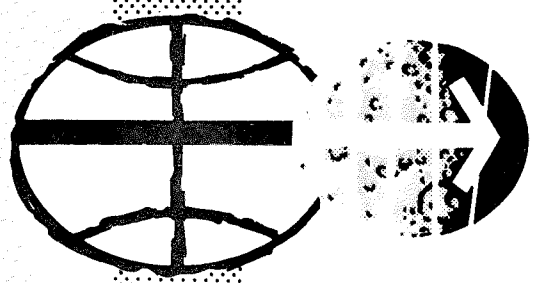
APOLLO 16

MSC-05171

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

SCIENCE CONTINGENCY PROCEDURES

MISSION J-2/APOLLO 16



MANNED SPACECRAFT CENTER

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SCIENCE

CONTINGENCY PROCEDURES

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Prepared for the

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ILLUSTRATIONS

SECTION I

GENERAL

1.1 ASSUMPTIONS

a. Launch delays of more than a few days may require replacement or adjustment of some experiment hardware.

b. For earth orbit mission case, the altitude and inclination will both be increased within operational limitations.

c. An experiment may be operated for engineering tests only, if orbit will not allow for science data collection.

d. A lunar flyby mission will not allow for proper attitude and operating time for SIM experiment operations.

1.2 TIME CONSTRAINT

a. If ALSEP deployment becomes constrained, refer to paragraph 1.5 and Section 4.9, Event No. 1.

b. 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 experiments abandonment. This additional time will be a real-time decision based on consumables and timeline constraints.

1.3 HOLD POINTS

The sequence of the experiment deployment or operation may be stopped after the completion of any one of the following hold points, to be continued at some time later by going to the next series of tasks.

Should Read Like Mission Rules Item 32-1-X (1-4) [Page 3-2]

10 Min With Following Exceptions:
1. RTG Fueling 20 Min
2. Cable Connections Prior to 2 Min
3. Antenna Erection & Align 30 Min 1-1
4. Consider Moving ALSEP Deploy & Later EVA for Operational ALSEP

a. Offload the Far UV Camera/Spectroscope. Place camera in LM shadow and the battery in the sun.

b. Remove ALSEP sub-packages #1 and #2; close SEQ bay door; emplace ALSEP sub-packages on the lunar surface facing the sun.

c. Tilt fuel cask; dome not removed. Remove drill from MESA and depress microswitch on battery to confirm operation.

d. Remove dome; fuel RTG, carry ALSEP to deployment site and place in sunlight.

e. Remove subpallets from sub-packages #1 and #2 but do not deploy. Connect cables to Central Station but do not actuate shorting switch.

f. Deploy PSE.

g. Deploy Thumper/Geophone package.

h. Partially deploy LSM (including legs), and rough sun align.

i. Remove HFE, deploy electronics package and first probe. Complete hole #1, insert probe, and properly orient drill on lunar surface.

j. Raise sunshield; remove gimbal box from subpallet, mount and aim antenna, activate shorting plug with UHT.

k. Deploy second probe. Complete hole #2, insert probe and properly orient drill on lunar surface.

l. Deploy Mortar Package Assembly.

m. Complete LSM deployment.

n. Recheck aiming mechanism alignment and document deployment with photographs.

1.4 EXPERIMENT RESCHEDULING

In the event of a change in mission profile, e.g., no TLI capability-earth orbit only, deployment and operation of non-lunar surface experiments will be affected. Table 1 shows which experiments may be scheduled for alternate missions. Lunar surface and orbital experiments are covered in Tables 2 thru 6.

Experiments should be exercised during any alternate mission to verify hardware operation and to evaluate procedures.

1.5 EXPERIMENT PRIORITIES

Mission priorities for Lunar Surface Experiments Deployment, Orbital Photography and Lunar Geology Investigation are defined as follows:

LUNAR SURFACE ACTIVITIES

PRIORITY	OBJECTIVE/EXPERIMENT
1.	Documented Samples (At highest priority area)
2.	Apollo 16 ALSEP • HFE • LSM • PSE • ASE
3.	Drill Core Sample
4.	Lunar Geology Investigation
5.	Far UV Camera/Spectroscope
6.	Solar Wind Composition
7.	Soil Mechanics
8.	Lunar Portable Magnetometer
9.	Soil Mechanics Penetrometer
10.	Cosmic Ray Detector (Sheets)

LUNAR ORBITAL AND TRANSEARTH COAST ACTIVITIES

PRIORITY	OBJECTIVE/EXPERIMENT
1.	Gamma-Ray Spectrometer
2.	X-Ray Fluorescence
3.	SM Orbital Photographic Tasks
4.	Subsatellite • Particle Shadows/Boundary Layer • Magnetometer • S-Band Transponder
5.	S-Band Transponder (CSM/LM)
6.	Alpha Particle Spectrometer
7.	Mass Spectrometer
8.	UV Photography - Earth and Moon
9.	Visual Light Flash Phenomenon
10.	Microbial Response in Space Environment
11.	CM Photographic Tasks

TABLE 1.1 Science Data Return Matrix for Alternate Missions

EXPERIMENT	MISSION TYPE				
	SL	EO	LF	LO/ NSE	NTE
SM Orbital Photographic Tasks:					
• 24-Inch Panoramic Camera	G[3]	G[1]	N	G	N
• 3-Inch Mapping Camera	G[3]	G[1]	N	G	N
• Laser Altimeter*	G	N	N	G	G
CM Photographic Tasks	G	G[1]	G[4]	G	G
UV Photography - Earth and Moon	G	G[4]	G[4]	G	G
Gamma-Ray Spectrometer	G[5]	N	G[4]	G	G
Alpha Particle Spectrometer*	G[5]	N	G[4]	G	G
X-Ray Fluorescence	G[5]	G[1]	G[4]	G	G
Mass Spectrometer	G[5]	N	G[4]	G	G
S-Band Transponder (CSM/LM)	G	N	N	G	G
Subsatellite:					
• Magnetometer*	N[2]	N	G[4]	G	G
• Particle Shadows/Boundary Layer	N[2]	G[1]	G[4]	G	G
• S-Band Transponder	N[2]	N	N	G	G
*No useful science data in earth orbit					

Legend:

SL - Scrubbed launch: can be recycled without experiment effect.
EO - Earth Orbit
LF - Lunar Flyby — G - Go
LO/NSE - Lunar Orbit/No Surface EVA — N - No/Go
NTE - No Transearth Coast EVA

Note:
1. Objectives may be changed if operated during alternate missions.
2. Batteries may have to be recharged.
3. Film may require reloading.
4. Possible partial and/or degraded data.
5. Dependent upon time period (calibration sources may have to be renewed).

SECTION II

EVA DECISIONS

TABLES

TABLE 2.1 Off Nominal EVA Planning

EVENT NO.	CONTINGENCY	ACTION
1.	Crew unable to locate touchdown point in the landing ellipse.	1. Make visual observations through Lunar Module (LM) window or by Standup Extra Vehicular Activity (SEVA) and describe features around the LM. 2. Compare television images and the astronauts' description of features to the overall features in the map package. 3. Revise ALSEP deployment and traverse plans as required (reference Table 2.2, Off Nominal Landings).
2.	Not enough time for EVA.	1. Make careful observations and descriptions of surface through LM windows or by SEVA. Numerous still camera photos should be taken with both black and white and color film. Photos with polarizing filter in three different positions should be made. 2. Study landing area on maps and submit pertinent questions relating to surface smoothness or roughness, the contours of surface, and the size of rocks and craters in area.

TABLE 2.1 Off Nominal EVA Planning (Continued)

EVENT NO.	CONTINGENCY	ACTION
3.	Time for brief EVA. (1 or 2 men)	1. Make careful observations and descriptions of surface through LM windows or by SEVA. Numerous still camera photos should be taken. 2. Study landing area on maps and submit pertinent questions relating to surface smoothness or roughness, the contours of surface and the size of rocks and craters in area. 3. Collect soil sample. 4. If possible, take a photographic panorama of area and photos of nearby surface. Take photos of surface under LM descent engine and around footpads. 5. Retrieve Cosmic Ray Detector experiment.

TABLE 2.1 Off Nominal EVA Planning (Continued)

EVENT NO.	CONTINGENCY	ACTION
4.	EVA 1 only. (2 men)	1. Pull appropriate lanyard of Cosmic Ray Detector (sheets) experiment. 2. Deploy ALSEP according to priorities. • HFE • LSM • PSE • ASE 3. Perform lunar geology investigation during return traverse from ALSEP site. Collect documented sample. NOTE Reduce the number of stations and distance attempted. 4. Retrieve Cosmic Ray Detector (sheets) experiment.

TABLE 2.1 Off Nominal EVA Planning (Continued)

EVENT NO.	CONTINGENCY	ACTION
5.	EVA 1 only (1 man)	1. Pull lanyard Cosmic Ray Detector (sheets) experiment. 2. Deploy ALSEP according to priorities. • HFE • LSM • PSE • ASE 3. Perform lunar geology investigation during traverse from ALSEP site. Collect documented sample. NOTE Reduce the number of stations and distance attempted. 4. Retrieve Cosmic Ray Detector (sheets) experiment.

TABLE 2.1 Off Nominal EVA Planning (Continued)

EVENT NO.	CONTINGENCY	ACTION
6.	EVA-1 - 1 man (EVA 2 planned, no EVA 3).	1. Pull lanyard on Cosmic Ray Detector (sheets) experiment. 2. Deploy ALSEP according to priorities. • HFE • LSM • PSE • ASE 3. Perform lunar geology investigation during return traverse from ALSEP site. Collect documented sample. NOTE Reduce the number of stations and distance attempted. 4. Deploy Far UV Camera/Spectroscope experiment.

TABLE 2.1 Off Nominal EVA Planning (Continued)

EVENT NO.	CONTINGENCY	ACTION
7.	EVA-1 - 2 men (EVA 2 planned, No EVA 3).	1. Pull lanyard on Cosmic Ray Detector (sheets) experiment. 2. Deploy Far UV Camera/Spectroscope experiment. NOTE Decisions for settings to obtain new targets will be made in real time. 3. Deploy ALSEP according to priorities. • HFE • LSM • PSE • ASE 4. Perform lunar geology investigation during return traverse from ALSEP site. Collect documented sample.

TABLE 2.1 Off Nominal EVA Planning (Continued)

EVENT NO.	CONTINGENCY	ACTION
8.	EVA 2 or 3 (1 man)	1. If LRV is operable: a. Perform geology sample collection and documentation, and take portable magnetometer measurements during LRV Traverse. b. Take panorama shots of traverse area. c. Retrieve Cosmic Ray Detector (sheets) experiments. NOTE Decision for retrieving experiment during EVA 2 or EVA 3 will be made in real time. d. Retrieve film transport device from Far UV Camera/Spectroscope experiment. NOTE Decision for retrieving film during EVA 2 or EVA 3 will be made in real time.

TABLE 2.1 Off Nominal EVA Planning (Concluded)

EVENT NO.	CONTINGENCY	ACTION
8.	EVA 2 or 3 (Continued) (1 man)	2. If LRV is inoperable: a. Perform geology sample collection and documentation during walking traverse. NOTE Crewman may abbreviate documentation requirements for samples if MCC concurs. HTC must be hand carried. b. Take panorama photographs of traverse area. c. Deploy the portable magnetometer as far as possible from LM. NOTE Decisions for settings to obtain new target will be made in real time. d. Retrieve Cosmic Ray Detector (sheets) experiments. NOTE Decision for retrieving experiment during EVA 2 or EVA 3 will be made in real time. e. Retrieve film transport device from far UV Camera/Spectroscope experiment. NOTE Decision for retrieving film during EVA 2 or EVA 3 will be made in real time.

TABLE 2.2 Off Nominal Landings

EVENT NO.	CONTINGENCY	ACTION
		Intentionally left blank -- TBD.

TABLE 2.3 Delayed EVA Timelines

EVENT NO.	CONTINGENCY	ACTION
		Intentionally left blank -- TBD.

TABLE 2.4 EVA Walking Traverse

EVENT NO.	CONTINGENCY	ACTION
		Intentionally left blank -- TBD.

SECTION III

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. Manually deploy MESA.
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 Apollo Lunar Hand Tools

EVENT NO.	CONTINGENCY	ACTION
1.	ALSEP forward tool support pull pin jams.	1. Apply additional force on pin with hammer. 2. Remove UHT and DRT pins. Remove UHT's, and break off bracket where pin is jammed using hammer. 3. Pry bracket away far enough to gain access to the tools.

TABLE 3.3 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 MESA sample collection bags for Selected Samples 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, abandon SRC. 4. Transfer the Sample Container Bags to LM.

TABLE 3.4 ALSEP Offload

EVENT NO.	CONTINGENCY	ACTION
	3.4.1 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 3.4 ALSEP Offload (Continued)

EVENT NO.	CONTINGENCY	ACTION
	3.4.2 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.
4.	Unable to release hockey stick.	Apply additional force on pin with hammer or break pin.

TABLE 3.5 RTG Fueling

EVENT NO.	CONTINGENCY	ACTION
1.	Cask will not rotate.	**CAUTION** USE EXTREME CARE WHEN WORKING NEAR HOT FUEL CASK. DIRECT EXPOSURE TO HOT CASK COULD DAMAGE OR FAIL THE SPACE SUIT. 1. Verify that the cask is free of the upper trunnion. 2. One crewman to apply forward and downward force with hammer/extension on the astronaut guard while the second crewman attempts to rotate the cask with the lanyard. 3. Continue to apply force to fail gear box. NOTE When gear box fails, one crewman must support cask with the hammer at the proper angle for capsule removal.
2.	Engaging mechanism on DRT does not lock on cask dome.	**CAUTION** STAND CLEAR OF DOME WHEN REMOVED. 1. Apply forward pressure and rotate. 2. Remove dome with side loading on the DRT. 3. After dome is rotated (without locking pin engagement) use hammer/extension to remove dome. 4. Use hammer to destroy cask dome and pry away bands to gain access to fuel capsule.

TABLE 3.5 RTG Fueling (Continued)

EVENT NO.	CONTINGENCY	ACTION
3.	Lock nut assembly will not rotate.	1. Use hammer on end of the DRT to jar loose the binding while continuing to rotate DRT. 2. Use hammer to destroy cask dome and pry away bands to gain access to fuel capsule.
4.	Pretension bands do not release causing excessive loading on dome locking legs.	1. Use hammer to free lugs at the lock nut assembly on the dome. 2. Use hammer to destroy cask dome and pry away bands.
5.	Fuel Transfer Tool (FTT) engagement fingers do not expand.	1. Visually inspect fingers for debris and re-engage FTT in fuel cask. 2. Request aid of second crewman to apply additional force to FTT knob. 3. If fingers still fail to expand, contact MCC for further direction.
6.	Capsule will not release from cask body after FTT is attached and locked.	1. Apply side load on FTT while pulling capsule out. 2. Retract FTT, rotate 120° and repeat task in all three positions. 3. Tap the cask body with hammer to free the capsule. 4. Tap the end of FTT with hammer. 5. Allow the back plate cool down (5-10 minutes) and repeat task.

TABLE 3.5 RTG Fueling (Concluded)

EVENT NO.	CONTINGENCY	ACTION
7.	Tempilabel indicates temperature of Fuel Capsule Assembly (FCA) is in excess of 250°F.	CAUTION DIRECT EXPOSURE TO TEMPERATURES IN EXCESS OF 250°F COULD DAMAGE OR FAIL THE SPACESUIT. Notify MCC. Use UHT or MESA tool to avoid direct contact with hot FCA and continue deployment.

SECTION IV

ALSEP SITE ACTIVITIES

TABLES

TABLE 4.1 ALSEP Traverse

EVENT NO.	CONTINGENCY	ACTION
1.	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 MESA tools. 4. If one or both sockets are unusable, carry subpackages in suitcase mode and transport carry bar on LRV.

TABLE 4.1 ALSEP Traverse (Concluded)

EVENT NO.	CONTINGENCY	ACTION
2.	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 #2. 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. Separate two carry bar sections and emplace subpackages #1 and #2 with carry bar section still attached to subpackage. NOTE The ALSEP antenna may be roughly aligned with the antenna aiming mechanism mounted on the Central Station sunshield.
3.	Planned deployment site > 300 feet west of LM (12 o'clock) unsuitable for ALSEP deployment.	Select alternate site > 300 feet from LM. NOTE Precise deployment direction will be determined in real time.
4.	Planned deployment site includes an outcropping whose height is greater than one foot.	1. Locate ALSEP components at least 12 feet from a one-foot outcropping, 24 feet from a two-foot outcropping, etc. 2. If outcropping cannot be avoided, orient ALSEP components thermal radiators away from outcropping to achieve a clear view of space.

TABLE 4.2 Subpallet Removal

EVENT NO.	CONTINGENCY	ACTION
1.	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 MESA tools and restow carry bar on subpallet taper fitting. 3. If taper fitting is unusable, stow carry bar on LRV or lean against subpallet.
2.	Unable to locate subpackage #1 10 feet due west of 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.
3.	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 4.3 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. Stow shorting plug on subpackage #1 until cool enough to handle manually. 5. If shorting plug cannot be mated to Central Station (CS), separate plug from RTG cable and connect cable directly to the CS.
2.	RTG cable reel binds or Boyd bolt(s) will not release.	1. Verify all Boyd bolts are released. 2. Use second UHT. 3. Force rotation of UHT to strip Boyd bolt threads. 4. If procedure fails to release bolts, tilt package on carry handle side, and utilize UHT to unwind cable manually to expose shorting plug. NOTE If cable reel cannot be removed, RTG will not radiate heat evenly, causing excessive heat buildup.

TABLE 4.3 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 4.3 RTG Cable Interconnect (Concluded)

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 (no movement).	1. Report condition and continue ALSEP deployment. 2. Reset the shorting switch if reading is zero.
7.	Shorting plug depressed but ammeter shows no drop in amperage.	1. Reset the switch, and redepress. 2. Apply additional force to shorting plug and note if amperage drops. 3. Disconnect shorting plug from Central Station. Separate shorting plug 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 4.4 Passive Seismic Experiment

EVENT NO.	CONTINGENCY	ACTION
1.	PSE stool binds or Boyd bolt(s) will not release.	1. Verify all Boyd bolts are released. 2. Use second UHT. 3. Force rotation of UHT to strip Boyd bolt threads. 4. Use hammer to pry the retainer bracket assembly loose. NOTE The PSE sensor can be placed directly on the lunar surface, if the PSE stool cannot be released. Experiment will be thermally degraded.
2.	Unable to deploy PSE stool 10 feet east of Central Station.	Locate PSE stool as far from Central Station and other experiments as possible.
3.	PSE sensor binds or Boyd bolt(s) will not release.	1. Verify all Boyd bolts are released. 2. Use second UHT. 3. Force rotation of UHT to strip Boyd bolt threads. 4. Leave experiment on sunshield and deploy PSE/Central Station as one unit. Do not deploy PSE skirt. NOTE Sunshield can be raised with sensor mounted. 5. Force cable reel free from retainer bracket and deploy sufficient cable to allow sunshield deployment.

TABLE 4.4 Passive Seismic Experiment (Concluded)

EVENT NO.	CONTINGENCY	ACTION
4.	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.
5.	Experiment falls off PSE stool while leveling after skirt fully deployed.	Retrieve experiment with UHT handle hooked into gnomon opening and lift experiment.
6.	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.
7.	UHT punctures thermal shroud during leveling sequence.	Remove UHT from puncture and cover the opening.

TABLE 4.5 Heat Flow Experiment

EVENT NO.	CONTINGENCY	ACTION
	4.5.1 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 4.5 Heat Flow Experiment (Continued)

EVENT NO.	CONTINGENCY	ACTION
	4.5.1 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 1, page 4-13.
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.

TABLE 4.5 Heat Flow Experiment (Continued)

EVENT NO.	CONTINGENCY	ACTION
	4.5.1 HFE Deployment (Concluded)	
7.	HFE Probe Package binds or Boyd bolt(s) will not release.	1. Verify all Boyd bolts are released. 2. Use second UHT. 3. Force rotation of UHT to strip Boyd bolt threads. 4. Rip probe containers apart with hammer. Retrieve emplacement tool and probes, and deploy probes as far as possible from Central Station.
8.	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.
9.	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.

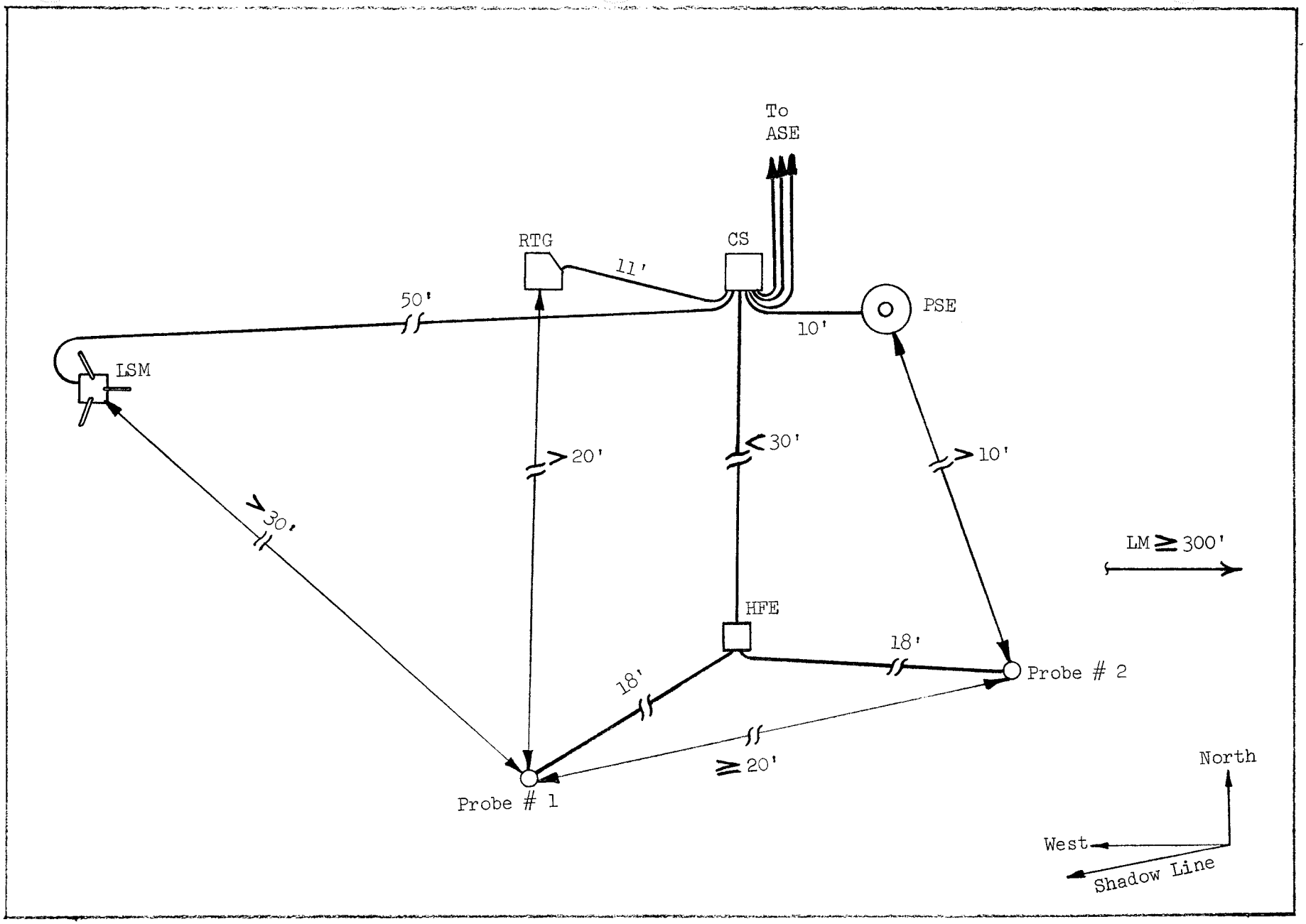

FIGURE 1 CONTINGENCY DEPLOYMENT PATTERN FOR HFE

TABLE 4.5 Heat Flow Experiment (Continued)

EVENT NO.	CONTINGENCY	ACTION
	4.5.2 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 (decal on thermal shroud 90° to sun). Do not place ALSD in a shaded area.
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 operations without the handle.
3.	Power head does not operate during pre-deployment test (no spindle rotation).	1. Remove power head and recheck operation. 2. Rotate spindle with wrench, ccw from the spindle end. 3. Use power head as hand auger and insert probes in holes as far as possible.
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 4.5 Heat Flow Experiment (Continued)

EVENT NO.	CONTINGENCY	ACTION
	4.5.2 Drill Operations (Continued)	
5.	Difficulty in drilling hole.	1. If drilling rate is < 5 in./min., 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. 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.
6.	Unable to add additional stem sections.	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 for additional torque.
7.	Unable to drill successfully with new stem sections.	1. Remove power head and check for damaged male or female joints. 2. Remove damaged section and replace with new section. 3. If unable to remove damaged section, replace power head and drill hole to nominal stem height. Proceed to second hole or coring operation.

TABLE 4.5 Heat Flow Experiment (Continued)

EVENT NO.	CONTINGENCY	ACTION
	4.5.2 Drill Operations (Concluded)	
8.	High torque exists during drilling operations.	1. Leave power head operating and lift repeatedly until torque decreases. 2. If unsuccessful, continue drilling. NOTE Slip clutch will prevent excessive torque from overpowering astronaut.
9.	Power head runs slowly.	1. Tap relief valve with hammer or wrench. 2. If unsuccessful, use as hand auger and apply power only when necessary.

TABLE 4.5 Heat Flow Experiment (Continued)

EVENT NO.	CONTINGENCY	ACTION
	4.5.3 Probe Emplacement	
1.	Drill inoperable.	1. Use core stem to make a hole in the lunar surface at least 54" deep. CAUTION USE CARE WHEN REMOVING CORE STEM AND/OR INSERTING PROBE TO MINIMIZE CAVE-IN OF THE HOLE. 2. Remove core stems and insert heat flow probe into hole. Should cave-in occur, use hammer to drive bore stem into existing hole. 3. If more than one section of bore stem can be buried, insert probe to maximum depth possible. 4. If upper section and cable cannot be placed in hole, dig trench approximately 4-feet long sloping from one-inch depth at one end to approximately 18 inches at the other end. Lay probes in tandem along the bottom of the trench and cover the first four feet of the cable with lunar 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 4.5.3, Event 1, Step 4).

TABLE 4.5 Heat Flow Experiment (Continued)

EVENT NO.	CONTINGENCY	ACTION
	4.5.3 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. **CAUTION** DO NOT USE EMPLACEMENT TOOL TO CLEAR OBSTRUCTIONS FROM HOLE UNTIL ONE PROBE HOLE/ASSEMBLY HAS BEEN COMPLETED.
4.	Obstructions in the bore stem prevent complete insertion of probe.	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, repeat step 1 until probe is inserted.
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 emplacement tool. 3. Read depth on emplacement tool.

TABLE 4.5 Heat Flow Experiment (Concluded)

EVENT NO.	CONTINGENCY	ACTION
	4.5.4 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 for additional torque.
2.	Power head spindle binds on male end of core stem after drilling.	1. Cradle handle assembly between thumbs and forefingers and lift up and forward. Align power head vertically. 2. Use wrench to decouple power head and core stem and repeat Event 1, Steps 1 and 2. 3. Use hammer to free binding.
3.	Core stems do not disengage at male/female connections.	1. Use treadle as additional torque. 2. Tap core stem joint with hammer and repeat step 1. 3. Bypass failed joint and disengage at next male/female connection.

TABLE 4.6 Lunar Surface Magnetometer Experiment

EVENT NO.	CONTINGENCY	ACTION
1.	LSM binds or Boyd bolt(s) will not release.	1. Verify all Boyd bolts are released. 2. Use second UHT. 3. Force rotation of UHT to strip Boyd bolt threads. 4. Leave experiment on sunshield and deploy LSM/Central Station as one unit. NOTE Sunshield can be raised with sensor mounted. 5. Force cable reel free from retainer bracket and deploy sufficient cable to allow sunshield deployment.
2.	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. 5. Leave LSM on sunshield and deploy LSM/Central Station as one unit.

TABLE 4.6 Lunar Surface Magnetometer Experiment (Concluded)

EVENT NO.	CONTINGENCY	ACTION
3.	Unable to deploy legs.	1. If spring-loaded legs do not self-deploy after removal of forward bracket, deploy by hand. 2. Place experiment on surface with legs in stowed position. Prop up with rocks or debris to obtain the best possible leveling. 3. As a last resort, lay the Electronic Gimbal Flip Unit flush on the lunar surface and attempt leveling.

TABLE 4.7 Active Seismic Experiment

EVENT NO.	CONTINGENCY	ACTION
	4.7.1 Thumper/Geophone (T/G) Offload	
1.	Thumper/Geophone binds or Boyd bolt will not release.	1. Verify Boyd bolt is released. 2. Use second UHT. 3. Force rotation of UHT to strip Boyd bolt threads.
2.	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.
3.	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 still unfolded. 4. Continue ASE deployment with T/G sleeve unlocked.

TABLE 4.7 Active Seismic Experiment (Continued)

EVENT NO.	CONTINGENCY	ACTION
	4.7.2 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, discontinue MPA deployment. **CAUTION** ASTRONAUT SAFETY HAZARD WILL EXIST IF MORTAR PACKAGE DEPLOYMENT IS CONTINUED.
2.	UHT will not engage in MPA carry socket.	1. Use second UHT. 2. Deploy manually using antenna to lower MPA to surface.
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 4.7 Active Seismic Experiment (Continued)

EVENT NO.	CONTINGENCY	ACTION
	4.7.2 Mortar Package Assembly (MPA) Deployment (Concluded)	
4.	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 2, Page 4-27).
5.	Leg does not deploy or lock during emplacement.	Apply additional force to deploy and lock leg. NOTE The MPA must be stable during and after firing.
6.	Safety rod release latch will not release.	1. Use second UHT. 2. Force rotation with UHT. 3. Retrieve lanyard and remove safety rods.
7.	Mortar package safe/arm switch jams.	1. Use second UHT. 2. If switch will not rotate, abandon mortar package deployment. NOTE Mortar package will not fire unless both the safe and arm switches are rotated.

TABLE 4.7 Active Seismic Experiment (Continued)

EVENT NO.	CONTINGENCY	ACTION
	4.7.3 Geophone Deployment	
1.	Prime geophone deployment site not suitable for geophone deployment.	1. Move the geophone/mortar line to a more suitable location within ± 45° of LM line of site. 2. If Step No. 1 cannot be accomplished, deploy geophones cross-sun per Figure 2, Page 4-27. NOTE Ensure that none of the geophones have been pulled out of the lunar surface. The MPA should be positioned to prevent launching grenades into a ridge or crater.
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 cross craters greater than 2 feet in depth to prevent the suspended cable from pulling a geophone out of the lunar surface. 2. If the crater is greater than 2 feet in depth, place geophone on rim or outside crater area.

TABLE 4.7 Active Seismic Experiment (Concluded)

EVENT NO.	CONTINGENCY	ACTION
	4.7.4 Thumper Activity	
1.	An Apollo Standard Initiator (ASI) does not fire.	1. Verify that the proper ASI has been selected. 2. Repeat the arming-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.	Not enough time to plan for all 19 thumper ASI firings.	If unable to schedule for a complete thumping exercise, do as many as possible.

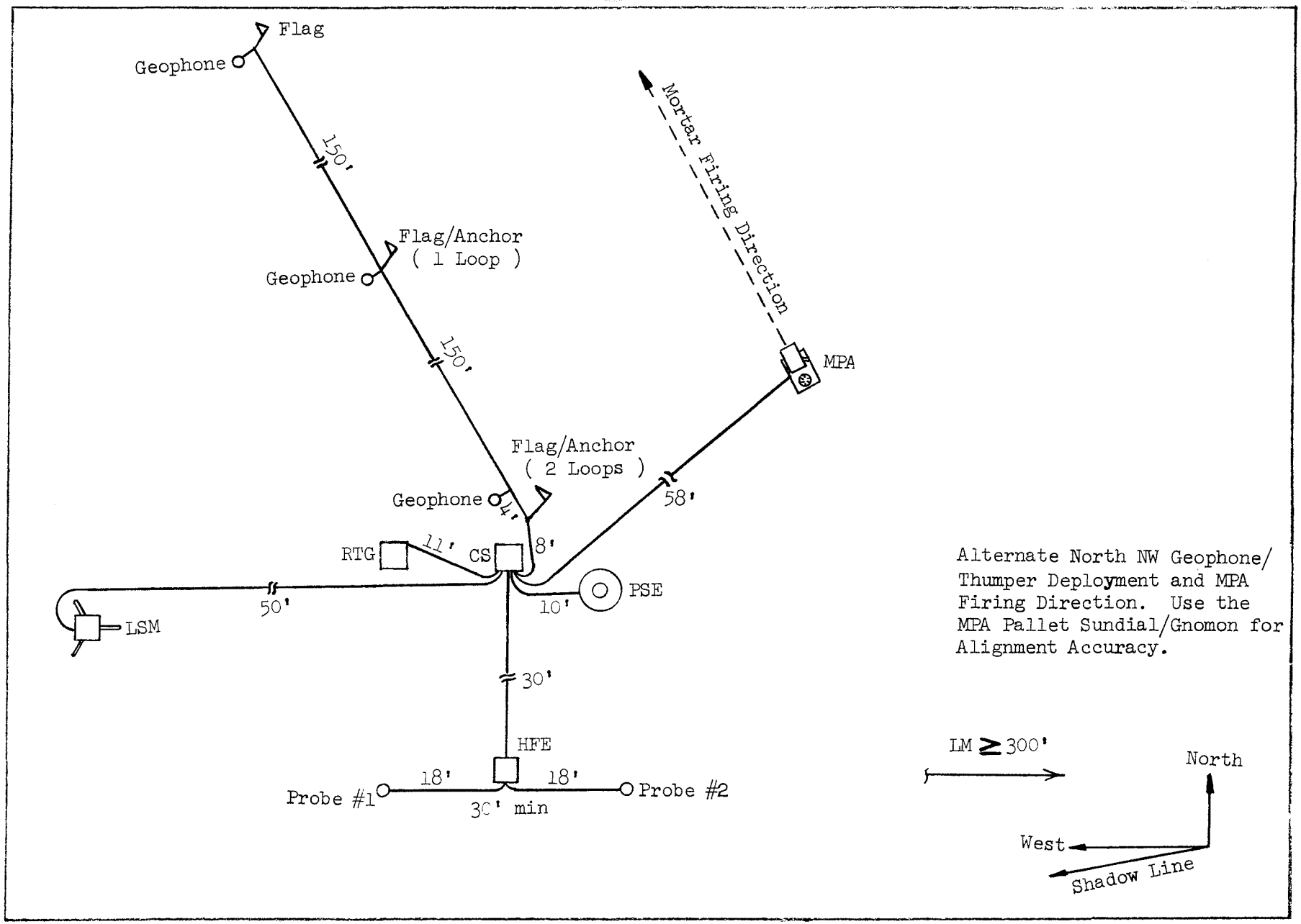

FIGURE 2 CONTINGENCY DEPLOYMENT PATTERN FOR ASE

TABLE 4.8 Central Station

EVENT NO.	CONTINGENCY	ACTION
1.	Boyd bolt(s) will not release or sunshield binds.	1. Verify all Boyd bolts are released. 2. Use second UHT. 3. Force rotation of UHT to strip Boyd bolt threads. 4. Verify rear thermal curtain on ALSEP antenna cable is not jammed. If jammed, release with UHT handle. 5. Leave sunshield in stowed condition. Gain access to antenna mass bracket. 6. If unsuccessful, mount antenna aiming mechanism on sunshield.
2.	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.
3.	UHT will not engage in aiming mechanism housing carry socket.	Use second UHT or deploy manually.

TABLE 4.8 Central Station (Continued)

EVENT NO.	CONTINGENCY	ACTION
4.	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.
5.	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 4.8 Central Station (Concluded)

EVENT NO.	CONTINGENCY	ACTION
6.	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.
7.	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 4.9 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 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.

TABLE 4.9 ALSEP Activation (Continued)

EVENT NO.	CONTINGENCY	ACTION
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.
4.	Central Station Contingency antenna Alignment.	1. Point antenna in general direction of earth. 2. Adjust antenna pointing angle in small increments, stepping back after each adjustment to avoid distortion of antenna beam pattern. 3. Perform required offsets under MCC direction.
5.	ALSEP transmitter turn on.	1. Initiate command CD-4 (octal 015) "Transmitter B Select." If no response, advise astronaut to turn on transmitter by actuating ALSEP back-up switch No. 2. 2. Acknowledge turn-on of transmitter. 3. If transmitter is not functioning, actuate ALSEP back-up switch No. 1. 4. If transmitter is still not functioning, actuate back-up switch No. 3 (experiments will energize sequentially). 5. Advise astronauts via voice link that all experiments have been turned on.

TABLE 4.9 ALSEP Activation (Concluded)

EVENT NO.	CONTINGENCY	ACTION
6.	MCC reports downlink signal problems.	1. Verify antenna is properly oriented, Central Station is properly leveled and aligned, and RF cable and connectors are intact. 2. Select Trans "B". 3. If unsuccessful, notify crew to adjust antenna pointing angle in small increments and to step back after each adjustment to avoid distortion of antenna beam pattern. 4. Request data through a site with 85-foot antenna. 5. Select "Low Bit Rate." 6. If signal is still too weak to yield useful data, notify crew to complete remainder of ALSEP deployment.
7.	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

LUNAR SURFACE EXPERIMENTS (NON-ALSEP)

5.1 Lunar Portable Magnetometer (LPM)

5.2 Cosmic Ray Detector Sheets

5.3 Far UV Camera

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. Deploy the defective leg first, and drag it in the soil while positioning the other two legs. NOTE Dragging the leg will apply a bending torque and with the friction between the sliding sections the leg should remain deployed. 2. If unsuccessful, leave all legs folded and continue deployment.
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. 2. If the full length of cable (35 feet) is not deployed, describe the sensor-LRV-Astronaut configuration in detail to MCC. (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.	Grasp the cable or reel and drag across lunar surface.

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

EVENT NO.	CONTINGENCY	ACTION
5.	The sensor head is dropped during setup, operation or transport.	Retrieve sensor with scoop or by lifting cable.
6.	Not enough time for all planned measurements.	Priority of Measurements a. Radial Crater Measurements (1) One measurement near rim of crater. (2) One measurement approximately one crater diameter away. (3) One measurement approximately two crater diameters away. b. Major Geological Features (1) One measurement in the North Hills region. (2) One measurement in the South Hills region. (3) One measurement in the Cayley Formation region. NOTE Sensor head must be a minimum of 250 feet from LM and 35 feet from any other hardware. One of the measurements performed must be a site survey. All other measurements must be performed with sensor head in position 3.

TABLE 5.2 Cosmic Ray Detector Sheets

EVENT NO.	CONTINGENCY	ACTION
1.	Dust covers panels after lunar landing.	Gently use brush to remove dust from panels.
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.	Panels will not shift.	1. Verify red lanyard has been pulled. 2. Proceed as planned. No effect on astronaut activities.
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.
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.

TABLE 5.3 Far UV Camera/Spectroscope

EVENT NO.	CONTINGENCY	ACTION
1.	Planned deployment site unsuitable for camera deployment.	Deploy camera farther west but in shadow of LM.
2.	Tripod turned over.	1. Clean the camera before removing spectrograph cover. 2. Remove dust from setting circles. 3. Relevel and realign Azimuth. 4. Orient camera toward target and press RESET switch.
3.	Battery overheating.	Place battery box into LM shadow for remainder of mission.
4.	No battery power immediately after deployment.	1. Check Power ON Switch. 2. Press RESET Switch. 3. Leave battery box in sunlight and recheck later in timeline.

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.

SECTION VI

LUNAR ORBITAL EXPERIMENTS

6.1 Gamma Ray Spectrometer

6.2 X-Ray Fluorescence Spectrometer

6.3 Alpha Particle Spectrometer

6.4 S-Band Transponder (CSM/LM)

6.5 Mass Spectrometer

6.6 Subsatellite

TABLE 6.1 Gamma Ray Spectrometer

EVENT NO.	CONTINGENCY	ACTION
1.	Earth orbit only.	Limited operation. NOTE Meaningful science data would be attenuated by earth's atmosphere. Would obtain operational and housekeeping data only.
2.	Lunar polar or modified lunar orbit.	Normal experiment operation. NOTE Excellent opportunity to obtain lunar gamma ray scientific data.
3.	Boom fails to extend.	1. Recycle retraction and extension controls. 2. Limited operation (real-time P.I. decision.) NOTE Degraded data. Operation based upon real-time data evaluation and P.I. determinations.
4.	Boom fails to retract for TEI SPS burn.	1. Recycle retraction control. 2. Jettison the boom.
5.	Experiment mechanical/ electrical malfunction.	Abort experiment. Conserve spacecraft power.

TABLE 6.2 X-Ray Fluorescence Spectrometer

EVENT NO.	CONTINGENCY	ACTION
1.	Earth orbit only.	Limited operation. Scientific data would be attenuated by earth's atmosphere. Would obtain operational and housekeeping data only.
2.	Lunar polar or modified lunar orbit.	Normal experiment operation. Excellent opportunity to obtain lunar x-ray scientific data.
3.	Experiment sensor direct sunlight exposure.	Normal experiment operation, degraded data. P.I. determination based upon real-time data evaluation.
4.	Experiment mechanical/ electrical malfunction.	Abort experiment. Conserve spacecraft power.

TABLE 6.3 Alpha Particle Spectrometer

EVENT NO.	CONTINGENCY	ACTION
1.	Earth orbit only.	Limited operation. Meaningful science data would be attenuated by earth's atmosphere. Would obtain operational and housekeeping data only.
2.	Lunar polar or modified lunar orbit.	Operate experiment in normal manner. Excellent opportunity to obtain lunar alpha particle scientific information.
3.	Experiment mechanical/ electrical malfunction.	Abort experiment. Conserve spacecraft power.

TABLE 6.4 S-Band Transponder (CSM/LM)

EVENT NO.	CONTINGENCY	ACTION
1.	No LM docking.	1. If CSM lunar orbit mission, proceed with CM portion of experiment only. 2. If CSM lunar flyby mission, scrub all experiment items.

TABLE 6.5 Mass Spectrometer

EVENT NO.	CONTINGENCY	ACTION
1.	Earth orbit only.	Limited operation. Obtain operational and housekeeping data only.
2.	Lunar polar or modified lunar orbit.	Normal experiment operation. Excellent opportunity to obtain lunar scientific data.
3.	Boom fails to extend.	1. Exercise retraction and extension controls. 2. Limited operation (real-time P.I. decision). NOTE Degraded data. Operation based upon real-time data evaluation and P.I. determinations.
4.	Boom fails to retract for TEI SPS burn.	1. Exercise retraction control. 2. Jettison the boom.
5.	Experiment mechanical/ electrical malfunction.	Abort experiment. Conserve spacecraft power.

TABLE 6.6 Subsatellite

EVENT NO.	CONTINGENCY	ACTION
1.	Subsatellite does not launch.	Position switch to retract and reinitiate extend launch sequence.
2.	Earth orbit.	Operations of subsatellite will be real-time decision depending upon type of orbit obtained.

APPENDIX

ABBREVIATIONS AND ACRONYMS

ABBREVIATIONS	DEFINITIONS
ALSD	Apollo Lunar Surface Drill
ALSEP	Apollo Lunar Surface Experiment Package
ASE	Active Seismic Experiment
ASI	Apollo Standard Initiator
CDR	Commander
CLSRC	Contingency Lunar Sample Return Container
CSM	Command Service Module
DRT	Dome Removal Tool
EMU	Extravehicular Mobility Unit
EVA	Extravehicular Activity
FTT	Fuel Transfer Tool
HFE	Heat Flow Experiment
HTC	Hand Tool Carrier
LEC	Lunar Equipment Conveyer
LM	Lunar Module
LMP	Lunar Module Pilot
LSM	Lunar Surface Magnetometer
MCC	Mission Control Center
MESA	Modularized Equipment Stowage Assembly
PCU	Power Control Unit
PDR	Power Dissipation Resister
PSE	Passive Seismic Experiment
RTG	Radioisotope Thermoelectric Generator
SEQ/Bay	Scientific Equipment Bay
SESC	Special Environmental Sample Container
SRC	Sample Return Container
SWC	Solar Wind Composition
TM	Telemetry
UHT	Universal Handling Tool