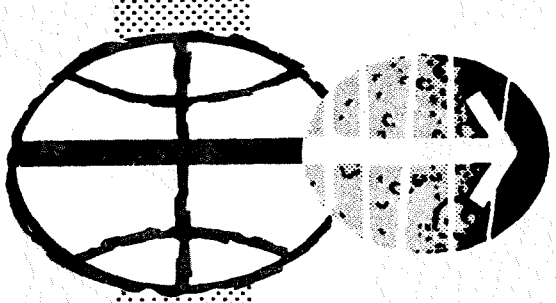
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

SCIENTIFIC EXPERIMENTS AND EQUIPMENT CONTINGENCY PROCEDURES

MISSION H-3/APOLLO 14



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MISSION H-3/APOLLO 14

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REFERENCES

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

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

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

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

5. Science Operations Support Plan, Mission H-3/Apollo 14.

6. Mission Requirements SA-509/CSM-110/LM8, H-3 Type Mission, Lunar Landing (June 9, 1970).

7. Apollo 14 Flight Plan, AS-509/CSM-110/LM8 (September 23, 1970).

TABLE OF CONTENTS

1.0 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. If the mission is off-nominal so that it appears unlikely that there will be no more than one surface EVA, in order to increase the possibility of collecting Fra Mauro material in the selected samples, the ALSEP should be deployed in a direction toward the nearest available and recognizable Fra Mauro material.

1.2 APOLLO 14 TIMELINE

The Apollo 14 Lunar Surface Timeline is used for planning lunar surface EVA contingency procedures. The Lunar Surface Timelines are essentially task flow analyses along a time base, showing the points of interaction between the two crewmen.

For a more detailed timeline procedure refer to the Mission H-3/ Apollo 14 Flight Plan.

1.3 TIME CONSTRAINT

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 that would result in total experiment abandonment. This additional time will be a real-time decision based on consumables and timeline constraints.

1.4 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.

1.4 (Cont'd)

a. Offload LRRR and emplace LRRR Array in and facing the sun.

b. Remove ALSEP Packages #1 and #2; close SEQ bay door; emplace ALSEP packages with experiments in and facing the sun.

c. Tilt fuel cask; dome not removed.

d. Tilt fuel cask; remove dome, do not defuel.

e. Fuel RTG; carry ALSEP to deployment site; remove subpallet from Package #2; carry Package #1 to emplace site (do not deploy); interconnect RTG cable (do not actuate shorting switch).

f. Deploy ALSEP Package #1 as well as ALSEP Package #2; release and remove experiments; raise sunshield; mount and aim antenna; deploy PSE.

g. Deploy ALSEP experiments and complete tasks. A hold point exists after each experiment is deployed.

1.5 EXPERIMENT PRIORITIES

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

PRIORITY	OBJECTIVE/EXPERIMENT
1.	Contingency Sample Collection
2.	Apollo Lunar Surface Experiments Package a. Passive Seismic Experiment b. Active Seismic Experiment c. Charged Particle Lunar Environment Experiment d. Suprathermal Ion Detector/Cold Cathode Gauge Experiment
3.	Selected Sample Collection
4.	Lunar Field Geology
5.	Photographs of Candidate Exploration Sites
6.	Laser Ranging Retro-Reflector
7.	Soil Mechanics
8.	Portable Magnetometer
9.	Modular Equipment Transporter Evaluation
10.	Selenodetic Reference Point Update
11.	CSM Orbital Science Photography
12.	Downlink Bi-Static Radar Observations of the Moon
13.	Transearth Lunar Photography
14.	Solar Wind Composition
15.	Evaluation of Landing Accuracy Techniques
16.	EMU Water Consumption Measurement
17.	Thermal Coating Degradation
18.	CSM/LM S-Band Transponder
19.	Dim Light Photography

2.0 EVA Decisions

Event No.	Contingency	Responsible Agent	Action	Remarks
2.1	Crew unable to locate touchdown point in the landing ellipse.	Crew	Make visual observations and describe features around the LM.	
		MCC	Compare television images and the astronauts description of features to the overall features in the map package.	After locating the touchdown point advise crewmen of which map sheet to use for plotting their traverse routes.
2.2	Not enough time for EVA	Crew	Make careful observations and descriptions of surface through LM windows. Numerous still camera photos should be taken with both black and white and color films from both windows.	Photos with polarizing filter in three different positions should be made.
		MCC	Study landing area on maps and submit pertinent questions relating to surface smoothness or roughness, the contours of surface size of rocks and craters in area.	
2.3	Time for brief EVA. (1 or 2 men)	Crew	1. Repeat activity in Event 2-2. above. 2. Collect contingency sample. 3. If possible, take a panorama of area and shots of surface nearby. Take shots of surface under LM descent engine and around footpads.	

Event No.	Contingency	Responsible Agent	Action	Remarks
2.4	EVA 1 only. (2 men)	Crew	1. Collect contingency sample.	
			2. Deploy ALSEP as normal but in direction toward the nearest available and recognizable Fra Mauro material.	
			3. Deploy LRRR.	
			4. Collect comprehensive sample during return traverse from ALSEP site.	
			5. Collect documented samples during traverse to the ALSEP site and while returning.	Cut down the number of stations and distance attempted rather than reduce quality of sample collections and documentation.
			6. Photograph and describe geological features as well as collect samples.	During the EVA, should it become evident that there is not time to collect both the core and the selected sample, then the selected sample should be collected in liew of the core.
		MCC	Study landing area on maps and make decision on ALSEP deployment site.	

Event No.	Contingency	Responsible Agent	Action	Remarks
2.5	One Man EVA 1. (NO EVA 2)	Crew	1. Collect contingency sample. 2. Deploy ALSEP as normal and according to priority listing in Mission Requirements Document, but in direction toward the nearest available and recognizable Fra Mauro material. 3. Deploy LRRR. 4. Collect documented samples during return traverse from ALSEP site.	Cut down the number of stations and distance attempted rather than reduce quality of sample collections and documentation.
2.6	One man EVA 1 (EVA 2 planned).	Crew	1. Collect contingency sample. 2. Deploy ALSEP as normal. 3. Deploy LRRR. 4. Collect documented samples during return traverse from ALSEP site.	

Event No.	Contingency	Responsible Agent	Action	Remarks
2.7	One man EVA 2	Crew	1. If MET is usable:	
			a. Perform geology sample collection and documentation.	Collect Fra Mauro material.
			b. Deploy LPM.	At least two of the three measurements should be obtained.
			c. Take panorama shots of traverse area.	
			d. Repeat Steps a, b and c for each additional LPM site.	
		Crew	2. If MET is not usable:	Crew will have to carry HTC.
			a. Perform geology sample collection and documentation.	Crew may abbreviate documentation requirements for samples if MCC concurs.
			b. Take panorama shots of traverse area.	
			c. Deploy LRRR.	

3.0 MESA Deployment

Event No.	Contingency	Responsible Agent	Action	Remarks
3.1	MESA release handle will not release	Crew	1. Attempt to free release handle by exerting side loads on pip pin. 2. Attempt to reach cable from release handle to MESA. Pull on this cable or cable bell crank mechanism with hand to deploy MESA. 3. Attempt to reach cable beyond bell crank and pull to deploy MESA.	
3.2	Release handle releases, MESA does not deploy.	Crew	1. Try repeated pulls on release handle. 2. Manually deploy MESA from surface with lanyard. 3. One crewman pull on MESA lanyard while other crewman pulls release handle.	
3.3	MESA fails to stop and hits lunar surface (lanyard breaks).	Crew	1. Attempt to block up MESA with LRRR pallet. 2. Attempt to tie up MESA if lanyard available.	

Event No.	Contingency	Responsible Agent	Action	Remarks
3.4	Unable to open SRC.	Crew	1. Hit corners of SRC lid with hammer and attempt to pull lid free.	
			2. If forced to abandon SRC #1 use MESA weigh bags for Selected Samples and transfer weigh bags to LM ascent stage in ETB and stow in the ISA.	Loss of SRC #1 will result in the loss of 3 core tubes and 2 SESC's.
			3. If forced to abandon SRC #2, use MESA weigh bags for Documented Samples and transfer weigh bags to LM ascent stage in the ETB and stow in the ISA. The SWC is to be transferred in the ETB and stowed in the ISA.	Loss of SRC #2 will result in the loss of 3 core tubes, 1 SESC, and the MSSC.
3.5	SRC Seal Area Dirty	Crew	Use hand brush to clean seal.	

Event No.	Contingency	Responsible Agent	Action	Remarks
3.6	Unable to latch SRC.	Crew	1. Check that spacer has been removed. If not, remove. 2. Open and look for interference. a. Relocate item, shake or pat to settle loaded weigh bag. If "O" ring is out of groove, pull out and discard. b. Remove excess packing material or sample and repack. 3. If no apparent interference close and engage other strap latch. If this latch will rotate to within 30° of being closed, place other hand on back of box to permit application of maximum closing pressure by a muscular squeezing action. a. If this strap latches, try first latch again in the same manner. b. If the second latch will not latch, bring it back to earth with latch closed. c. If still cannot latch at least one side, abandon SRC. 4. Transfer samples in Sample Containers.	

Event No.	Contingency	Responsible Agent	Action	Remarks
3.7	Unable to transfer items via LEC.	Crew	1. Use LEC as a tether, attach and pull it up to hatch. 2. If possible climb ladder while holding SRC.	

4.0 Apollo Lunar Hand Tools

Event No.	Contingency	Responsible Agent	Action	Remarks
4.1	Unable to attach extension handle.	Crew	1. Verify locking collar will not rotate. 2. Hit locking collar against LM on MESA to attempt to free locking mechanism.	
4.2	Pull pin jams at ALSEP pallet/ HTC interface.	Crew	1. Apply additional force while rotating pin with the aid of the second crewman. 2. Use MESA hammer to pry pin free or break pin. 3. Attempt to pry HTC free from ALSEP pallet. 4. Remove all accessible tools, stow on MESA and deploy sub-package #2 with HTC attached.	HTC - hand tool carrier.

Event No.	Contingency	Responsible Agent	Action	Remarks
4.3	HTC quarter turn fastener jams or will not release.	Crew	1. Apply additional force while rotating $\frac{1}{4}$ turn pins with the aid of second crewman. 2. Use MESA hammer to rotate or break fasteners. 3. Attempt to pry HTC free from ALSEP pallet. 4. Remove all accessible tools, stow on MESA and deploy Subpackage #2 with HTC attached. Note: With HTC pull pins removed, the HTC can be partially removed at deployment site to provide better thermal view factor for RTG.	
4.4	HTC legs on carrier will not extend and lock.	Crew	1. Apply additional force with the aid of second crewman. 2. Abandon task.	If legs will not extend and lock there will be a reduced geology capability.
4.5	HTC will not open to deployed position.	Crew	1. Request aid of second crewman. 2. Apply additional force with MESA hammer. 3. Abandon task.	There will be a reduced geology capability if HTC will not open or lock.

Event No.	Contingency	Responsible Agent	Action	Remarks
4.6	HTC lower forward tool support pull pin jams.	Crew	1. Apply additional force on pin with MESA hammer. 2. Remove upper tool support pin and attempt to pry open the outer half to break the bracket off at the point where the pin is jammed. 3. Use MESA hammer to break bracket. 4. The tools can be removed by prying the bracket away far enough to gain access to the tools.	
4.7	HTC upper tool bracket pull pin jams.	Crew	1. Apply additional force on pin with MESA hammer. 2. Remove lower tool support pin, and attempt to pry open the outer half with MESA hammer breaking the bracket off at the point where the pin jammed. 3. The tools can be removed if the bracket is pried away far enough to gain access to the tools.	Note: ALSEP cannot be deployed without access to DRT, FTT and one UHT.

Event No.	Contingency	Responsible Agent	Action	Remarks
4.8	UHT tools do not engage in stowage/carry sockets on Subpackage #1 and #2.	Crew	1. Stow in alternate socket on PSE, or Subpallet. 2. LMP/CDR use YO YO to secore UHT's.	
4.9	Handle comes off CSC before sampling, container falls on lunar surface.	Crew	1. Attempt to retrieve with handle. 2. Get tongs from MESA and retrieve bag from surface, then reinstall bag ring on handle.	
4.10	Handle will not come off CSC after sampling.	Crew	1. Remove clip. 2. If handle is stuck, bend sampler toward cup ring until bag retaining pin is free of cup ring (approximately 90°) and remove bag.	
4.11	Unable to open special environmental sample containers (SESC).	Crew	1. Unable to open - hit rotation handle with hammer. 2. Unable to seal - check/remove both seal protectors. Check/free lanyard if impeding proper lid manipulation.	If it is not possible to open and close container, abandon sample task.

Event No.	Contingency	Responsible Agent	Action	Remarks
4.12	SRC table will not remain in proper position.	Crew	1. Attempt to set on struts. 2. Get assistance from other crewman to hold SRC during filling or to hold table.	

5.0 CAMERAS

5.1 Lunar Surface Close-Up Camera

Event No.	Contingency	Responsible Agent	Action	Remarks
5.1.1	Cycle light does not come on after depressing trigger on first exposure.	Crew	Determine if red scale marks on camera top skirt are visible, indicating skirt is fully deployed. If marks are not visible depress camera skirt and release, noting if both latches are released.	Note: Occasionally the last skirt retaining latch released will catch in a secondary mode and not permit the skirt to fully extend and enable the camera.
5.1.2	Cycle light does not come on after depressing trigger first time and red scale marks on camera skirt are visible.	Crew	Depress the black safety switch located to the left of the handle extension pole base and push camera down until skirt is fully retracted and then release. Repeat two times. Repeat exposure noting if flash discharged and cycle light comes on. If flash discharges and cycle light does not come one, cycle light has failed, but camera is still operative. Continue photography allowing 15 seconds between exposures. If flash does not discharge discard camera.	
5.1.3	Cycle light remains on for more than 10 seconds.	Crew	If cycle light goes off within 25 seconds continue photography. If cycle light does not go off after 25 seconds, and pictures have been taken, remove cassette and discard camera.	

5.0 CAMERAS

5.1 Lunar Surface Close-Up Camera

Event No.	Contingency	Responsible Agent	Action	Remarks
5.1.4	Film attached to supply roll when take-up cassette is removed from camera.	Crew	Rotate film cutter until it detents. Grasp film and cut by pulling it back against cutter blade. Stow cassette.	

5.0 CAMERAS

5.2 Still Camera

Event No.	Contingency	Responsible Agent	Action	Remarks
5.2.1	Still camera not working.	Crew	1. Try new magazine and take test photographs through window. 2. Keep in view of television and time sequence cameras so long as data return not compromised. 3. Use photomap if LM location is known, to locate sampling sites with reference to LM.	

6.0 Solar Wind Composition Experiment

Event No.	Contingency	Responsible Agent	Action	Remarks
6.1	Pole will not go into surface.	Crew	Lean against LM, facing sun.	
6.2	Pole partially extended.	Crew	1. If pole is half or more of normal length, continue experiment. 2. Remove foil and proceed to event 6.6.	
6.3	Reel not removable. No foil exposed to solar radiation.	Crew	Discard experiment.	
6.4	Foil torn during extension.	Crew	Continue experiment.	
6.5	Foil comes off reel.	Crew	Hang foil on pole by lanyard.	
6.6	Foil reel comes off poles.	Crew	1. Reconnect to pole. 2. Hang foil on LM structure facing most available solar radiation.	
6.7	Unable to reroll foil by spring.	Crew	Roll by hand or fold as conveniently as possible.	
6.8	No SWC bag available.	Crew	Continue experiment. Bag not mandatory. Attempt to put one weigh bag over each end.	
6.9	Deployment selection alternative	Crew	In full sunlight at least 6 feet from any shadow.	

7.0 Laser Ranging Retro-Reflector Experiment

Event No.	Contingency	Responsible Agent	Action	Remarks
7.1	Unable to deploy LRRR at least 100 feet west of Central Station	Crew	1. Locate LRRR as far west of Central Station as possible. 2. Locate LRRR as far northwest or north of Central Station as possible, as far from mortar package flight path as possible and at least 300 feet from LM. 3. Locate LRRR as far southwest or south of Central Station as possible, as far from mortar package and geophone line as possible and at least 300 feet from LM. 4. Locate LRRR east or northeast of Central Station at least 300 feet from LM, and at least 10 ft. from the RTG. 5. Locate LRRR southeast of Central Station, at least 300 feet from LM, at least 10 feet from RTG, and as far as possible from mortar package and geophone line.	Note: Possible thermal degradation of LRRR due to deposition of lunar debris kicked up by grenade impact, mortar package blast, LM ascent stage blast, and RTG heating.

7.0 Laser Ranging Retro-Reflector Experiment

Event No.	Contingency	Responsible Agent	Action	Remarks
7.2	UHT will not engage in LRRR UHT socket.	Crew	1. Try to engage UHT in second UHT socket.	
			2. Try to engage second UHT in both UHT sockets.	
			3. IF UHT engagement fails, use UHT handle hooked into carry handle to rotate LRRR to lunar surface. Attempt to use UHT handle hooked into carry handle to level and align LRRR.	LRRR aiming accuracy may be degraded.
7.3	LRRR tips over during deployment	Crew	1. Pick up unit using UHT handle as a hook.	Dust will degrade performance if the unit tips over on the array with the dust cover off.
			2. Brush off with EMU brush.	
7.4	Leveling leg pull pin jams or unable to deploy.	Crew	1. Attempt to pry pin out or jar leg free.	Leveling may be out of limits.
			2. Attempt to level using core tube or penetrometer for props.	Experiment aiming accuracy stability on the thermal control may be degraded.

Event No.	Contingency	Responsible Agent	Action	Remarks
7.5	Latching Mechanism spring failure.	Crew	1. After pull pin removal, manually raise latching arm in leveling assembly and apply additional force to leg. 2. Emplace experiment on lunar surface with leg in deployed position and prop up experiment with core tube or penetrometer.	
7.6	Lanyard broken.	Crew	Attempt to remove dust cover by peeling Velcro tabs on dust cover and manually removing cover.	
7.7	UHT will not disengage from LRRR UHT socket.	Crew	1. Apply additional force: 2. Obtain assistance from second crewman. 3. Leave UHT in socket.	Experiment aiming accuracy, stability or thermal control may be degraded.

8.0 Lunar Portable Magnetometer Experiment

Event No.	Contingency	Responsible Agent	Action	Remarks
8.1	Tripod leg does not lock in extended position	Crew	Deploy the defective leg first, and drag it in the soil while positioning the other two legs.	Dragging the legs will apply a bending torque to the leg and with the friction between the sliding sections the leg will remain deployed.
8.2	The flat cable will not deploy from the cable reel because of binding within the reel.	Crew	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 in detail to MCC, the sensor - METS-Astronaut configuration.	The cable may have vibrated during flight to lunar surface to an unusual state causing the cable to bind against the inside of the reel.
8.3	The retaining clip in the tripod U channel does not engage.	Crew	Maintain a grasp on the sensor head during tripod leveling and alignment.	The failure to engage the retaining clip will require additional operations by the crewman, but it will not affect the equipment's operation.

8.0 Lunar Portable Magnetometer Experiment

Event No.	Contingency	Responsible Agent	Action	Remarks
8.4	The cable reeling task (stowage) not possible because: a. Crank arm not operable. b. Cable binds in reel. c. Lack of EVA time.	Crew	1. Pick up cable reel and hand-carry it, dragging cable in soil. 2. Grasp cable and drag cable and reel along lunar surface.	
8.5	The sensor head is dropped during setup, operation or transport.	Crew	Retrieve sensor with scoop or by lifting cable and continue.	
8.6	Not enough time for all planned measurements.		Priority of Measurements	
			a. Site Survey (all 3 positions)	Sensor head must be minimum 250 feet from LM and 35 feet from any other hardware.
			b. Traverse measurement at maximum distance from LM during traverse (sensor head in position 3).	
			c. Normal second traverse measurement.	Normally all 3 measurements required. More than 3 highly desirable.

9.0 ALSEP Offload

9.1 SEQ Bay Door

Event No.	Contingency	Responsible Agent	Action	Remarks
9.1.1	SEQ Bay door lanyards unusable (for opening)	Crew	1. Lanyard free from cable, pull cable. 2. Lanyard melted and fused to Inconel--if unable to break free with hand pull, use hammer to free and pull cable.	
9.1.2	SEQ Bay doors will not open.	Crew	1. No cable movement (worse case) pry open astronaut protection door and fail mechanism. Pull on lanyard again. Use hammer to chop hole in main door Inconel shield at center patch. Hook hammer behind cable and pull to release latch and open door while latch is pulled. Continue to open door upward. 2. With small cable movement, doors are unlatched and can be opened manually.	
9.1.3	SEQ Bay door partially open and jammed.	Crew	1. Continue pulling on lanyard, get assistance to aid manually in raising door. 2. Discontinue lanyard use and manually raise door.	

9.0 ALSEP Offload

9.1 SEQ Bay Door

Event No.	Contingency	Responsible Agent	Action	Remarks
9.1.4	SEQ Bay Door will not lower (for closing).	Crew	Attempt to close manually.	Note: SEQ Bay door should be closed to thermally insulate the LM.
9.1.5	SEQ Bay door partially closed.	Crew	1. Continue pulling on lanyard while second crewman manually assists in closing door. 2. Discontinue use of lanyard and manually close door or use hammer to fail mechanism in order to close door.	

9.2 Package Removal by Booms

Event No.	Contingency	Responsible Agent	Action	Remarks
9.2.1	Package latching mechanism will not release.	Crew	1. If lanyard pulls loose or mechanism jams, remove thermal covering from bottom of SEQ bay and attempt to move release mechanism lever forward. 2. Use hammer to pry outward from structure on right-hand link of latching mechanism forcing latch over center and releasing packages.	
9.2.2	Package will not slide on rails.	Crew	Get assistance from second crewman.	
9.2.3	Boom will not deploy.	Crew	Release hockey stick at boom interface and manually deploy package.	
9.2.4	Boom partially deployed.	Crew	Package partially deployed--use two-man deployment: One supports, other man releases hockey stick at boom interface and manually deploys package.	
9.2.5	Ratchet fails.	Crew	Ratchet fails--use two-man deployment: one supports, other pulls small lanyard to release hockey stick from boom.	

9.2 Package Removal by Booms

Event No.	Contingency	Responsible Agent	Action	Remarks
9.2.6	White portion of deployment lanyard will not release from base of package.	Crew	1. Grasp release latch at base of package and twist with an upward motion in an effort to break the latch or the slot. 2. Cut lanyard with hammer against LM or rock to break or tear lanyard (webbing) loose.	
9.2.7	Unable to release hockey stick at boom interface (pin jams or lanyard breaks)	Crew	1. Attempt to pull pin manually. 2. Release hockey stick at handle interface.	
9.2.8	Unable to release hockey stick at package interface (pin jams).	Crew	1. Apply additional force on pin with MESA hammer or break pin. 2. Attempt to break the hockey stick off at the point where the pin jammed either manually or with MESA hammer. 3. Attempt to pry hockey stick away from package.	
9.2.9	Boom does not retract.	Crew	1. Attempt retraction by both crewmen working simultaneoulsy, one pulling the lanyard and the second pushing on boom (if within reach). 2. Apply loads on end of the boom with the hammer while second crewman pulls lanyard.	Crewmen should spend a minimum amount of time on task before abandoning.

Event No.	Contingency	Responsible Agent	Action	Remarks
9.3.1	Unable to release hockey stick at boom interface (Pin jammed or lanyard breaks)	Crew	1. Attempt to pull pin at pin interface. 2. Remove package on boom. 3. Remove entire hockey stick by removing pull pin at carry handle interface after boom removal.	
9.3.2	Package latching mechanism will not release.	Crew	1. If lanyard pulls loose or mechanism jams, remove thermal covering from bottom of SEQ bay and attempt to move release mechanism lever forward. 2. Use hammer claw to pry outward from structure on righ-hand link of latching mechanism forcing latch over center and releasing packages.	
9.3.3	White portion of deployment lanyard will not release from base of package.	Crew	1. Grasp release latch at base of package and twist with an upward motion in an effort to break the latch or the slot. 2. Cut lanyard with hammer against LM or rock.	

9.3 Manual Package Removal

Event No.	Contingency	Responsible Agent	Action	Remarks
9.3.4	Package will not slide on rails	Crew	Using MESA tools with assistance of second crewman, attempt to clear package.	
9.3.5	Unable to release hockey stick at package interface (pin jams)	Crew	1. Apply additional force on pin with MESA hammer or break pin. 2. Attempt to break the hockey stick off at the point where the pin jammed, either manually or with MESA hammer. 3. Attempt to pry hockey stick away from package.	

10.0 RTG Fueling

Event No.	Contingency	Responsible Agent	Action	Remarks
10.1	Lanyard breaks or pulls away from cam lever.	Crew	Use MESA tools hammer/extension as hook and pull forward on cam lever to release.	Caution: Direct exposure to hot fuel cask could damage or fail the space suit. If cam lever cannot be released, abandon ALSEP.
10.2	Cam lever fails to release the upper trunnion after lever is fully deployed.	Crew	Use hammer/extension as hook on astronaut guard to break cask free at trunnions while second crewman pulls lanyard to tilt.	If upper trunnion cannot be released, abandon ALSEP.
10.3	Lanyard fails to remove spline lock from cask/dome or breaks.	Crew	1. Continue to release trunnion lock. 2. Rotate cask, attempt to gain access to fuel capsule by using hammer to destroy cask dome and pry away bands.	If spline lock cannot be removed from dome, abandon ALSEP.

Event No.	Contingency	Responsible Agent	Action	Remarks
10.4	Cask will not rotate with lanyard.	Crew	1. Verify upper trunnion release by attaching extension to MESA hammer, hook hammer on astronaut guard and ensure that the cask is free of the upper trunnion. 2. Request aid of the second crewman to apply forward and downward force with hammer and extension on the guard while the first crewman attempts to rotate with the lanyard. 3. Continue to apply force to fail gear box if required. 4. If gear box fails, second crewman must support cask with the hammer/extension handle to the proper angle for fuel capsule removal.	If cask cannot be rotated, abandon ALSEP.
10.5	Engaging mechanism on DRT does not lock due to mechanical failure.	Crew	1. Apply forward pressure and rotate. Attempt to remove dome with side loading on the DRT so it will be removed with some assistance from the tool. (CAUTION: Stand clear of dome when finally released and removed.) 2. Attempt to gain access to fuel capsule by using hammer to destroy cask dome and pry away bands.	If dome cannot be removed, abandon ALSEP.

Event No.	Contingency	Responsible Agent	Action	Remarks
10.6	Lock nut assembly will not rotate.	Crew	1. Apply additional force with hammer on the end of the DRT, side of cask and dome to "jar loose" the binding while continuing to rotate DRT. 2. Attempt to gain access to fuel capsule by using hammer to destroy cask dome and pry away bands.	If assembly cannot be rotated, abandon ALSEP.
10.7	Pretension bands do not release causing excessive loading on dome locking lugs.	Crew	1. Use MESA hammer to free lugs at the lock nut assembly on the dome. 2. Attempt to gain access to fuel capsule by using hammer to destroy cask dome and pry away bands.	If lugs cannot be freed, abandon ALSEP.
10.8	FTT engagement fingers do not expand (inoperative)	Crew	1. Visually inspect fingers for debris. 2. Request aid of second crewman to apply additional force to FTT knob. 3. Apply impact pressure on knob by knocking on the LM landing gear.	If FTT will not function, the RTG cannot be fueled and ALSEP will be abandoned.

Event No.	Contingency	Responsible Agent	Action	Remarks
10.9	Capsule will not release from cask body after FTT is attached and locked.	Crew	1. Apply additional side loads by wiggling on FTT while pulling capsule out. 2. Retract FTT, rotate 120° and repeat task in all three positions. 3. Using MESA hammer, apply intact force on side of cask body to free the capsule. 4. Using MESA hammer, apply impact force on the end of the FTT to free the capsule. 5. Allow for back plate cool down (5-10 min.) and repeat task.	If capsule cannot be released, abandon ALSEP.
10.10	FTT will not release from capsule while in RTG body.	Crew	1. Visually check engagement alignment. 2. Check for full outward travel of FTT fingers. 3. Apply additional force to release knob. 4. Leave FTT in place on the fueled RTG. While the CDR carries subpackage #2 in the barbell mode, the LMP will monitor the RTG/Capsule during preparation for the traverse to the site.	There will be no problem of excessive heat buildup if the FTT cannot be disengaged from the fueled RTG.

10.0 RTG Fueling

Event No.	Contingency	Responsible Agent	Action	Remarks
10.11	Tempilabel indicates temperature of component is in excess of 250°F.	Crew	Do not handle component manually. Use UHT or MESA tool to avoid direct contact with hot component.	Direct exposure to temperatures in excess of 250°F could damage or fail the space suit.

11.0 ALSEP Traverse

Event No.	Contingency	Responsible Agent	Action	Remarks
11.1	Carry bar will not engage in subpackage keyhole socket.	Crew	1. Check mating bar to see if properly mated. Mating bar could be mated 180° out of phase. 2. Ensure flange on carry bar is free of debris; if not, clean by impact or with gloved hand. 3. Ensure keyhole socket is clean; if not, clean with available MESA tools on UHT. 4. If one or both sockets are unuseable, the LMP must carry subpackage #1 and subpackage #2 in suitcase mode, CDR will pull MET and carry LR^3.	The carry bar is required for use as an antenna mast and must be transported to the ALSEP deployment site.
11.2	Carry bar sections become disengaged and rotate.	Crew	1. Attempt to relock carry bar sections. 2. If carry bar sections do not lock, disengage carry bar from subpackages. Use suitcase carry mode and transport carry bar on MET.	If carry bar sections do not lock, ensure that sections are properly aligned when they are used as an antenna mast in order to permit proper alignment of ALSEP antenna.

11.0 ALSEP Traverse

Event No.	Contingency	Responsible Agent	Action	Remarks
11.3	Carry bar becomes disengaged from subpackage.	Crew	1. Attempt to re-engage carry bar in subpackage keyhole socket.	The carry bar is required for use as an antenna mast and must be transported to the ALSEP deployment site.
			2. If carry bar will not remain in keyhole socket, use suitcase carry mode and transport carry bar on MET.	
11.4	Carry bar binds in keyhole socket on subpackage.	Crew	1. Ensure trigger release is operable.	
			2. If trigger is released, apply additional downward pressure while applying side loads to subpackage #2.	
			3. Request aid of CDR 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. Attempt 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 to subpackage.	The ALSEP antenna may be roughly aligned with the antenna aiming mechanism mounted on the central station sunshield.

11.0 ALSEP Traverse

Event No.	Contingency	Responsible Agent	Action	Remarks
11.5	Planned deployment site >300 feet west of LM (12 o'clock) unsuitable for ALSEP deployment.	Crew	Select alternate site >300 feet Northwest to West or Southwest to West of LM.	Landing site analysis may provide additional inputs.
11.6	Planned deployment site includes a crater with walls that slope more than 5°.	Crew	Locate ALSEP components on rim of crater, on elevated local terrain or select another deployment site.	If the craters south wall slopes more than 5°, select another deployment site.
11.7	Planned deployment site includes an outcropping whose height is greater than 1 foot.	Crew	1. Locate ALSEP components at least 12 feet from a 1-foot outcropping, 24 feet from a two-foot outcropping, etc. 2. If coutcropping cannot be avoided, orient ALSEP components thermal radiators away from outcropping (so as to achieve a clear view of space).	
11.8	Planned deployment site is in LM shadow.	Crew	Locate ALSEP components outside LM shadow, but within ± 15° of E-W axis drawn through $\overline{LM}$.	Separation distance from LM is more critical than angular relationship with respect to LM E-W axis.
11.9	Planned deployment site is comprised of loose, granular soil or small rocks.	Crew	1. Compact individual areas prior to final emplacement of each ALSEP component. 2. Attempt to avoid emplacing ALSEP components on small rocks.	

12.0 Subpallet Removal

Event No.	Contingency	Responsible Agent	Action	Remarks
12.1	Carry bar will not stow on subpallet taper fitting.	Crew	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 MET.	The carry bar is required for use as an antenna mast and cannot be discarded or emplaced on the lunar surface where debris might foul the subpackage or aiming mechanisms interfaces.
12.2	Unable to locate subpackage #1 10 feet due West of subpackage #2.	Crew	Locate subpackage #1 as far from subpackage #2 as possible and attempt to keep RTG out-of-field of view of Central Station radiator.	

12.0 Subpallet Removal

Event No.	Contingency	Responsible Agent	Action	Remarks
12.3	Subpallet boydbolt spline will not depress.	Crew	1. Check hex head of UHT and, if damaged, use second UHT. 2. Use hammer on top of UHT to force depression of boydbolt spline. 3. Attempt to overcome spline lock by forcefully rotating UHT. 4. Leave subpallet on subpackage #2.	If subpallet cannot be removed, RTG will not radiate heat evenly causing excessive heat buildup.
12.4	Subpallet boydbolt will not rotate.	Crew	1. Check hex head of UHT and, if damaged, use second UHT. 2. Remove SIDE/CCGE, PSE Stool and antenna aiming mechanism and then use MESA hammer to attempt to break fastener. 3. Leave subpallet on subpackage #2.	If subpallet cannot be removed, RTG will not radiate heat evenly, causing excessive heat buildup.

12.0 Subpallet Removal

Event No.	Contingency	Responsible Agent	Action	Remarks
12.5	Subpallet will not come off subpackage #2	Crew	1. Ensure both boydbolts have been released. 2. Use UHT to ensure that boyd-bolts have been sprung upward. 3. Ensure that front of subpallet has been raised 3/8 inch to clear the mounting stud. 4. Use hammer to force forward movement of subpallet. 5. Leave subpallet on subpackage #2.	If subpallet cannot be removed, RTG will not radiate heat evenly causing excessive heat buildup.

13.0 RTG Cable Interconnect

Event No.	Contingency	Responsible Agent	Action	Remarks
13.1	RTG cable reel boydbolts cannot be released.	Crew	1. Visually check (if possible) to see if bolt is released and not loose/raised due to side loading. 2. Check for spring loading on bolt. 3. Repeat release procedure, i.e., engage depress, rotate ccw 75°. 4. Insert UHT and apply downward pressure on center spline. Use hammer if necessary, turn ccw to release. 5. If spline is depressed and bolt will not rotate, back off slightly cw then turn back ccw, and wiggle. 6. Visually check hex head on UHT and if broken, use second tool. 7. If procedure fails to release bolts, tilt package on carry handle side, and utilize UHT to unwind cable manually to expose shorting plug. 8. With the aid of the second crewman, release pull pin and retainers. 9. Lower package to lunar surface.	Exercise caution when working in close proximity to hot RTG. If RTG cable reel cannot be removed, RTG will not radiate heat evenly, causing excessive heat buildup.

Event No.	Contingency	Responsible Agent	Action	Remarks
13.2	Cable reel falls to the lunar surface when final boydbolt is removed.	Crew	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. The CDR will retrieve reel with UHT, deploy the cable, lay the reel assembly on subpackage #1, secure with UHT and continue deployment.	

13.0 RTG Cable Interconnect

Event No.	Contingency	Responsible Agent	Action	Remarks
13.3	RTG cable reel tempilabel dots are all black.	Crew	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. Attempt to carry out RTG cable interconnect using available tools and materials. 4. Stow shorting plug on sub-package #1 until cool enough to handle manually.	If shorting plug cannot be mated to Central Station, abandon ALSEP.

13.0 RTG Cable Interconnect

Event No.	Contingency	Responsible Agent	Action	Remarks
13.4	Shorting plug pull pin does not release.	Crew	1. Apply additional force while rotating pin. 2. Apply additional force on pin with MESA hammer or break pin. 3. Use MESA hammer to break bracket. 4. Attempt to separate cable from shorting switch. 5. If shorting plug cannot be mated to Central Station, abandon ALSEP.	If ALSEP deployment is terminated anytime prior to Central Station activation, the RTG shorting plug reset lanyard will be pulled to assure the RTG is shorted.

13.0 RTG Cable Interconnect

Event No.	Contingency	Responsible Agent	Action	Remarks
13.5	Shorting plug connector fails to engage and lock to Central Station (C/S).	Crew	1. Check shorting plug connector for proper orientation. 2. Check both connectors for debris on pins or C/S receptacle. 3. Depress outer flange of shorting plug connector to ensure proper function ($\frac{1}{4}$" sliding action). 4. Reconnect applying additional downward pressure on the flange assembly with the LMP helping to provide additional stability (LMP can aid by holding PLSS). 5. Manually separate the shorting plug from the RTG cable, discard and connect RTG cable directly to C/S. 6. Abandon ALSEP.	

13.0 RTG Cable Interconnect

Event No.	Contingency	Responsible Agent	Action	Remarks
13.6	Ampere gauge unreadable due to debris or arrow in ampere gauge is at zero (no movement).	Crew	1. Report condition and continue ALSEP deployment. 2. Reset the shorting switch if reading is zero.	
13.7	Shorting plug depressed but ammeter shows no drop in amperage.	Crew	1. Reset the switch, and re-depress. 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 connector to Central Station.	Absence of amperage drop is not justification for abandoning ALSEP deployment.
13.8	Shorting plug engages, but fails off when subpackage is rotated.	Crew	1. Return subpackage to vertical position, retrieve cable, remove any debris and remate connectors. 2. Ensure locking mechanism is fully forward.	

14.0 Passive Seismic Experiment

Event No.	Contingency	Responsible Agent	Action	Remarks
14.1	Deploy PSE Stool (Boyd bolt fails to release)	Crew	1. Insert UHT and apply downward pressure on center spline. Use hammer if necessary; turn ccw to release. 2. If spline is depressed and bolt will not rotate, back off slightly cw then turn back ccw and wiggle. 3. Visually check hex head on UHT, if broken, use second tool. 4. Attempt to pry the retainer bracket assembly loose with MESA hammer.	The PSE sensor could be placed directly on the lunar surface, if the PSE stool cannot be released. Experiment thermal control and science may be degraded.
14.2	Unable to deploy PSE stool 10 feet northwest of Central Station.	Crew	Locate PSE stool as far from Central Station and ASE mortar package as possible.	
14.3	Unable to pack lunar surface.	Crew	Provide best PSE stool to lunar surface coupling that site will permit.	

14.0 Passive Seismic Experiment

Event No.	Contingency	Responsible Agent	Action	Remarks
14.4	Boyd bolts do not release on PSE mounts.	Crew	1. Visually check (if possible) to see if bolt is released and not loose/raised due to side loading. 2. Check for spring loading on bolt. 3. Insert UHT and apply downward pressure on center spline. Use hammer if necessary; turn ccw to release. 4. If spline is depressed and bolt will not rotate, back off slightly cw then turn back ccw and wiggle. 5. Visually check hex head on UHT, if broken, use second tool. 6. Leave experiment on sunshield and deploy PSE/Central Station as one unit. Do not deploy PSE skirt. 7. Force cable reel free from retainer bracket and deploy sufficient cable to allow sunshield deployment.	Sunshield can be raised with sensor mounted.

14.0 Passive Seismic Experiment

Event No.	Contingency	Responsible Agent	Action	Remarks
14.5	PSE binds on pallet and will not come off in normal manner using UHT.	Crew	1. Ensure the front portion of the subpallet has been raised (3/8") to clear the mounting stud. 2. Apply side loads. Kick with lunar boot (foot) as necessary to eliminate binding. 3. Assist the forward movement of the PSE with the lunar boot making sure the mounting stud is clear. 4. With the second crewman's help, manually aid in removal by using the back support structure as additional lever. 5. Leave PSE on sunshield and deploy PSE/Central Station as one unit. Do not deploy PSE skirt. 6. With UHT, tear away or deploy cable from cable reel.	
14.6	UHT will not engage in PSE carry socket.	Crew	1. Try to engage second UHT in carry socket. 2. If UHT engagement fails, deploy manually or remove girdle, partially open shroud/skirt assembly and manually emplace experiment using gnomon.	Reduced alignment accuracy if gnomon is handled. NOTE: At 1/6 gravity the skirt should not unfold and cause interference.

14.0 Passive Seismic Experiment

Event No.	Contingency	Responsible Agent	Action	Remarks
14.7	Experiment falls off UHT due to accidental triggering of UHT.	Crew	1. Using UHT, retrieve cable and gently lift experiment with cable. Secure mounting lug (tab) with hand and attempt to re-engage UHT in socket.	Reduced thermal control due to degradation of skirt and shroud assembly with lunar debris.
			2. If UHT engagement fails pull shroud pin, discard shroud/skirt assembly and emplace experiment manually using PSE gnomon as a handle.	Reduced alignment accuracy due if gnomon is handled. NOTE: At 1/6 gravity, skirt should not unfold and cause interference.
14.8	Experiment falls off PSE stool while leveling after skirt fully deployed.	Crew	1. Retrieve experiment with UHT handle hooked into gnomon opening and lift experiment.	Reduced thermal control due to degradation of skirt and shroud assembly with lunar debris and reduced alignment accuracy due to handling of gnomon.
			2. Grasp thermal skirt and raise to a position to observe stool.	
			3. Lower experiment on stool.	
14.9	Thermal shroud will not lay flat at outer edge.	Crew	Place discarded ALSEP parts and/or lunar rocks on shroud edge.	
14.10	UHT punctures thermal shroud during leveling sequence.	Crew	Remove UHT from puncture and attempt to cover the opening, if the hole remains.	Experiment thermal control may be degraded.

14.0 Passive Seismic Experiment

Event No.	Contingency	Responsible Agent	Action	Remarks
14.11	Lunar debris degrades readability of bubble leveling indicator and alignment index on shroud.	Crew	1. Level by using the local surface area as a reference (PSE shadow).	Improper alignment will result in difficulty correlating PSE data to a position on the lunar surface.
			2. Ensure ample picture coverage is obtained to verify experiment orientation.	Without $\pm 5^{\circ}$ leveling of LP XYZ and tidal sensors, sensors will not operate.

15.0 Active Seismic Experiment

15.1 Thumper/Geophone (T/G) Offload

Event No.	Contingency	Responsible Agent	Action	Remarks
15.1.1	Thumper/Geophone boyd bolts fail to release.	Crew	1. Visually check (if possible) to see if bolt is released and not loose/raised due to side loading. 2. Check for spring loading on bolt. 3. Insert UHT and apply downward pressure on center spline. Use hammer if necessary; turn ccw to release. 4. If spline is depressed and bolt will not rotate, back off slightly cw, then turn back ccw and wiggle. 5. Visually check hex head on UHT, if broken, use second tool. 6. Use MESA hammer to break shaft of T/G and attempt to retrieve mortar package, but avoid damaging geophones and cable reels. 7. Leave ASE on sunshield and deploy ASE/Central Station as one unit. 8. Use UHT to unreel sufficient cable to permit sunshield deployment.	Thumper activity would be lost, but geophones and mortar package would still be functional. Experiment thermal control and science, as well as Central Station thermal control, will be degraded.

15.0 Active Seismic Experiment

15.1 Thumper/Geophone (T/G) Offload

Event No.	Contingency	Responsible Agent	Action	Remarks
15.1.1 (Cont'd.)			9. Attempt to cut or break ASE cables or break ASE connectors in order to permit sunshield deployment.	If unsuccessful, sunshield will not deploy and Central Station thermal control will be degraded. Loss of ASE will permit successful operation of remainder of ALSEP.
15.1.2	T/G restraining arm will not rotate.	Crew	1. Obtain aid of second crewman to force T/G restraining arm rotation.	Avoid damaging T/G.
			2. Use hammer to jar or break restraining arm.	
			3. Attempt to continue ASE deployment with T/G on plate assembly.	Thumper activity would be lost, but geophones and mortar package would still be functional.
15.1.3	T/G falls off plate assembly or dropped during transport to MET.	Crew	Use UHT handle to retrieve T/G from lunar surface and remove debris, as required.	
15.1.4	T/G section cannot be unfolded.	Crew	1. Obtain aid of second crewman to force T/G unfolding.	
			2. Use hammer to jar or force unfolding.	Avoid damaging T/G.
			3. Attempt to continue ASE deployment with T/G still unfolded.	Thumper activity would be lost, but geophones and mortar package would still be functional.

15.0 Active Seismic Experiment

15.1 Thumper/Geophone (T/G) Offload

Event No.	Contingency	Responsible Agent	Action	Remarks
15.1.5	T/G sleeve will not lock.	Crew	1. Obtain aid of second crewman to force T/G locking. 2. Use hammer to jar or force unfolding. 3. Attempt to continue ASE deployment with T/G sleeve unlocked, but exercise caution.	Avoid damaging T/G.

15.0 Active Seismic Experiment

15.2 Mortar Package Assembly (MPA) Deployment

Event No.	Contingency	Responsible Agent	Action	Remarks
15.2.1	Switch #5 cannot be turned cw to OFF position.	Crew	1. Report to MCC.	
			2. Apply additional force to switch.	
			3. Do not continue mortar package deployment if unable to turn switch #5.	ASE science will be degraded but astronaut safety hazard may exist if mortar package deployment is continued.
15.2.2	UHT will not engage in MPA carry socket.	Crew	1. Try to engage second UHT in carry socket.	
			2. If UHT engagement fails, deploy manually (i.e., using MPA antenna to lower MPA to lunar surface).	MPA antenna is fragile and subject to damage.
15.2.3	MPA binds on pins during removal from sunshield.	Crew	1. Rock MPA and apply additional force.	
			2. Obtain aid of second crewman.	
			3. Leave MPA on sunshield and deploy MPA/Central Station as one unit.	MPA thermal control and science, as well as Central Station, will be degraded. Thumper activity will not be effected
			4. Use UHT to unreel sufficient cable to permit sunshield deployment.	If unsuccessful, sunshield will not deploy and Central Station thermal control will be degraded. Loss of MPA will permit successful operation of remainder of ALSEP. Thumper activity will not be effected.
			5. Attempt to cut or break MPA cable or break connector in order to permit sunshield deployment.	

15.2 Mortar Package Assembly (MPA) Deployment

Event No.	Contingency	Responsible Agent	Action	Remarks
15.2.4	Experiment falls off UHT due to accidental triggering of UHT release mechanism.	Crew	1. Use UHT handle to retrieve cable, gently lift experiment, manually secure experiment and attempt to re-engage UHT in socket.	Reduced thermal control due to degradation of experiment with lunar debris.
			2. If UHT engagement fails, deploy manually (i.e., using MPA antenna to lower MPA to lunar surface).	MPA antenna is fragile and subject to damage.
15.2.5	Unable to deploy MPA 10 feet west of Central Station	Crew	Locate MPA as far from Central Station and PSE as possible and attempt to keep PSE and Central Station in front of MPA, but out of the MPA line of fire.	
15.2.6	MPA carry socket pull pin jams.	Crew	1. Apply additional force while rotating pin or break pin with MESA hammer.	
			2. If unsuccessful, deploy manually (i.e., using MPA antenna to lower MPA to lunar surface).	
15.2.7	Leg does not deploy or lock during emplacement.	Crew	1. Apply additional force in an attempt to deploy and lock leg.	
			2. If unsuccessful, use lunar surface material to shore up MPA.	Since MPA must be stable during and after firing, the lunar surface material must be compacted so as to form a firm base for MPA emplacement.

15.2 Mortar Package Assembly (MPA) Deployment

Event No.	Contingency	Responsible Agent	Action	Remarks
15.2.8	Safety rod release latch will not release.	Crew	1. Check hex head of UHT and if damaged, use second UHT. 2. Attempt to overcome lock by forcefully rotating UHT. 3. If unsuccessful, retrieve lanyard and attempt to remove safety rods. 4. If latch will not rotate or lanyard breaks, abandon mortar package deployment.	ASE science will be degraded.
15.2.9	Mortar package safe/arm switch jams.	Crew	1. Check hex head of UHT and, if damaged, use second UHT. 2. Apply additional force. 3. If switch will not rotate, abandon mortar package deployment.	Mortar package will not fire unless both the safe and arm switches are rotated.

15.0 Active Seismic Experiment

15.3 Geophone Deployment

Event No.	Contingency	Responsible Agent	Action	Remarks
15.3.1	A prime geophone deployment site not suitable for geophone deployment.	Crew	1. Move the site up to 10 feet in a lateral direction from the geophone/mortar line.	If geophone line cannot be deployed in straight line, science data will be degraded.
			2. Move the geophone/mortar line to a more suitable location.	
			3. Wedge geophone spike vertically ($\pm$ 5°) into a crack between rocks or boulders. Also, rocks should be placed on top of geophone to aid in maintaining contact with underlying rock.	Caution should be exercised during geophone deployment to avoid putting any strain on cables to ensure that none of the geophones have been disturbed or pulled out of the lunar surface.
15.3.2	Unable to deploy geophone southeast of Central Station.	Crew	Deploy geophones anywhere south to southeast of the Central Station.	The crewman should survey the deployment area and recommend the exact deployment direction of the geophone and MPA so that the geophones are deployed on flat terrain and not in craters if possible and that the MPA does not launch the grenades into a ridge area.
15.3.3	Thumper falls on lunar surface.	Crew	Use UHT handle to retrieve thumper from lunar surface and remove debris, as required.	

15.0 Active Seismic Experiment

15.3 Geophone Deployment

Event No.	Contingency	Responsible Agent	Action	Remarks
15.3.4	During deployment the cable becomes suspended between crater rim edges.	Crew	1. If it is a crater of less than 2 feet in depth, continue deployment.	Geophone cable line should not cross craters in depth of 2 feet or more due to possibility of suspended cable pulling a geophone out of the lunar surface.
			2. If it is a crater of larger depth than 2 feet, attempt to place geophone on rim or outside crater area.	
15.3.5	During a geophone deployment, its planned placement changes to a very rocky location.	Crew	1. Move the geophone laterally with respect to the geophone deployment line.	Any geophone may be displaced laterally up to 10 feet from the geophone-mortar axis.
			2. If it is impossible to imbed the geophone spike, try to wedge the geophone vertically into a crack between rocks or boulders. If required, a small boulder should be placed on top of the geophone to hold it securely in contact with underlying rock.	Experiment science may be degraded.

15.0 Active Seismic Experiment

15.4 Thumper Activity

Event No.	Contingency	Responsible Agent	Action	Remarks
15.4.1	The prime thumping site not level.	Crew	The thumper should be aligned normal to the ground surface to obtain the firmest coupling of thumper baseplate to the lunar surface. The thumper traverse line may be moved up to 5 ft. in a normal direction to the geophone line for an improved site.	
15.4.2	An ASI does not fire.	Crew	1. Verify that the proper ASI has been selected.	
			2. Repeat the arming-firing sequence.	Be sure 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.	ASI failure to fire will not affect the mortar package activity.
15.4.3	Not enough time to plan for all 21 thumper ASI firings.	Crew/MCC	If unable to schedule for a complete thumping exercise then do as many as time allows.	

16.0 Suprathermal Ion Detector Experiment/ Cold Cathode Gauge Experiment

Event No.	Contingency	Responsible Agent	Action	Remarks
16.1	UHT will not engage in SIDE/CCGE carry socket.	Crew	1. Try to engage second UHT in carry socket. 2. If UHT engagement fails, deploy manually by grasping ground screen tube.	
16.2	Experiment falls off UHT due to accidental triggering of UHT release mechanism.	Crew	1. Use UHT handle to retrieve cable, gently lift experiment, manually secure ground screen tube or leg and attempt to re-engage UHT in socket. 2. If UHT engagement fails, deploy manually by grasping ground screen tube.	
16.3	Crewman walks too far and jerks Central Station out of alignment	Crew	1. Carry experiment back toward Central Station to provide slack cable, continue deployment of SIDE/CCGE and realign Central Station and check other experiments upon return. 2. Check cable and connector at experiment and Central Station interfaces for visible signs of damage.	

16.0 Suprathermal Ion Detector Experiment/ Cold Cathode Gauge Experiment

Event No.	Contingency	Responsible Agent	Action	Remarks
16.4	SIDE/CCGE boyd bolt spline will not depress.	Crew	1. Check hex head of UHT and, if damaged, use second UHT. 2. Use hammer on top of UHT to force depression of boydbolt spline. 3. Attempt to overcome spline lock by forcefully rotating UHT. 4. Leave SIDE/CCGE on subpallet and deploy SIDE/CCGE subpallet as one unit.	Experiment thermal control and science may be degraded.
16.5	SIDE/CCGE boyd bolt will not rotate.	Crew	1. Check hex head of UHT and, if damaged, use second UHT. 2. Leave SIDE/CCGE on subpallet and deploy SIDE/CCGE subpallet as one unit.	Experiment thermal control and science may be degraded.
16.6	SIDE/CCGE will not come off subpallet.	Crew	1. Ensure all boydbolts have been released. 2. Use UHT to ensure that boyd-bolts have been sprung upward. 3. Leave SIDE/CCGE on subpallet and deploy SIDE/CCGE subpallet.	Experiment thermal control and science may be degraded.

16.0 Suprathermal Ion Detector Experiment/ Cold Cathode Gauge Experiment

Event No.	Contingency	Responsible Agent	Action	Remarks
16.7	Connector retainer pull pin does not release	Crew	1. Attempt release by pushing down on fastener before pulling up, using UHT. 2. Apply additional force while rotating pin. 3. Use MESA hammer or break pin.	
16.8	Cable reel does not deploy from experiment stowage cavity.	Crew	1. Check to see if boyd bolt and cup are free; if not, remove manually. 2. Grasp the reel and remove manually. 3. Use second UHT handle to aid in extracting the reel. 4. Deploy as much cable as possible which tends to force the reel out. 5. Deploy experiment as far from ALSEP in the preferred direction as possible.	Experiment thermal control and science may be degraded.
16.9	SIDE connector falls to lunar surface.	Crew	1. Retrieve connector with UHT handle in pull ring on lanyard. 2. Retrieve connector by lifting cable and working hand along cable to connector. 3. Ensure connector is free of foreign particles.	

16.0 Suprathermal Ion Detector Experiment/ Cold Cathode Gauge Experiment

Event No.	Contingency	Responsible Agent	Action	Remarks
16.10	Unable to deploy legs.	Crew	1. If lanyard breaks, attempt to remove pin manually.	
			2. Emplace experiment on lunar surface with legs in a stowed position.	Experiment stability may be degraded.
16.11	UHT will not engage in ground screen socket.	Crew	1. Attempt to release ground screen with UHT and to remove and deploy ground screen manually.	
			2. Try to engage second UHT in ground screen socket.	
			3. If unsuccessful, continue SIDE/CCGE deployment without ground screen.	SIDE science will be degraded.
16.12	Ground screen will not disengage from UHT with trigger during screen deployment.	Crew	1. Manually remove screen from UHT.	
			2. Deploy screen manually and drop on the lunar surface as flat as possible.	
			3. If UHT will not disengage, leave it on the screen and continue deployment using second UHT.	Loss of one UHT will increase deployment time. Second crewman could carry out geological tasks while first crewman completes ALSEP deployment.

16.0 Suprathermal Ion Detector Experiment/ Cold Cathode Gauge Experiment

Event No.	Contingency	Responsible Agent	Action	Remarks
16.13	SIDE falls over while emplacing experiment or removing dacron bag.	Crew	1. Attempt to pick up experiment by cable after retrieving cable with UHT. 2. Grasp experiment at reel housing and reinsert UHT. 3. Clean experiment with thermal glove or through gentle impact.	Reduced thermal control due to degradation of experiment with lunar debris.
16.14	SIDE leg breaks.		1. Prop up experiment on RTG cable reel, rock, or other lunar debris. 2. Break off remaining legs and emplace experiment directly on the RTG cable reel or on the surface.	Place ground screen beside experiment (not touching SIDE or CCGE). Experiment thermal control may be degraded.
16.15	Connector fails to engage to Central Station	Crew	1. Check connectors on cable and Central Station for foreign material and bent pins. 2. Remove or shake out debris. 3. Ensure outer flange is free to travel to the lock position. 4. Attempt to reconnect checking visual indicator (orange ring).	

Event No.	Contingency	Responsible Agent	Action	Remarks
16.16	Connector engages but falls off when package is rotated.	Crew	1. Return package to vertical position, retrieve cable (as above) check for foreign matter and remote connectors. 2. Ensure locking mechanism is fully forward and orange ring is visible.	
16.17	CCGE boyd bolt jams.	Crew	1. Check hex head of UHT and, if damaged, use second UHT. 2. Leave CCGE in stowage cavity and continue SIDE deployment.	Loss of CCGE will not interfere with successful operation of SIDE.
16.18	CCGE cannot be removed from stowage cavity.	Crew	1. Ensure that CCGE boydbolt is not preventing CCGE removal. 2. Use second UHT to aid in extracting CCGE. 3. Pull on cable in order to force the CCGE out of the cavity. 4. Leave CCGE in stowage cavity and continue SIDE deployment.	
16.19	CCGE cannot be oriented away from LM or C/S.	Crew	Orient North or South with as clear a view as possible. (Orifice perpendicular to E-W.)	

16.0 Suprathermal Ion Detector Experiment/ Cold Cathode Gauge Experiment

Event No.	Contingency	Responsible Agent	Action	Remarks
16.20	Dust cover releases when pull pin is removed.	Crew	Deploy with cover open, but minimize dust contamination.	Experiment thermal control science may be degraded.
16.21	Dacron dust bag does not come free.	Crew	Manually lift experiment and remove dacron bag.	

17.0 Charged Particle Lunar Environment Experiment

Event No.	Contingency	Responsible Agent	Action	Remarks
17.1.1	Boyd bolts fail to release.	Crew	1. Visually check (if possible) to see if bolt is released and not loose/raised due to side loading. 2. Check for spring loading on bolt. 3. Insert UHT and apply downward pressure on center spline. Use hammer if necessary; turn ccw to release. 4. If spline is depressed and bolt will not rotate, back off slightly cw then turn back ccw and wiggle. 5. Visually check hex head on UHT, if broken, use second tool. 6. Leave experiment on sunshield and deploy CPLEE/central station as one unit. 7. Force cable reel free from retainer bracket and deploy sufficient cable to allow sunshield deployment.	

Event No.	Contingency	Responsible Agent	Action	Remarks
17.1.2	CPLEE carry/removal socket unusable. UHT will not lock in socket.	Crew	1. Remove CPLEE manually by grasping leg. 2. Deploy cable from reel while grasping leg. 3. Emplace experiment while grasping thermal plate, using UHT (as required) to aid in emplacing unit upright. 4. Use UHT on thermal plate to align and level unit.	
17.1.3	Swivel socket pull pin jams.	Crew	1. Apply additional force while supporting experiment on HTC. 2. If unsuccessful, disengage UHT, emplace experiment by grasping thermal plate, and use UHT to level and align experiment.	
17.1.4	CPLEE dust cover comes off during deployment	Crew	Do not reinstall.	Continue deployment.
17.1.5	Experiment falls off UHT due to accidental triggering of UHT release mechanism.	Crew	1. Use UHT handle to retrieve cable, gently lift experiment, manually secure experiment and attempt to re-engage UHT in socket. 2. If UHT engagement fails, deploy manually (i.e., using CPLEE thermal plate and UHT, as required, to emplace unit upright).	Reduced thermal control due to degradation of experiment with lunar debris.

Event No.	Contingency	Responsible Agent	Action	Remarks
17.1.6	Unable to deploy CPLEE 10 feet northeast of Central Station.	Crew	1. Locate CPLEE as far from Central Station as possible. 2. Attempt to maintain a 10 foot separation between PSE and CPLEE. 3. Attempt to maintain a 10 foot separation between RTG and CPLEE.	
17.1.7	Unable to deploy legs.	Crew	1. If lanyard breaks attempt to remove pin manually. 2. Emplace experiment on lunar surface with legs in stowed position.	Experiment stability will be degraded.
17.1.8	Leg breaks off while emplacing the experiment.	Crew	1. Prop up experiment with core tube, penetrometer, or other lunar debris. 2. Break or fold remaining legs and emplace experiment directly on the lunar surface.	Experiment thermal control may be degraded.

Event No.	Contingency	Responsible Agent	Action	Remarks
18.1.1	Boyd bolt(s) fail to release.	Crew	1. Visually check (if possible) to see if bolt is released and not loose/raised due to side loading. 2. Check for spring loading on bolt. 3. Insert UHT and apply downward pressure on center spline. Use hammer if necessary; turn ccw to release. 4. If spline is depressed and bolt will not rotate, back off slightly cw then turn back ccw and wiggle. 5. Visually check hex head on UHT, if broken, use second tool. 6. Engage UHT in Subpackage #1 temporary stowage socket and use UHT as a lever to raise sunshield. 7. Leave sunshield in stowed condition and attempt to gain access to antenna mass bracket. 8. If unsuccessful, mount antenna aiming mechanism on sunshield.	Central Station thermal control will be degraded. Antenna aiming accuracy will be degraded.

Event No.	Contingency	Responsible Agent	Action	Remarks
18.1.2	Sunshield fails to raise after all boyd bolts are released.	Crew	1. Engage UHT in temporary stowage socket and raise sunshield manually with UHT as lever arm. 2. Check to see if rear thermal curtain on ALSEP antenna cable is jammed and release it with UHT handle, if required. 3. Check to see if curtain covers are marred. 4. If sunshield does not raise, remove curtain retainers and mount antenna mast bracket on the bottom shoe of the structure bracket.	
18.1.3	RF antenna cable reel lanyard breaks or pin jams.	Crew	1. Use handle of UHT to engage (hook) restraining brackets and bend/break restraining brackets off the sunshield. 2. Deploy cable using UHT.	
18.1.4	UHT will not engage in aiming mechanism housing carry socket.	Crew	1. Try to engage second UHT in carry socket. 2. If UHT engagement fails, deploy manually.	

Event No.	Contingency	Responsible Agent	Action	Remarks
18.1.5	Aiming mechanism boyd bolts fail to release.	Crew	1. Visually check (if possible) to see if bolt is released and not loose/raised due to side loading. 2. Check for spring loading on bolt. 3. Insert UHT and apply downward pressure on center spline. Use hammer if necessary; turn ccw to release. 4. If spline is depressed and bolt will not rotate, back off slightly cw, then turn back ccw and wiggle. 5. Visually check hex head on UHT, if broken, use second tool. 6. If unsuccessful, break housing off mounting legs with side loading to gain access to aiming mechanism. 7. If unable to gain access to aiming mechanism, mount antenna on Central Station sunshield brackets and point antenna toward earth.	Antenna aiming accuracy will be degraded.

Event No.	Contingency	Responsible Agent	Action	Remarks
18.1.6	Antenna mast binds on subpallet taper fitting.	Crew	Stand on edge of subpallet and rotate mast while applying additional lifting force on lower half.	
18.1.7	Aiming mechanism housing will not come off subpallet.	Crew	1. Ensure both boyd bolts have been released. 2. Use UHT to ensure that boyd bolts have been sprung upward. 3. If unsuccessful, use MESA hammer to break housing off mounting legs in order to gain access to aiming mechanism. 4. If unable to gain access to aiming mechanism, mount antenna on Central Station sunshield.	Antenna aiming accuracy will be degraded.
18.1.8	Antenna mast bracket on Central Station covered with lunar debris.	Crew	Clear area with lunar boot or use UHT to probe or jar bracket and free it of debris.	
18.1.9	Aiming mechanism falls out of housing on lunar surface.	Crew	Retrieve mechanism with UHT handle and shake off debris. Clean taper fitting with glove.	Reduced operational capability or jamming of the gears and pivot points is possible due to degradations of the aiming mechanism surfaces with lunar debris.

Event No.	Contingency	Responsible Agent	Action	Remarks
18.1.10	Aiming mechanism knobs will not rotate.	Crew	1. Apply additional force with hand and hammer, being careful not to damage mechanism. 2. Attempt to intentionally fail mechanism, achieve approximately correct orientation using sighting and shim or brace antenna to maintain aiming accuracy. 3. Remove antenna mast from C/S and push it into surface pointing at earth (rough alignment). 4. Adjust as required in real-time communication to capsule communicator.	
18.1.11	Antenna mast will not seat in bracket on Central Station.	Crew	1. Examine antenna mast for obstructions, dislodge obstructions by impact and reseat antenna mast in bracket in Central Station. 2. Use MESA 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.	If antenna mast cannot be fully seated in bracket the antenna aiming accuracy may be degraded. Caution: Do not damage aiming mechanism interface.

Event No.	Contingency	Responsible Agent	Action	Remarks
18.1.12	Aiming mechanism will not seat on antenna mast.	Crew	1. Examine antenna mast for obstructions, dislodge obstructions by impact and reseat aiming mechanism on antenna. 2. If aiming mechanism is partially seated and stable, continue with nominal deployment. 3. Examine antenna mast for damage and if damaged, mount aiming mechanism and antenna on sunshield.	If aiming mechanism cannot be fully seated on antenna mast the antenna aiming accuracy may be degraded.
18.1.13	Antenna will not seat on aiming mechanism.	Crew	1. Ensure cable outlet is properly oriented. 2. Examine antenna and aiming mechanism for obstructions, dislodge obstructions by impact and reseat antenna on aiming mechanism. 3. If antenna is partially but firmly seated on aiming mechanism, continue with nominal deployment. 4. Examine antenna and aiming mechanism for damage and, if damaged, mount antenna on sunshield.	

Event No.	Contingency	Responsible Agent	Action	Remarks
18.1.14	ALSEP deployment time becomes constrained.	Crew	1. If antenna is level and aligned, actuate the RTG shorting switch and ASTRO switch No. 1. 2. If antenna is not aligned or level and there will be a second EVA, do not actuate these switches. 3. If no second EVA, level and align as accurate as possible and actuate switches. 4. Do not activate any switches if none of the experiments have been deployed and no second EVA.	

Event No.	Contingency	Responsible Agent	Action	Remarks
19.1	Switch #1 cannot be turned cw to ON position	Crew	1. Report to MCC. 2. Verify that switch is in ccw position. 3. Apply additional force to switch. 4. Report to MCC and continue ALSEP deployment. Do not activate thumper until MCC confirms "ready".	
19.2	Switch #5 cannot be turned ccw to ON position.	Crew/MCC Crew Crew Crew/MCC	1. Report to MCC 2. Verify that switch is in cw position. 3. Apply additional force to switch. 4. Report to MCC and continue ALSEP deployment. Do not activate thumper until MCC confirms "ready".	MCC will command ASE on.

19.0 ALSEP Activation

Event No.	Contingency	Responsible Agent	Action	Remarks
19.3	Central Station contingency antenna alignment.	Crew	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.	

19.0 ALSEP Activation

Event No.	Contingency	Responsible Agent	Action	Remarks
19.4	Turn-on of ALSEP transmitter	Crew/MCC	1. Astronaut standby for manual turn-on of ALSEP transmitter.	Initiate command CD-4 (octal 015) "Transmitter B Select." If no response, advise astronaut via voice link to turn on transmitter
			2. Actuate ALSEP back-up switch No. 2 with following functions: a. Select Transmitter B. b. Turn on Transmitter. c. Reset receiver circuit breaker. d. Select and turn on data processor Y.	Acknowledge turn-on of transmitter by reception of RF signal from ALSEP.
			3. Advise MCC via voice link back-up switch No. 2 has been actuated.	Advise astronaut via voice link whether transmitter is functioning.
			4. Acknowledge MCC transmitter message via voice link.	
			5. If transmitter is not functioning, actuate ALSEP back-up switch No. 1, permitting PCU to operate on marginal voltage output of RTG.	
			6. If transmitter is still not functioning, actuate back-up switch No. 3, energizing all experiments, sequentially.	Acknowledge back-up switch No. 3 actuation via voice link. Confirm power turn-on by telemetry indication (Channe 12 and 14).
			7. Advise MCC via voice link that switch No. 3 has been actuated.	Advise astronauts that all experiments have been turned on via voice link.

Event No.	Contingency	Responsible Agent	Action	Remarks
19.5	MCC reports downlink signal problems.	Crew	1. Crew should verify that antenna is properly oriented, Central Station is properly leveled and aligned, and RF cable and connectors are intact.	
		Crew	2. Notify MCC if antenna did not require reorientation, leveling or alignment, and if RF cable and connectors are intact.	
		MCC	3. If antenna is properly oriented, Central Station is leveled and aligned and RF cable and connectors are intact, select Trans "B".	
		MCC/Crew	4. If unsuccessful, notify crew to adjust antenna pointing angle in small increments under MCC direction and to step back after each adjustment to avoid distortion of antenna beam pattern.	
		MCC	5. Request data through a site with 85 foot antenna.	
			6. Select "Slow Bit Rate".	
		MCC/Crew	7. If signal still too weak to yield useful data, notify crew to abandon thumper activity but to complete remainder of ALSEP deployment.	NOTE: HBR data not useable.

19.0 ALSEP Activation

Event No.	Contingency	Responsible Agent	Action	Remarks
19.6	Downlink frequency so unstable that MSFN receiver cannot synchronize.	MCC	1. Select redundant transmitter.	
		MCC/Crew	2. Select "Slow Bit Rate".	
		MCC/Crew	3. If signal still unstable, notify crew to abandon thumper activity but to complete remainder of ALSEP deployment.	
19.7	ALSEP fails to respond to command to switch to high bit rate.	MCC/Crew	1. Notify crew to turn Switch #4 cw to ON position.	
			2. If no change in data rate, notify crew to abandon thumper activity but to complete remainder of ALSEP deployment.	
19.8	Data absent in high bit rate mode.	MCC/Crew	1. Crew verify that Switch #5 is turned ccw to ON position.	
			2. Crew abandon thumper activity but complete remainder of ALSEP deployment.	

20.0 CSM/LM S-Band Transponder

Event No.	Contingency	Responsible Agent	Action	Remarks
20.1	No LM docking.	MCC	1. If CM lunar orbit mission, proceed with CM portion of experiment only. 2. If CM lunar flyby mission, scrub all experiment items.	

21.0 Down-Link Bi-Static Radar Observation of the Moon

Event No.	Contingency	Responsible Agent	Action	Remarks
21.1	VHF antenna failure.	Crew	Switch to other VHF antenna. Position S/C so that selected antenna faces lunar surface.	Assumes one antenna failure.
21.2	VHF ground equipment failure	Crew	Scrub VHF position of experiment.	Special VHF ground equipment located at Stanford University.
21.3	Not enough time for completion of both phases.	Crew	Try to do one complete phase.	Phase A - From Earth-Moon centerline traversing to Horizon (LOS). Phase B - From horizon (AOS) to Earth-Moon centerline.
21.4	S-band 210' dish at Goldstone not available.	Crew	Scrub S-band portion of experiment.	
21.5	Unable to determine S-band antenna pointing.	Crew	Scrub S-band portion of experiment.	

22.0 Gegenschein from Lunar Orbit

Event No.	Contingency	Responsible Agent	Action	Remarks
22.1	Not possible to schedule during lunar orbit.	MCC/Crew	Try during TEC.	Updated pointing and camera Settings may be required.
22.2	Film magazine jams or fails.	Crew	Switch to other magazine using dim light (fast) film.	
22.3	Attitude rates higher than allowed.	Crew	1. Control rates to low as possible.	May reduce number of exposures.
			2. Try 20-second exposures.	
22.4	Not enough time to accomplish all photography.	Crew	Photo priority	
			1. 20-second exposures	Of Moulton Point
			2. 20-second exposures	Of Antisolar Point
			3. 20-second exposures	of Midway Point
			4. 5-second exposures	of Moulton Point
			5. 5-second exposures	of Antisolar Point
			6. 5-second exposures	of Midway Point

23.0 ABBREVIATIONS AND ACRONYMS

ABBREVIATIONS	DEFINITIONS
ALSEP	Apollo Lunar Surface Experiment Package
ASI	Apollo Standard Initiator
CCGE	Cold Cathode Gauge Experiment
CDR	Commander
CPLEE	Charged Particle Lunar Environment Experiment
CSC	Contingency Sample Container
CSM	Command Service Module
DRT	Dome Removal Tool
EMU	Extravehicular Mobility Unit
EVA	Extravehicular Activity
FTT	Fuel Transfer Tool
GASC	Gas Analysis Sample Container
HTC	Hand Tool Carrier
LEC	Lunar Equipment Conveyer
LM	Lunar Module
LMP	Lunar Module Pilot
LRRR/LR^3	Laser Ranging Retro-Reflector
MCC	Mission Control Center
MESA	Modularized Equipment Stowage Assembly
MPA	Mortar Package Assembly
MSSC	Magnetic Shield Sample Container
PCU	Power Control Unit
PDR	Power Dissipation Resistor
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