NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
WASHINGTON, D.C. 20546

REPLY TO
ATTN OF:

Post Launch
Mission Operation Report
No. M-932-69-11

24 July 1969

To: A/Administrator

From: MA/Apollo Program Director

Subject: Apollo 11 Mission (AS-506) Post Launch Mission Operation Report No. 1

The Apollo 11 Mission was successfully launched from the Kennedy Space Center on Wednesday, 16 July 1969 and was completed as planned, with recovery of the spacecraft and crew in the Pacific Ocean recovery area on Thursday, 24 July 1969. Initial review of the flight indicates that all mission objectives were attained. Further detailed analysis of all data is continuing and appropriate refined results of the mission will be reported in the Manned Space Flight Centers' technical reports.

Attached is the Mission Director's Summary Report for Apollo 11 which is hereby submitted as Post Launch Mission Operation Report No. 1. I recommend that the Apollo 11 Mission be adjudged as having achieved the primary objective of a manned lunar landing and return, and be considered a success.

Sam C. Phillips
Lt. General, USAF
Apollo Program Director

APPROVAL:

George E. Mueller
Associate Administrator
for Manned Space Flight

M-932-69-11

NASA OMSF PRIMARY MISSION OBJECTIVES

FOR APOLLO 11

PRIMARY OBJECTIVE

Perform a manned lunar landing and return.

Sam C. Phillips
Lt. General, USAF
Apollo Program Director

Date: June 26, 1969

George E. Mueller
Associate Administrator
for Manned Space Flight

Date: June 26, 1969

RESULTS OF APOLLO 11 MISSION

Based upon a review of the assessed performance of Apollo 11, launched 16 July 1969 and completed 24 July 1969, this mission is adjudged a success in accordance with the objective stated above.

Sam C. Phillips
Lt. General, USAF
Apollo Program Director

Date: 24 July 1969

George E. Mueller
Associate Administrator
for Manned Space Flight

Date: July 24 1969

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
WASHINGTON, D.C. 20546

IN REPLY REFER TO: MAO

24 July 1969

TO : Distribution

FROM : MA/Apollo Mission Director

SUBJECT: Mission Director's Summary Report, Apollo 11

INTRODUCTION

The Apollo 11 mission was planned to perform a manned lunar landing and return. Flight crew members were: Commander, Mr. N. A. Armstrong; Command Module Pilot, Lt. Col. M. Collins; Lunar Module Pilot, Col. E. E. Aldrin. Significant detailed mission information is contained in Tables 1 through 10. Initial review of the flight indicates that all mission objectives were attained (Reference Table 1). Table 2 lists achievements.

PRELAUNCH

The Apollo 11 countdown was accomplished with no unscheduled holds.

LAUNCH AND EARTH PARKING ORBIT

The Apollo 11 space vehicle was successfully launched from Kennedy Space Center, Florida, at 9:32 a.m. EDT on 16 July 1969. All launch vehicle stages performed satisfactorily, inserting the S-IVB/spacecraft combination into an earth parking orbit of 103 nautical miles (NM) circular -- precisely as planned. (Refer to Table 4 for powered flight sequence of events). All systems operated satisfactorily.

Pre-TLI (translunar injection) checkout was conducted as planned and the second S-IVB burn was initiated on schedule. (Reference Table 6). All systems operated satisfactorily and all end conditions were nominal for the translunar coast on a free return trajectory.

TRANSLUNAR COAST

The Command/Service Module (CSM) was separated from the remainder of the orbital vehicle at about 3:17 GET, (hr:min ground elapsed time). The crew reported at 3:29 GET that CSM transposition and docking with the Lunar Module (LM)/

Instrument Unit (IU)/S-IVB were complete. Ejection of the CSM/LM was successfully accomplished at about 4:17 GET and a SM Service Propulsion System (SPS) evasive maneuver was performed as planned at 4:40 GET. (Reference Table 6). All launch vehicle safing activities were performed as scheduled.

The S-IVB/IU slingshot maneuver was successful in avoiding spacecraft recontact, lunar impact and earth capture. The closest approach to the moon of 2340 nautical miles occurred at 78:50:34 (4:22:34 p.m. EDT, 19 July).

The accuracy with which the TLI maneuver was performed was such that midcourse correction number one (MCC-1) was not required.

An unscheduled 16-minute television transmission was recorded at the Goldstone station beginning at 10:32 GET. The tape was played back at Goldstone and transmitted to Houston beginning at 11:26 GET. An unscheduled 50-minute television transmission was accomplished at 30:28 GET, and a 36-minute scheduled TV transmission began at 33:59 GET.

MCC-2 was performed at 26:45 GET as planned and all SPS burn parameters were nominal (Reference Table 6). The accuracy of the MCC-2 calculation and performance was such that MCC-3 and MCC-4 were not necessary.

The crew initiated a 96-minute color television transmission at 55:08 GET. The picture resolution and general quality were exceptional. The coverage was outstanding, including the interior of both the CM and LM, and views of the exterior of the CM and the earth. Excellent views of the crew accomplishing probe and drogue removal, spacecraft tunnel hatch opening, LM housekeeping and equipment were obtained. The picture was transmitted live throughout North and South America, Japan, and Western Europe.

The spacecraft passed into the moon's sphere of influence at 61:39:55 GET. At that time, the distance from the spacecraft to earth was 186,436 NM and its distance from the moon was 33,823 NM. The velocity was 2,990 feet per second (fps) relative to earth and 3,775 fps relative to the moon.

LUNAR ORBIT

Lunar orbit insertion (LOI) was performed in two separate maneuvers using the SPS. The first maneuver, LOI-1, was initiated at 75:50 GET. The retrograde maneuver placed the spacecraft in a 168.8 x 61.3 NM elliptical orbit.

During the second lunar orbit, a scheduled live color television transmission was accomplished. Spectacular views of the lunar surface included the approach path to Lunar Landing Site 2.

After two revolutions and a navigation update, a second SPS retrograde burn (LOI-2) was made. The resulting orbit had an apolune of 65.7 NM and a perilune of 53.8 NM. LOI-1 and 2 burn parameters were nominal (Reference Table 7).

After LOI-2, the crew transferred to the LM and for about two hours performed various housekeeping functions, a voice and telemetry test, and an Oxygen Purge System check. LM functions and consumables quantities checked out very well. Additionally, both LM Hasselblad and Maurer cameras were checked and verified as being operational.

The Commander (CDR) and LM Pilot (LMP) re-entered the LM at approximately 95:20 GET to perform a thorough check of all LM systems in preparation for descent. Undocking of the LM from the CSM occurred at approximately 100:14 GET. Station-keeping was then initiated. At 100:40 GET, the SM Reaction Control System (RCS) was used to perform a small separation maneuver directed radially downward toward the center of the moon as planned (Reference Table 7).

DESCENT

The descent orbit insertion (DOI) maneuver was performed by a LM Descent Propulsion System (DPS) retrograde burn one-half revolution after LM/CSM separation, placing the LM in an elliptical orbit whose perilune was 8.5 NM (Reference Table 7).

The LM powered descent maneuver was initiated at perilune of the descent orbit. The time of powered descent initiate (PDI) was as planned. However, the position at which PDI occurred was about 4 NM downrange from that which was expected. This resulted in the landing point being shifted downrange about 4 NM.

During the final approach phase, the crew noted that the landing point toward which the spacecraft was headed was in the center of a large crater which appeared extremely rugged with boulders of 5 to 10 feet in diameter and larger. Consequently, the crew elected to fly to a landing point beyond this crater. This required manual attitude control and fine adjustments of the rate of descent plus high horizontal velocity to translate beyond the rough terrain area. As indicated above, the final landing point was estimated to be about four miles downrange from the center of the planned landing ellipse. Lunar landing occurred at

102:45:43 GET (4:17:43 p.m. EDT) (Reference Table 7 for powered descent parameters). Current estimate of landing point coordinates, based on analysis of all available data is 23.5° E and .64° N. This is approximately 20,800 feet west and 4,000 to 5,000 feet south of the center of the planned landing ellipse. Site altitude is estimated at approximately 8600 ft below the moon's mean radius.

LUNAR SURFACE ACTIVITIES

LM attitude on the surface was tilted 4.5° from the vertical, and yawed left about 13°. The crew indicated the landing site area contained numerous boulders of varying shapes and sizes up to 2 feet. The surface color varied from very light to dark gray. From his window view, the CDR reported seeing some boulders that were apparently fractured by engine exhaust. He reported that the surface of these boulders appeared to be coated light gray whereas the fractures were much darker. A hill was in sight at about ½ to 1 mile in front of the LM.

The crew indicated that they could immediately adapt to the 1/6 (earth) gravity in the LM and moved very easily in this environment. About two hours after landing, the crew requested that the extravehicular activity (EVA) be accomplished prior to the sleep period, or about 4½ hours earlier than originally scheduled. The rest period originally planned to occur prior to EVA was slipped until post-EVA and added to the second sleep period.

EXTRAVEHICULAR ACTIVITY

After the postlanding checks, the LM hatch was opened at 109:07:35 GET. As the CDR descended the LM ladder, he deployed the Modularized Equipment Stowage Assembly (MESA). The television camera mounted on the MESA access panel recorded his descent to the lunar surface. The CDR's first step on the moon occurred at 109:24:15 GET (10:56:15 p.m. EDT). He made a brief check of the LM exterior, indicating that penetration of the footpads was only about 3 to 4 inches and collapse of the strut was minimal. He reported sinking approximately 1/8 inch into the fine, powdery surface material, which adhered readily to the lunar boots in a thin layer. There was no crater from the effects of the descent engine, and about one foot of clearance was observed between the engine bell and the lunar surface. He also reported that it was quite dark in the shadows of the LM which made it difficult for him to see his footing. During the EVA, a small microdot disk containing messages from numerous world leaders was left on the moon.

The CDR then collected a contingency sample of lunar soil from the vicinity of the LM ladder. He reported that although loose material created a soft surface, as he dug down six or eight inches, he encountered very hard cohesive material.

The CDR photographed the LMP's egress and descent to the lunar surface. The CDR and LMP then unveiled the plaque mounted on the strut behind the ladder and read its inscription to their worldwide television audience. Next, the CDR removed the TV camera from the Descent Stage MESA, obtained a panorama, and placed the camera on its tripod in position to view the subsequent surface EVA operations.

The LMP deployed the Solar Wind Composition experiment on the lunar surface in direct sunlight to the north of the LM as planned.

Subsequently, the crew erected a 3 x 5-foot American flag on an 8-foot aluminum staff. During the ensuing environmental evaluation, the LMP indicated that he had to be careful of his center of mass in maintaining balance. He noted that the LM shadow had no significant effect on his EMU temperature. The LMP also noted that his agility was better than expected. He was able to move about with great ease. Both crewmen indicated that their mobility throughout the EVA significantly exceeded all expectations. Also, indications were that metabolic rates were much lower than premission estimates.

A conversation between President Nixon and Armstrong and Aldrin was held. The conversation originated from the White House and contained congratulations and good wishes.

The CDR collected a Bulk Sample consisting of assorted surface material and selected rock chunks, and placed them in a Sample Return Container (SRC). Following the Bulk Sample collection, the crew inspected the LM and reported no discrepancies. The quads, struts, skirts, and antennas were satisfactory.

The Passive Seismic Experiment Package (PSEP) and Laser Ranging Retro Reflector were deployed south of the LM. Excellent PSEP data was obtained including detection of the crewmen walking on the surface and later, in the LM. The crew then collected more lunar samples until EVA terminiation including two core samples and about 20 pounds of discretely selected material. The LMP had to exert a considerable force to drive the core tubes an estimated six to eight inches deep.

Throughout the EVA, TV was useful in providing continuous observation for time correlation of crew activity with telemetered data and voice comments and in providing live documentation of

this historically significant achievement. Lunar surface photography consisted of both still and sequence coverage using the Hasselblad camera, the Maurer data acquisition camera and the Apollo Lunar Surface Close-Up camera.

EVA terminiation, film and sample transfer, LM ingress, and equipment jettison were accomplished according to plan. A rest period followed the post-EVA activities prior to preparation for liftoff. A record of lunar events is presented in Table 3.

ASCENT, RENDEZVOUS AND TRANSEARTH INJECTION

LM liftoff from the lunar surface occurred at 124:22 GET (1:34 p.m. EDT, 21 July) concluding a total lunar stay time of 21 hours 36 minutes. All lunar ascent and rendezvous maneuvers were nominal and terminated with CSM/LM docking at 128:03 GET. After transfer of the crew, samples and film to the CSM, the LM Ascent Stage was jettisoned at 130:10 GET. The LM ascent stage will remain in lunar orbit for an indefinite period of time. Subsequently, a small SM RCS separation maneuver placed the CSM in a 62.6 by 54.7 nautical mile orbit. (Reference Table 7 for maneuver parameters).

At 135:24 GET, the SPS injected the CSM into a transearth trajectory after a total time in lunar orbit of 59 hours 28 minutes (30 revolutions) (Reference Table 6). The TEI resulted in a transearth return time of about 60 hours.

TRANSEARTH COAST AND ENTRY

MCC-5 was initiated at 150:30 GET. The 10.8-second SM RCS burn produced a velocity change of 4.7 feet per second (Reference Table 6). An 18-minute television transmission was initiated at 155:36 GET and produced good quality pictures. The transmission featured crew demonstrations of the effect of weightlessness on food and water and brief scenes of the moon and earth. The accuracy of MCC-5 was such that MCC-6 and MCC-7 were not required.

The final color television broadcast was made at 177:32 GET. The 12½ minute transmission featured a sincere message of appreciation by each crew member to all people who helped make the Apollo 11 mission possible.

The crew awoke at 189:15 GET and initiated reentry preparations. CM/SM separation occurred at 194:49:19 GET and entry interface was reached at 195:03 GET.

Because of deteriorating weather in the nominal landing area, the aim point had been moved downrange 215 NM. Weather in the new landing area was excellent: visibility was 12 miles, wave height 3 feet, and wind 16 knots.

Visual contact of the spacecraft was reported at 195:06 GET. Drogue and main parachutes deployed normally. Landing occurred about 14 minutes after entry interface at 195:18:35 GET (12:50:35 EDT). The landing point was in the mid-Pacific, approximately 169:09° W longitude by 13:18° N latitude, about 13 NM from the prime recovery ship, USS HORNET. The CM landed in the Stable 2 position. Flotation bags were deployed to right the S/C into Stable 1 position at 195:25:10. The crew reported that they were in good condition.

ASTRONAUT RECOVERY OPERATIONS

Following landing, the recovery helicopter dropped swimmers who installed the flotation collar to the CM. A large, 7-man raft was deployed and attached to the flotation collar. Biological Isolation Garments (BIG's) were lowered into the raft, and one swimmer donned a BIG while the astronauts donned BIG's inside the CM. Two other swimmers moved upwind of the CM on a second large raft. The post-landing ventilation fan was turned off, the CM powered down, and the astronauts egressed and assisted the swimmer in closing the CM hatch. The swimmer then decontaminated all garments, the hatch area, the collar, and the area around the post landing vent valves.

The helicopter recovered the astronauts. After landing on the recovery carrier, the astronauts and a recovery physician entered the Mobile Quarantine Facility (MQF).

President Nixon, aboard USS HORNET, spoke to the crew members by intercommunications. He congratulated the Apollo 11 crew for this stupendous feat.

The flight crew, recovery physician and recovery technician will remain inside the MQF until it is delivered to the Lunar Receiving Laboratory (LRL) in Houston, Texas. This delivery is currently planned to occur on July 27.

CM RETRIEVAL OPERATIONS

After flight crew pickup by the helicopter, the CM was retrieved and placed in a dolly aboard the recovery ship. It was then moved to the MQF and mated to the transfer tunnel. From inside the MQF/CM containment envelope, the MQF engineer began post-retrieval procedures (removal of lunar samples, data, equipment, etc.), passing the removed items through the decontamination lock. The CM will remain sealed during RCS deactivation and delivery to the LRL.

The Sample Return Containers (SRC), film, data, etc. will be flown to Johnson Island by fixed wing aircraft from USS HORNET. The two SRC's will then be flown by separate aircraft to Houston for transport to the LRL.

MISSION SCIENTIFIC ACTIVITY

CONTINGENCY SAMPLE

A Contingency Sample was acquired early in the EVA in the immediate MESA area. The CDR indicated little difficulty in scooping material to a depth of six inches.

SOLAR WIND COMPOSITION EXPERIMENT

The Solar Wind Composition Experiment aluminum foil was deployed in the direct sunlight north of the LM. After an exposure for 77 minutes it was retracted and packaged in Sample Return Container number 2. The Principal Investigator has stated that exposure time of 75 minutes or higher would provide optimum results. There will be no data available from this experiment until after it is released from quarantine and returned to Switzerland for analysis.

BULK SAMPLE

A full sample bag was acquired in the Bulk Sample collection. The CDR collected a number of rock fragments of a wide variety of texture, color, size, angularity and consistency. The soil or "groundmass" was defined as being like very fine sand or silt; the best terrestrial analog according to the CDR is "powdered graphite".

CLOSEUP STEREO CAMERA

Closeup stereo photographs of various lunar surface areas were taken during LM inspection by the LMP.

HASSELBLAD SURFACE CAMERA

Extensive photographs were taken of the sampling activity and sample areas. Deployed experiments as well as the general topography were photographed.

EARLY APOLLO SCIENTIFIC EXPERIMENTS PACKAGE

Because of the LM landing attitude the Early Apollo Scientific Experiments Packages (EASEP) were manually removed from the LM; that is, the LM extendable booms were not used. The packages were deployed between the 9 and 10 o'clock positions referenced

to the LM hatch (as 12 o'clock) at a distance of approximately 50 feet.

PASSIVE SEISMIC EXPERIMENT PACKAGE

Data acquisition began approximately four minutes after Passive Seismic Experiment (PSEP) deployment or approximately 00:45 a.m. EDT, July 21. All engineering data followed preflight predictions during initial activity. The EVA and astronaut/LM activity were detected by the seismometer.

Telemetry received subsequent to LM lunar liftoff indicated that the Central Station thermal plate temperature experienced a substantial increase in rate of temperature rise. Preliminary analysis indicates a degradation of PSEP radiating surfaces of some 10 to 15 per cent.

The Principal Investigator has identified several lunar seismic events that are attributable to natural phenomena.

LASER RANGING RETRO-REFLECTOR

The Laser Ranging Retro-Reflector (LRRR) experiment is optimally designed for lunar night operation and has consequently not yet been acquired by any laser ranging stations.

DOCUMENTED SAMPLE

During the abbreviated Documented Sampling period two core tube samples of 6 to 8 inches in depth were obtained. Discrete samples were obtained north of the LM and around an elongated double crater to the south. Approximately 20 pounds of sample were obtained in this period and a number of photographs were taken of an 80 foot (diameter) by 15 foot (deep) crater containing rocks at the bottom.

The Contingency Sample, the two SRC's and film cassettes were successfully transferred to the LM and subsequently to the CM.

SYSTEMS PERFORMANCE

All launch vehicle systems performed satisfactorily throughout their expected lifetimes. There were no launch vehicle anomalies. All spacecraft systems continued to function satisfactorily throughout the mission. No major anomalies occurred. Those CSM and LM discrepancies which did occur are described in Tables 9 and 10, respectively. Temperatures and consumables usage rates remained generally within normal limits throughout the mission. Refer to Table 8 for a summary of end of mission consumables. Complete analyses of systems performance will be reported in subsequent Manned Space Flight Center engineering reports.

FLIGHT CREW PERFORMANCE

Flight crew performance was outstanding. All three crew members remained in excellent health. They made continued references to the high quality of the food.

The flight crew's (as well as ground crew's) good spirits and highly proficient performance were evident throughout the mission and were a major factor in the mission's enormously successful results. There are two quotes from Commander Armstrong that I believe reflect the spirit of this mission to the Apollo team:

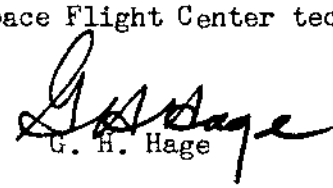
"Houston, Tranquility Base here -- the Eagle has landed."

and

"One small step for man -- one giant leap for mankind."

These statements truly reflect the significant way in which the lunar landing mission was executed as a team effort.

All information and data in this report are preliminary and subject to revision by the normal Manned Space Flight Center technical reports.



G. H. Hage

LIST OF TABLES

24 July 1969 TABLE 1

DETAILED OBJECTIVES AND EXPERIMENTS

	ACCOMPLISHMENT SCHEDULE (DAY)								
	1	2	3	4	5	6	7	8	9
A. Contingency Sample collection.					X				
B. Lunar surface EVA operations.					X				
C. EMU lunar surface operations.					X				
D. Landing effects on LM.					X				
E. Lunar surface characteristics.					X				
F. Bulk Sample collection.					X				
G. Landed LM location.					X				
H. Lunar environment visibility.				X	X	X			
I. Assessment of contamination by lunar material.					X	X	X	X	X
S-031. Passive Seismic Experiment.					X				
S-078. Laser Ranging Retro-Reflector.					X				
S-080. Solar Wind Composition.					X				
S-059. Lunar Field Geology.					X				
L. Television coverage					X				
M. Photographic coverage.					X				

1. It is considered that accomplishment of the primary objective (manned lunar landing and return) qualified Apollo 11 as a success. The accomplishment of the Detailed Objectives and Experiments further enhanced the scientific and technological return of this mission.

2. Other major activities not listed as Detailed Objectives or Experiments:

- Color TV
- LM Post Jettison Systems Lifetime Evaluation (emphasis on PGNCS operation without primary coolant loop).
- Passive Thermal Control Mode Test
- Visual Observation of Transient events at Aristarchus

3. All objectives were 100 per cent accomplished except as indicated below:

- Detailed Objective G: May be only partial, because it is not yet known if photographs of landed LM were taken by CM.

- Experiment S-078: Since ranging with the retro-reflector has not yet been accomplished, the degree of this experiment's success is not yet known.

- Experiment S-059: Carried as partial, because the environmental and gas analysis samples were not collected.

24 July 1969 TABLE 2

APOLLO 11 ACHIEVEMENTS

- FIRST MANNED LUNAR LANDING AND RETURN.
- FIRST LUNAR SURFACE EVA.
- FIRST SEISMOMETER DEPLOYED ON MOON.
- FIRST LASER REFLECTOR DEPLOYED ON MOON.
- FIRST SOLAR WIND EXPERIMENT DEPLOYED ON MOON.
- FIRST LUNAR SOIL SAMPLES RETURNED TO EARTH.
- SUCCESSFUL ACCOMPLISHMENT OF ALL MISSION OBJECTIVES.
- SIXTH SUCCESSFUL SATURN V ON-TIME LAUNCH.
- LARGEST PAYLOAD EVER PLACED IN LUNAR ORBIT.
- FIRST LUNAR MODULE TEST IN TOTAL OPERATIONAL ENVIRONMENT.
- ACQUISITION OF NUMEROUS VISUAL OBSERVATIONS, PHOTOGRAPHS AND TELEVISION OF SCIENTIFIC AND ENGINEERING SIGNIFICANCE.
- FIRST OPERATIONAL USE OF MQF AND LRL.

24 July 1969 TABLE 3

APOLLO 11

RECORD OF LUNAR EVENTS

EVENT	Ground Elapsed Time Hr:Min:Sec	Greenwich Mean Time Hr:Min:Sec - Date
Lunar Orbit Insertion	75:55:52	17:27:52 19 July 69
Lunar Landing Time	102:45:43	20:17:43 20 July 69
LM Hatch Open	109:07:35	02:39:35 21 July 69
Armstrong Completely Out Of LM	109:19:16	02:51:16 21 July 69
Armstrong On Lunar Surface	109:24:15	02:56:15 21 July 69
Aldrin Out Of LM	109:39:00	03:11:00 21 July 69
Aldrin On Lunar Surface	109:43:15	03:15:15 21 July 69
Aldrin Inside LM	111:29:39	05:01:39 21 July 69
Armstrong Inside LM (Hatch Closed)	111:39:12	05:11:12 21 July 69
LM Liftoff From Lunar Surface	124:22:00	17:54:00 21 July 69
Transearth Injection	135:23:42	04:55:42 22 July 69

EVENT	Duration Hr:Min:Sec
Stay On Lunar Surface	21:36:17
Stay Outside LM	
Armstrong	02:31:37
Aldrin	01:50:24
Lunar Orbit	59:27:50

Weight Landed On Moon	15,897 Pounds
Weight Lifted From Moon	10,821 Pounds

APOLLO 11

POWERED FLIGHT SEQUENCE OF EVENTS

EVENT	*PLANNED (GET) HR:MIN:SEC	ACTUAL (GET) HR:MIN:SEC
Range Zero (09:32:00.0 EDT)	00:00:00.0	00:00:00.0
Liftoff Signal (TB-1)	00:00:00.6	00:00:00.6
Pitch and Roll Start	00:00:13.8	00:00:12.4
Roll Complete	00:00:31.8	00:00:31.1
S-IC Center Engine Cutoff (TB-2)	00:02:15.3	00:02:15.2
Begin Tilt Arrest	00:02:40.8	00:02:40.0
S-IC Outboard Engine Cutoff (TB-3)	00:02:41.1	00:02:41.6
S-IC/S-II Separation	00:02:41.8	00:02:42.3
S-II Ignition (Engine Start Command)	00:02:42.5	00:02:43.0
S-II Second Plane Separation	00:03:11.8	00:03:12.3
Launch Escape Tower Jettison	00:03:17.5	00:03:17.9
S-II Center Engine Cutoff	00:07:40.1	00:07:40.6
S-II Outboard Engine Cutoff (TB-4)	00:09:11.7	00:09:08.2
S-II/S-IVB Separation	00:09:12.5	00:09:09.0
S-IVB Ignition (Engine Start Command)	00:09:12.7	00:09:09.2
S-IVB Cutoff (TB-5)	00:11:39.5	00:11:39.3
Earth Parking Orbit Insertion	00:11:49.5	00:11:49.3
Begin S-IVB Restart Preparations (TB-6)	02:34:37.3	02:34:38.2
Second S-IVB Ignition	02:44:15.3	02:44:16.2
Second S-IVB Cutoff (TB-7)	02:50:04.1	02:50:03.0
Translunar Injection	02:50:14.1	02:50:13.0

*Prelaunch planned times are based on MSFC Launch Vehicle operational trajectory.

APOLLO 11
MISSION SEQUENCE OF EVENTS

EVENT	*PLANNED (GET) HR:MIN:SEC	ACTUAL (GET) HR:MIN:SEC
Range Zero (09:32:00 EDT)	00:00:00	00:00:00
Earth Parking Orbit Insertion	00:11:49	00:11:49
Second S-IVB Ignition	02:44:15	02:44:16
Translunar Injection	02:50:14	02:50:13
CSM/S-IVB Separation, SLA Panel Jettison	03:15:00	03:17:--
CSM/LM Docking Complete	03:25:00	03:29:--
Spacecraft Ejection from S-IVB	04:09:45	04:17:13
Spacecraft Evasive Maneuver	04:39:45	04:40:01
S-IVB Slingshot Maneuver	05:02:03	Not available
Midcourse Correction -1	11:45:00	Not Performed
Midcourse Correction -2	26:45:00	26:44:58
Midcourse Correction -3	53:55:00	Not Performed
Midcourse Correction -4	70:55:00	Not Performed
LOI-1 (Lunar Orbit Insertion) Ignition	75:54:28	75:49:50
LOI-2 Ignition	80:09:30	80:11:36
LM Undocking from CSM	100:13:38	100:13:38
CSM Separation Maneuver	100:39:50	100:39:50
LM Descent Orbit Insertion	101:38:48	101:36:14
Powered Descent Initiation	102:35:13	102:33:04
Lunar Landing	102:47:11	102:45:43
Plane Change Maneuver (CSM)	107:05:33	Not Performed
Crew Egress for Lunar Surface Operations	112:40:00	109:07:35
Crew Ingress	115:10:00	111:39:12
LM Liftoff	124:23:26	124:22:00
Coelliptic Sequence Initiate Maneuver	125:21:19	125:19:35
Plane Change Maneuver (LM)	125:50:28	Not Performed
Constant Differential Height Maneuver	126:19:37	126:17:46
Terminal Phase Initiate Maneuver	126:58:08	127:03:31
Terminal Phase Finalize Maneuver	127:40:38	127:45:54
CSM/LM Docking	128:00:00	128:03:--
LM Jettison	131:53:05	130:09:55
CSM Separation Maneuver	131:53:05	130:30:00
Transearth Injection (Ignition)	135:24:34	135:23:42
Midcourse Correction -5	150:24:00	150:29:55
Midcourse Correction -6	172:00:00	Not performed
Midcourse Correction -7	192:06:00	Not performed
CM/SM Separation	194:50:00	194:49:19
Entry Interface (400,000 feet)	195:05:04	195:03:06
Landing	195:19:06	195:18:35

*Prelaunch planned times are based on MSFC Launch Vehicle Operational Trajectory and MSC Spacecraft Operational Trajectory

Date: 24 July 1969

APOLLO 11 TRANSLUNAR AND TRANSEARTH MANEUVER SUMMARY

TABLE 6

MANEUVER	GROUND ELAPSED TIME (GET) AT IGNITION (hr:min:sec)			BURN TIME (seconds)			VELOCITY CHANGE (feet per second - fps)			GET OF CLOSEST APPROACH HT. (NM) CLOSEST APPROACH		
	PRE-LAUNCH PLAN	REAL-TIME PLAN	ACTUAL	PRE-LAUNCH PLAN	REAL-TIME PLAN	ACTUAL	PRE-LAUNCH PLAN	REAL-TIME PLAN	ACTUAL	PRE-LAUNCH PLAN	REAL-TIME PLAN	ACTUAL
TLI (S-IVB)	2:44:15.3	2:44:16.2	2:44:16.2	349.5	347.5	347.3	10451.2	10435.9	10441.0	75:24:06.1 346.5	75:04:28 854.1	75:16:24 701.9
Evasive Maneuver (SPS)	4:39:44.9	4:39:44.9	4:40:01.0	2.8	2.8	3.4	19.7	19.7	19.7	75:57:39.4 59.8	75:40:35.2 335.0	75:38:22 179.7
MCC-1 (SPS)	11:45:00	11:30:00	N.P. (Not performed)	0.0	2.4	N.P.	0.0	17.3	N.P.	75:57:39.4 59.8	75:53:49.0 60.0	N.P.
MCC-2 (SPS)	26:45:00	26:44:58	26:44:58	0.0	3.0	2.9	0.0	21.3	20.9	75:57:39.4 59.8	75:53:49.0 60.0	75:53:46 62.8
MCC-3	53:55:00	53:55:00	N.P.	0.0	8.0	N.P.	0.0	.8	N.P.	75:57:34.4 59.8	75:53:49 60.0	N.P.
MCC-4	70:55:00	70:55:00	N.P.	0.0	21.6	N.P.	0.0	2.6	N.P.	75:57:34.4 59.8	75:53.49 60.1	N.P.
LUNAR ORBIT MANEUVERS	Lunar orbit maneuvers are summarized on a separate table.									GET ENTRY INTERFACE (EI) VELOCITY (fps) AT EI FLIGHT PATH ANGLE AT EI		
TEI (SPS)	135:24:33.8	135:23:41.6	135:23:42.0	149.1	147.9	150.0	3292.7	3283.6	3278.8	195:05:03.5 36194.3 -6.50	195:05:03.5 36194.3 -6.50	No Entry Vac. Per. over 66 NM
MCC-5	150:24:00	150:29:54.5	150:29:54.5	0.0	11.0	10.8	0.0	4.8	4.7	195:05:03.5 36194.3 -6.50	195:03:06 36194.3 -6.51	195:03:08 36194.3 -6.46
MCC-6	172:00:00	172:00:00	N.P.	0.0	1.1	N.P.	0.0	.4	N.P.	195:05:03.5 36194.3 -6.50	195:03:04 36194.3 -6.51	N.P.
MCC-7	192:06:00	192:06:00	N.P.	0.0	.5	N.P.	0.0	.1	N.P.	195:05:03.5 36194.3 -6.50	195:03:05 36194.3 -6.50	N.P.

APOLLO 11 LUNAR ORBIT MANEUVER SUMMARY

Date: 24 July 1969

TABLE 7

MANEUVER	GROUND ELAPSED TIME (GET) AT IGNITION (hr:min:sec)			BURN TIME (seconds)			VELOCITY CHANGE (feet per second - fps)			APOLUNE/PERILUNE RESULTANT (NAUTICAL MILES)		
	PRE-LAUNCH PLAN	REAL-TIME PLAN	ACTUAL	PRE-LAUNCH PLAN	REAL-TIME PLAN	ACTUAL	PRE-LAUNCH PLAN	REAL-TIME PLAN	ACTUAL	PRE-LAUNCH PLAN	REAL-TIME PLAN	ACTUAL
Lunar Orbit Insertion	75:54:28.4	75:49:49.6	75:49:49.6	358.9	362.1	362.1	2924.1	2917.3	2917.5	169.8 / 59.7	169.1 / 61.1	168.8 / 61.3
Lunar Orb Circularization	80:09:29.7	80:11:36.0	80:11:36.0	16.4	17.0	17.0	157.8	159.2	158.8	65.6 / 53.6	65.7 / 53.7	65.7 / 53.8
CSM/LM Separation	100:39:50.4	100:39:50.0	100:39:50	8.0	8.0	8.2	2.5	2.5	2.6	63.1 / 55.6	64.0 / 56.0	63.7 / 55.8
Descent Orbit Insertion	101:38:48.0	101:36:14.1	101:36:14.1	28.0	29.8	29.8	74.0	76.4	76.4	60.0 / 8.2	57.2 / 8.5	57.2 / 8.5
Powered Descent Initiation	102:35:13.0	102:33:04.4	102:33:04.4	714.0	712.7	712.6	6775.0	6776.0	6775.8	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
(CSM) Plane Change	107:05:33.4	106:05:00	N.P.	.8	.8	N.P.	16.6	15.0	N.P.	63.1 / 55.6	64.0 / 56.0	N.P.
Ascent	124:23:26.0	124:22:00.0	124:22:00.0	437.9	439.4	439.9	6060.2	6070.2	6070.1	45.0 / 9.9	45.2 / 9.0	45.2 / 9.0
Coelliptic Sequence Initiate	125:21:19.1	125:19:34.7	125:19:34.7	44.8	48.5	47.0	49.4	53.2	51.5	45.7 / 44.9	47.1 / 45.5	48.6 / 45.3
(LM) Plane Change	125:50:28.0	126:12:33	N.P.	0.0	1.0	N.P.	0.0	.2	N.P.	45.7 / 44.9	47.0 / 45.5	N.P.
Constant Delta Altitude	126:19:37.0	126:17:46.0	126:17:46.0	2.0	18.2	18.1	4.5	20.0	19.9	45.1 / 42.8	47.0 / 40.9	47.0 / 40.9
Terminal Phase Initiate	126:58:08.4	126:57:00	127:03:30.8	22.2	22.7	22.8	24.6	25.1	25.3	61.2 / 42.6	61.1 / 43.9	61.2 / 43.9
Terminal Phase Finalize	127:40:37.7	127:39:34.2	127:45:54	28.3	28.4	28.4	31.4	31.5	31.4	59.5 / 59.0	62.6 / 56.6	62.2 / 56.6
CSM/LM Separation	131:53:04.7	130:30:00	130:30:00	3.2	6.5	7.1	1.0	2.0	2.2	59.6 / 59.0	62.6 / 54.7	62.6 / 54.7

APOLLO 11 CONSUMABLES SUMMARY AT END OF MISSION

CONSUMABLE		LAUNCH LOAD	PRELAUNCH PLANNED REMAINING	ACTUAL REMAINING
CM RCS PROP (POUNDS/PERCENT)	U	208/100	169/81	Not Available
SM RCS PROP (POUNDS/PERCENT)	U	1,225/100	629/51	622/51
SPS PROP (POUNDS/PERCENT)	TK	40,600/100	4,304/11	4467/11
SM HYDROGEN (POUNDS/PERCENT)	U	51.6/100	14.6/28	16.8/60
SM OXYGEN (POUNDS/PERCENT)	U	601.5/100	204/34	238/76
LM RCS PROP (POUNDS/PERCENT)	U	5491/100	*296/54	*200/37
LM DPS PROP (POUNDS/PERCENT)	U	17,921/100	** 911/5.1	** 444/2.5
LM APS PROP (POUNDS/PERCENT)	U	5,177/100	*211/4.1	* 411/3.0
LM A/S OXYGEN (POUNDS/PERCENT)	T	4.74/100	*2.29/48	* 3.8/80
LM D/S OXYGEN (POUNDS/PERCENT)	T	49.4/100	**25.0/51	**30.9/63
LM A/S WATER (POUNDS/PERCENT)	T	84.4/100	*35.9/42	*46.0/54
LM D/S WATER (POUNDS/PERCENT)	T	214.4/100	**39.6/19	**70.0/33
LM A/S BATTERIES (AMP-HRS/PERCENT)	T	592/100	*162/27	*337/57
LM D/S BATTERIES (AMP-HRS/PERCENT)	T	1,600/100	**462/29	**541/34

U - Usable Quantity
TK - Tank Quantity
T - Total Quantity

* At LM jettison
** At LM liftoff from moon

COMMAND/SERVICE MODULE 107

DISCREPANCY SUMMARY

* PRIMARY AND SECONDARY ISOLATION VALVES ON QUAD B INDICATED BARBERPOLE AT PYRO FIRE FOR SEPARATION.

* CONDENSER EXIT TEMPERATURE ON FUEL CELL 2 SUDDENLY DROPS ABOUT 1° TO 2°F EVERY 5 MINUTES.

* ECS O_2 FLOW TRANSDUCER READS .2 - .3 LBS/HR DURING THE CABIN O_2 ENRICHMENT PURGE. THE READING SHOULD BE PEGGED HIGH (APPROXIMATELY .981 LBS/HR) DURING THIS CONDITION.

* UNEXPLAINED O_2 FLOW MASTER ALARM OCCURRED AT 55:00 GET, WITH THE CLOSING OF THE DIRECT O_2 VALVE, AND FOLLOWED AN EXPECTED ALARM.

* SPS GN2 PRESSURE INDICATED APPROXIMATELY 300 PSI LOWER THAN EXPECTED DURING LOI_1 BURN.

* PRIMARY GLYCOL MIXING VALVE DID NOT CONTROL MIXED TEMPERATURE TO $45^{\circ} \pm 3^{\circ}$F.

* ONE HEATER IN CRYOGENIC OXYGEN TANK 2 FAILED BEFORE LAUNCH.

* CMP IMPEDANCE PNEUMOGRAPH (RESPIRATION) SIGNAL LOST.

24 July 1969 TABLE 10

LUNAR MODULE 5

DISCREPANCY SUMMARY

* MISSION TIMER STOPPED AT 907:34:47 AND WHEN CREW RESET TIMER IT READ 902:34:47. CIRCUIT BREAKER WAS RECYCLED AND TIMER WENT TO ALL NINES. WOULD NOT START COUNTING.

* POST PDI BURN DPS FUEL INTERFACE PRESSURE UNDERWENT RAPID PRESSURE RISE TO OFF SCALE READING. FUEL LINE FROZE DURING SHe VENTING TRAPPING FUEL BETWEEN PRE-VALVE AND SHe HEAT EXCHANGER CAUSING PRESSURE RISE.

* DURING DESCENT, THE STEERABLE ANTENNA WAS NOT ABLE TO LOCK-UP PROPERLY ON THE MSFN. REACQUISITION WAS TRIED SEVERAL TIMES PRIOR TO PDI WITHOUT SUCCESS. AFTER THE YAW MANEUVER, PROPER ACQUISITION WAS OBTAINED.

* THE CREW REPORTED THAT THE KNOB ON THE ASCENT ENGINE ARM CIRCUIT BREAKER WAS BROKEN.

* AT APPROXIMATELY 126 HOURS THE CO_2 PARTIAL PRESSURE READ HIGH CAUSING THE CREW TO SELECT THE SECONDARY Li OH CANISTER. THE READINGS REMAINED ERRATIC. THE PRIMARY CANISTER WAS AGAIN SELECTED. THE READINGS REMAINED ERRATIC AND CAUSED THE CAUTION AND WARNING TO BE ACTIVATED.

* SUBSEQUENT TO ERRATIC CO_2 SENSOR READINGS AT APPROXIMATELY 126 HOURS THE CREW REPORTED WATER IN ONE SUIT.

* RENDEZVOUS RADAR TEMPERATURE STABILIZED 7° BELOW ACCEPTANCE TEST HEATER ACTIVATION LEVEL. RADAR OPERATION WAS NOT AFFECTED.