Bendix

Aerospace Systems Division

ALSEP Contingency Procedures
For Apollo 16

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ATM-1077	

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The following contingency procedures represent various remedies for contingency events which may arise during the ALSEP deployment period.

This information will be used by the Apollo 16 crew and CAPCOM during training exercises with CPD and FOD and will be incorporated in the Mission Science Requirements Document which is to be used in the Science Support Room during the J-2/Apollo 16 Mission. This document adheres to the Revision B ALSEP deployment procedure, dated 1 December 1971, that is currently being used to train the Apollo 16 crew.

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A contingency event is defined as a possible malfunction or off-nominal event; an event that is not likely to occur, but still possible under certain circumstances.

These procedures represent, in approximately chronological order, the lunar surface EVA contingency events and the appropriate remedial actions to be undertaken by the astronauts or MCC in conjunction with the astronauts. The procedures encompass the following EVA functions pertaining to ALSEP:

If a contingency event occurs, the astronauts will generally spend up to a maximum of ten minutes engaged in remedial actions and then, if unsuccessful, abandon the deployment of the malfunctioning equipment. Additional time may be allocated for certain remedial actions (i.e., for ALSEP Offload, RTG Fueling and Cable Interconnect and for Central Station Deployment tasks required for successful ALSEP system operation). An additional time allocation will be based on a real-time decision made by the Flight Director and CAPCOM depending on PLSS consumable usage and timeline constraints.

In the event of a PLSS or operational contingency (i.e., a PLSS malfunction or an imminent consumables redline due to an inability to complete the deployment tasks within the nominal timeline), the sequence of ALSEP deployment tasks may be temporarily stopped after the completion of any one of the following hold points. In case the ALSEP deployment cannot be completed during EVA 1 and part of the deployment must be deferred to EVA 2, three prime hold points (following the completion of Tasks #3, 6 and 12) provide the highest return from an ALSEP system viewpoint. The deployment may be resumed at a later point intime by continuing with the next series of tasks.

1. Open SEQ Bay doors, offload ALSEP Subpackages #1 and #2, and emplace subpackages with handles upward, in and facing the sun. (Close SEQ Bay doors before a hold.)

2. Remove UHT's and carry bar.

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

4. Remove fuel cask dome.

5. Unstow ALSD, place on LRV.

6. Remove fuel capsule from cask and insert into RTG, close SEQ Bay doors, carry ALSEP and drive LRV to ALSEP deployment site, offload HFE subpallet and MPA pallet, pull shorting switch lanyard and connect RTG and HFE cables to Central Station, deploy HFE subpallet (*), offload and deploy HFE Probe Package (*), offload tool carrier, offload aiming mechanism, and rotate Central Station. (PRIME EVA 1 HOLD POINT) (**)

7. Offload and deploy PSE. (**)

8. Offload and deploy ALSD. (*) (**)

9. Offload ASE. (**)

10. Drill first bore hole and insert first probe into bore stem. (*) (**)

11. Offload and deploy LSM. (**)

12. Release sunshield Boyd bolts, raise sunshield, install antenna mast, install aiming mechanism on mast, install antenna on aiming mechanism and aim antenna (***). (PRIME EVA 1 HOLD POINT)

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

14. Depress shorting switch and turn on Astro Switch #1.

15. Offload and deploy HFE Electronics Package.

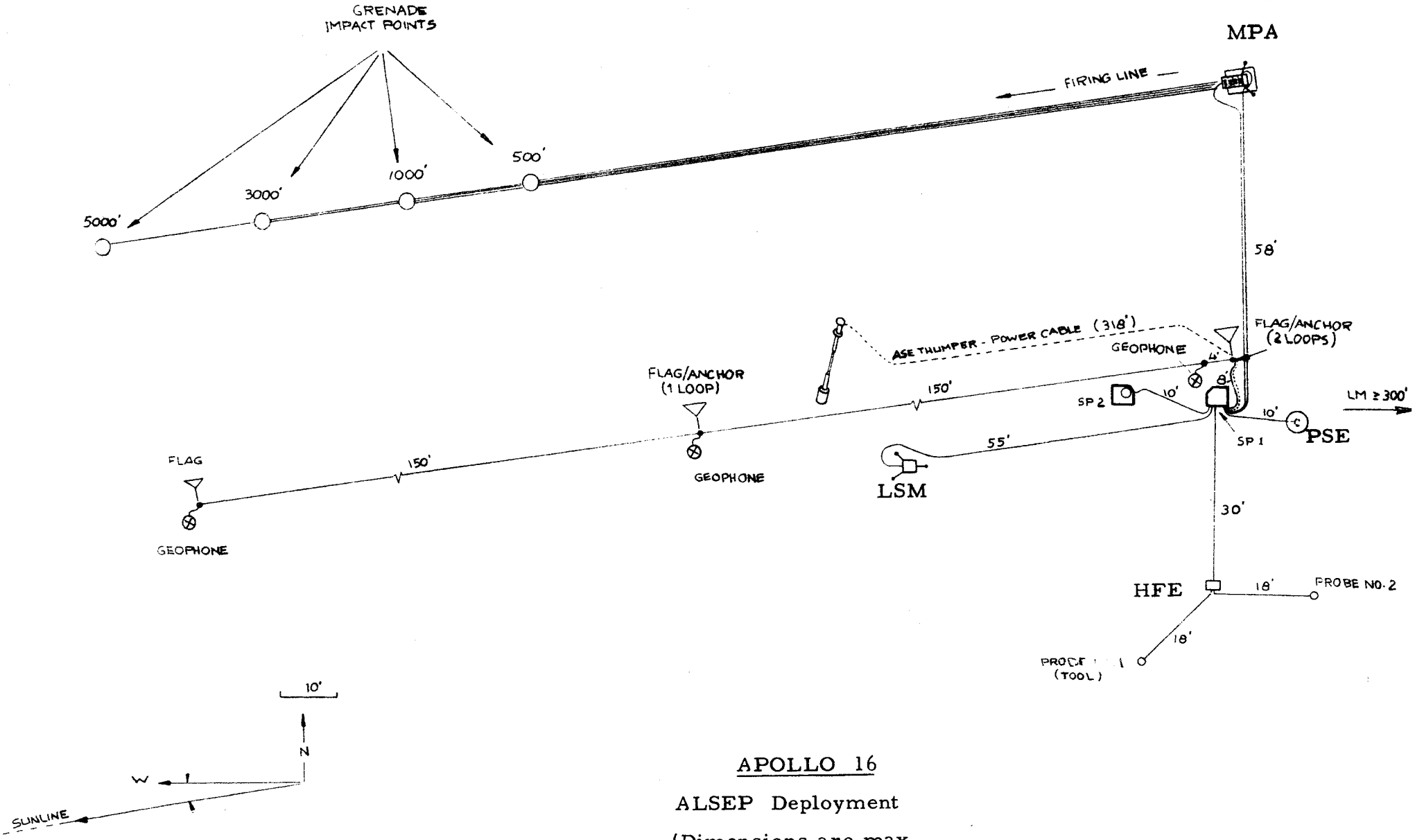
16. Turn on Astro Switch #5 and deploy ASE.

(*) May be deferred if a hold is imminent. HFE and ALSD tasks may be interrupted in order to permit completion of other, less time-consuming ALSEP tasks.

(**) If ammeter does not indicate any amperage after plug-in, (sunshield has not been raised), and a hold is imminent, pull shorting switch lanyard.

(***) Depress shorting switch and turn on Astro Switch #1 if a hold is imminent. Experiments can be commanded to standby power OFF so no hazard would exist for astronauts.

Real time decisions by the CDR, LMP, CAPCOM and SSR will cover any contingencies not anticipated in this document.



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ALSEP Deployment

(Dimensions are max. cable lenghts)

DESCARTES Landing Site:
15.5° E 8.9° S

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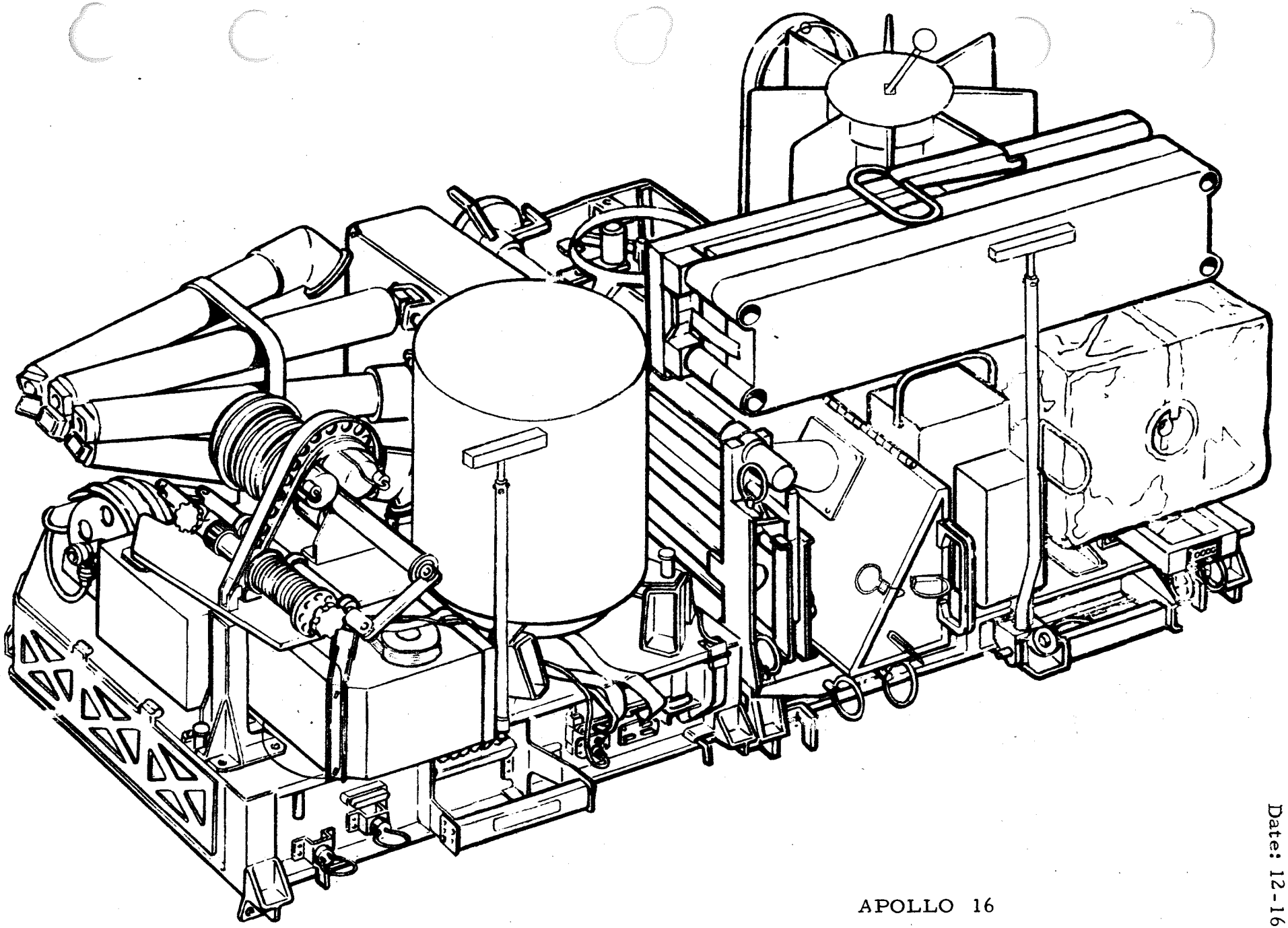

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Subpackage #1 and Subpackage #2

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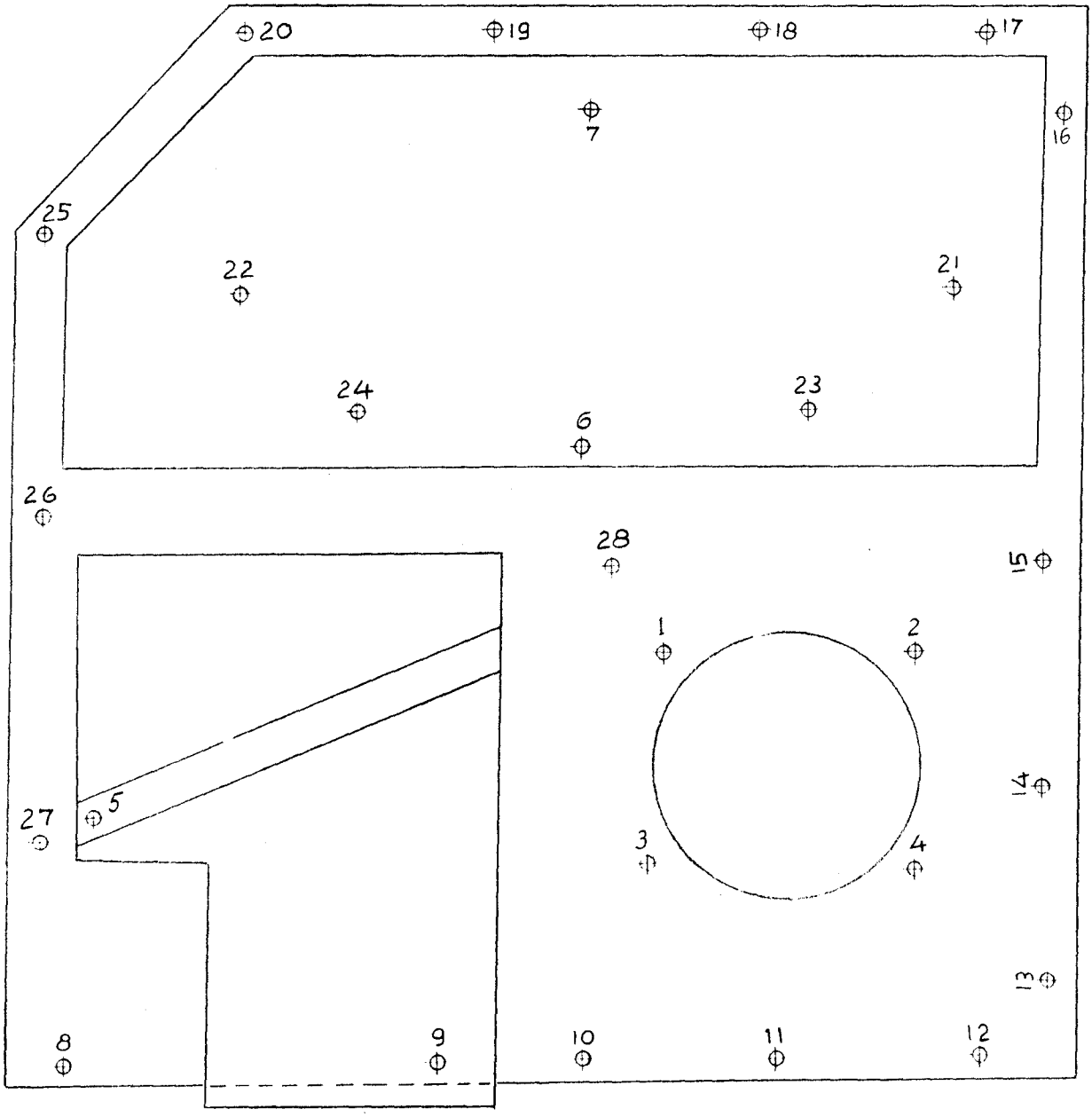
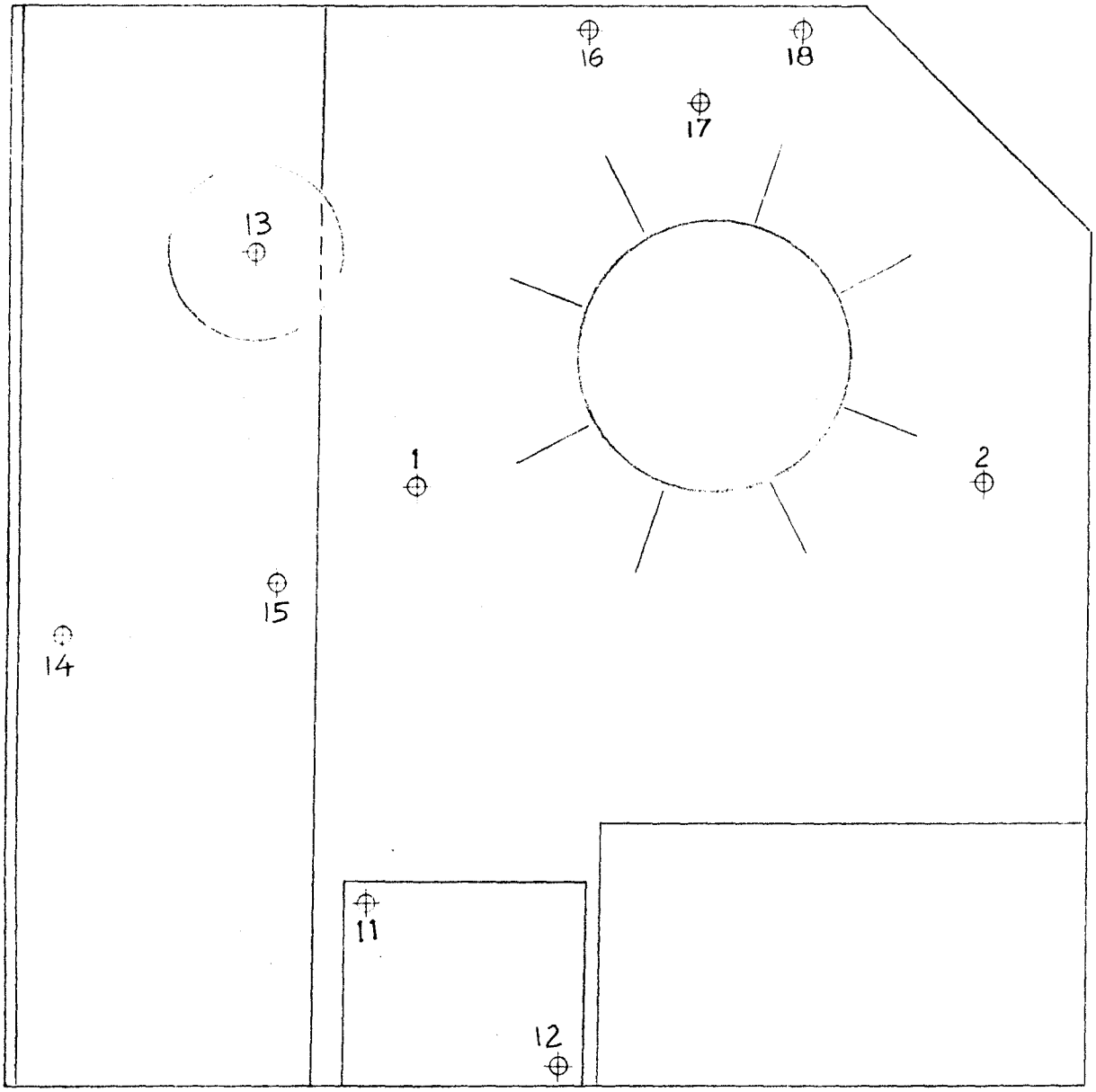
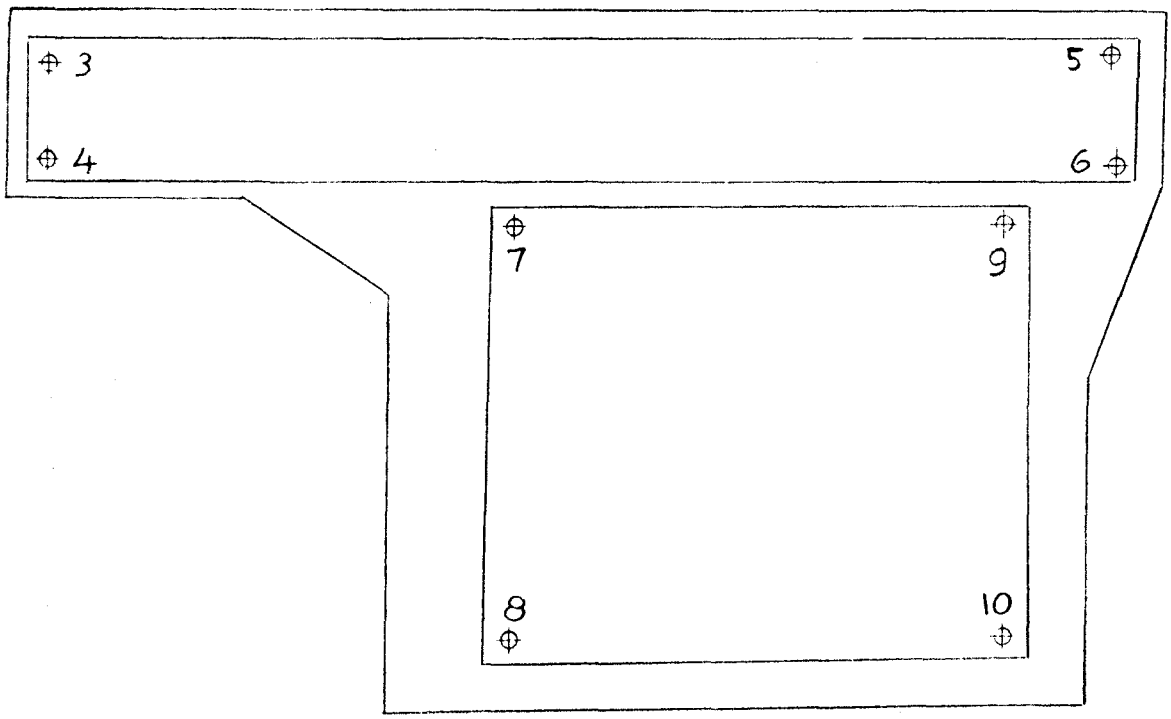


Subpackage #1 Boyd Bolt Locations



Subpackage #2 Boyd Bolt Locations



HFE Subpallet Boyd Bolt Locations

Event No.	Contingency	Agent	Action	Remarks
1.1	No time for EVA or time for one brief EVA only (1 or 2 man).	Crew	Do not deploy ALSEP.	
1.2	One man EVA 1 only.	Crew	1. Collect contingency sample.	
			2. Deploy ALSEP at least 300 feet west of LM.	Central Station thermal control and experiments' thermal control and science will be degraded if deployment site is east, south or north of LM.
			3. Perform lunar geology investigation on return traverse from ALSEP deployment site.	
1.3	Two man EVA 1 only.	Crew	1. Collect contingency sample.	
		Crew/ MCC	2. Make decision on ALSEP deployment site, trading off desire to deploy ALSEP in direction toward the nearest available and recognizable Descartes geological material and ALSEP requirement for deployment at least 300 feet west of LM. If trade-off dictates deployment in other than a westerly direction, ALSEP deployment should be at least 300 feet east of LM or, if this is not a satisfactory direction, first south and then north of LM.	Central Station thermal control and experiments' thermal control and science will be degraded if deployment site is east, south or north of LM.
		Crew	3. Perform lunar geology investigation during return traverse from ALSEP deployment site.	

Event No.	Contingency	Agent	Action	Remarks
1.4	One man EVA 1; EVA 2 planned.	Crew	1. Collect contingency sample. 2. Deploy all of ALSEP at least 300 feet west of LM. 3. Perform lunar geology investigation on return from ALSEP deployment site.	

Event No.	Contingency	Agent	Action	Remarks
2.1	SEQ Bay door lanyards unusable.	Crew	1. If lanyard free from cable, pull cable. 2. If lanyard melted and fused to Inconel, attempt to break lanyard free with hard pull. 3. If unable to manually break lanyard free, use MESA hammer to free lanyard and pull cable.	
2.2	SEQ Bay doors will not open when lanyard is pulled and there is no cable movement.	Crew	1. Pry open astronaut protection door, fail mechanism, and pull on lanyard again. 2. If unsuccessful, use MESA hammer to chop hole in main door Inconel shield at center patch, hook MESA hammer behind cable, pull to release latch and open door while latch is pulled, and continue to open door upward.	Exercise caution when working in close proximity to hot fuel cask.
2.3	SEQ Bay doors will not open when lanyard is pulled and there is a small cable movement.	Crew	1. Ensure that lanyard is not tangled. 2. Discontinue lanyard use and manually open astronaut protection door and raise SEQ Bay door.	Exercise caution when working in close proximity to hot fuel cask.
2.4	SEQ Bay door partially open and jammed.	Crew	1. Ensure that lanyard is not tangled. 2. Discontinue lanyard use and manually open astronaut protection door and raise SEQ Bay door. 3. If unsuccessful, continue pulling on lanyard and get assistance from second crewman to manually raise door.	Exercise caution when working in close proximity to hot fuel cask.

Event No.	Contingency	Agent	Action	Remarks
2.5	Astronaut protection door will not stay open.	Crew	1. Verify that door is fully open. 2. Continue with nominal ALSEP deployment sequence.	Exercise caution when working in close proximity to hot fuel cask.
2.6	SEQ Bay door will not stay open.	Crew	1. Verify that door is fully open and folded up over SEQ Bay. 2. If Quad II is low, secure door with velcro strap.	

Event No.	Contingency	Agent	Action	Remarks
3.1	Subpackage unlatching mechanism will not function.	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. If unsuccessful, use MESA hammer to pry outward from structure on right-hand link of latching mechanism, forcing latch over center and releasing subpackages.	
3.2	White portion of deployment lanyard will not release from base of subpackage.	Crew	1. Grasp release latch at base of subpackage and twist in an effort to break the latch or the slot. 2. If unsuccessful, attempt to cut lanyard with MESA hammer against LM or rock in order to break or tear (webbing) loose.	
3.3	Subpackage will not slide on rails.	Crew	Get assistance from second crewman.	
3.4	Subpackage strikes rails during offload.	Crew/ MCC	Check subpackage for visible signs of damage and notify MCC if there are visible signs of damage.	Equipment operation may be degraded if there are visible signs of damage.

Event No.	Contingency	Agent	Action	Remarks
3.5	Handling assembly pull pin jams.	Crew	1. Apply additional force while rotating pin. 2. Apply additional force on pin with MESA hammer on break pin. 3. Attempt to pry handling assembly away from subpackage. 4. If unsuccessful, attempt to break the handling assembly off at the point where the pin jammed, either manually or with MESA hammer. 5. If still unsuccessful, leave handling assembly on subpackage.	Access to Subpackage #1 temporary stowage socket will be prevented. Left strut on HFE subpallet would have to be collapsed to permit HFE subpallet removal from Subpackage #2.

Event No.	Contingency	Agent	Action	Remarks
4.1	Lower forward tool support pull pin jams.	Crew	1. Apply additional force while rotating pin.	
			2. Apply additional force on pin with MESA hammer or break pin.	
			3. Remove upper tool support pin and attempt to pry open the outer half of the bracket or break off the outer half of the bracket at the point where the pin is jammed.	The tools can be removed by prying the bracket away far enough to gain access to the tools.
			4. If unsuccessful, use MESA hammer to fail bracket in an attempt to retrieve tools.	
			5. If still unsuccessful, abandon ALSEP.	ALSEP can not be deployed without FTT and one UHT.
4.2	Upper forward tool support pull pin jams.	Crew	1. Apply additional force while rotating pin.	
			2. Apply additional force on pin with MESA hammer or break pin.	
			3. Ensure lower tool support pin has been removed and attempt to break off the outer half of the bracket at the point where the pin is jammed or at the bottom clevis.	
			4. If unsuccessful, use MESA hammer to fail bracket in an attempt to retrieve tools.	
			5. If still unsuccessful, abandon ALSEP.	ALSEP can not be deployed without FTT and one UHT.

Event No.	Contingency	Agent	Action	Remarks
4.3	ALSEP tool binds in stowage bracketry.	Crew	1. Jiggle tool and/or apply additional force, as appropriate.	
			2. Obtain assistance from second crewman.	
			3. If unable to remove one UHT, continue deployment using second UHT.	Although only one UHT is needed for deployment, deployment time will be increased. Second crewman could carry out geological tasks while first astronaut completes ALSEP deployment.
			4. If unable to remove either UHT, abandon ALSEP.	ALSEP can not be deployed without one UHT.
		Crew/ MCC	5. If unable to remove one or both carry bar sections, use suitcase carry mode to transport ALSEP to deployment site and, later, place aiming mechanism and antenna on Central Station sunshield and prop up for stability and to ensure assembly is level and adjust antenna under MCC direction to achieve good communication.	ALSEP antenna aiming accuracy will be degraded.
		Crew	6. If unable to remove DRT, attempt to gain access to fuel capsule by using MESA hammer/extension to destroy cask dome and pry away bands.	Exercise caution when working in close proximity to hot fuel cask.
			7. If dome can not be removed, abandon ALSEP	
			8. If unable to remove FTT, abandon ALSEP.	

Event No.	Contingency	Agent	Action	Remarks
4.4	UHT will not engage in subpackage temporary stowage socket.	Crew	Stow in alternate socket on PSE, HFE, HFE subpallet, or on Yo-Yo or LRV. Hook UHT handle in subpackage carry handle in order to rotate subpackage.	
4.5	Carry bar sections do not lock in position after being engaged and rotated.	Crew	1. Separate carry bar sections, examine for obstructions, dislodge obstructions by knocking sections together and reconnect sections. 2. If sections do not lock, use suitcase carry mode and transport carry bar on LRV.	The carry bar is required for use as an antenna mast and must be transported to the ALSEP deployment site. Ensure that sections are properly aligned when they are used as an antenna mast in order to permit proper alignment of ALSEP antenna.
4.6	Carry bar will not engage in Subpackage #1 keyhole socket.	Crew	1. Examine carry bar flange for obstructions, dislodge obstructions by impact and re-engage carry bar in subpackage keyhole socket. 2. Examine subpackage keyhole socket for obstructions, dislodge obstructions with UHT or MESA tools and re-engage carry bar in subpackage keyhole socket. 3. If keyhole socket is unusable, use suitcase carry mode and transport carry bar on LRV.	The carry bar is required for use as an antenna mast and must be transported to the ALSEP deployment site.

Event No.	Contingency	Agent	Action	Remarks
5.1	Astronaut is about to contact or has come in contact with hot fuel cask or metal part of cask lanyard.	Crew/ MCC	Warn astronaut to keep his distance from hot fuel cask and not to touch metal part of cask lanyard.	Direct exposure to hot fuel cask or metal part of cask lanyard could damage or fail the space suit.
5.2	Lanyard breaks or pulls away from cam lever.	Crew	1. Use MESA hammer/extension as hook and pull forward on cam lever to release cask. 2. If cam lever can not be rotated, abandon ALSEP.	Exercise caution when working in close proximity to hot fuel cask.
5.3	Cam lever fails to release the upper trunnion after lever is fully deployed.	Crew	1. Use MESA hammer/extension as hook on astronaut guard to break cask free at trunnions, while second crewman pulls lanyard to tilt cask. 2. If upper trunnion can not be released, abandon ALSEP.	Exercise caution when working in close proximity to hot fuel cask.
5.4	Lanyard breaks or fails to remove spline lock from cask/dome.	Crew	1. Use MESA hammer/extension to release second trunnion lock, rotate cask if required, and use MESA hammer/extension as hook to remove spline. 2. If unable to remove spline, rotate cask and attempt to gain access to fuel capsule by using MESA hammer/extension to destroy cask dome and pry away bands. 3. If spline can not be removed from dome or dome can not be removed by impacting with MESA hammer/extension, abandon ALSEP.	Exercise caution when working in close proximity to hot fuel cask.

Event No.	Contingency	Agent	Action	Remarks
5.5	Cask will not rotate with lanyard pull.	Crew	1. Verify upper trunnion release by hooking MESA hammer/extension on astronaut guard and insure that the cask is free of the upper trunnion.	Exercise caution when working in close proximity to hot fuel cask.
			2. Request aid of the second crewman to apply forward and downward force with MESA hammer/extension on the astronaut guard, while the first crewman attempts to rotate cask with the lanyard.	
			3. Attempt to fail gear box.	If gear box is failed, second crewman will have to use MESA hammer/extension to support cask at proper viewing angle for fuel capsule removal.
			4. If unsuccessful, use LRV as a platform to permit vertical removal of fuel capsule.	
			5. If still unable to gain access to fuel capsule, abandon ALSEP.	
5.6	Tempilabel indicates temperature of component is in excess of 250°F.	Crew/ MCC	Do not handle component manually. Notify MCC. Use UHT, MESA tool, etc. to avoid direct contact with hot component and continue deployment, if possible, but exercise caution when indirectly handling component. Request aid of second crewman if tasks can not be safely carried out by one crewman. If unable to continue deployment without coming into direct contact with component, attempt to place component in shade and work around deployment of hot component until MCC directs that component should have cooled off enough to permit manual handling.	CAUTION: Direct exposure to temperatures in excess of 250°F could damage or fail the space suit.

Event No.	Contingency	Agent	Action	Remarks
5.7	Engaging mechanism on DRT does not lock on cask dome.	Crew	1. Attempt to remove dome by applying forward pressure or side loading on the DRT. The dome will rotate without the locking pin engaged. 2. After dome is rotated (without locking pin engagement) use MESA hammer/extension to remove dome. 3. If unable to remove dome without DRT engagement, attempt to gain access to fuel capsule by using MESA hammer/extension to destroy cask dome and pry away bands. 4. If dome can not be removed, abandon ALSEP.	Exercise caution when working in close proximity to hot fuel cask.
5.8	Lock nut assembly will not rotate.	Crew	1. Use MESA hammer/extension to impact the DRT, cask or dome in order to overcome any binding, while continuing to rotate DRT. 2. If unable to rotate lock nut assembly, attempt to gain access to fuel capsule by using MESA hammer/extension to destroy cask dome and pry away bands. 3. If dome can not be removed, abandon ALSEP.	Exercise caution when working in close proximity to hot fuel cask.

Event No.	Contingency	Agent	Action	Remarks
5.9	Pretension bands will not release, causing excessive loading on dome locking lugs.	Crew	1. Use MESA hammer/extension to free lugs at the lock nut assembly on the dome. 2. If unable to release bands, attempt to gain access to fuel capsule by using MESA hammer/extension to destroy cask dome and pry away bands. 3. If dome can not be removed, abandon ALSEP.	Exercise caution when working in close proximity to hot fuel cask.
5.10	FTT fingers will not engage in fuel capsule.	Crew	1. Check for side loading on FTT and for full inward travel of FTT fingers. 2. Apply additional force to FTT knob. 3. Examine FTT fingers for obstructions, dislodge obstructions by impacting and attempt to re-engage FTT in fuel capsule. 4. Retract FTT fingers, rotate FTT 120°, attempt to re-engage FTT in capsule, and repeat task in all three positions, if required. 5. Jar mechanism by banging FTT knob against the LM landing gear. 6. If FTT will not function, abandon ALSEP.	Exercise caution when working in close proximity to hot fuel cask.

Event No.	Contingency	Agent	Action	Remarks
5.11	Capsule will not release from cask after FTT is attached and locked to capsule.	Crew	1. Apply side loads to FTT while attempting to pull capsule out of cask. 2. Retract FTT fingers, rotate FTT 120°, attempt to re-engage FTT in capsule, and repeat task in all three positions, if required. 3. Use MESA hammer/extension to impact side of cask to free the capsule. 4. Use MESA hammer/extension to impact the end of the FTT to free the capsule. 5. If unsuccessful, allow for backplate cool-down (5-10 minutes) and repeat task. 6. If capsule will not release, abandon ALSEP.	Exercise caution when working in close proximity to hot fuel cask.

Event No.	Contingency	Agent	Action	Remarks
5.12	FTT fingers will not release from fuel capsule.	Crew	1. Check for side loading on FTT and for full outward travel of FTT fingers.	Exercise caution when working in close proximity to hot fuel capsule.
			2. Apply additional force to FTT knob.	
			3. Use MESA hammer/extension to impact the end of the FTT in an attempt to free the FTT.	
			4. If FTT will not release from capsule, leave FTT in place on the fueled RTG and ensure capsule is locked into RTG.	There will be no problem of excessive heat buildup if the FTT can not be disengaged from the fueled RTG.
			5. If fuel capsule is not locked in RTG, manually carry Subpackage #2 in horizontal position or transport on LRV. (Carry Subpackage #1 in suitcase mode and transport carry bar on LRV).	The carry bar is required for use as an antenna mast and must be transported to the ALSEP deployment site.

6.0 Preparation for ALSEP Traverse

Event No.	Contingency	Agent	Action	Remarks
6.1	Subpackage #2 falls off UHT due to accidental triggering of UHT release mechanism.	Crew	1. Attempt to re-engage UHT in socket. 2. If UHT engagement fails, hook UHT handle in subpackage carry handle in order to rotate subpackage and stow UHT on Yo-Yo.	
6.2	Carry bar will not engage in Subpackage #2 keyhole socket.	Crew	1. Examine carry bar flange for obstructions, dislodge obstructions by impactand re-engage carry bar in subpackage keyhole socket. 2. Examine subpackage keyhole socket for obstructions, dislodge obstructions with UHT or MESA tools and re-engage carry bar in subpackage keyhole socket. 3. If keyhole socket is unusable, use suitcase carry mode and transport carry bar on LRV.	The carry bar is required for use as an antenna mast and must be transported to the ALSEP deployment site.
6.3	SEQ Bay door will not close when lanyard is pulled and there is no cable movement.	Crew	1. Attempt to manually initiate door closure and pull on lanyard again. 2. If unsuccessful, use MESA hammer to fail mechanism in order to close door.	SEQ Bay door must be closed to thermally insulate LM.
6.4	SEQ Bay door partially closed and jammed.	Crew	1. Ensure that lanyard is not tangled. 2. Continue pulling on lanyard while second crewman manually assists in closing door. 3. If unsuccessful, discontinue use of lanyard and use MESA hammer to fail mechanism in order to close door.	SEQ Bay door must be closed to thermally insulate LM.

Event No.	Contingency	Agent	Action	Remarks
7.1	Planned ALSEP deployment site more than 300 feet west of LM is not level or is otherwise unsuitable for ALSEP deployment.	Crew	1. Select another site more than 300 feet west of LM. 2. If no site is available west of LM, select a site more than 300 feet east of LM. 3. If no site is available east of LM, select a site more than 300 feet south of LM. 4. If not site is available south of LM, select a site more than 300 feet north of LM.	Landing site analysis may provide additional inputs.
7.2	Carry bar sections become unlocked 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 LRV.	The carry bar is required for use as an antenna mast and must be transported to the ALSEP deployment site. Ensure that sections are properly aligned when they are used as an antenna mast in order to permit proper alignment of ALSEP antenna.
7.3	Carry bar becomes disengaged from subpackage.	Crew	1. Attempt to re-engage carry bar in subpackage keyhole socket. 2. If carry bar will not remain in keyhole socket, use suitcase carry mode and transport carry bar on LRV.	The carry bar is required for use as an antenna mast and must be transported to the ALSEP deployment site.

Event No.	Contingency	Agent	Action	Remarks
8.1	Terrain 300 feet down sun from planned ALSEP deployment site is unsuitable for geophone deployment due to presence of craters, etc.	Crew	1. Select another ALSEP deployment site more than 300 feet west of LM that is more suitable for geophone deployment. 2. If no better site is available, deploy geophones in line, but not along sunline.	Compass rose on MPA pallet permits an off-sunline deployment.
8.2	Planned ALSEP deployment site includes a crater with walls that slope more than 5^{o}.	Crew	Locate ALSEP components on rim of crater, on elevated local terrain or select another deployment site.	Do not emplace ALSEP components in craters with walls that slope more than 5^{o}.
8.3	Planned ALSEP deployment site includes an outcropping whose height is greater than one foot.	Crew	1. Locate ALSEP components at least 12 feet from a one foot outcropping, 24 feet from a two foot outcropping, etc. 2. If outcroppings can not be avoided, move ALSEP parallel to equator so that ALSEP component thermal radiators are away from outcropping (so as to achieve a clear view of space).	
8.4	Planned ALSEP deployment site is in LM shadow.	Crew	Locate ALSEP components outside LM shadow, but within $\pm$ 15^{o} of E-W axis drawn through LM.	Separation distance from LM is more critical than angular relationship with respect to LM E-W axis.

Event No.	Contingency	Agent	Action	Remarks
8.5	Local slope of planned ALSEP deployment site is in excess of 5°.	Crew	Find level area, if nearby, and other constraints are not compromised.	This contingency is not critical.
8.6	Planned ALSEP deployment site is comprised of loose, granular soil.	Crew	Compact individual areas prior to final emplacement of each ALSEP component, with the exception of HFE.	
8.7	Planned deployment areas for ALSEP components include small rocks.	Crew	Attempt to avoide emplacing ALSEP components on small rocks.	

Event No.	Contingency	Agent	Action	Remarks
9.1	Carry bar binds in keyhole socket on Subpackage #2.	Crew	1. Ensure trigger release is operable.	
			2. Apply additional downward pressure to carry bar while pushing on Subpackage #2.	
			3. If unsuccessful, attempt to break carry bar off at keyhole socket by using MESA hammer.	
			4. If still unsuccessful, dig or bore hole in lunar surface material, separate two carry bar sections, and emplace Subpackage #2 with attached carry bar section embedded in lunar surface material.	
			5. Attempt to rough level Subpackage #2.	Without rough leveling, RTG will not radiate heat evenly, causing excessive heat buildup.
			6. Place aiming mechanism and antenna on Central Station sunshield and prop up for stability and to ensure assembly is level.	If assembly is not leveled to within $\pm 6^{o}$, leveling capability of antenna aiming mechanism will be exceeded and antenna aiming accuracy will be degraded.
		MCC/ Crew	7. Adjust antenna as required, in real time, to achieve good communication.	
9.2	Unable to locate Subpackage #2 10 feet due west of Subpackage #1 due to presence of craters, etc.	Crew	1. Locate Subpackage #2 as far from Subpackage #1 as RTG cable will permit.	
			2. Deploy Subpackage #2 north of planned location.	
			3. If no site available north of planned location, deploy Subpackage #1 south of planned location, but no more than 5 feet south, in order to keep RTG out of field of view of Central Station radiator.	

Event No.	Contingency	Agent	Action	Remarks
9.3	UHT will not disengage from Subpackage #2 temporary stowage socket.	Crew	1. Apply additional force. 2. Obtain assistance from second crewman. 3. If UHT will not disengage, leave it on the subpackage and continue deployment using second UHT.	Although only one UHT is needed for deployment, deployment time will be increased. Second crewman could carry out geological tasks while first astronaut completes ALSEP deployment.
9.4	UHT can not be attached to Yo-Yo or Yo-Yo has failed.	Crew	Engage UHT in subpackage, subpallet or experiment UHT sockets, as required, for temporary stowage.	Do not place UHT in lunar soil because soil may foul the UHT balls.

10.0 HFE Subpallet Offload

Event No.	Contingency	Agent	Action	Remarks
10.1	Astromate pull pin lanyard breaks.	Crew	1. Attempt to remove pin by grasping any remaining lanyard. 2. Manually remove pin.	
10.2	Astromate pull pin jams.	Crew	1. Apply additional force while rotating pin. 2. Apply additional force with MESA hammer or break pin. 3. If unsuccessful, use MESA hammer to break bracket. 4. If Astromate connector can not be released, abandon HFE deployment after removing HFE subpallet.	
10.3	HFE subpallet pull pin lanyard breaks.	Crew	1. Attempt to remove pin by grasping any remaining lanyard. 2. Manually remove pin.	
10.4	HFE subpallet pull pin jams.	Crew	1. Apply additional force while rotating pin. 2. Apply additional force with MESA hammer or break pin. 3. If unsuccessful, use MESA hammer to break bracket. 4. If still unsuccessful, leave HFE subpallet on Subpackage #2, but remove Astromate connector, HFE Electronics Package and HFE Probe Package immediately.	If HFE subpallet can not be removed, RTG will not radiate heat evenly, causing excessive heat buildup.

Event No.	Contingency	Agent	Action	Remarks
10.5	HFE subpallet carry handle will not lock.	Crew	Continue HFE deployment, using UHT if required.	
10.6	HFE subpallet Boyd bolt spline will not depress.	Crew	1. Check hex head of UHT and, if damaged, use second UHT. 2. Apply steady downward pressure with UHT and rotate bolt (approx. 2°) CW to relieve compression of balls. 3. Use MESA hammer on top of UHT to force depression of Boyd bolt spline. 4. Attempt to overcome spline lock by forcefully rotating UHT. 5. If unsuccessful, use MESA hammer to break bracket or strut. 6. If still unsuccessful, leave HFE subpallet on Subpackage #2, but remove Astromate connector, HFE Electronics Package and HFE Probe Package immediately.	If HFE subpallet can not be removed, RTG will not radiate heat evenly, causing excessive heat buildup.
10.7	HFE subpallet Boyd bolt will not rotate.	Crew	1. Check hex head of UHT and, if damaged, use second UHT. 2. Forcefully rotate UHT to overcome Boyd bolt. 3. If unsuccessful, use MESA hammer to break bracket or strut. 4. If still unsuccessful, leave HFE subpallet on Subpackage #2, but remove Astromate connector, HFE Electronics Package and HFE Probe Package immediately.	If HFE subpallet can not be removed, RTG will not radiate heat evenly, causing excessive heat buildup.

Event No.	Contingency	Agent	Action	Remarks
10.8	HFE Subpallet will not come off Subpackage #2.	Crew	1. Ensure both Boyd bolts have been released. 2. Use UHT to ensure that Boyd bolts have been sprung upward. 3. Use MESA hammer to break bracket or strut. 4. If unsuccessful, leave HFE subpallet on Subpackage #2, but remove Astromate connector, HFE Electronics Package and HFE Probe Package immediately.	If HFE subpallet can not be removed, RTG will not radiate heat evenly, causing excessive heat buildup.

Event No.	Contingency	Agent	Action	Remarks
11.1	MPA pallet cover pull ring fails.	Crew	Use UHT handle or manually peel velcro.	
11.2	MPA pallet cover lanyard breaks.	Crew	1. Attempt to remove cover by grasping any remaining lanyard. 2. Use UHT or manually attempt to remove cover. 3. If unsuccessful, pull on anchor pull rings to lift cover enough to remove cover and restow anchors.	
11.3	MPA pallet tie down pull pin jams.	Crew	1. Apply additional force while rotating pin. 2. Apply additional force on pin with MESA hammer or break pin. 3. If unsuccessful, use MESA hammer to break bracket. 4. If MPA pallet can not be removed, deploy MPA on lunar surface and remove ASE stool immediately after subpackage is rotated to the ground.	MPA initial aiming and aiming accuracy after firing will be degraded. Since tool carrier can not be removed with MPA pallet in place, RTG will not radiate heat evenly, causing excessive heat buildup.

Event No.	Contingency	Agent	Action	Remarks
11.4	MPA pallet will not come off tool carrier.	Crew	1. Ensure that front of MPA pallet has been raised 3/8 inch to clear mounting stud. 2. Apply additional force. 3. Obtain assistance from second crewman. 4. If unsuccessful, use MESA hammer to force upward movement of the MPA pallet. 5. If MPA pallet can not be removed, deploy MPA on lunar surface and remove PSE stool immediately after subpackage is rotated to the ground.	MPA initial aiming and aiming accuracy after firing will be degraded. Since tool carrier can not be removed with MPA pallet in place, RTG will not radiate heat evenly, causing excessive heat buildup.
11.5	ALSEP tool carrier pull pin jams.	Crew	1. Apply additional force while rotating pin. 2. Apply additional force on pin with MESA hammer or break pin. 3. If unsuccessful, use MESA hammer to break bracket. 4. If still unsuccessful, leave tool carrier on Subpackage #2, but remove PSE stool immediately after subpackage is rotated to the ground.	If tool carrier can not be removed, RTG will not radiate heat evenly, causing heat buildup.

Event No.	Contingency	Agent	Action	Remarks
12.1	UHT will not disengage from Subpackage #1 temporary stowage socket.	Crew	1. Apply additional force. 2. Obtain assistance from second crewman. 3. If UHT will not disengage, leave it on the subpackage and continue deployment using second UHT.	Although only one UHT is needed for deployment, deployment time will be increased. Second crewman could carry out geological tasks while first astronaut completes ALSEP deployment.
12.2	UHT can not be attached to Yo-Yo or Yo-Yo has failed.	Crew	Engage UHT in subpackage, subpallet or experiment UHT sockets, as required, for temporary stowage.	Do not place UHT in lunar soil because soil may foul the UHT balls.
12.3	RTG cable reel tempilabel dots are all black.	Crew/ MCC	1. Do not manually handle RTG cable reel assembly and notify MCC. Request aid of second crewman if tasks can not be safely carried out by one crewman.	CAUTION: Direct exposure to temperatures in excess of 250°F could damage or fail the space suit.
		Crew	2. Use UHT handle to deploy RTG cable, release shorting plug pull pin and retrieve shorting plug, but exercise caution when indirectly handling components. 3. Attempt to carry out RTG cable interconnect using available tools and materials to avoid direct manual contact with hot components.	

Event No.	Contingency	Agent	Action	Remarks
		Crew/ MCC	4. If unsuccessful, stow shorting plug on Subpackage #1 (in the shade) and continue nominal ALSEP deployment sequence until MCC directs that shorting plug has cooled off enough to handle manually. Ensure shorting switch lanyard is pulled outward.	
		Crew	5. If shorting plug can not be mated to Central Station, abandon ALSEP.	
12.4	RTG cable reel Boyd bolt spline will not depress.	Crew	1. Check hex head of UHT and, if damaged, use second UHT.	Exercise caution when working in close proximity to hot RTG.
			2. Apply steady downward pressure with UHT and rotate bolt (approx. 2^{o}) CW to relieve compression of balls.	
			3. Use MESA hammer on top of UHT to force depression of Boyd bolt spline.	
			4. Attempt to overcome spline lock by forcefully rotating UHT.	
			5. If unsuccessful, leave RTG cable reel on subpackage.	If RTG cable reel can not be removed, RTG will not radiate heat evenly, causing excessive heat buildup.
			6. Use UHT handle to deploy RTG cable, release shorting plug pull pin and retrieve shorting plug.	

Event No.	Contingency	Agent	Action	Remarks
12.5	RTG cable reel Boyd bolt will not rotate.	Crew	1. Check hex head of UHT and, if damaged, use second UHT.	Exercise caution when working in close proximity to hot RTG.
			2. Forcefully rotate UHT to overcome Boyd bolt.	
			3. If unsuccessful, leave RTG cable reel on subpackage.	If RTG cable reel can not be removed, RTG will not radiate heat evenly, causing excessive heat buildup.
			4. Use UHT handle to deploy RTG cable, release shorting plug pull pin and retrieve shorting plug.	
12.6	UHT will not engage in RTG cable reel carry socket.	Crew	1. Try to engage second UHT in carry socket.	Exercise caution when working in close proximity to hot RTG.
			2. If UHT engagement fails, deploy by using handle of UHT. Do not deploy RTG cable reel manually if it can be avoided.	
12.7	RTG cable reel will not come off subpackage.	Crew	1. Ensure all Boyd bolts have been released.	Exercise caution when working in close proximity to hot RTG.
			2. Use UHT to ensure that Boyd bolts have been sprung upward.	
			3. Leave RTG cable reel on subpackage and use UHT handle to deploy RTG cable, release shorting plug pull pin and retrieve shorting plug.	If RTG cable reel can not be removed, RTG will not radiate heat evenly, causing excessive heat buildup.

Event No.	Contingency	Agent	Action	Remarks
12.8	Cable reel falls to the lunar surface when final Boyd bolt is released or falls off UHT due to accidental triggering of UHT release mechanism.	Crew	Retrieve cable reel with UHT handle, grasp reel assembly, connect UHT, and continue nominal deployment.	
12.9	Crewman walks too far and jerks Subpackage #2.	Crew	1. Obtain assistance from second crewman to move Subpackage #1 closer to Subpackage #2 to provide sufficient slack cable for RTG cable interconnect and continue deployment of RTG cable.	
		Crew/ MCC	2. Check cable and connectors at shorting plug and RTG interfaces for visible signs of damage and notify MCC if there are visible signs of damage.	Exercise caution when working in close proximity to hot RTG. Central Station operation may be degraded if there are visible signs of damage.
12.10	Shorting plug pull pin jams.	Crew	1. Apply additional force while rotating pin. 2. Apply additional force on pin with MESA hammer or break pin. 3. If unsuccessful, use MESA hammer to fail bracket in an attempt to retrieve shorting plug. 4. If shorting plug can not be released from cable reel, abandon ALSEP.	

Event No.	Contingency	Agent	Action	Remarks
12 11	Shorting plug falls to lunar surface.	Crew	Retrieve shorting plug with UHT handle.	Ensure shorting plug is free of debris.
12.12	UHT will not disengage from RTG cable reel UHT socket.	Crew	1. Apply additional force. 2. Obtain assistance from second crewman. 3. If UHT will not disengage, leave it on the RTG cable reel and continue deployment using second UHT.	Although only one UHT is needed for deployment, deployment time will be increased. Second crewman could carry out geological tasks while first astronaut completes ALSEP deployment.
12.13	Ammeter does not indicate any amperage prior to plug-in.	Crew Crew/ MCC	1. Pull shorting switch pull ring and check ammeter for amperage reading. 2If there is still no amperage reading, notify MCC, remove shorting plug from cable and mate RTG cable directly to Central Station.	Absence of amperage reading after pulling lanyard is an indication of possible failure of shorting plug. Direct connection of RTG cable to Central Station will result in ALSEP having RTG power available after plug-in.

Event No.	Contingency	Agent	Action	Remarks
12.14	Shorting switch pull ring fails or lanyard breaks.	Crew	1. Attempt to pull shorting switch outward by grasping any remaining lanyard.	
		Crew/ MCC	2. If unsuccessful, continue nominal ALSEP deployment sequence and notify MCC.	If shorting switch has been depressed and ammeter indicates a zero amperage reading, ALSEP will have RTG power available after plug-in.
12.15	Shorting plug will not engage and lock.	Crew	1. Check shorting plug for proper orientation and, if not oriented properly, reorient shorting plug and attempt to re-engage shorting plug.	
			2. Check shorting plug and connector on Central Station for debris, and, if debris is visible, remove or shake out debris and attempt to re-engage shorting plug.	
			3. Ensure shorting plug outer flange is free to travel to the lock position and, if flange is free to travel, attempt to re-engage shorting plug.	
		Crew/ MCC	4. Check shorting plug and connector on Central Station for bent pins and, if bent pins are visible on Central Station connector, notify MCC and attempt to force re-engagement of shorting plug.	ALSEP operation may be degraded.
		Crew	5. If shorting plug is properly oriented, there is no debris visible, outer flange is not free to travel or if bent pins are visible on shorting plug, Manually separate the	

Event No.	Contingency	Agent	Action	Remarks
			shorting plug from the RTG cable and connect RTG cable connector to Central Station. 6. If RTG cable connector can not be mated to Central Station, abandon ALSEP.	
12.16	Ammeter does not indicate any amperage after plug-in.	Crew/ MCC	1. Do not pull shorting switch pull ring, notify MCC and continue with nominal ALSEP deployment sequence as long as a hold point is not imminent. 2. If a hold point is imminent prior to Central Station sunshield deployment, pull shorting switch pull ring and notify MCC.	Shorting switch has probably been inadvertently depressed and ALSEP will have RTG power available. Pulling lanyard will automatically switch PCU's. Failure to pull the lanyard could cause overheating of Central electronics and failure of Central Station.
12.17	Shorting plug engages, but falls off when subpackage is rotated.	Crew	1. Return subpackage to vertical position, retrieve cable, remove any debris, check ammeter for amperage reading, ensure shorting plug outer flange is free to travel, remate connector, and ensure locking mechanism is fully forward and orange ring is visible. 2. If outer flange is not free to travel or shorting plug falls off again, manually separate the shorting plug from the RTG cable and connect RTG cable connector to Central Station. 3. If RTG cable connector will not stay mated to Central Station, abandon ALSEP.	

Event No.	Contingency	Agent	Action	Remarks
13.1	Astromate connector will not come out of stowage assembly.	Crew	1. Apply additional force. 2. Obtain assistance from second crewman. 3. If unsuccessful, use MESA hammer to break bracket. 4. If Astromate connector can not be removed from stowage assembly, abandon HFE deployment. 5. If Astromate connector is partially deployed, but is hung up, ensure that cable reel is free of stowage bracket.	
13.2	Astromate connector falls to lunar surface.	Crew	Retrieve connector with UHT handle.	Ensure connector is free of debris.
13.3	Crewman walks too far and jerks HFE subpallet.	Crew	1. Unreel additional cable or move HFE subpallet closer to Central Station to provide sufficient slack cable for HFE cable interconnect and continue deployment of HFE cable.	
		Crew/ MCC	2. Check cable and connectors at Astromate and HFE Electronics Package interfaces for visible signs of damage and notify MCC if there are visible signs of damage.	HFE operation may be degraded if there are visible signs of damage.
13.4	HFE subpallet falls over on lunar surface.	Crew	Use UHT handle to hook HFE subpallet carry handle and retrieve HFE subpallet.	Reduced experiment thermal control due to degradation of thermal paint with lunar debris.

Event No.	Contingency	Agent	Action	Remarks
13.5	Astromate connector dust cover can not be removed.	Crew	1. Apply additional force and twist whole dust cover.	
			2. Obtain assistance from second crewman.	
13.6	Astromate connector will not engage and lock.	Crew	1. Check connector for proper orientation and, if not oriented properly, reorient connector and attempt to re-engage connector.	
			2. Check connectors on cable and Central Station for debris and, if debris is visible, remove or shake out debris and attempt to re-engage connector.	
		Crew/ MCC	3. Check connectors on cable and Central Station for bent pins and, if bent pins are visible, notify MCC and attempt to force re-engagement of connector.	HFE operation may be degraded.
		Crew	4. If Astromate connector can not be mated to Central Station, abandon HFE deployment.	
13.7	Astromate connector locking lever will not rotate and lock.	Crew	1. Apply additional force.	
			2. Abandon effort to rotate locking lever.	Primary locking feature should suffice.

Event No.	Contingency	Agent	Action	Remarks
13.8	Astromate connector engages, but falls off when subpackage is rotated.	Crew	1. Return subpackages to vertical position, retrieve cable, remove any debris, remate connectors, and ensure locking lever is fully rotated. 2. If Astromate connector will not stay mated to Central Station, abandon HFE deployment.	

Event No.	Contingency	Agent	Action	Remarks
14.1	Unable to deploy HFE subpallet 25 feet south of Central Station due to presence of craters, etc.	Crew	1. Locate HFE as far from RTG, Central Station and other ALSEP experiment sites as cable permits. 2. Deploy HFE east of planned location, but located so that HFE probe will be at least 25 feet from Central Station and 20 feet from PSE. Attempt to locate HFE so that HFE cables will not cross other cables or run along with and in contact with another cable. 3. If no site available east of planned location, deploy HFE west of planned location, but located so that HFE probe will be at least 30 feet from RTG, 25 feet from Central Station and 10 feet from LSM site and any cables. Attempt to locate HFE so that HFE cables will not cross other cables or run along with and in contact with another cable.	
14.2	HFE subpallet falls to lunar surface.	Crew	Use UHT handle to hook HFE subpallet carry handle and retrieve HFE subpallet.	Reduced experiment thermal control due to degradation of thermal paint with lunar debris.
14.3	Crewman walks too far and jerks Central Station.	Crew	1. Carry HFE subpallet back toward Central Station to provide sufficient slack cable and continue deployment of HFE.	
		Crew/ MCC	2. Check cable and connectors at experiment and Central Station interfaces for visible signs of damage and notify MCC if there are visible signs of damage.	HFE operation may be degraded if there are visible signs of damage.

Event No.	Contingency	Agent	Action	Remarks
14.4	HFE subpallet strut will not collapse.	Crew	1. Apply additional force. 2. Apply additional force with MESA hammer. 3. If unsuccessful, continue nominal HFE deployment sequence with strut uncollapsed.	Subpallet instability will not prevent completing HFE deployment.
14.5	HFE subpallet falls over on lunar surface.	Crew	Use UHT handle to hook HFE subpallet carry handle and properly emplace HFE subpallet.	Reduced experiment thermal control due to dégradation of thermal paint with lunar debris.

Event No.	Contingency	Agent	Action	Remarks
15.1	HFE Probe Package Boyd bolt spline will not depress.	Crew	1. Check hex head of UHT and, if damaged, use second UHT. 2. Apply steady downward pressure with UHT and rotate bolt (approx. 2°) CW to relieve compression of balls. 3. Use MESA hammer on top of UHT to force depression of Boyd bolt spline. 4. Attempt to overcome spline lock by forcefully rotating UHT. 5. Use MESA hammer in an attempt to break HFE Probe Package free. 6. If unsuccessful, attempt to use MESA hammer to rip HFE Probe Package apart and retrieve probes and emplacement tool. 7. If still unsuccessful, cover HFE Probe Package with lunar soil.	HFE science will be severely degraded.
15.2	HFE Probe Package Boyd bolt will not rotate.	Crew	1. Check hex head of UHT and, if damaged, use second UHT. 2. Forcefully rotate UHT to overcome Boyd bolt. 3. Use MESA hammer in an attempt to break HFE Probe Package free. 4. If unsuccessful, attempt to use MESA hammer to rip HFE Probe Package apart and retrieve probes and emplacement tool.	

Event No.	Contingency	Agent	Action	Remarks
			5. If still unsuccessful, cover HFE Probe Package with lunar soil.	HFE science will be severely degraded.
15.3	HFE Probe Package will not come off HFE subpallet.	Crew	1. Ensure all Boyd bolts have been released.	
			2. Use UHT to ensure that Boyd bolts have been sprung upward.	
			3. Use MESA hammer in an attempt to break HFE Probe Package free.	
			4. If unsuccessful, attempt to use MESA hammer to rip HFE Probe Package apart and retrieve probes and emplacement tool.	
			5. If still unsuccessful, cover HFE Probe Package with lunar soil.	HFE science will be severely degraded.

Event No.	Contingency	Agent	Action	Remarks
16.1	HFE Probe Package halves will not separate.	Crew	1. Apply additional force. 2. Obtain assistance from second crewman. 3. If unsuccessful, attempt to use MESA hammer to rip HFE Probe Package apart and retrieve probes and emplacment tool. 4. If still unsuccessful, cover HFE Probe Package with lunar soil.	HFE science will be severely degraded.
16.2	Unable to deploy HFE Probe Package half 18 feet west or east of HFE Electronics Package due to presence of craters, etc.	Crew	1. Locate HFE Probe Package as far from RTG, the other Probe Package half, Central Station and other ALSEP experiment sites as cable permits. 2. Deploy HFE Probe Package half south of planned location and maintain maximum separation from other Probe Package half. 3. If no site available south of planned location, deploy HFE Probe Package half north of planned location, but at least 30 feet from RTG, 25 feet from Central Station, 20 feet from PSE, 10 feet from LSM site and any cables, and maintain maximum separation from other Probe Package half.	
16.3	HFE Probe Package falls to lunar surface.	Crew	Use UHT handle to hook handle or carry strap and retrieve HFE Probe Package.	
16.4	Crewman walks too far and jerks HFE Electronics Package.	Crew	1. Carry HFE Probe Package back toward HFE Electronics Package to provide sufficient slack cable for probe emplacement and continue deployment of HFE.	

Event No.	Contingency	Agent	Action	Remarks
		Crew/ MCC	2. Check cable, connector at HFE Electronics Package interface and probe interface for visible signs of damage and notify MCC if there are visible signs of damage.	HFE operation may be degraded if there are visible signs of damage.

Event No.	Contingency	Agent	Action	Remarks
17.1	Tool carrier Boyd bolt spline will not depress.	Crew	1. Check hex head of UHT and, if damaged, use second UHT. 2. Apply steady downward pressure with UHT and rotate bolt (approx. 2°) CW to relieve compression of balls. 3. Use MESA hammer on top of UHT to force depression of Boyd bolt spline. 4. Attempt to overcome spline lock by forcefully rotating UHT. 5. If unsuccessful, leave tool carrier on Subpackage #2.	If tool carrier can not be removed, RTG will not radiate heat evenly, causing excessive heat buildup.
17.2	Tool carrier Boyd bolt will not rotate.	Crew	1. Check hex head of UHT and, if damaged, use second UHT. 2. Forcefully rotate UHT to overcome Boyd bolt. 3. If unsuccessful, leave tool carrier on Subpackage #2.	If tool carrier can not be removed, RTG will not radiate heat evenly, causing excessive heat buildup.
17.3	UHT will not engage in tool carrier carry socket.	Crew	1. Try to engage second UHT in carry socket. 2. If UHT engagement fails, remove manually by grasping back support structure or tool brackets.	

Event No.	Contingency	Agent	Action	Remarks
17.4	Tool carrier will not come off Subpackage #2.	Crew	1. Ensure both Boyd bolts have been released. 2. Use UHT to ensure that Boyd bolts have been sprung upward. 3. Ensure that front of tool carrier has been raised 3/8 inch to clear mounting stud. 4. Kick tool carrier to force forward movement. 5. If unsuccessful, use MESA hammer to force forward movement of the tool carrier. 6. If still unsuccessful, leave tool carrier on Subpackage #2.	If tool carrier can not be removed, RTG will not radiate heat evenly, causing excessive heat buildup.
17.5	Tool carrier falls off UHT due to accidental triggering of UHT release mechanism.	Crew	1. Attempt to re-engage UHT in socket. 2. If UHT engagement fails, use UHT handle to hook PSE stool bracket and emplace tool carrier.	
17.6	UHT will not disengage from tool carrier UHT socket.	Crew	1. Apply additional force. 2. Obtain assistance from second crewman. 3. If UHT will not disengage, leave it on the tool carrier and continue deployment using second UHT.	Tool carrier stability will be degraded. Although only one UHT is needed for deployment, deployment time will be increased. Second crewman could carry out geological tasks while first astronaut completes ALSEP deployment.

Event No.	Contingency	Agent	Action	Remarks
18.1	Aiming Mechanism housing Boyd bolt spline will not depress.	Crew	1. Check hex head of UHT and, if damaged, use second UHT.	
			2. Apply steady downward pressure with UHT and rotate bolt (approx. 2°) CW to relieve compression of balls.	
			3. Use MESA hammer on top of UHT to force depression of Boyd bolt spline.	
			4. Attempt to overcome spline lock by forcefully rotating UHT.	
			5. If unsuccessful, use MESA hammer to break housing off mounting lugs in order to gain access to aiming mechanism.	
			6. If unable to gain access to aiming mechanism, place antenna on Central Station sunshield and prop up for stability and to ensure antenna is pointed toward earth.	Antenna aiming accuracy will be degraded.
		MCC/ Crew	7. Adjust antenna as required, in real time, to achieve good communication.	
18.2	Aiming Mechanism housing Boyd bolt will not rotate.	Crew	1. Check hex head of UHT and, if damaged, use second UHT.	
			2. Forcefully rotate UHT to overcome Boyd bolt.	
			3. If unsuccessful, use MESA hammer to break housing off mounting lugs in order to gain access to aiming mechanism.	

Event No.	Contingency	Agent	Action	Remarks
			4. If unable to gain access to aiming mechanism, place antenna on Central Station sunshield and prop up for stability and to ensure antenna is pointed toward earth.	Antenna aiming accuracy will be degraded.
		MCC/ Crew	5. Adjus. antenna as required, in real time, to achieve good communication.	
18.3	Aiming mechanism housing will not come off subpackage.	Crew	1. Ensure both Boyd bolts have been released.	
			2. Use UHT to ensure that Boyd bolts have been sprung upward.	
			3. Use MESA hammer to break housing off mounting lugs in order to gain access to aiming mechanism.	
			4. If unable to gain access to aiming mechanism, place antenna on Central Station sunshield and prop up for stability and to ensure antenna is pointed toward earth.	Antenna aiming accuracy will be degraded.
		MCC/ Crew	5. Adjust antenna as required, in real time, to achieve good communication.	
18.4	Aiming mechanism housing falls to lunar surface.	Crew	Use UHT handle to hook handle and retrieve aiming mechanism housing.	

Event No.	Contingency	Agent	Action	Remarks
19.1	PSE stool Boyd bolt spline will not depress.	Crew	1. Check hex head of UHT and, if damaged, use second UHT. 2. Apply steady downward pressure with UHT and rotate bolt (approx. 2°) CW to relieve compression of balls. 3. Use MESA hammer on top of UHT to force depression of Boyd bolt spline. 4. Attempt to overcome spline lock by forcefully rotating UHT. 5. If unsuccessful, use MESA hammer to pry or break PSE stool off bracket. 6. If still unsuccessful, pack lunar surface, gouge hole and place PSE directly on lunar surface.	Experiment thermal control and science will be degraded.
19.2	PSE stool Boyd bolt will not rotate.	Crew	1. Check hex head of UHT and, if damaged, use second UHT. 2. Forcefully rotate UHT to overcome Boyd bolt. 3. If unsuccessful, use MESA hammer to pry or break PSE stool off bracket. 4. If still unsuccessful, pack lunar surface, gouge hole and place PSE directly on lunar surface.	Experiment thermal control and science will be degraded.

Event No.	Contingency	Agent	Action	Remarks
19.3	PSE stool will not come off subpallet.	Crew	1. Ensure Boyd bolt has been released. 2. Use UHT to ensure that Boyd bolt has been sprung upward. 3. Use MESA hammer to pry or break PSE stool off bracket. 4. If unsuccessful, pack lunar surface, gouge hole and place PSE directly on lunar surface.	Experiment thermal control and science will be degraded.
19.4	PSE stool falls to lunar surface.	Crew	Retrieve PSE stool with UHT handle.	
19.5	Unable to deploy PSE stool 10 feet east of Central Station due to presence of craters, etc.	Crew	1. Locate PSE stool as far from Central Station, RTG and other experiment sites as PSE cable will permit. 2. Deploy PSE stool north of planned location, but attempt to locate PSE stool so that PSE cable will not cross other cables or run along with and in contact with another cable. 3. If no site available north of planned location, deploy PSE stool south of planned location, but at least 20 feet from nearest HFE probe site and attempt not to block Central Station field of view. Attempt to locate PSE stool so that PSE cable will not cross other cables or run along with and in contact with another cable.	

Event No.	Contingency	Agent	Action	Remarks
19.6	Unable to pack lunar surface.	Crew	Provide best PSE stool to lunar surface coupling that site will permit	
19.7	Unable to gouge hole in lunar surface.	Crew	Abandon effort.	Experiment thermal control and science may be degraded.
19.8	PSE stool turns upside down while being emplaced on lunar surface.	Crew	Use UHT handle to turn stool over.	

20.0 Subpackage #1 Emplacement

Event No.	Contingency	Agent	Action	Remarks
20.1	Carry bar binds in keyhole socket on Subpackage #1.	Crew	1. Ensure trigger is operable.	
			2. Apply additional downward pressure to carry bar while pushing on Subpackage #1.	
			3. If unsuccessful, attempt to break carry bar off at keyhole socket.	
			4. If still unsuccessful, dig or bore hole in lunar surface material, separate two carry bar sections and emplace Subpackage #1 with attached carry bar section embedded in lunar surface material.	
			5. Attempt to accurately level and align Central Station.	Without accurate leveling and alignment, Central Station thermal control may be degraded.
			6. Place aiming mechanism and antenna on Central Station sunshield and prop up for stability and to ensure assembly is level.	If assembly is not leveled to within $\pm 6^{o}$, leveling capability of antenna aiming mechanism will be exceeded and antenna aiming accuracy will be degraded.
		MCC/ Crew	7. Adjust antenna as required, in real time, to achieve good communication.	

20.0 Subpackage #1 Emplacement

Event No.	Contingency	Agent	Action	Remarks
20.2	Carry bar will not stow on tool carrier taper fitting.	Crew	1. Examine carry bar for obstructions, dislodge obstructions by impact and restow carry bar on tool carrier taper fitting. 2. Examine tool carrier taper fitting for obstructions, dislodge obstructions with UHT or MESA tools and restow carry bar on tool carrier taper fitting. 3. If taper fitting is unusable, stow carry bar on LRV.	The carry bar is required for use as an antenna mast and can not be discarded or emplaced on the lunar surface where debris might foul the subpackage or aiming mechanism interfaces.
20.3	Subpackage #1 dust cover gets hung up during removal, or drawstring or pull ring fails.	Crew	1. Use UHT handle to peel off dust cover. 2. Request aid of second crewman.	

Event No.	Contingency	Agent	Action	Remarks
21.1	PSE Boyd bolt spline will not depress.	Crew	1. Check hex head of UHT and, if damaged, use second UHT.	
			2. Apply steady downward pressure with UHT and rotate bolt (approx. 2°) CW to relieve compression of balls.	
			3. Use MESA hammer on top of UHT to force depression of Boyd bolt spline.	
			4. Attempt to overcome spline lock by forcefully rotating UHT.	
			5. If unsuccessful, leave PSE on sunshield and deploy PSE/Central Station as one unit. Do not deploy PSE skirt. Use UHT to unreel sufficient cable to permit sunshield deployment.	Experiment thermal control and science, as well as Central Station thermal control, will be degraded.
			6. If still unsuccessful, attempt to cut or break PSE cables or break PSE connectors in order to permit sunshield deployment.	If unsuccessful, sunshield will not deploy and Central Station thermal control will be degraded. Loss of PSE does not preclude successful operation of remainder of ALSEP.

Event No.	Contingency	Agent	Action	Remarks
21.2	PSE Boyd bolt will not rotate.	Crew	1. Check hex head of UHT and, if damaged, use second UHT.	
			2. Forcefully rotate UHT to overcome Boyd bolt.	
			3. If unsuccessful, leave PSE on sunshield and deploy PSE/Central Station as one unit. Do not deploy PSE skirt. Use UHT to unreel sufficient cable to permit sunshield deployment.	Experiment thermal control and science, as well as Central Station thermal control, will be degraded.
			4. If still unsuccessful, attempt to cut or break PSE cables or break PSE connectors in order to permit sunshield deployment.	If unsuccessful, sunshield will not deploy and Central Station thermal control will be degraded. Loss of PSE does not preclude successful operation of remainder of ALSEP.
21.3	UHT will not engage in PSE carry socket.	Crew	1. Try to engage second UHT in 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.	

Event No.	Contingency	Agent	Action	Remarks
21.4	PSE will not come off sunshield.	Crew	1. Ensure all Boyd bolts have been released. 2. Use UHT to ensure that Boyd bolts have been sprung upward. 3. Leave PSE on sunshield and deploy PSE/Central Station as one unit. Do not deploy PSE skirt. Use UHT to unreel sufficient cable to permit sunshield deployment. 4. If unsuccessful, attempt to cut or break PSE cables or break PSE connectors in order to permit sunshield deployment.	Experiment thermal control and science, as well as Central Station thermal control, will be degraded. If unsuccessful, sunshield will not deploy and Central Station thermal control will be degraded. Loss of PSE does not preclude successful operation of remainder of ALSEP.
21.5	Experiment falls off UHT due to accidental triggering of UHT release mechanism.	Crew	1. Use UHT handle to retrieve cable, gently lift experiment, grasp mounting lug and attempt to re-engage UHT in socket. 2. If UHT engagement fails, deploy manually or remove girdle, partially open shroud/skirt assembly and manually emplace experiment using gnomon. NOTE: At 1/6 gravity the skirt should not unfold and cause interference.	Reduced thermal control due to degradation of skirt and shroud assembly with lunar debris. Reduced alignment accuracy if gnomon is handled.

Event No.	Contingency	Agent	Action	Remarks
21.6	Crewman walks too far and jerks Central Station.	Crew	1. Carry experiment back toward Central Station to provide sufficient slack cable, obtain assistance from second crewman to move PSE stool closer to Subpackage #1, pack lunar surface, gouge hole in lunar surface and emplace PSE stool, then continue deployment of PSE.	
		Crew/ MCC	2. Check cable and connectors at experiment and Central Station interfaces for visible signs of damage and notify MCC if there are visible signs of damage.	PSE operation may be degraded if there are visible sings of damage.
21.7	Lanyard between girdle pull pin and girdle breaks.	Crew	1. Attempt to remove cover by grasping any remaining lanyard.	
			2. Manually remove girdle.	
21.8	UHT will not disengage from PSE UHT socket.	Crew	1. Apply additional force.	
			2. Obtain assistance from second crewman.	
			3. If UHT will not disengage, leave it on the PSE and continue deployment using second UHT. Prop up PSE, as required, to maintain experiment stability.	Experiment science, leveling, alignment, stability and thermal control will be degraded. Although only one UHT is needed for deployment, deployment time will be increased. Second crewman could carry out geological tasks while first astronaut completes ALSEP deployment.

Event No.	Contingency	Agent	Action	Remarks
21.9	Experiment falls off PSE stool while deploying thermal shroud or during leveling.	Crew	Retrieve experiment with UHT handle hooked into gnomon opening, gently lift experiment, grasp thermal skirt, raise skirt to observe PSE stool and lower experiment onto PSE stool.	Reduced thermal control due to degradation of shroud assembly with lunar debris and reduced alignment accuracy due to handling of gnomon.
21.10	UHT punctures thermal shroud during leveling.	Crew	Remove UHT from puncture and attempt to cover the opening if the hole remains.	Experiment thermal control may be degraded.
21.11	Thermal shroud will not lie flat on lunar surface.	Crew	1. Place small discarded ALSEP parts on edge of thermal shroud.	Possibly reduced thermal control.
			2. If there are not enough small discarded ALSEP parts available, lunar rocks may be placed on edge of thermal shroud.	Reduced thermal control due to degradation of shroud assembly with lunar debris.
21.12	Lunar debris degrades readability of bubble level or compass rose, or bubble level or sun compass is damaged.	Crew	Level by using ball level, estimation of true vertical and other equipment as a reference; estimate alignment by using shadows and other equipment as a reference; and ensure ample photo coverage is obtained to verify experiment orientation	Without $\pm 5^{o}$ leveling, PSE sensors will not operate and without accurate alignment readout, PSE science will be degraded.

Event No.	Contingency	Agent	Action	Remarks
22.1	Switch #5 is not in CW position.	Crew/ MCC	1. Report to MCC.	
		Crew	2. Use UHT to turn Switch #5 CW to OFF position.	
		Crew/ MCC	3. If Switch #5 can not be turned CW to OFF position, report to MCC so that MCC can verify ASE status and turn ASE OFF, if required.	
		Crew	4. Apply additional force to switch.	
		Crew/ MCC	5. If unsuccessful, report to MCC and continue ASE deployment, but do not remove safety rod or arm MPA until MCC confirms that it is safe to continue MPA deployment.	ASE science will be degraded if T/G is deployed and MPA deployment is not completed, but an astronaut safety hazard may exist if MPA deployment were contined with ASE power on.
22.2	T/G Boyd bolt spline will not depress.	Crew	1. Check hex head of UHT and, if damaged, use second UHT.	
			2. Apply steady downward pressure with UHT and rotate bolt (approx. 2°) CW to relieve compression of balls.	
			3. Use MESA hammer on top of UHT to force depression of Boyd bolt spline.	
			4. Attempt to overcome spline lock by forcefully rotating UHT.	
			5. If unsuccessful, use MESA hammer in an attempt to break bracket.	

Event No.	Contingency	Agent	Action	Remarks
			6. If still unsuccessful, use MESA hammer to break shaft of T/G and attempt to retrieve MPA, but avoid damaging geophones and cable reels.	Thumper activity would be lost, but geophones and MPA would still be functional.
			7. If unsuccessful, leave ASE on sunshield and deploy ASE/Central Station as one unit. Use UHT to unreel sufficient cable to permit sunshield deployment.	Experiment thermal control and science, as well as Central Station thermal control, will be degraded.
			8. If still unsuccessful, 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 does not preclude successful operation of remainder of ALSEP.
22.3	T/G Boyd bolt will not rotate.	Crew	1. Check hex head of UHT and, if damaged, use second UHT.	
			2. Forcefully rotate UHT to wipe out Boyd bolt.	
			3. If unsuccessful, use MESA hammer in an attempt to break bracket.	
			4. If still unsuccessful, use MESA hammer to break shaft of T/G and attempt to retrieve MPA, but avoid damaging geophones and cable reels.	Thumper activity would be lost, but geophones and MPA would still be functional.
			5. If unsuccessful, leave ASE on sunshield and deploy ASE/Central Station as one unit. Use UHT to unreel sufficient cable to permit sunshield deployment.	Experiment thermal control and science, as well as Central Station thermal control, will be degraded.

Event No.	Contingency	Agent	Action	Remarks
			6. If still unsuccessful, 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 does not preclude successful operation of remainder of ALSEP.
22.4	T/G restraining arm will not rotate.	Crew	1. Ensure Boyd bolt has been released.	
			2. Use UHT to insure that Boyd bolt has been sprung upward.	
			3. Obtain aid of second crewman to force T/G restraining arm rotation.	
			4. Use MESA hammer to break bracket.	
			5. If unsuccessful, use MESA hammer to break restraining arm, but avoid damaging T/G.	
			6. If still unsuccessful, use MESA hammer to break shaft of T/G and attempt to retrieve MPA, but avoid damaging geophones and cable reels.	Thumper activity would be lost, but geophones and MPA would still be functional.
			7. If unsuccessful, leave ASE on sunshield and deploy ASE/Central Station as one unit. Use UHT to unreel sufficient cable to permit sunshield deployment.	Experiment thermal control and science, as well as Central Station thermal control, will be degraded.
			8. If still unsuccessful, 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 does not preclude successful operation of remainde of ALSEP .

Event No.	Contingency	Agent	Action	Remarks
22.5	T/G plate assembly will not come off sunshield.	Crew	1. Ensure restraining arm is fully rotated. 2. Obtain aid of second crewman to force T/G plate assembly off sunshield. 3. If unsuccessful, use MESA hammer to jar or break T/G plate assembly, but avoid damaging T/G. 4. If still unsuccessful, deploy T/G, but leave MPA on sunshield and deploy MPA/Central Station as one unit. Use UHT to unreel sufficient cable to permit sunshield deployment. 5. If still unsuccessful, attempt to cut or break MPA cable or break MPA connector in order to permit sunshield deployment.	MPA activity would be lost but thumper and geophones would still be functional. Experiment thermal control and science, as well as Central Station thermal control, will be degraded. If unsuccessful, sunshield will not deploy and Central Station thermal control will be degraded. Loss of MPA does not preclude successful operation of remainder of ALSEP. Thumper activity will not be affected.
22.6	T/G falls off plate assembly.	Crew	Use UHT handle to retrieve T/G from lunar surface and remove debris as required.	

Event No.	Contingency	Agent	Action	Remarks
22.7	T/G section can not be unfolded.	Crew	1. Obtain aid of second crewman to force T/G unfolding.	
			2. If unsuccessful, use MESA hammer to jar or force unfolding. Avoid damaging T/G.	
			3. If still unsuccessful, attempt to continue ASE geophone deployment with T/G still folded.	Thumper activity would be lost, but geophones and MPA would still be functional.
22.8	T/G sleeve will not lock.	Crew	1. Obtain aid of second crewman to force T/G locking.	
			2. If unsuccessful, use MESA hammer to jar or force locking. Avoid damaging T/G.	
			3. If still unsuccessful, attempt to continue ASE geophone deployment with T/G sleeve unlocked, but exercise caution.	Thumper activity with sleeve unlocked is hazardous unless thumper is held so as to prevent flexion of unlocked sections.
22.9	Crewman walks too far and jerks Central Station.	Crew	1. Obtain assistance from second crewman to move tool carrier closer to Subpackage #1 in order to permit T/G storage.	
		Crew/ MCC	2. Check cable and connectors at first geophone and Central Station interfaces for visible signs of damage and notify MCC if there are visible signs of damage. Check PSE leveling and alignment, and relevel, realign and notify MCC if experiment was disturbed.	T/G operation may be degraded if there are visible signs of damage.

Event No.	Contingency	Agent	Action	Remarks
22.10	T/G falls to lunar surface.	Crew	Leave T/G on lunar surface until ready for next step of T/G deployment and then remove debris as required.	

Event No.	Contingency	Agent	Action	Remarks
23.1	Unable to drill one or both bore holes or to complete drilling of bore hole(s).	Crew	1. If unable to complete bore stem insertion into lunar surface, insert probe into bore stem to maximum depth and add one bore stem section above ground to support probe, if required.	HFE science may be degraded.
			2. If unable to insert bore stem into lunar surface, make deepest possible hole in lunar surface, insert entire probe vertically into hole, and backfill around probe after measuring depth of probe with emplacement tool.	
			3. If upper section of probe will not fit vertically into hole, dig a sloping trench running outward and upward from the hole, insert lower probe section vertically into hole and upper probe section into trench with the cable at the shallow end of the trench, and backfill around probe and first six feet of cable with as much lunar soil as possible, after photographing trench.	HFE science will be degraded.
			4. If neither probe section will fit vertically into hole, dig a trench with as great a slope as possible, insert probe into trench with the cable at the shallow end of the trench, and backfill around probe and first six feet of cable with as much lunar soil as possible, after photographing trench.	

Event No.	Contingency	Agent	Action	Remarks
			5. If unable to dig a trench, emplace HFE probe on lunar surface and cover probe and first six feet of cable with as much lunar soil as possible and photograph mound of lunar soil.	HFE science will be severely degraded.

Event No.	Contingency	Agent	Action	Remarks
24.1	UHT will not engage in MPA carry socket.	Crew	1. Try to engage second UHT in socket.	
			2. If UHT engagement fails, deploy manually (i.e., by grasping MPA leg).	Do not use antenna as a handle.
24.2	MPA binds on pins during removal from sunshield.	Crew	1. Rock MPA and apply additional force.	
			2. Obtain aid of second crewman.	
			3. Use MESA hammer in an attempt to pry MPA free from sunshield.	MPA may be damaged, resulting in experiment thermal control and science degradation.
			4. If unsuccessful, leave MPA on sunshield and deploy MPA/Central Station as one unit. Use UHT to unreel sufficient cable to permit sunshield deployment.	MPA thermal control and science, as well as Central Station thermal control, will be degraded. Thumper activity will not be affected.
			5. If still unsuccessful, attempt to cut or break MPA cable or break MPA connector in order to permit sunshield deployment.	If unsuccessful, sunshield will not deploy and Central Station thermal control will be degraded. Loss of MPA does not preclude successful operation of remainder of ALSEP. Thumper activity will not be affected.

Event No.	Contingency	Agent	Action	Remarks
24.3	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 thermal paint with lunar debris.
			2. If UHT engagement fails, deploy manually (i.e., by grasping MPA leg)or use other UHT socket.	Do not use antenna as a handle.
24.4	MPA carry socket/ leg release lanyard breaks.	Crew	1. Attempt to release and rotate carry socket and deploy leg by grasping any remaining lanyard.	
			2. Manually release pin, rotate carry socket and deploy leg.	
24.5	MPA carry socket pin jams.	Crew	1. Apply additional force while rotating pin.	
			2. Apply additional force on pin with MESA hammer or break pin.	
			3. If unsuccessful, deploy manually, (i.e., by grasping MPA leg)or use other UHT socket.	Do not use antenna as a handle.
24.6	MPA carry socket does not rotate or lock.	Crew	1. Apply additional force in an attempt to rotate socket.	
			2. If unsuccessful in attempt to rotate socket or socket will not lock, deploy manually (i.e., by grasping MPA leg)or use other UHT socket.	Do not use antenna as a handle.

24.0 ASE MPA Offload

Event No.	Contingency	Agent	Action	Remarks
24.7	Leg does not deploy and lock before emplacement.	Crew	1. Apply additional force in an attempt to deploy and lock leg. 2. If unsuccessful, place MPA on tool carrier or use lunar surface material to temporarily shore up MPA.	
24.8	Leg foot pad will not rotate and remain in deployed position.	Crew	1. Apply additional force in an attempt to rotate foot pad. 2. If unsuccessful in attempt to rotate foot pad or foot pad will not remain in deployed position, abandon effort to deploy foot pad and continue nominal ALSEP deployment sequence.	
24.9	MPA RF cable jams in canister.	Crew	1. Retrieve canister and remove velcro strap retaining canister clam shells. (Clam shells should separate by themselves). 2. If clam shells do not separate, grasp canister by ring and tug cable near exit in order to open clam shells. 3. Pry open clam shells using UHT.	
24.10	Leg unlocks after emplacement or breaks.	Crew	Place MPA on tool carrier or use lunar surface material to temporarily shore up MPA.	
24.11	MPA falls over while emplacing experiment.	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., by grasping MPA leg).	Reduced thermal control due to degradation of thermal paint with lunar debris. Do not use antenna as a handle.

Event No.	Contingency	Agent	Action	Remarks
24.12	UHT will not disengage from MPA UHT socket.	Crew	1. Apply additional force. 2. Obtain assistance from second crewman. 3. If UHT will not disengage, leave it on the MPA and continue deployment using second UHT.	MPA stability and thermal control will be degraded. Although only one UHT is needed for deployment, deployment time will be increased. Second crewman could carry out geological tasks while first astronaut completes ALSEP deployment.

Event No.	Contingency	Agent	Action	Remarks
25.1	LSM Boyd bolt spline will not depress.	Crew	1. Check hex head of UHT and, if damaged, use second UHT.	
			2. Apply steady downward pressure with UHT and rotate bolt (approx. 2°) CW to relieve compression of balls.	
			3. Use MESA hammer on top of UHT to force depression of Boyd bolt spline.	
			4. Attempt to overcome spline lock by forcefully rotating UHT.	
			5. If unsuccessful, use MESA hammer in an attempt to break bracket.	LSM may be damaged, resulting in experiment thermal control and science degradation.
			6. If still unsuccessful, pull upper support bracket handle/pip pin and lever lanyards, deploy lift-off handle, and use MESA hammer in an attempt to pry LSM free from sunshield.	LSM may be damaged, resulting in experiment thermal control and science degradation.
			7. If still unsuccessful, use MESA hammer to destroy LSM to whatever extent is necessary to gain access to ALSEP antenna.	If LSM is partially sacrificed, experiment thermal control and science will be degraded. If LSM is totally destroyed, its loss will permit the successful operation of the remainder of ALSEP.
			8. If successful in attempt to gain access to ALSEP antenna but still unsuccessful in attempt to remove LSM from sunshield, leave LSM on sunshield and deploy LSM/Central Station as one unit. Use UHT to unreel sufficient cable to permit sunshield deployment.	Experiment thermal control and science, as well as Central Station thermal control, will be degraded.

Event No.	Contingency	Agent	Action	Remarks
			9. If still unsuccessful, attempt to cut or break LSM cable or break LSM connector in order to permit sunshield deployment.	If unsuccessful, sunshield will not deploy and Central Station thermal control will be degraded. Loss of LSM does not preclude successful operation of remainder of ALSEP.
			10. If unsuccessful in attempt to gain access to ALSEP antenna, obtain aid of second crewman, move Central Station toward deployed experiments, turn over Central Station onto its western side without disturbing deployed experiments, and attempt to tilt Central Station approximately 15° off vertical so that antenna is pointed toward earth.	Central Station thermal control and antenna aiming accuracy will be degraded.
		MCC/ Crew	11. Adjust Central Station as required, in real time, to achieve good communication.	
25.2	LSM Boyd bolt will not rotate.	Crew	1. Check hex head of UHT and, if damaged, use second UHT.	
			2. Forcefully rotate UHT to overcome Boyd bolt.	
			3. If unsuccessful, use MESA hammer in an attempt to break bracket.	LSM may be damaged, resulting in experiment thermal control and science degradation.
			4. If still unsuccessful, pull upper support bracket handle/pip pin and lever lanyards, deploy lift-off handle, and use MESA hammer in an attempt to pry LSM free from sunshield.	LSM may be damaged, resulting in experiment thermal control and science degradation.

Event No.	Contingency	Agent	Action	Remarks
			5. If still unsuccessful, use MESA hammer to destroy LSM to whatever extent is necessary to gain access to ALSEP antenna.	If LSM is partially sacrificed, experiment thermal control and science will be degraded. If LSM is totally destroyed, its loss will permit the successful operation of the remainder of ALSEP.
			6. If successful in attempt to gain access to ALSEP antenna, but still unsuccessful in attempt to remove LSM from sunshield, leave LSM on sunshield and deploy LSM/Central Station as one unit. Use UHT to unreel sufficient cable to permit sunshield deployment.	Experiment thermal control and science, as well as Central Station thermal control, will be degraded.
			7. If still unsuccessful, attempt to cut or break LSM cable or break LSM connector in order to permit sunshield deployment.	If unsuccessful, sunshield will not deploy and Central Station thermal control will be degraded. Loss of LSM does not preclude successful operation of remainder of ALSEP.
			8. If unsuccessful in attempt to gain access to ALSEP antenna, obtain aid of second crewman, move Central Station toward deployed experiments, turn over Central Station onto its western side without disturbing deployed experiments, and attempt to tilt Central Station approximately 15^{o} off vertical so that antenna is pointed toward earth.	Central Station thermal control and antenna aiming accuracy will be degraded.

Event No.	Contingency	Agent	Action	Remarks
		MCC/ Crew	9. Adjust Central Station as required, in real time, to achieve good communication.	
25.3	Upper support bracket handle will not rotate to upright position or can not be pulled upward.	Crew	1. Ensure both Boyd bolts have been released.	
			2. Use UHT to ensure that both Boyd bolts have been sprung upward.	
			3. Manually pull upward on handle.	
			4. Use UHT handle in an attempt to pry upper support bracket upward.	
			5. If unsuccessful, use MESA hammer in an attempt to break bracket.	LSM may be damaged, resulting in experiment thermal control and science degradation.
			6. If still unsuccessful, pull upper support bracket handle/pip pin and lever lanyards, deploy lift-off handle, and use MESA hammer in an attempt to pry LSM free from sunshield.	LSM may be damaged, resulting in experiment thermal control and science degradation.
			7. If still unsuccessful, use MESA hammer to destroy LSM to whatever extent is necessary to gain access to ALSEP antenna.	If LSM is partially sacrificed, experiment thermal control and science will be degraded. If LSM is totally destroyed, its loss will permit the successful operation of the remainder of ALSEP.

Event No.	Contingency	Agent	Action	Remarks
			8. If successful in attempt to gain access to ALSEP antenna, but still unsuccessful in attempt to remove LSM from sunshield, leave LSM on sunshield and deploy LSM/ Central Station as one unit. Use UHT to unreel sufficient cable to permit sunshield deployment.	Experiment thermal control and science, as well as Central Station thermal control, will be degraded.
			9. If still unsuccessful, attempt to cut or break LSM cable or break LSM connector in order to permit sunshield deployment.	If unsuccessful, sunshield will not deploy and Central Station thermal control will be degraded. Loss of LSM does not preclude successful operation of remainder of ALSEP.
			10. If unsuccessful in attempt to gain access to ALSEP antenna, obtain aid of second crewman, move Central Station toward deployed experiments, turn over Central Station onto its western side without disturbing deployed experiments, and attempt to tilt Central Station approximately 15° off vertical so that antenna is pointed toward earth.	Central Station thermal control and antenna aiming accuracy will be degraded.
		MCC/ Crew	11. Adjust Central Station as required, in real time, to achieve good communication.	
25.4	Upper support bracket handle/ Boyd bolt lanyard breaks.	Crew	1. Ensure both Boyd bolts have been released.	
			2. Use UHT to ensure that both Boyd bolts have been sprung upward.	

25.0 LSM Offload and Deployment

Event No.	Contingency	Agent	Action	Remarks
			3. Attempt to remove Boyd bolt and guide cup by grasping any remaining lanyard.	
			4. Manually remove Boyd bolt and guide cup.	
25.5	Upper support bracket handle/ pip pin lanyard breaks.	Crew	1. Attempt to remove pin by grasping any remaining lanyard.	
			2. Manually remove pin.	
25.6	Upper support bracket handle/ lever lanyard breaks.	Crew	1. Attempt to rotate lever by grasping any remaining lanyard.	
			2. Use UHT handle or manually rotate levers.	
25.7	Upper support bracket handle can not be pulled forward and upper support bracket/brace assembly can not be removed because pin jams, etc.	Crew	1. Apply additional force while rotating pin.	
			2. Apply additional force with MESA hammer or break pin.	
			3. If unsuccessful, use MESA hammer to break bracket or pry levers free.	
			4. If still unsuccessful, gain access to lift-off handle, remove LSM from sunshield and deploy LSM with support bracket undeployed and booms partially deployed.	LSM science will be degraded.
25.8	Lift-off handle lanyard breaks.	Crew	Attempt to release LSM from mounting pins by grasping any remaining lanyard.	

Event No.	Contingency	Agent	Action	Remarks
25.9	LSM will not come off sunshield.	Crew	1. Rock LSM and apply additional force.	
			2. Obtain aid of second crewman.	
			3. If unsuccessful, use MESA hammer in an attempt to pry Electronics/Gimbal Flip Unit free from sunshield.	LSM may be damaged, resulting in experiment thermal control and science degradation.
			4. If still unsuccessful, use MESA hammer to destroy LSM to whatever extent is necessary to gain access to ALSEP antenna.	If LSM is partially sacrificed, experiment thermal control and science will be degraded. If LSM is totally destroyed, its loss will permit the successful operation of the remainder of ALSEP.
			5. If successful in attempt to gain access to ALSEP antenna, but still unsuccessful in attempt to remove LSM from sunshield, leave LSM on sunshield and deploy LSM/ Central Station as one unit. Use UHT to unreel sufficient cable to permit sunshield deployment.	Experiment thermal control and science, as well as Central Station thermal control, will be degraded.
			6. If still unsuccessful, attempt to cut or break LSM cable or break LSM connector in order to permit sunshield deployment.	If unsuccessful, sunshield will not deploy and Central Station thermal control will be degraded. Loss of LSM does not preclude successful operation of remainder of ALSEP.

Event No.	Contingency	Agent	Action	Remarks
			7. If unsuccessful in attempt to gain access to ALSEP antenna, obtain aid of second crewman, move Central Station toward deployed experiments, turn over Central Station onto its western side without disturbing deployed experiments, and attempt to tilt Central Station approximately 15° off vertical so that antenna is pointed toward earth.	Central Station thermal control and antenna aiming accuracy will be degraded.
		MCC/ Crew	8. Adjust Central Station as required, in real time, to achieve good communication.	
25.10	Unable to deploy LSM 50 feet southwest of Central Station due to presence of craters, etc.	Crew	1. Locate LSM as far from HFE, Central Station and RTG as cable permits and attempt to keep RTG out of LSM Parabolic Reflector Array field of view. 2. Deploy LSM north of planned location, but do not allow LSM cable to touch RTG and attempt not to block RTG field of view. Attempt not to cross cables or run LSM cable along with and in contact with another cable. 3. If no site available north of planned location, deploy LSM south of planned location, but at least 10 feet from nearest HFE probe and attempt not to block HFE Electronics Package and Central Station field of view. Attempt not to cross cables or run LSM cable along with and in contact with another cable.	
25.11	Carry handle lanyard breaks.	Crew	Use lift-off handle for carry.	

Event No.	Contingency	Agent	Action	Remarks
25.12	Experiment falls to lunar surface.	Crew	Use UHT handle to hook carry or lift-off handle and retrieve LSM.	Reduced thermal control due to degradation of thermal paint with lunar debris.
25.13	Crewman walks too far and jerks Central Station.	Crew	1. Carry experiment back toward Central Station to provide sufficient slack cable and continue deployment of LSM.	
		Crew/ MCC	2. Check cable and connectors at experiment and Central Station interfaces for visible signs of damage and notify MCC if there are visible signs of damage.	LSM operation may be degraded if there are visible signs of damage.
			3. Upon return from LSM deployment site, check PSE leveling and alignment, and re-level, realign and notify MCC if experiment was disturbed.	
25.14	Unable to deploy or lock legs or leg collapses.	Crew	1. Apply additional force to achieve complete leg deployment or ensure locking.	
			2. If unsuccessful, prop up LSM with a rock or other lunar debris and level LSM by embedding the Electronics/Gimbal Flip Unit in the lunar surface.	Experiment stability or thermal control will be degraded.
25.15	Unable to deploy or lock sensor arm.	Crew	1. Apply additional force to achieve complete sensor arm deployment.	
			2. Ensure that elbow cover has popped off.	
			3. If unsuccessful, deploy LSM with sensor arm in stowed or partially deployed position if necessary.	Experiment science will be degraded.

25.0 LSM Offload and Deployment

Event No.	Contingency	Agent	Action	Remarks
25.16	Leveling leg mechanism is inoperable.	Crew	1. Level by using only two of the three leveling leg mechanisms. 2. If unsuccessful, level by embedding leveling leg in the lunar surface through the use of the UHT to press downward on leveling leg foot pad. 3. If still unsuccessful, prop up LSM leg with a rock or other lunar debris.	Experiment stability may be degraded.
25.17	Parabolic Reflector Array lanyard breaks.	Crew	1. Attempt to release pin and remove cover by grasping any remaining lanyard. 2. Manually release pin and remove cover.	
25.18	Parabolic Reflector Array cover can not be removed.	Crew	1. Use UHT or MESA hammer in an attempt to forcefully remove cover. 2. If unsuccessful, leave cover in place.	Experiment alignment, science and thermal control will be degraded.
25.19	Alignment mechanism fails to self deploy.	Crew	Deploy alignment mechanism manually or use UHT handle as a pry.	
25.20	Lunar debris degrades readability of bubble level or sun compass, or bubble level or sun compass is damaged.	Crew	Level by using estimation of true vertical and other equipment as a reference; align by using shadows and other equipment as a reference; and ensure ample photo coverage is obtained to verify experiment orientation.	Without accurate leveling and alignment, experiment science and thermal control will be degraded.

Event No.	Contingency	Agent	Action	Remarks
26.1	Emplacement tool can not be locked in extended position.	Crew	1. Apply additional force, but be careful not to fail the tool.	
			2. Obtain assistance from second crewman.	
		Crew/ MCC	3. Use tool as is, report which section would not lock and insert probe into bore hole as far as possible	HFE science may be degraded.
26.2	Probe end piece can not be removed or sail cloth strip separates from end piece.	Crew	Use MESA tool to pry end piece from probe.	
26.3	Emplacement tool collapses while driving probe into bore hole.	Crew	1. Withdraw emplacement tool, re-extend and lock emplacement tool and resume driving probe into bore hole.	
		Crew/ MCC	2. If emplacement tool collapses again, insert probe into bore hole as far as possible and report collapse of tool.	HFE science may be degraded.
26.4	Probe can not be fully inserted into bore stem or emplacement tool reading is off-nominal.	Crew	1. Continue probe emplacement and apply additional force.	
		Crew/ MCC	2. Abandon effort and report depth of insertion.	HFE science may be degraded.
26.5	HFE probe does not lock in bore stem (cable or probe is pulled out when emplacement tool is withdrawn from bore hole).	Crew	1. Repeat probe emplacement.	
		Crew/ MCC	2. Abandon effort and report depth of insertion.	HFE science may be degraded.

27.0 Sunshield Operations

Event No.	Contingency	Agent	Action	Remarks
27.1	Alignment mechanism fails to self deploy.	Crew	Deploy alignment mechanism manually or use UHT handle as a pry.	
27.2	Lunar debris degrades readability of bubble level or compass rose, or bubble level or sun compass is damaged.	Crew	Level by using estimation of true vertical and other equipment as a reference; align by using shadows and other equipment as a reference; and ensure ample photo coverage is obtained to verify Central Station orientation.	Without accurate leveling and alignment, Central Station thermal control may be degraded. If primary structure is not leveled to within $\pm 6^{\circ}$, leveling capability of antenna aiming mechanism will be exceeded and antenna aiming accuracy will be degraded.
27.3	Sunshield Boyd bolt spline will not depress.	Crew	1. Check hex head of UHT and, if damaged, use second UHT.	
			2. Apply steady downward pressure with UHT and rotate bolt (approx. 2°) CW to relieve compression of balls.	
			3. Use MESA hammer on top of UHT to force depression of Boyd bolt spline.	
			4. Attempt to overcome spline lock by forcefully rotating UHT.	
			5. If unsuccessful, leave sunshield in stowed condition and attempt to gain access to antenna mast bracket.	Central Station thermal control will be degraded.
			6. If still unsuccessful, place aiming mechanism and antenna on sunshield and prop up for stability and to ensure assembly is level.	If assembly is not leveled to within $\pm 6^{\circ}$, leveling capability of antenna aiming mechanism will be exceeded and antenna aiming accuracy will be degraded.
		MCC/ Crew	7. Adjust antenna as required, in real time, to achieve good communication.	
27.4	Sunshield Boyd bolt will not rotate.	Crew	1. Check hex head of UHT and, if damaged, use second UHT.	
			2. Forcefully rotate UHT to overcome Boyd bolt.	

Event No.	Contingency	Agent	Action	Remarks
			3. If unsuccessful, leave sunshield in stowed condition and attempt to gain access to antenna mast bracket.	Central Station thermal control will be degraded.
			4. If still unsuccessful, place aiming mechanism and antenna on sunshield and prop up for stability and to ensure assembly in level.	If assembly is not leveled to within $\pm 6^{o}$, leveling capability of antenna aiming mechanism will be exceeded and antenna aiming accuracy will be degraded.
		MCC/ Crew	5. Adjust antenna as required, in real time, to achieve good communication.	
27.5	UHT will not engage in rear thermal curtain cover UHT socket.	Crew	Use UHT handle to hook lanyard, and release and remove curtain cover.	
27.6	Rear thermal curtain cover lanyard breaks.	Crew	1. Attempt to remove cover by grasping any remaining lanyard.	
			2. Manually remove pins and use UHT handle to remove curtain cover.	
27.7	Rear thermal curtain cover pin jams.	Crew	1. Apply additional force while rotating pin.	
			2. Apply additional force on pin with MESA hammer or break pin.	
			3. If unsuccessful, attempt to use UHT handle to bend or break thermal curtain cover.	

Event No.	Contingency	Agent	Action	Remarks
27.8	Rear thermal curtain cover jams.	Crew	Use UHT to force downward movement of thermal curtain cover and pry cover free of Central Station, if required.	
27.9	UHT will not disengage from rear thermal curtain cover UHT socket.	Crew	1. Apply additional force. 2. Obtain assistance from second crewman. 3. If UHT will not disengage, discard it and continue deployment using second UHT.	Although only one UHT is needed for deployment, deployment time will be increased. Second crewman could carry out geological tasks while first astronaut completes ALSEP deployment.
27.10	UHT will not engage in ALSEP antenna cable reel UHT socket.	Crew	Use UHT handle to hook lanyard and deploy ALSEP antenna cable reel and cable.	
27.11	ALSEP antenna cable reel lanyard breaks.	Crew	1. Attempt to release cable reel by grasping any remaining lanyard. 2. Manually remove pins and use UHT handle to release cable reel.	
27.12	ALSEP antenna cable reel pin jams.	Crew	1. Apply additional force while rotating pin. 2. Apply additional force on pin with MESA hammer or break pin. 3. If unsuccessful, attempt to use UHT handle to bend or break antenna cable reel.	

Event No.	Contingency	Agent	Action	Remarks
			4. If still unsuccessful, leave sunshield in stowed condition, deploy antenna on stowed sunshield and prop up for stability and to ensure antenna is pointed toward earth.	Central Station thermal control and antenna aiming accuracy will be degraded.
		MCC/ Crew	5. Adjust antenna as required, in real time, to achieve good communication.	
27.13	ALSEP antenna cable reel jams.	Crew	1. Use UHT handle to bend or break antenna cable reel and to deploy antenna cable.	
			2. If unsuccessful, leave sunshield in stowed condition, deploy antenna on stowed sunshield and prop up for stability and to ensure antenna is pointed toward earth.	Central Station thermal control and antenna aiming accuracy will be degraded.
		MCC/ Crew	3. Adjust antenna as required, in real time, to achieve good communications.	
27.14	UHT will not disengage from ALSEP antenna cable reel UHT socket.	Crew	1. Apply additional force.	
			2. Obtain assistance from second crewman.	
			3. If UHT will not disengage, discard it and continue deployment using second UHT.	Although only one UHT is needed for deployment, deployment time will be increased. Second crewman could carry out geological tasks while first astronaut completes ALSEP deployment.
27.15	Antenna Boyd bolt spline will not depress.	Crew	1. Check hex head of UHT and, if damaged, use second UHT.	
			2. Apply steady downward pressure with UHT and rotate bolt (approx. 2°) CW to relieve compression of balls.	

Event No.	Contingency	Agent	Action	Remarks
			3. Use MESA hammer on top of UHT to force depression of Boyd bolt spline.	
			4. Attempt to overcome spline lock by forcefully rotating UHT.	
			5. If unsuccessful, use MESA hammer to pry antenna free or break bracket.	
			6. If still unsuccessful in attempt to gain access to ALSEP antenna, obtain aid of second crewman, move Central Station toward deployed experiments, turn over Central Station onto its western side without disturbing deployed experiments, and attempt to tilt Central Station approximately 15° off vertical so that antenna is pointing toward the earth.	Central Station thermal control and antenna aiming accuracy will be degraded.
		MCC/ Crew	7. Adjust Central Station as required, in real time, to achieve good communication.	
27.16	Antenna Boyd bolt will not rotate.	Crew	1. Check hex head of UHT and, if damaged, use second UHT.	
			2. Forcefully rotate UHT to overcome Boyd bolt.	
			3. If unsuccessful, use MESA hammer to pry antenna free or break bracket.	

Event No.	Contingency	Agent	Action	Remarks
			4. If still unsuccessful in attempt to gain access to ALSEP antenna, obtain aid of second crewman, move Central Station toward deployed experiements, turn over Central Station onto its western side without disturbing deployed experiments, and attempt to tilt Central Station approximately 15° off vertical so that antenna is pointing toward the earth.	Central Station thermal control and antenna aiming accuracy will be degraded.
		MCC/ Crew	5. Adjust Central Station as required, in real time, to achieve good communication.	
27.17	Antenna restraining arm will not rotate.	Crew	1. Ensure Boyd bolt has been released.	
			2. Use UHT to ensure that Boyd bolt has been sprung upward.	
			3. If unsuccessful, use UHT handle to force antenna restraining arm rotation.	
			4. If still unsuccessful, use MESA hammer to pry antenna free or break bracket.	
			5. If unsuccessful in attempt to gain access to ALSEP antenna, obtain aid of second crewman, move Central Station toward deployed experiments, turn over Central Station onto its western side without disturbing deployed experiments, and attempt to tilt Central Station approximately 15° off vertical so that antenna is pointing toward the earth.	Central Station thermal control and antenna aiming accuracy will be degraded.

27.0 Sunshield Operations

Event No.	Contingency	Agent	Action	Remarks
		MCC/ Crew	6. Adjust Central Station as required, in real time, to achieve good communication.	
27.18	Sunshield will not move when depressed by UHT to check for Boyd bolt release or will not deploy.	Crew	1. Ensure all Boyd bolts have been released. 2. Use UHT to ensure that Boyd bolts have been sprung upward. 3. Check to see if thermistor cable, curtain covers or thermal curtains are jammed, or if ALSEP antenna cable is clear of sunshield and release them with UHT handle, if required. 4. Engage UHT in Subpackage #1 temporary stowage socket and use UHT as a lever to raise sunshield. 5. If unsuccessful, use UHT handle in an attempt to pry sunshield upward. 6 If guy wire is preventing sunshield extension, attempt to free the guy wire if it is entangled or caught. 7. If guy wire can not be freed, fail the tufbraid in order to permit sunshield extension. 8. If unsuccessful, use MESA hammer to jar or break sunshield free, if site of resistance to deployment can be located.	Central Station thermal control may be degraded.

Event No.	Contingency	Agent	Action	Remarks
			9. If sunshield can not be deployed, leave sunshield in stowed condition and attempt to gain access to antenna mast bracket.	Central Station thermal control will be degraded.
			10. If unsuccessful, place aiming mechanism and antenna on sunshield and prop up for stability and to ensure assembly is level.	If assembly is not leveled to within $\pm 6^{o}$, leveling capability of antenna aiming mechanism will be exceeded and antenna aiming accuracy will be degraded.
		MCC/ Crew	11. Adjust antenna as required, in real time, to achieve good communication.	
27.19	Antenna falls off sunshield.	Crew	Use UHT handle to retrieve antenna from lunar surface and remove debris, as required.	
27.20	Central Station is not properly leveled, but sunshield is fully extended. (Note to see that guy wires are taut.)	Crew	1. Use UHT to relevel Central Station by pressing downward on front of Central Station, "scrunching" the subpackage, or lifting up the primary structure to kick dirt underneath.	Do not relevel if primary structure will be misleveled more than $\pm 6^{o}$, which would exceed the leveling capability of the antenna aiming mechanism and would degrade the antenna aiming accuracy. Do not use sunshield as a handhold for releveling. The extenders could be failed and the thermal control system would be compromised.
			2. If unsuccessful, use UHT handle to lift rear or side of primary structure, as required, to kick dirt underneath.	
			3. If still unsuccessful, step on subpackage carry handle to force subpackage into lunar surface.	
			4. If still unsuccessful in attempt to relevel Central Station, continue nominal ALSEP deployment sequence.	Without accurate leveling, Central Station thermal control may be degraded. If primary structure is not leveled to within $\pm 6^{o}$, leveling capability of antenna aiming mechanism will be exceeded and antenna aiming accuracy will be degraded.

27.0 Sunshield Operations

Event No.	Contingency	Agent	Action	Remarks
27.21	Central Station is not properly leveled and sunshield is not fully extended. (Guy wires will not be taut.)	Crew	1. Attempt to manually ensure full sunshield erection.	
			2. If front extender can not be fully extended, gently press downward on rear of sunshield to level sunshield and increase size of (open) front side of Central Station.	Do not press downward on front of sunshield to level sunshield or decrease size of Central Station opening since Central Station thermal control would be degraded.
			3. Use UHT to relevel Central Station by pressing downward on front of Central Station, "scrunching" the subpackage, or lifting up the primary structure to kick dirt underneath.	Do not relevel if primary structure will be misleveled more than $\pm$ 6°, which would exceed the leveling capability of the antenna aiming mechanism and would degrade the antenna aiming accuracy. Do not use sunshield as a handhold for releveling. The extenders could be failed and the thermal control system further compromised.
			4. If unsuccessful, use UHT handle to lift rear or side of primary structure, as required, to kick dirt underneath.	
			5. If still unsuccessful, step on subpackage carry handle to force subpackage into lunar surface.	
			6. If still unsuccessful in attempt to relevel Central Station, continue nominal ALSEP deployment sequence.	Without accurate leveling, Central Station thermal control may be degraded. If primary structure is not leveled to within $\pm$ 6°, leveling capability of antenna aiming mechanism will be exceeded and antenna aiming accuracy will be degraded.

27.0 Sunshield Operations

Event No.	Contingency	Agent	Action	Remarks
27.22	Central Station is not properly aligned, but sunshield is fully extended. (Note to see that guy wires are taut.)	Crew	1. Ensure Central Station is properly leveled.	Proper alignment is dependent on meeting leveling requirement.
			2. Use UHT handle in subpackage carry handle to realign Central Station.	Do not use sunshield as a handhold for realignment. The extenders could be failed and the thermal control system would be compromised.
			3. If unsuccessful, kick subpackage primary structure.	
			4. If still unsuccessful in attempt to realign Central Station, continued nominal ALSEP deployment sequence.	Without accurate alignment, Central Station thermal control may be degraded.
27.23	Central Station is not properly aligned and sunshield is not fully extended. (Guy wires will not be taut.)	Crew	1. Attempt to manually ensure full sunshield erection.	
			2. Ensure Central Station is properly leveled.	Proper alignment is dependent on meeting leveling requirement.
			3. Use UHT handle in subpackage carry handle to realign Central Station.	Do not use sunshield as a handhold for realignment. The extenders could be failed and the thermal control system would be further compromised.
			4. If unsuccessful, kick subpackage primary structure.	
			5. If still unsuccessful in attempt to realign Central Station, continue nominal ALSEP deployment sequence.	Without accurate alignment, Central Station thermal control may be degraded.

27.0 Sunshield Operations

Event No.	Contingency	Agent	Action	Remarks
27.24	Side thermal curtain cover can not be removed.	Crew	Use UHT handle to bend or break side thermal curtain cover.	
27.25	Velcro tabs on side curtains will not mate or match up properly.	Crew	1. Run UHT between mating surfaces to release velcro and attempt to reattach velcro properly. 2. If unsuccessful in attempt to mate or match up velcro properly, continue nominal ALSEP deployment sequence.	Central Station thermal control may be degraded.

28.0 ALSEP Antenna Deployment

Event No.	Contingency	Agent	Action	Remarks
28.1	Antenna mast binds on subpallet taper fitting.	Crew	Stand on subpallet and rotate mast while applying additional lifting force on lower half.	
28.2	Antenna mast bracket on Central Station covered with lunar debris.	Crew	Clear area with boot or use UHT to probe or jar bracket and free it of debris.	
28.3	Antenna mast will not seat in bracket on Central Station.	Crew	1. Apply additional force.	
			2. Examine antenna mast for obstructions, dislodge obstructions by impact and reseat antenna mast in bracket on Central Station.	
			3. If unsuccessful, use MESA hammer to apply additional force. Do not damage aiming mechanism interface.	
			4. If antenna mast is partially seated and stable, continue with nominal ALSEP deployment sequence.	Antenna aiming accuracy may be degraded.
			5. If antenna mast can not be seated in bracket or is unstable, place aiming mechanism and antenna on sunshield and prop up for stability and to ensure assembly is level.	If assembly is not leveled to within $\pm 6^{o}$, leveling capability of antenna aiming mechanism will be exceeded and antenna aiming accuracy will be degraded.
		MCC/ Crew	6. Adjust antenna as required, in real time, to achieve good communication.	

28.0 ALSEP Antenna Deployment

Event No.	Contingency	Agent	Action	Remarks
28.4	Aiming mechanism housing dust cover pull ring/lanyard fails.	Crew	1. Attempt to remove cover by grasping any remaining lanyard. 2. Manually peel off dust cover. 3. If unsuccessful, request aid of second crewman.	
28.5	Aiming mechanism falls out of aiming mechanism housing.	Crew	Retrieve mechanism with UHT handle and shake debris off or clean taper fitting with glove.	Reduced operational capability or jamming of the gears and pivot points is possible due to degradation of the aiming mechanism surfaces with lunar debris.
28.6	Aiming mechanism will not seat on antenna mast.	Crew	1. Apply additional force. 2. Examine antenna mast for obstructions, dislodge obstructions by impact and reseat aiming mechanism on antenna mast.	
			3. If aiming mechanism is partially seated and stable, continue with nominal ALSEP deployment sequence.	Antenna aiming accuracy may be degraded.
			4. If aiming mechanism can not be seated on antenna mast or is unstable, place aiming mechanism and antenna on sunshield and prop up for stability and to ensure assembly is level.	If assembly is not leveled to within $\pm 6^{o}$, leveling capability of antenna aiming mechanism will be exceeded and antenna aiming accuracy will be degraded.
		MCC / Crew	5. Adjust antenna if required, in real time, to achieve good communication.	

28.0 ALSEP Antenna Deployment

Event No.	Contingency	Agent	Action	Remarks
28.7	Aiming mechanism release pin can not be removed.	Crew	1. Apply additional force.	
			2. Apply additional force on pin with MESA hammer or break pin.	
			3. If unsuccessful, obtain aid of second crewman.	
			4. If unable to gain access to aiming mechanism, place antenna on Central Station sunshield and prop up for stability and to ensure antenna is pointed toward earth.	Antenna aiming accuracy will be degraded.
		MCC/ Crew	5. Adjust antenna as required, in real time, to achieve good communication.	
28.8	Aiming mechanism housing can not be removed.	Crew	1. Apply additional force.	
			2. Obtain aid of second crewman.	
28.9	Clam shells can not be removed.	Crew	1. Use UHT handle to pry clam shells off.	
			2. Obtain aid of second crewman.	
28.10	Antenna will not seat on aiming mechanism.	Crew	1. Ensure cable outlet is properly oriented.	
			2. Apply additional force.	
			3. If unsuccessful, examine antenna and aiming mechanism for obstructions, dislodge obstructions by impact and reseat antenna on aiming mechanism.	
			4. If antenna is partially seated and stable continue with nominal ALSEP deployment sequence.	Antenna aiming accuracy may be degraded.

Event No.	Contingency	Agent	Action	Remarks
			5. If antenna can not be seated on aiming mechanism or is unstable, place antenna on sunshield and prop up for stability and to ensure antenna is pointed toward earth.	Antenna aiming accuracy will be degraded.
		MCC/ Crew	6. Adjust antenna as required, in real time, to achieve good communication.	
28.11	Aiming mechanism knob will not rotate.	Crew	1. Apply additional force with hand or MESA hammer, being careful not to damage mechanism.	
			2. If unsuccessful, attempt to intentionally fail mechanism, achieve approximately correct orientation using visual sighting, and shim or brace antenna to maintain aiming accuracy.	Antenna aiming accuracy may be degraded.
			3. If still unsuccessful, remove antenna from aiming mechanism, place it on sunshield, achieve approximately correct orientation using visual sighting and shim or brace antenna to maintain aiming accuracy.	Antenna aiming accuracy will be degraded.
		MCC/ Crew	4. Adjust antenna as required, in real time, to achieve good communication.	

28.0 ALSEP Antenna Deployment

Event No.	Contingency	Agent	Action	Remarks
28.12	Lunar debris degrades readability of bubble level or sun compass, or bubble level or sun compass is damaged.	Crew	1. Level by using estimation of true vertical and other equipment as a reference; align by using shadows and other equipment as a reference, and ensure ample photo coverage is obtained to verify aiming mechanism orientation.	Without accurate leveling and alignment, antenna aiming accuracy will be degraded.
		MCC/ Crew	2. Adjust antenna as required, in real time, to achieve good communication.	
28.13	ALSEP equipment is lying on lunar surface adjacent to Central Station PDM panel.	Crew	Move any debris away from PDM panel and at least 10 feet from Central Station.	

29.0 ALSEP Activation

Event No.	Contingency	Agent	Action	Remarks
29.1	Shorting switch depressed, but ammeter shows no drop in amperage.	Crew	1. Apply additional force to shorting switch and note if there is an amperage drop.	Absence of amperage drop is not justification for abandoning ALSEP deployment.
			2. If unsuccessful, disconnect shorting plug from Central Station, separate shorting plug from the RTG cable and connect RTG cable connector to Central Station.	
29.2	Switch #1 can not be turned CW to ON position.	Crew/ MCC	1. Report to MCC.	
		Crew	2. Apply additional force to switch.	
		Crew/ MCC	3. If unsuccessful, report to MCC and continue nominal ALSEP deployment sequence.	
29.3	Switch #5 can not be turned CCW to ON position.	Crew/ MCC	1. Report to MCC.	
		Crew	2. Apply additional force to switch.	
		Crew/ MCC	3. If unsuccessful, report to MCC and continue nominal ALSEP deployment sequence, but abandon any further ASE deployment.	ASE can not be commanded ON.
29.4	ALSEP signal is not received.	MCC	1. Transmit ON command.	
		MCC/ Crew	2. If unsuccessful, notify crew to turn Switches #2 and #3 CW to ON position.	
			3. If still unsuccessful, notify crew to check ammeter for zero amperage reading, to ensure shorting plug is properly connected to Central Station, to check ALSEP antenna, antenna cable and RTG cable for visible signs of damage, and to report to MCC.	

Event No.	Contingency	Agent	Action	Remarks
		Crew	4. If ammeter indicates a non-zero reading or shorting plug is not properly connected to Central Station, disconnect shorting plug from Central Station, separate shorting plug from the RTG cable and connect RTG cable and connect RTG cable connector to Central Station.	
		MCC/ Crew	5. If visible signs of damage and ALSEP signal is still not received, abandon ALSEP.	
29.5	Downlink signal strength too low to maintain decom lock.	MCC	1. Select Transmitter B.	
		MCC/ Crew	2. If unsuccessful, notify crew to verify that ALSEP antenna is properly oriented and to report to MCC.	
		Crew	3. If antenna is not properly oriented, adjust antenna as required.	
		Crew/ MCC	4. If antenna is properly oriented, continue nominal ALSEP deployment sequence, but do not fire thumper until given a GO by MCC.	
29.6	Downlink frequency so unstable that MCC receiver can not synchronize, signal is strong but data is noisy, etc.	MCC	1. Select redundant transmitter or redundant data processor, etc.	
		MCC/ Crew	2. If signal unstable, noisy, etc., notify crew to continue nominal ALSEP deployment sequence, but not to fire thumper until given a GO.	
29.7	MCC unable to get ALSEP to respond to commands.	MCC/ Crew	Notify crew to turn Switch #4 CW to ON position and to continue with nominal ALSEP deployment sequence.	

30.0 HFE Electronics Package Offload and Deployment

Event No.	Contingency	Agent	Action	Remarks
30.1	HFE Electronics Package Boyd bolt spline will not depress.	Crew	1. Check hex head of UHT and, if damaged, use second UHT. 2. Apply steady downward pressure with UHT and rotate bolt (approx. 2°) CW to relieve compression of balls. 3. Use MESA hammer on top of UHT to force depression of Boyd bolt spline. 4. If unsuccessful, attempt to overcome spline lock by forcefully rotating UHT. 5. If still unsuccessful, leave HFE Electronics Package on HFE subpallet and attempt to level and align assembly.	HFE thermal control may be degraded.
30.2	HFE Electronics Package Boyd bolt will not rotate.	Crew	1. Check hex head of UHT and, if damaged, use second UHT. 2. Forcefully rotate UHT to overcome Boyd bolt. 3. If unsuccessful, leave HFE Electronics Package on HFE subpallet and attempt to level and align assembly.	HFE thermal control may be degraded.
30.3	UHT will not engage in HFE Electronics Package carry socket.	Crew	1. Try to engage second UHT in carry socket. 2. If UHT engagement fails, attempt to remove, emplace, level and align HFE Electronics Package manually and use UHT as a gnomon without engaging tool.	Reduced thermal control due to degradation of thermal paint with lunar debris from astronaut's gloves. HFE thermal control will be further degraded if alignment is inaccurate.

30.0 HFE Electronics Package Offload and Deployment.

Event No.	Contingency	Agent	Action	Remarks
30.4	HFE Electronics Package will not come off HFE subpallet.	Crew	1. Ensure all Boyd bolts have been released. 2. Use UHT to ensure that Boyd bolts have been sprung upward. 3. If unsuccessful, leave HFE Electronics Package on HFE subpallet and attempt to level and align assembly.	HFE thermal control may be degraded.
30.5	Experiment falls off UHT due to accidental triggering of UHT release mechanism.	Crew	1. Attempt to re-engage UHT in socket. 2. If UHT engagement fails, attempt to emplace, level and align HFE Electronics Package manually and use UHT as a gnomon without engaging tool.	Reduced thermal control due to degradation of thermal paint with lunar debris. Reduced thermal control due to degradation of thermal paint with lunar debris from astronaut's gloves. HFE thermal control will be further degraded if alignment is inaccurate.
30.6	HFE dust cover pull ring fails.	Crew	1. Manually peel off dust cover. 2. Request aid of second crewman.	
30.7	Lunar debris degrades readability of bubble level or compass rose, or bubble level or compass rose is damaged.	Crew	Level by using estimation of true vertical and other equipment as a reference; align by using shadows and other equipment as a reference; and ensure ample photo coverage is obtained to verify experiment orientation.	Without accurate leveling and alignment, thermal control will be degraded.

30.0 HFE Electronics Package Offload and Deployment

Event No.	Contingency	Agent	Action	Remarks
30.8	UHT will not disengage from HFE Electronics Package UHT socket.	Crew	1. Apply additional force. 2. Obtain assistance from second crewman. 3. If UHT will not disengage, leave it on the HFE Electronics Package and continue deployment using second UHT. Prop up the experiment, as required, to maintain experiment stability.	Experiment leveling, alignment, stability, and thermal control will be degraded. Although only one UHT is needed for deployment, deployment time will be increased. Second crewman could carry out geological tasks while first astronaut completes ALSEP deployment.

31.0 ASE Geophone Deployment

Event No.	Contingency	Agent	Action	Remarks
31.1	Cable anchor will not unfold or lock.	Crew	1. Apply additional force in an attempt to unfold and lock anchor.	
			2. Obtain aid of second crewman.	
			3. If unsuccessful, use MESA hammer to jar anchor or force sleeve to lock.	
			4. If still unsuccessful, use second anchor in first cable loops and geophone flag at second cable loop.	Geophone alignment accuracy should not be degraded with one flag and one anchor.
			5. If both anchors can not be used, use geophone flag at first cable loops and any available discarded hardware at second cable loop.	Geophone alignment accuracy may be degraded without both anchors.
			6. If anchors and flag are unusable and no discarded hardware is available, continue with geophone deployment, but ensure all geophones are embedded prior to thumper activity. Exercise caution during geophone deployment to avoid putting any strain on Central Station connectors, geophones or cables. Second crewman can assist in achieving satisfactory alignment.	Geophone alignment accuracy will be degraded without both anchors, flag or discarded hardware if second crewman does not provide some assistance.
31.2	Cable anchor pedal will not deploy.	Crew	1. Apply additional force.	
			2. If unsuccessful, use MESA hammer to jar or force pedal to deploy.	
			3. If still unsuccessful, drive anchor into lunar surface using hammer.	

31.0 ASE Geophone Deployment

Event No.	Contingency	Agent	Action	Remarks
31.3	Crewman walks too far and jerks Central Station	Crew	1. Carry T/G back toward Central Station to provide sufficient slack cable and continue geophone deployment.	
		Crew/ MCC	2. Check cable and connectors at first geophone and Central Station interfaces for visible signs of damage and check Central Station and ALSEP antenna leveling and alignment prior to thumper activity, relevel and realign Central Station and ALSEP antenna if required, and notify MCC if there are visible signs of damage or if releveling and realignment were required.	T/G operation may be degraded if there are visible signs of damage.
			3. Upon return from thumper activity, if Central Station and ALSEP antenna were disturbed, check PSE, LSM and HFE leveling and alignment, and relevel, realign, and notify MCC if experiments were disturbed.	
31.4	Cable anchor can not be embedded in lunar surface because its planned placement location is too hard or due to presence of craters, etc.	Crew	1. Locate anchor (and its associated geophone) as far from Central Station or preceeding geophone as cable permits.	
			2. Move anchor (and geophone) laterally with respect to the geophone deployment line, but do not allow geophone cable to touch RTG. Attempt not to cross cables or run geophone cable along with and in contact with another cable.	Any geophone (and its associated anchor) may be displaced laterally up to 10 feet from the geophone axis.

Event No.	Contingency	Agent	Action	Remarks
			3. If unable to move anchor (and geophone) laterally, continue geophone deployment without using anchor, but ensure geophone is embedded in lunar surface prior to thumper activity. Exercise caution during geophone deployment to avoid putting any strain on Central Station connectors, geophones or cables.	Geophone alignment accuracy should not be degraded with one flag and one anchor.
31.5	Unable to deploy geophones along sunline due to presence of craters, etc.	Crew	1. Deploy geophones in a line running west of Central Station and MPA should fire west.	The MPA/MPA pallet must be aligned parallel with the geophone line and situated at least 40 feet north of Central Station. Do not allow geophone cable to touch RTG and attempt not to cross cables or run geophone cable along with and in contact with another cable.
			2. If unable to deploy geophones west of Central Station deploy geophones in a line running up to 45° northwest of Central Station-LM axis and MPA should fire northwest.	
			3. If unable to deploy geophones northwest of Central Station, deploy geophones in a line running north-northeast or south-southeast of Central Station-LM axis and MPA should fire south-southwest or north-northwest, respectively.	Experiment science will be degraded.
			4. If unable to deploy geophones north-northeast or south-southeast of Central Station, deploy geophones in a line running east of Central Station and MPA should fire west.	

Event No.	Contingency	Agent	Action	Remarks
			5. If unable to deploy geophones east of Central Station, deploy geophones in a line running north of Central Station and MPA should fire north.	
31.6	Thumper falls on lunar surface.	Crew	Use UHT handle to retrieve T/G from lunar surface and remove debris, as required.	
31.7	T/G cable reel does not turn freely or will not rotate.	Crew	Deploy cable manually.	
31.8	T/G cable spews off cable reel.	Crew	Remove any kinks or snarls in cable.	
31.9	During deployment the cable becomes suspended between crater rim edges.	Crew	1. If it is a small crater, continue on same deployment line.	Slack cable suspended between small crater rims is not expected to affect experiment.
			2. If it is a large crater, skirt crater and continue on a parallel deployment line.	
31.10	Crewman walks too far and jerks geophone(s) or anchor(s) out of ground, disturbs Central Station, etc.	Crew	1. Carry geophone back toward Central Station to provide sufficient slack cable and continue geophone deployment.	
		Crew/ MCC	2. Re-emplant geophone(s) if required and anchor(s), check cable and connectors at geophones, thumper and Central Station interfaces for visible signs of damage and check Central Station and ALSEP antenna leveling and alignment prior to thumper activity, relevel and realign Central Station and ALSEP antenna if required, and notify MCC if there are visible signs of damage or if releveling and realignment were required.	T/G operation may be degraded if there are visible signs of damage.

Event No.	Contingency	Agent	Action	Remarks
			3. Upon return from thumper activity, if Central Station and ALSEP antenna were disturbed, check PSE, LSM and HFE leveling and alignment, and relevel, realign and notify MCC if experiments were disturbed.	
31.11	Geophone falls on lunar surface.	Crew	Use UHT handle to retrieve geophone cable, grasp geophone cable and continue geophone deployment.	
31.12	Geophone can not be embedded in lunar surface because its planned placement location is too hard or due to presence of craters, etc.	Crew	1. Locate geophone as far from Central Station or preceding geophone as cable permits.	
			2. Move the geophone laterally with respect to the geophone deployment line, but do not allow geophone cable to touch RTG. Attempt not to cross cables or run geophone cable along with and in contact with another cable.	Any geophone may be displaced laterally up to 10 feet from the geophone axis.
			3. If unable to embed geophone in lunar surface, lateral to geophone deployment line, change the direction of deployment of the geophone line toward the west, northwest, north-northeast, south-southeast, east or north.	The MPA/MPA pallet must be aligned parallel with the new deployment direction, should be situated at least 40 feet north of Central Station, and the MPA should fire in the direction cited in 31.5
31.13	Geophone flag will not unfold or lock.	Crew	1. Apply additional force in an attempt to unfold and lock flag.	
			2. If unsuccessful, abandon effort.	Flag is used for photographic purposes. Experiment alignment should not be degraded with two anchors.

Event No.	Contingency	Agent	Action	Remarks
31.14	Geophone flag can not be embedded in lunar surface because its planned placement location is too hard or due to presence of craters, etc.	Crew	Abandon effort.	Flag is used for photographic purposes. Experiment alignment accuracy should not be degraded with two anchors.
31.15	LSM sunshade lanyard breaks.	Crew	1. Attempt to deploy sunshade by grasping any remaining lanyard. 2. Manually deploy sunshade and attempt to attach lanyard to sensor arm.	
31.16	LSM sunshade tears or can not be properly.	Crew	Deploy sunshade so as to provide as much shade to Electronics/Gimbal Flip Unit as possible.	Experiment thermal control will be degraded.

Event No.	Contingency	Agent	Action	Remarks
32.1	Selector switch jams	Crew	1. Apply additional force to selector switch.	
			2. If unsuccessful, use UHT or MESA hammer to jar selector switch.	
			3. If still unsuccessful, abandon thumper activity.	MPA activity will not be affected.
32.2	Arm-fire switch jams	Crew	1. Check if selector switch is turned to the corrected position.	
			2. Apply additional force to the arm-fire switch.	
			3. If unsuccessful, use UHT or MESA hammer to jar arm-fire switch.	
			4. If still unsuccessful, abandon thumper activity.	MPA activity will not be affected.
32.3	ASI does not fire when the arm-fire switch is activated.	Crew	1. Rotate selector switch back one position then forward to initial position and repeat firing sequence	
			2. Repeat firing sequence. Be sure that 4 seconds have passed after turning the arm-fire switch and before the arm-fire switch is depressed.	
		Crew/ MCC	3. If unsuccessful, go to the next point along the cable, start a new thumper firing sequence for the next ASI and notify MCC.	

Event No.	Contingency	Agent	Action	Remarks
32.3		Crew	4. If thumper doesn't fire after several repeated firing sequence failures, continue along cable attempting to fire thumper at each successive position.	MPA activity will not be affected.
32.4	Thumper has to be fired in a small crater or on a slope, or in a very rocky or granular area in order to fire thumper near geophone line.	Crew	1. Ensure thumper base plate is flush with the lunar surface prior to firing.	If thumper base plate coupling to the lunar surface material is poor, ASE science may be degraded.
		Crew/ MCC	2. If required, move off the geophone line in a direction normal to it by as much as 5 feet, in order to improve the thumper coupling, and notify MCC of the change in the site of thumper activity.	

Event No.	Contingency	Agent	Action	Remarks
33.1	Switch #5 can not be turned CW to OFF position.	Crew/ MCC	1. Report to MCC so that MCC can verify ASE status and turn ASE OFF, if required.	
		Crew	2. Apply additional force to switch.	
		Crew/ MCC	3. If unsuccessful, report to MCC but do not remove MPA safety rod or arm MPA until MCC confirms that it is safe to continue MPA deployment.	ASE science will be degraded if MPA deployment is not completed, but an astronaut safety hazard may exist if MPA deployment were continued with ASE power on.
33.2	Unable to locate MPA and MPA pallet 50 feet north of Central Station due to presence of craters, etc.	Crew	1. Locate MPA and MPA pallet as far from Central Station, PSE and RTG as cable permits, but no closer than 40 feet.	
			2. Deploy MPA and MPA pallet east of planned location, but do not position MPA so that it will fire over ALSEP. Do not cross cables or run MPA cable along with and in contact with another cable.	
			3. If unable to deploy MPA and MPA pallet east of planned location, deploy MPA and MPA pallet west of planned location, but do not position MPA so that it will fire over ALSEP. Do not cross cables or run MPA cable along with and in contact with another cable.	

Event No.	Contingency	Agent	Action	Remarks
33.3	MPA pallet panel pull pin jams	Crew	1. Apply additional force while rotating pin. 2. Apply additional force on pin with MESA hammer or break pin. 3. If unsuccessful, use MESA hammer to break bracket. 4. If MPA pallet can not be opened, deploy MPA on lunar surface.	MPA initial aiming and aiming accuracy after firing will be degraded.
33.4	MPA pallet panels will not deploy.	Crew	1. Apply additional force. 2. Obtain assistance from second crewman. 3. If unsuccessful, use MESA hammer to force panels to deploy. 4. If MPA will not fully deploy, place MPA pallet on lunar surface and step on pallet in an attempt to fully deploy panels. 5. If MPA pallet can not be fully deployed deploy MPA on lunar surface.	MPA initial aiming and aiming accuracy after firing will be degraded.
33.5	MPA pallet panels will not lock.	Crew	1. Apply additional force. 2. Obtain assistance from second crewman. 3. If unsuccessful, use MESA hammer to force panels to lock.	

Event No.	Contingency	Agent	Action	Remarks
33.5			4. If still unsuccessful, deploy pallet with panels unlocked.	MPA aiming accuracy after firing may be degraded.
33.6	UHT will not engage in MPA pallet UHT socket.	Crew	1. Try to engage second UHT in socket.	
			2. If UHT engagement fails, attempt to level, align, carry, manipulate and emplace MPA pallet manually and use UHT as a gnomon without engaging tool.	MPA aiming accuracy will be degraded.
33.7	Geophones have not been deployed along sunline.	Crew	1. Deploy MPA and MPA pallet at least 40 feet north of Central Station, align MPA/MPA pallet parallel with the geophone line and aim the MPA in the direction cited in 31.5.	
33.8	MPA pallet falls off UHT due to accidental triggering of UHT release mechanism.	Crew	1. Use UHT handle to retrieve MPA pallet and attempt to re-engage UHT in socket.	
			2. If UHT engagement fails, deploy manually	
33.9	MPA falls to lunar surface.	Crew	Use UHT handle to retrieve cable, gently lift experiment and deploy manually, (i.e., by grasping MPA leg).	Reduced thermal control due to degradation of thermal paint with lunar debris.
33.10	Crewman walks too far and jerks Central Station.	Crew	1. Carry experiment back toward Central Station to provide sufficient slack cable and continue deployment of MPA.	
		Crew/ MCC	2. Check cable and connectors at experiment and Central Station interfaces for visible signs of damage and notify MCC if there are visible signs of damage.	MPA operation may be degraded if there are visible signs of damage.

Event No.	Contingency	Agent	Action	Remarks
33.10			3. Upon return from MPA deployment site, check Central Station and ALSEP antenna leveling and alignment, relevel and realign Central Station and ALSEP antenna if required, and notify MCC if releveling and realignment were required. 4. If Central Station and ALSEP antenna were disturbed, check PSE, LSM and HFE leveling and alignment, and relevel, realign and notify MCC if experiments were disturbed	
33.11	MPA pallet anchor lanyard breaks.	Crew	1. Attempt to remove pins by grasping any remaining lanyard. 2. Manually release pins.	
33.12	MPA pallet anchor pin jams.	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. If pin can not be removed, deploy MPA pallet with anchor still stowed.	MPA aiming accuracy after firing may be degraded.
33.13	MPA pallet can not be fully embedded in lunar surface because its planned placement location is too hard or due to presence of craters, etc.	Crew	1. Locate MPA pallet at another location that is at least 40 feet north of Central Station. 2. If unable to embed MPA pallet in lunar surface 40 feet north of Central Station, continue deployment	MPA aiming accuracy after firing will be degraded.

Event No.	Contingency	Agent	Action	Remarks
33.14	MPA pallet anchor bends	Crew	1. Attempt to manually straighten anchor or use MESA hammer.	
			2. If anchor is not badly bent, deploy in normal manner.	
			3. If anchor is badly bend and can not be straightened, use MESA hammer to break off damaged anchor and continue deployment.	MPA aiming accuracy after firing may be degraded
33.15	UHT will not disengage from MPA pallet UHT socket.	Crew	1. Apply additional force.	
			2. Obtain assistance from second crewman.	
			3. If UHT will not disengage, attempt to manually break off UHT.	
			4. If unsuccessful, use MESA hammer to break off UHT.	
			5. If still unsuccessful, leave it on the MPA pallet and continue deployment using second UHT.	ASE science will be degraded when grenade strikes UHT.

Event No.	Contingency	Agent	Action	Remarks
34.1	MPA will not engage with MPA pallet.	Crew	1. If MPA guide bracket is bent, use hammer to straighten or, if necessary, break off the bent guide bracket.	
			2. If rear pedestal is bent, use MESA hammer in attempt to straighten pedestal.	
			3. If rear pedestal breaks or can not be straightened, deploy MPA on lunar surface.	MPA alignment accuracy after firing will be degraded.
			4. If MPA lugs will not engage in MPA pallet receptacles, apply additional force.	
			5. If unsuccessful, ensure MPA is engaged to rear pedestals and continue MPA deployment.	MPA initial aiming and aiming accuracy after firing will be degraded.
			6. If MPA will not engage on rear pedestals, apply additional force to free plunger.	
			7. If unsuccessful, ensure lugs are engaged in MPA pallet receptacles and continue MPA deployment.	MPA initial aiming and aiming accuracy after firing will be degraded.
34.2	Antenna can not be deployed or locked	Crew	1. Apply additional force in an attempt to deploy and lock antenna.	MPA antenna is fragile and subject to damage.
			2. If unsuccessful, continue MPA deployment.	MPA science will be degraded.
34.3	Antenna breaks	Crew	Continue MPA deployment.	MPA science will be degraded.

Event No.	Contingency	Agent	Action	Remarks
34.4	Safety rod release latch will not rotate	Crew	1. Check hex head of UHT and, if damaged, use second UHT.	
			2. Attempt to overcome lock by forcefully rotating UHT.	
			3. If latch will not rotate, abandon MPA deployment.	ASE science will be degraded.
34.5	Safety rod release latch rotates but will not release.	Crew	1. Jiggle UHT to obtain latch release.	
			2. If unsuccessful, retrieve lanyard and attempt to remove safety rods.	
			3. If unsuccessful or lanyard breaks, abandon MPA deployment.	ASE science will be degraded.
34.6	UHT will not engage in MPA UHT socket	Crew	If UHT will not engage in socket remove safety rod without engaging UHT.	
34.7	Safety rod can not be removed.	Crew	1. Apply additional force.	
			2. Obtain aid of second crewman.	
			3. If lanyard breaks, use ring on safety rod.	
			4. If unsuccessful, abandon MPA deployment.	ASE science will be degraded.
34.8	UHT will not disengage from MPA UHT socket	Crew	1. Apply additional force.	
			2. Obtain assistance from second crewman.	
			3. If UHT will not disengage, leave it on the MPA and continue deployment using second UHT.	MPA aiming accuracy after firing may be degraded.

Event No.	Contingency	Agent	Action	Remarks
34.9	MPA 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, turn Switch #5 CCW to ON position and return to LM.	MPA will not fire unless both safe/arm switches are rotated and Switch #5 is CCW (ON) position.
34.10	Lunar debris degrades readability of bubble level or bubble level is damaged.	Crew	Level by using bubble level on MPA pallet or by estimation of true vertical and other equipment as a reference and ensure ample photo coverage is obtained to verify experiment orientation.	Without accurate leveling science will be degraded.
34.11	Switch #5 can not be turned CCW to ON position.	Crew/ MCC	1. Report to MCC	
		Crew	2. Apply additional force to switch.	
		Crew/ MCC	3. Report to MCC and return to LM	MPA will not fire unless Switch #5 is in CCW (ON) position.

Event No.	Contingency	Agent	Action	Remarks
35.1	ALSEP and/or experiment transmissions are not as expected or equipment is not accepting commands properly.	MCC/ Crew	MCC may request crew to return to ALSEP deployment site to check-out equipment and perform operations as required.	