This ATM is submitted as the Flight 3 deployment sequence and is based on current data and flight configurations.

It describes the tasks associated with the deployment of Flight 3, configuration B, and lists the time associated with each task. The experiments to be deployed on this flight consist of the Passive Seismic Experiment (PSE), the Heat Flow Experiment (HFE), the Charged Particle Lunar Environment Experiment and the Cold Cathode Gauge Experiment (CPLEE).

The following conditions are assumed:

1. The LM landing on the lunar surface was accomplished with the scientific equipment bay (SEQ) in the direction of the sun (lunar East).

2. ALSEP will be deployed on the second excursion by the systems engineer.

3. The ALHT was removed from the ALSEP No. 2 package on the first excursion and was taken to the site where the drilling operation will be accomplished.

4. A dual purpose tool exists for removing the in-flight stowage cask cap and for spline removal.

5. The device for opening the SEQ bay door is the same as reflected in the sequence.

Time elements associated with the sequence are estimates only and are based on the most accurate times available from Mission and Crew Engineering test and evaluation data.

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ONE MAN DEPLOYMENT

Predeployment Tasks	Time	(PLSS) Cumulative Time
Don EMU.	00:15:30	
Don PLSS.	00:11:30	
Depressurize LM cabin.	00:02:00	00:02:00
Open forward hatch.	00:00:30	00:02:30
Mount boarding platform.	00:00:30	00:03:00
Descend to lunar surface.	00:01:30	00:04:30
Test body mobility.	00:05:00	00:09:30
Predeployment Total	00:36:30	00:09:30

ALSEP Deployment Tasks			
1.0	Proceed to SEQ bay.	00:00:36	00:10:06
2.0	Clear unloading area of hazardous rubble and obstructions.	00:05:00	00:15:06
3.0	Gain access to SEQ bay.		
3.1	Adjust suit tie-down strap for ease of ALSEP removal--dependent on SEQ bay height.	00:00:15	00:15:21
3.2	Release door reel mechanism.	00:00:30	00:15:51
3.3	Walk out from SEQ bay door to point where cable is taut (at 11 feet).	00:00:15	00:16:06

		Time	(PLSS) Cumulative Time
3.4	Pull right hand segment of cable loop and raise SEQ door until hinge detents hold door in place.	00:01:00	00:17:06
3.5	Return to SEQ bay.	00:00:15	00:17:21
3.6	Restow reel mechanism.	00:00:30	00:17:51
	Segment 3.0 Total	00:02:45	
4.0	Remove Package No. 1		
4.1	Walk to position directly in front of No. 1 package.	00:00:10	00:18:01
4.2	Grasp boom/package withdrawal lanyard with right hand.	00:00:05	00:18:06
4.3	Walk directly out from SEQ bay pulling lanyard, extending boom, and withdrawing package until boom is fully extended.	00:00:25	00:18:31
4.4	Package release is actuated when the lanyard has pulled the package to the end of the boom. The package is lowered automatically to the lunar surface.	00:00:08	00:18:39
4.5	Carry lanyard and return to Package No. 1.	00:00:15	00:18:54
4.6	Release lanyard.	00:00:03	00:18:57
4.7	Remove package removal yoke by pulling retaining pin on front of package while grasping yoke.	00:00:05	00:19:02
4.8	Retract (or remove) boom.	00:00:05	00:19:07

		Time	(PLSS) Cumulative Time
4.9	Place lanyard and removal yoke in SEQ bay.	00:00:10	00:19:17
4.10	Place Package No. 1 on lunar surface about 10 feet directly out from SEQ bay in position for barbell attachment. (Handle up).	00:00:15	00:19:32
	Segment 4.0 Total	00:01:41	
5.0	Remove Package No. 2		
5.1	Walk to position directly in front of No. 2 package.	00:00:10	00:19:42
5.2	Grasp boom/package withdrawal lanyard with right hand.	00:00:05	00:19:47
5.3	Walk directly out from SEQ bay pulling lanyard, extending boom, and withdrawing package until boom is fully extended.	00:00:25	00:20:12
5.4	Package release is actuated when the lanyard has pulled the package to the end of the boom. The package is lowered automatically to the lunar surface.	00:00:08	00:20:20
5.5	Carry lanyard and return to Package No. 2.	00:00:15	00:20:35
5.6	Release lanyard.	00:00:03	00:20:38
5.7	Remove package removal yoke by pulling retaining pin on front of package.	00:00:05	00:20:43
5.8	Retract (or remove) boom.	00:00:05	00:20:48

		Time	Cumulative Time
5.9	Place lanyard and removal yoke in SEQ bay.	00:00:10	00:20:58
5.10	Place Package No. 2 slightly to right of where it has been lowered to lunar surface. Place in position for fuel transfer.	00:00:15	00:21:13
	Segment 5.0 Total	00:01:41	
6.0	Replace SEQ bay insulating door.		
6.1	Release door reel mechanism.	00:00:30	00:21:43
6.2	Walk out from SEQ bay door to a point where cable is taut (about 11 feet).	00:00:15	00:21:58
6.3	Pull left hand segment of cable loop until force overcomes the hinge detents.	00:00:20	00:22:18
6.4	Allow door to hinge down in place. (Protective door remains open.)	00:00:10	00:22:28
6.5	Return to SEQ bay door.	00:00:08	00:22:36
6.6	Stow door reel mechanism on LM.	00:00:10	00:22:46
	Segment 6.0 Total	00:01:33	
7.0	Prepare No. 2 Package for Fuel Transfer.		
7.1	Walk to No. 2 package.	00:00:04	00:22:50
7.2	Adjust suit tie-down strap to allow bending mobility.	00:00:15	00:23:05
7.3	With right hand remove tie-down release tool (TDRT) from stowed position in No. 2 package by twisting counter clockwise.	00:01:00	00:24:05

		Time	Cumulative Time
7.4	With TDRT, remove tool bracket assembly and discard under LM.	00:00:40	00:24:45
7.5	Stow TDRT in No. 2 package stowage fitting. (No. 2 section had end colored with international orange.)	00:00:02	00:24:47
7.6	Install No. 1 antenna mast/carry bar section on No. 1 package.		
7.6.1	Remove section from No. 2 package.	00:00:03	00:24:50
7.6.2	Walk to No. 1 package.	00:00:04	00:24:54
7.6.3	Install section in carry bar socket.	00:00:40	00:25:34
7.6.4	Return to No. 2 package.	00:00:04	00:25:38
7.7	Remove antenna mast/carry bar section No. 2	00:00:02	00:25:40
7.8	Rotate No. 2 package to fueling position.		
7.8.1	Move to experiment side of package.	00:00:02	00:25:42
7.8.2	Grasp TDRT and guide package through the rotation.	00:00:03	00:25:45
7.9	Stow antenna mast/carry bar section No. 2 on G. E. flight handling tool (FHT).	00:00:30	00:26:15
7.10	Remove experiment handling tool (EHT) from stowed position with right hand.	00:00:05	00:26:20
7.11	Mate EHT and TDRT.	00:00:10	00:26:30
7.12	Remove TDRT from stowage fitting.	00:00:03	00:26:33

		Time	Cumulative Time
7.13	Release two (2) outboard fasteners for radioisotope thermoelectric generator (RTG) back support structure.	00:00:30	00:27:03
7.14	Separate EHT from TDRT.	00:00:20	00:27:23
7.15	With EHT and TDRT walk to Package No. 1.	00:00:06	00:27:29
7.16	Stow EHT in CCGE.	00:00:03	00:27:32
7.17	Return to Package No. 2.	00:00:06	00:27:38
	Segment 7.0 Total	00.04:52	
8.0	Prepare Cask for fuel transfer.		
8.1	Remove Dome Removal Tool (DRT) from stowed position on Package No. 2	00:01:05	00:28:43
8.2	Walk to fuel cask.	00:00:04	00:28:47
8.3	Unfold T-handles of DRT.	00:00:03	00:28:50
8.4	Holding DRT by distal end, insert either one of "T" handles in spline ring on cask.	00:00:07	00:28:57
8.5	Remove spline.	00:00:03	00:29:00
8.6	Discard spline in LM foot pad.	00:00:05	00:29:05
8.7	Walk to Package No. 1 and stow DRT on package.	00:00:05	00:29:10
8.8	Return to cask.	00:00:05	00:29:15
8.9	Retrieve cask tilt lanyard from protective door.	00:00:10	00:29:25

		Time	Cumulative Time
8.10	Holding lanyard, walk out from cask until slack is removed from lanyard loop.	00:00:15	00:29:40
8.11	With right hand, pull lanyard, feeding loop through left hand, until cask is rotated downward to the proper angle.	00:00:20	00:30:00
8.12	Release cask tilt lanyard.	00:00:03	00:30:03
8.13	Return to Package No. 1.	00:00:05	00:30:08
8.14	Retrieve DRT.	00:00:03	00:30:11
8.15	Walk to cask.	00:00:04	00:30:15
8.16	Holding "T" handle in right hand, tool shaft held steady in left hand, engage dome with DRT.	00:00:20	00:30:35
8.17	Turn handle counterclockwise and remove cask dome.	00:00:10	00:30:45
8.18	With Dome and DRT, turn to left and walk to LM foot pad.	00:00:15	00:31:00
8.19	Discard DRT/Dome in LM foot pad.	00:00:10	00:31:10
8.20	Return to Package No. 2.	00:00:15	00:31:25
8.21	Rest.	00:02:00	00:33:25
	Segment 8.0 Total	β 00:05:47	
9.0	Fuel RTG.		
9.1	Assemble tools for fuel transfer.		
9.1.1	Remove TDRT from Package No. 2.	00:00:10	00:33:35

		Time	Cumulative Time
9.1.2	Release FHT tie-down bracket using TDRT.	00:00:15	33:50
9.1.3	Insert TDRT in antenna mast and engage FHT.	00:00:05	33:55
9.1.4	Remove assembly.	00:00:02	33:57
9.1.5	Elevate assembly and slide tie-down bracket down mast toward handle end.	00:00:03	34:00
9.1.6	Remove tie-down bracket over trigger and TDRT handle and discard under LM.	00:00:03	34:03
9.2	Remove RTG dust cover and discard under LM.	00:00:10	34:13
9.3	Walk to fuel stowage cask with fuel transfer assembly, ensuring FHT fingers are fully extended.	00:00:05	34:18
9.4	Insert fuel transfer assembly into fuel cask.	00:00:05	34:23
9.5	Engage fingers of FHT in fuel capsule head.	00:00:15	34:38
9.6	Lock fuel transfer assembly to fuel capsule.		
9.6.1	Apply sufficient pressure to maintain fingers of FHT in fully seated position.	00:00:00	34:38
9.6.2	Rotate knurled handle on TDRT in a clockwise direction until fingers are completely retracted (indicated by inability to turn further).	00:00:30	35:08
9.6.3	Test for secure locking by partially withdrawing capsule, rotating it slowly and observing to ensure all fingers of FHT are fully engaged.	00:00:20	35:28
9.7	Step back and assume desirable body position for unloading.	00:00:05	35:33

		Time	Cumulative Time
9.8	Withdraw fuel capsule from stowage cask.	00:00:05	35:38
9.9	Carry capsule at left oblique angle to the body and walk to No. 2 package.	00:00:10	35:48
9.10	Rest end of capsule on RTG orifice lip.	00:00:02	35:50
9.11	Raise aft end of fuel transfer assembly and lower capsule completely in RTG	00:00:03	35:53
9.12	Ensure capsule is fully seated in RTG, (determined by observing whether top of capsule is flush with top of RTG).	00:00:05	35:58
9.13	Unlock fuel transfer assembly from fuel capsule.		
9.13.1	Apply sufficient pressure to maintain capsule in fully seated position.	00:00:00	35:58
9.13.2	Rotate TDRT handle in counterclockwise direction until fingers of FHT are fully extended.	00:00:30	36:28
9.13.3	Withdraw fuel transfer assembly.	00:00:02	36:30
9.14	Disassemble fuel transfer assembly.		
9.14.1	Carry assembly and walk to LM.	00:00:03	36:33
9.14.2	Remove TDRT from assembly.	00:00:05	36:38
9.14.3	Remove FHT by tapping with TDRT and discard under LM.	00:00:10	36:48
9.15	Rest.	00:01:00	37.48
	Segment 9.0 Total	00:04:23	

		Time	Cumulative Time
10.0	Rig ALSEP for Traverse.		
10.1	Return to No. 2 package.	00:00:02	37:50
10.2	Secure TDRT in No. 2 package stowage fitting.	00:00:10	38:00
10.3	Carry antenna mast/carry bar section No. 2 to No. 1 package.	00:00:04	38:04
10.4	Assemble antenna mast/carry bar.		
10.4.1	Insert section No. 2 in section No. 1.	00:00:03	38:07
10.4.2	Twist section No. 2 in a counter clockwise direction to located position (indicated by arrows).	00:00:04	38:01
10.4.3	Test to ensure locked condition.	00:00:02	38:13
10.5	Carry No. 1 package and return to No. 2 package (accomplished by gripping carry bar with one hand and package handle with the other).	00:00:06	38:19
10.6	Place No. 1 package on lunar surface in position to complete carry bar attachment No. 2 package.	00:00:02	38:21
10.7	Use TDRT and rotate No. 2 package up on end.	00:00:04	38:25
10.8	Install carry bar on No. 2 package.		
10.8.1	Tilt No. 1 package and carry bar toward No. 2 package.	00:00:02	38:27
10.8.2	Align carry bar end fitting with socket on No. 2 package.	00:00:02	38:29

		Time	Cumulative Time
10.8.3	Raise carry bar and lock in place.	00:00:03	38:32
10.9	Test to ensure locked condition by rotating carry bar.	00:00:03	38:35
10.10	Rest.	00:02:00	40:35
	Segment 10.0 Total	00:02:47	
11.0	Prepare Drill Rod Segments (Drill Strings) and Drill Casings Segments for traverse.		
11.1	Rearrange casing segments.		
11.1.1	Release two (2) rack stowage clip retaining fasteners on Package No. 2 ALSD.	00:00:40	41:15
11.1.2	Discard two (2) rack stowage clip retaining fasteners under LM.	00:00:04	41:19
11:1:3	Remove casing segments, one by one, inserting each casing into a casing remaining on the rack, until six (6) units consisting of two casings are attached to the ALSD rack, and leaving six (6) vacated holes.	00:01:30	42:49
11.2	Prepare Drill String Segments for traverse.		
11.2.1	Walk to ALSRC	00:00:03	42:52
11.2.2	Open ALSRC and lift lid.	00:00:06	42:58
11.2.3	Remove two (2) drill strings from ALSRC lid.	00:00:04	43:02
11.2.4	Join two (2) drill rod sections.	00:00:08	43:10
11.2.5	Stow double length drill string on ALSRC.	00:00:02	43:12

		Time	Cumulative Time
11.2.6	Remove two (2) sections of drill string, join them, and stow on ALSRC.	00:00:14	43:26
11.2.7	Remove two (2) sections of drill string, join them and stow on ALSRC.	00:00:14	43:40
11.2.8	Remove last two (2) sections of drill string, join them and place with other three (3) double length drill string sections on ALSRC.	00:00:14	43:54
11.2.9	Pick up four (4) double length sections of drill string.	00:00:02	43:56
11.2.10	Walk to Package No. 1 with drill strings.	00:00:06	44:02
11.2.11	Stow double length drill strings on Package No. 1	00:00:04	44:06
11.2.12	Take two (2) double length drill segments and go to Package No. 2.	00:00:03	44:09
11.2.13	Place drill strings in two (2) of the six vacated holes on ALSD rack.	00:00:06	44:15
11.2.14	Return to Package No. 1.	00:00:03	44:18
11.2.15	Take two (2) remaining double length drill string segments and return to Package No. 2.	00:00:03	44:21
11.2.16	Place drill string segments in two of the remaining four vacated holes in ALSD rack.	00:00:06	44:27
11.2.17	Rest.	00:01:00	45:27
	Segment 11.0 Total	00:04:52	

12.0 Complete Traverse to ALSEP Deployment Site.

		Time	Cumulative Time
12.1	Pick up ALSEP packages by carry bar.		
12.1.1	Assume position for carrying packages (No. 1 package on left when facing carry bar).	00:00:02	45:29
12.1.2	Grasp carry bar with both hands.	00:00:02	45:31
12.1.3	Raise package off surface.	00:00:02	45:33
12.1.4	Adjust grip to compensate for package weight differences.	00:00:04	45:37
12.2	Walk 320 feet from LM on Z axis to predetermined deployment site.	00:12:00	57:37
12.3	Rest enroute. Recheck deployment site.	00:05:00	01:02:37
	Segment 12.0 Total	00:17:10	
13.0	Emplace No. 2 Package.		
13.1	Place ALSEP on lunar surface on a N/S axis with No. 1 package on South side.	00:00:04	01:02:41
13.2	Rest and check terrain for acceptable field of view (no large rocks or depressions in immediate emplacement area).	00:02:00	01:04:41
13.3	Disengage carry bar from No. 2 package.		
13.3.1	Graph No. 2 package with right hand.	00:00:01	01:04:42
13.3.2	Actuate carry bar locking slide with left hand.	00:00:05	01:04:47
13.3.3	With left hand slide carry bar down "T" fitting and disengage from package.	00:00:05	01:04:52

		Time	Cumulative Time
13.3.4	Move No. 1 package to emplacement site (approximately 10 feet East of No. 2 package).		
13.4	Check for rock or rubble in No. 2 package emplacement area -- remove if necessary.	00:00:05	01:04:57
13.5	Remove ALSD pull ring (1).	00:00:04	01:05:01
13.6	Discard pin.	00:00:04	01:05:05
13.7	Grasp ALSD by carry handle, remove from bullet pins.	00:00:04	01:05:09
13.8	Remove ALSD subpackage, place on lunar surface toward Package No. 1.	00:00:08	01:05:17
13.9	Return to No. 2 package.	00:00:04	01:05:21
13.10	Use TDRT and rotate No. 2 package to an upright position.	00:00:02	01:05:23
13.11	Align package on E-W axis with RTG on East side.	00:00:08	01:05:31
	Segment 13.0 Total	00:02:54	
14.0	Remove Heat Flow Probe Box and Heat Flow Electronics Box.		
14.1	Remove TDRT from No. 2 package.	00:00:02	01:05:33
14.2	Walk to Package No. 1	00:00:04	01:05:37
14.3	Remove EHT from CCGE.	00:00:02	01:05:39
14.4	Mate EHT/TDRT.	00:00:02	01:05:41
14.5	With EHT/TDRT release (4) four tie-down release fasteners on Heat Flow Probe Box.	00:00:12	01:05:53

		Time	Cumulative Time
14.6	Remove EHT from TDRT.	00:00:02	01:06:07
14.7	Stow TDRT on Package No. 1.	00:00:02	01:06:09
14.8	Insert EHT in Heat Flow Probe Box.	00:00:02	01:06:11
14.9	Remove probe box and electronics box as one unit.	00:00:04	01:06:15
14.10	Walk 10 feet to electronic box deployment site.	00:00:04	01:06:19
14.11	Place Probe Box/Electronics package on lunar surface.	00:00:02	01:06:21
14.12	Remove EHT.	00:00:02	01:06:23
14.13	Return to Package No. 1	00:00:04	01:06:27
	Segment 14.0 Total	00:00:56	
15.0	Remove CCGE.		
15.1	Remove TDRT from No. 1 package.	00:00:02	01:06:29
15.2	Mate EHT with TDRT.	00:00:02	01:06:31
15.3	Release CCGE tie-down fasteners (4) with TDRT/EHT.	00:00:12	01:06:43
15.4	Remove TDRT from EHT and retain in left hand.	00:00:02	01:06:45
15.5	Insert EHT in CCGE carry fitting.	00:00:02	01:06:47
15.6	Remove CCGE from No. 1 package.	00:00:10	01:06:57
15.7	Walk to area adjacent to No. 1 package.	00:00:02	01:06:59
15.8	Place CCGE on lunar surface.	00:00:02	01:07:01

		Time	Cumulative Time
15.9	Remove EHT from CCGE and mate with TDRT.	00:00:04	01:07:05
15.10	Return to No. 2 package.	00:00:02	01:07:07
	Segment 15.0 Total	00:00:40	
16.0	Complete RTG to Central Station Interconnection.		
16.1	Remove remaining RTG BSS tie-down fastener.	00:00:20	01:07:27
16.2	Remove TDRT from EHT and stow in fitting.	00:00:04	01:07:31
16.3	Insert EHT in cable reel housing and remove from package freeing cable from retaining clips.	00:00:02	01:07:33
16.4	Remove cable reel housing from BSS.		
16.4.1	Grasp BSS outer structure with left hand.	00:00:02	01:07:35
16.4.2	Remove outer structure and discard outside of work area.	00:00:10	01:07:45
16.5	Remove cable from cable reel.		
16.5.1	Grasp first cable loop as it is pulled free from reel and allow cable to play out through hand.	00:00:06	01:07:51
16.5.2	Ensure reel is freed from power cable and is discarded outside of work area.	00:00:02	01:07:53
16.5.3	Retain power cable connector in left hand.		
16.5.4	Discard cable reel by releasing EHT -- ensure it is not in work area.	00:00:02	01:07:55

		Time	Cumulative Time
16.5.5	Retain EHT in right hand.		
16.5.6	Walk to CCGE, adjacent to Package No. 1.	00:00:02	01:07:57
16.6	Stow EHT in CCGE fitting.	00:00:02	01:07:59
16.7	Complete power cable connection.		
	Segment 16.0 Total	00:00:52	
17.0	Complete CCGE to Central Station Interconnect.		
17.1	Remove cable connector dust cover.	00:00:06	01:08:05
17.2	Remove dust cover on central station receptacle.	00:00:06	01:08:11
17.3	Insert connector into central station receptacle ensuring positive interconnect.	00:00:06	01:08:17
17.4	Remove entire connector assembly from sunshield and lower to lunar surface.	00:00:08	01:08:25
	Segment 17.0 Total	00:00:26	
18.0	Emplace No. 1 Package.		
18.1	Install EHT in PSE carry socket.	00:00:02	01:08:27
18.2	Grasp No. 1 package carry handle with left hand.	00:00:01	01:08:28
18.3	Grasp carry bar with right hand.	00:00:01	01:08:29
18.4	Ensure package is setting on lunar surface with carry bar pointing North.	00:00:04	01:08:33

		Time	Cumulative Time
18.5	Roughly align package on East-West axis by utilizing shadow cast by package.	00:00:04	01:08:37
18.6	Remove carry bar from No. 1 package.		
18.6.1	Grasp package with left hand.	00:00:01	01:08:38
18.6.2	Actuate carry bar locking slide.	00:00:05	01:08:43
18.6.3	Slide carry bar down and out of package "T" fitting.	00:00:05	01:08:48
18.7	Install carry bar/antenna mast on sub-pallet taper fitting.	00:00:02	01:08:50
18.8	Rotate No. 1 package to upright position.		
18.8.1	Ensure area is free of rocks and rubble.	00:00:04	01:08:54
18.8.2	Align package roughly on an E-W axis using shadow cast by package as a guide.	00:00:03	01:08:57
18.8.3	Rotate package and allow to free fall into upright position.	00:00:02	01:08:59
	Segment 18.0 Total	00:00:34	
19.0	Remove PSE from Central Station and Deploy.		
19.1	Remove TDRT from stowage on No. 1 package.	00:00:02	01:09:01
19.2	Remove EHT from stowage position on PSE.	00:00:02	01:09:03
19.3	Mate TDRT and EHT.	00:00:02	01:09:05
19.4	Walk to Subpallet.	00:00:02	01:09:07

		Time	Cumulative Time
19.5	Use TDRT/EHT, release PSE leveling stool tie-down fasteners and remove retaining assembly.	00:00:16	01:09:23
19.6	Engage TDRT/EHT in stool and remove from subpallet.	00:00:04	01:09:27
19.7	Carry TDRT/EHT/stool to a point 10 feet East of No. 1 package.	00:00:04	01:09:31
19.8	Emplace PSE leveling stool.		
19.8.1	Place stool on lunar surface.	00:00:02	01:09:33
19.8.2	Hold stool firmly in place with foot.		
19.8.3	Disengage TDRT/EHT.	00:00:04	01:09:37
19.8.4	Rough level and implant leveling stool with foot.	00:00:02	01:09:39
19.9	Return to central station.	00:00:04	01:09:43
19.10	Release PSE tie-down fasteners (4) with TDRT/EHT.	00:00:24	01:10:07
19.11	Remove TDRT from EHT and retain in left hand.	00:00:02	01:10:09
19.12	Insert EHT in PSE carry socket.	00:00:04	01:10:13
19.13	Remove PSE from No. 1 package.	00:00:02	01:10:15
19.14	Walk to stool emplacement site.	00:00:04	01:10:19
19.15	Release thermal shroud restraint with TDRT.	00:00:06	01:10:25

		Time	Cumulative Time
19.16	Emplace PSE on leveling stool and align using EHT shadow as a reference.	00:00:08	01:10:33
19.17	Release EHT.	00:00:02	01:10:35
19.18	Mate EHT and TDRT.	00:00:04	01:10:39
19.19	Use EHT/TDRT, push shroud outward and allow to fall to surface.	00:00:08	01:10:47
19.20	Work clockwise and successively engage EHT/TDRT in 5 of the shroud tabs. Lift up and out on the shroud, tugging lightly to achieve smooth deployment	00:00:40	01:11:27
19.21	Check level and alignment -- use EHT/TDRT to tap mounting ears as required to achieve leveling.	00:00:20	01:11:47
19.22	Engage EHT/TDRT in last shroud tab.	00:00:04	01:11:51
19.23	Fold tab out onto surface.	00:00:10	01:12:01
19.24	Report level and alignment condition.	00:00:10	01:12:11
19.25	Return to central station.	00:00:04	01:12:15
	Segment 19.0 Total	00:03:16	
20.0	Remove CPLEE.		
20.1	With EHT/TDRT remove tie down fasteners on CPLEE (3).	00:00:06	01:12:21
20.2	Stow TDRT/EHT on Package No. 1.	00:00:02	01:12:23
20.3	Pick up CPLEE.	00:00:02	01:12:25

		Time	Cumulative Time
20.4	Deploy legs (inboard to outboard).	00:00:09	01:12:34
20.5	Invert CPLEE.	00:00:02	01:12:36
20.6	Remove EHT from TDRT.	00:00:02	01:12:38
20.7	Insert EHT in CPLEE socket.	00:00:02	01:12:40
20.8	Walk 10 feet due South.	00:00:06	01:12:46
20.9	Set CPLEE on lunar surface.	00:00:02	01:12:48
20.10	Align shadowgraph to $\pm 5^{\circ}$.	00:00:05	01:12:53
20.11	Level with bubble level to $\pm 5^{\circ}$.	00:00:12	01:13:05
20.12	Remove EHT.	00:00:02	01:13:07
20.13	Insert EHT in TDRT.	00:00:01	01:13:08
20.14	Walk to Central Station	00:00:06	01:13:15
20.15	Stow TDRT/EHT in central station.	00:00:02	01:13:16
20.16	Rest	00:01:00	
	Segment 20.0 Total	00:02:01	
21.0	Complete No. 1 Package Emplacement.		
21.1	Remove TDRT from stowed position and mate with EHT.	00:00:04	01:14:20
21.2	Release RF cable restraint and deploy cable.	00:00:08	01:14:28
21.3	Release antenna tie-downs.	00:00:20	01:14:48
21.4	Release peripheral sunshield tie-downs. (Stand on West side of package, release South fasteners first, and continue to work clockwise around package.)	00:02:00	01:16:48

		Time	Cumulative Time
21.5	Release center (outside) fasteners.	00:00:24	01:17:12
21.6	Raise sunshield.		
21.6.1	Insert EHT/TDRT in center collar and release final fastener.	00:00:04	01:17:16
21.6.2	Using EHT/TDRT against collar as a lever, free the sunshield from structure and also free curtain restraints.	00:00:20	01:17:36
21.6.3	Using EHT/TDRT, control upward movement of sunshield.	00:00:20	01:17:56
21.6.4	Leave EHT/TDRT in collar. After raising sunshield, place hands under sunshield and complete upward travel.	00:00:10	01:18:06
21.6.5	Remove and discard curtain restraints.	00:00:20	01:18:26
21.6.6	Extend thermal curtain extensions.	00:00:20	01:18:46
21.6.7	Lower LSM protective back structure.	00:00:10	01:18:56
21.6.8	Deploy sunshield extensions.	00:00:20	01:19:16
21.6.9	Stow EHT/TDRT on sunshield.	00:00:02	01:19:18
21.7	Assemble antenna.		
21.7.1	Retrieve antenna mast from subpallet and install on structure.	00:00:30	01:19:48
21.7.2	Retrieve EHT/TDRT and walk to subpallet.	00:00:04	01:19:52
21.7.3	Release antenna gimbal fasteners (2).	00:00:12	01:20:04
21.7.4	Separate EHT from TDRT and insert EHT in antenna gimbal housing.	00:00:06	01:20:10

		Time	Cumulative Time
21.7.5	Carry package to central station.	00:00:04	01:20:14
21.7.6	Lay TDRT on sunshield.	00:00:02	01:20:16
21.7.7	Remove end of antenna gimbal housing and discard.	00:00:06	01:20:22
21.7.8	Remove EHT while holding housing and lay EHT on sunshield.	00:00:06	01:20:28
21.7.9	Emplace antenna gimbal on mast.	00:00:06	01:20:34
21.7.10	Remove packaging and discard.	00:00:20	01:20:54
21.7.11	Remove and discard helix antenna tie-downs.	00:00:18	01:21:12
21.7.12	Retrieve antenna and install on gimbal assembly.	00:00:12	01:21:24
21.8	Level and align central station.		
21.8.1	Level package to within $\pm 5^{\circ}$ while observing leveling sensor.	00:01:00	01:22:24
21.8.2	Align package to within $\pm 5^{\circ}$ of east-west axis by manually positioning package while observing sun compass.	00:01:00	01:23:24
21.8.3	Relevel and realign until both sensors indicate "in-tolerance".	00:00:30	01:23:54
	Segment 21.0 Total	00:09:38	
22.0	Align Central Station Antenna.		
22.1	Check central station level and alignment condition to ensure proper tolerances have been maintained.	00:00:08	01:24:02

		Time	Cumulative Time
22.2	Enter azimuth offset. Actuate adjustment knob until proper whole number appears on indicator.	00:00:40	01:24:42
22.2.1	Fine adjust until desired setting (to within $\pm 0.25^{\circ}$) is reached.	00:00:10	01:24:52
22.3	Enter elevation offset.		
22.3.1	Actuate adjustment knob until proper whole number appears on indicators.	00:00:40	01:25:32
22.3.2	Fine adjust until desired setting (to within $\pm 0.25^{\circ}$) is reached.	00:00:10	01:25:42
22.4	Level antenna subsystem to within $\pm 0.50^{\circ}$ of vertical by adjusting thumb screws (2) and observing bubble level.	00:00:40	01:26:22
22.5	Align antenna subsystem to within $\pm 0.75^{\circ}$ of east-west line by rotating adjustment knob and observing sun compass.	00:00:30	01:26:52
22.6	Rest.	00:05:00	01:31:52
	Segment 22.0 Total	00:07:58	
23.0	Request Activation and Confirmation of Central Station "Turn On".	00:01:00	01:32:52
	Segment 23.0 Total	00:01:00	
24.0	Prepare to Drill First Hole.		
24.1	Carry drill rack to first hole site.	00:02:00	01:34:52
24.1.1	Walk to drill rack.	00:00:04	01:34:56
24.1.2	Pick up drill rack.	00:00:04	01:35:00

		Time	Cumulative Time
24.1.3	Carry drill rack to first hole site.	00:00:30	01:35:30
24.1.4	Place rack on ALHT (placed at site on first excursion).	00:00:05	01:35:35
24.2	Deployment of drill rack.		
24.2.1	Release power head from stowage clips.	00:00:06	01:35:41
24.2.2	Deploy rack legs.	00:00:10	01:35:51
24.2.3	With TDRT, release three tie-down release fasteners.	00:00:12	01:36:03
24.2.4	Release hold down bracket.	00:00:03	01:36:08
24.2.5	Discard hold down bracket.	00:00:02	01:36:08
24.2.6	Lift rack off treadle.	00:00:02	01:36:10
24.2.7	Place rack on lunar surface.	00:00:04	01:36:14
	Segment 24.0 Total	00:03:22	
25.0	Deployment of Power Head.		
25.1	Loosen remaining power head clamp.	00:00:04	01:36:18
25.2	Rotate power head 90° placing switch side up.	00:00:04	01:36:22
25.3	Remove handle from stowed position.	00:00:05	01:36:27
25.4	Snap handle in place on power head.	00:00:05	01:36:32
25.5	Remove vertical indicator from its stowed position on treadle.	00:00:02	01:36:34
25.6	Attach vertical indicator to power head.	00:00:04	01:36:38

		Time	Cumulative Time
25.7	Remove first double section of drill rod (with bit).	00:00:02	01:36:40
25.8	Attach drill rods to power head spindle.	00:00:05	01:36:40
25.9	Pick up power head.	00:00:04	01:36:44
25.10	Activate switch momentarily to verify drill operability.	00:00:04	01:36:48
25.11	Rest drill bit on lunar surface, supporting drill with one hand (monopod).	00:00:03	01:36:51
25.12	Remove thermal shroud.	00:00:02	01:36:53
25.13	Discard shroud.	00:00:02	01:36:55
25.14	Invert drill, resting power head on lunar surface, holding drill rod as handle.	00:00:06	01:37:01
	Segment 25.0 Total	00:00:47	
26.0	Deployment of Treadle		
26.1	Remove treadle from rack.	00:00:03	01:37:04
26.2	Drop treadle, in horizontal position, on lunar surface.	00:00:03	01:37:07
26.3	Remove drill wrench.	00:00:02	01:37:09
26.4	Position treadle with wrench.	00:00:04	01:37:13
26.5	Stow wrench in empty casing on drill rack.	00:00:02	01:37:15
26.6	Invert drill to drilling position.	00:00:03	01:37:18
26.7	Place one foot on treadle.	00:00:02	01:37:20
26.8	Lift drill and insert drill bit and rod in treadle hole.	00:00:03	01:37:23

		Time	Cumulative Time
26.9	Position drill vertically and with both hands on handle, foot on treadle, actuate power.	00:00:01	01:37:24
26.10	Drill. *	INDETERMINATE	
26.11	When low point is reached (28 inches from lunar surface to handles) turn off drill.	00:00:01	01:37:25
26.12	Rotate drill handle counterclockwise locking treadle.	00:00:02	01:37:27
26.13	Rotate counterclockwise further until drill string/spindle joint is broken. (Approximately 4 ft. lbs.)	00:00:04	01:37:31
26.14	Remove power head spindle from drill string.	00:00:10	01:37:41
26.15	Place drill on lunar surface.	00:00:06	01:37:47
26.16	Remove double section of drill string from rack.	00:00:02	01:37:49
26.17	Attach double section of drill string to protruding drill string in probe hole.	00:00:08	01:37:57
26.18	Pick up drill.	00:00:04	01:38:01
26.19	Attach drill spindle to drill string sections.	00:00:06	01:38:07
26.20	Place foot on treadle, hands on handle and manually release treadle lock by turning drill handle clockwise.	00:00:02	01:38:09
26.21	Actuate power switch.	00:00:01	01:38:10
26.22	Continue drilling. *	INDETERMINATE	

		Time	Cumulative Time
26.23	When low point is reached (28 inches from lunar surface to handles), turn off drill.	00:00:01	01:38:11
26.24	Rotate drill handle counterclockwise locking treadle.	00:00:02	01:38:13
26.25	Rotate counterclockwise further until drill string/spindle joint is broken. (Approximately 4 ft. lbs.)	00:00:04	01:38:17
	Segment 26.0 Total	00:01:16	
NOTE:	Continue adding drill strings until 3 meter hole depth is reached.		
27.0	Remove drill string from hole		
27.1	Apply lifting force on drill, actuate power.	00:00:01	01:38:18
27.2	"Power out" drill string. *	INDETERMINATE	
27.3	Remove two drill string sections from hole.	00:00:10	01:38:28
27.4	When two drill string sections are above lunar surface, shut off drill power.	00:00:01	01:38:29
27.5	Lock treadle on third string by turning handle counterclockwise.	00:00:01	01:38:30
27.6	Remove wrench from rack.	00:00:02	01:38:32
27.7	With wrench, break joint between second and third drill strings.	00:00:04	01:38:36
27.8	Replace wrench in empty drill casing on rack.	00:00:02	01:38:38
27.9	Remove drill and two drill strings from remainder of drill string.	00:00:04	01:38:42

		Time	Cumulative Time
27.10	Walk one step away from hole and holding drill downward at approximately 45° angle, actuate power, vibrating and removing core in drill string.	00:00:06	01:38:48
27.11	Walk to drill rack.	00:00:02	01:38:50
27.12	Set drill on surface on drill string, (monopod) remove wrench from rack.	00:00:02	01:38:52
27.13	With wrench, remove drill string as one double section.	00:00:04	01:38:56
27.14	Stow wrench in rack.	00:00:01	01:38:57
27.15	Stow drill string double section in rack.	00:00:02	01:38:59
27.16	Join drill spindle to drill string in probe hole.	00:00:04	01:39:03
27.17	Turn drill handle clockwise to unlock treadle.	00:00:02	01:39:05
27.18	Actuate power, lifting drill.	00:00:01	01:39:06
27.19	Remove drill string. *	INDETERMINATE	
27.20	When two drill sections are above lunar surface, shut off drill power.	00:00:01	01:39:07
NOTE:	Remove all drill strings from probe hole by above sequence.		
	Segment 27.0 Total	00:00:50	
28.0	Emplace drill casing.		
28.1	Remove first drill casing double section from rack. (Includes closed casing and casing adapter.)	00:00:02	01:39:09

		Time	Cumulative Time
28.2	Attach casing adapter to spindle.	00:00:04	01:39:13
28.3	Insert casing through treadle hole and into probe hole.	00:00:03	01:39:16
28.4	Activate power.	00:00:01	01:39:17
28.5	Power casing into probe hole until drill handle is 28 inches from lunar surface. *	INDETERMINATE	
28.6	Turn power off.	00:00:01	01:39:18
28.7	Turn drill handle counterclockwise to lock treadle on drill casing.	00:00:04	01:39:22
28.8	Remove drill from casing.	00:00:06	01:39:28
28.9	Remove double section of casing from rack.		
28.10	Insert double casing section into casing protruding from probe hole.	00:00:04	01:39:32
28.11	Join adapter to drill casing.	00:00:08	01:39:40
28.12	Turn drill handle clockwise to release treadle lock.	00:00:06	01:39:46
NOTE:	Repeat until six (6) sections of drill casing are in probe hole and drill is removed from casing. *	INDETERMINATE	
	Segment 28.0 Total	00:00:39	
29.0	Prepare for first H. F. Probe.		
29.1	Invert drill	00:00:04	01:39:50
29.2	Set drill on lunar surface.	00:00:02	01:39:52

		Time	Cumulative Time
29.3	Remove first double section of drill section with bit attached from stowed position on rack.	00:00:02	01:39:54
29.4	Attach drill string to drill spindle.	00:00:04	01:39:58
29.5	Leavedrill on surface, walk to probe/ electronics box.	00:00:06	01:40:04
	Segment 29.0 Total	00:00:18	
30.0	Prepare HFE for probe emplacement.		
30.1	Utilize EHT and remove assembly from lunar surface.	00:00:02	01:40:06
30.2	Separate probe box from electronics box by rotating probe box down and away from electronics box--retain box in left hand.	00:00:12	01:40:18
30.3	Place electronics box on lunar surface in an East-West orientation, leaving EHT installed.	00:00:04	01:40:22
30.4	Remove first Velcro tab from probe box and discard.	00:00:08	01:40:30
30.5	Invert box, remove second Velcro tab and discard.	00:00:10	01:40:40
30.6	Separate two halves of probe box.	00:00:08	01:40:48
30.7	Lean half of probe box which does not contain emplacement tool against electronics box. (Half that contains emplacement tool is indicated by three lozenges painted international orange.)	00:00:04	01:40:52

		Time	Cumulative Time
30.8	Actuate emplacement tool bulkhead release pull ring.	00:00:06	01:40:58
30.9	Rotate bulkhead out of the way.	00:00:06	01:41:04
30.10	Attach bulkhead to Velcro strip on probe box.	00:00:08	01:41:12
30.11	Insert right hand into probe box carrying strap.	00:00:06	01:41:18
	Segment 30.0 Total	00:01:14	
31.0	Emplace Probe No. 1.		
31.1	Walk 18 feet to emplacement site--deploy and observe interconnecting cable. Cable marking will appear at a distance of 18 feet from the electronics box.	00:00:26	01:41:44 ;
31.2	Place probe box on lunar surface with open side down.	00:00:04	01:41:48
31.3	Retrieve drill multipurpose tool from stowed position.	00:00:04	01:41:52
31.4	Utilize tool and retrieve probe box from lunar surface.	00:00:06	01:41:58
31.5	Insert left hand into probe box carrying strap.	00:00:06	01:42:04
31.6	Stow drill multipurpose tool.	00:00:04	01:42:08
31.7	Remove emplacement tool from bulkhead.	00:00:06	01:42:14
31.8	Extend emplacement tool to maximum length.	00:00:24	01:42:38
31.9	Lean emplacement tool against drill package.	00:00:02	01:42:40

		Time	Cumulative Time
31.10	Remove remainder of interconnecting cable in probe box.	00:00:10	01:42:50
31.11	Use pull ring and rotate sleeve containing probe assembly forward.	00:00:10	01:43:00
31.12	Use pull ring and remove probe assembly from sleeve.	00:00:10	01:43:10
31.13	Lean empty probe box against drill assembly.	00:00:02	01:43:12
31.14	Remove packing from probe assembly and stow in probe box.	00:00:03	01:43:15
31.15	Remove sail cloth retaining first probe end piece.	00:00:06	01:43:21
31.16	Remove end piece and stow in probe box.	00:00:08	01:43:29
31.17	Remove sail cloth retaining second probe end piece.	00:00:06	01:43:35
31.18	Remove end piece and stow in probe box.	00:00:08	01:43:43
31.19	Attach lower sunshield over spring on upper probe section.	00:00:18	01:44:01
31.20	Unfold the probe.	00:00:06	01:44:07
31.21	Place lower half of probe assembly in drill hole leaving upper half exposed.	00:00:10	01:44:17
31.22	Retrieve emplacement tool.	00:00:02	01:44:19
31.23	Place tool "crow's foot" over spring and cable on upper end of probe.	00:00:06	01:44:25
31.24	Complete emplacement of probe in drill hole with the tool.	00:00:20	01:44:45

		Time	Cumulative Time
31.25	When probe is inserted to maximum depth note and report first exposed marking on emplacement tool.	00:00:30	01:45:15
31.26	Remove emplacement tool from drill hole.	00:00:20	01:45:35
31.27	Remove "crow's foot" from cable.	00:00:04	01:45:39
31.28	Use emplacement tool and retrieve cable near upper sunshield.	00:00:04	01:45:43
31.29	Use emplacement tool and ensure upper sunshield is fully deployed over drill hole.	00:00:06	01:45:49
31.30	Lean emplacement tool against drill assembly.	00:00:02	01:45:51
31.31	Pick up empty probe box and discard at least 18 feet from drill hole.	00:00:40	01:46:31
31.32	Pick up emplacement tool and drill packages.	00:00:30	01:47:01
31.33	Return to electronics box.	00:00:24	01:47:25
	Segment 31.0 Total	00:06:07	
32.0	Drill second hole.		
32.1	Go to second hole site.	00:00:40	01:48:05
32.2	Remove first double section of drill rod (with bit).	00:00:02	01:48:07
32.3	Attach drill rods to power head spindle.	00:00:05	01:48:12
32.4	Pick up power head.	00:00:04	01:48:16

		Time	Cumulative Time
32.5	Activate switch momentarily to verify drill operability.	00:00:04	01:48:20
32.6	Rest drill bit on lunar surface, supporting drill with one hand (monopod).	00:00:03	01:48:23
32.7	Remove thermal shroud.	00:00:02	01:48:25
32.8	Discard shroud.	00:00:02	01:48:27
32.9	Invert drill, resting power head on lunar surface, holding drill rod as handle.	00:00:06	01:48:33
	Segment 32.0 Total	00:01:08	
33.00	Deployment of Treadle.		
33.1	Remove treadle from rack.	00:00:03	01:48:36
33.2	Drop treadle, in horizontal position, on lunar surface.	00:00:03	01:48:39
33.3	Remove drill wrench.	00:00:02	01:48:41
33.4	Position treadle with wrench.	00:00:04	01:48:45
33.5	Stow wrench in empty casing on drill rack.	00:00:02	01:48:47
33.6	Invert drill to drilling position.	00:00:03	01:48:50
33.7	Place one foot on treadle.	00:00:02	01:48:52
33.8	Lift drill and insert drill bit and rod in treadle hole.	00:00:03	01:48:55
33.9	Position drill vertically and with both hands on handle, foot on treadle, actuate power.	00:00:01	01:48:56

		Time	Cumulative Time
33.10	Drill. *	INDETERMINATE	
33.11	When low point is reached, (28 inches from lunar surface to handles) turn off drill.	00:00:01	01:48:57
33.12	Rotate drill handle counterclockwise locking treadle.	00:00:02	01:48:59
33.13	Rotate counterclockwise further until drill string/spindle joint is broken. (Approximately 4 ft. lbs.)	00:00:04	01:49:03
33:14	Remove power head spindle from drill string.	00:00:10	01:49:13
33:15	Place drill on lunar surface.	00:00:06	01:49:19
33.16	Remove double section of drill string from rack.	00:00:02	01:49:21
33.17	Attach double section of drill string to protruding drill string in probe hole.	00:00:08	01:49:29
	Segment 33.0 Total	00:00:56	
34.0	Cap Drill Strings. *	INDETERMINATE	
	NOTE: Upon removal of drill strings, each section is capped, retaining core.		
35.0	With EHT, return to central station.	00:01:00	01:50:29
36.0	Deploy CCGE.		
36.1	Remove TDRT/EHT from central station.	00:00:02	01:50:31
36.2	Walk to CCGE.	00:00:04	01:50:35
36.3	Insert TDRT/EHT in CCGE.	00:00:02	01:50:37

		Time	Cumulative Time
36.4	Walk in predetermined direction (SW) 55 ft. ± 5 ft. deploying cable.	00:03:00	01:53:37
36.5	Place CCGE on lunar surface.	00:00:02	01:53:39
36.6	Discard TDRT/EHT.	00:00:02	01:53:41
36.7	Return to LM.	00:05:00	01:58:41
	Segment 36.0 Total	00:08:12	
37.0	Rest enroute.	00:02:00	02:00:41
38.0	Re-Enter LM.		
38.1	Ascend boarding ladder.	00:01:30	02:02:21
38.2	Open forward boarding hatch.	00:00:30	02:02:51
38.3	Transfer into LM.	00:03:00	02:05:51
38.4	Connect to LM systems.	00:02:00	02:07:51
	Segment 38.0 Total	00:07:00	

NOTE: Drilling time, removing drill string, implacing casing, and capping drill strings will be accomplished within 00:54:12 (54 minutes, 12 seconds). This time, added to total mission time equals: 03:02:03