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

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Post Launch
Mission Operation Report
No. M-932-69-10

26 May 1969

TO: A/Administrator

FROM: MA/Apollo Program Director

SUBJECT: Apollo 10 Mission (AS-505) Post Launch Mission Operation Report No. 1

The Apollo 10 mission was successfully launched from the Kennedy Space Center on Sunday, 18 May 1969 and was completed as planned, with recovery of the spacecraft and crew in the Pacific Ocean recovery area on Monday, 26 May 1969. Initial review of the flight indicates that all mission objectives were attained.

Attached is the Mission Director's Summary Report for Apollo 10 which is hereby submitted as Post Launch Mission Operation Report No. 1. Following further detailed analysis of data, crew briefing and other technical reviews, significant new information and OMSF evaluation of Apollo 10 primary mission objectives will be submitted in Post Launch Mission Operation Report No. 2.

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Apollo Program Director

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

IN REPLY REFER TO: MAO

May 26, 1969

TO: Distribution

FROM: MA/Apollo Mission Director

SUBJECT: Mission Director's Summary Report, Apollo 10

INTRODUCTION

The Apollo 10 mission was planned as a manned lunar mission development flight to demonstrate crew/space vehicle/mission support facilities performance during a manned lunar mission with the Command/Service Module (CSM) and Lunar Module (LM), and to evaluate LM performance in the cislunar and lunar environment. Flight crew members were: Commander, Col. T. P. Stafford; Command Module Pilot, Cdr. J. W. Young; Lunar Module Pilot, Cdr. E. A. Cernan. Initial review of the flight indicates that all mission objectives were attained (See Table 1).

PRELAUNCH

The Apollo 10 countdown was accomplished with no unscheduled holds.

Prior to launch, the Command Module Reaction Control System A helium manifold pressure decayed slightly. A suspect transducer fitting was found to be finger-tight and was subsequently retorqued. Difficulty was encountered in wetting the sintered metal wicks in the Command Module suit loop water separator, a component of the Environmental Control System. The procedure was successfully accomplished on the third attempt to service.

FIRST PERIOD

Major activity in this period included space vehicle launch, insertion into earth orbit and translunar injection of the S-IVB/Instrument Unit (IU)/CSM/LM, transposition, docking and ejection of the CSM/LM, and S-IVB propellant dump injecting the S-IVB into solar orbit.

The Apollo 10 space vehicle was successfully launched on time from Kennedy Space Center, Florida at 12:49 p.m. EDT on 18 May 1969. This was the fifth successive successful launch on-time of a Saturn V. All launch vehicle stages performed satisfactorily, inserting the S-IVB/IU/CSM/LM combination into a nominal earth parking orbit of 102.6 by 99.6 nautical miles (NM) after 11 minutes, 53 seconds of powered flight. Pre-TLI (translunar injection) checkout was conducted as planned and the S-IVB burn was initiated at 2:33:27 (hr:min:sec) ground elapsed time (GET). The TLI burn lasted 5 minutes, 43 seconds with all systems operating satisfactorily and all end conditions being nominal for the translunar coast on a free return, circumlunar trajectory.

At about 3:03 (hr:min) GET, the CSM was separated normally from the rest of the orbital vehicle consisting of the LM, Spacecraft LM Adapter (SLA), IU and S-IVB Stage. SLA panel deployment was normal. CSM transposition and docking were completed by approximately 3:17 GET. Excellent quality color television (TV) coverage of the docking sequences was transmitted to the Goldstone tracking station and was seen on worldwide commercial television. Ejection of the CSM/LM from the S-IVB was successfully accomplished at about 3:56 GET and a 2.5-second Service Propulsion System (SPS) evasive maneuver was performed as planned at 4:39 GET.

All launch vehicle safing activities were performed as scheduled. S-IVB liquid oxygen and liquid hydrogen lead temperature measurement experiments were conducted satisfactorily. Subsequent propellant dump was successful and provided sufficient impulse to the S-IVB/IU for a "slingshot" maneuver to earth escape velocity. Therefore, augmentation of this impulse by the S-IVB Auxiliary Propulsion System ullage engine burn was terminated by ground command immediately after ignition. S-IVB/IU closest approach to the moon was 1752 NM at 78:54 GET (19:43 EDT, May 21).

SECOND PERIOD

Major activities during the second period were a midcourse correction, two lunar orbit insertion burns, and initial LM activation.

Midcourse correction maneuver number 1 (MCC-1), originally planned as a 47 foot-per-second (fps) SPS maneuver, was not conducted at 11:30 GET, since without this maneuver, the correction requirement at the next planned time, 26:39 GET, was for only 48.8 fps. The extended tracking time established a high probability of not requiring any additional midcourse corrections during translunar coast.

Midcourse correction maneuver number two (MCC-2) was performed at 26:32:56 GET by a 6.7-second firing of the SPS resulting in a velocity change of 48.9 fps (48.7 fps planned). All parameters appeared nominal and the resulting pericynthion was 60.9 NM. Consequently, midcourse correction maneuvers numbers 3 and 4 were not required. Five color TV transmissions totaling 72 minutes were made during translunar coast. Views of the receding earth and of the spacecraft interior were shown. Picture quality was excellent.

The spacecraft crossed into the moon's sphere of influence at 61:50:50 GET (02:39 EDT, May 21). At that time, the distance from the spacecraft to earth was 190,535 NM and its distance from the moon was 33,820 NM. The velocity was 3120 fps relative to earth and 3795 fps relative to the moon.

The lunar orbit insertion maneuver (LOI-1) was planned in real time for 75:55:53 GET and was accomplished on schedule. The SPS Engine burned for 356 seconds slowing the CSM/LM down from a velocity of 8222 fps to a velocity of 5472 fps and resulting in an initial orbit of 170.4 by 59.6 NM. This compares very well with the prelaunch planned orbit of 170 by 60 NM, and the real-time planned orbit of 170.7 by 59.7 NM. The SPS burn data appeared to be nominal with fuel tank pressure and oxidizer interface pressure slightly on the high side of nominal, but well within expected tolerances. Spacecraft weight at initiation of the burn was 93,281 pounds and at termination of the burn, spacecraft weight in lunar orbit was 69,493 pounds. Propellant expended for the burn was 23,788 pounds.

The lunar orbit circularization maneuver, LOI-2, was planned in time for 80:25:07 GET and was also accomplished on schedule. The SPS engine burned for 13.9 seconds producing a differential velocity of 138.4 fps and resulting in an initial orbit of 61.5 by 58.9 NM. This compares well with the prelaunch planned orbit of 60 by 60 NM and the real-time planned orbit of 60.1 by 60.1 NM. All SPS parameters were nominal.

A 29-minute scheduled color television transmission of the lunar surface was conducted 80:45 GET (21:34 EDT, 21 May). Picture quality of lunar scenes was excellent.

Lunar landmark tracking on two targets was accomplished and indications are that these landmarks were well spaced and of good quality.

The Lunar Module Pilot transferred to the LM at about 81:55 GET for about two hours of scheduled "housekeeping" activities and some LM communications tests. The tests were terminated after the LM relay communications tests due to time limitations. Results of completed tests were excellent and those tests remaining were conducted at a later time in the mission.

THIRD PERIOD

Major activities in this period were the LM descent to within 50,000 feet of the lunar surface, and subsequent rendezvous with the orbiting CSM.

The Commander and Lunar Module Pilot entered the LM at 95:02 GET and performed the preplanned checks of all systems. The rendezvous exercise was begun on time with undocking at approximately 98:22 GET. The Service Module Reaction Control System (SM RCS) was used to separate the CSM to about 30 feet from the LM. Subsequently the landing gear was deployed. Stationkeeping was initiated at this point while the Command Module Pilot in the CSM visually inspected the LM. The SM RCS was then used to perform the separation maneuver directed radially downward toward the moon's center. This maneuver provided a LM/CSM separation at descent orbit insertion (DOI) of about two NM. The DOI was performed by a LM Descent Propulsion System (DPS) burn (horizontal, retrograde), such that the resulting pericynthion (lowest point in orbit) occurred about 15° prior to lunar landing site number 2. The lowest altitude above the moon's surface achieved by the LM was 8.4 NM. Numerous photographs of the lunar surface were taken. Some camera malfunctions were reported and although some communications difficulties were experienced, the crew provided a continuous commentary of their observations. The LM landing radar test was executed during the low altitude pass over the surface. Early data indicates initial acquisition occurred at a height of 65,000 feet. Indicated pericynthion altitude as measured by the landing radar in the fly-by was 47,000 feet.

The second LM maneuver, the DPS phasing burn, was accomplished on time and established (as planned), at the resulting LM pericynthion (about one revolution later), a CSM lead angle equivalent to that which occurs at nominal powered ascent cutoff for the lunar landing mission. The apocynthion (orbital high point) altitude of the phasing orbit was 190.0 NM.

About ten minutes prior to pericynthion, the LM Descent Stage was jettisoned. The LM Reaction Control System (LM RCS) separation maneuver at staging was accomplished using the Abort Guidance System (AGS) as prescribed in premission plans. Inadvertently, the control mode was left in AUTO rather than the required ALTITUDE HOLD mode. In AUTO, the AGS drove the LM to acquire the CSM which was not in accordance with the planned attitude timeline. The Commander took over manual control to reestablish the proper attitude. Then at pericynthion, the insertion maneuver was performed on time using the LM Ascent Propulsion System (APS). This burn established the equivalent of the standard LM insertion orbit (45 x 11.2 NM) of a lunar landing mission.

The LM coasted from insertion in a 45 NM by 11.2 NM elliptical orbit for about an hour. Concentric sequence initiation (CSI) was initiated at apocynthion. A small constant delta height (CDH) maneuver was required (as expected preflight) to null out minor dispersions. The terminal maneuver occurred at about the midpoint of darkness, and braking during the terminal phase finalization (TPF) was performed manually as planned.

The rendezvous was highly successful and all parameters were very close to nominal. CSM-active docking at 106.33 GET was accomplished smoothly and expeditiously.

Once docked to the CSM, the two LM crewmen transferred with the exposed film packets and the LM Hasselblad camera to the CSM. The LM Maurer sequence camera and primary lithium hydroxide cannister (both of which incurred inflight problems) were also transferred in order that these items could be inspected post flight. The CSM was separated from the LM at 108:43:30 GET using the SM RCS.

FOURTH PERIOD

Major activity in the fourth period included the LM APS burn to depletion, extensive landmark tracking, photography, TV, and the transearth injection (TEI) burn.

About one revolution after docking, the LM APS burn to depletion was commanded by the Manned Space Flight Network (MSFN), as planned, utilizing the LM Ascent Engine Arming Assembly. This burn was targeted to place the LM in a solar orbit. LM/MSFN communications were maintained until LM ascent stage battery depletion at about 120 hours GET. The ascent batteries lasted about 12 hours after LM jettison.

During the remaining lunar orbital period of operation, 18 landmark sightings, and extensive stereo strip and oblique photographs were taken. Two scheduled TV periods were deleted because of crew fatigue. The crew visually acquired the LM descent stage on several occasions. At 137:36:28 GET, the SPS injected the CSM into a transearth trajectory after a total time in lunar orbit of about 61.5 hours (31 orbits). The TEI burn was targeted for a transearth return time of about 53 hours.

FIFTH PERIOD

Major activities during this period included star-lunar landmark sightings, live color television transmissions, star-earth horizon navigation sightings, CSM S-band high gain antenna reflectivity test, and MCC-7.

This period commenced with a live television transmission through the Honeysuckle tracking station and Intelsat III communications satellite beginning shortly after TEI at about 137:51 GET. Pictures of the moon as seen from the receding spacecraft were spectacular. Focus at all "zoom" lens settings was excellent and color fidelity of lunar surface scenes agreed very well with crew descriptions.

Another color television transmission was received at 139:27 GET.

Following a sleep period, star lunar landmark navigation sightings were taken at 151:00 GET.

The accuracy of the transearth injection (TEI) maneuver was such that the first transearth midcourse correction (MCC-5) originally scheduled for 152:00 GET was not necessary. The Atlantic Ocean contingency recovery forces were released from mission support at 153:00 GET.

The waste water dump conducted at 153:50 was oriented to reduce the probability of midcourse corrections. Checkout of the Entry Monitor System was accomplished at 154:35 GET to ensure its readiness for the entry phase.

A ten-minute color television broadcast was made at approximately 147:23 GET. Earth scenes were shown for about three minutes with moon scenes throughout the remainder of the broadcast. A twenty-nine-minute broadcast of the moon, earth and spacecraft interior was received at 152:29 GET.

A number of Star-earth horizon navigation sightings were taken. The CSM S-band high gain reflectivity test was conducted at 168:00 GET. An unscheduled live color television transmission of the earth and the command module interior was received at 173:27 GET. The second transearth midcourse correction (MCC-6) originally scheduled for 176:50 GET was not necessary.

SIXTH PERIOD

Major activities during this period included MCC-7, live color television, reentry and recovery.

The crew was awakened at 185:00 GET and initiated reentry preparations. The final live color television transmission was received at 186:50 GET. MCC-7 was performed at 188:49 GET. Entry interface was reached at 191:48:54 GET with splashdown in the mid Pacific, approximately 165°W and 15°S.

Weather in the prime recovery area was excellent; visibility, 10 miles, wave height 4 feet, cloud cover 1800 feet scattered, winds less than 12 knots.

RESCUE 1 reported visual contact of the spacecraft at 191:52. AIRBOSS 1 visually acquired the spacecraft one minute later. Voice communications with the crew were reported by the USS PRINCETON at 191:53:42 GET. Drogue and main parachutes deployed normally. Splashdown occurred about 14 minutes after entry interface at 192:03:23 GET, approximately 3 NM from the prime recovery ship, USS PRINCETON. The Command Module remained in the Stable 1 position, and the crew reported that they were in good condition. The crew was picked up by a recovery helicopter and was safe aboard the ship at 13:31 EDT, May 26, 1969, to end a fantastic mission.

SYSTEMS PERFORMANCE

All launch vehicle systems performed satisfactorily throughout their expected lifetimes. All spacecraft systems continued to function satisfactorily throughout the mission with the exception of fuel cell No. 1.

At 120:47 GET, fuel cell No. 1 experienced an electrical failure in the cooling pump circuit and was isolated from the main bus. It was placed back on the bus for the transearth injection meneuver and with close monitoring of temperature limits, provided satisfactory voltages and currents. Subsequently an effective purging cycle was initiated and the fuel cell was taken off circuit for the remainder of the mission. It remained available for load sharing, if required.

A number of other minor discrepancies occurred which were primarily procedural, and were corrected in flight with no mission impact, or involved instrumentation errors on quantities which could be checked by other means. Temperature and consumables usage rates remained generally within normal limits throughout the mission. Complete analysis of systems performance will be reported in subsequent MSF Center engineering reports.

FLIGHT CREW PERFORMANCE

Flight crew performance was outstanding. All three crew members remained in excellent health throughout the mission. Their prevailing good spirits were continually evident as they took time from their busy schedule to share their voyage with the world via 19 color television transmissions totalling almost six hours.

G. H. Hage

G. H. Hage

LIST OF TABLES

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APOLLO 10

DETAILED TEST OBJECTIVES

LAUNCH VEHICLE

CATEG.	TITLE	ACCOMPLISHMENT SCHEDULE (DAYS) 1	2	3	4	5	6	7	8
S	J-2 Engine Modification	X							
S	J-2 Engine environ. in S-II and S-IVB	X							
S	LV Longitudinal Oscillation environ/S-IC	X							
S	S-IC Mod suppression of low freq. osc.	X							
S	S-II longitudinal oscillation environ.	X							
S	S-II early CECO oscillation suppression	X							

SPACECRAFT

CATEG./NO.	TITLE	ACCOMPLISHMENT SCHEDULE (DAYS) 1	2	3	4	5	6	7	8	
P20.78	CSM/LM Rendezvous Capability					X				
P16.10	LM Steerable Antenna Performance				X	X				
P20.121	Lunar Orbit Determination						X			
P20.91	Lunar Landing Site Determination				X					
P16.14	Landing Radar Test					X				
P20.66	Crew Activities Lunar Distance				X	X	X			
P11.15	PGNCS Undocked DPS Performance					X				
*S16.17	Relay Modes Voice/TM				X	X				Partial
S16.12	LM Omni Antennas Lunar Distance				X	X				
S16.15	Rendezvous Radar Performance					X				
S13.14	LM Supercritical Helium				X	X				
S12.9	Unmanned AGS Controlled APS Burn					X				
S20.77	VHF Ranging					X				
S20.86	Lunar Orbit Visibility				X	X				
S 7.26	Space Environment Thermal Control	X	X	X	X	X	X	X		
*S20.79	Passive Thermal Control Modes					X				Partial
S12.8	AGS/CES Attitude/Translation Control					X				
S12.10	LM/AGS Rendezvous Evaluation					X				
S20.82	PGNCS/AGS Monitoring				X	X				
S20.80	Ground Support Lunar Distance				X	X	X			
S13.13	Long Duration Unmanned APS Burn					X				
S20.117	LOI Maneuver					X				
S11.17	LM IMU Performance					X				
S 6.9	CSM High Gain Antenna Reflectivity							X		
S20.46	Transposition/Docking/LM Ejection	X								
S20.95	Midcourse Correction Capability		X							
S12.6	AGS Performance					X				
S 1.39	Midcourse Navigation/Star-Lunar Landmark							X		
S20.83	LM Consumables Lunar Orbit				X	X				

Other Major Activities Not Listed As DTO's:
Color TV
Scientific and Engineering Photography
CSM S-Band Auto Reac Test
LM Post APS Depl Tests (Comm and PGNS/AGS Switch)
Star/Earth Horiz Navig Sightings

SUMMARY

LV DTO's - Secondary 6
SC DTO's
Principal 7
Secondary 22
All 100 pct except 2 second. SC DTO's*

APOLLO 10 ACHIEVEMENTS

1. SUCCESSFUL ACCOMPLISHMENT OF ALL PRIMARY OBJECTIVES.
2. FIFTH SATURN V ON-TIME LAUNCH.
3. LARGEST PAYLOAD EVER PLACED IN EARTH ORBIT.
4. LARGEST PAYLOAD EVER PLACED IN LUNAR ORBIT.
5. FIRST DEMONSTRATION OF LUNAR ORBIT RENDEZVOUS.
6. FIRST DOCKED CSM/LM LUNAR LANDMARK TRACKING.
7. FIRST BURN OF DESCENT PROPULSION SYSTEM ENGINE IN THE LUNAR LANDING MISSION CONFIGURATION AND ENVIRONMENT.
8. FIRST EVALUATION OF THE LM STEERABLE ANTENNA AT LUNAR DISTANCES.
9. FIRST FIDELITY DEMONSTRATION OF LUNAR LANDING MISSION PROFILE (EXCEPT FOR PRE-DOI LANDMARK TRACKING, POWERED DESCENT, LUNAR SURFACE ACTIVITY AND ASCENT).
10. FIRST LOW LEVEL (50,000 FEET) EVALUATION OF LUNAR VISIBILITY.
11. FIRST EVALUATION OF THE LM OMNI DIRECTIONAL ANTENNAS AT LUNAR DISTANCE.
12. FIRST IN-FLIGHT TEST OF THE ABORT GUIDANCE SYSTEM DURING A LONG DURATION ASCENT PROPULSION SYSTEM BURN.
13. FIRST IN-FLIGHT USE OF VHF RANGING.
14. FIRST LANDING RADAR TEST IN NEAR LUNAR ENVIRONMENT.
15. FIRST TIME DEMONSTRATION TRANSLUNAR MIDCOURSE CORRECTION CAPABILITIES WITH A DOCKED CSM/LM.
16. FIRST DEMONSTRATION OF WESTINGHOUSE COLOR TV CAMERA IN FLIGHT.
17. FIRST MANNED NAVIGATIONAL, VISUAL AND PHOTOGRAPHIC EVALUATION OF LUNAR LANDING SITES 2 AND 3.
18. FIRST MANNED VISUAL AND PHOTOGRAPHIC EVALUATION OF RANGE OF POSSIBLE LANDING SITES IN APOLLO BELT HIGHLANDS AREAS.
19. ACQUISITION OF MAJOR QUANTITIES OF PHOTOGRAPHIC TRAINING MATERIALS FOR APOLLO 11 AND SUBSEQUENT MISSIONS.
20. ACQUISITION OF NUMEROUS VISUAL OBSERVATIONS AND PHOTOGRAPHS OF SCIENTIFIC SIGNIFICANCE.

TABLE 3

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APOLLO 10

MAY 26, 1969

POWERED FLIGHT SEQUENCE OF EVENTS

EVENT	PRELAUNCH PLANNED (GET) * HR:MIN:SEC	ACTUAL (GET) HR:MIN:SEC
Range Zero (12:49:00.0 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	00:00:12.5	00:00:12.5
Roll Complete	00:00:31.2	00:00:31.2
S-IC Inboard Engine Cutoff (TB-2)	00:02:15.3	00:02:15.2
Begin Tilt Arrest	00:02:36.7	00:02:37.3
S-IC Outboard Engine Cutoff (TB-3)	00:02:40.2	00:02:41.6
S-IC/S-II Separation	00:02:40.9	00:02:42.3
S-II Ignition	00:02:41.6	00:02:43.1
S-II Second Plane Separation	00:03:10.9	00:03:12.3
Launch Escape Tower Jettison	00:03:16.4	00:03:17.8
S-II Center Engine Cutoff	00:07:39.2	00:07:40.6
S-II Outboard Engine Cutoff (TB-4)	00:09:14.1	00:09:12.6
S-II/S-IVB Separation	00:09:15.0	00:09:13.5
S-IVB Ignition	00;09:15.1	00:09:13.6
S-IVB Cutoff (TB-5)	00:11:43.5	00:11:43.8
Earth Parking Orbit Insertion	00:11:53.5	00:11:53.8
Begin S-IVB Restart Preparations (TB-6)	02:23:46.9	02:23:47.7
Second S-IVB Ignition	02:33:26.9	02:33:27.7
Second S-IVB Cutoff (TB-7)	02:38:48.6	02:38:49.5
Translunar Injection	02:38:58.6	02:38:59.5

*Prelaunch planned times are based on MSFC Saturn V AS-505 Apollo 10 mission LV operational trajectory dated April 17, 1969 as revised by MSFC memo, S and E-AERO-FMT-106-69, May 5, 1969.

TABLE 4

APOLLO 10 TRANSLUNAR AND TRANSEARTH MANEUVER SUMMARY

Date: May 26, 1969

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	PRLAU PLAN	RLTIM PLAN	ACTUAL	PRE-LAU PLAN	RL-TIME PLAN	ACTUAL	PRE-LAU PLAN	RL-TIME PLAN	ACTUAL
TLI (S-IVB)	02:33:25.5	02:33:25.1	02:33:25.1	343.8	343.9	344.9	10429.4	10437.6	10437.0	76:13:22 957.0	76:10:15 907.5	76:22:02 712.6
Evasive Maneuver (SPS)	04:38:47.6	04:39:09.0	04:39:09.0	2.8	2.65	2.5	19.7	19.7	18.7	76:45:01.4 303.5	76:41:53 252.3	76:40:02 311.6
MCC-1 (SPS)	11:38:46.4	11:30:00	N.P.	8.1	6.6	N.P.	57.0	47.2	N.P.	75:49:40 58.4	75:52:00 59.0	N.P. N.P.
MCC-2 (SPS)	26:33:00	26:32:56.1	26:32:56.1	0	6.67	6.70	0	48.7	48.9	N.A. N.A.	76:00:19 58.7	76:00:11 65,9
MCC-3	53:45:00	53:45:00	N.P.	0	N.A.	N.P.	0	0.7	N.P.	N.A. N.A.	N.A. N.A.	N.P. N.P.
MCC-4	70:45:00	N.A.	N.P.	0	N.A.	N.P.	0	N.A.	N.P.	N.A. N.A.	N.A. N.A.	N.P. 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)	137:20:22.4	137:36:28	137:36:28	168.9	161.3	164	3622.5	3630.3	3625	191:50:32 36,309 -6.52	191:50:16 36,314 -6.52	191:48:46 36,315 -6.9
MCC-5	152:20:22.4	151:59:59	N.P.	0	1.8	N.P.	0	0.4	N.P.	N.A. N.A. N.A.	191:50:11 36,314 -6.52	N.P. N.P. N.P.
MCC-6	176:50:32	176:49:58.4	N.P.	0	2.9	N.P.	0	1.3	N.P.	N.A N.A. N.A.	191:48:56 36,315 -6.52	N.P. N.P. N.P.
MCC-7	188:50:32	188:49:56.8	188:49:56.8	0	6.5	6.54	0	1.6	1.6	N.A. N.A. N.A.	191:48:54 36,315 -6.52	191:48:54 36,312 -6.53

N.P. - Not Performed   N.A. - Not Available

TABLE 5

APOLLO 10 LUNAR ORBIT MANEUVER SUMMARY

Date: May 26, 1969

MANEUVER	GROUND ELAPSED TIME (GET) AT IGNITION (hr:min:sec)			BURN TIME (seconds)			VELOCITY CHANGE (feet per second - fps)			APOCYNTHION / PERICYNTHION RESULTANT (NAUTICAL MILES)		
	PRE-LAUNCH PLAN	REAL-TIME PLAN	ACTUAL	PRLAU PLAN	RLTIM PLAN	ACTUAL	PRE-LAU PLAN	RL-TIME PLAN	ACTUAL	PRE-LAU PLAN	RL-TIME PLAN	ACTUAL
LOI-1 (SPS)	75:45:43.2	75:55:53.3	75:55:53	362	353.9	356	2974	2981.5	2981.4	170 60	170.7 59.7	170.4 59.6
LOI-2 (SPS)	80:10:45.5	80:25:07.4	80:25:07	14.4	14	13.9	138.5	138.9	138.4	60 60	60.1 60.1	61.5 58.9
UNDOCK (SM RCS)	98:05:15.6	98:22:00	98:22:00	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
CSM SEP (SM RCS)	98:35:15.6	98:47:16.0	98:47:16.0	6.9	8.1	10.4	2.5	2.5	3.2	59.2 60.1	62.1 57.9	61.9 58.0
DOI (LM DPS)	99:33:57	99:46:00.9	99:46:00.9	27.7	27.4	27.4	71.1	71.3	71.2	59.5 8.8	61.2 8.4	61.2 8.4
PHASING (LM DPS)	100:46:21	100:58:25.2	100:58:25.2	45.3	40.1	40.1	195.6	176.9	176.7	195.1 9.2	189.8 11.7	190.0 11.9
STAGING (LM RCS)	102:33:18	102:45:00	102:45:00	0.0	0.0	0.0	-2.0 +2.0	0.0	0.0	195.1 9.2	189.9 11.7	190.1 11.8
INSERTION (LM APS)	102:43:18	102:55:01.4	102:55:01.4	15.4	15.3	15.5	206.9	220.9	221.0	45.8 8.6	45.8 11.1	45.3 11.2
CSI (LM RCS)	103:33:46	103:45:54.6	103:45:54.6	32.2	27.3	27.3	50.5	45.3	45.3	44.9 44.3	47.2 41.8	47.2 41.8
CDH (LM RCS)	104:31:43	104:43:52.0	104:43:52.0	2.3	3.4	3.7	3.4	2.8	3.1	44.4 44.2	47.6 42.2	46.8 42.1
TPI (LM RCS)	105:08:57	105:22:55.0	105:22:55	16.1	14.7	28.8	25.4	24.3	24.0	61.8 43.8	58.1 46.8	58.0 46.8
DOCKING (SM RCS)	106:15:00	106:22:00	106:22:00	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
P J SEP (SM RCS)	108:09:24	108:43:30.0	108:43:30	5.5	6.5	6.9	2.0	2.0	2.1	60.0 59.3	63.4 56.2	63.2 55.0
APS DEPL (LM APS)	108:38:57	108:51:01.0	108:51:01.0	214.5	246.5	212.93	3836.0	4600	3838.4	59.0 XXXXXXXX	59.0 XXXXXXX	59.4 XXXXXX

N.A. - Not Available

APOLLO 10 CONSUMABLES SUMMARY AT END OF MISSION

DATE: May 26, 1969

CONSUMABLE		LAUNCH LOAD	PRELAUNCH PLANNED REMAINING	ACTUAL REMAINING
CM RCS PROP (POUNDS /PERCENT)	U	207/100	107/51.7	Not Available
SM RCS PROP (POUNDS /PERCENT)	U	1,220/100	370/30.2	623/51.1
SPS PROP (POUNDS /PERCENT)	TK	40,590/100	4,154/10.2	3,336/8.2
SM HYDROGEN (POUNDS /PERCENT)	U	52.5/100	16.6/31.7	13.7/26.1
SM OXYGEN (POUNDS /PERCENT)	U	615.6/100	263.6/42.8	267.7/43.5
LM RCS PROP (POUNDS /PERCENT)	U	548.9/100	* 134/24.4	* 77/14.0
LM DPS PROP (POUNDS /PERCENT)	U	17,741/100	** 16,893/95.4	** 16,982/95.9
LM APS PROP (POUNDS /PERCENT)	U	2,567/100	* 0/0	* 0/0
LM A/S OXYGEN (POUNDS /PERCENT)	T	4.72/100	* 3.37/71.4	* 4.08/86.5
LM D/S OXYGEN (POUNDS /PERCENT)	T	48.7/100	** 42.2/86.6	** 42.4/87.0
LM A/S WATER (POUNDS /PERCENT)	T	84.8/100	* 32.5/61.9	* 47.5/56.0
LM D/S WATER (POUNDS /PERCENT)	T	318.1/100	** 257.8/81.1	** 262.7/82.6
LM A/S BATTERIES (AMP-HRS /PERCENT)	T	592/100	* 282/47.6	* 274.9/46.4
LM D/S BATTERIES (AMP-HRS /PERCENT)	T	1,600/100	** 1150/71.9	** 1160.2/72.5

U - Usable quantity
TK - Tank quantity
T - Total quantity

* At termination of APS burn to depletion
**At descent stage jettison

APOLLO 10 COLOR TV LOG

Number		Transmission Start		Transmission Time (Min/Sec)			
Plan	Actual	Planned	Actual	Planned	Actual	STA	EVENT
1	1	3:03:24	3:06:00	15:00	22:00	GDS	SEPARATION, TRANSPOSITION and DOCKING
	2		3:56:00		13:25	GDS	CSM/LM EJECTION FROM S-IVB
	3		5:06:34		13:15	GDS	VIEW OF EARTH and S/C INTERIOR
	4		7:11:27		24:00	GDS	VIEW OF EARTH and S/C INTERIOR
2	5	27:15:00	27:00:48	15:00	27:43	GDS	VIEW OF EARTH and S/C INTERIOR
	6		48:00:51		14:39	MAD	VIEW OF EARTH and S/C INTERIOR (RECORDED)
	7		48:24:00		3:51	MAD	VIEW OF EARTH and S/C INTERIOR (RECORDED)
	8		49:54:00		4:49	GDS	VIEW OF EARTH
3	9	54:00:00	53:35:30	15:00	25:00	GDS	VIEW OF EARTH and S/C INTERIOR
4	10	72:20:00	72:37:26	15:00	17:16	GDS	VIEW OF EARTH and S/C INTERIOR (BOTH 210' and 85' DISH)
5	11	80:45:00	80:44:40	10:00	29:09	GDS	VIEW OF LUNAR SURFACE
6	12	98:13:00	98:29:20	10:00	20:10	GDS	VIEW OF SEPARATION MANEUVER
7		108:35:50		15:00		GDS	
8		126:20:00		40:00		GDS	
	13		132:07:12		24:12	GDS	VIEW OF LUNAR SURFACE and S/C INTERIOR
9	14	137:45:00	137:50:51	15:00	43:03	HSK	VIEW OF MOON POST TEI
	15		139:30:16		6:55	HSK	VIEW OF MOON POST TEI
	16		147:23:00		11:25	GDS	VIEW OF RECEDING MOON and S/C INTERIOR
10	17	152:35:00	152:29:19	10:00	29:05	GDS	VIEW OF EARTH, MOON and S/C INTERIOR
	18		173:27:17		10:22	GDS	VIEW OF EARTH and S/C INTERIOR
11	19	186:50:00	186:51:49	15:00	11:53	GDS	VIEW OF EARTH and S/C INTERIOR
Total				2:55:00	5:52:12		

Quality, color and resolution of color TV was outstanding. Resolution remained excellent throughout focussina range of 6:1 zoom lens.

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APOLLO 10 SPACE VEHICLE DISCREPANCY SUMMARY

LAUNCH VEHICLE DISCREPANCY SUMMARY

S-IVB STAGE AUXILIARY HYDRAULIC PUMP MOTOR AMPERAGE DROPPED FROM NORMAL READING ABOUT 220 SECONDS INTO S-IVB SECOND BURN. THE HYDRAULIC SYSTEM BURN ALSO INDICATED MARGINAL PUMP PERFORMANCE.

COMMAND/SERVICE MODULE DISCREPANCY SUMMARY

* EDS MODULE LIGHT BULBS FAILED INTERMITTENTLY. (PRELAUNCH)
* COMMAND MODULE REACTION CONTROL SYSTEM A HELIUM MANIFOLD PRESSURE DECAY. (PRELAUNCH)
* FUEL CELL 1 OXYGEN FLOWMETER FAILED. (PRELAUNCH)
* COMMAND MODULE REACTION CONTROL SYSTEM B HELIUM MANIFOLD PRESSURE ABRUPTLY DROPPED FROM 44 TO 37 PSI WHEN PROPELLANT ISOLATION VALVES OPENED. (PRELAUNCH)
* SUIT LOOP WATER SEPARATOR BREAKTHROUGH; CHANGE IN WICK WETTING TECHNIQUE WAS SUCCESSFUL. (PRELAUNCH)
* PRIMARY ENVIRONMENTAL CONTROL SYSTEM EVAPORATOR DRIED OUT. SWITCHED TO SECONDARY EVAPORATOR AT 0:15:00. PRIMARY EVAPORATOR RESERVICED AT 73:15:00, DRIED OUT AGAIN.
* THIN WHITE LINE ON RIGHT HAND SIDE WINDOW (TOP TO BOTTOM).
* CREW REPORTED HIGH FREQUENCY VIBRATION PRIOR TO COMPLETION OF S-IVB TRANSLUNAR INJECTION FIRING.
* HIGH OXYGEN FLOW CAUTION AND WARNING DURING TRANSLUNAR INJECTION FIRING. CABIN OXYGEN REGULATORS OPERATED AT SAME TIME.
* CARBON DIOXIDE PARTIAL PRESSURE READINGS 1.2 MM HG; SHOULD BE LOWER.
* PROGRAM ALARM 122 OCCURRED WHILE OR IMMEDIATELY AFTER THE CREW WAS OBSERVING THE EARTH THROUGH OPTICS.
* ENVIRONMENTAL CONTROL SYSTEM OXYGEN MANIFOLD PRESSURE DROPPED TO 75 PSI (SHOULD BE 100) FOR ABOUT 3 SECONDS DURING REDUNDANCY CHECKS.
* WATER PROBLEMS:
  WATER/GAS SEPARATOR DID NOT OPERATE SATISFACTORILY.
  AIR IN INITIAL SERVICED POTABLE WATER.

COMMAND/SERVICE MODULE, DISCREPANCY SUMMARY (CONT)

* DIGITAL EVENT TIMER ON PANEL 1 JUMPED 2 MINUTES WHILE COUNTING DOWN TO FIRST MIDCOURSE CORRECTION.

* THERMAL COATING ON FORWARD HATCH FLAKED OFF DURING LUNAR MODULE CABIN PRESSURIZATION.

* TUNNEL WOULD NOT VENT.

* SIMPLEX-A NOT OPERATING; OPERATED PROPERLY LATER.

* NO DOWN-VOICE FROM COMMAND AND SERVICE MODULE.

* TRANSPONDER IN COMMAND MODULE HAD TO BE CYCLED TO GET RENDEZVOUS RADAR TRACKING.

* LUNAR MODULE CAMERA FAILURES.

* AC CIRCUIT BREAKER TO FUEL CELL 1 OPEN; RESET GAVE UNDERVOLTAGE INDICATION.
  FUEL CELL OPEN-CIRCUITED AT 121:16.
  SHORT IN GLYCOL PUMP, HYDROGEN PUMP, PH SENSOR, OR ASSOCIATED WIRING.

* CONDENSER EXIT TEMPERATURE ON FUEL CELL 2 FLUCTUATING AND TRIGGERED CAUTION AND WARNING SEVERAL TIMES.

* CRYOGENIC HYDROGEN AUTOMATIC HEATER CONTROL DID NOT TURN OFF (SIMILAR OCCURRENCE ON APOLLO 9 WITH CRYOGENIC OXYGEN HEATER).

* FUEL CELL 1 HYDROGEN PURGE VALVE DID NOT CLOSE UNTIL SWITCH CYCLED, AT WHICH TIME FLOW SLOWLY DECREASED TO 0.04 LB/HR IN 40 MINUTES.

LUNAR MODULE
DISCREPANCY SUMMARY

* CREW REPORTED THAT THE LUNAR MODULE POTABLE WATER CONTAINED AIR THROUGH-USE.

* NOISE IN CABIN

  S-BAND ANTENNA MOVEMENT NOISE.

  GLYCOL PUMP NOISE BAD.

  FANS

* ABORT GUIDANCE SYSTEM DEADBAND SWITCH INDICATED MAX. ON TELEMETRY WHEN IN MIN. POSITION.

LUNAR MODULE, DISCREPANCY SUMMARY (CONT)

* INSTRUMENTATION DISCREPANCIES:

  GLYCOL TEMPERATURE READ ZERO DURING FIRST MANNING; LATER NORMAL (82:45:00).

  CHAMBER PRESSURE SWITCHES FAILED ON REACTION CONTROL THRUSTERS--B3D (97:34), B4U (98:31).

  CASK TEMPERATURE READ PROPERLY PRELAUNCH, READ OPEN INFLIGHT.

  REACTION CONTROL SYSTEM A MANIFOLD PRESSURE WENT TO ZERO (108:30).

  DESCENT PROPULSION FUEL PRESSURE GQ3501 READ ZERO IN CABIN, TELEMETRY NORMAL.

  ASCENT PROPULSION OXIDIZER MANIFOLD PRESSURE 187 ON TELEMETRY, 180 IN CABIN; PREDICTED WAS 170 PSI (GP1503).

  ABSOLUTE PRESSURE IN GLYCOL SYSTEM NOT STEADY.

* SIMPLEX-A NOT OPERATING AT 94:28:00.

* BACKUP VOICE NOISY BUT READABLE WHILE ON OMNI IN REVOLUTION 13.

* S-BAND STEERABLE ANTENNA OPERATION SHOWED DROP IN SIGNAL DURING PART OF REVOLUTION 13. . ATTITUDES WERE PROPER FOR MAINTAINING LOCK.

* RENDEZVOUS RADAR ALARMS DURING FIRST MARKS, INDICATING BAD INPUTS TO COMPUTER.

  101:09:29 - RANGE RATE READ MINUS 9800 FT/SEC; SHOULD BE ABOUT 200 FT/SEC.

  103:14:24 - READ 9999 FT/SEC; SHOULD BE 295 FT/SEC.

  104:37:00 - READ 6722 FT/SEC; SHOULD BE MINUS 124 FT/SEC (NO ALARM).

  105:17:00 - RANGE READ 22 N. MI.; SHOULD BE 40 N. MI. (RANGE RATE MAY ALSO HAVE BEEN IN ERROR).

* ABORT GUIDANCE VERSUS VERB 83 IN PRIMARY GUIDANCE COMPUTER LOCAL VERTICAL DIFFERENT BY 20 DEG; NO DIFFERENCE AFTER UNDOCK.

* APPARENT GIMBAL DRIVE ACTUATOR PITCH FAILURE; TELEMETRY INDICATES ACTUATOR NEVER MOVED.

  AC TRANSIENT MAY BE ASSOCIATED; 124 V PEAK (PHASING BURN).

  CAUTION AND WARNING ON ACTUATOR FAIL DURING PHASING BURN.

* LARGE ATTITUDE EXCURSIONS DURING STAGING. ABORT GUIDANCE MODE CONTROL SWITCH WAS IN "AUTO" RATHER THAN "ATTITUDE HOLD" AND APPARENTLY IN MAXIMUM DEADBAND. MANUAL CONTROL OVERRODE. THE ABORT GUIDANCE "AUTO" CONFIGURATION WAS ATTEMPTING

LUNAR MODULE, DISCREPANCY SUMMARY (CONT)

TO POINT THE LUNAR MODULE Z-AXIS AT THE COMMAND MODULE AS SET IN TO THE ABORT GUIDANCE. SIMULATION RESULTS SHOW WHAT HAPPENED IS ASSOCIATED WITH THE ABORT GUIDANCE MODE SWITCH.

* DURING DESCENT PROPULSION PHASING, CAUTION AND WARNING AND ALARM

  GIMBAL WARNING

  LOW LEVEL SENSOR

* CREW COMMENTED THAT RETICLE WAS BAD DURING PLATFORM REALIGNMENT AFTER PHASING BURN.

* GLYCOL PUMP SWITCHOVER PRIOR TO ASCENT PROPULSION FIRING DURING CABIN CLOSEOUT.

* INVESTIGATE 3.5-DEG ALIGNMENT DIFFERENCE BETWEEN LUNAR MODULE AND COMMAND MODULE PRIOR TO SEPARATION AT 96:30.

* ABNORMAL RISE IN CARBON DIOXIDE INDICATION ON PRIMARY LIOH CARTRIDGE.

* LUNAR MODULE CABIN PRESSURE DROPPED ABRUPTLY AT COMMAND MODULE/LUNAR MODULE SEPARATION.

* RATE ERROR NEEDLES INDICATION OFF BY 0.2 DEG IN PITCH, 0.3 DEG IN YAW, AND 0.2 DEG IN ROLL.

Postlaunch
Mission Operation Report
No. M-932-69-10

TO: A/Administrator 18 July 1969

FROM: MA/Apollo Program Director

SUBJECT: Apollo 10 Mission (AS-505) Postlaunch Mission Operation Report #2

Review of the Apollo 10 Mission results since issuance of Postlaunch Mission Operation Report No. 1 (26 May 1969) 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 Manned Space Flight Center technical reports.

Attached is Postlaunch Mission Operation Report No. 2, which updates or supplements Report No. 1 and includes our assessment of the mission. Based on the mission performance as described in these reports, it is recommended that the Apollo 10 Mission be adjudged as having achieved agency preset primary objectives and be considered a success.

Sam C. Phillips

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

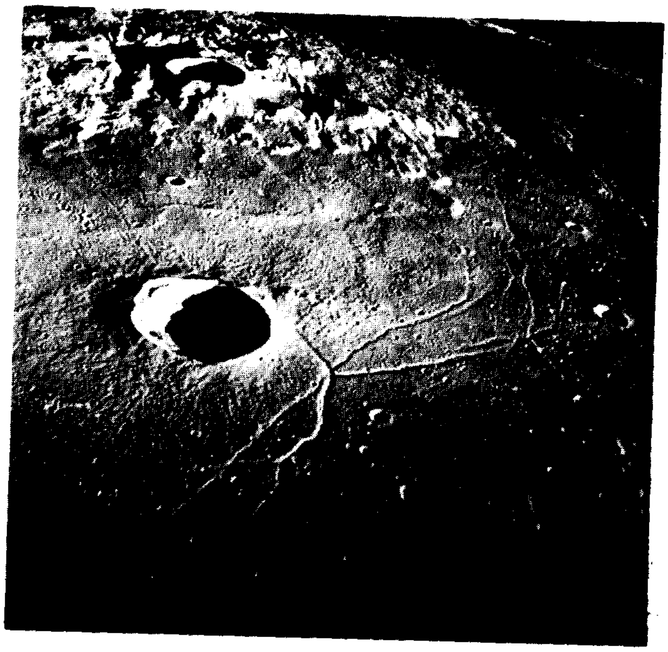
APPROVAL:

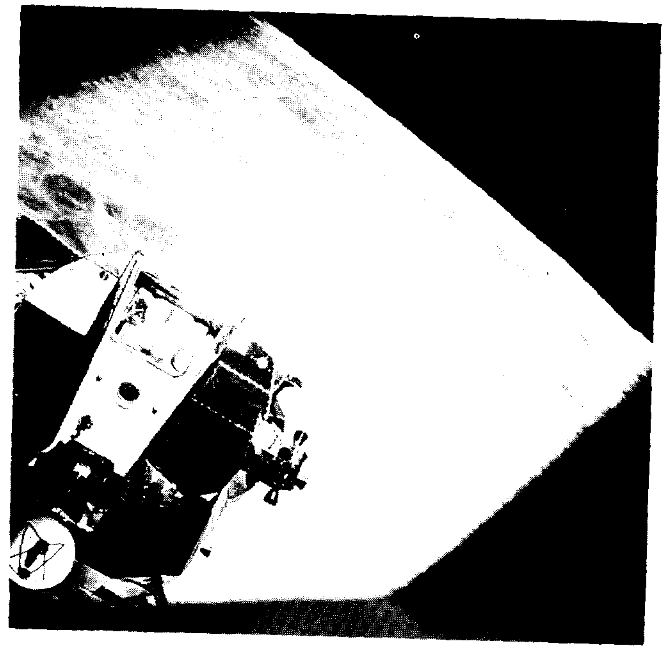
G. E. Mueller

George E. Mueller
Associate Administrator for
Manned Space Flight

Report No. M-932-69-10

POST LAUNCH
MISSION OPERATION REPORT NO. 2





APOLLO 10 (AS-505) MISSION

OFFICE OF MANNED SPACE FLIGHT

Prepared by: Apollo Program Office-MAO

FOR INTERNAL USE ONLY

NASA OMSF PRIMARY MISSION OBJECTIVES

FOR APOLLO 10

PRIMARY OBJECTIVES

- Demonstrate crew/space vehicle/mission support facilities performance during a manned lunar mission with CSM and LM.
- Evaluate LM performance in the cislunar and lunar environment.

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

Date: 6 May 1969

George E. Mueller
George E. Mueller
Associate Administrator for
Manned Space Flight

Date: MAY 8 1969

RESULTS OF APOLLO 10 MISSION

Based upon a review of the assessed performance of Apollo 10, launched 18 May 1969 and completed 26 May 1969, this mission is adjudged a success in accordance with the objectives stated above.

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

Date: 18 July 1969

George E. Mueller
George E. Mueller
Associate Administrator for
Manned Space Flight

Date: 18 July 1969

GENERAL

As stated in Postlaunch Mission Operation Report No. 1, all elements of the Apollo system performed satisfactorily during the Apollo 10 Mission. Tables 1 and 2 provide updated values for the mission sequence of events. Tables 3 through 6 present summaries of the major discrepancies experienced by the launch vehicle, Command/Service Module, Lunar Module, and mission support.

TABLE 1. APOLLO 10 SEQUENCE OF EVENTS

EVENT	GROUND ELAPSED TIME (GET) (hr:min:sec) PLANNED*	ACTUAL
Range Zero (12:49:00.0 EDT)	0:00:00.0	0:00:00.0
Liftoff Signal (TB-1) (Time Base -1)	0:00:00.6	0:00:00.6
Begin Pitch and Roll	0:00:12.5	0:00:12.5
Roll Complete	0:00:31.2	0:00:31.2
Maximum Dynamic Pressure (Max Q)	0:01:17	0:01:22.6
S-IC Inboard Engine Cutoff (TB-2)	0:02:15.3	0:02:15.2
Begin Tilt Arrest	0:02:36.7	0:02:37.3
S-IC Outboard Engine Cutoff (TB-3)	0:02:40.2	0:02:41.6
S-IC/S-II Separation	0:02:40.9	0:02:42.3
S-II Ignition	0:02:41.6	0:02:43.1
Jettison S-II Aft Interstage	0:03:10.9	0:03:12.3
Launch Escape Tower Jettison	0:03:16.4	0:03:17.8
S-II Center Engine Cutoff	0:07:39.2	0:07:40.6
S-II Outboard Engine Cutoff (TB-4)	0:09:14.1	0:09:12.6
S-II/S-IVB Separation	0:09:15.0	0:09:13.5
S-IVB Ignition	0:09:15.1	0:09:13.6
S-IVB Cutoff (TB-5)	0:11:43.5	0:11:43.8
Earth Parking Orbit Insertion	0:11:53.5	0:11:53.8
Begin S-IVB Restart Preparations (TB-6)	2:23:46.9	2:23:47.7
Second S-IVB Ignition (Translunar Injection)	2:33:26.9	2:33:27.7
Second S-IVB Cutoff (TB-7)	2:38:48.6	2:38:49.5
CSM/S-IVB Separation, SLA Panel Jettison	3:00:00	3:02:51
CSM Transposition and Docking Complete	3:10:00	3:17:38
CSM/LM Ejection from S-IVB/IU/SLA	4:09:00	3:56:24
CSM/LM SPS Evasive Maneuver	4:29:00	4:39:09.8
S-IVB Slingshot Maneuver (Propellant Dump)	4:39:00	4:49:00
Midcourse Correction No. 1 (MCC-1)	11:33:00	Not Required
Midcourse Correction No. 2 (MCC-2)	26:33:00	26:32:56.8
Midcourse Correction No. 3 (MCC-3)	53:45:00	Not Required
Midcourse Correction No. 4 (MCC-4)	70:45:00	Not Required
Lunar Orbit Insertion No. 1**	75:45:00	75:55:54
Lunar Orbit Insertion No. 2 (Circularization)	80:10:00	80:25:07
Intravehicular Transfer to LM	94:25:00	95:02:00
Undocking	98:05:00	98:22:00
LM/CSM Separation Maneuver	98:35:00	98:47:16
Descent Orbit Insertion	99:34:00	99:46:01
Phasing Maneuver	100:46:00	100:58:25
LM Descent Stage Jettison	102:33:00	102:45:00
Ascent Insertion Maneuver	102:43:00	102:55:01
Concentric Sequence Initiation	103:34:00	103:45:55

EVENT	GROUND ELAPSED TIME (GET) (hr:min:sec) PLANNED*	ACTUAL
Constant Delta Height Maneuver	104:32:00	104:43:52
Terminal Phase Initiation	105:09:00	105:22:55
Docking	106:20:00	106:22:08
LM Ascent Stage Jettison	108:09:00	108:24:37
APS Burn to Propellant Depletion	108:39:00	108:51:01
Transearth Injection (Ignition)	137:20:00	137:36:28
Midcourse Correction No. 5 (MCC-5)	152:20:00	Not Required
Midcourse Correction No. 6 (MCC-6)	176:50:00	Not Required
Midcourse Correction No. 7 (MCC-7)	188:50:00	188:49:57
CM/SM Separation	191:35:00	191:33:24
Entry Interface (400,000 feet altitude)	191:50:00	191:48:54
Enter S-band Blackout	191:50:26	191:49:21
Exit S-band Blackout	191:53:26	191:52:22
Drogue Parachute Deployment	191:58:33	191:57:11
Main Parachute Deployment	191:59:22	191:58:01
Landing	192:04:00	192:03:23

*Prelaunch planned times are based on MSFC Saturn V AS-505 Apollo 10 Mission LV Operational Trajectory, April 17, 1969, as revised by MSFC memo no. S and E-AERO-FMT-106-69, May 5, 1969; and on MSC Revision 1 of Spacecraft Operational Trajectory for Apollo 10, April 28, 1969.

**Delay of the first midcourse correction to the MCC-2 option caused the translunar trajectory to be longer than planned thus delaying lunar orbit events approximately 12 minutes.

TABLE 2. APOLLO 10 RECOVERY EVENTS

EVENT	EDT (p.m.)
First visual contact	12:40
First radar contact	12:41
Visual contact by USS PRINCETON	12:45
First voice contact	12:50
Landing (164°41' W.Long., 15°1' S.Lat.)	12:52
Flotation collar installed	1:10
CM hatch open	1:17
Crew in raft	1:20
Crew aboard helicopter	1:26
Crew aboard USS PRINCETON	1:31
CM aboard USS PRINCETON	2:22

Table 3. LAUNCH VEHICLE DISCREPANCY SUMMARY

DESCRIPTION	REMARKS
The S-IVB auxiliary hydraulic pump stopped producing full pressure during the second burn.	Probably caused by structural failure of the compensator spring guide. The spring guide was replaced on AS-506 (Apollo 11).
At T-9 hours, the ECS air/nitrogen purge duct in the IU failed, apparently at the duct joint 4 inches inside the stage skin.	A second clamp will be added over the duct at the joint and the screw torque on both clamps will be increased. This change has been completed on AS-506.
Low frequency (19-Hz) longitudinal and lateral oscillations were present during both S-IVB burns. High-frequency (46-Hz) oscillations occurred during the latter part of the second S-IVB burn.	The 19-Hz vibration is a normal low-level response to the uncoupled J-2 engine thrust oscillations. The 46-Hz vibration is attributed to excitation of the forward skirt ring mode by noise originating in the liquid hydrogen non-propulsive vent system. This condition is not a constraint on Apollo 11.

Table 4. COMMAND/SERVICE MODULE DISCREPANCY SUMMARY

DESCRIPTION	REMARKS
CM Reaction Control System A developed a small leak in the helium manifold prior to launch.	On future missions, the RCS pressure will be monitored for approximately 1 month prior to launch to ensure early detection of any leaks.
Rupture of the RCS oxidizer burst disc was noticed when the CM Reaction Control System B helium manifold pressure abruptly dropped from 44 to 37 psi as the propellant isolation valves were opened.	There is no mission impact as long as the shutoff valves and the engine control valves hold leak-tight. A burst disc leak check has been added after RCS propellant servicing.
The primary ECS evaporator dried out during the launch phase and again during the second lunar revolution.	A check of the water control microswitch assembly revealed that the actuator travel was at times not sufficient to open the switch. Actuator rigging procedures will be modified to assure proper overtravel.
Water problems on the flight were: (1) the water/gas separator did not operate satisfactorily; (2) air was contained in the ground-serviced potable water.	Three new designs for the water/gas separator have been tested with good results. Operational procedures are being prepared for possible use on Apollo 11.
For about 2 hours on the seventh day of the flight, the flow from the CM water dispenser appeared to be less than normal.	The gun was probably clogged by excess O-ring lubricant. Should the gun become clogged in flight, several alternate sources are available for drinking water.
The thermal blanket on the CM forward hatch flaked off during LM cabin pressurization. Particles went throughout both spacecraft, requiring clean-up and causing crew discomfort.	The thermal blanket has been deleted effective on CSM 107 (Apollo 11).

Table 4. COMMAND/SERVICE MODULE DISCREPANCY SUMMARY (CONT.)

DESCRIPTION	REMARKS
The tunnel would not vent when the crew tried to perform the hatch integrity check prior to undocking. An alternate venting procedure through the LM had to be used.	Due to a ground procedural error, the vent line was terminated by a plug instead of a fitting with holes in it. CSM 107 and 108 have been verified as being properly configured.
Twice during lunar revolution 10, transmissions from the LM on VHF Simplex-A were not received in the CM. VHF Simplex-A operated satisfactorily for both voice and ranging during the remainder of the mission.	The most probable cause for the apparent failure of VHF Simplex-A was that, because of the numerous switch configuration changes in both vehicles, the LM & CSM were not configured simultaneously for communications on Simplex-A.
The CM rendezvous radar transponder had to be cycled to obtain operation following undocking.	Postflight testing of the switch and wiring did not reveal any problem. Failure analysis of the switch is continuing.
The CM 16mm sequence camera stopped operating in the pulse mode at 173:00 GET.	The problem has been traced to a faulty microswitch. All cameras on Apollo 11 will have high-reliability microswitches.
The fuel cell 1 AC circuit breaker tripped at 120:47 GET, due to a short circuit in the AC pump package.	The most probable cause was a breakdown in the insulation within the hydrogen pump.
Condenser exit temperature of fuel cell 2 fluctuated and triggered the caution and warning light several times.	The cause has not yet been determined. This behavior is not detrimental to fuel cell component life or performance, but it does represent a nuisance to the crew because the caution and warning light must be reset manually.

Table 4. COMMAND/SERVICE MODULE DISCREPANCY SUMMARY (CONT.)

DESCRIPTION	REMARKS
During the extended purge of fuel cell 1, the cryogenic hydrogen automatic pressure control twice failed to turn off the hydrogen tank heaters. The heaters were controlled manually after 170:30 GET.	If long-duration purges are required in the future, the heaters will be operated manually. The Apollo Operations Handbook has been changed appropriately.
When the purge valve was closed following the extended purge of fuel cell 1, it took 30 minutes for the hydrogen flow to decrease to zero, and an overpressure of 9 psi occurred in the regulated hydrogen supply to the fuel cell.	Extended hydrogen purge should not be conducted if preheat capability is lost, because of the effect of low temperatures on the hydrogen regulators (valve seat warpage and leakage). The Apollo Operations Handbook will be changed to caution against such an operation.
Four of the ten light bulbs in the launch vehicle engine warning annunciator failed intermittently prior to launch.	Caused by cold solder joints where the lamp leads are attached to the printed circuit board. The units for Apollo 11 and subsequent vehicles have been screened.
The stylus of the entry monitor system stopped scribing while initializing after the pre-entry tests. The scribe worked after slewing the scroll back and forth.	Subsequent to Apollo 12, either the scroll emulsion base will be made using the originally formulated soap or pressure-sensitive paper which was recently qualified will be used for the scroll.
The VHF beacon antenna did not deploy on entry; however, three helicopters received the beacon signals.	The antenna did not deploy because one radial was caught under the outboard edge of the ramp. No change is required for Apollo 11.
Two retaining springs for the tunnel shaped-charge holder ring did not capture on the minus y side.	Based on the Apollo 10 flight experience, ground tests, and analytical results, the probability of a failure to capture the charge holder under normal separation conditions is judged to be low.

Table 4. COMMAND/SERVICE MODULE DISCREPANCY SUMMARY (CONT.)

DESCRIPTION	REMARKS
The data storage equipment tape recorder slowed down several times during entry.	The recorder vent valve allowed enough differential pressure to build up to deform the recorder cover sufficiently to contact the tape reel. For future missions, vent valves will be selected that open at the low end of the allowable range in the specification.
The stabilizer, which maintains the couch position when the foot strut of the center couch is removed, was connected during launch.	The stabilizer must be in the stowed position to allow strut stroking during an abort landing. A mandatory inspection step has been added to the pre-ingress checklist.
The gyro display coupler drifted excessively in roll and yaw (5° in 20 minutes) after performing properly early in the mission.	Postflight tests are in progress.
During one injection, the chlorine ampule leaked, and no water sample could be drawn.	Postflight inspection revealed no defects. Probably caused by improper insertion of the ampule.
Relative motion occurred between the CM and LM at the docking ring interface when the CM RCS roll thrusters were fired.	Pressure in the tunnel reduced the frictional force at the docking ring interface. Proper tunnel venting capability has been verified on CSM 107 and 108.
The left-hand x-x head strut lockout torsion spring was found on the wrong side of the retention pin during the postflight check of lockout lever forces.	Correct installation on CSM 107 and 108 will be verified at KSC.

Table 4. COMMAND/SERVICE MODULE DISCREPANCY SUMMARY (CONT.)

DESCRIPTION	REMARKS
The digital event timer on panel 1 advanced a total of 2 minutes during the countdown for the first midcourse correction. At other times, the tens of seconds failed to advance.	A screening test has been developed for the timers installed in future spacecraft; however, the capability of the test to isolate unreliable timers has not yet been proven.

Table 5. LUNAR MODULE DISCREPANCY SUMMARY

DESCRIPTION	REMARKS
A master alarm with an engine pitch gimbal fail warning occurred during the DPS phasing burn. Telemetry shows both actuators operated normally.	Apparently caused by gimbal coasting. For Apollo 11 and subsequent missions, the brake mechanism has been redesigned and the fail warning has been made less sensitive to coasting.
Two master alarms with DPS propellant low quantity warnings occurred during the phasing burn.	A gas bubble probably uncovered the low level sensor accompanied by an intermittent open circuit in the low level signal circuit. The system has been greatly simplified on Apollo 11 and subsequent.
During revolution 13 the signal at the Mission Control Center was very weak when the LM omni antenna was used with backup downvoice.	The problem occurred in equipment at the Goldstone station, and an investigation is being conducted by Goddard Space Flight Center.
During the beginning of revolution 13, the S-band steerable antenna did not track properly for about 13 minutes, but it tracked well both before and after this period.	The crew may have inadvertently switched the track-mode switch to OFF instead of to AUTO at the time S-band acquisition was established.

Table 5. LUNAR MODULE DISCREPANCY SUMMARY (CONT.)

DESCRIPTION	REMARKS
The LM drinking water contained gas.	Consideration is being given to placing a gas separator in the drinking line.
The cabin was excessively noisy, primarily because of the glycol pump. The cabin fans and S-band steerable antenna also were noisy.	Modification of the LM hardware does not appear practical. Ear muffs or ear plugs will be provided for the crew to use during sleep periods.
During checkout of the Commander's oxygen purge system, the heater light did not come on.	Manned tests have shown that the gas temperature is acceptable for comfort without the heater.
The output from the yaw rate gryo did not always correspond to the actual LM yaw rate from 50 seconds prior to staging until several seconds after staging, but the output was normal before and after this period.	Data are being analyzed to identify the characteristics of the abnormal operation and to determine the failure mode.
The dump of the LM low-bit-rate PCM data recorded in the CM stopped abruptly at 99:38:52 GET instead of continuing until approximately 99:46:00 GET.	The CM was reconfigured from the voice and data mode to the ranging mode approximately 11 minutes early because the times on the flight plan were incorrect since lunar orbit was initiated 12 minutes later than originally planned.
When the LM Ascent Stage separated from the CM, the LM cabin pressure dropped from 4.86 psia to less than 1.0 psia in 0.3 second.	The residual tunnel pressure of 4.86 psia, plus the pressure generated when the separation pyrotechnics fired, caused the latch on the LM tunnel hatch to fail and the cabin then vented through the hatch.

Table 5. LUNAR MODULE DISCREPANCY SUMMARY (CONT.)

DESCRIPTION	REMARKS
The CO_2 level and rate of increase were abnormally high while using the primary lithium hydroxide cartridge. The level decreased rapidly to the predicted level when the secondary cartridge was selected.	Lithium hydroxide cartridge variations combined with CO_2 sensor tolerances could account for the observed flight performance. Predictions for future flights will use more realistic operational characteristics.
Large attitude excursions occurred prior to and during LM staging.	For an undetermined reason the abort guidance system mode control changed from "attitude-hold" to "automatic" coincident with each vehicle gyration.
During the low-altitude lunar pass the Hasselblad 70mm camera stopped because of film binding in the magazine.	The Apollo 11 cameras and magazines will be inspected for damage, clearances, and contamination. The 1.6-ampere fuses will be replaced with 1.2-ampere high-reliability fuses.
During the low-altitude lunar pass, the LM 16mm camera failed to operate with magazine F installed. Magazine F was reinstalled later and the camera operated satisfactorily.	Magazine F had marginal clearances at the interface surfaces and edges. All magazines for subsequent missions will be fit-checked before flight.
Three operational anomalies occurred during use of the LM optical system: contamination of the reticle of the alignment optical telescope by hair-like material, difficulty in operating the dimmer control rheostat of the computer control and reticle dimmer, and disappearance of stars at approximately six star diameters from the center of the reticle.	Contamination of the reticle may have occurred through a gap in the housing that is required to allow for thermal expansion. The operation of the dimmer control rheostat as described by the crew was normal. Disappearance of stars may have been caused by contamination on the prism; the LM-5 (Apollo 11) prism and reticle have been cleaned and inspected.

Table 6. MISSION SUPPORT DISCREPANCY SUMMARY

DESCRIPTION	REMARKS
During line childown in preparation for LOX loading at about T-8 hours, the primary LOX replenish pump failed to start.	A blown fuse was found in the pump motor starter circuit. Troubleshooting and fuse replacement delayed completion of LOX loading by 50 minutes, but the built-in 1-hour hold at T-3:30 hours prevented a launch delay.

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