CHANGE SHEET

FOR

NASA-MSC INTERNAL REPORT

APOLLO 13 MISSION REPORT

Change 1

May 1970

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Manager, Apollo Spacecraft Program

After the attached enclosures (pages 7-3, 7-4, 7-7, 7-8, 11-3 through 11-6, E-3, E-4, and back cover), which are replacement pages, have been inserted, insert this CHANGE SHEET between the cover and title page and write on the cover "Change 1 inserted."

In addition to the attached changes, please complete the attached Mission Report Questionaire and return as indicated.

NOTE: A black bar in the margin of affected pages indicates the information that was changed or added.

Signature of person incorporating changes

Date

7.1.3 Cryogenic Fluids

Cryogenic oxygen and hydrogen usages were nominal until the time of the incident. The pressure decay in oxygen tank 2 was essentially instantaneous, while oxygen tank 1 was not depleted until approximately 2 hours following the incident. Usages listed in the following table are based on an analysis of the electrical power produced by the fuel cells.

	Hydrogen, lb	Oxygen, lb
Available at lift-off		
Tank 1	29.0	326.8
Tank 2	29.2	327.2
Totals	58.2	654.0
Consumed		
Tank 1	7.1	71.8
Tank 2	6.9	85.2
Totals	14.0	157.0
Remaining at the time of the incident		
Tank 1	21.9	255.0
Tank 2	22.3	242.0
Totals	44.2	497.0

7.1.4 Oxygen

Following the incident and loss of pressure in tank 1, the total oxygen supply consisted of 3.77 pounds in the surge tank and 1 pound in each of the three repressurization bottles. About 0.6 pound of the oxygen from the surge tank was used during potable water tank pressurizations and to activate the oxygen system prior to entry. An additional 0.3 pound was used for breathing during entry.

7.1.5 Water

At the time of the incident, about 38 pounds of water was available in the potable water tank. During the abort phase, the crew used juice bags to transfer approximately 14 pounds of water from the command module to the lunar module for drinking and food preparation.

7.1.6 Batteries

The command module was completely powered down at 58 hours 40 minutes, at which time 99 ampere-hours remained in the three entry batteries. By charging the batteries with lunar module power, available battery capacity was increased to 118 ampere-hours. Figure 7.1-1 depicts the battery energy available and used during entry. At landing, 29 ampere-hours of energy remained.

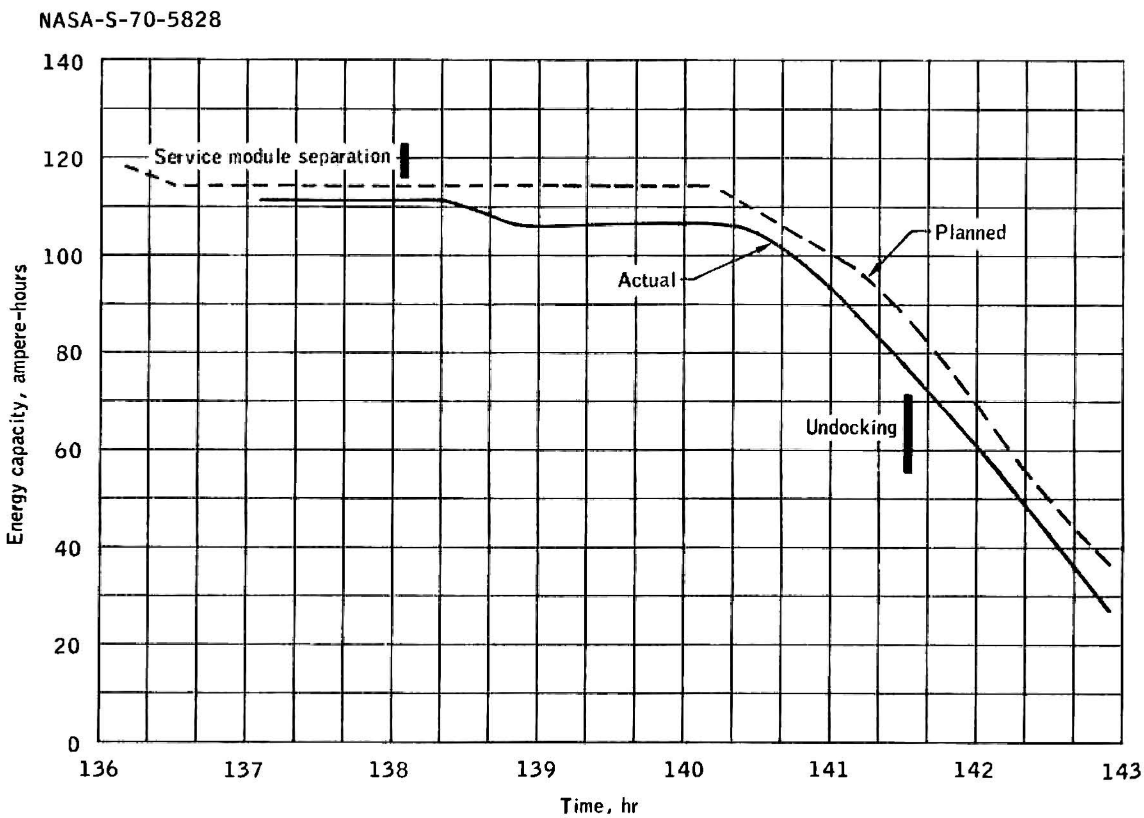


Figure 7.1-1.- Entry battery energy.

7.2 LUNAR MODULE

Following lunar module power-up, oxygen, water, and battery power were consumed at the lowest practical rate to increase the duration of operate the reaction control heaters and telemetry equipment. The estimated total energy transferred to the command module was approximately 129 ampere hours. A total of 410 ampere hours remained in the lunar module batteries at the time of undocking.

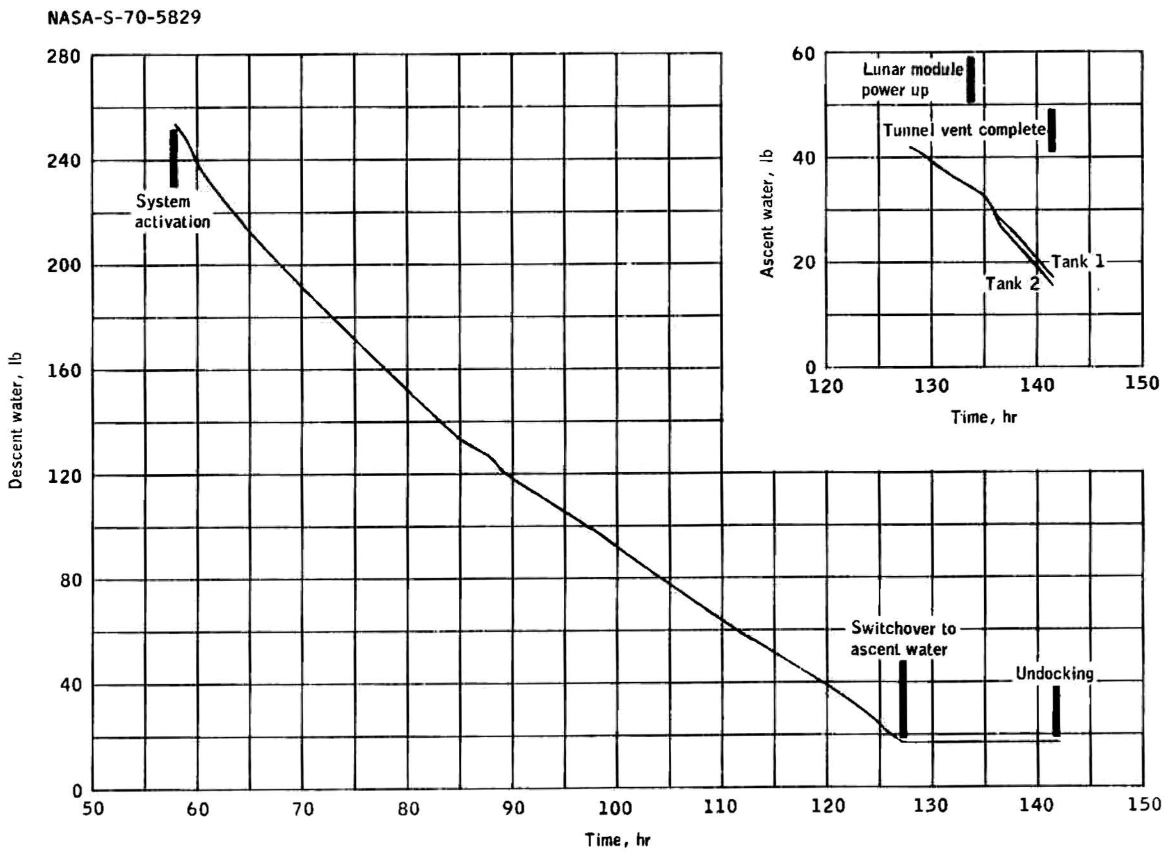


Figure 7.2-1.- Lunar module water usage.

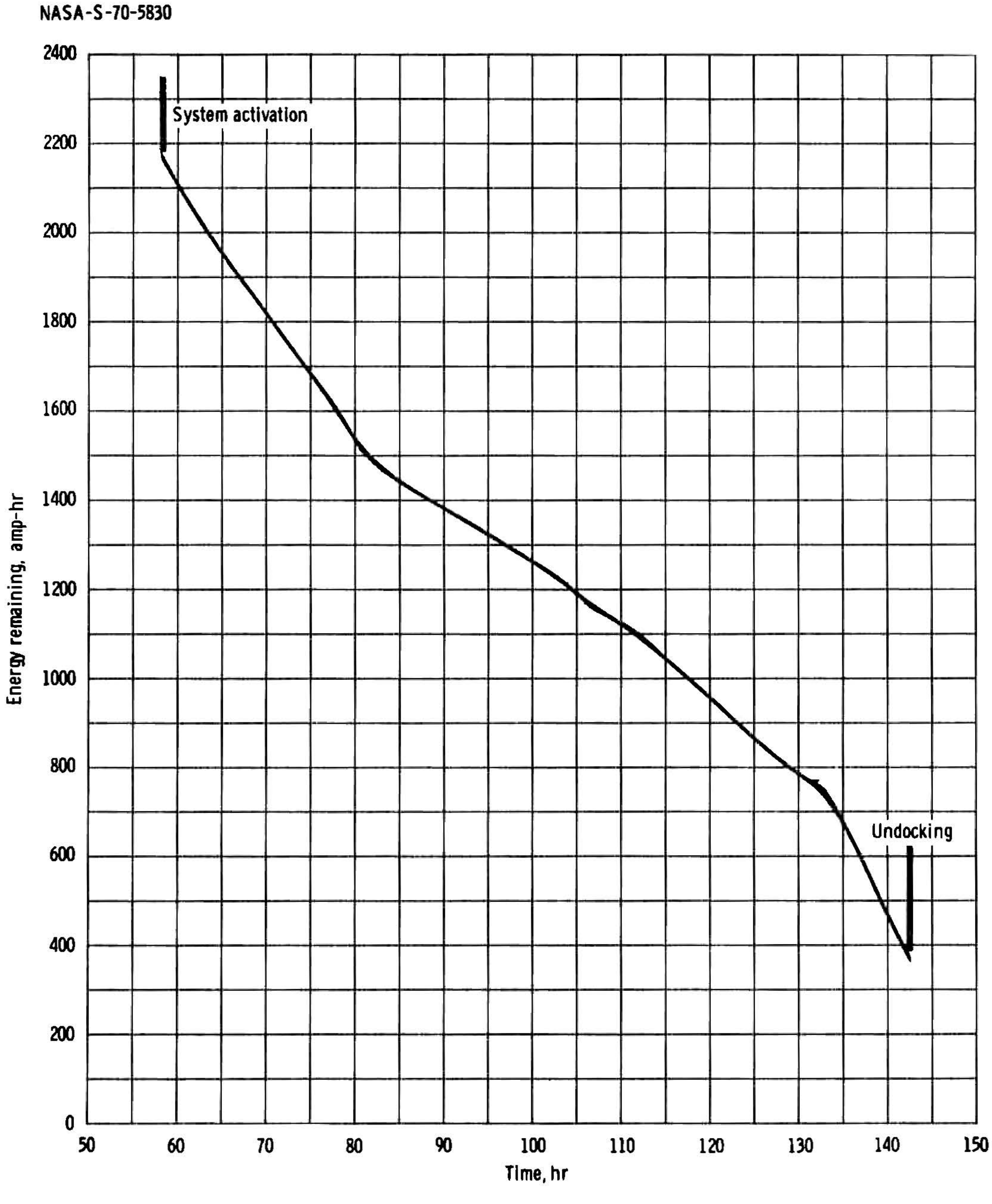


Figure 7.2-2.- Lunar module total battery capacity during flight.

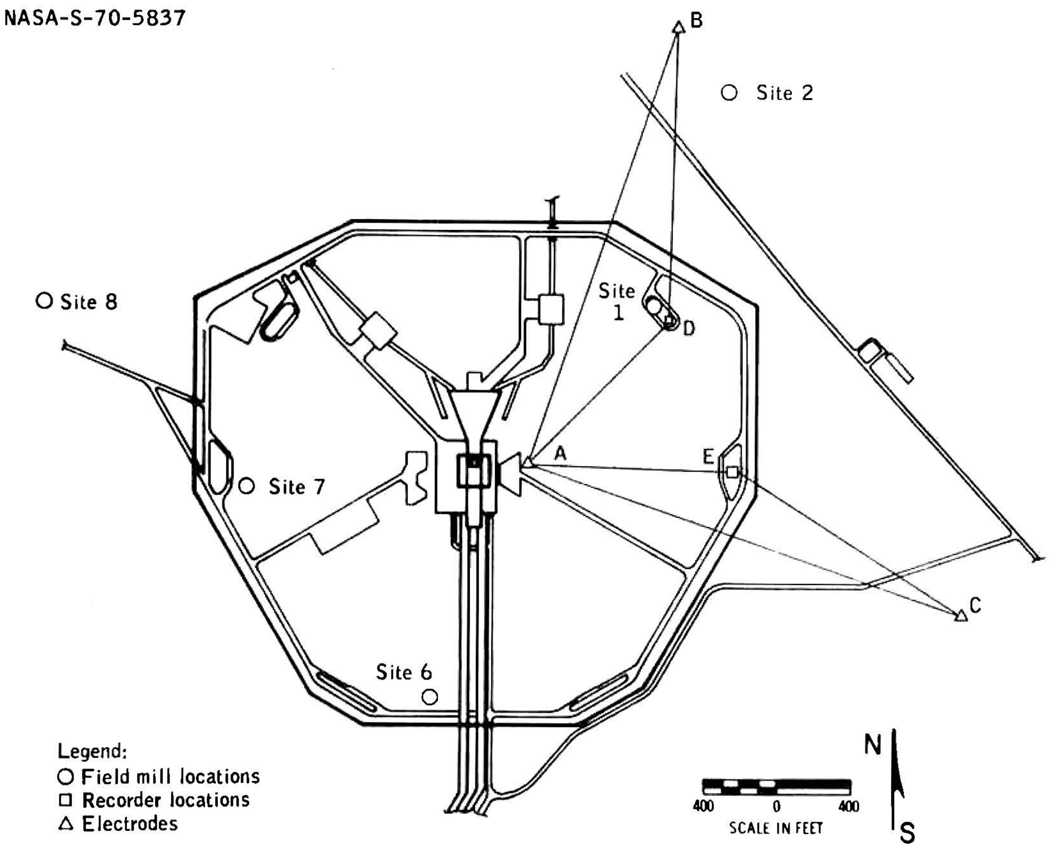
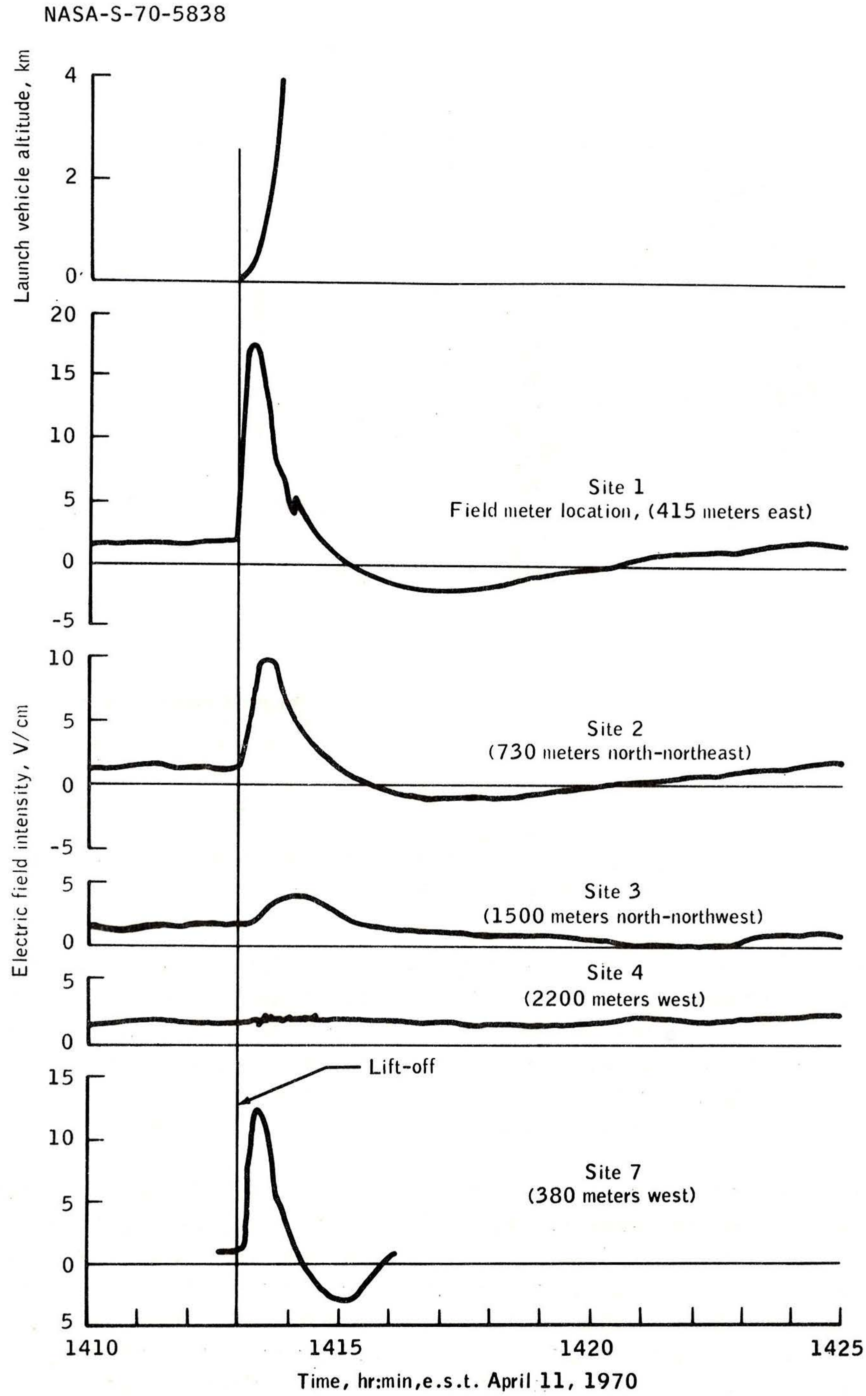


Figure 11.1-2.- Field meter locations in the proximity of the launch complex.

gravel and dust stirred up by the exhaust of the launch vehicle engine. After launch, a quantity of such debris was found near the surface of the field meter and its surrounding area. After the oscillations had subsided at T plus 40 seconds, there was a large negative field of approximately minus 3000 volts/meter which probably resulted from the exhaust and steam clouds that tended to remain over site 6.

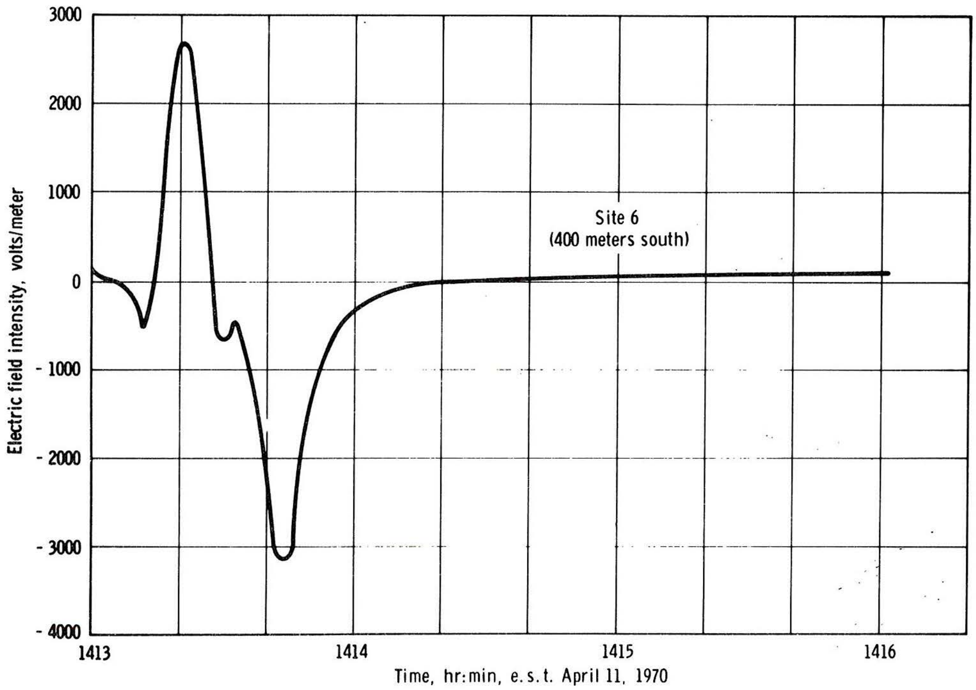
Because of access restrictions to sites 8 and 9, the corresponding recorders were started several hours prior to launch and unfortunately had stopped before lift-off. However, substantial positive and negative field perturbations found on the stationary parts of the records were greater than anything found on the moving portion. Comparison of these records with those from sites 6 and 7 confirmed that the only large field perturbations were those accompanying launch. Consequently, the peak excursions of the records at sites 8 and 9 could be confidently associated with the maximum field perturbations occurring just after lift-off.



(a) Sites 1 to 4 and 7.

Figure 11.1-3.- Electrical discharge data for the Apollo 13 launch.

NASA-S-70-5839



(b) Site 6.

Figure 11.1-3.- Concluded

No significant perturbation in the electric field was produced by the launch cloud at stations 4 or 5, although small-scale fluctuations, apparently resulting from vibrations, can be seen on the records of the fine weather field at both stations.

The field-change and sferics detectors at site 5 gave no indication of any lightning-like discharge during launch, although sporadic signals were later recorded during the afternoon of launch day. These signals probably came from lightning in a cold front which was stalled some distance to the northwest of the launch site and which passed over the launch site on April 12.

The above field meter records indicate the launch of the Apollo 13 vehicle produced a significant separation of electrical charge which could possibly increase the hazard in an otherwise marginal weather situation. At the present time the location and amount of the charge on the vehicle or exhaust clouds or a combination thereof are not well understood.

It is known that the electrostatic potentials develop on jet aircraft. These are caused by an engine charging current, which is balanced by a corona current loss from the aircraft. For a conventional jet aircraft, the equilibrium potential can approach a million volts. For the Saturn V launch vehicle, the charging current may be larger than that of a jet aircraft, and therefore, the equilibrium potential for the Saturn vehicle might be on the order of a million volts or more.

TABLE E-I.- MISSION REPORT SUPPLEMENTS - Continued

Supplement number	Title	Publication date/status
Apollo 10		
1	Trajectory Reconstruction and Analysis	March 1970
2	Guidance, Navigation, and Control System Performance Analysis	December 1969
3	Performance of Command and Service Module Reaction Control System	Final review
4	Service Propulsion System Final Flight Evaluation	September 1970
5	Performance of Lunar Module Reaction Control System	Final review
6	Ascent Propulsion System Final Flight Evaluation	January 1970
7	Descent Propulsion System Final Flight Evaluation	January 1970
8	Cancelled	
9	Analysis of Apollo 10 Photography and Visual Observations	In publication
10	Entry Postflight Analysis	December 1969
11	Communications System Performance	December 1969
Apollo 11		
1	Trajectory Reconstruction and Analysis	May 1970
2	Guidance, Navigation, and Control System Performance Analysis	September 1970
3	Performance of Command and Service Module Reaction Control System	Review
4	Service Propulsion System Final Flight Evaluation	Review
5	Performance of Lunar Module Reaction Control System	Review
6	Ascent Propulsion System Final Flight Evaluation	September 1970
7	Descent Propulsion System Final Flight Evaluation	September 1970
8	Cancelled	
9	Apollo 11 Preliminary Science Report	December 1969
10	Communications System Performance	January 1970
11	Entry Postflight Analysis	April 1970

TABLE E-I.- MISSION REPORT SUPPLEMENTS - Concluded

Supplement number	Title	Publication date/status
	Apollo 12	
1	Trajectory Reconstruction and Analysis	September 1970
2	Guidance, Navigation, and Control System Performance Analysis	September 1970
3	Service Propulsion System Final Flight Evaluation	Preparation
4	Ascent Propulsion System Final Flight Evaluation	Preparation
5	Descent Propulsion System Final Flight Evaluation	Preparation
6	Apollo 12 Preliminary Science Report	July 1970
7	Landing Site Selection Processes	Final review
	Apollo 13	
1	Guidance, Navigation, and Control System Performance Analysis	Review
2	Descent Propulsion System Final Flight Evaluation	Preparation
3	Entry Postflight Analysis	Cancelled

MISSION REPORT QUESTIONNAIRE

Mission Reports are prepared as an overall summary of specific Apollo flight results, with supplemental reports and separate anomaly reports providing the engineering detail in selected areas. Would you kindly complete this one-page questionnaire so that our evaluation and reporting service to our readership might be improved.

1. DO YOU THINK THE CONTENT OF THE MISSION REPORTS SHOULD BE:

☐ LESS DETAILED ☐ MORE DETAILED ☐ ABOUT THE SAME?

2. WOULD YOU SUGGEST ANY CHANGES TO THE PRESENT CONTENT?

3. YOUR COPY IS *(check more than one)*:

☐ READ COMPLETELY ☐ READ PARTIALLY ☐ SCANNED ☐ NOT READ OR SCANNED

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☐ MORE THAN 5 TIMES ☐ FROM 2 TO 5 TIMES ☐ ONCE ☐ NEVER

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☐ USE THOSE YOU RECEIVE ☐ DO NOT RECEIVE ANY, BUT WOULD LIKE TO ☐ DO NOT NEED THEM

6. DO YOU WISH TO CONTINUE RECEIVING MISSION REPORTS?

☐ YES ☐ NO

7. FURTHER SUGGESTIONS OR COMMENTS:

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APOLLO SPACECRAFT FLIGHT HISTORY

(Continued from inside front cover)

Mission	Spacecraft	Description	Launch date	Launch site
Apollo 4	SC-017 LTA-10R	Supercircular entry at lunar return velocity	Nov. 9, 1967	Kennedy Space Center, Fla.
Apollo 5	LM-1	First lunar module flight	Jan. 22, 1968	Cape Kennedy, Fla.
Apollo 6	SC-020 LTA-2R	Verification of closed-loop emergency detection system	April 4, 1968	Kennedy Space Center, Fla.
Apollo 7	CSM 101	First manned flight; earth-orbital	Oct. 11, 1968	Cape Kennedy, Fla.
Apollo 8	CSM 103	First manned lunar orbital flight; first manned Saturn V launch	Dec. 21, 1968	Kennedy Space
Apollo 9	CSM 104 LM-3	First manned lunar module flight; earth orbit rendezvous; EVA	Mar. 3, 1969	Kennedy Space Center, Fla.
Apollo 10	CSM 106 LM-4	First lunar orbit rendezvous; low pass over lunar surface	May 18, 1969	Kennedy Space Center, Fla.
Apollo 11	CSM 107 LM-5	First lunar landing	July 16, 1969	Kennedy Space Center, Fla.
Apollo 12	CSM 108 LM-6	Second lunar landing	Nov. 14, 1969	Kennedy Space Center, Fla.
Apollo 13	CSM 109 LM-7	Aborted during trans-lunar flight because of cryogenic oxygen loss	April 11, 1970	Kennedy Space Center, Fla.