APOLLO PROGRAM

LUNAR SURFACE EQUIPMENT STATUS

1 DECEMBER 1973

NOTE: Discussions of closed problems will be deleted from subsequent issues.

Italics indicate change from previous issue.

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Experiments Manager

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APOLLO LUNAR SURFACE EQUIPMENT STATUS
1.0 INTRODUCTION

Scientific data gathering equipment and related communications and power equipment were deployed on the lunar surface by the crew on each of the six Apollo lunar landing missions from July 20, 1969, (Apollo 11 mission) through December 12, 1972, (Apollo 17 mission). This report covers the performance of the deployed equipment which was designed to continue to provide data after the return of the crew to earth.

The report is divided into five sections, section one being the Introduction. The second section is an overall summary in the form of a graphic presentation of the time history of the percent of full capability of the instruments from the time of deployment on the lunar surface, with a gross indication of when changes occurred. The third section includes a brief word status of each instrument in a listing which is grouped by experiment, so that the status for each of the experiments on each applicable mission can be seen at a glance. The fourth section discusses each problem encountered. Problems are arranged in chronological order, and a listing of all problems by subject and number is included.

Section 5.0, Particles and Fields Subsatellite, has been added to this issue. The two subsatellites were not lunar surface equipment, but were launched into lunar orbit from the Apollo 15 and 16 command service modules after the return of the lunar modules from the lunar surface. However, like the lunar surface equipment, the equipment on the two satellites was designed to continue to provide data after the return of the crew to earth.

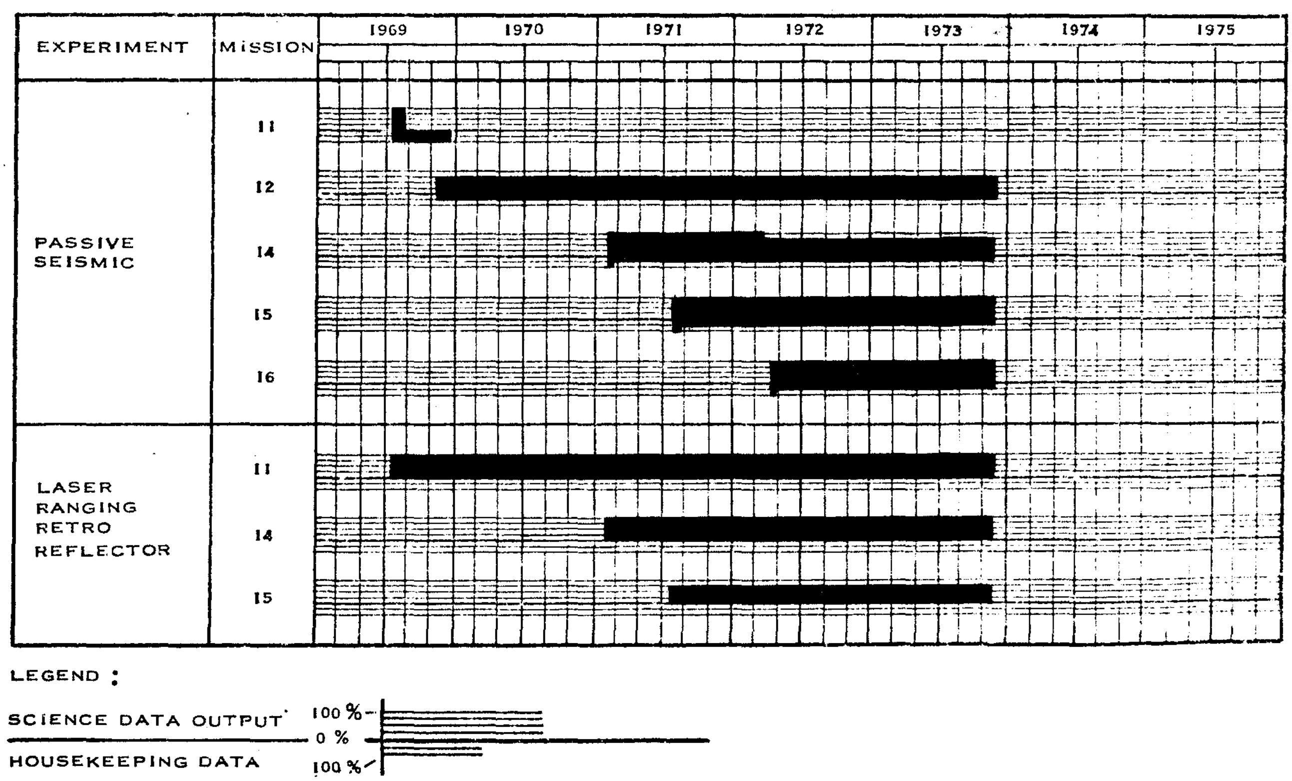
This issue of the Apollo Lunar Surface Equipment Status Report updates previous issues of the report. Problems which have been *CLOSED* in previous issues of the report are not included in the discussion protion of Section 4.0. However, the date of the issue in which the *CLOSED* discussion last appeared is so indicated in the Chronological Listing of Problems at the end of Section 4.1.

APOLLO LUNAR SURFACE EQUIPMENT STATUS

2.0 OVERALL SUMMARY

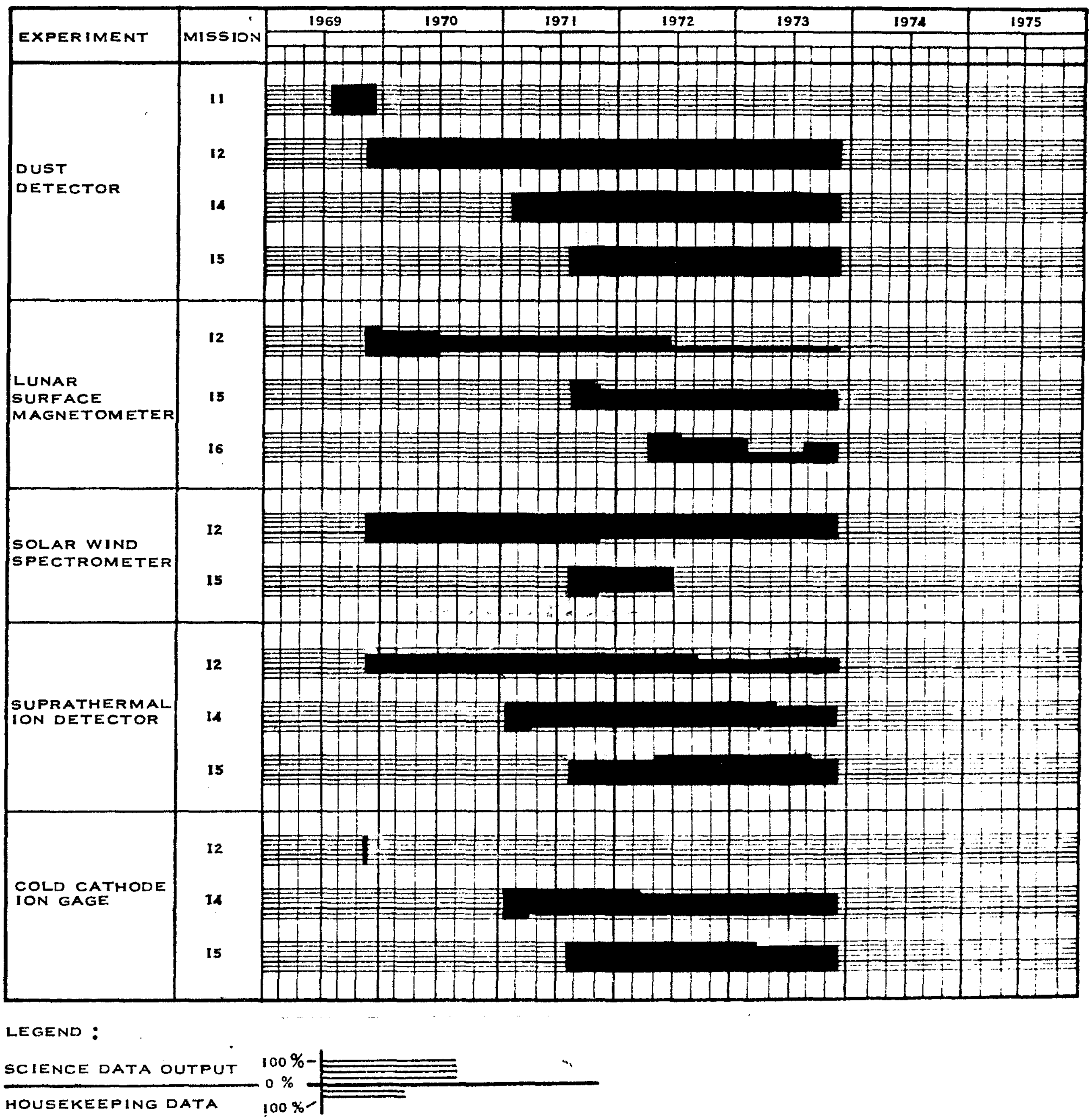
MISSION	LAUNCH DATE	LUNAR SURFACE DATA		
		START	END	
			UPLINK	DOWNLINK
11	Jul. 16, 1969	Jul. 21, 1969	Aug. 25, 1969	Dec. 14, 1969
12	Nov. 14, 1969	Nov. 19, 1969		
14	Jan. 31, 1971	Feb. 5, 1971		
15	Jul. 26, 1971	Jul. 31, 1971		
16	Apr. 16, 1972	Apr. 21, 1972		
17	Dec. 7, 1972	Dec. 12, 1972		

TIME – HISTORY PROPORTION OF FULL CAPABILITY OF INSTRUMENT



APOLLO LUNAR SURFACE EQUIPMENT STATUS

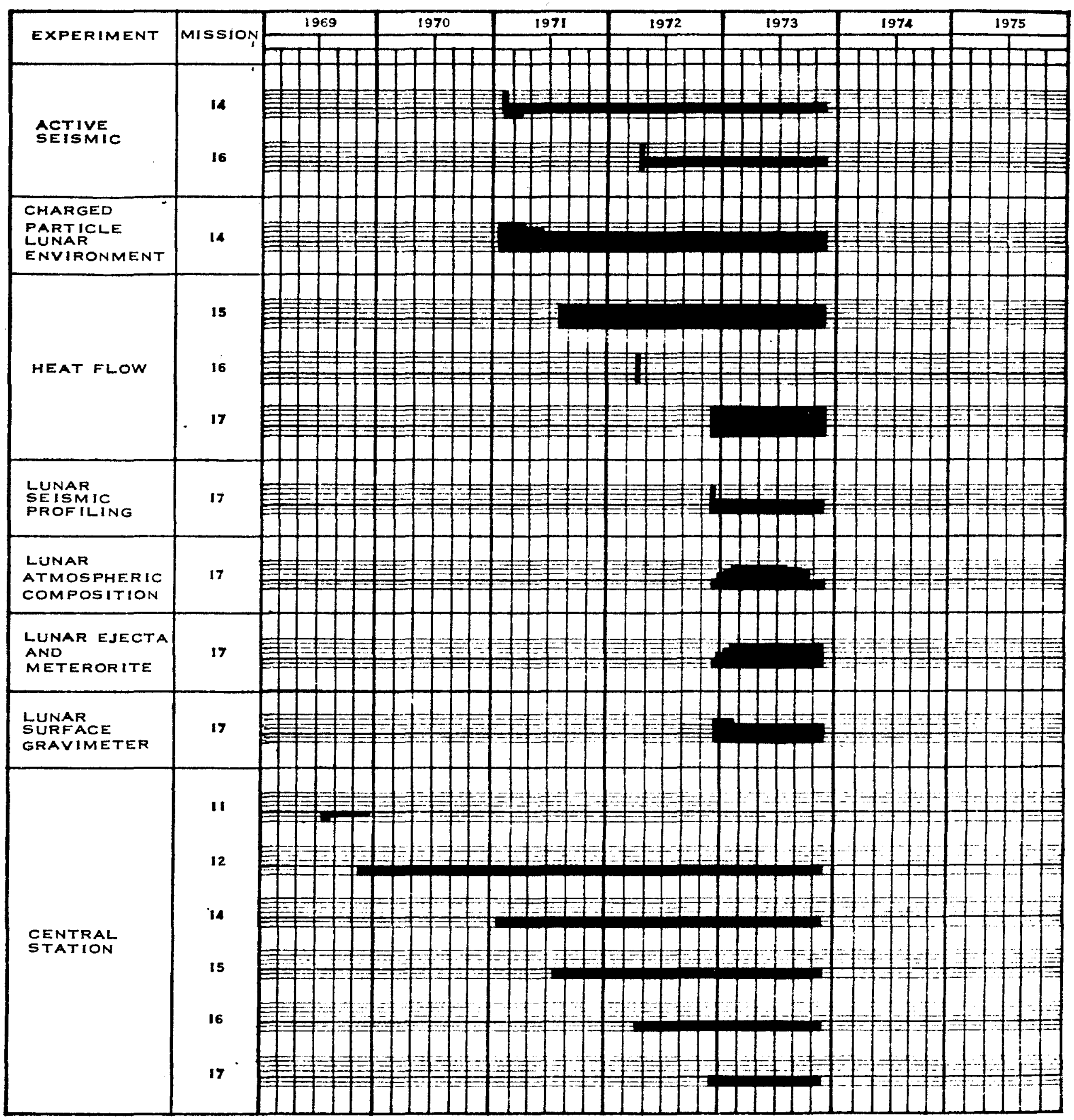
2.0 OVERALL SUMMARY
(continued)



APOLLO LUNAR SURFACE EQUIPMENT STATUS

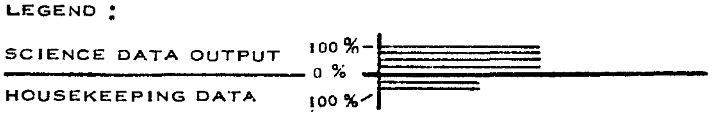
2.0 OVERALL SUMMARY

(concluded)



Note: All central station data is considered housekeeping rather than science data.

LEGEND :



APOLLO LUNAR SURFACE EQUIPMENT STATUS

3.0 INSTRUMENT STATUS

	APOLLO 12 ALSEP	APOLLO 14 ALSEP	APOLLO 15 ALSEP	APOLLO 16 ALSEP	APOLLO 17 ALSEP
PSE	SPZ AXIS MALFUNCTIONED SINCE DEPLOYMENT. Z DRIVE MOTOR REQUIRED @ NIGHT FOR THERMAL CONTROL SINCE 2/1/70.	LPY AXIS OCCASIONALLY DIFFICULT TO LEVEL. LPZ AXIS INOPERATIVE SINCE 11/17/72. INTERMITTENT REAL TIME DIGITAL DATA DURING 33rd LUNAR NIGHT (9/30/73 TO 10/5/73).	FULL OPERATION	LPX, LPY, & LPZ AXES OCCASIONALLY DIFFICULT TO LEVEL.	N/A
ASE	N/A	MORTARS NOT FIRED. HBR FOR 30 MIN/WK ABOVE -60°C. #3 GEOPHONE NOISY SINCE 3/26/71, DATA PARTIALLY RECOVERABLE.	N/A	LAUNCHED 3 OF 4 MORTARS. HBR 30 MIN/WK. PITCH SENSOR AND ROLL SENSOR FAILED SINCE 5/23/73.	N/A
LSM	DATA INTERMITTENT STARTING 12/11/69. DATA STATIC SINCE 6/4/72. FLIP CAL CMD WAS DISCONTINUED 6/14/72.	N/A	NO FLIP CAL CMD ABOVE 62°C. Y-AXIS FLIP CAL FAILED 8/30/71. Y-AXIS DATA STATIC SINCE 9/20/72.	REAL TIME SCIENCE DATA INTERMITTENT FROM 2/15/73 TO 8/17/73.	N/A
SWS	INTERMITTENT MODULATION DROP IN PROTON ENERGY LEVELS 13 AND 14 SINCE 11/5/71.	N/A	IN STANDBY SINCE 6/30/72, TM OUT OT SYNC & EXCESSIVE POWER DRAIN. PERIODIC CHECKING FOR POSSIBLE RECOVERY.	N/A	N/A

APOLLO LUNAR SURFACE EQUIPMENT STATUS

3.0 INSTRUMENT STATUS

(continued)

	APOLLO 12 ALSEP	APOLLO 14 ALSEP	APOLLO 15 ALSEP	APOLLO 16 ALSEP	APOLLO 17 ALSEP
SIDE	CYCLIC COMMANDING REQUIRED BECAUSE OF HIGH VOLTAGE ARCING ABOVE 55°C. INTERMITTENT DIGITAL DATA (SCIENCE AND ENGINEERING) SINCE 9/9/72.	LOSS OF SOME ENGINEERING DATA BECAUSE OF FAILURE OF POSITIVE PART OF A/D CONVERTER ON 4/5/71. LUNAR NIGHT OPERATION ONLY BECAUSE OF ANOMALOUS STAND-BY OPERATIONS OF SIDE SINCE 4/15/73.	• *CYCLIC COMMANDING REQUIRED TO PRECLUDE SPURIOUS MODE CHANGES ABOVE 85°C. FULL OPERATION FROM 5/1/72 TO 9/13/73.*	N/A	N/A
HFE	N/A	N/A	TEMP REF 2 OFF-SCALE HIGH SINCE 8/7/71. USING TEMP REF 1. PROBES NOT TO FULL DEPTH INTENDED.	INOPERATIVE: ELECTRICAL CABLE BROKEN DURING DEPLOYMENT.	FULL OPERATION THERMAL ACCURACY BEING EVALUATED.
CCIG	FAILED 14 HRS AFTER TURN ON, 11/20/69.	INTERMITTENT NIGHT TIME SCIENCE DATA SINCE 2/19/72. FULL OPERATION UNTIL SIDE ANOMALY (4/15/73). LUNAR NIGHT OPERATION SINCE THEN AS DICTATED BY SIDE.	*ERRATIC SCIENCE DATA THROUGHOUT LUNAR CYCLE SINCE 2/22/73. AUTOMATIC ZERO AND CALIBRATION FUNCTIONS NOT OPERATING.*	N/A	N/A

APOLLO LUNAR SURFACE EQUIPMENT STATUS

3.0 INSTRUMENT STATUS

(continued)

	APOLLO 12 ALSEP	APOLLO 14 ALSEP	APOLLO 15 ALSEP	APOLLO 16 ALSEP	APOLLO 17 ALSEP
LEAM	N/A	N/A	N/A	N/A	THERMAL PROBLEM: *196°F TURN-OFF FOR LUNATIONS 11 & 12. SUBSEQUENT OPERATIONAL PLAN TBD.*
LSPE	N/A	N/A	N/A	N/A	HBR 30 MIN/WK.
LACE	N/A	N/A	N/A	N/A	*APPARENT FAILURE OF MULTIPLIER HIGH VOLTAGE POWER SUPPLY ON 10/17/73, CAUSING TOTAL LOSS OF SCIENCE DATA. INSTRUMENT CURRENTLY CONFIGURED TO HIGH VOLTAGE, OFF; FILAMENT, OFF; MULTIPLIER, LOW; AND BACK-UP HEATER OFF. SUBSEQUENT OPERATIONAL PLAN TBD.*
LSG	N/A	N/A	N/A	N/A	*INSTRUMENT RECONFIGURED 9/26/73 TO IMPROVE QUALITY OF FREE MODE DATA, DETECT TIDAL VARIATIONS, AND DETERMINE SPRING CONSTANT OF BEAM. SENSOR BEAM CENTERED.*

APOLLO LUNAR SURFACE EQUIPMENT STATUS

3.0 INSTRUMENT STATUS
(concluded)

	APOLLO 12 ALSEP	APOLLO 14 ALSEP	APOLLO 15 ALSEP	APOLLO 16 ALSEP	APOLLO 17 ALSEP
CPLEE	N/A	ANALYZER B FAILED 4/8/71. ANALYZER A INTERMITTENT OPERATIONS SINCE 6/6/71.	N/A	N/A	N/A
C/S	FULL OPERATION WITH XMTR B & PROCESSOR Y. (12-HOUR TIMER FAILED ON 2/16/70.)	FULL OPERATION WITH XMTR A & PROCESSOR Y. (12-HOUR TIMER FAILED ON 2/17/71.) ANTENNA SEATING PROBLEMS DURING DEPLOYMENT AFFECTS SIGNAL STRENGTH.	FULL OPERATION	FULL OPERATION WITH XMTR B & PROCESSOR Y.	FULL OPERATION
DTREM	FULL OPERATION	FULL OPERATION	FULL OPERATION	N/A	N/A

	APOLLO 11 ALSEP	APOLLO 12 ALSEP	APOLLO 14 ALSEP	APOLLO 15 ALSEP	APOLLO 16 ALSEP	APOLLO 17 ALSEP
LR^3	FULL OPERATION	N/A	FULL OPERATION	FULL OPERATION	N/A	N/A

The signal strength fluctuations that are observed in the downlink signal of each of the five ALSEP's is of no consequence as no system telemetry is lost due to this phenomenon. These signal strength phenomenon are most probably caused by variations in the tracking stations characteristics, the Earth-Moon libration pattern, and associated atmospheric phenomenon.

APOLLO LUNAR SURFACE EQUIPMENT STATUS

4.1 CHRONOLOGICAL LISTING OF PROBLEMS

This section provides a chronological listing of problems encountered with the ALSEP stations. Although the original design requirement for ALSEP was a one year life, much longer useful lifetimes are being realized. Problems in this section, therefore, cover the period from deployment of Apollo 11 ALSEP (21 July 1969).

SEQUENCE NUMBER	APOLLO MISSION	EXPERIMENT OR SYSTEM	PROBLEM	INITIAL DATE OF OCCURRENCE	DISCUSSION REFERENCE
1	11	PSE	Level Indicator Not Stable	21 Jul 69	Apollo 11 Mission, 5-Day Report, Jul 69
2	11	PSE & C/S	Leveling Motor Inadvertently Triggered	21 Jul 69	Apollo 11 Mission, 5-Day Report, Jul 69
3	11	PSE & C/S	Thermal Control	21 Jul-3 Aug 69	Apollo Experience Report Thermal Design of ALSEP, Dec 71, NASA TN D-6738
4	11	C/S	Data Processor X Selected	23 Aug 69	EASEP 30-Day Report, Sep 69
5	11	C/S	Command Capability Loss	25 Aug 69	Apollo 11 Mission Report, Nov 69, Section 11.4.4
6	11	PSE	PSE STANDBY Mode	27 Aug 69	EASEP 30-Day Report, Sep 69
7	11	C/S	Power Dissipation Module Failure	16 Sep 69	Daily Science Report, 17 Sep 69
8	12	RTG	Fuel Element Difficult to Remove From Cask	EVA (19 Nov 69)	Apollo 12 Mission Report, Mar 70, Section 14.3.3

APOLLO LUNAR SURFACE EQUIPMENT STATUS
4.1 CHRONOLOGICAL LISTING OF PROBLEMS
(continued)

SEQUENCE NUMBER	APOLLO MISSION	EXPERIMENT OR SYSTEM	PROBLEM	INITIAL DATE OF OCCURRENCE	DISCUSSION REFERENCE
9	12	C/S	Shorting Plug Ammeter Did Not Indicate RTG Current During Deployment	EVA (19 Nov 69)	Apollo 12 P & D List, 16 Dec 69, Item GFE-7
10	12	PSE	Deployment Difficulties	EVA (19 Nov 69)	Apollo 12 Mission Report, Mar 70, Section 14.3.4
11	12	SIDE	Dust Covers Deployed Prematurely	EVA (19 Nov 69)	Apollo 12 P & D List, 16 Dec 69, Item GFE-15
12	12	SIDE/ CCIG	Deployment Difficulties	EVA (19 Nov 69)	Apollo 12 Mission Report, Mar 70, Section 14.3.5
13	12	PSE	SPZ Displaying Reduced Sensivity at Low Signal Levels	19 Nov 69	Apollo 12 P & D List, 20 Aug 70, Item ALSEP-9
14	12	PSE	Negative Square Wave Like Pulses Appeared on SPZ Data Channel	19 Nov 69	Apollo 12 P & D List, 20 Aug 70, Item ALSEP-10
15	12	SIDE/ CCIG	High Voltage Arcing Problems (CCIG Failure)	20 Nov 69	Apollo 12 P & D List, 20 Aug 70, Item ALSEP-5
16	12	PSE	LPZ Displaying Unstable Period & a Long Time Constant After Releveling	22 Nov 69	Apollo 12 P & D List, 20 Aug 70, Item ALSEP-4

APOLLO LUNAR SURFACE EQUIPMENT STATUS
4.1 CHRONOLOGICAL LISTING OF PROBLEMS
(continued)

SEQUENCE NUMBER	APOLLO MISSION	EXPERIMENT OR SYSTEM	PROBLEM	INITIAL DATE OF OCCURRENCE	DISCUSSION REFERENCE
17	12	LSM	Loss of Data above 50°C (Digital Filter Problem)	22 Nov 69	Apollo 12 P & D List, 20 Aug 70, Item ALSEP-6
18	12	C/S	Failure Timer Functions	4 Dec 69	Apollo 12 P & D List, 26 Mar 70, Item ALSEP-2
19	12	LSM	X, Y, & Z Sensor Data Dropped Offscale Unexpectedly & Science Data was Lost	11 Dec 69	Apollo 12 P & D List, 20 Aug 70, Item ALSEP-7
20	11	C/S	Loss of Downlink	14 Dec 69	Apollo 12 SMEAR, ALSEP 16
21	12	SIDE	High Voltage Power Supply Arcing	22 Dec 69	Apollo 12 P & D List, 20 Aug 70, Item ALSEP-5
22	12	LSM	Science Data Offset Y-axis	22 Dec 69	Apollo 12 P & D List, 20 Aug 70, Item ALSEP-8
23	12	LSM	Temperature Range Exceeded Predictions	23 Dec 69	Apollo 12 P & D List, 20 Aug 70, Item ALSEP-14
24	12	C/S	Systematic Spurious CVW's	27 Dec 69	Apollo 12 P & D List, 26 Mar 70, Item ALSEP-3
25	12	PSE	Temperature Range Exceeded	25 Jan 70	Apollo 15 P & D List, 13 Sep 71, Item ALSEP-4

APOLLO LUNAR SURFACE EQUIPMENT STATUS

4.1 CHRONOLOGICAL LISTING OF PROBLEMS

(continued)

SEQUENCE NUMBER	APOLLO MISSION	EXPERIMENT OR SYSTEM	PROBLEM	INITIAL DATE OF OCCURRENCE	DISCUSSION REFERENCE
26	12	C/S	Transmitter A Switched Out of Service	30 Jan 70	Apollo P & D List, 20 Aug 70, Item ALSEP-11
27	12	SIDE	Limited Operating Time During Lunar Noon (55°C Maximum)	18 Mar 70	Apollo 12 SMEARS, ALSEP 42, 66 & 73
28	12	PSE	LPX & LPY Shroud Noise	14 Jun 70	Apollo 12 SMEAR, ALSEP 46
29	12	LSM	Flip Cal Data Undefinable	14 Jun 70	Apollo 12 P & D List, 8 Oct 70, Item ALSEP-13
30	12	LSM	Y-axis Sensor Head Failure	29 Jun 70	Apollo 12 P & D List, 8 Oct 70, Item ALSEP-13
31	12	PSE	Thermal Effect of Lunar Seasonal Cycle	29 Jun 70	Apollo 12 P & D List, 20 Aug 70, Item ALSEP-12
32	12	LSM	Science & Engineering Data Static & Invalid	30 Jun 70	Apollo 12 P & D List, 8 Oct 70, Item ALSEP-13
33	12	C/S	Transmitter Switch from B to A	1 Sep 70	Apollo 12 P & D List, 8 Oct 70, Item ALSEP-15
34	12	C/S	Transmitter A Intermittent	13 Dec 70	Apollo 12 P & D List, 8 Oct 70, Item ALSEP-15

APOLLO LUNAR SURFACE EQUIPMENT STATUS

4.1 CHRONOLOGICAL LISTING OF PROBLEMS

(continued)

SEQUENCE NUMBER	APOLLO MISSION	EXPERIMENT OR SYSTEM	PROBLEM	INITIAL DATE OF OCCURRENCE	DISCUSSION REFERENCE
35	14	RTG Cask	Difficult to Latch RTG Dome Removal Tool in Cask Dome	EVA (5 Feb 71)	Apollo 14 P & D List, 12 Apr 71, Item ALSEP-13
36	14	SIDE	SIDE Boyd Bolt Blocked due to Compacted Lunar Dirt	EVA (5 Feb 71)	Apollo 14 P & D List, 12 Apr 71, Item ALSEP-2
37	14	SIDE/ CCIG	Difficult to Deploy	EVA (5 Feb 71)	Apollo 14 P & D List, 26 Mar 71, Item ALSEP-3
38	14	ASE	Geophone and Flag Easy to Knock Over	EVA (5 Feb 71)	Apollo 14 P & D List, 12 Mar 71, Item ALSEP-11
39	14	C/S	Sunshield Sags	EVA (5 Feb 71)	Apollo 14 P & D List, 26 Mar 71, Item ALSEP-10
40	14	ASE	Thumper Misfired Five of Eighteen Times	EVA (5 Feb 71)	Apollo 14 Mission Report, May 71, Section 14.4.1
41	14	C/S	Received Signal Strength Lower Than Expected	EVA (5 Feb 71)	Apollo 14 P & D List, 26 Mar 71, Item ALSEP-6

APOLLO LUNAR SURFACE EQUIPMENT STATUS
4.1 CHRONOLOGICAL LISTING OF PROBLEMS
(continued)

SEQUENCE NUMBER	APOLLO MISSION	EXPERIMENT OR SYSTEM	PROBLEM	INITIAL DATE OF OCCURRENCE	DISCUSSION REFERENCE
42	14	SIDE	Exhibited Noisy Data During Initial Turn ON	6 Feb 71	Apollo 14 Mission Report, May 71, Section 14.4.2
43	14	C/S	12-hour Timer Pulses Did Not Occur	7 Feb 71	Apollo 14 Mission Report, May 71, Section 14.4.4
44	14	PSE	Y-axis Levelling Intermittent & Sluggish	9 Feb 71	Apollo 14 Mission Report, May 71, Section 14.4.5
45	14	PSE	Thermal Control Problem	12 Feb 71	Apollo 14 P & D List, 26 Mar 71, Item ALSEP-15
46	14	C/S	Systematic Spurious CVW's	16 Feb 71	Apollo 12 P & D List, 26 Mar 70, Item ALSEP-3
47	14	PSE	Long Period Vertical Feedback Filter Not Operating	2 Mar 71	Apollo 14 Mission Report, May 71, Section 14.4.6
48	14	ASE	Geophone 3 Data Noisy	26 Mar 71	Apollo 14 P & D List, 15 Jul 71, Item ALSEP-18 Apollo 14 Mission Anomaly Report No. 6, Dec 72

APOLLO LUNAR SURFACE EQUIPMENT STATUS

4.1 CHRONOLOGICAL LISTING OF PROBLEMS

(continued)

SEQUENCE NUMBER	APOLLO MISSION	EXPERIMENT OR SYSTEM	PROBLEM	INITIAL DATE OF OCCURRENCE	DISCUSSION REFERENCE
49	14	SIDE/ CCIG	Analog to Digital Converter Positive Section Data Loss	5 Apr 71	Apollo 14 Mission Report, May 71, Section 14.4.8
50	14	CPLEE	Analyzer B Data Loss	8 Apr 71	Apollo 14 Mission Report, May 71, Section 14.4.9
51	14	CPLEE	Analyzer A Data Decay and Undervoltage Condition	6 Jun 71	Apollo 14 P & D List, 15 Jul 71, Item ALSEP-21
52	15	C/S	Rear Curtain Retainer Removal Lanyard Broke	EVA (31 Jul 71)	Apollo 15 Mission Report, Dec 71, Section 14.4.2
53	15	SIDE/ CCIG	Experiment Connector was Difficult to Mate	EVA (31 Jul 71)	Apollo 15 P & D List, 13 Sep 71, Item ALSEP-17
54	15	C/S	Shorting Switch Actuated Early	EVA (31 Jul 71)	Apollo 15 P & D List, 8 Oct 71, Item ALSEP-18
55	15	SIDE/ CCIG	Intermittent Lock of UHT in Fitting of SIDE/CCIG Experiment	EVA (31 Jul 71)	Apollo 15 Mission Report, Dec 71, Section 14.4.3
56	15	HFE	Subpallet Boyd Bolts Did Not Release Immediately	EVA (31 Jul 71)	Apollo 15 P & D List, 13 Sep 71, Item ALSEP-13

APOLLO LUNAR SURFACE EQUIPMENT STATUS

4.1 CHRONOLOGICAL LISTING OF PROBLEMS
(continued)

SEQUENCE NUMBER	APOLLO MISSION	EXPERIMENT OR SYSTEM	PROBLEM	INITIAL DATE OF OCCURRENCE	DISCUSSION REFERENCE
57	15	PSE	LPZ Axis Leveling Difficulties	1 Aug 71	Apollo 15 SMEAR, SX-194
58	15	C/S	Systematic Spurious CVW's	5 Aug 71	Apollo 12 P & D List, 26 Mar 70, Item ALSEP-3
59	15	HFE	Probe 2 Reference Temperature Measurement Intermittent	7 Aug 71	Apollo 15 P & D List, 30 Nov 71, Item ALSEP-25
60	15	PSE	Thermal Control Degradation	13 Aug 71	Apollo 15 P & D List, 13 Sep 71, Item ALSEP-4
61	15	C/S	Loss of Science Data Due to Experiment Ripple Off	19 Aug 71	Apollo 15 SMEAR, ALSEP 16
62	15	LSM	Y-axis Sensor Head Failure to Flip On Command	30 Aug 71	Apollo 15 P & D List, 23 Feb 72, Item ALSEP-26
63	14	SIDE/ CCIG	Lunar Noon & Arcing Constraints	20 Oct 71	Apollo 14 SMEAR, ALSEP 58
64	15	LSM	Y-axis Sensor Data Loss	2 Nov 71	Apollo 15 P & D List, 14 Jan 72, Item ALSEP-27
65	12 15	SWS SWS	Intermittent Modulation Drop in Proton Energy Levels 13 and 14	5 Nov 71	Apollo 15 P & D List, 14 Jan 72, Item ALSEP-28

APOLLO LUNAR SURFACE EQUIPMENT STATUS

4.1 CHRONOLOGICAL LISTING OF PROBLEMS (continued)

SEQUENCE NUMBER	APOLLO MISSION	EXPERIMENT OR SYSTEM	PROBLEM	INITIAL DATE OF OCCURRENCE	DISCUSSION REFERENCE
66	15	SIDE/CCIG	Limited Operating Time During Lunar Noon (85°C Maximum)	16 Dec 71	Apollo 15 SMEAR, ALSEP 36
67	14	ASE	-60°C Minimum Operating Temperature	10 Feb 72	Apollo 14 SMEAR, ALSEP 67
68	15	C/S	Lunar Night Operating Temperature Limits	18 Feb 72	Apollo 15 SMEAR, ALSEP 40
69	14	PSE	LPZ Axis Inoperative	20 Mar 72	Apollo 14 SMEAR, ALSEP 72
70	16	Subpackage 2	Fell OFF Carry Bar	EVA (21 Apr 72)	Apollo 16 P & D List, 26 Jun 72, Item ALSEP-1
71	16	HFE	Electrical Cable Broke	EVA (21 Apr 72)	Apollo 16 Mission Report, Aug 72, Section 14.4.1
72	16	ASE	Number 3 Spike on Mortar Package Did Not Deploy	EVA (21 Apr 72)	Apollo 16 Mission Report, Aug 72, Section 14.4.2
73	16	ASE	Thumper Cables Stiff to Deploy	EVA (21 Apr 72)	Apollo 16 P & D List, 16 May 72, Item ALSEP-6

APOLLO LUNAR SURFACE EQUIPMENT STATUS
4.1 CHRONOLOGICAL LISTING OF PROBLEMS
(continued)

SEQUENCE NUMBER	APOLLO MISSION	EXPERIMENT OR SYSTEM	PROBLEM	INITIAL DATE OF OCCURRENCE	DISCUSSION REFERENCE
74	16	ASE	Mortar Box Roll Angle Telemetry Offscale HIGH	23 Apr 72	Apollo 16 Mission Report, Aug 72, Section 14.4.3
75	16	PSE	Temperature HIGH During Lunar Day	24 Apr 72	Apollo 16 P & D List, 16 May 72, Item ALSEP-11
76	16	ASE	Pitch Sensor Offscale HIGH After Launching 3rd Grenade	23 May 72	Apollo 16 Mission Report, Aug 72, Section 14.4.12
77	16	ASE	Mortar Package Pitched Down 9 Degrees as a Result of Launching Grenade 2	23 May 72	Apollo 16 P & D List, 13 Jun 72, Item ALSEP-17
78	12	LSM	Flip Cal Suspension	14 Jun 72	Apollo 12 SMEAR, ALSEP 76
79	12	SWS	AC Calibrate Measurements LOW (Sequence 15)	20 Jun 72	Apollo 12 SMEAR, ALSEP 77
80	16	C/S	Systematic Spurious CVW's	29 Jun 72	Apollo 12 P & D List, 26 Mar 70, Item ALSEP-3
81	15	SWS	Loss of Experiment, Science and Engineering	30 Jun 72	Apollo 15 SMEAR, ALSEP 42
82	16	LSM	Failure of all 3 Axes to Flip	24 Jul 72	Apollo 16 SMEAR, ALSEP 23
83	12	SIDE/ CCIG	Intermittent Failure of Digital Electronics to Process Data	9 Sep 72	Apollo 12 SMEAR, ALSEP 80

APOLLO LUNAR SURFACE EQUIPMENT STATUS

4.1 CHRONOLOGICAL LISTING OF PROBLEMS

(continued)

SEQUENCE NUMBER	APOLLO MISSION	EXPERIMENT OR SYSTEM	PROBLEM	INITIAL DATE OF OCCURRENCE	DISCUSSION REFERENCE
84	12	PSE	LPX Axis Leveling in Auto Mode Balky	4 Dec 72	Apollo 12 SMEAR, ALSEP 81
85	16	PSE	LPY Axis Leveling in Forced and Auto Mode Balky	4 Dec 72	Apollo 16 SMEAR, ALSEP 24
86	17	RTG	Cask Dome Removal was Difficult	EVA (12 Dec 72)	Apollo 17 Mission Report, Mar 73, Section 15.4.4
87	17	C/S	Downlink Signal Strength Fluctuations	EVA (12 Dec 72)	Apollo 17 P & D List, 12 Jan 73, Item SX-1
88	17	LSG	Sensor Beam Cannot be Stabilized in the Null Position	EVA (12 Dec 72)	Lunar Surface Equipment Status Report, *1 Dec 73*, Section 4/2 Apollo 17 Mission Report, Mar 73, Section 15.4.1
89	17	C/S	Power Dissipation Module HIGH Temperature	EVA (13 Dec 72)	ALSEP Status Report, 14 Dec 72
90	17	LEAM	Excessive Temperature	17 Dec 72	Lunar Surface Equipment Status Report, *1 Dec 73*, Section 4.4 Apollo 17 Mission Report, Mar 73, Section 15.4.3

4.1 CHRONOLOGICAL LISTING OF PROBLEMS
(continued)

SEQUENCE NUMBER	APOLLO MISSION	EXPERIMENT OR SYSTEM	PROBLEM	INITIAL DATE OF OCCURRENCE	DISCUSSION REFERENCE
91	17	LACE	Excessive Temperature with Covers ON	17 Dec 72	Lunar Surface Equipment Status Report, *1 Dec 73*, Section 4.3
92	17	LACE	Zero Offset in Data Output of Mass Channels	18 Dec 72	Lunar Surface Equipment Status Report, 18 Sep 73, Section 4.5 Apollo 17 Mission Report, Mar 73, Section 15.4.5
93	17	LACE	Mode Change - Sweep Lock	8 Jan 73	ALSEP Status Report, 9 Jan 73
94	16	LSM	Loss of Science Data	15 Feb 73	Apollo 16 SMEAR, ALSEP 25
95	16	C/S	Transmitter B and Processor Y Selected	26 Mar 73	ALSEP Status Report, 30 Mar 73
96	14	SIDE/ CCIG	Anomalous STANDBY Operations	15 Apr 73	Apollo 14 SMEAR, ALSEP 71
97	17	LACE	Limited Operation During Lunar Day (125°F Maximum)	5 Jun 73	Lunar Surface Equipment Status Report, *1 Dec 73*, Section 4.3
98	14	CCIG	Intermittent Night Time Science Data Since 2/19/72.	1 Jul 73	Lunar Surface Equipment Status Report, 18 Sep 73, Section 4.6

APOLLO LUNAR SURFACE EQUIPMENT STATUS

4.1 CHRONOLOGICAL LISTING OF PROBLEMS
(concluded)

SEQUENCE NUMBER	APOLLO MISSION	EXPERIMENT OR SYSTEM	PROBLEM	INITIAL DATE OF OCCURRENCE	DISCUSSION REFERENCE
99	15	CCIG	Intermittent Night Time Science Data Since 2/22/73.	1 Jul 73	Lunar Surface Equipment Status Report, 18 Sep 73, Section 4.7
100	*17*	*LACE*	*Loss of Intermediate Mass Range Output*	*18 Sep 73*	*Lunar Surface Equipment Status Report, 1 Dec 73, Section 4.8*
101	*17*	*LACE*	*Filament #1 Failure*	*23 Sep 73*	*Lunar Surface Equipment Status Report, 1 Dec 73, Section 4.9*
102	*14*	*PSE*	*Intermittent Digital Data From 9/30/73 Thru 10/5/73*	*30 Sep 73*	*Apollo 14 SMEAR, ALSEP 85*
103	*17*	*LACE*	*Loss of Science Data*	*17 Oct 73*	*Lunar Surface Equipment Status Report, 1 Dec 73, Section 4.10*

APOLLO LUNAR SURFACE EQUIPMENT STATUS
4.2 LUNAR SURFACE GRAVIMETER SENSOR BEAM

Problem Date	Problem
Initial: 12 December 1972 (1st lunar day)	Lunar Surface Gravimeter Experiment
Presence throughout lunar cycle	Lunar surface gravimeter sensor beam cannot be stabilized in the null position.
	Sensor beam could not be center balanced in normal configuration because 1/6-g weights were too light. Weights were too light because of an error in calculations converting from 1-g to 1/6-g requirements.

Remarks:

Cause: Following the initial experiment turn-on, the set-up procedure of nulling the sensor beam in the proper stable position between capacitor plates could not be accomplished.

When the command was given to add any or all of the nulling masses to the sensor beam assembly, the data indicated that the beam would not move away from the upper capacitor plate. The only way to bring the beam down was by caging it against the lower capacitor plate.

During the second and third extravehicular activities, the Lunar Module Pilot rapped the exposed top plate on the gimbal; rocked the experiment in all directions; releveled the instrument, working the base well against the surface; and verified the sunshade tilt. This was done in an attempt to free a mass/weight assembly or sensor beam thought to have been caught or bound. No apparent change or improvement was detected.

Review of sensor development test records revealed that an error in arithmetic resulted in the sensor mass weights being about 2 percent lighter than the proper nominal weight for 1/6-g operation of the flight unit. The sensor mechanism allows ground command adjustment of up to ±1.5 percent from nominal to compensate for possible inaccuracies. Unfortunately, the 2 percent error in weight made in initial conversion calculations from 1-g to 1/6-g mass exceeded this for the qualification unit and was also passed on to the flight unit final calculations.

APOLLO LUNAR SURFACE EQUIPMENT STATUS
4.2 LUNAR SURFACE GRAVIMETER SENSOR BEAM
(continued)

Initial: 12 December 1972 (1st lunar day) — Lunar Surface Gravimeter Experiment

Activity: The 45-day real-time monitoring period for the LSG showed a lack of seismic signals which was unusual for a site going through the thermal excursions associated with a lunation, yet the seismic channel indicated a low seismic background noise which was consistent with what had been determined for other lunar locations by the PSE (Passive Seismic Experiment). The LSG free mode channel appeared to be providing usable data and the frequency response was as expected.

During the 6 April 1973 7-hour special test it was determined that the seismic channel had been operated in a saturated condition during the first 45 days and by reducing the post amplifier from gain step 15 to gain step 10, the instrument could be operated in seismic high gain mode without saturation of the data channel by instrument noise. Calibration of LSG was attempted by use of integrator and bias control commands. At the lower gain settings significant beam response was obtained that requires further analysis. The instrument was subsequently operated in the reconfigured condition in an attempt to detect seismic signals associated with the thermal effects of terminator crossing. Seismic events associated with thermal effects which occur during this period as had been previously detected by PSE and ASE (Active Seismic Experiment) at other lunar sites. Terminator crossing occurred on 8 April and repetitive seismic events, approximately 50% higher than noise, were detected by the LSG.

The second special test to exercise the flight LSG was held on 19 April 1973, to lower the beam resonant frequency to better detect lunar seismic signals known to have predominant frequencies in the 1 Hz region. Beam resonances for the operational configuration previously used were determined by calculations to be in the order of 30-40 Hz which was too high for useful monitoring of lunar seismic acitivity.

The method to lower frequency was to drive the coarse screw to its lower stop position thereby lessening tension on both the LaCoste spring and mass support spring. While driving the screw to its lower position data were taken to attempt to verify the beam resonant frequency. Data taken during the first

APOLLO LUNAR SURFACE EQUIPMENT STATUS
4.2 LUNAR SURFACE GRAVIMETER SENSOR BEAM
(continued)

Initial: 12 December 1972 (1st lunar day) — Lunar Surface Gravimeter Experiment

Activity: half of the coarse screw drive implied instrument resonant frequencies were 20 - 40 Hz. Beam position was changed during the last half of the coarse screw drive to the all masses ON condition. This was done to observe if the beam would center freely and had not been attempted since the last astronaut EVA. The beam did not center. Ultimately, both coarse and fine screws were driven to the lower stop and the beam was centered using the mass change uncaging system. In this condition, the beam movement vs screw drive was significantly more sensitive. Employing the integration normal and bias commands an electrical calibration input excited the beam which oscillated at approximately 1.5 hertz which also gave an indication of increased sensitivity over all previous operations. The LSG was left in the beam centered condition to gather seismic data for the lunation of 22 April 1973 through lunar sunset. Seismic activity was noted on LSG with amplitudes approximately twice that previously noted, however repetitious seismic signals were not present and good calibration versus LSP (Lunar Seismic Profiling Experiment) was not obtained.

Consequently, comparative tests between the LSG and the LSP were accomplished during lunar sunrise on 7 May 1973. The LSG was operated thru terminator crossing to obtain the expected sequence of repetitive events and then the LSP listening mode was accomplished to obtain comparative data. Event correlation between instruments indicated that signal-to-noise detection capability of the LSP was approximately an order of magnitude better than that of the LSG. Accordingly, it seems unlikely the LSG would detect the low amplitude signals typically associated with small magnitude lunar events such as distant moonquakes and meteoroid impacts. A question still remains about the instrument's capability to detect gravity waves events. Real-time correlation will be performed on LSG data tapes to attempt to uncover this type of event.

During a special real-time support period on 26 September 1973, the LSG was configured to the closed loop mode of operation with the integrator normal and bias IN. The sensor beam was centered to within the accuracy of the real-time data display capability of measuring the voltage between the sensor plates by driving the sensor attitude coarse and fine screws. The mass change mechanism was not adjusted, and remains unchanged from the 19 April 1973 configuration. Based on data obtained the natural frequency of the LSG sensor was calculated to be approximately 2.2 hertz.

APOLLO LUNAR SURFACE EQUIPMENT STATUS
4.2 LUNAR SURFACE GRAVIMETER SENSOR BEAM
(concluded)

Initial: 12 December 1972 (1st lunar day) Lunar Surface Gravimeter Experiment

Activity: *The tidal channel data now appears to be grossly following the tidal peaks, the re-configuration improved the sensitivity of the free modes data but the relatively high 2.2 hertz frequency is limiting its usefulness.*

In an attempt to further improve the performance of the instrument, another re-configuration is planned for 29 November 1973. A lower resonant frequency will be established by using the mass caging motor to balance the beam, with the gravimeter screws in the extreme down position. These changes, if successful, will improve tidal data and enhance sensitivity in the free mode band.

Result: The beam has been centered by applying a load on the beam through the mass support springs by partial caging of the mass weight assembly. Signals being received are being processed and analyzed for seismic, free mode, and gravity wave information. Comparison with the LSP indicates the LSG is not adequate for detecting typical low level moonquake signals, although further processing of data needs to be done. Further analysis of data channels is also in process to determine if free mode oscillations and gravity waves are being detected.

APOLLO LUNAR SURFACE EQUIPMENT STATUS
4.3 LUNAR ATMOSPHERIC COMPOSITION EXPERIMENT EXCESSIVE TEMPERATURE

Problem Date

Initial: 17 December 1972
(1st lunar day)

Repeats each lunar day

CLOSED

Problem

Lunar Atmospheric Composition Experiment

Thermal control does not maintain operating temperature below qual test maximum level during the lunar day at the Apollo 17 site.

LACE is commanded OFF each lunar day until the temperature cools down again within limits.

Remarks:

Cause: Difference in thermal condition at the Apollo 17 site from design site (level plain at equator), and error in calculating thermal control configuration capability and effectivity.

Activity: Component part, used in both the emission control assembly and the sweep high voltage power supply, is thermally sensitive at 158°F. Component is a photo transistor (Monsanto part number MCT-1). Although temperature rating for the part is 185°F, the gain decreases with increasing temperature above 158°F. No further thermal analysis in progress.

Operational restrictions required for sensor outgassing contamination have required the instrument to be operated only at temperatures below 125°F. As expected, the contamination level (from analysis of the science data) in the sensor has been lower with each lunar day; and use of the instrument during the lunar day will be extended as low levels of sensor contamination are confirmed.

However, the ion source has a limited operational lifetime (from self-contamination). As a result, only spot operation at selected times are planned, rather than full-time continuous operation. Consequently, these selected short-time data-gathering periods may be accomplished during the lunar days, whereas the inadequate thermal control might prevent continuous operation through a complete lunar day.

During real-time support on 12 October 1973 the LACE was commanded ON (sun angle = 130.3°) in an attempt to gather additional daytime data. Following the execution of commands for multiplier, HIGH; automatic sweep; ion source filament #2, ON, discriminator level, HIGH; and high voltage power supply, ON; it was determined on the analog and digital data that the engineering data (high voltage OFF; ion source filament, OFF; and discriminator level, LOW) were incorrect. The instrument

APOLLO LUNAR SURFACE EQUIPMENT STATUS

4.3 LUNAR ATMOSPHERIC COMPOSITION EXPERIMENT EXCESSIVE TEMPERATURE (concluded)

CLOSED

Problem Date	Problem
Initial: 17 December 1972 (1st lunar day)	Lunar Atmospheric Compositon Experiment

Activity: (concluded)

was commanded OFF, pending analysis of this anomaly. On 17 October 1973, the LACE was configured to automatic sweep ion source filament #2, ON; high voltage power supply, ON; multiplier, HIGH; and discriminator level, HIGH. The analog and digital data indicated that engineering and science information were correct and the instrument was operating properly. The anomaly of 12 October 1973 is considered to have been caused by elevated temperatures (AM-41 = 63.1°F) at the time of turn-on.

Result: Operating the experiment during the selected times for the sensor operation may restrict operation within a temperature range acceptable for the sensitive component. It may be necessary to restrict operation within the selected time periods to temperatures below 158°F, or accept some degradation of the data.

APOLLO LUNAR SURFACE EQUIPMENT STATUS
4.4 LUNAR EJECTA AND METEORITE EXPERIMENT EXCESSIVE TEMPERATURE

Problem Date

Initial: 17 December 1972
(1st lunar day)

Repeats each lunar day

CLOSED

Problem

Lunar Ejecta and Meteorite Experiment

Thermal control does not maintain operating temperature below qual test maximum level during the lunar day at the Apollo 17 site.

LEAM is commanded OFF each lunar day until the temperature cools down again within limits.

Remarks:

Cause: Difference in thermal conditions at the Apollo 17 site from design site (level plain at equator), and error in calculating thermal control configuration capability and effectivity.

Activity: Components are rated higher (200° - 212°F) than maximum qual test temperature (167°F). Have been increasing allowable maximum temperature of operations in controlled increments with each lunar day per Apollo 17 SMEAR, ALSEP 49 R-2. No further thermal analysis in progress.

Surface temperature increase is due to lunar winter/summer effects of the moon. Higher surface temperature makes it inadvisable to increase experiment operating temperature. Maximum temperature of AJ-11 is to be 196.0°F. This maximum temperature has already been reached on lunations 11 (October 1973) and 12 (November 1973). It is estimated that this maximum temperature will result in monitoring of about 70-85% of each lunation when lunar winter returns.

Result: The percentage of time the experiment monitored the Apollo 17 lunar site for lunar ejecta and meteorite activity was: 59.2% on day 2; 67.4% on day 7; 71.0% on day 8 and 9; 73.3% on day 10; 75.0% on day 11; and 72.7% on day 12. This anomaly is considered CLOSED.

APOLLO LUNAR SURFACE EQUIPMENT STATUS

4.8 LUNAR ATMOSPHERIC COMPOSITION EXPERIMENT LOSS OF INTERMEDIATE MASS RANGE OUTPUT

Problem Date

Initial: 18 September 1973

CLOSED

Problem

Lunar Atmospheric Composition Experiment

On 18 September 1973 the LACE was commanded to OPERATE SELECT with high voltage ON for lunar night operation (sun angle = 197.7°). It was noted at that time that the intermediate mass range output (DM-04) was indicating all zeros.

Remarks:

Cause: The cause of the anomaly remains undetermined. Subsequent multiple failures of the instrument precluded further analysis of the problem.

Activity: The LACE was commanded to the redundant filament during real-time support on 21 September 1973 in an attempt to categorize the failure. No change nor conclusive results were obtained. Failure of filament #1 on 23 September and loss of all science data on 17 October 1973 terminated further attempts to correct the anomaly.

Result: Currently no plans are anticipated for continued investigation of the problem. This anomaly is considered CLOSED.

APOLLO LUNAR SURFACE EQUIPMENT STATUS
4.9 LUNAR ATMOSPHERIC COMPOSITION EXPERIMENT FILAMENT #1 FAILURE

Problem Date

Initial: 23 September 1973

CLOSED

Problem

Lunar Atmospheric Composition Experiment

During real-time support on 24 September 1973 it was noted that all three mass data channel outputs were indicating all zeros. Data playback revealed that filament #1 failed on 23 September 1973.

Remarks:

Cause: Filament #1 failed after approximately 2900 hours of operation, resulting in loss of science data. Tungsten filaments in this type application have a limited operational lifetime because of progressive self contamination.

Activity: Redundant filament #2 was commanded ON during real-time operations on 25 September 1973. Experiment analog and digital data indicated that the LACE was operating normally. Scientific data were being collected in the HIGH and LOW mass range outputs. The intermediate mass range output continued to indicate all zeros (since anomaly of 18 September 1973).

Result: The LACE was operated with filament #2 until anomaly of 17 October 1973 (loss of the LACE multiplier high voltage power supply).

APOLLO LUNAR SURFACE EQUIPMENT STATUS
4.10 LUNAR ATMOSPHERIC COMPOSITION EXPERIMENT LOSS OF SCIENCE DATA

Problem Date	Problem
Initial: 17 October 1973	Lunar Atmospheric Composition Experiment Data playback of problem period indicated the sweep high voltage dropped to zero, the electronics noise data ramps disappeared from all three mass data channel outputs, with all science data outputs locked in the continuous calibrate mode with readings at offscale HIGH.

Remarks:

Cause: Preliminary results of the troubleshooting and analysis indicate that the multiplier high voltage power supply apparently failed. This common high voltage power supply also affected the sweep high voltage (AM-44), and cross-coupled into the mass data channel outputs (DM-03, DM-04, and DM-05).

Activity: Subsequent to the failure a series of high voltage and filament commands were executed during real-time support on 19 October 1973 in an unsuccessful attempt to correct the anomaly. The instrument was then allowed to cold soak (i.e., back-up heater OFF) and attempts to correct the anomaly were made again without success on 22 and 26 October 1973. Again on 17 November 1973 the instrument was commanded ON with high voltage ON to determine if any change in operational status had occurred. The scientific data outputs remained invalid. The experiment high voltage was commanded OFF. Periodic checks of the LACE operational status are planned during subsequent lunar night operation.

Result: The instrument will be cycled from ON to OFF to maintain the electronics temperature below the previously established 125°F limit, while the future troubleshooting or termination of instrument operation is considered.

CLOSED

APOLLO LUNAR SURFACE EQUIPMENT STATUS
5.0 PARTICLES AND FIELDS SUBSATELLITE

The two Particles and Fields Subsatellites were launched from the Apollo 15 and 16 command service modules while in lunar orbit. Each carried three experiments: Particle Shadows/Boundary Layer Experiment, Magnetometer Experiment, and S-Band Transponder Experiment. The experiments were to be operated in lunar orbit for a one-year period.

5.1 Apollo 15

The Apollo 15 subsatellite (P&FS #1) was launched into lunar orbit 4 August 1971, and performed satisfactorily in all modes of operation until 3 February 1972. Data were lost from about one-third of its measurements beginning on 3 February 1972, during its 2203 lunar revolution. Data from additional measurements were lost beginning on 29 February 1972, during its 2520 lunar revolution.

Analysis of the data indicated the data loss was the result of multiple failures within a single integrated circuit flatpack in the bilevel, main-frame, and drivers board of the digital electronics unit (figures 5-1 and 5-2). The cause of the integrated circuit failure is not known. The particular model six-channel integrated circuit low level logic amplifier for switch driving has been used in space applications satisfactorily, and component screening and systems acceptance tests have been satisfactory. No generic parts problem with this integrated circuit were found in an industry survey.

No further flight failures occurred.

Following this failure, the subsatellite continued operation with the remaining particles experiment measurements, but primarily as an S-band transponder lunar gravity experiment.

Response of the under voltage protection circuit during October 1972 indicated that the battery, which was now well past the one-year lifetime, had approximately 2.5 ampere-hour capacity remaining. This was enough to provide power for a tracking pass to alternate with a battery charging pass. In January 1973 the schedule was changed to two battery charge passes to one tracking pass.

The last tracking pass for the subsatellite was on 23 August 1973, on its 9046 lunar revolution. The subsatellite specification for the silver cadmium battery was for a cell life for a 365-day space mission with 5,000 charge/discharge cycles. The flight battery was activated in August 1971, and accumulated over 8,000 charge/discharge cycles by April 1973 when it began showing charging problems and data became intermittent. It ceased charging in August 1973 after approximately 9,400 cycles. Normal deterioration of the silver cadmium battery during its lifetime eventually resulted in the shorted cells of the battery

APOLLO LUNAR SURFACE EQUIPMENT STATUS
5.0 PARTICLES AND FIELDS SUBSATELLITE
(continued)

5.1 Apollo 15 (concluded)

loading the solar panels so that the terminal voltage available was at the cut-off value of the automatic under-voltage protection circuit. This resulted in intermittent data when the transponder was switched on and off by the undervoltage protection circuit.

Two additional attempts were made to contact the satellite on 7 and 12 September 1973, but no signal was received.

5.2 Apollo 16

The Apollo 16 subsatellite (P&FS #2) was launched into lunar orbit 24 April 1972, and performed satisfactorily in all modes of operation until impacting the lunar surface on 29 May 1972. The physical cause for the short orbital life appeared to be the lunar mass concentrations located relatively near the subsatellite ground track. The subsatellite was placed in an orbit different from the one planned as the result of a problem with the command service module service propulsion system engine gimbal actuator which made it advisable to delete the orbit-shaping maneuver.

CLOSED

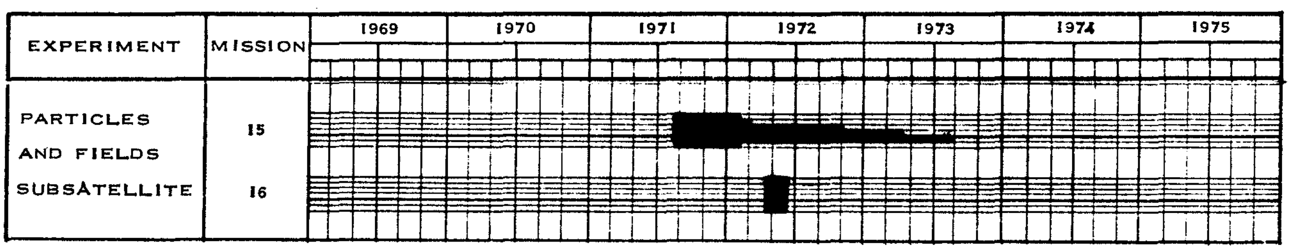
APOLLO LUNAR SURFACE EQUIPMENT STATUS

5.0 PARTICLES AND FIELDS SUBSATELLITE

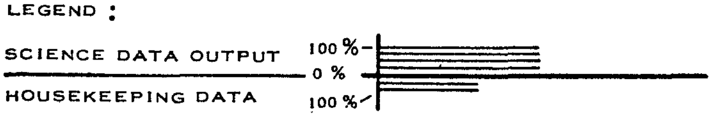
OVERALL SUMMARY

MISSION	LAUNCH DATE	LUNAR SURFACE DATA		
		START	END	
			UPLINK	DOWNLINK
11	Jul. 16, 1969	Jul. 21, 1969		
12	Nov. 14, 1969	Nov. 19, 1969		
14	Jan. 31, 1971	Feb. 5, 1971		
15	Jul. 26, 1971	Jul. 31, 1971		
16	Apr. 16, 1972	Apr. 21, 1972		
17	Dec. 7, 1972	Dec. 12, 1972		

TIME – HISTORY PROPORTION OF FULL CAPABILITY OF INSTRUMENT



LEGEND :



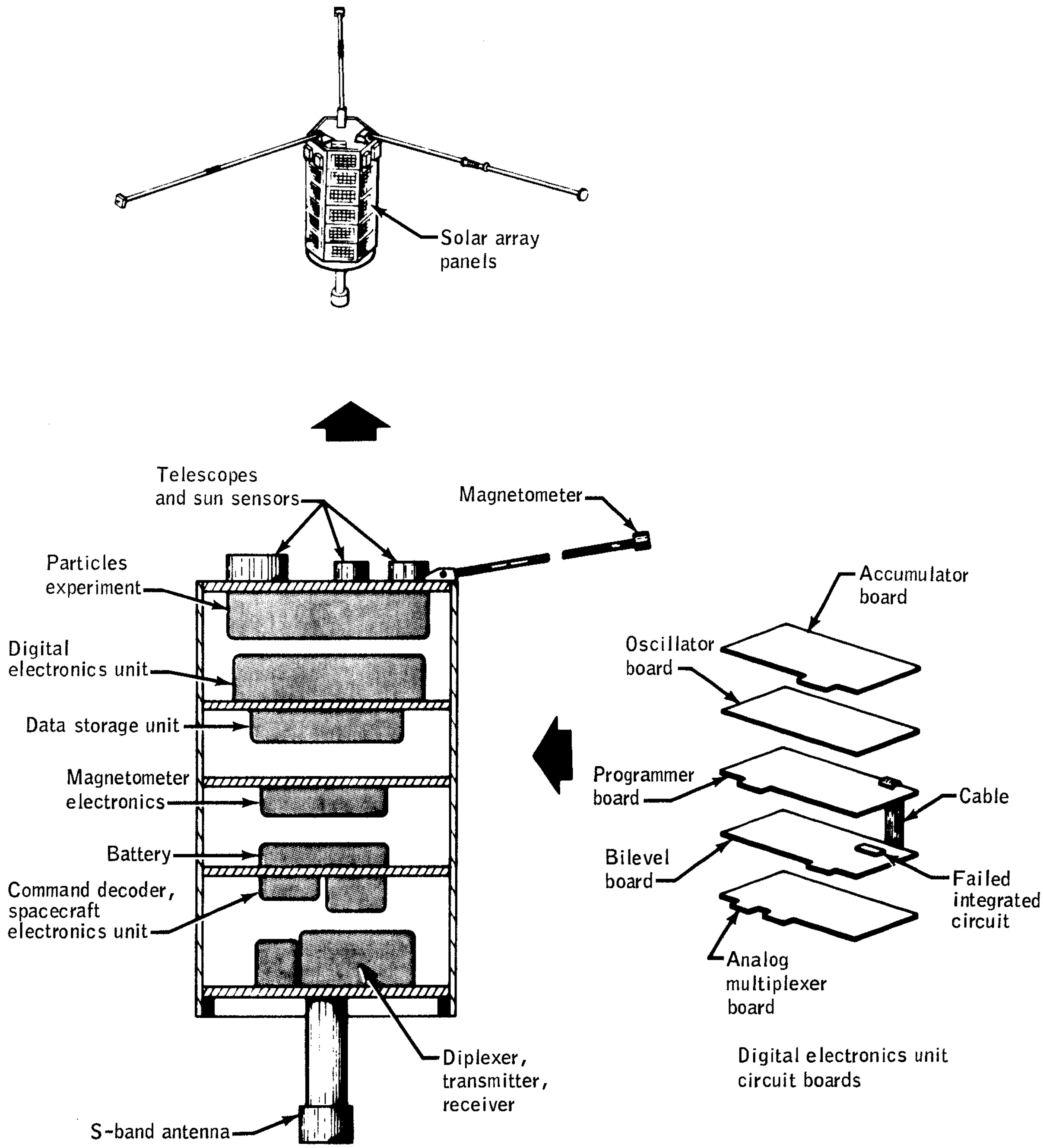
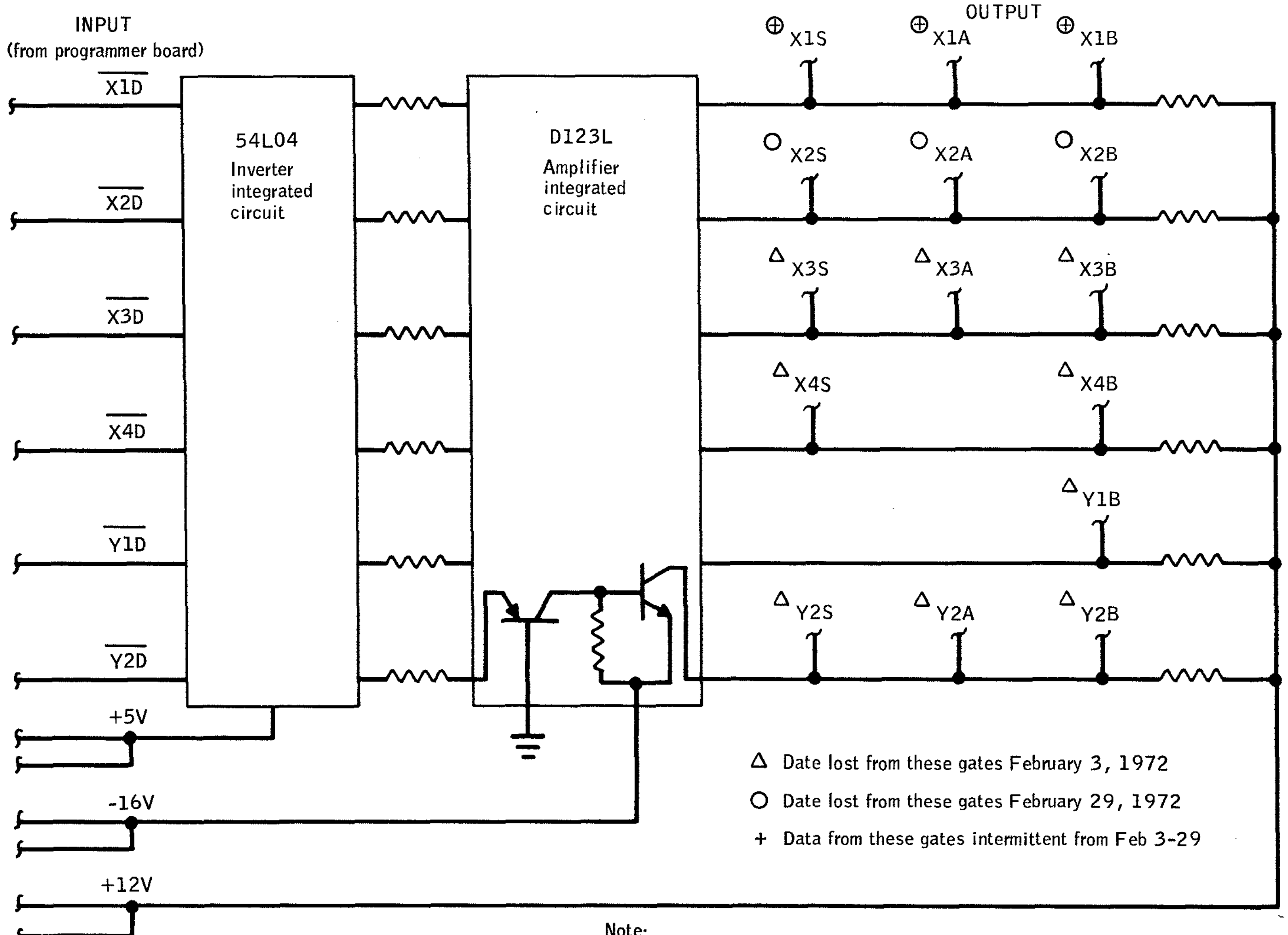


Figure 5-1.- Particle and fields subsatellite.



Note:
Remaining after loss of February 29, 1972:
- Command and tracking capability
- Main frame words 1 and 2
- Reveiver loop stress
- Particles count C1, and C5 sectors II, III, and IV
- Data above for front side passes only (no data storage capability)

Figure 5-2.- Digital electronics unit bi-level main frame and drivers board circuit integrated circuit flat pack failure.

APOLLO LUNAR SURFACE EQUIPMENT STATUS
APPENDIX A - LOSS OF ALSEP DOWNLINK DATA HISTORY

A.1 INTRODUCTION

Prior to 15 April 1973, the participating Spaceflight Tracking and Data Network ground stations receive/record equipment capability was restricted to receiving and recording of up to four ALSEP downlink data streams simultaneously. This limitation was resolved by the acquisition and implementation of additional receive/record equipments, enabling the primary supporting stations (those with 30-foot antennas) to receive and record up to six downlink data streams simultaneously. In addition, to assure uninterrupted ALSEP receive/record coverage during Skylab mission supplemental support stations were utilized.

A.2 ALSEP DATA LOSS HISTORY

Spaceflight Tracking and Data Network ground station coverage for receiving and recording of the ALSEP downlink data stream was not available at the following times due to either programmatic or equipment constraints.

APOLLO LUNAR SURFACE EQUIPMENT STATUS
A.2 ALSEP DATA LOSS HISTORY
(continued)

DATE	GROUND STATION	TIME (G.m.t.)	ALSEP SYSTEM	DATA TIME LOSS
1973				
12 Feb	GWM ACN	LOS 12/1513 AOS 12/1531	15-16-17	18^m
25 Feb	GWM CYI	LOS 25/0139 AOS 25/0200	12	21^m
25 Feb	GWM CYI	LOS 25/0100 AOS 25/0200	14	1^h00^m
26 Feb	GWM CYI	LOS 26/0228 AOS 26/0250	12	22^m
28 Feb	HAW CYI	LOS 28/0006 AOS 28/0427	12	04^h21^m
02 Mar	MAD MIL	LOS 02/0951 AOS 02/1021	12	31^m
03 Mar	ACN ACN	LOS 03/0918 AOS 03/1022	16	01^h04^m
04 Mar	HSK CYI	LOS 04/0642 AOS 04/0659	12	17^m
04 Mar	ACN CYI	LOS 04/0926 AOS 04/0945	15	19^m
05 Mar	CYI MIL	LOS 05/0942 AOS 05/1154	12	02^h12^m
06 Mar	CYI MIL	LOS 06/0955 AOS 06/1227	12	02^h32^m
07 Mar	CRO CYI	LOS 07/1203 AOS 07/1228	12	25^m
09 Mar	ACN ACN	LOS 09/1500 AOS 09/1550	12	50^m

APOLLO LUNAR SURFACE EQUIPMENT STATUS
A.2 ALSEP DATA LOSS HISTORY (continued)

DATE	GROUND STATION	TIME (G.m.t.)	ALSEP SYSTEM	DATA TIME LOSS
1973				
14 Mar	HSK ACN	LOS 14/1315 AOS 14/1350	12	35^m
24 May	ORR TAN	LOS 24/2105 AOS 24/2125	14-17	20^m
27 May	TAN ACN	LOS 27/0718 AOS 27/0730	12-14-15-16-17	12^m
30 May	CRO TAN	LOS 30/0721 AOS 30/0755	12-14-15-16-17	34^m
11 Jun	BUR ACN	LOS 11/1455 AOS 11/1547	12	52^m
12 Jun	GWM TAN	LOS 12/1115 AOS 12/1207	12	52^m
14 Jun	MAD MAD	LOS 14/2228 AOS 14/2250	14	22^m
15 Jun	VAN VAN	LOS 15/0720 AOS 15/0856	14	1^h36^m
19 Jun	VAN VAN	LOS 19/0930 AOS 19/1054	12	1^h24^m
20 Jun	VAN VAN	LOS 20/0712 AOS 20/1000	12	2^h48^m
02 Jul	ORR GWM	LOS 02/0435 AOS 02/0730	12	2^h55^m
08 Jul	TEX ORR	LOS 08/0336 AOS 08/0530	12	1^h54^m
17 Sep	HAW TAN	LOS 17/2113 AOS 17/2227	12	1^h14^m
23 Sep	GULA GWM	LOS 23/2156 AOS 23/2302	12	1^h6^m

APOLLO LUNAR SURFACE EQUIPMENT STATUS
A.2 ALSEP DATA LOSS HISTORY
(concluded)

DATE	GROUND STATION	TIME (G.m.t.)	ALSEP SYSTEM	DATA TIME LOSS
1973				
25 Oct	GDS GWM	LOS 25/2355 AOS 26/0536	12	5^h41^m
28 Oct	GWM ORR	LOS 28/0421 AOS 28/0657	12	2^h36^m
15 Nov	TAN	LOS 15/2142 AOS 15/2223	14	41^m
16 Nov	GWM TAN	LOS 16/2005 AOS 16/2127	14	1^h22^m
17 Nov	GWM	LOS 17/1915 AOS 17/2350	14	4^h35^m
18 Nov	GWM HSK	LOS 18/1834 AOS 18/1940	15	1^h06^m
18 Nov	HSK	LOS 18/1940 AOS 18/2040	16	1^h00^m
18 Nov	HSK	LOS 18/2040 AOS 18/2140	14	1^h00^m
18 Nov	HSK	LOS 18/2140 AOS 18/2240	17	1^h00^m
18 Nov	HSK CRO	LOS 18/2240 AOS 18/2350	12	1^h10^m

APPENDIX B - ALSEP RTG STATUS

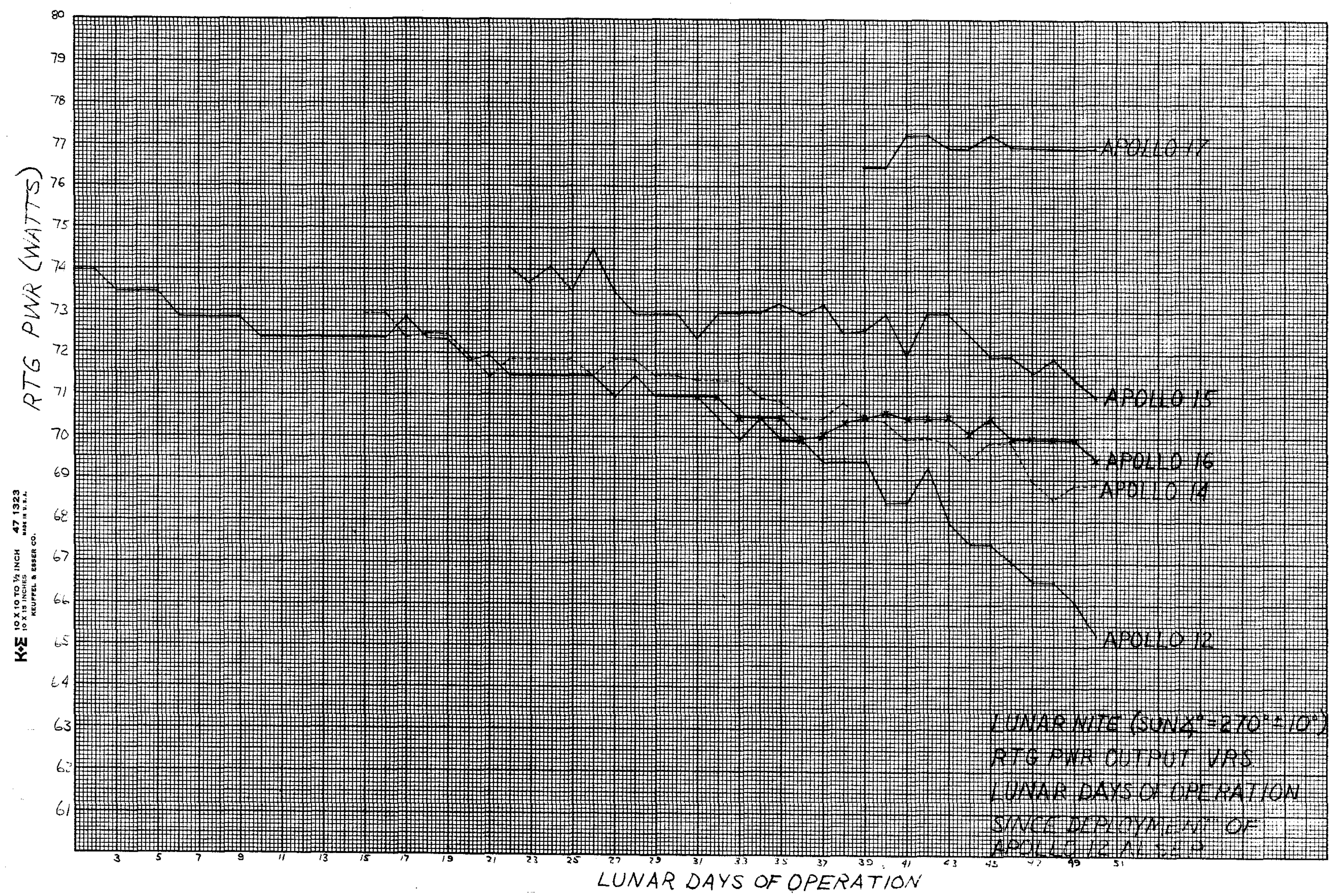
The ALSEP Radioisotopic Thermoelectric Generators (specifically Apollo 12 and 14 ALSEP RTGs) are experiencing an expected but progressive gradual degradation. Cumulative operation of Apollo 12 and 14 ALSEP stations alone have provided over six and one-half years of continuous operation, exceeding the initial design requirement of one year each. The graphical presentations on the following pages illustrate this power regression of the ALSEP RTGs over their total period of lunar operation.

Based on current RTG data, no catastropic failure should occur through normal system operation. However, operation of the ALSEPs with reduced RTG power available has to be considered. Currently, alternate operational guidelines and procedures are being formulated.

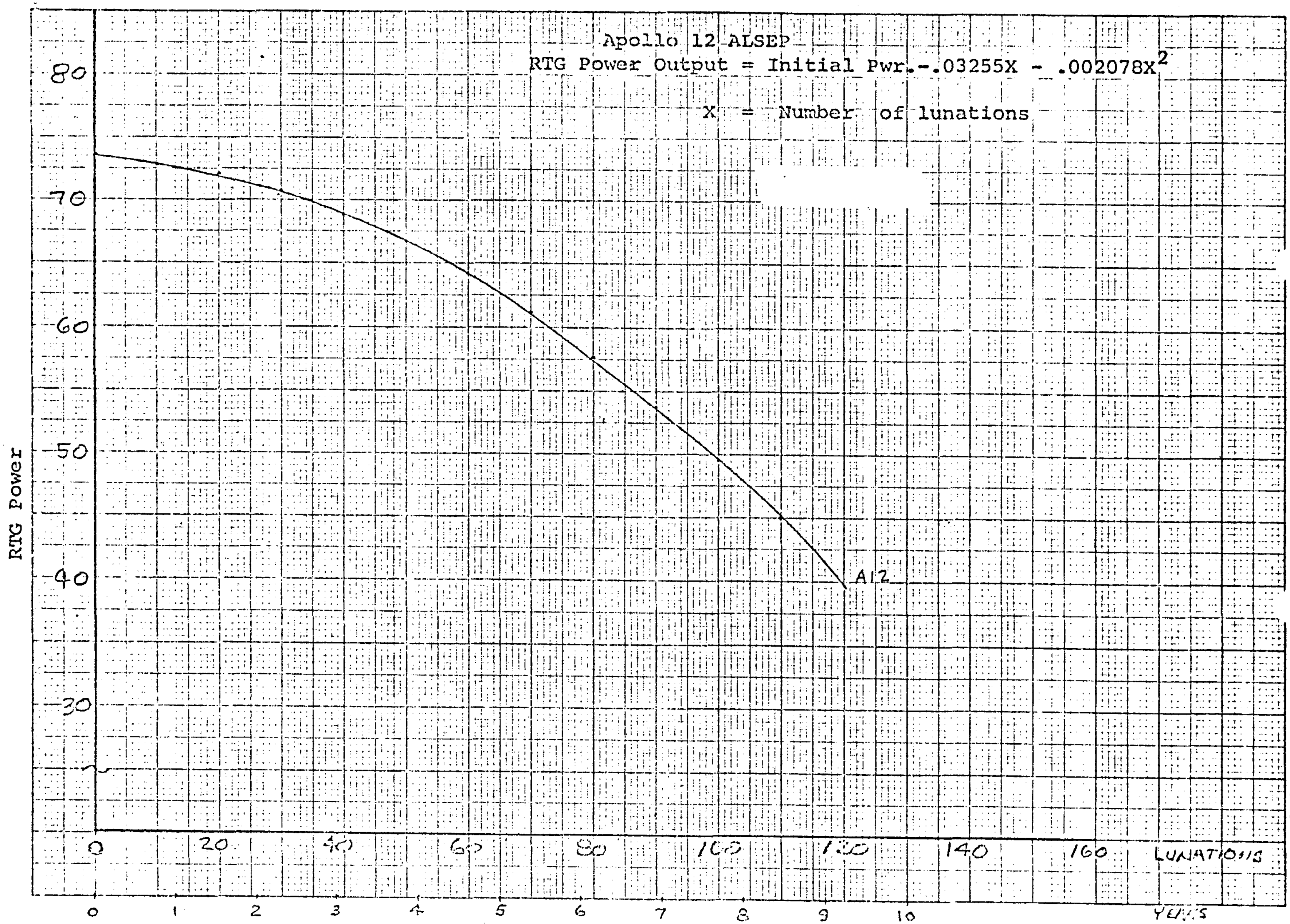
The operational approach assumes that system operation is a function of RTG power available and the distribution of this power for subsystem operation and thermal control. Thermal control (and, therefore, power consumption) will be based on minimum allowable thermal plate temperatures near the transmitters and receiver. The remaining power available will be utilized to support experiment subsystem operation. Eventually, in a power limited situation, experiments will be commanded to STANDBY or OFF to achieve a power/thermal balance. The sequence of experiment termination will be based on experiment priority in effect at that time.

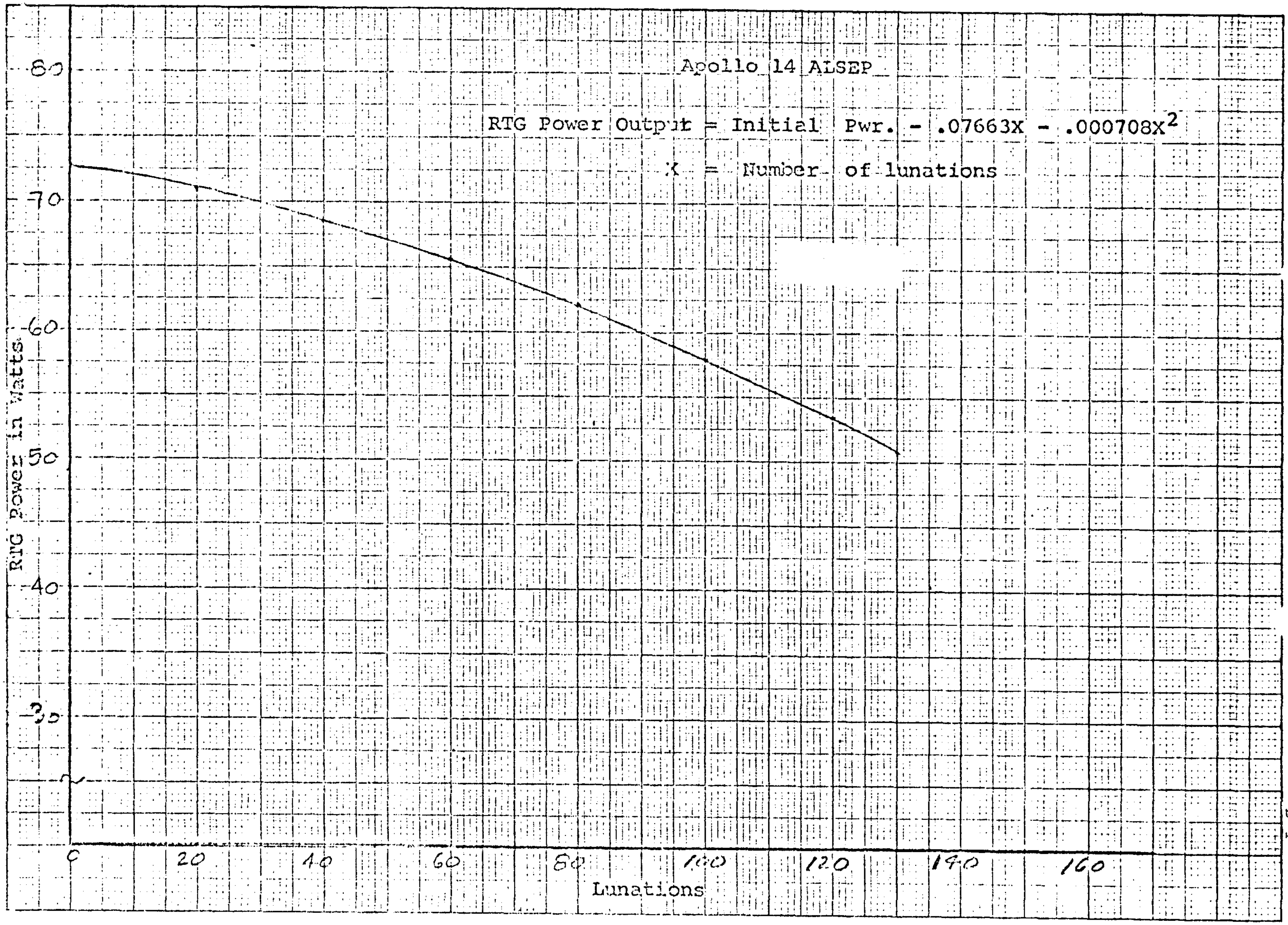
Based on information currently available, RTG power regression has been extrapolated and plotted over a long duration. The graphs presented for Apollo 12 and 14 ALSEPs on the following pages provide an initial baseline guide for planning future system operation at reduced power levels.

Since there are five ALSEPs currently operational, each with a different system configuration, the effective operational procedure for each will be unique.



RTG PWR (WATTS)
80
79
78
77
76
75
74
73
72
71
70
69
68
67
66
65
64
63
62
61
3
5
7
9
11
13
15
17
19
21
23
25
27
29
31
33
35
37
39
41
43
45
47
49
51
APOLLO 17
APOLLO 15
APOLLO 16
APOLLO 14
APOLLO 12
LUNAR NITE (SUN∠° = 270° ± 10°)
RTG PWR OUTPUT VRS
LUNAR DAYS OF OPERATION
LUNAR DAYS OF OPERATION
K+E 10 X 10 TO 1/2 INCH 10 X 15 INCHES 47 1323
KEUFFEL & ESSER CO. MADE IN U.S.A.


Apollo 12 ALSEP
RTG Power Output = Initial Pwr.-.03255X - .002078X2
X = Number of lunations
RTG Power
80
70
60
50
40
30
A12
0
20
40
60
80
100
120
140
160
LUNATIONS
0
1
2
3
4
5
6
7
8
9
10
YEARS


Apollo 14 ALSEP
RTG Power Output = Initial Pwr. - .07663X - .000708X²
X = Number of lunations
RTG Power in Watts
80
70
60
50
40
30
0
20
40
60
80
100
120
140
160
Lunations

APPENDIX C - ABBREVIATIONS AND ACRONYMS

ACN	Ascension Island, United Kingdom (30')
A/D	Analog-to-Digital
AGO	Santiago, Chile (40')
ALSEP	Apollo Lunar Surface Experiments Package
AOS	Acquisition of Signal
ASE	Active Seismic Experiment
BDA	Bermuda, United Kingdom (30')
BUR	Johannesburg, South Africa (40')
CCIG	Cold Cathode Ion Gauge
CMD	Octal Command Number
CPLEE	Charged Particle Lunar Environment Experiment
CRO	Carnarvon, Australia (30')
C/S	Central Station
CVW	Command Verification Word
CYI	Canary Islands, Spain (30')
EVA	Extravehicular Activity
GDS	Goldstone, California, U.S.A. (85')
GWM	Guam, U.S.A. (30')
HAW	Kokee Park, Hawaii, U.S.A. (30')
HBR	High Bit Rate
HFE	Heat Flow Experiment
HSK	Honeysuckle Creek, Australia (85')
LACE	Lunar Atmospheric Composition Experiment
LEAM	Lunar Ejecta and Meteorite Experiment
LM	Lunar Module
LOS	Loss of Signal
LP	Long Period (PSE sensors)
LSG	Lunar Surface Gravimeter
LSM	Lunar Surface Magnetometer
LSPE	Lunar Seismic Profiling Experiment
MAD	Madrid, Spain (85')
MIL	Merritt Island, Florida, U.S.A. (30')
ORR	Orroral Valley, Australia (85')

APPENDIX C - ABBREVIATIONS AND ACRONYMS (concluded)

P & D	Problem and Discrepancy List
PI	Principal Investigator
PSE	Passive Seismic Experiment
QUI	Quito, Ecquador (40')
ROS	Rosman, North Carolina, U.S.A. (85')
RTG	Radioisotope Thermoelectric Generator
SIDE	Suprathermal Ion Detector Experiment
SMEAR	Span/Mission Evaluation Action Request
SP	Short Period (PSE sensor)
SWS	Solar Wind Spectrometer
TAN	Tannanarive, Malagasy Republic (40')
TEX	Corpus Christi, Texas, U.S.A_ (30')
TM	Telemetry
UHT	Universal Handling Tool
ULA	Fairbanks, Alaska, U.S.A. (85' & 40')
VAN	Vanguard, Tracking Ship, U.S.A. (30')
XMTR	Transmitter

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