermediate volcanics

Idd	Idd_1
	Idd_2

MATERIALS OF THE DESCARTES MOUNTAINS

Stratified, with layers about 10-40 m thick; forms domical mountains. Divided on Stone Mountain into a light medium-gray, smoother, lower unit (Idd_1) and a dark medium-gray, rougher, upper unit (Idd_2); underlain by a thin unit (Idd?) transitional with material of Cayley Formation. Interpreted to be intermediate volcanics

IMBRIAN

Area of 1:25,000 scale geologic map

FIGURE 1 APOLLO 16 LANDING DISPERSION ELLIPSES - EXPLANATION

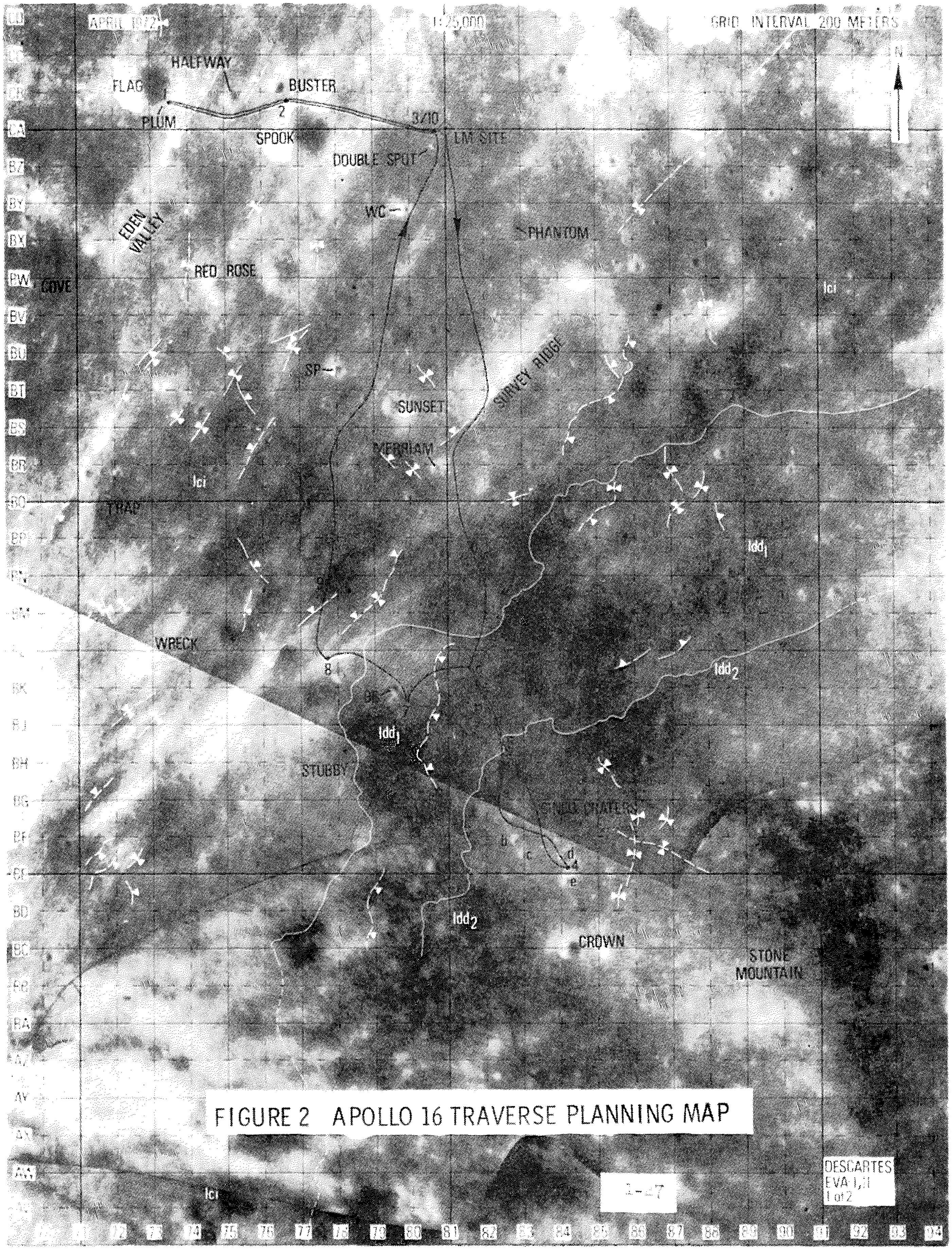


FIGURE 2 APOLLO 16 TRAVERSE PLANNING MAP

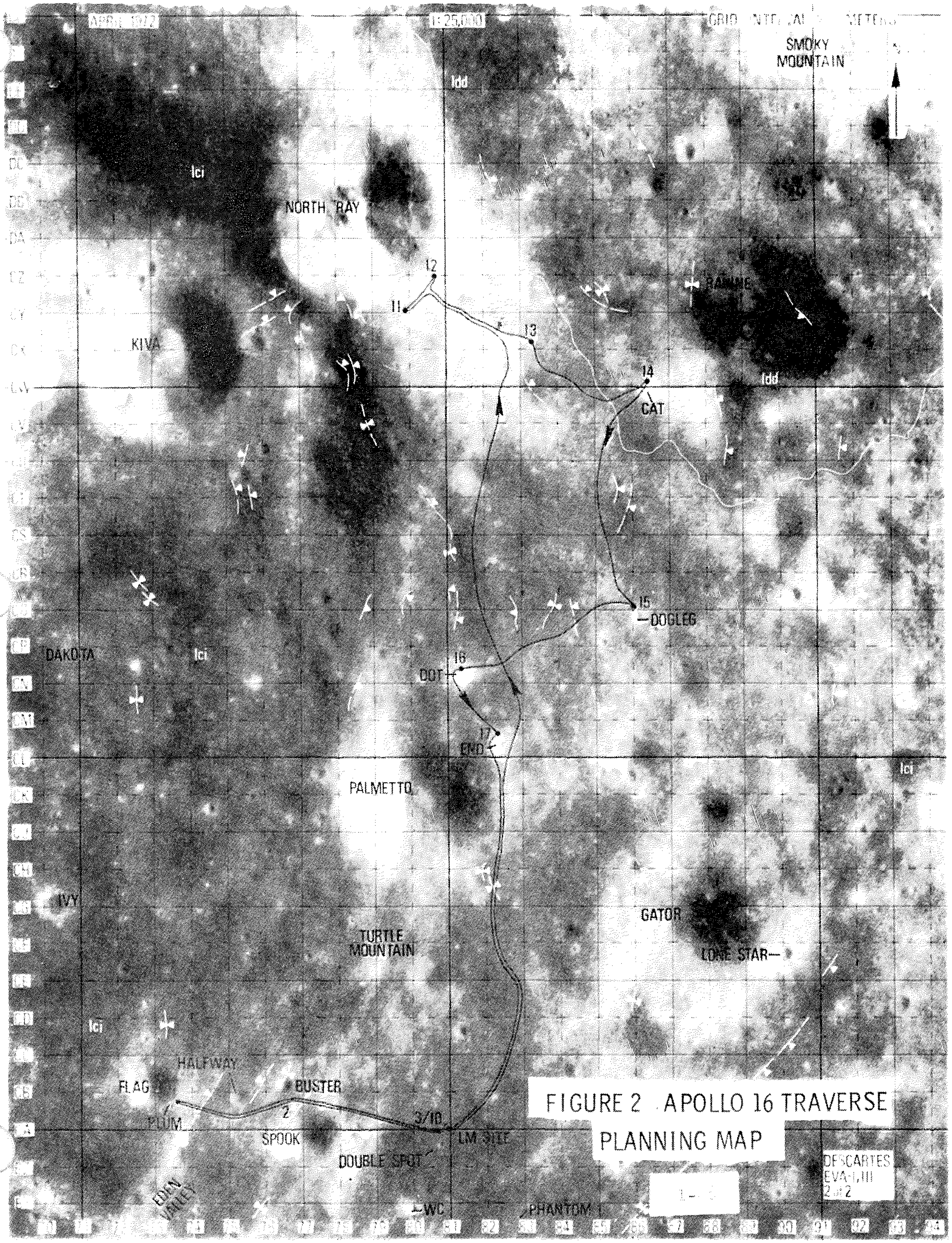


FIGURE 2 APOLLO 16 TRAVERSE PLANNING MAP

SECTION II

2.0 EVA CONTINGENCY PLANNING GUIDELINES

TABLES

2.0 EVA CONTINGENCY PLANNING GUIDELINES

2.1 Off-Nominal Landing Point Contingencies

Under nominal conditions, the 3σ landing dispersion ellipse is 1 x 1.4 km cross-range. Any landing point within this ellipse is considered nominal and the planned traverse will remain essentially the same. Station times will be adjusted to compensate for the small difference in driving time over those traverses originating from the center of the ellipse.

Certain non-nominal conditions could result in landings outside the above dispersion ellipse. A low thrust descent engine, for example, could result in landing far downrange. The absence of landmark tracking from lunar orbit can result in greater cross-range dispersions and the failure to achieve an update of the position of the landing site relative to the LM just prior to descent initiation can cause large uprange and downrange uncertainties. The magnitude of these latter two effects is shown in Figure 1.

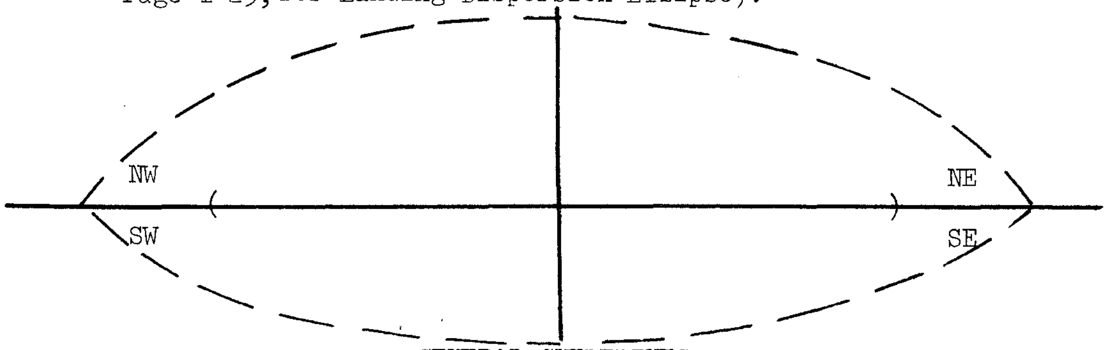
Pre-mission planning of new traverses to accommodate the range of these off-nominal landing points is a prohibitive job. However, certain guidelines can be agreed to beforehand and traverse planning tools can be constructed to facilitate planning when the actual landing point is determined. This section discusses such guidelines and sample traverses are presented to illustrate the effects of off-nominal landing points in attaining the original objectives on EVA's II and III.

2.1.1 Off-Nominal Landing Point for LM Landing with No Landmark Tracking and with NOUN 69 Update. See Figure 1, Page 1-25 for landing dispersion ellipses.

General Guidelines for Replanning the EVA Traverse

	EVA-1	EVA-2	EVA-3
EXTREME NORTHERLY LANDINGS	• Prior to investing any additional driving time to reach Flag and Spook, look for craters in landing area to accommodate the same objectives, of sampling the Cayley Plains. • Work out new traverse after landing point is known.	• Drop stations as outlined in behind time-contingency (Reference Section 2.5) to maintain 1 hour on Stone Mountain and 30 min on South Ray Ray area.	• Invest extra time on North Ray/Smoky Mountain.
EXTREME SOUTHERLY LANDING	Same as Northerly landings.	• Invest extra time on Stone Mountain/South Ray Ray area.	• Drop stations as outline in Behind Time Contingency (Reference Section 2.5) to maintain $1\frac{1}{2}$ hours at North Ray and 20 minutes on Smoky Mountain provided EVA-1 and EVA-2 experiences indicate LRV emergency drive-back speed can be accomplished, and PLSS consumables constrains are not exceeded. • Consider new EVA-3 traverse to Baby Ray and South Ray.

2.1.2 Off-Nominal Landing Point Plan for LM Landing with No Landmark Tracking with No NOUN 69 Update (Worse Case) (See Figure 1, Page 1-25, for Landing Dispersion Ellipse).



GENERAL GUIDELINES

Quadrant	EVA 1: Hardware Deployment	EVA 2: Traverse to Primary Objective	EVA 3: Traverse to Secondary Objective
NW	• Nominal 7-hr EVA. • Deploy LRV, ALSEP, drill deep core, LPM, and soil mech. • Geol. sites at crew discretion.	• Nominal 7-hr EVA. • Eastern ½: traverse to Stone Mountain. • Western ½: traverse to Descartes highlands.	• Nominal 7-hr EVA. • Eastern ½: traverse to North Ray. • Western ½: traverse to South Ray Ray area and/or large (1.1) Km crater.
SW	"	• Nominal 7-hr EVA. • Traverse to Stone Mountain and spend minimum of 2 hrs.	• Nominal 7-hr EVA. • Traverse to South Ray Ray area and/or large (1.1) Km crater.
NE	"	• Nominal 7-hr EVA. • Traverse to Stone Mountain for minimum of 2 hrs.	• Nominal 7-hr EVA. • Travers to North Ray and Smoky Mountain.
SE	"	• Nominal 7-hr EVA. • Traverse South to Descartes formation or Stone Mountain area.	• Nominal 7-hr EVA. • Attempt to get to South Ray or North Ray if possible. • Return to Descartes or large, deep crater.

2.2 Reduced Lunar Stay Time

Under certain circumstances, it may be necessary to shorten the EVA's (duration and number) and replan the traverses accordingly. These circumstances could range from having relatively minor effects such as replanning EVA II and III based on slightly higher than predicted PLSS consumables usage on EVA 1, to circumstances which could have drastic effects such as a leak in the descent water tank which reduced the lunar surface staytime to only a few hours. Figure 3, page 2-9 provides a chart from which the EVA configurations can be estimated dependent upon the predicted staytime capability.

As in the previous section dealing with off-nominal landing points, there are too many of these situations to permit pre-planning. Therefore, this section is limited to discussing general guidelines.

In general, with prior knowledge of the situation in terms of EVA time and number of EVA's, the traverses (and other EVA activities) will be replanned in accordance with the priorities listed in Section 1.5. (Experiment priorities, traverse station priorities, and station task priorities) In attempting to accomplish as many of these objectives as possible under the circumstances, the traverse planning team must exercise careful judgement in abridging the objectives of a given experiment before proceeding on to embrace the next lower priority experiment. The final product to fit the particular circumstances will receive thorough review by the cognizant elements (science, operations, and management) before implementation.

2.2.1 <u>Minimum EVA (1-3 hours)</u>

Guidelines -- EVA Activity in Order of Priority

1. Collect rock samples and soil samples.

2. Deploy ALSEP experiments as indicated.

   - LSM
   - PSE

3. Retrieve Cosmic Ray Detector experiment.

2.2.2 <u>One EVA Only (7 hours)</u>

Guidelines -- EVA Activity in Order of Priority

1. Lunar Field Geology including documented samples.

2.2.2 <u>One EVA Only (7 Hours)</u> (Continued)

2. Deploy ALSEP according to priorities.

    - HFE (Emplace one HFE probe in surface.)
    - LSM
    - PSE
    - ASE (Perform only 5 ASI firings at the following locations: 1, 6, 11, 15, and 19.)

3. - Obtain deep core.

    - Attempt to emplace second HFE probe in existing deep core hole.

4. Deploy LSUC.

5. Deploy CRD.

NOTE: LSUC must be deployed at beginning of EVA or abandon activity.

2.3 One Man EVA's

Certain hardware problems, principally associated with the EMU, could result in the situation where one crewman would have to remain in the LM cabin while the other crewman performed the EVA alone. For example, a problem in the PLSS electrical system could result in the loss of fan and/or pump operation which would preclude EVA operations with that EMU. If such a problem developed it would most likely be discovered during the EVA preparation period and only a short time would be available for the ground to prepare contingency EVA plans. Thus, although such a situation is very unlikely to occur, it will be desirable to establish constraints and outline traverse objectives within these constraints.

Although it is possible to perform all the planned EVA tasks with one man (including ALSEP deployment and LRV deployment), it will obviously be more difficult and more time consuming. Insofar as the traverse is concerned, the constraints remain the same in that the consumables margins must be retained to walk back from a failed LRV, or to drive back with a failed PLSS. The absence of the Buddy-PLSS, however, for cooling with a failed PLSS case results in a different radius of action for the one man case compared to the nominal two man case.

With the PLSS failure on the one man EVA, the crewman becomes completely dependent on the OPS for both oxygen, cooling, and CO_2 removal. To accomplish this, the OPS is operated in the purge mode with either of two flow rates, the selection of which depends upon the amount of cooling required. The necessity for the high flow rate (and hence early depletion) can be avoided if the crewman's activity after the PLSS failure can be minimized. Hence, the first constraint on the one man EVA is that traverse operations be restricted to the near vicinity of the LRV, on the order of 100 m. Allowing for the high metabolic rate in returning to the LRV over this distance and for a later

2.3 One Man EVA's (Continued)

period of high metabolic rate ingressing the LM, leaves the portion of the OPS capability which remains for use on the LRV return to the LM. This remainder is equivalent to a certain number of minutes driving time and dictates how far (in terms of driving time) the single crewman can range on the traverse.

The other consideration on one man traverse design is the fact that the LRV navigation tasks should be simplified by providing a return route where it will be possible to simply follow the outbound LRV tracks back to the LM. The reason for this consideration is that absence of the second crewman (who does much of the visual navigation) could compromise a time-critical emergency return.

The following is a brief discussion on one man EVA's which was constructed within the framework of the above constraints.

2.3.1 One Man EVA Activity in Order of Priority

EVA-1	EVA-2	EVA-3
1. Collect rock and soil samples (55 min. minimum). 2. Deploy ALSEP according to priority. • HFE • LSM • PSE • ASE 3. Deploy LSUC, CRD, and SWC.	1. Deploy LRV and LCRU/GCTA. 2. Obtain Deep Core. Sufficient time will be allocated at the end of EVA to drill and retrieve the Deep Core. 3. Conduct Field geology investigation with documented samples (3 hours, 47 min.) according to the following station priorities: a. Stone Mountain (1 hr. Minimum) b. South Ray Ray (30 min. Minimum)	1. Conduct field geology investigation with documented samples according to the following station priorities: (4 + 57): a. North Ray $1\frac{1}{2}$ hrs. Minimum b. Smoky Mountain 20 min. Minimum c. Palmetto 1 hr. Minimum d. Spook Crater 2. Retrieve CRD, SWC, and LSUC film. 3. Conduct soil mechanics trench and penetrometer readings. (25 min.) 4. Conduct LPM measurement. 5. Do LRV Grand Prix.

A. Maximum Distance from LM for a single crewman using the LRV is constrained to the time a crewman can return in the most optimum emergency configuration at maximum LRV speed and is approximately 4 Km.

B. The LRV will be deployed in EVA-2. The LCRU/GCTA will be utilized.

C. ALSEP will be deployed in EVA-1; however, a minimum of 55 minutes traverse time will be reserved at end of EVA-1.

D. LPM measurements will be limited to a site measurement and one traverse measurement in EVA-3 at the following locations:

E. A single crewman should follow the outbound LRV tracks for the return traverse to the LM.

NOMINALLY PLANNED REST PERIODS ARE 8 HOURS DURATION, HOWEVER IN EVENT OF CREW WAKEUP AT 7 HOURS, EVA'S WILL BE INITIATED WITH 7 HOURS REST

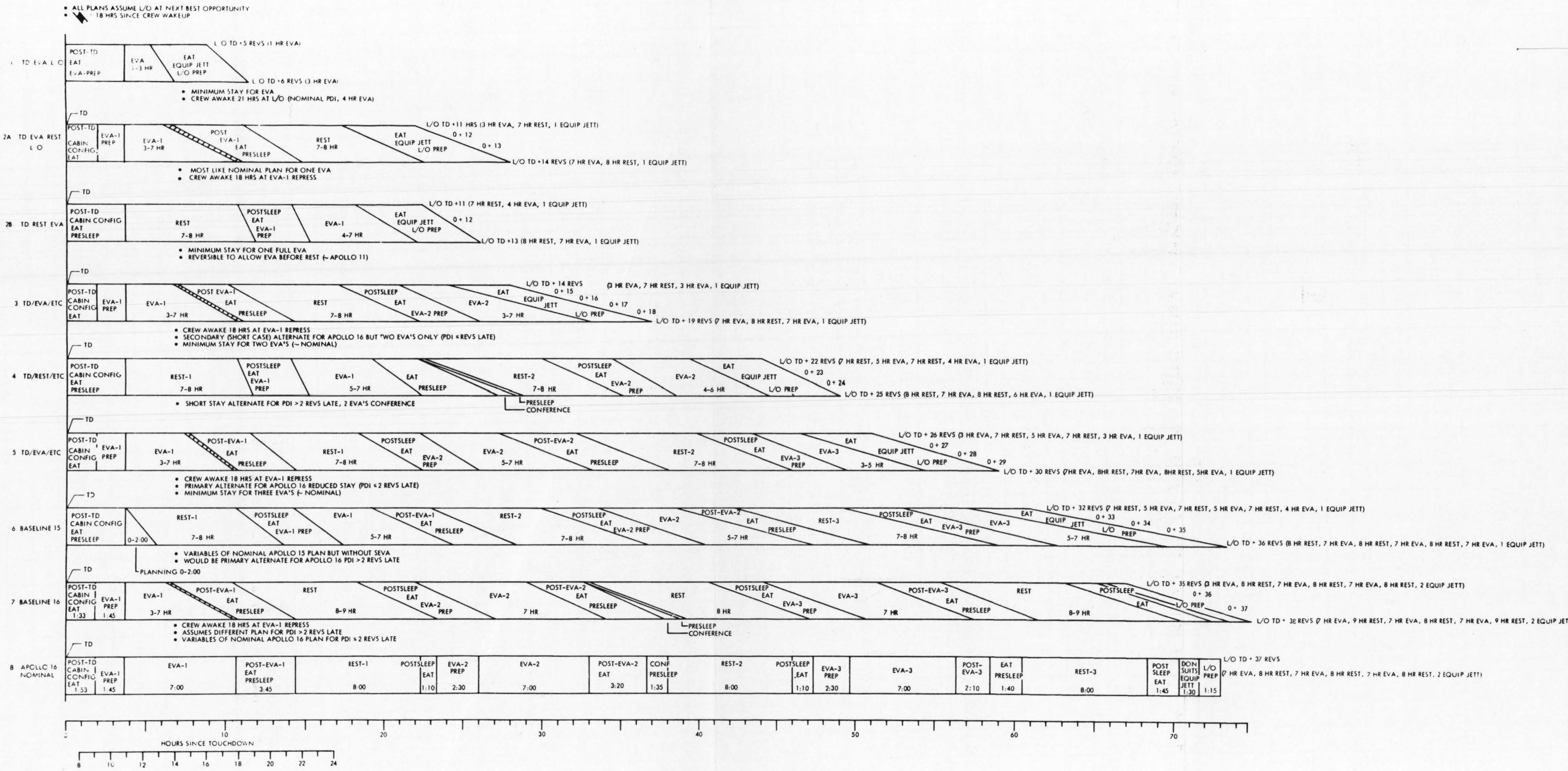


Figure 3 Guidelines for Alternate Surface Stay Situations

2.4 Walking Traverses

The major constraining factors on walking traverses are: radius of action is more limited than LRV traverses to accommodate the B-SLSS emergency return mode (approximately 3.6 km is the maximum distance), average metabolic rate is higher and therefore PLSS consumables margins are lower and the equipment which can be handcarried precludes doing certain station tasks which were done on the LRV traverses (LMP measurements, for example).

The walking traverses presented herein are consistent with these limitations while trying to accommodate as many of the original science objectives as practical. It is assumed that the traverses originate from the nominal landing point and no attempt is made to preplan walking traverses from off-nominal landings. Such planning will be done after landing, if necessary. It should also be noted that the three walking traverses discussed herein will apply whether the LRV is inoperative for all three EVA's or whether it becomes inoperative later in the mission.

The only tools or experiments that will not be carried by the crewman on the walking traverse are the following:

(a) Lunar portable magnetometer
(b) Penetrometer
(c) Scoop (Lunar surface rake carried instead)
(d) 500mm camera (carried on EVA III only)
(e) Padded bags, polarizing filter

Figure 4 shows the geometry of the three walking traverses, the details of which appear below.

A. EVA Activity in Order of Priorities.

EVA-1	EVA-2	EVA-3
1. Collect rock and soil samples (55 min. minimal including arming MPA). (Spook Crater prime area.) 2. Deploy ALSEP according to priorities. 3. Obtain Deep Core 4. Deploy LSUC, CRD, and SWC. 5. Soil Mechanics include trench and penetrometer measurement.	1. Conduct field geology investigation with documented samples according to following station priorities: a. Base of Stone Mtn. (1 hour Minimum) b. South Ray Ray (30 min. Minimum) c. Stations in route to LM. 2. Soil Mechanics include trench and penetrometer measurement.	1. Conduct field geology investigation with documented samples according to following station priorities: a. North side of Palmetto Crater (45 min. Minimum) b. Around Palmetto Crater (1 hour Minimum) c. Stations in route to LM. 2. Retrieve CRD, LSUC, SWC.

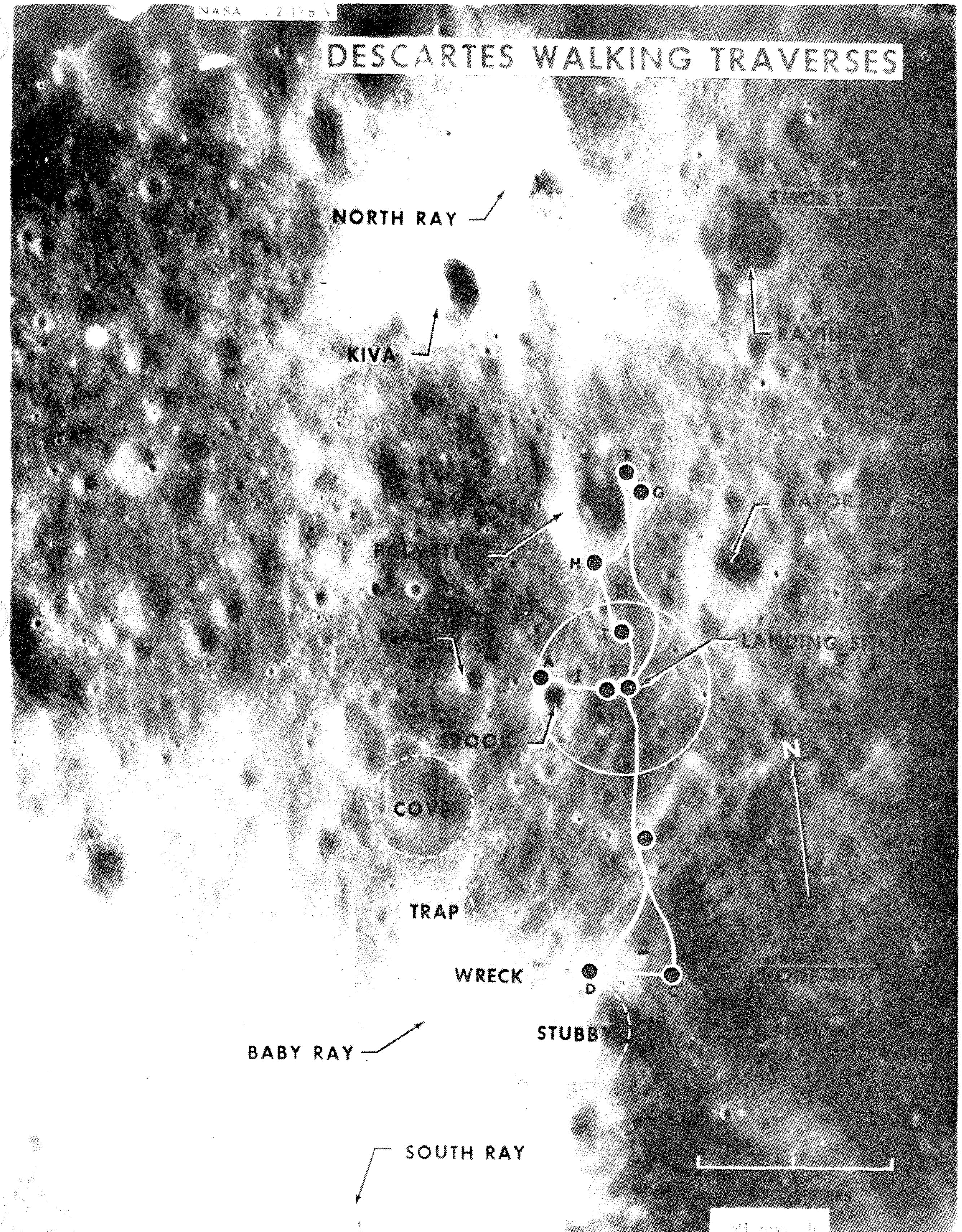
2.4 Walking Traverses (Continued)

B. ALSEP will be deployed in EVA-1; however, a minimum of 55 minutes will be reserved for sampling at the end of the EVA.

C. The LPM will be abandoned.

D. Maximum distance from LM for two walking crewmen is constrained to the time crewmen can return on BSLSS/OPR (low flow rate) at contingency walking speed of 3.6 Kph and is approximately 3.6 Km. The BLSS hose must be carried.

E. Soil Mechanics activities will be scheduled at the end of EVA-2.


NASA
DESCARTES WALKING TRAVERSES
NORTH RAY
KIVA
F
G
H
I
A
LANDING SI
N
COV
TRAP
WRECK
D
STUBB
BABY RAY
SOUTH RAY
Figure 4

2.5 Delayed EVA Timelines

During an EVA, the ground operations team must be prepared to make revisions to the planned EVA to accommodate "lost" time. This could happen as a result of several circumstances: Activities could simply take longer than estimated, an unscheduled traverse stop may have occurred because of some unanticipated item of scientific interest, or EMU consumables may be depleting faster than predicted so that the EVA duration will have to be reduced. In general, the priorities discussed in the appendix will be the guidelines for dealing with these cases. However, since there is a high likelihood of encountering the "behind time" situation, several cases have been preplanned in detail. These cases are presented in this section for each EVA.

Since EVA II and III both represent ambitious traverse objectives with little room for accommodating spillover tasks from EVA I, it will be important to try to accommodate behind time situations on EVA without impacting subsequent EVA's. This is accomplished insofar as possible by allowing the traverse time on EVA I to be reduced down to a minimum acceptable value while attempting to complete the planned ALSEP deployment. Beyond this point, portions of the ALSEP area operations are deferred to the end of EVA II.

A. General Guidelines

1. Activities deleted from EVA-1 should not be carried over to EVA-2 or EVA-3 unless they affect the ALSEP or Drill Activity or the LPM Site Measurement.

2. The LRV should be used at all times even though the rate approaches that of a walking astronaut.

3. LRV rates will be computed in real-time and applied to a plan plot which integrates real-time PLSS consumables data.

4. The order of priority for deleting activities on a shortened EVA-1 is as follows:

   - Reduce Geology activity down to a minimum of 55 minutes.
   - Delete the LPM experiment.
   - Reduce the thumper activity of the ASE to no less than 5. B
   - Delete the Deep Core Sample.
   - Delete ASE.
   - Delete ALSEP deployment down to a minimum of 1 hour, 30 minutes, then slip ALSEP to EVA-2.

2.6 Delayed Eva Contingency Considerations for North Ray (Stations 11, 12, and 13)

A. Operational constraints for walking from LRV

1. Communications:

a. LCRU only - OK to 500m from LRV; probably OK to 800m; degraded 800m to a few km } effect of boulders is unknown

b. LM - OK to several km but needs line of sight which will probably not be the case. Effect of boulders is unknown.

☘ Nature of comm. during walk from LRV will require real time decisions.

2. Life Support:

a. OPS only - 650m maximum from LRV (about 10 min. in lo-purge mode).

b. OPS + BSLSS - essentially a few km from LRV at North Ray.

☘ If more than 500m walk from LRV is expected, configure for carrying BSLSS.

B. Science constraints for North Ray ejecta sampling

1. If LRV cannot proceed through boulders:

a. Walking search for rim limited to 30 minutes behind nominal time line for arriving at station 11. If LRV is stopped over 400m from rim, consider its position as station 13.

i. Rim is found - leaves minimum of 1:00 hour sampling and photo time either at (1) rim or (2) combined rim and radial during walk back contingent upon boulder population observed on walk in vs. that observed at rim.

ii. Rim is not found - leaves minimum of 1:00 hour sampling and photo time during walk back contingent upon boulder population observed during walk in. Look for variety in boulders and radial distribution.

2. If LRV is not stopped by boulders but rim not easily located:

a. Limit driving search for rim to 30 minutes behind nominal time for reaching station 11.

2.6 Delayed EVA Contingency Considerations for North Ray (Stations 11, 12, and 13) (Continued)

i. Rim is found - leaves minimum of 1:00 hours sampling and photo time either at (1) rim or (2) combined rim and radial during drive back contingent upon boulder population observed on drive in vs. that found at rim.

ii. Rim is not found - leaves 1:00 hours minimum for sampling time on variety of boulders along radial distribution again contingent upon boulder population seen during driving.

Other possible problems to consider:

1. If rim is found late but before 30 min. constraint, consider making only one expanded rim stop and eliminating second stop at station 12 (particularly in walking configuration).

2. If LRV mobility is greatly diminished (below 3 km/hr) in ejecta blanket, consider dismounting and walking.

2.7 Delayed EVA Timeline for EVA's 1, 2 and 3

Behind time on EVA-1 with resultant effects on EVA's 2 and 3.

Behind Time	EVA-1	EVA-2	EVA-3	
0-30 min.	Nominal traverse with reduced sampling at stations 1 and 2.	No effect.	No effect.	B
30-60 min.	Delete station 1. Combine station 1 activity with station 2 activity. Station 3 unchanged.	No effect.	No effect.	B
60-90 min.	Same as above but drop Grand Prix at station 3. Delay LPM site meas. Delete 500mm. Reduce sampling at station 2. Reduce number of ASI firings to 5 minimum.	No effect.	No effect.	B B B
1 + 30 2 + 30	Same as above except delay activity to EVA-2 as follows: • Core Recovery • Core Drilling • 5 ASI Firings • MPA Deployment • ALSEP Photos • ASE Geophone Deployment	Accomplish all delayed tasks from EVA-1 at the end of EVA-2.	No effect.	B B B
>2 + 30	Delay ALSEP deployment to EVA-2. Retain at least 55 min. of Geology during EVA-1. Drop LPM as necessary to provide 55 min. of sampling time.	Deploy ALSEP at beginning of EVA-2.	No effect.	B

2.7 Delayed EVA Timeline for EVA's 1, 2 and 3 (Continued)

Behind time on EVA-2 with resultant effect on EVA-3.

Behind Time	EVA-2	EVA-3	
0-30 min.	• Delete station 7. • Reduce stations 4 and 5 stay time (≈15 min. total).	No effect.	
30-60 min.	• Same as above and • Delete station 9. • Reduce stations 4 and 5 stay time (≈15 min. total).	No effect.	B B
60-90 min.	• Same as above and • Delete stations 10 and 6. • Maintain 1 hour at stations 4 and 5 and 1 hour at station 8. • Consider moving planned EVA-2 traverse to EVA-3.	No effect	B B B
>90 min.	• Replan traverse to close by geological features.	Consider deleting EVA-3 planned activity and doing the planned EVA-2 activity instead.	

Behind time on EVA-3.

Behind Time	EVA-3
0-30 min.	• Delete station 15. • Reduce stations 11 and 12 stay time (20 min. total).
30-55 min.	• Same as above and • Reduce station 14 to 30 min. stay time. • Reduce station 17 stay time (15 min. total).
55-70 min.	• Same as above and • Delete station 13.
>70 min.	• Consideration should be given to reorienting the EVA to concentrate on only one of the two objectives depending on how well the Cayley and Descartes materials were investigated during EVA-1 and 2.

SECTION III

3.0 LUNAR MODULE SITE ACTIVITIES

TABLES

TABLE 3.1 MESA Deployment

EVENT NO.	CONTINGENCY	ACTION
1.	MESA does not deploy.	1. Try repeated pulls on release handle. 2. Grasp cable beyond bell crank and pull to deploy MESA. 3. Pull white lanyard and have second crewman pull "O" ring to release MESA. NOTE MESA is free to fall once latch has been released.
2.	Lanyard fails, MESA falls to lunar surface.	1. Block up MESA. NOTE Far UV Camera Pallet may be utilized for this task. 2. Tie up MESA if lanyard available.

TABLE 3.2 SRC Preparation

EVENT NO.	CONTINGENCY	ACTION
1.	Unable to open Sample Return Container (SRC).	1. Tap corners of SRC lid with available tools and attempt to pull lid free. 2. If forced to abandon either SRC #1 or SRC #2, use sample collection bags for sample storage and transfer the bags to LM ascent stage.
2.	SRC seal area dirty.	Use brush to clean seal.
3.	Unable to latch SRC.	1. Verify spacer has been removed. If not, remove. 2. Open SRC and check for interference. 3. If no interference, close and engage other strap latch. If this latch will rotate to within 30° of being closed, force closing by applying pressure on back of box. a. If this strap latches, try first latch again in the same manner. b. If the second latch will not latch, return to earth with the first latch closed. c. If still cannot latch at least one side, wrap lanyard around SRC or tap closed.

TABLE 3.3 ALSEP Offload

EVENT NO.	CONTINGENCY	ACTION
	3.3.1 SEQ Bay Doors	
1.	SEQ Bay door lanyards unusable.	1. Lanyard free from cable, pull cable. 2. Lanyard melted and fused to Inconel -- if unable to break free with hand, use hammer to free and pull cable.
2.	SEQ Bay doors will not open.	No cable movement (worse case), pry open astronaut protection door and fail mechanism. Pull lanyard. NOTE Doors can be unlatched and opened manually with minimum cable movement.
3.	SEQ Bay door partially closed.	1. Continue pulling on lanyard while second crewman assists in closing door. 2. Discontinue use of lanyard and manually close door, or use hammer to fail mechanism. NOTE SEQ Bay door should be closed to thermally insulate the LM. If door cannot be fully closed, use thermal blankets to close opening.

TABLE 3.3 ALSEP Offload (Continued)

EVENT NO.	CONTINGENCY	ACTION
	3.3.2 Subpackage Removal	
1.	Subpackage latching mechanism will not release.	1. If lanyard pulls loose or mechanism jams, remove thermal covering from bottom of SEQ Bay and move release mechanism lever forward. 2. Use hammer to pry outward from structure on right-hand link of latching mechanism forcing latch over center.
2.	Subpackage will not slide on rails.	Get assistance from second crewman.
3.	White portion of deployment lanyard will not release from base of subpackage.	Grasp release latch at base of subpackage and twist with an upward motion in an effort to break the latch or the slot or use scissors to cut lanyard.

TABLE 3.3 ALSEP Offload (Continued)

EVENT NO.	CONTINGENCY	ACTION
	3.3.3 ALSEP Traverse Preparation	
1.	ALSEP forward tool support pull pin jams.	1. Apply additional force on pin with hammer. 2. Pry bracket away far enough to gain access to the tools. 3. Remove UHT and DRT pins. Remove UHT's, and break off bracket where pin is jammed using hammer. NOTE ALSEP cannot be deployed without the FTT and one UHT.
2.	Tool carrier will not come off Subpackage #2.	1. Ensure Boyd bolts have been released. 2. Ensure tool carrier has been raised to clear mounting stud. 3. Apply additional force with hammer to force forward movement of the tool carrier. 4. If still unsuccessful, leave tool carrier on Subpackage #2. NOTE If tool carrier cannot be removed, RTG will not radiate heat evenly causing excessive heat buildup.

TABLE 3.3 ALSEP Offload (Concluded)

EVENT NO.	CONTINGENCY	ACTION
	3.3.3 ALSEP Traverse Preparation (Concluded)	
3.	Carry bar will not engage in subpackage keyhole socket.	1. Check mating bar to see if properly mated. Bar could be mated 180° out of phase. NOTE The carry bar is required for use as an antenna mast and must not be discarded or placed on the lunar surface. 2. Ensure flange on carry bar is free of debris; if not, clean by impact or with glove. 3. Ensure keyhole socket is clean; if not, clean with available tools. 4. If one or both sockets are unusable, carry subpackages in suitcase mode and transport carry bar on LRV.

SECTION IV

4.0 ALSEP SITE ACTIVITIES

TABLES

TABLE 4.1 Subpallet Removal

EVENT NO.	CONTINGENCY	ACTION
1.	Carry bar binds in keyhole socket on subpackage.	1. Ensure trigger release is operable. 2. Apply additional downward pressure while applying side loads to subpackage. 3. Request aid of second crewman to lift subpackage #1. 4. With second crewman's UHT, depress antenna lock and rotate subpackage #1 to separate masts. With single section attached to subpackage #2, continue as in step #2 above. 5. Use hammer to break carry bar off at keyhole socket. 6. Separate two carry bar sections and emplace subpackages #1 and #2 with carry bar section still attached on the lunar surface with handle toward the sun. NOTE The ALSEP antenna may be roughly aligned with the antenna aiming mechanism mounted on the Central Station sunshield.

TABLE 4.1 Subpallet Removal (Continued)

EVENT NO.	CONTINGENCY	ACTION
2.	Carry bar will not stow on subpallet taper fitting.	1. Examine carry bar for obstruction, dislodge obstruction by impact and restow carry bar on subpallet taper fitting. 2. Examine subpallet taper fitting for obstruction, dislodge obstruction with UHT or available tools and restow carry bar on subpallet taper fitting. 3. If taper fitting is unusable, stow carry bar on LRV or lean against subpallet.
3.	Unable to locate subpackage #1 10 feet from subpackage #2.	Locate subpackage #1 as far from subpackage #2 as possible and attempt to keep RTG out of field-of-view of Central Station radiator.
4.	Subpallet will not come off subpackage.	1. Ensure subpallet pull pin has been released. 2. Ensure Boyd bolts have been released. 3. Ensure that front of subpallet has been raised to clear the mounting stud. 4. Use hammer to force forward movement of subpallet or to break bracket or strut. 5. Leave subpallet on subpackage, but remove as much of related equipment as possible.

TABLE 4.1 Subpallet Removal (Continued)

EVENT NO.	CONTINGENCY	ACTION
5.	Subpallet binds or Boyd bolt(s) will not release.	NOTE Reference Figures 5, 6, and 7, pages 4-6, 4-7, and 4-8 for Boyd bolt positions on the subpackages. 1. Verify all Boyd bolts are released. 2. Use second UHT. 3. Force rotation of UHT to strip Boyd bolt threads. 4. Use hammer or available tools to apply an upward force on the opposite side of subpallet where the Boyd bolts are binding in an attempt to break Boyd bolts free. 5. If unable to release RTG cable reel Boyd bolts, tilt package on carry handle side, and utilize UHT to unwind cable manually to expose shorting plug. 6. If unable to release the Boyd bolts for the PSE sensor or stool, leave PSE on sunshield and deploy PSE/Central Station as one unit. Do not deploy PSE skirt. Force cable reel free from retainer bracket and deploy sufficient cable to allow sunshield deployment. NOTE PSE sensor can be placed directly on the lunar surface, if the PSE stool cannot be released. Experiment will be thermally degraded.

TABLE 4.1 Subpallet Removal (Concluded)

EVENT NO.	CONTINGENCY	ACTION
5.	Subpallet binds or Boyd Bolt(s) will not release. (Concluded)	7. If unable to release Boyd bolt(s) on HFE electronics or probe package, leave HFE electronics on sunshield and deploy HFE/Central Station as one unit. Rip probe containers apart with hammer or available tools. Retrieve emplacement tool and probes, and deploy probes. Reference Figure 8, page 4-18. 8. If unable to release Boyd bolt(s) on LSM, leave LSM on sunshield and deploy LSM/Central Station as one unit. NOTE LSM must be destroyed to whatever extent necessary to gain access to the ALSEP antenna which is stowed under the LSM. 9. If unable to release Boyd bolt(s) on ASE, use hammer to break shaft of T/G and attempt to retrieve MPA. Avoid damaging geophones and cable reel, and leave ASE on sunshield and deploy ASE/Central Station as one unit. 10. If unable to release Boyd bolt(s) on Central Station sunshield, leave sunshield in stowed position and continue ALSEP deployment.

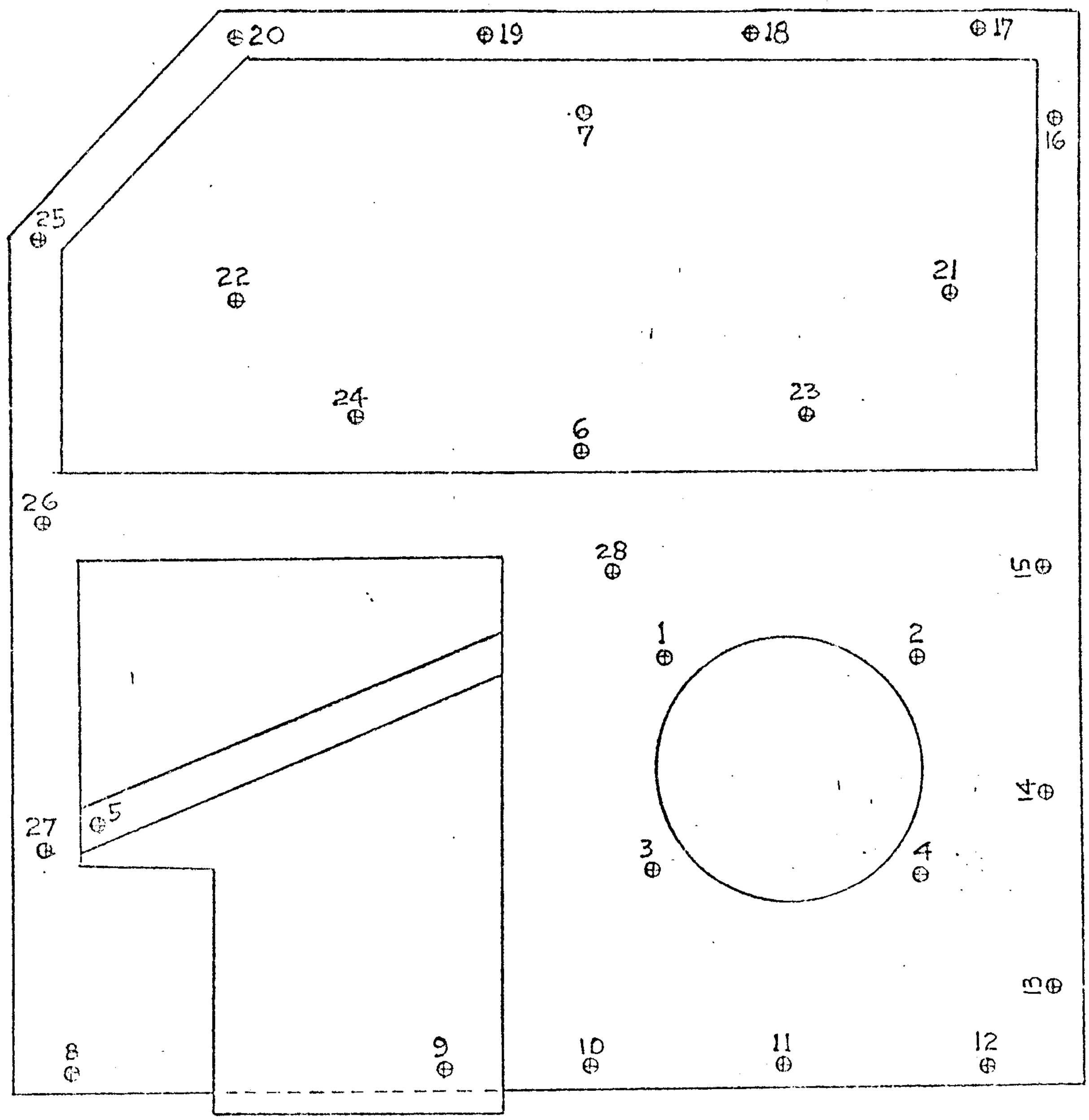


Figure 5 Subpackage No. 1 Boyd Bolt Location

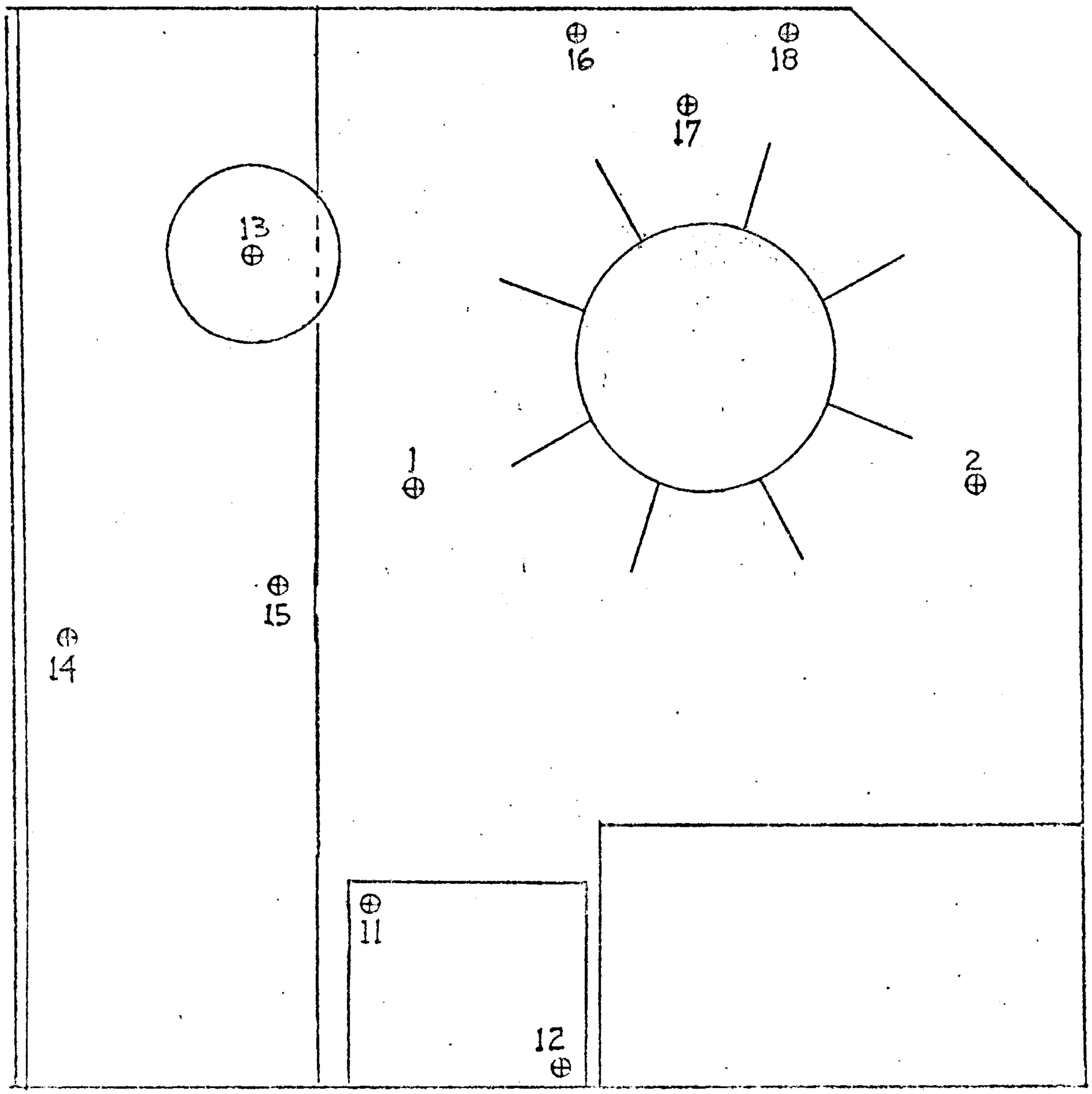


Figure 6 Subpackage No. 2 Boyd Bolt Location Identification

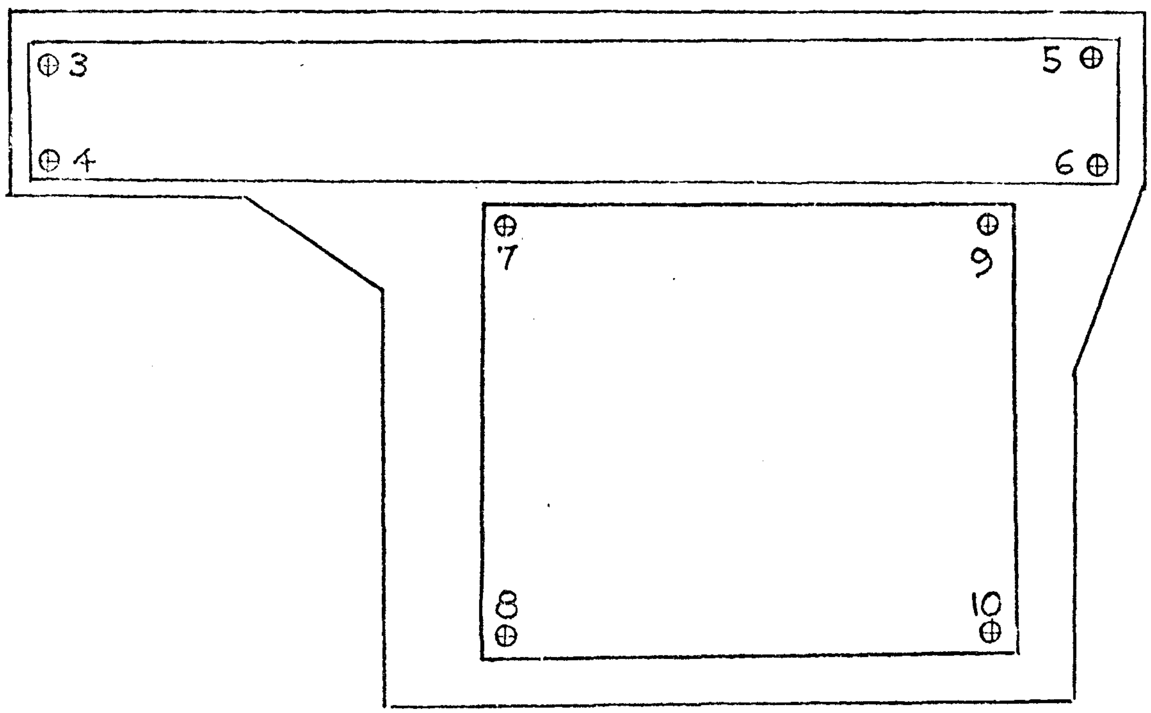


Figure 7 Subpackage No. 2, HFE Subpallet Boyd Bolt Location Identification

TABLE 4.2 RTG Cable Interconnect

EVENT NO.	CONTINGENCY	ACTION
1.	RTG cable reel tempilabel dots are all black.	**CAUTION** USE EXTREME CARE WHEN WORKING NEAR HOT RTG. DIRECT EXPOSURE TO TEMPERATURE IN EXCESS OF 250°F COULD DAMAGE SPACE SUIT. 1. Do not touch RTG cable reel, cable or shorting plug. 2. Use UHT handle to deploy RTG cable, release shorting plug pull pin and retrieve shorting plug. 3. Carry out RTG cable interconnect using available tools and materials. 4. If unsuccessful, stow shorting plug on subpackage #1 (in shade if possible) until temperature is below 250°F. 5. If shorting plug cannot be mated to Central Station (CS), separate plug from RTG cable and connect cable directly to the CS.
2.	UHT will not engage in RTG cable reel carry socket.	1. If first UHT will not engage, try second UHT in carry socket. 2. If UHT engagement fails, deploy by using handle of UHT. **NOTE** Do not deploy RTG cable reel manually if it can be avoided.

TABLE 4.2 RTG Cable Interconnect (Continued)

EVENT NO.	CONTINGENCY	ACTION
3.	Cable reel falls to the lunar surface.	1. Retrieve cable reel with UHT handle. Determine tempilabel temperature. If under 250°F, grasp reel assembly, connect UHT, and continue deployment. 2. If tempilabel indicates a temperature over 250°F, request the aid of the second crewman. Retrieve reel with UHT, deploy the cable, lay the reel assembly on subpackage #1, secure with UHT and continue deployment.
4.	Shorting plug pull pin does not release.	1. Apply additional force on pin or break pin with hammer. 2. Use hammer to break bracket. 3. Attempt to separate cable from shorting switch. 4. If shorting plug cannot be mated to Central Station, separate plug from RTG cable and connect cable directly to the CS. NOTE If ALSEP deployment is terminated anytime prior to Central Station activation, the RTG shorting plug reset lanyard must be pulled to assure the RTG is shorted.

TABLE 4.2 RTG Cable Interconnect (Continued)

EVENT NO.	CONTINGENCY	ACTION
5.	Shorting plug connector fails to engage and lock to Central Station (C/S).	1. Check shorting plug connector for proper orientation. 2. Check both connectors for debris on pins or Central Station receptacle. 3. Depress outer flange of shorting plug connector to ensure proper function. 4. Reconnect, applying additional downward pressure on the flange assembly. Second crewman can aid by holding PLSS. 5. Manually separate the shorting plug from the RTG cable, discard and connect RTG cable directly to Central Station. NOTE If RTG cable connector cannot be mated to Central Station, abandon ALSEP.
6.	Ampere gauge unreadable or arrow is at zero after plug in (no movement).	1. Report condition but do not pull shorting switch pull ring. NOTE Shorting switch has probably been depressed which powers up ALSEP. Pulling lanyard will remove power and when subsequently powered again, ALSEP will have switched PCU's. 2. Continue ALSEP deployment

TABLE 4.2 RTG Cable Interconnect (Concluded)

EVENT NO.	CONTINGENCY	ACTION
7.	Shorting switch depressed but ammeter shows no drop in amperage.	1. Reset the switch, and redepress. 2. Apply additional force to shorting switch and note if amperage drops. 3. Disconnect shorting plug from Central Station. Separate shorting switch from the RTG cable and connect RTG cable to Central Station.
8.	Shorting plug engages, but falls off when subpackage is rotated.	1. Return subpackage to vertical position, retrieve cable, remove debris and remate connectors. 2. Ensure locking mechanism is fully forward.

TABLE 4.3 Passive Seismic Experiment

EVENT NO.	CONTINGENCY	ACTION
1.	Unable to deploy PSE stool 10 feet east of Central Station.	Locate PSE stool as far from Central Station and other experiments as possible. NOTE If sensor cannot be deployed in full sunlight, avoid placing the PSE sensor in an area where shadows cover only part of the sensor.
2.	UHT will not engage in PSE carry socket or experiment falls off of UHT.	1. If first UHT will not engage, try second UHT in carry socket. 2. If the PSE is accidentally triggered from UHT, retrieve cable using UHT and lift experiment with cable. Secure mounting lug (tab) with hand and re-engage UHT in socket. 3. If UHT engagement fails, deploy manually or remove girdle, partially open shroud/skirt assembly and manually emplace experiment using gnomon. NOTE Reduced alignment accuracy will occur if gnomon is handled. At 1/6 gravity, the skirt should not unfold and cause interference.
3.	Experiment falls off PSE stool while leveling after skirt fully deployed.	Retrieve experiment with UHT handle hooked into gnomon opening and lift experiment. Relevel and align.

TABLE 4.3 Passive Seismic Experiment (Concluded)

EVENT NO.	CONTINGENCY	ACTION
4.	Thermal shroud will not lay flat at outer edge.	Place discarded ALSEP parts such as Boyd bolts or small lunar rocks on shroud edge. NOTE Avoid placing large objects or dirt on shroud, if possible.
5.	UHT punctures thermal shroud during leveling sequence.	Remove UHT from puncture and smooth thermal skirt at puncture to cover as much of the opening as possible.

TABLE 4.4 Heat Flow Experiment

EVENT NO.	CONTINGENCY	ACTION
	4.4.1 HFE Deployment	
1.	Astromate connector will not come out of stowage assembly.	1. Apply additional force. 2. Obtain assistance from second crewman. 3. Use hammer to break bracket. NOTE If astromate connector cannot be removed from stowage assembly, abandon HFE deployment.
2.	Astromate connector fails to engage and lock.	1. Check connector for proper orientation. 2. Check connectors on cable and Central Station for debris and bent pins. 3. Remove debris. 4. Ensure flange is free to travel to the lock position. 5. Reconnect. NOTE If astromate connector cannot be mated to Central Station, abandon HFE deployment.

TABLE 4.4 Heat Flow Experiment (Continued)

EVENT NO.	CONTINGENCY	ACTION
	4.4.1 HFE Deployment (Continued)	
3.	Unable to deploy heat flow experiment electronics thirty feet from Central Station.	1. Deploy electronics as far as possible from the Central Station, staying as far as possible from the RTG. 2. Probe should be placed in bore hole pattern as shown in Figure 8, page 4-18.
4.	UHT will not engage in HFE carry socket.	1. Use second UHT. 2. If UHT engagement fails, deploy manually. Carry experiment to deployment site by holding the leg.
5.	Crewman walks too far and jerks Central Station.	1. Carry HFE subpallet back toward Central Station to provide slack cable and continue deployment of HFE. 2. Check cable and connectors of experiment and Central Station interfaces for visible sign of damage.
6.	HFE subpallet strut will not collapse.	1. Apply additional force. Use hammer if necessary. 2. Continue HFE deployment with strut uncollapsed.
7.	Unable to deploy HFE Probe Package 16 feet minimum east and west of HFE Electronics Package.	Locate HFE Probe Package as far from RTG, Central Station and other surface experiments as possible.

TABLE 4.4 Heat Flow Experiment (Continued)

EVENT NO.	CONTINGENCY	ACTION
	4.4.1 <u>HFE Deployment (Concluded)</u>	
8.	Crewman walks too far and jerks HFE Electronics Package.	1. Carry HFE Probe Package back toward HFE Electronics Package to provide sufficient slack cable for probe emplacement. Continue deployment of HFE. NOTE Orange and black marker at 16' on probe cable. 2. Check cable and connector at HFE Electronics Package interface for visible signs of damage.

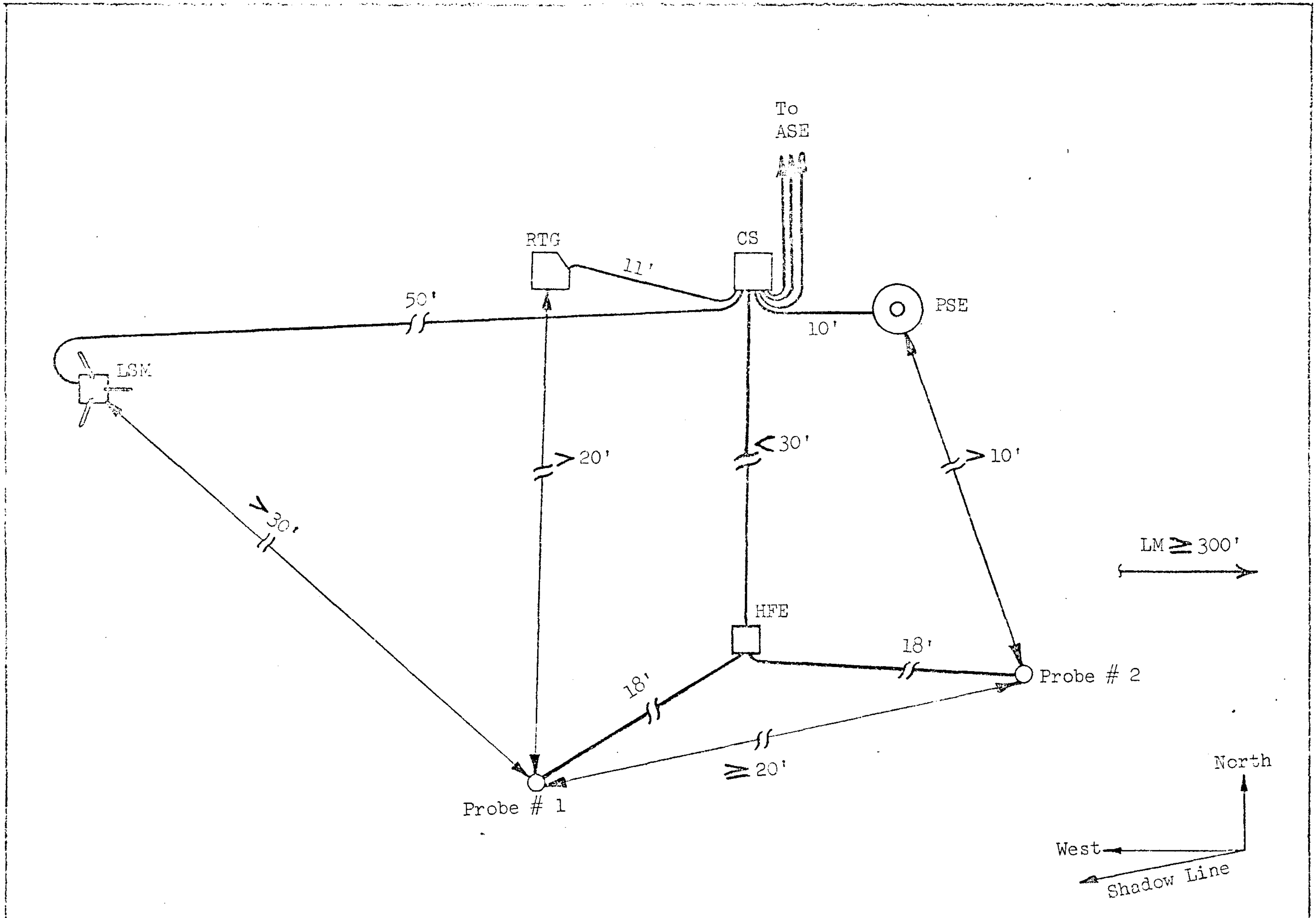


Figure 8 Contingency Deployment Pattern for HFE

TABLE 4.4 Heat Flow Experiment (Continued)

EVENT NO.	CONTINGENCY	ACTION
	4.4.2 Drill Operation	
1.	Temporary delay period exceeding 30 minutes in ALSD operations.	Place drill on lunar surface with battery end down and oriented such that the back of the battery is directed toward the sun. Do not place ALSD in a shaded area. If sun angles are in the range of 9 to 22 degrees, the thermal shroud should be attached before placing on the lunar surface.
2.	Handle assembly fails to lock properly to battery.	1. Verify handle is free of interference and properly aligned. 2. Verify that fixed pin is fully engaged and force handle to locked position. 3. With the aid of the second crewman, attempt drilling operation without the handle.
3.	Power head does not operate during pre-deployment test (no spindle rotation).	1. Remove power head from treadle outbound stowage and recheck operation. 2. Put bore section in spindle and apply torque CW. 3. Tap on power head spindle "axially." 4. Abandon drill and proceed to section 4.4.3, event 1, page 4-22.
4.	Power head bracket jams causing difficulty in removal from the treadle.	Grasp spindle with left hand and press down on treadle with thumb.

TABLE 4.4 Heat Flow Experiment (Continued)

EVENT NO.	CONTINGENCY	ACTION
	4.4.2 Drill Operations (Continued)	
5.	Difficulty in drilling hole. a. Hard lurain b. Spindle fails to turn but impacts normally (clutch failure). c. Spindle rotates but does not impact (energy spring failure).	1. If drilling rate is < 5 in./min. and hole is less than 40 inches deep, remove drill and move 3 feet to new location. 2. If unsuccessful, repeat step 1 up to 2 new locations. 3. If unsuccessful at third location, continue drilling until 10 minutes power-on-time has elapsed per HFE bore hole. NOTE If crewman is drilling on first hole, then proceed to second hole after completing step #3. If drilling on second hole, proceed to coring operation after completion of step #3. 4. If unable to obtain hole greater than 40 inches deep, proceed to section 4.4.3, event 1, page 4-22.
6.	Unable to add additional stem section.	1. Check axial alignment and attempt rearrangement. 2. Inspect male joint for foreign material and clean. 3. Add new stem sections and repeat steps 1 and 2 until engagement. 4. If unsuccessful in mating, use wrench or power head for additional torque.

TABLE 4.4 Heat Flow Experiment (Continued)

EVENT NO.	CONTINGENCY	ACTION
	4.4.2 Drill Operations (Concluded)	
7.	High torque exists during drilling operations	Continue drilling. **NOTE** Slip clutch will prevent excessive torque from overpowering astronaut.
8.	Power head runs slowly.	1. Tap relief valve with hammer or wrench. 2. If unsuccessful, continue drilling if drill rate is > 5 in./min. 3. If drill rate < 5 in./min., continue drilling for 10 minutes power on time.
9.	Bore stem binds on power head and backdrives spindle/drive train before breaking loose.	1. Hit joint with a hammer. 2. Remove top joint from rest of Bore stem, screw core stem adapter into Bore stem and drill core hole. 3. Remove core stem adapter from Bore stem, insert second Bore stem string, place in core hole and complete second Bore stem drilling. **NOTE** This procedure prevents the Bore string from becoming too long with the bound up Bore section still attached to the power head.

TABLE 4.4 Heat Flow Experiment (Continued)

EVENT NO.	CONTINGENCY	ACTION
	4.4.3 <u>Probe Emplacement</u>	
1.	Drill inoperable.	1. Hand auger the bore stems into the subsurface combined with hammering of the bore stems. Place the probe inside the bore stem. **NOTE** One 28-inch bore stem section should be used exclusively for pounding. This is to preserve the threaded joints on the stems. 2. If unsuccessful, insert the probe into a hole made by a double or triple core tube. Apply force to the top of the probe for better penetration into the subsurface. Not more than 10 lbs. of force should be exerted to prevent damage to the probe. Fill hole around probe. 3. If unable to obtain a depth $>$ 40 inches, then dig trench approximately 4 feet long sloping from one-inch depth at one end to approximately 18 inches at the other end. Lay probe in tandem along the bottom of the trench and cover probe and the first two feet of the cable with lunar soil. 4. If unsuccessful in digging trench, lay probe and cable on top of lunar surface and cover probe with loose soil.
2.	Possible to drill only a shallow bore hole.	1. If the first section or more of bore stems are drilled into the lunar surface, emplace heat flow probes into bore holes. 2. Make careful measurement with the emplacement tool to determine the depth of hole and probe emplacement. 3. If first section of bore stem cannot be completely drilled into the lunar surface, use available tools to make deepest possible trench for emplacement of probes. (Refer to section 4.4.3, event 1).

TABLE 4.4 Heat Flow Experiment (Concluded)

EVENT NO.	CONTINGENCY	ACTION
	4.4.3 Probe Emplacement (Concluded)	
3.	Emplacement tool collapses while driving probe into bore hole.	1. Withdraw emplacement tool. Re-extend and lock the tool and resume driving probe into bore hole. 2. If emplacement tool collapses again, discard tool, insert probe into bore hole as far as possible and report to MCC.
4.	Obstructions in the bore stem prevent complete insertion of probe.	CAUTION DO NOT USE EMPLACEMENT TOOL TO CLEAR OBSTRUCTIONS FROM HOLE UNTIL ONE PROBE HOLE/ASSEMBLY HAS BEEN COMPLETED. 1. Use emplacement tool to clear obstruction from the hole, then insert probe. Probe can safely be pulled with a force up to 30 lbs. 2. If unsuccessful, abandon effort and report depth of insertion.
5.	Heat flow probe does not lock on bottom "Hook" of first bore stem.	1. Apply downward pressure to engage hook. 2. Emplace probe as deep in stem as possible with opposite end of emplacement tool and read depth on emplacement tool.
6.	Unable to drill HFE hole with bore stems.	1. If unable to obtain a HFE hole greater than 40 inches deep into the subsurface with the bore stems at either probe locations, then proceed to drill the deep core at probe #1 location. Using the treadle and extractor, remove the deep core and insert the probe through the treadle into the deep core drill hole. Care must be taken that the treadle does not shift when removing the stem or emplacing the probe. 2. To obtain the second HFE probe hole, proceed as outlined in section 4.4.3, event 1.

TABLE 4.4 Heat Flow Experiment (Continued)

EVENT NO.	CONTINGENCY	ACTION
	4.4.4 Core Operations	
1.	Core sections do not engage at male/female connections.	1. Check axial alignment. 2. Inspect male joint for foreign material. 3. Add new stem section and repeat steps 1 and 2. 4. If unsuccessful in mating by hand, use wrench or power head for additional torque.
2.	Power head spindle binds on male end of core stem after drilling.	1. Extract core with power head attached by using the alternate extractor method of laying the treadle beside the stem instead of placing it over the stem. 2. Use the vise/wrench at the LRV to separate the core stems. a. Remove bottom three core stems as usual. b. Remove the next two stems together and cap. c. Leave top stem attached to power head and discard.
3.	Core stems do not disengage at male/female connections.	1. Bypass failed joint and disengage at next male/female connection. 2. Tap core stem joint with hammer.
4.	Wrench fails to grip the core stem.	1. Use second crewman to hold stem if still in drilling operation. 2. If drilling is completed, use LRV vise and treadle locking pawl to separate stems.

TABLE 4.4 Heat Flow Experiment (Concluded)

EVENT NO.	CONTINGENCY	ACTION
	4.4.4 Core Operations (Concluded)	
5.	Vise fails to grip core stem.	Use wrench and treadle locking pawl at the LRV to separate stems.
6.	Extractor stroke is excessively short.	1. Insure core puller is engaging stem. 2. Attempt to use extractor to get stem started out of the ground and then use second crewman to lift it the rest of the way.
7.	Reconnection of core stem after subsurface decoupling.	Carefully insert the emplacement tool into the hole to serve as an alignment mandrel. Place core stem over emplacement tool and carefully lower stem section into subsurface and recouple core stem sections.

TABLE 4.5 Lunar Surface Magnetometer Experiment

EVENT NO.	CONTINGENCY	ACTION
1.	Upper support bracket handle does not deploy.	1. Use the UHT to pry handle into the upright position for grasping. 2. Apply tension to the center lanyard with glove or UHT to release "pip pin" at the Electronic Gimbal Flip Unit. 3. If successful, apply tension to other two lanyards to release "A" frame swing brackets from the Electronic Gimbal Flip Unit. NOTE The forward bar bracket upper and lower sections can be separated later after removal from subpackage #1. 4. Use hammer to break bracket to gain access to ALSEP antenna. 5. Leave LSM on sunshield and deploy LSM/Central Station as one unit.
2.	Unable to deploy LSM 50 feet southwest of CS.	1. Locate LSM at least 10 feet from nearest HFE probe and as far from CS and RTG as cable permits and attempt to keep RTG out of LSM Parabolic Reflector Array field-of-view. 2. Attempt not to run LSM cable along with and in contact with another cable.

TABLE 4.5 Lunar Surface Magnetometer Experiment (Concluded)

EVENT NO.	CONTINGENCY	ACTION
3.	Unable to deploy or lock legs.	1. If spring-loaded legs do not self-deploy after removal of forward bracket, deploy by hand. 2. As a last resort, lay the Electronic Gimbal Flip Unit flush on the lunar surface and attempt leveling. NOTE Dust should not be above the PRA. 3. If leg fails to lock or fully deploy, apply additional force on leg in an attempt to lock. 4. If unsuccessful, continue turning leveling screws CCW until legs permit the Electronics Gimbal Flip Unit to be flush on the lunar surface and then attempt leveling the unit.
4.	Parabolic Reflector Array cover binds or cannot be removed.	1. Verify that release pin has been pulled and remove cover by grasping lanyard. 2. Use hammer or available tools to forcefully remove cover. 3. If unsuccessful, leave cover in place.

TABLE 4.6 Active Seismic Experiment

EVENT NO.	CONTINGENCY	ACTION
	4.6.1 Thumper/Geophone (T/G) Offload	
1.	T/G restraining arm will not rotate.	1. Force T/G restraining arm rotation. 2. Use hammer to jar or break restraining arm. 3. Continue ASE deployment with T/G on plate assembly. NOTE Thumper activity would be lost, but geophones and mortar package would still be functional.
2.	T/G section will not lock.	1. Obtain aid of second crewman to force T/G to deployed position. 2. Use hammer to jar or force unfolding. Avoid damaging Thumper/Geophone. 3. Continue ASE deployment with T/G sleeve unlocked.

TABLE 4.6 Active Seismic Experiment (Continued)

EVENT NO.	CONTINGENCY	ACTION
	4.6.2 Mortar Package Assembly (MPA) Deployment	
1.	Switch #5 cannot be turned CW to OFF position.	1. Report to MCC. 2. Apply additional force to switch. 3. If unable to turn switch #5, report to MCC but do not remove MPA safety rod or arm MPA until MCC confirms that it is safe to continue.
2.	UHT will not engage in MPA carry socket.	1. Use second UHT. 2. Deploy manually using legs to lower MPA to surface. NOTE Do not use antenna as a handle.
3.	MPA binds during removal from sunshield.	1. If unable to remove, leave MPA on sunshield and deploy MPA/Central Station as one unit. NOTE MPA and Central Station thermal control and science will be degraded. Thumper activity will not be affected. 2. Use UHT to unreel sufficient cable to permit sunshield deployment. 3. Cut or break MPA cable or break connector to deploy sunshield.

TABLE 4.6 Active Seismic Experiment (Continued)

EVENT NO.	CONTINGENCY	ACTION
	4.6.2 Mortar Package Assembly (MPA) Deployment (Continued)	
4.	MPA pallet will not come off subpackage or unable to deploy pallet.	1. Verify all pins are released. 2. Ensure that front of MPA pallet has been raised 3/8 inch to clear mounting stud. 3. Use hammer to force upward movement of the MPA pallet. 4. If MPA pallet cannot be removed, deploy MPA on lunar surface and remove PSE stool after subpackage is rotated to the ground. NOTE Without the use of the MPA pallet, the MPA should be deployed in the same manner as the Apollo 14 MPA. Extend and lock the MPA legs and position the MPA on the lunar surface in the same orientation as required with the pallet. The aiming and firing accuracy after firing may be degraded. 5. Remove geophone cable anchors and flags from pallet.
5.	Unable to deploy MPA 58 feet north of Central Station.	Locate MPA as far north from Central Station and PSE as possible. Attempt to keep PSE and Central Station to the front of MPA, and out of the MPA discharge area (See Figure 9; Page 4-35.)

TABLE 4.6 Active Seismic Experiment (Continued)

EVENT NO.	CONTINGENCY	ACTION
	4.6.2 <u>Mortar Package Assembly (MPA) Deployment</u> (Continued)	
6.	Surface too hard to properly push MPA pallet stakes into.	<u>NOTE</u> Do not unfold stakes from pallet. Once stakes are deployed, crewman cannot refold them. 1. Build up lunar surface for pallet to rest on. 2. Assure pallet has soil under entire surface. 3. Assure surface slope that pallet rests on is less than 5°. 4. If stakes are deployed and will not fully insert into surface, move MPA/pallet around in general area to find a softer surface if possible.
7.	MPA leg does not deploy or lock.	1. Apply additional force to deploy and lock leg. 2. Place MPA on lunar surface.
8.	MPA RF cable jams in canister.	1. Retrieve canister and remove velcro strap, retaining canister clam shells. (Clam shells should separate by themselves.) 2. If clam shells do not separate, grasp canister by ring and tug cable near exit in order to open clam shells.

TABLE 4.6 Active Seismic Experiment (Continued)

EVENT NO.	CONTINGENCY	ACTION
	4.6.2 Mortar Package Assembly (MPA) Deployment (Concluded)	
9.	Safety rod release latch will not release.	1. Use second UHT. 2. Force rotation with UHT. 3. Retrieve lanyard and remove safety rods. 4. If unsuccessful, abandon MPA deployment.
10.	Mortar package safe/arm switch jams.	1. Use second UHT. 2. If switch will not rotate, turn switch #5 CCW to ON position and return to LM. NOTE Mortar package will not fire unless both the safe and arm switches are rotated and switch #5 is CCW to ON position.

TABLE 4.6 Active Seismic Experiment (Continued)

EVENT NO.	CONTINGENCY	ACTION
	4.6.3 Geophone Deployment	
1.	Cable anchor will not unfold or lock.	1. Use hammer to jar anchor or force sleeve to lock. 2. Use second anchor in first cable loops and geophone flag at second cable loop. 3. If both anchors cannot be used, use geophone flags at cable loops and continue geophone deployment but ensure all geophones are embedded prior to thumper activity. NOTE Exercise caution during geophone deployment to avoid putting any strain on Central Station connectors, geophones or cables.
2.	During deployment, the cable becomes suspended between crater rim edges.	1. If crater is less than 2 feet in depth, continue deployment. NOTE The geophone cable should not suspend across crater rims greater than 2 feet in depth. A suspended cable could pull a geophone out of the lunar surface. 2. If possible, place geophones on the rim or outside the crater area.

TABLE 4.6 Active Seismic Experiment (Concluded)

EVENT NO.	CONTINGENCY	ACTION
	4.6.4 Thumper Activity	
1.	An Apollo Standard Initiator (ASI) does not fire.	1. Verify that the proper ASI has been selected. 2. Rotate selector switch back one position, then forward to initial position and report firing sequence. NOTE Ensure that 4 seconds have passed after turning the arm/fire switch and before the switch is depressed. 3. Move to next thumping site. Do not substitute ASI's in the event of an ASI failure at a site. Continue until each ASI has been tried or fired.
2.	Thumper has to be fired in small crater or on slope.	Maintain a constant firing distance from marked position. NOTE Ensure thumper base plate is flush with the lunar surface prior to firing.

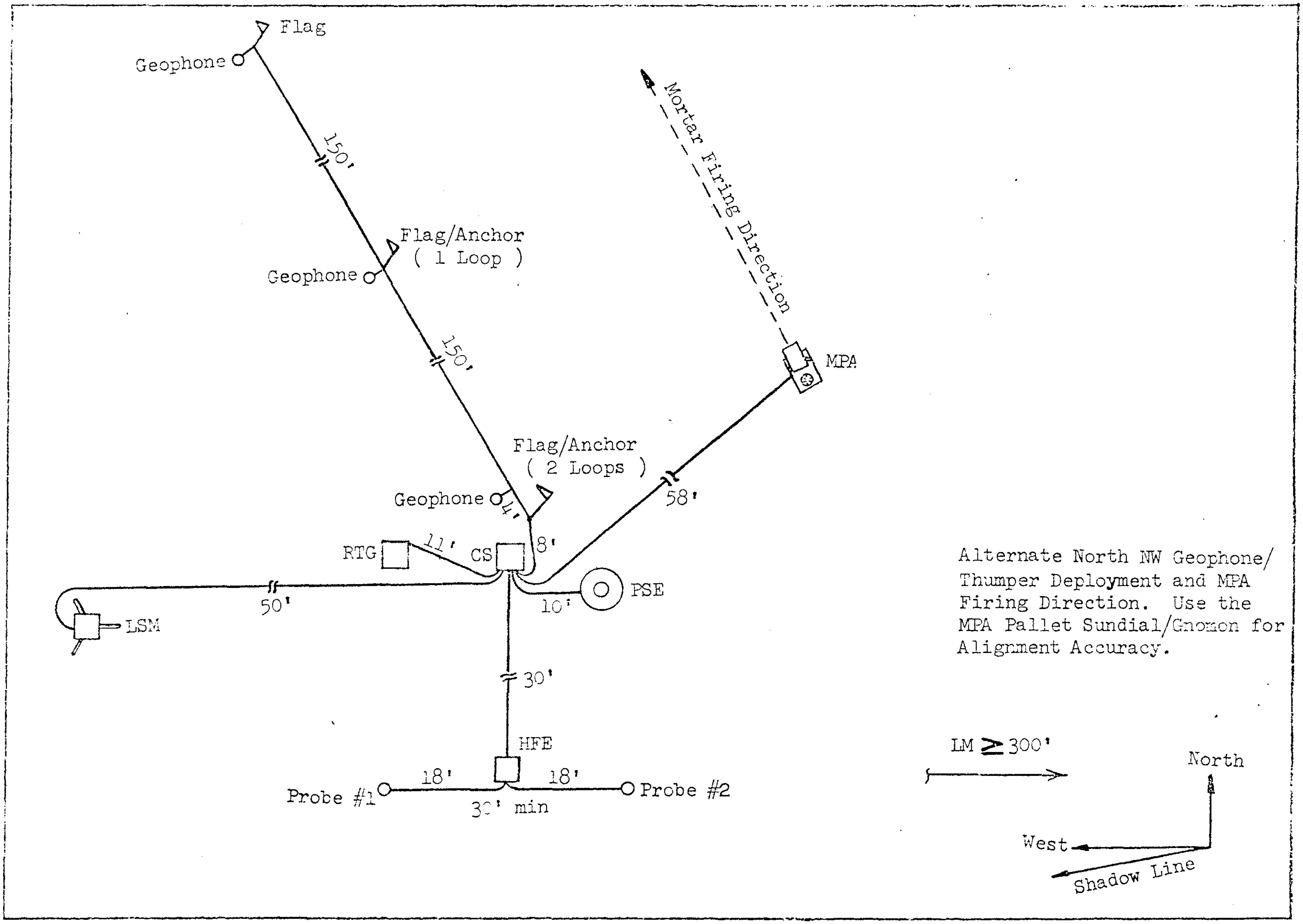


Figure 9 Contingency Deployment Pattern for ASE

TABLE 4.7 Central Station

EVENT NO.	CONTINGENCY	ACTION
1.	Central Station sunshield binds.	1. Verify that thermistor cable, curtain covers or thermal curtains are not jammed and ALSEP antenna cable is clear of sunshield. If jammed, release with UHT handle. 2. Verify that the guy wire is not preventing sunshield extension. If so, fail the tufbraid in order to permit sunshield extension. 3. Use hammer to force sunshield free. 4. Leave sunshield in stowed condition. Gain access to antenna mass bracket. 5. If unsuccessful, mount antenna aiming mechanism on sunshield.
2.	CS sunshield not fully deployed.	1. Verify guy wires are taut. 2. If front extender cannot be fully extended, gently press downward on rear of sunshield to level sunshield and increase size of opening, front side of Central Station. NOTE Do not press downward on front of sunshield since Central Station thermal control would be degraded.
3.	RF antenna cable reel lanyard breaks or pin jams.	1. Use handle of UHT to hook restraining brackets. Bend or break restraining brackets off the sunshield. 2. Deploy cable using UHT.

TABLE 4.7 Central Station (Continued)

EVENT NO.	CONTINGENCY	ACTION
4.	UHT will not engage in aiming mechanism housing carry socket.	Use second UHT or deploy manually.
5.	Aiming mechanism housing will not come off sub-pallet.	1. Verify Boyd bolts have been released. 2. Use second UHT. 3. Force rotation of UHT to strip Boyd bolt threads. 4. If unsuccessful, use hammer to break housing off mounting legs to gain access to aiming mechanism. 5. If unable to gain access to aiming mechanism, mount antenna on Central Station sunshield and point toward earth.
6.	Antenna mast will not seat in bracket on Central Station.	1. Examine antenna mast for obstructions. 2. Use hammer to apply additional force. 3. If antenna mast is partially seated, continue with nominal deployment sequence. 4. If antenna mast cannot be seated in bracket or is unstable, mount aiming mechanism and antenna on sunshield. 5. Adjust antenna and aiming mechanism as required in real time.

TABLE 4.7 Central Station (Concluded)

EVENT NO.	CONTINGENCY	ACTION
7.	Aiming mechanism will not seat on antenna mast.	1. Examine antenna mast for obstruction. 2. If aiming mechanism is partially seated and stable, continue with nominal deployment. 3. Examine antenna mast for damage. If damaged, mount aiming mechanism and antenna on sunshield.
8.	Antenna will not seat on aiming mechanism.	1. Ensure cable outlet is properly oriented. 2. Check for obstructions. 3. If antenna is partially but firmly seated on aiming mechanism, continue with nominal deployment. 4. Examine antenna and aiming mechanism for damage. If damaged, mount antenna on sunshield and adjust as required in real time.

TABLE 4.8 ALSEP Activation

EVENT NO.	CONTINGENCY	ACTION
1.	ALSEP deployment time becomes constrained.	Level and align the antenna. Actuate the RTG shorting switch and ASTRO switch No. 1. NOTE If none of the experiments have been deployed and no second EVA is planned, do not activate Central Station.
2.	Switch #1 cannot be turned CW to ON position.	1. Verify that switch is in CCW position. 2. Apply additional force to switch. 3. Report to MCC and continue ALSEP deployment.
3.	Switch #5 cannot be turned CCW to ON position.	1. Verify that switch is in CW position. 2. Apply additional force to switch. 3. Report to MCC and continue ALSEP deployment. NOTE MPA will not fire unless switch #5 is in CCW (ON) position.
4.	Central Station Contingency antenna alignment.	1. Point antenna in general direction of earth. 2. Adjust antenna pointing angle in small increments. 3. Perform required offsets under MCC direction.

TABLE 4.8 ALSEP Activation (Concluded)

EVENT NO.	CONTINGENCY	ACTION
5.	ALSEP turn on.	1. Initiate ON command. 2. If no response, advise astronaut to turn on transmitter by actuating ALSEP back-up switch No. 2. 3. If transmitter is still not functioning, actuate back-up switch No. 3 (experiments will energize sequentially). 4. Verify antenna is properly oriented, Central Station is properly leveled and aligned, and RF cable and connectors are intact. 5. If ammeter indicates a non-zero reading, disconnect shorting plug from Central Station, separate shorting plug from the RTG cable and connect RTG cable connector to Central Station. 6. Notify crew to adjust antenna pointing angle in small increments. 7. Request data through a site with 85-foot antenna. 8. Select "Low Bit Rate." 9. If signal is too weak to yield useful data, notify crew to complete remainder of ALSEP deployment.
6.	ALSEP fails to respond to high bit rate command.	1. Turn switch #4 CW to ON. 2. Verify switch #5 is turned CCW to ON. 3. If no change in data rate, abandon thumper activity but complete remainder of ALSEP deployment.

TABLE 4.8 ALSEP Activation (Concluded)

EVENT NO.	CONTINGENCY	ACTION
5.	ALSEP turn on.	1. Initiate ON command. 2. If no response, advise astronaut to turn on transmitter by actuating ALSEP back-up switch No. 2. 3. If transmitter is still not functioning, actuate back-up switch No. 3 (experiments will energize sequentially). 4. Verify antenna is properly oriented, Central Station is properly leveled and aligned, and RF cable and connectors are intact. 5. If ammeter indicates a non-zero reading, disconnect shorting plug from Central Station, separate shorting plug from the RTG cable and connect RTG cable connector to Central Station. 6. Notify crew to adjust antenna pointing angle in small increments. 7. Request data through a site with 85-foot antenna. 8. Select "Low Bit Rate." 9. If signal is too weak to yield useful data, notify crew to complete remainder of ALSEP deployment.
6.	ALSEP fails to respond to high bit rate command.	1. Turn switch #4 CW to ON. 2. Verify switch #5 is turned CCW to ON. 3. If no change in data rate, abandon thumper activity but complete remainder of ALSEP deployment.

SECTION V

5.0 LUNAR SURFACE EXPERIMENTS (NON-ALSEP)

5.1 Lunar Portable Magnetometer (LPM)

5.2 Cosmic Ray Detector Sheets

5.3 Far UV Camera Spectroscope

5.4 Solar Wind Composition (SWC)

TABLE 5.1 Lunar Portable Magnetometer (LPM) Experiment

EVENT NO.	CONTINGENCY	ACTION
1.	Tripod leg does not lock in extended position.	1. Press down on extension leg retaining spring to force it behind the extended leg, locking it in place. 2. Bend defective leg slightly or drag it in the soil to bind it in the extended position. 3. Remove the sensor head from the tripod and place on as level surface as is possible.
2.	The flat cable will not deploy from the cable reel.	1. Rotate the cable reel crank arm in the cable stowage direction until winding resistance is noted. Attempt to deploy cable again. If unsuccessful, abandon experiment. 2. If the full length of cable is not deployed, describe the approximate distance. (If possible, utilize TV to show cable deployment.)
3.	The tripod U channel retaining clip does not engage.	Maintain a grasp on the sensor head during tripod leveling and alignment.
4.	Cable stowage not possible because: a. Crank arm not operable. b. Cable binds in reel. c. Lack of EVA time.	1. Place the reel in its normal location and drape the ribbon cable either over the pallet behind the seats or between the tool carrier and pallet. 2. If cable will not stay in place on LRV, rip cable loose from LRV with scissors or available tools and abandon experiment.

TABLE 5.1 Lunar Portable Magnetometer (LPM) Experiment (Concluded)

EVENT NO.	CONTINGENCY	ACTION
5.	Loss of one sensor a. Inconsistent readings between each of the three separate measurements at stop. b. Noncomplementary readings at the site survey.	1. If Y or Z axis, make two readings at each stop. One with the tripod and sensor head in the normal orientation and one with the tripod rotated 90 degrees CW from the normal position. 2. If X axis, make two readings at each stop, one with the tripod and sensor head in the normal orientation and one with the sensor head rotated on its side with the #3 sun decal next to the bubble level.
6.	Temperature indicator on electronics box > 130°F.	No crew action. Proceed with normal deployment and timeline. Temperature readings are for data calibration purposes only.

TABLE 5.2 Cosmic Ray Detector (Sheets)

EVENT NO.	CONTINGENCY	ACTION
1.	Dust covers panels or panel temperature indicators > 130°F.	1. Pull lanyard to shift CRD Panel. 2. Remove CRD from LM and place in the shade on the cross-sun footpad of the LM. The CRD should be in the vertical position with the back of the CRD against the LM landing strut. NOTE After removal of the CRD from the LM, if the CRD panels are covered with dust, gently use brush to remove the dust or tap edge of frame with available tools to knock the dust off.
2.	RTG cannot be removed from LM area.	If RTG cannot be removed from LM area, pull red lanyard and expose panel in nominal manner.
3.	Panel will not shift. (Hole in upper left-hand area of panel cover still visible.)	1. Attempt to shift panel by applying additional force to lanyard. 2. If hole is still visible, discontinue panel shifting task and continue with normal surface activity.
4.	Assembly will not release from LM.	1. Verify white lanyard has been pulled. 2. Pull blue lanyard. Lower panels from frame, fold, and stow in designated bag.

TABLE 5.2 Cosmic Ray Detector (Sheets) (Concluded)

EVENT NO.	CONTINGENCY	ACTION
5.	Panels will not slide out of frame.	1. Verify blue lanyard has been pulled. 2. Assure thermal blanket on back of frame is not deformed so as to obstruct the motion of the panels. 3. Stow entire assembly in LM. 4. Avoid excessive touching or scraping the front of the panels.

LUNAR SURFACE EXPERIMENTS (NON-ALSEP)

TABLE 5.3 Far UV Camera/Spectroscope

EVENT NO.	CONTINGENCY	ACTION
1.	Protection bag will not open in normal manner.	Use scissors or available tools to rip bag open for retrieval of experiment.
2.	Tripod turned over or inadvertently moved.	1. Remove dust from setting circles and camera. 2. Relevel and resight down sun. MCC will provide new azimuth and elevation settings for earth. 3. Sight earth in viewfinder and center it using azimuth circle only. With set screw loosened, reset azimuth circle to earth utilizing setting from MCC.
3.	Leg fails to latch or is broken.	1. Place tripod on lunar surface with defective leg firmly pushed into the soil so as to jam defective leg against its deployed stop. Be careful not to apply a CCW rotational torque to the camera. 2. Bend or fold defective leg out of the way and utilize the LSUC pallet under tripod as the third leg. 3. Break off other leg(s) near base plate. Place pallet with rails on lunar surface. Deploy LSUC on top of pallet approximately 2 feet above lunar surface, then level and align as required.
4.	Battery temperature too hot.	1. If the temperature indicates > 5 temp. spots are black $(T > 140^{\circ}F)$ during EVA 1 LSUC deployment, no change in crew action is necessary. Continue LSUC deployment as normal. Battery will cool to normal temperature during EVA 1. 2. Report any change in battery temperature at end of EVA 1.

TABLE 5.3 Far UV Camera/Spectroscope (Continued)

EVENT NO.	CONTINGENCY	ACTION
4.	Battery temperature too hot. (Concluded)	3. At the beginning of EVA 3, should the battery temperature show 5 or more temp. spots being black ($T > 140^{\circ}F$), place the battery into LM shadow and leave during EVA 3. NOTE Should the battery inadvertently be moved into the shade during EVA 1 or EVA 2, move the battery back into direct sunlight.
5.	Temperature indicators on film cassette $> 130^{\circ}F$.	No crew action. Proceed with normal deployment and timeline. Temperature readings are for calibration purposes for the PI in processing the film.
6.	Film transport gears fail to turn when RESET switch is pressed.	1. Check power on switch. 2. Press RESET switch. 3. Check battery in sunlight, set azimuth and elevation for next target. 4. Note whether camera mode is changed, press RESET switch and check gear movement. 5. Check cable connection into sequencer box near the handle on the film transport box. Press RESET switch again. 6. Pick up battery pack and untwist cable connector CCW 1/4 turn, then replace connector with 1/4 turn CW and replace battery pack in sunlight. Press RESET switch again. 7. Remove small pip pin, rotate film transport box CCW, then back to locked position, then press RESET switch again. If no gear change, further camera pointings are unnecessary.

TABLE 5.3 Far UV Camera/Spectroscope (Concluded)

EVENT NO.	CONTINGENCY	ACTION
7.	Camera top in sunlight.	1. Move camera into LM shadow immediately. NOTE More than 20-minutes in sun degrades film. 2. Relevel and resight down sun. 3. Obtain from MCC new azimuth and elevation settings for earth. 4. Sight earth in viewfinder and center it, using azimuth circle only. With set screw loosened, reset azimuth circle to earth value from MCC.
8.	Film box jams.	1. Verify pip pin is removed. 2. Turn film box handle CCW. 3. If necessary, use hammer to break retaining arm so that the film box can be turned CCW. NOTE Damage film box to whatever extent necessary to retrieve film for return to MSC.
9.	Earth is not at expected elevation angle.	1. Relevel camera, rotate camera in azimuth 180 degrees. If bubble not centered move the bubble 1/2 of the distance to the center of the level. 2. Return to first camera setting. 3. If camera bubble indicates no movement, return to first camera setting and proceed normal.

TABLE 5.4 Solar Wind Composition Experiment

EVENT NO.	CONTINGENCY	ACTION
1.	Pole will not go into surface.	Lean against LM, facing sun.
2.	Pole partially extended.	1. If pole is half or more of normal length, continue experiment. 2. Remove foil and proceed to event 6, step 2.
3.	Reel not removable. No foil exposed to solar radiation.	Discard experiment.
4.	Foil torn during extension.	Continue experiment.
5.	Foil comes off reel.	Hang foil on pole by lanyard.
6.	Foil reel comes off pole.	1. Reconnect to pole. 2. Hang foil on LM structure facing most available solar radiation.
7.	Unable to reroll foil by spring.	Roll by hand or fold as conveniently as possible.
8.	No SWC bag available.	Continue experiment. Bag not mandatory. Attempt to put a bag over each end.
9.	Deployment selection alternative.	In full sunlight at least 6 feet from any shadow.

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