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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

APOLLO 7 MISSION

3-DAY REPORT

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MANNED SPACECRAFT CENTER
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3-DAY REPORT

October 25, 1968

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The evaluation in this report is based on preliminary data; and the values are subject to change. All times are referenced to range zero, the integral second before lift-off. Range zero was 15:02:45 G.m.t.

SUMMARY

The Apollo 7 space vehicle was launched from Cape Kennedy, Florida, at 11:02:45 a.m. e.d.t. on October 11, 1968. Following a nominal boost phase, the spacecraft and S-IVB combination was inserted into an orbit of 123 by 153 nautical miles. Prior to separation of the command and service modules from the S-IVB, the crew manually controlled the spacecraft/S-IVB combination. After separation, a transposition and simulated docking exercise was completed. Phasing maneuvers were later executed in preparation for a successful rendezvous with the S-IVB. During the 10.8-day flight, eight planned maneuvers using the service propulsion system were completed, and all major test objectives were satisfied.

Almost without exception, spacecraft systems operated as intended. All temperatures varied within acceptable limits and essentially exhibited predicted behavior. Consumable usage was always maintained at safe levels and permitted introduction of additional flight activities toward the end of the mission. Communications quality was generally good, and live television was transmitted to ground stations on seven occasions. A test of the rendezvous radar system was completed in support of later flights with the lunar module. Manual operation of the spacecraft by the crew was good. Even though they were somewhat hampered by head colds and congestion, the crew satisfactorily performed all flight-plan functions, and the photographic experiments were completed.

A normal deorbit, entry, and landing sequence was completed, with all parachutes operating properly. The vehicle landed at approximately 260:09:00 in the Atlantic Ocean southeast of Bermuda, with recovery coordinates of 27° 33' north latitude and 64° 04' west longitude. This landing point is approximately 7 nautical miles downrange of the planned landing point. The crew was retrieved by helicopter, and both the spacecraft and crew were taken aboard the prime recovery ship, *USS Essex*.

TRAJECTORY

Lift-off of the Apollo 7 mission occurred at 15:02:45 G.m.t. (11:02:45 a.m. e.d.t.) with subsequent orbital insertion at 00:10:27. The orbital insertion conditions were a velocity of 25 554 ft/sec, a flight-path angle of 0.00 degree, and an altitude of 123.1 n. mi.

After the command and service modules were separated from the S-IVB, two phasing maneuvers for rendezvous were performed with the reaction control system. The rendezvous sequence was initiated over Carnarvon in revolution 17 at 26:24:55, with the first service propulsion maneuver. The second service propulsion maneuver was performed one revolution later to establish the necessary catch-up rate. The crew reported station-keeping with the S-IVB at 30:00:00. A final separation maneuver from the S-IVB was performed in revolution 19 at 30:20:00.

The deorbit maneuver (eighth service propulsion maneuver) occurred during revolution 163 over Hawaii at 259:39:16, with subsequent landing at approximately 260:09:00.

Table I contains a summary of all rendezvous and subsequent service propulsion maneuvers. Table II contains the orbital elements for each maneuver.

SYSTEMS PERFORMANCE

STRUCTURES AND MECHANICAL SYSTEMS

Structural loads were below design limit values for all phases of flight. The peak ground winds just prior to lift-off were within 3 knots of the structural red line; however, the measured launch vehicle strain data indicated that only 50 percent of the limit loads were encountered. The peak wind in the max q region was 52 ft/sec, and structural loads were less than 25 percent of limit. The axial load factor at the end of S-IB boost was 4.3g, compared with the design axial load factor of 4.86g.

All mechanical systems required functioned properly.

THERMAL CONTROL

Temperatures of all passive elements of the spacecraft remained within limits for an earth orbit mission. The command module ablator temperature ranged from 3° to 95° F as expected. However, the service propulsion feedlines were warmer than expected; consequently, the heaters were not required. The monitored temperatures for the service propulsion and reaction control propellant and helium tanks slowly decreased throughout the mission. The "fracture mechanics" temperature limits were never approached during the flight. The thermal efficiency of the service module insulation appeared to be adequate based on the temperature histories of the tanks.

No specific instances of extended temperature increases were noted during the entire mission. Over the 3-hour period of the service propulsion system cold soak, all quad tanks showed a definite cooling trend. This type of response is indicative of what will occur on a translunar mission when the vehicle is not in the passive thermal control mode and the service module is being cold soaked.

EARTH LANDING SYSTEM

The earth landing system performed satisfactorily. The crew reported that all parachutes disreefed and deployed properly. After landing, the spacecraft assumed a stable II (apex-down) attitude for 8 minutes, at which time the uprighting system was activated; 4.5 minutes later, the spacecraft was returned to the stable I (apex-up) attitude. Operation of the recovery aids was interrupted while the spacecraft was in the stable II attitude. Communications were reestablished and the flashing light was activated after the spacecraft was uprighted.

ELECTRICAL POWER AND SEQUENTIAL

Power Distribution

The electrical power system maintained the ac and dc voltages within nominal limits except for the discrepancies discussed in the following paragraphs.

The crew reported two ac bus 1 failure indications and one ac bus 1 and 2 failure indication early in the mission. The loss of voltage was verified by the onboard meter, and the voltage was restored to normal by resetting the ac bus sensors. The occurrences were coincident with the cryogenic oxygen tank fans and heaters cycling OFF in the automatic mode. The only condition under which an ac bus can be automatically disconnected is an overvoltage being sensed by the ac overload sensing unit. After a procedural change was made to prevent the fans in both tanks from cycling OFF simultaneously, the problem did not recur for the remaining 200 hours of flight.

Two other occurrences were associated with activation of the cryogenic tank fans: a master alarm was observed at the beginning of the cryogenic heater cycle at the time both buses dropped out, and the digital event timer started inadvertently once when the oxygen fans were turned on manually.

Fuel Cells

All power requirements imposed on the three fuel cells were satisfied.

Prior to the fifth service propulsion maneuver, the condenser exit temperature of fuel cell 2 increased from 160° to 180° F (nominal is 155° to 165° F). The electrical load was removed from fuel cell 2 for approximately 54 minutes to permit cooling prior to the service propulsion maneuver. Performance of the fuel cell was satisfactory during the maneuver. Four days later, the electrical load was again removed from fuel cell 2 for a short period of time as a precautionary measure to insure proper performance during the deorbit maneuver.

The data indicate a possible malfunction in the generator bypass valve which controls glycol flow to the condenser exit. Another possibility is that the flow in the glycol coolant loop was restricted. The result was that the glycol coolant entering the fuel cell from the spacecraft radiator was hotter than normal, and the condenser exit temperature subsequently increased under the higher power load. The load-sharing capability of the fuel cell was only slightly affected. Thermal control by the corresponding bypass valve in fuel cell 1 was abnormal in one instance; the condenser exit temperature increased above the normal operating temperature during the first period when only two fuel cells were carrying the load. It operated normally after fuel cell 2 was returned to the bus, and the problem was not evident the second time fuel cell 2 was removed from the bus.

Batteries

The voltage and current delivered by the entry batteries and pyrotechnic batteries were within the range of normal battery performance throughout the mission considering loads, states of charge, and ambient temperature in the areas in which the batteries were installed.

The charge rates on batteries A and B were much lower than expected. However, special ground tests performed during the flight showed that two factors contributed to this condition: line impedance between the battery and charger, and the particular characteristics of the battery and battery charger system under the flight conditions.

The main bus voltage, as read-out onboard at command module/service module separation, unexpectedly dropped to approximately 25.0 volts but then gradually increased to a nominal level prior to blackout.

Sequential

During the mission, the sequential system performed emergency detection system abort enable, tower jettison, launch-vehicle/spacecraft separation, command module/service module separation, and the earth landing function (see table III for a list of mission event times).

The logic and pyrotechnic bus supplied the sequential system with the proper voltages throughout the flight.

CRYOGENICS

The cryogenic storage system performed satisfactorily during the mission. Excess reactants were available because spacecraft power levels were slightly below those predicted for the mission.

Automatic quantity balancing in the oxygen tanks was accomplished within 1-1/2 percent even though the fans in oxygen tank 2 were not operated automatically for a major portion of the mission. Automatic quantity balancing in the hydrogen tanks and one manual quantity adjustment were successfully performed. The criteria for this mission were balancing to within 3 percent.

Heat leak values of approximately 80 Btu/hr on the oxygen tanks after the launch phase vibration were as expected since the VAC-ION pumps were not energized. As the mission continued, the heat leak values decreased to 25 Btu/hr and the predicted oxygen venting did not occur. The phenomenon of heat leak decrease cannot be explained at this time.

As previously mentioned, an overvoltage condition occurred three times in the ac electrical system. Coincidently in each case, the four oxygen tank fans were turned off. By placing the tank 2 fans in manual mode, no further overvoltage conditions were observed during the remainder of the mission, and no significant pressure or quantity readout fluctuations were noted with approximately 5-minute motor runs at intervals of 8 to 12 hours.

COMMUNICATIONS

The communications system, which includes voice, telemetry, updata, television, and tracking capability, satisfactorily supported the mission.

The VHF and S-band voice links provided good communications. The onboard television equipment was operated on seven occasions with good picture quality. The playback voice performance varied in quality from noisy to good as received by the network sites during recorder dumps. Some dropouts of both real-time and playback telemetry were noted; however, overall telemetry performance was satisfactory.

Downlink data were lost at approximately 65 hours into the mission. Real-time telemetry and television were time-shared on the backup S-band FM mode until full communications capability was restored by switching to the alternate S-band transponder.

The VHF voice duplex-B mode was very good during the countdown and launch phase until about 7 minutes. At that time, voice quality became garbled on downlink receivers and did not completely clear until simplex-A was selected over the Canary Islands tracking station. The operation of the duplex-B mode was successfully reverified at about 7-1/2 hours into the mission.

USS Huntsville lost contact with the spacecraft approximately 2 minutes early during the final revolution. S-band communications blackout at Merritt Island occurred at 259:54:58; the signal was acquired by Bermuda at 259:59:46, the first reported contact after blackout.

RADAR

A test of the rendezvous radar transponder was successfully completed with the White Sands Missile Range during revolution 48. Approximately 47 seconds of data were obtained. The ground radar acquired and locked-on the spacecraft transponder at a range of 390 n. mi. and tracked to a range of 415 n. mi.

INSTRUMENTATION

The instrumentation performance was satisfactory throughout the mission except for the discrepancies noted. The performance of the data storage equipment was satisfactory throughout the mission.

At 11:09:23, the central timing equipment was reading correctly over *USS Redstone*. At 12:07:26, it was reading 00:42:09, indicating a reset at 11:25:17. The timing equipment was updated at 12:26:20 over Hawaii and continued to read correctly.

Two discrepancies were encountered with the biomedical instrumentation equipment; these are discussed under Crew Provisions.

GUIDANCE AND CONTROL

Guidance and control system performance was satisfactory throughout the mission. The inertial measurement unit was aligned optically, as scheduled, within small tolerances. Backup alignment methods were demonstrated for the inertial measurement unit and the stabilization and control system attitude reference. Data were obtained on star visibility, landmark tracking, star/horizon sightings, and optics utilization. The guidance and navigation system, using optical tracking data, supported the rendezvous with the S-IVB. All significant attitude control modes in both the prime and the backup system were tested and appeared to perform satisfactorily. Thrust vector control of the service propulsion engine was demonstrated using both the guidance and navigation and the stabilization and control systems, and mid-maneuver manual takeover techniques were also successfully demonstrated.

Two hardware problems were encountered. The rotational hand controller minus-pitch breakout switch was reported to have operated inadvertently once early in the mission. The ball on flight director attitude indicator no. 1 indicated an abnormal shift in the pitch axis when being driven by the backup attitude reference system. No operational capability was lost as a result of either problem.

At 215:59:00, the crew reported that the interior lights had been dimmed to check the visibility of the exterior lights. When the lights were brightened, a program alarm was signalled by the computer. The alarm was reset and the problem did not recur.

REACTION CONTROL SYSTEMS

All spacecraft reaction control system parameters were normal throughout the mission, and both systems operated satisfactorily.

The primary service module quad heaters performed normally and maintained all quad package temperatures between 118° and 141° F during the mission.

The helium regulators for the service module reaction control system maintained the helium and propellant manifold pressures essentially constant. Propellant utilization was near the predicted nominal in most cases.

Zero helium leakage was indicated from the command module reaction control system prior to activation just before the deorbit maneuver. The command module engine heaters were not required because the engine injector temperatures remained above 46° F prior to system activation. The command module reaction control system performed normally from activation through landing. System 1 was used for entry control as planned, and system 2 was not used.

SERVICE PROPULSION SYSTEM

The eight planned firings of the service propulsion engine were performed, and the system operation was satisfactory in all aspects. The actual times, durations, and velocity changes are summarized in table I.

The ignition time for the third maneuver was advanced 16 hours from the original flight plan to improve the margin of deorbit capability with the service module reaction control system. To ensure the verification of the propellant gaging system, the firing time for the fifth maneuver was increased from 61 to 66 seconds so that both point sensors would be uncovered during steady-state engine operation. Propellant quantity data indicate that both sensors were uncovered. After the fifth maneuver, a 3-hour cold-soak test was performed, with no notable decrease in temperatures within the system.

Thermal characteristics of the system appeared to be better than anticipated for random, drifting flight in that the rate of temperature decrease was less than predicted.

ENVIRONMENTAL CONTROL SYSTEM

Performance of the environmental control system was satisfactory. During prelaunch operations, the cabin was purged to an atmosphere of 60-percent oxygen and 40-percent nitrogen. The crew was isolated from the cabin by the suit circuit, which contained 100-percent oxygen. During launch, the cabin sealed off at 5.9 psia. Cabin pressure continued to decrease as a function of the cabin enrichment procedure. This procedure was terminated at about 00:11:00, and the oxygen content was 73 percent of the total cabin pressure. Cabin leakage was estimated to have been 0.1 lb/hr, which agrees with the prelaunch value.

The radiators satisfactorily rejected the spacecraft heat loads to the extent that the evaporators were not required. The primary evaporator is required only when the heat loads exceed the radiator capability; under the low, variable heat loads which existed, the evaporator operated erratically in the automatic mode, causing what appeared to be wick drying and subsequent flash freezing. The automatic control dynamics are such that this condition can be expected. The evaporator was frequently serviced with water in an attempt to keep it working under these conditions but was subsequently turned off.

The secondary coolant loop was tested for 8 hours with the secondary evaporator, which was serviced prior to flight. The test was begun with a heat load of 1400 watts; halfway through the test, the load was increased to 1800 watts. The dynamic response of the secondary evaporator was such that stable operation of the evaporator control system was achieved. Under the automatic demand, the evaporator was required about 50 minutes per revolution during the test. The secondary evaporator operated differently from the primary because the heat load was higher as a result of the lower capacity of the secondary radiators.

Moisture condensed on cold, uninsulated coolant lines, as anticipated, and was dumped overboard by the crew utilizing the urine transfer hose and cabin enrichment purge assembly. Some condensation was also noted in the suit umbilical hoses.

A water leak was observed at the B-nut connection to the waste water quick disconnect during the overboard dumps.

The urine dump system operated normally and no indication of freezing was observed.

Both cabin fans were operating at lift-off; however, one was turned off after orbital insertion to reduce the high noise level. The second cabin fan was subsequently turned off. The measured cabin temperature was between 65° and 75° F and was not significantly effected by fan operation.

CREW PROVISIONS

The crew equipment operated satisfactorily during the mission with the exception of the biomedical instrumentation equipment and the water metering dispenser.

Two discrepancies were encountered with the biomedical instrumentation equipment. First, a wire was broken at the connector to the EKG signal conditioner on each of two harnesses. In addition, the pin connectors to the sensors periodically became disconnected. Second, the dc-dc converter on the command module pilot was reported to have become warm. As a precautionary measure, the harnesses were disconnected from all three crewmen.

The manual triggering device for the water metering dispenser became increasingly difficult to operate as the mission progressed.

FLIGHT CREW ACTIVITIES

Crew performance was satisfactory throughout the mission, even though all three crewmen had head colds and congestion.

The mission was conducted essentially in accordance with the nominal flight plan. The only significant alteration to the flight plan was the rescheduling of the third service propulsion maneuver from the 58th to the 48th revolution. Additional photography was accommodated during the latter portion of the mission.

The deorbit, entry, and landing sequences were accomplished normally. The spacecraft assumed the stable II (apex-down) attitude after landing and was uprighted to the stable I (apex-up) position by inflation of the uprighting bags. The crew elected a helicopter pickup for the approximately 3-mile trip to the recovery carrier.

MISSION SUPPORT PERFORMANCE

FLIGHT CONTROL

Flight control performance was satisfactory for the entire mission; the only major ground system problem encountered was in the data recovery from the Manned Space Flight Network.

NETWORK

Network performance was satisfactory during the mission. Several minor problems were encountered, but none affected the mission operations.

RECOVERY

Recovery operations were successfully effected in the West Atlantic by the prime recovery ship, *USS Essex*, on October 22, 1968. The following table lists the major recovery events on October 22, 1968:

Greenwich mean time, hr:min	Event
11:05	S-band contact by recovery aircraft
11:08	VHF contact by recovery aircraft
11:12	Landing
11:34	Visual sighting by recovery aircraft
11:36	Radar contact by *USS Essex*
11:40	Flotation collar installed and inflated
13:03	Spacecraft aboard *USS Essex*

The spacecraft landing point was estimated from ship position (by LORAN) and a helicopter bearing to be 27° 33' north latitude, 64° 04' west longitude. The sea condition at the recovery site was moderate.

Because the spacecraft assumed a stable II orientation for approximately 12 minutes after landing, the operation of the command module voice transmitters and recovery beacons was temporarily interrupted.

EXPERIMENTS

Two experiments, Synoptic Terrain Photography and Synoptic Weather Photography, were included on this mission. Preliminary information indicates that most of the terrain photography was performed. For meteorological photography, 27 phenomena were of interest; at least 7 were apparently photographed and 8 others may have been. The most successful was photography of tropical storms. Three storms were in view of the spacecraft, two of which reached hurricane intensity.

TABLE I.- MANEUVER SUMMARY

Maneuver	Time, hr:min:sec	Duration, sec	Velocity change, ft/sec	Apogee/perigee, n. mi.
Phasing (reaction control system)	03:20:21	16.3	5.7	124/165
Phasing (reaction control system)	15:52:00	18.5	6.5	120/164
First service propulsion	26:24:55	10.0	206	125/196
Second service propulsion	28:00:56	7.8	175	114/153
Terminal phase initiate (reaction control system)	29:17:55		16.7	122/153
Terminal phase finalize (reaction control system)	29:54:33		17	122/161
Separation (reaction control system)	30:20:00	5.4	2	122/161
Third service propulsion	75:47:59	9.3	215	90/160
Fourth service propulsion	120:43:00	0.5	15.3	90/158
Fifth service propulsion	165:00:00	67.6	1692.0	90/245
Sixth service propulsion	210:08:00	0.5	18.6	90/236
Seventh service propulsion	239:06:11	7.9	277	90/231
Eighth service propulsion	259:39:16	11.8	350	

TABLE II.- ORBITAL ELEMENTS

Event	Condition	Before	After
Insertion	Apogee, n. mi. . . .		153.5
	Perigee, n. mi. . . .		122.6
	Period, min		89.70
	Inclination, deg . .		31.64
S-IVB safing	Apogee, n. mi. . . .	153.5	167.0
	Perigee, n. mi. . . .	122.6	122.8
	Period, min	89.70	89.86
	Inclination, deg . .	31.64	31.61
Reaction control system phasing maneuver	Apogee, n. mi. . . .	167.0	165.1
	Perigee, n. mi. . . .	122.8	124.1
	Period, min	89.86	89.88
	Inclination, deg . .	31.61	31.62
Reaction control system phasing maneuver	Apogee, n. mi. . . .	164.8	164.4
	Perigee, n. mi. . . .	123.9	119.8
	Period, min	89.87	89.75
	Inclination, deg . .	31.62	31.61
First service propulsion system maneuver	Apogee, n. mi. . . .	164.0	196.1
	Perigee, n. mi. . . .	119.9	125.1
	Period, min	89.75	90.43
	Inclination, deg . .	31.62	31.62
Second service propulsion system maneuver	Apogee, n. mi. . . .	196.1	153.1
	Perigee, n. mi. . . .	125.1	113.6
	Period, min	90.43	89.43
	Inclination, deg . .	31.61	31.62
Terminal phase initiation	Apogee, n. mi. . . .	153.1	153.9
	Perigee, n. mi. . . .	113.6	121.7
	Period, min	89.43	89.65
	Inclination, deg . .	31.62	31.62

TABLE II.- ORBITAL ELEMENTS - Concluded

Event	Condition	Before	After
Terminal phase finalize	Apogee, n. mi. . . . Perigee, n. mi. . . . Period, min . . . . . Inclination, deg . .	153.9 121.7 89.65 31.62	161.4 121.6 89.76 31.62
Separation after rendezvous	Apogee, n. mi. . . . Perigee, n. mi. . . . Period, min . . . . . Inclination, deg . .	161.4 121.6 89.76 31.62	161.5 122.0 89.83 31.64
Third service propulsion system maneuver	Apogee, n. mi. . . . Perigee, n. mi. . . . Period, min . . . . . Inclination, deg . .	159.3 121.5 89.68 31.61	160.0 90.3 89.13 31.23
Fourth service propulsion system maneuver	Apogee, n. mi. . . . Perigee, n. mi. . . . Period, min . . . . . Inclination, deg . .	150.7 88.9 88.99 31.23	157.5 90.3 89.15 31.25
Fifth service propulsion system maneuver	Apogee, n. mi. . . . Perigee, n. mi. . . . Period, min . . . . . Inclination, deg . .	148.6 89.4 88.87 31.22	244.7 89.8 90.72 31.07
Sixth service propulsion system maneuver	Apogee, n. mi. . . . Perigee, n. mi. . . . Period, min . . . . . Inclination, deg . .	236.3 90.1 90.61 30.10	236.2 90.2 90.61 30.06
Seventh service propulsion system maneuver	Apogee, n. mi. . . . Perigee, n. mi. . . . Period, min . . . . . Inclination, deg . .	230.8 90.2 90.51 30.07	231.3 90.0 90.51 29.86
Eighth service propulsion system maneuver (deorbit)	Apogee, n. mi. . . . Perigee, n. mi. . . . Period, min . . . . . Inclination, deg . .	227.0 90.0 90.45 29.89	

TABLE III.- SEQUENCE OF EVENTS

Event	Time, hr:min:sec	
	Planned	Actual
Launch Phase		
Range zero (15:02:45 G.m.t.)		
Lift-off (15:02:45.36 G.m.t.)	00:00:00.2	00:00:00.36
Maximum dynamic pressure	00:01:15.0	00:01:18.0
S-IB inboard engine cutoff	00:02:20.28	00:02:20.65
S-IB outboard engine cutoff	00:02:23.28	00:02:24.32
S-IB/S-IVB separation	00:02:24.58	00:02:25.59
S-IVB engine ignition	00:02:25.98	00:02:27.06
Escape tower jettison	00:02:43.28	00:02:46.54
S-IVB engine cutoff	00:10:14.80	00:10:16.76
Orbital Phase		
Orbital insertion	00:10:26.76	00:10:24.8
S-IVB safing start	01:34:27.0	01:34:28.96
S-IVB safing terminate	01:46:28.0	01:46:29.96
S-IVB takeover	02:29:55	Not avail.
CSM/S-IVB separation	02:54:55.17	02:55:07
First phasing maneuver (RCS) start	03:20:00	03:20:21
First phasing maneuver (RCS) cutoff	03:20:16.3	03:20:37.3
Second phasing maneuver (RCS) start	15:52:00	15:52:00
Second phasing maneuver (RCS) cutoff	15:52:18.5	15:52:18.5
First service propulsion ignition	26:24:55.2	26:24:55.2
First service propulsion cutoff	26:25:04.7	26:25:05.2
Second service propulsion ignition	28:00:56.0	28:00:56.0
Second service propulsion cutoff	28:01:03.8	28:01:03.8
Terminal phase initiate (RCS) start	29:18:34.0	29:17:55
Terminal phase initiate (RCS) cutoff		Not avail.
Terminal phase finalize (RCS) on	29:53:34	Not avail.
Terminal phase finalize (RCS) off		29:54:33

TABLE III.- SEQUENCE OF EVENTS - Concluded

Event	Time, hr:min:sec	
	Planned	Actual
Orbital Phase - Concluded		
Separation maneuver (RCS) start	30:20:00	30:20:00
Separation maneuver (RCS) cutoff	30:20:05.4	30:20:05.4
Third service propulsion ignition	75:47:58.6	75:47:58.6
Third service propulsion cutoff	75:48:07.8	75:48:07.9
Fourth service propulsion ignition	120:43:00	120:43:00
Fourth service propulsion cutoff	120:43:00.4	120:43:00.5
Fifth service propulsion ignition	165:00:00	165:00:00
Fifth service propulsion cutoff	165:01:05.9	165:01:07.6
Sixth service propulsion ignition	210:08:00	210:08:00
Sixth service propulsion cutoff	210:08:00.4	210:08:00.5
Seventh service propulsion ignition	239:06:11	239:06:11
Seventh service propulsion cutoff	239:06:18.8	239:06:18.9
Eighth service propulsion ignition	259:39:15.9	259:39:15.9
Eighth service propulsion cutoff	259:39:27.9	259:39:27.7
Entry Phase		
Command module/service module separation	259:40:58	259:40:46
Entry interface (400 000 feet)	259:53:26	259:53:25
Enter blackout	259:56:17	259:54:58
Leave blackout	259:59:14	259:59:46
Drogue deployment	260:03:28	260:03:30
Main parachute deployment	260:04:14	260:03:56
Landing	260:08:58	260:09:00