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PRELIMINARY

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13. ~~Generation of AT + Data~~

APOLLO 11 FLIGHT PLAN

AS-506/CSM-107/LM-5

Book Use in Review

APRIL 15, 1969

PREPARED BY
FLIGHT PLANNING BRANCH
FLIGHT CREW SUPPORT DIVISION

MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

SECTION I
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APOLLO 11

APOLLO AS-506/CSM-107/LM-5

PRELIMINARY FLIGHT PLAN

APRIL 15, 1969

Submitted by: ______________________________
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INTRODUCTION

This Flight Plan has been prepared by the Flight Planning Branch, Flight Crew Support Division, with technical support by TRW Systems.

This document schedules the AS-506/CSM-107/LM-5 operations and crew activities to fulfill, when possible, the test objectives defined in the Mission Requirements, G Type Mission Lunar Landing to be published.

The trajectory parameters used in this Flight Plan are for July 16, 1969 launch, with a 72° launch azimuth and were supplied by Mission Planning and Analysis Division as defined by the Apollo Mission G Spacecraft Operational Trajectory to be published.

The Apollo 11 Flight Plan is under the configuration control of the Crew Procedures Control Board (CPCB). All proposed changes to this document that fall in the following categories should be submitted to the CPCB via a Crew Procedures Change Request:

1. Items that impose additional crew training or impact crew procedures.

2. Items that impact the accomplishment of detailed test objectives.

3. Items that result in a significant RCS or EPS budget change.

4. Items that result in moving major activities to a different activity day in the Flight Plan.

5. Items that require a change to the flight data file.

The Chief, Flight Planning Branch (FCSD) will determine what proposed changes fall in the above categories.

Mr. T. A. Guillory will act as co-ordinator for all proposed changes to the Apollo 11 Flight Plan.

Any requests for additional copies or changes to the distribution lists of this document must be made in writing to Mr. W. J. North, Chief, Flight Crew Support Division, MSC, Houston, Texas.

ABBREVIATIONS

ACCEL	Accelerometer
ACN	Ascension
ACT	Activation
ACQ	Acquisition
AEA	Abort Electronics Assembly
AGS	Abort Guidance Subsystem
AH	Ampere Hours
ALT	Altitude
AMP or amp	Ampere
AMPL	Amplifier
ANG	Antigua
Ant	Antenna
AOH	Apollo Operations Handbook
AOS	Acquisition of Signal or Acquisition of Site
AOT	Alignment Optical Telescope
APS	Ascent Propulsion Subsystem
ARS	Atmosphere Revitalization
ATT	Attitude
AUX	Auxiliary
AZ	Azimuth
BAT	Battery
BDA	Bermuda
Bio	Bio-Medical Data on Voice Downlink
BP	Barber Pole
BT	Burn Time
BU	Backup
B&W	Black & White
BRKT	Bracket
CAP COM	Capsule Communicator
CAL γ	Calibration Angle
CAM	Camera
CB	Circuit Breaker
CDH	Constant Delta Altitude
CDR	Commander
CDU	Coupling Data Unit
CIRC	Circularization
CK	Check
CM	Command Module
CMC	Command Module Computer
CONT	Continue
CMD	Command
CMP	Command Module Pilot
CNTL	Control
C/O	Check out
COAS	Crew Optical Alignment Sight
COMM	Communications
CONFIG	Configuration
CONT	Continue
CP	Control Point
CRO	Carnarvon, Australia
CRYO	Cryogenic
CSI	Coelliptic Sequence Initiation Maneuver
CSM	Command Service Module
C&WS	Caution and Warning System
CYI	Grand Canary Island
DAP	Digital Auto Pilot
D/B	Deadband
DCA	Digital Command Assembly
DEDA	Data Entry and Display Assembly
DEGS	Degrees
DEPL	Depletion
DET	Determination or Digital Event Timer
DIFF	Difference
DK	Dock or Docked
DOI	Descent Orbit Insertion
DPS	Descent Propulsion Subsystem
DSE	Data Storage Equipment
DSKY	Display and Key Board
DTO	Detailed Test Objective
DUA	Digital Uplink Assembly
DWN	Down
E	Erasable
EASEP	Early Apollo Scientific Equipment Package
ECS	Environmental Control System
EFH	Earth Far Horizon
EI	Earth (atmosphere) Interface
EL	Elevation
ELM	Earth Landmark
EMS	Entry Monitor System
ENH	Earth Near Horizon
EPO	Earth Parking Orbit
EPS	Electrical Power Subsystem
EQUIP	Equipment
EST	Eastern Standard Time
EVA	Extravehicular Activity
EVAP	Evaporator
EVT	Extravehicular Transfer
EXT	External
f	F Stop
FC	Fuel Cell
FDAI	Flight Director Attitude Indicator
FLT	Flight
FM	Frequency Modulated
FOV	Field of View
fps or FPS	Feet per second
FT or ft	Feet
FTP	Full Throttle Position
GBI	Grand Bahama Islands, Eastern Test Range
GBM	Grand Bahama (MSFN)
GDC	Gyro Display Coupler
GDS	Goldstone, California
GET	Ground Elapsed Time
GETI	Ground Elapsed Time of Ignition
GLY	Glycol
GMT	Greenwich Mean Time
G&N	Guidance and Navigation
GNCS	Guidance Navigation Control System
GWM	Guam
GYM	Guaymas, Mexico
H2	Hydrogen
HA	Apogee Altitude
HAW	Hawaii
HBR	High Bit Rate (TLM)
HD	Highly Desirable
HGA	High Gain Antenna
HI	High
Hp	Perigee Altitude
HSK	Honeysuckle (Canberra, Australia)
HTR	Heater
HTV	USNS Huntsville
ICDU	Inertial Coupling Data Unit
ID	Identification
IGN	Ignition
IMU	Inertial Measurement Unit
INIT	Initialization
INT	Intervalometer
IP	Initial Point
IU	Instrumentation Unit
IVC	Intervehicular Communications
IVT	Intravehicular Transfer
JETT	Jettison
kwh	Kilowatt Hour
LA	Launch Azimuth
LAT	Latitude
LBR	Low Bit Rate (TLM)
LBS or lbs	Pounds
LCG	Liquid Cooled Garment
LDG	Landing
LDMK	Landmark
LEB	Lower Equipment Bay
LFH	Lunar Far Horizon
LGC	LM Guidance Computer
LH	Left-hand
L/H	Local Horizontal
LHEB	Left-hand Equipment Bay
LHFEB	Left-hand Forward Equipment Bay
LHSSC	Left Hand Side Storage Container
LiOH	Lithium Hydroxide
LLM	Lunar Landing Mission
LLOS	Landmark Line of Sight
LM	Lunar Module
LMP	Lunar Module Pilot
LNH	Lunar Near Horizon
LOI	Lunar Orbit Insertion
LONG	Longitude
LOS	Loss of Signal or Loss of Site
LPO	Lunar Parking Orbit
LR	Landing Radar
LT	Light
LTG	Lighting
LV	Launch Vehicle
L/V	Local Vertical
LVPD	Launch Vehicle Pressure Display
M	Mandatory
MAD	Madrid, Spain
MAN	Manual
MAX	Maximum
MAX Q	Maximum Dynamic Pressure
MCC	Midcourse Correction
MCC-H or MCC	Mission Control Center - Houston
MDC	Main Display Console
MEAS	Measurement
MER	USNS Mercury
MET	Mission Event Timer
MGA	Middle Gimbal Angle
M/I	Minimum Impulse
MIN	Minimum
MLA	Merrit Island, Florida
MNVR	Maneuver
MPS	Main Propulsion System
MSFN	Manned Space Flight Network
MTVC	Manual Thrust Vector Control
N2	Nitrogen
NAV	Navigation
NCC	Corrective Combination Maneuver
nm	Nautical Miles
NOM	Nominal
NSR	Nominal Slow Rate
NXX	Noun XX
O2	Oxygen
OBS	Observation
O/F	Oxidizer to Fuel Ratio
OGA	Outer Gimbal Angle
OMNI	Omnidirectional Antenna
OPS	Oxygen Purge System
ORB	Orbital
ORDEAL	Orbit Rate Display Earth and Lunar
ORIENT	Orientation
OVHD	Overhead
P	Pitch
PAD	Voice Update
PCM	Pulse Code Modulation
PC	Pericynthion
PGA	Pressure Garment Assembly
PGNCS	Primary Guidance Navigation Control Section
PIPA	Pulse Integrating Pendulous Accelerometer
PLSS	Portable Life Support Systems
PM	Phase Modulated
POL	Polarity or Polarizing
PRE	Pretoria, South Africa
PREF	Preferred
PREP	Preparation
PRESS	Pressure
PRIM	Primary
PT	Point
PROP	Proportional
PU	Propellant Utilization
PUGS	Propellant Utilization and Gaging System
PTC	Passive Thermal Control
PWR	Power
Pxx	Program XX
Qty	Quantity
R	Roll/Range
R&B	Red & Blue
RAD	Radiator
RCDR	Recorder
RCS	Reaction Control System
RCU	Remote Control Unit
RCV	Receiver
RED	USNS Redstone
REFSMMAT	Reference Stable Member Matrix
REG	Regulator
REQD	Required
RH	Right-hand
RLS	Radius of Landing Site
RNDZ	Rendezvous
RR	Rendezvous Radar
RSI	Roll Stability Indicator
RT	Real Time
RTC	Real-Time Command
Rxx	Routine XX
SA	Shaft Angle
S/C	Spacecraft
SCE	Signal Conditioning Equipment
SCS	Stabilization Control System
SCT	Scanning Telescope
SEC	Secondary
SECO	S-IVB Engine Cut-off
SEP	Separate
SEQ	Sequence
SIVB	Saturn IV B(Third Stage)
SLA	Service Module LM Adapter
SLOS	Star Line-of-Sight
SM	Service Module
SPOT	Spot Meter
SPS	Service Propulsion System
SR	Sunrise
SRC	Sample Return Container
SRX	S-Band Receiver Mode No. X
SS	Sunset
STX	S-Band Transmit Mode No. X
SWC	Solar Wind Component
Sw	Switch
SXT	Sextant
T EPHEM	Time of Ephemeris Update
TA	Trunnion Angle
TAN	Tananarive, Madagascar
TB (x)	Time Base No.
TCA	Time of Closest Approach
TD&E	Transposition Docking & LM Ejection
TEC	Trans Earth Coast
TEI	Transearth Insertion
TEMP	Temperature
TERM	Terminate
TEX	Corpus Christi, Texas
TGT	Target
TIG	Time of Ignition
TLC	Trans Lunar Coast
TLI	Translunar Insertion
TLM	Telemetry
TPF	Terminal Phase Final
TPI	Terminal Phase Initiation
TPM	Terminal Phase Midcourse
T/R	Transmitter/Receiver
TRANS	Translation
TV	Television
TVC	Thrust Vector Control
TWR	Tower
UMB	Umbilical
UNDK	Undock
US	United States Pass
V	Velocity
VAN	USNS Vanguard
VHF	Very High Frequency
VLV	Valve
VI	Inertial Velocity
VOX	Voice Keying
Vxx	Verb xx
W/O	Without
WRT	With Respect to
WTN	USNS Watertown
XFER	Transfer
XMIT	Transmit or Transmitter
XPONDER	Transponder
Y	Yaw
ΔV	Velocity Change (Differential)
ΔVC	Velocity Change at Engine Cutoff
ΔR	Position Change (Differential)
8-balls	Flight Director Attitude Indicator (FDAI)
X	CSM TCA

SECTION I - GENERAL

MISSION DESCRIPTION

1. Launch and E.P.O. (Duration 2:44) T_0 - 2:44 GET

   (a) Nominal launch time is 8:32 EST, July 16, 1969, with a launch window duration of 4 hrs. 24 min.
   (b) Earth orbit insertion into a 100 nm circular orbit at 11 min. 24 sec. after lift-off
   (c) CSM systems C/O in earth orbit
   (d) Optional IMU realign (P52) to the pad REFSMMAT during the first night period
   (e) TLI occurs at 2:44:18 GET over the Pacific Ocean during the second revolution. (See Table 1-1 for burn data).

2. Translunar Coast (Duration 73:11) 2:44 - 75:55 GET

   After TLI, which places the spacecraft in a free lunar return trajectory, the following major events occur prior to LOI:
   (a) Transposition, docking and LM ejection, including SIVB photography
   (b) Separation from SIVB and a CSM evasive maneuver
   (c) SIVB propulsive venting of propellants (slingshot)
   (d) Two series of P23 cislunar navigation sightings, star/earth horizon, consisting of five sets at 06:00 GET and five sets at 24:00 GET
   (e) Four midcourse corrections which take place at TLI + 9, TLI + 24, LOI - 22 and LOI - 5 hours with ΔV nominally zero (See Table 1-1).
   (f) Passive thermal control (PTC) will be conducted during all periods when other activities do not require different attitudes.
   (g) LM inspection and housekeeping
   (h) LOI_1, performed at 75:55:03 GET, ends the TLC phase.

3. Lunar Orbit (Duration 55:38) 75:55 - 131:33 GET

LOI Day

(a) LOI_1

(b) Photos of targets of opportunity

(c) LOI_2

(d) Post LOI_2 LM entry and inspection. Ten minutes of VHF-B LBR data will be transmitted to CSM/DSE for playback to MSFN.

(e) Post LOI_2 Pseudo landmark tracking (one set of sightings) (See Table 1-3)

(f) Rest period of 8 hours

4. Descent and Landing Day (Duration 23:48) 94:32 - 118:20 GET

(a) Docked LM activation and checkout

(b) Docked landing site landmark sighting (one set of sightings) (See Table 1-3)

(c) Undocking and separation (See Figure 1-3 Rendezvous Profile)

(d) DOI thru landing

(e) LM post touchdown and simulated liftoff

(f) Rest period (LM) of 4 hours

(g) CSM plane change

(h) Rest period (CSM) of 4 hours

5. LUNAR EXPLORATION DAY (Duration 10:30) 109:30 - 12:00 GET

(a) EVA prep

(b) EVA for 2 hours 40 minutes

(c) Post EVA

(d) Rest period (LM) 4 hours 40 minutes

(e) Rest period (CSM) 4 hours

6. Lift-Off, Rendezvous & TEI Day (Duration 17:00) 122:28 - 139:28 GET

(a) LM Lift-Off and Insertion

(b) LM active rendezvous

CSI

PC

CDH

TPI

(c) Docking

(d) LM jettison

(e) TEI

(f) Rest Period

7. Lunar Orbit Particulars (Average Values for a 60 x 60 nm orbit)

(a) Revolutions start at 180° longitude

(b) Revolution duration - 1 hr. 58.2 min.

(c) S/C night period duration - 47 min.

(d) MSFN coverage per rev. - 72 min.

(e) Orbit inclination - 1.25° for July 16, 1969 launch

(f) S/C orbital rate - 3°/min. (.05°/sec)

(g) Lighting change at fixed ground point - 1°West/Rev.

(h) Ground track change - 1°West/Rev. at equator

(i) Horizon visibility ± 20° selenocentric angle on the lunar surface

(j) One lunar degree on lunar surface is 16.38 nm.

(k) Site 2 will be visible (3° sun angle) at REV. 7

(l) S/C sublunar point to horizon 320 nm.

8. Transearth Coast and Entry (Duration 63:38) 131:29 - 195:07 GET

Transearth coast begins with TEI at 131:28:43 GET and consists of the following major events:

(a) Three midcourse corrections are scheduled at TEI + 17, EI - 22 and EI - 3 hours with ΔV nominally zero.

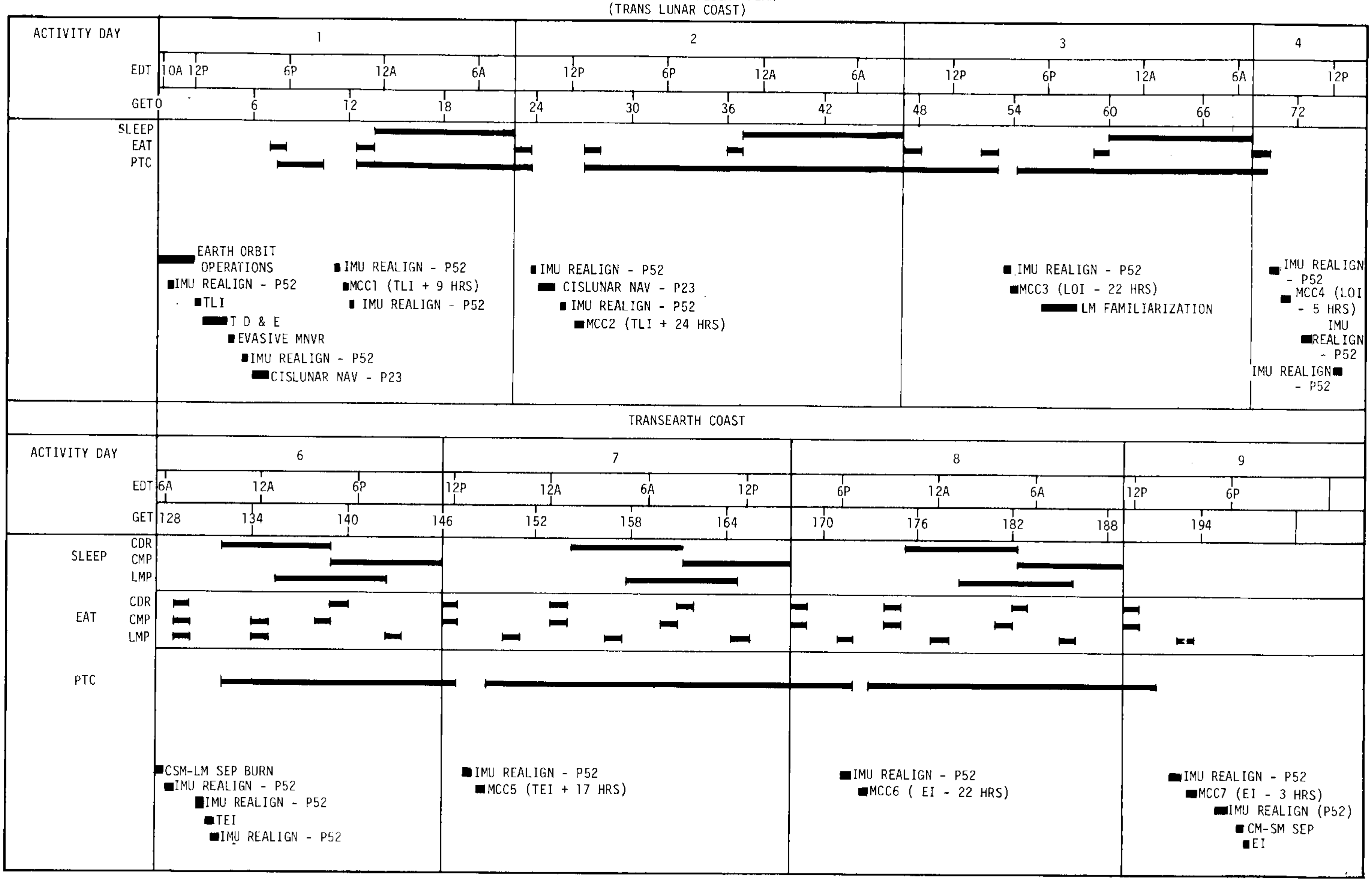
(b) CM/SM separation takes place at 194:51 GET and Entry Interface occurs at 195:06 GET.

(c) Splashdown will occur in the Pacific Ocean at a longitude of about 165^{o} west at 195:21 GET. This will occur approximately 15 minutes prior to sunrise local time.

(d) During TEC the crew will follow a staggered rest period so that at least one crewman will be awake to monitor PTC.

FIGURE 1-1

MISSION SUMMARY FLIGHT PLAN
(TRANS LUNAR COAST)



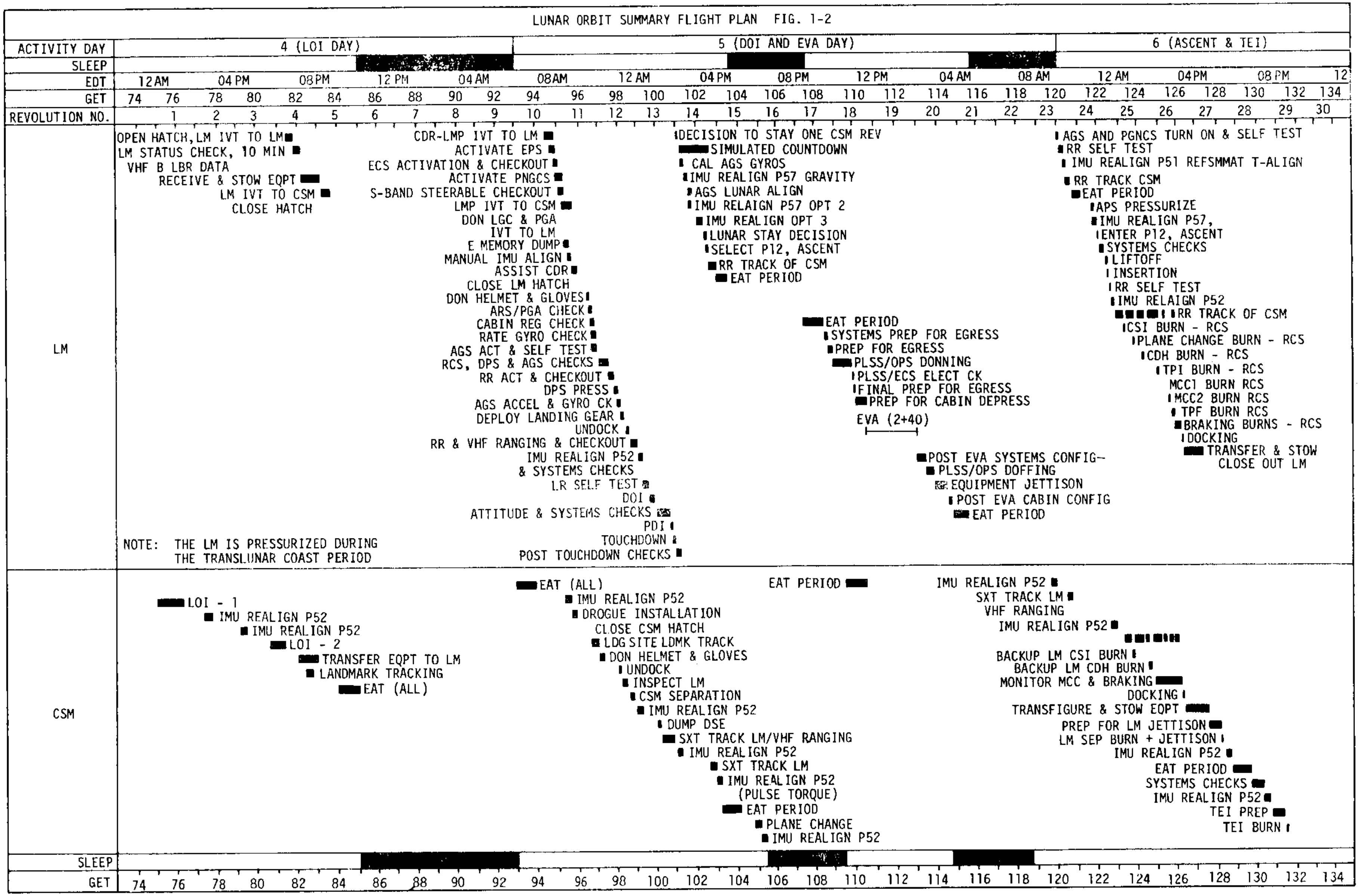
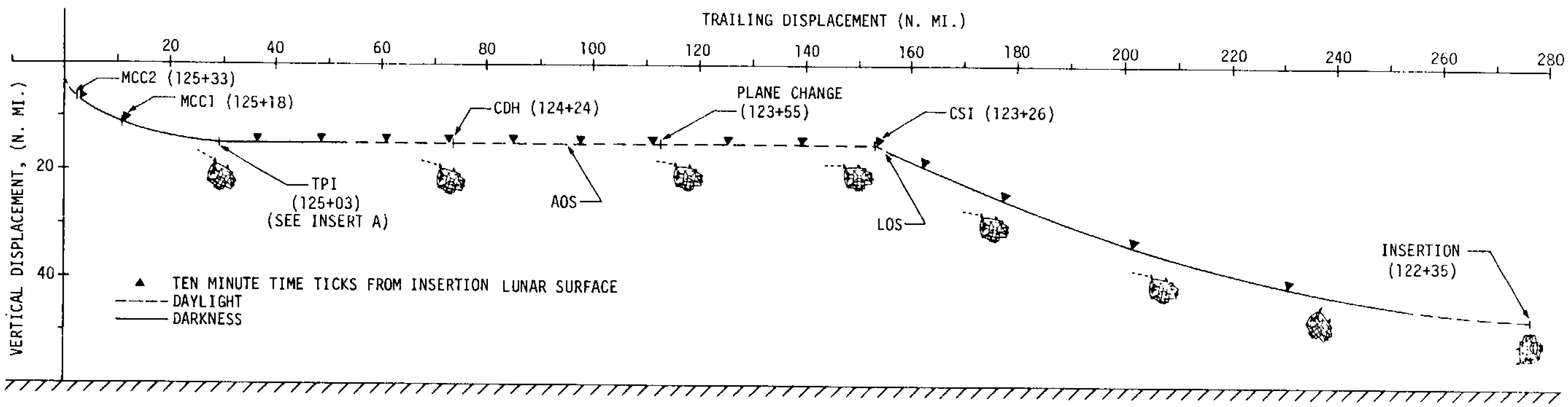
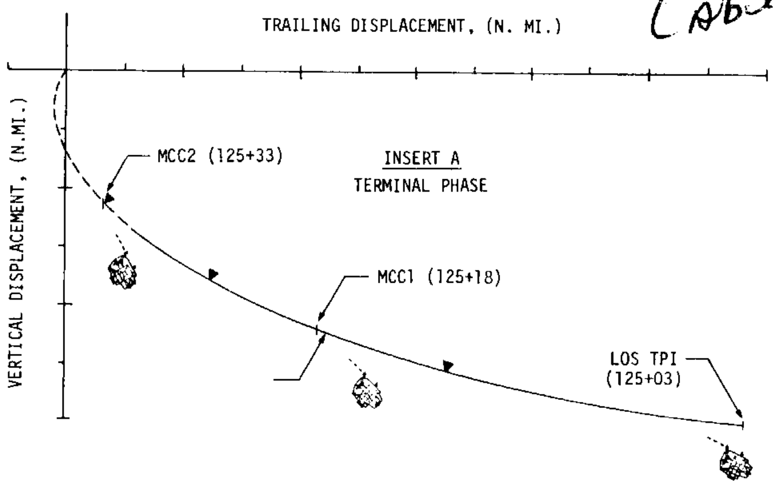

LUNAR ORBIT SUMMARY FLIGHT PLAN FIG. 1-2
ACTIVITY DAY
4 (LOI DAY)
5 (DOI AND EVA DAY)
6 (ASCENT & TEI)
SLEEP
EDT
12 AM 04 PM 08 PM 12 PM 04 AM 08 AM 12 AM 04 PM 08 PM 12 PM 04 AM 08 AM 12 AM 04 PM 08 PM 12
GET
74 76 78 80 82 84 86 88 90 92 94 96 98 100 102 104 106 108 110 112 114 116 118 120 122 124 126 128 130 132 134
REVOLUTION NO.
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
LM
OPEN HATCH, LM IVT TO LM
LM STATUS CHECK, 10 MIN
VHF B LBR DATA
RECEIVE & STOW EQPT
LM IVT TO CSM
CLOSE HATCH
CDR-LMP IVT TO LM
ACTIVATE EPS
ECS ACTIVATION & CHECKOUT
ACTIVATE PNGCS
S-BAND STEERABLE CHECKOUT
LMP IVT TO CSM
DON LGC & PGA
IVT TO LM
E MEMORY DUMP
MANUAL IMU ALIGN
ASSIST CDR
CLOSE LM HATCH
DON HELMET & GLOVES
ARS/PGA CHECK
CABIN REG CHECK
RATE GYRO CHECK
AGS ACT & SELF TEST
RCS, DPS & AGS CHECKS
RR ACT & CHECKOUT
DPS PRESS
AGS ACCEL & GYRO CK
DEPLOY LANDING GEAR
UNDOCK
RR & VHF RANGING & CHECKOUT
IMU REALIGN P52
& SYSTEMS CHECKS
LR SELF TEST
DOI
ATTITUDE & SYSTEMS CHECKS
PDI
TOUCHDOWN
POST TOUCHDOWN CHECKS
NOTE: THE LM IS PRESSURIZED DURING THE TRANSLUNAR COAST PERIOD
DECISION TO STAY ONE CSM REV
SIMULATED COUNTDOWN
CAL AGS GYROS
IMU REALIGN P57 GRAVITY
AGS LUNAR ALIGN
IMU RELAIGN P57 OPT 2
IMU REALIGN OPT 3
LUNAR STAY DECISION
SELECT P12, ASCENT
RR TRACK OF CSM
EAT PERIOD
EAT PERIOD
SYSTEMS PREP FOR EGRESS
PREP FOR EGRESS
PLSS/OPS DONNING
PLSS/ECS ELECT CK
FINAL PREP FOR EGRESS
PREP FOR CABIN DEPRESS
EVA (2+40)
POST EVA SYSTEMS CONFIG-
PLSS/OPS DOFFING
EQUIPMENT JETTISON
POST EVA CABIN CONFIG
EAT PERIOD
AGS AND PGNCS TURN ON & SELF TEST
RR SELF TEST
IMU REALIGN P51 REFSMMAT T-ALIGN
RR TRACK CSM
EAT PERIOD
APS PRESSURIZE
IMU REALIGN P57,
ENTER P12, ASCENT
SYSTEMS CHECKS
LIFTOFF
INSERTION
RR SELF TEST
IMU RELAIGN P52
RR TRACK OF CSM
CSI BURN - RCS
PLANE CHANGE BURN - RCS
CDH BURN - RCS
TPI BURN - RCS
MCC1 BURN RCS
MCC2 BURN RCS
TPF BURN RCS
BRAKING BURNS - RCS
DOCKING
TRANSFER & STOW
CLOSE OUT LM
CSM
LOI - 1
IMU REALIGN P52
IMU REALIGN P52
LOI - 2
TRANSFER EQPT TO LM
LANDMARK TRACKING
EAT (ALL)
EAT (ALL)
IMU REALIGN P52
DROGUE INSTALLATION
CLOSE CSM HATCH
LDG SITE LDMK TRACK
DON HELMET & GLOVES
UNDOCK
INSPECT LM
CSM SEPARATION
IMU REALIGN P52
DUMP DSE
SXT TRACK LM/VHF RANGING
IMU REALIGN P52
SXT TRACK LM
IMU REALIGN P52
(PULSE TORQUE)
EAT PERIOD
PLANE CHANGE
IMU REALIGN P52
EAT PERIOD
IMU REALIGN P52
SXT TRACK LM
VHF RANGING
IMU REALIGN P52
BACKUP LM CSI BURN
BACKUP LM CDH BURN
MONITOR MCC & BRAKING
DOCKING
TRANSFIGURE & STOW EQPT
PREP FOR LM JETTISON
LM SEP BURN + JETTISON
IMU REALIGN P52
EAT PERIOD
SYSTEMS CHECKS
IMU REALIGN P52
TEI PREP
TEI BURN
SLEEP
GET
74 76 78 80 82 84 86 88 90 92 94 96 98 100 102 104 106 108 110 112 114 116 118 120 122 124 126 128 130 132 134

FIGURE 1-3

ORBIT TRAVEL



Label?



G1 MISSION RENDEZVOUS
(CSM-CENTERED RELATIVE MOTION)

PREPARED BY STEPHEN P. GREGA
ORBITAL PROCEDURES SECTION

TABLE 1-1 CSM BURN SCHEDULE

BURN/MANEUVER	GETI BURN TIME ΔVc	ATTITUDE (DEG)		LIGHTING	ΔV (FPS)	ULLAGE ΔV (FPS)	TVC MODE	REFSMMAT	ΔV RESULT (SC WT, HP, HA)	REMARKS
		LH/LV	INERTIAL							
S-IVB TLI	2:44:18 5MIN 21 SEC	R: P: Y:	R: P: Y:	BURNOUT AT SUNRISE	ΔVX: ΔVY: ΔVZ: ΔV REQ: 10,446	—	—	PAD	WT: HP: HA:	S-IVB BURN
CSM/LM S-IVB EVASIVE MNVR	4:39:37 3 SEC	R:180 P:282.6 Y: 1.9	R:180.2 P:118.8 Y:329.6	SUNLIGHT	ΔVX: 5.1 ΔVY: 0.0 ΔVZ: 19.0 ΔV REQ: 19.7	NOT REQUIRED	G&N AUTO	PAD	WT: 96807 HP: HA:	SPS BURN
MIDCOURSE CORRECTIONS MCC_1 to MCC_4	11:24 26:44 53:55 70:55	R: - P: - Y: -	R: - P: - Y: -	--	ΔVX: NOMINALLY ΔVY: ZERO ΔVZ: ΔV REQ:	NOT REQUIRED	G&N AUTO	PAD PTC PTC LDG SITE		TLI + 9 TLI + 24 LOI - 22 LOI - 5
LOI_1	75:55:03 6 MIN 5 SEC	R:357.9 P:165.4 Y:349.6	R:357.9 P:227.1 Y:345.1	DAYLIGHT (SS-1HR 8 MIN)	ΔVX: -2892.8 ΔVY: - 425.9 ΔVZ: - 50.3 ΔV REQ: -2924.4	NOT REQUIRED	G&N AUTO	LDG SITE	WT: 95013.8 HP: 60 HA: 170	SPS BURN
LOI_2	80:12:01 14 SEC	R: 0 P:182.1 Y:357.6	R: 13.3 P:239.3 Y:357.6	DAYLIGHT (SR+14 MIN)	ΔVX: -138.5 ΔVY: 0 ΔVZ: - 70.8 ΔV REQ: -138.5	2 Jet 14 Sec fps	G&N AUTO	LDG SITE	WT: 71148.9 HP: 60 HA: 60	SPS BURN
CSM/LM SEP	98:43:14 7 SEC	R: 0 P:269.8 Y: 0	R: 0 P:193.6 Y: 0	SUNLIGHT (SS-14 MIN)	ΔVX: 0 ΔVY: 0 ΔVZ: 2.5 ΔV REQ: 2.5	—	G&N AUTO	LDG SITE	WT: 36276.2 HP: HA:	RCS BURN
CSM PLANE CHANGE	105:09:17 1 SEC	R:276.2 P:263.9 Y: 88.2	R:276.2 P: 95.6 Y: 88.3	DARKNESS (SS+16 MIN)	ΔVX: 0 ΔVY: 16.5 ΔVZ: 0 ΔV REQ: 16.5	2 Jet 19 Sec fps	G&N AUTO	PLANE CHANGE	WT: 36264.9 HP: HA:	SPS BURN
LM JETTISON	128:24:26 3 SEC	R: 0 P: 180 Y: 0	R: 0 P: 84.5 Y: 0	DAYLIGHT (SS+12 MIN)	ΔVX: -1.0 ΔVY: 0 ΔVZ: 0 ΔV REQ: -1.0		G&N AUTO	LIFT OFF	WT: 36370.9 HP: HA:	RCS BURN
TEI	131:28:43 2 MIN 29 SEC	R:181.5 P:353.2 Y: 13.2	R: 181.6 P: 57.6 Y: 13.2	DAYLIGHT (SR+8 MIN)	ΔVX: 3078.1 ΔVY: 708.2 ΔVZ: 39.0 ΔV REQ: 3158.7	2 Jet 14 Sec fps	G&N AUTO	LIFT OFF	WT: 33626.6 HP: HA:	SPS BURN
MIDCOURSE CORRECTIONS MCC_5 to MCC_7	148:28 173:00 192:06	R: P: Y:	R: P: Y:	—	ΔVX: ΔVY: NOMINALLY ΔVZ: ZERO ΔV REQ:	—	G&N AUTO	PTC PTC ENTRY	—	TEI + 17 EI - 22 EI - 3

TABLE 1-2 LM BURN SCHEDULE

BURN/MANEUVER	GETI BURN TIME ΔVc	ATTITUDE (DEG) LH/LV	 INERTIAL	LIGHTING	ΔV (FPS)	ULLAGE ΔV (FPS)	TVC MODE	REFSMMAT	ΔV RESULT (SC ST, HP, HA)	REMARKS
DOI	99:42:27 28 SEC 71.6	R: 0 P: 180 Y: 1.4	R: 0.1 P: 75.8 Y: 0	DARKNESS (SR - 2 MIN)	ΔVX: +57.4 ΔVY: -39.1 ΔVZ: -17.1 ΔV REQ: 71.6	2 Jet 7.5 Sec 1.5 fps	PGNCS AUTO	LDG SITE	WT: 33,686 HP: 8.23NM HA: 58.1 NM	DPS BURN
PDI	100:38:57 11MIN 53SEC 6747	R: 181.2 P: 171.7 Y: 0	R: 0 P: 104.2 Y: 0	DAYLIGHT	ΔVX: -4324 ΔVY: 3137 ΔVZ: 1365 ΔV REQ: 6747	2 Jet 7 1/2 Sec 1.5 fps	PGNCS AUTO	LDG SITE	WT: 16,624 HP: HA:	DPS BURN
ASCENT	122:28:11 434.6 SEC 6550	R: 0 P: 0 Y: 0	R: 0 P: 0 Y: 0	DAYLIGHT	ΔVX: ΔVY: ΔVZ: ΔV REQ:	—	PGNCS AUTO	LIFT OFF	WT: 5,894 AT INS HP: HA:	APS BURN
CSI	123:26:27 45.8 SEC 50.1	R: 0 P: 90 Y: 0	R: 0 P: 172 Y: 0	DARKNESS (SR - 4 MIN)	ΔVX: 50.1 ΔVY: 0.0 ΔVZ: 0.1 ΔV REQ: 50.1	—	PGNCS AUTO	LIFT OFF	WT: 5894.57 HP: 44.7 HA: 45.7	RCS + Z 2 JET BURN
PLANE CHANGE	123:55:25 0 0	R: - P: - Y: -	R: - P: - Y: -	DAYLIGHT (SR + 25 MIN)	ΔVX: 0 ΔVY: 0 ΔVZ: 0 ΔV REQ: 0	—	PGNCS AUTO	LIFT OFF	WT: 5895 HP: 44.7 HA: 45.7	RCS + Y 2 JET BURN
CDH	124:24:25 2.8 6.0	R: 0 P: 90 Y: 0	R: 0 P: 7.5 Y: 0	DAYLIGHT (SS - 15 MIN)	ΔVX: -0.2 ΔVY: 0.0 ΔVZ: 6.0 ΔV REQ: 6.0	—	PGNCS AUTO	LIFT OFF	WT: 5861 (TIG) HP: 44.4 HA: 45.0	RCS - X 4 JET BURN
TPI	125:02:45 23.3 25.7	R: 0 P: 117.8 Y: 0	R: 0.1 P: 276 Y: 0.2	DARKNESS (MIDDLE OF DARKNESS)	ΔVX: 22.9 ΔVY: -0.1 ΔVZ: -11.5 ΔV REQ: 25.7	—	PGNCS AUTO	LIFT OFF	WT: 5857 HP: 43.8 HA: 62.6	RCS + Z 2 JET BURN
MCC_1	125:17:46 0 0	R: - P: - Y: -	R: - P: - Y: -	DARKNESS (SR - 7 MIN)	ΔVX: 0 ΔVY: 0 ΔVZ: 0 ΔV REQ: 0		PGNCS AUTO	LIFT OFF	WT: 5840 HP: 43.8 HA: 62.6	RCS + Z 2 JET BURN NOMINALLY ZERO
MCC_2	125:32:46 0 0	R: - P: - Y: -	R: - P: - Y: -	DAYLIGHT (SR + 8 MIN)	ΔVX: 0 ΔVY: 0 ΔVZ: 0 ΔV REQ: 0		PGNCS AUTO	LIFT OFF	WT: 5840 HP: 43.8 HA: 62.6	
1st BRAKING MNVR	125:42:22 0 0	R: - P: - Y: -	R: - P: - Y: -	DAYLIGHT (SR + 17 MIN)	ΔVX: 0 ΔVY: 0 ΔVZ: 0 ΔV REQ: 0		MANUAL	LIFT OFF	WT: 5840 HP: 44.6 HA: 62.3	RCS - Z 2 JET BURN
2nd BRAKING MNVR	125:44:03 9.6 SEC 10.6	R: 0.1 P: 210.4 Y: 259.9	R: 259.9 P: 118.3 Y: 0.1	DAYLIGHT (SR + 19 MIN)	ΔVX: ΔVY: ΔVZ: ΔV REQ: 10.6	—	MANUAL	LIFT OFF	WT: 5839 HP: 49.3 HA: 61.7	RCS - Z 2 JET BURN
3rd BRAKING MNVR	125:45:16 9.0 SEC 9.9	R: 0.1 P: 216.4 Y: 259.8	R: 259.8 P: 244.0 Y: 0.1	DAYLIGHT (SR + 20 MIN)	ΔVX: ΔVY: ΔVZ: ΔV REQ: 9.9		MANUAL	LIFT OFF	WT: 5832 HP: 54.1 HA: 61.2	RCS - Z 2 JET BURN
4th BRAKING MNVR	125:46:55 4.3 SEC 4.8	R: 0.1 P: 221.3 Y: 259.8	R: 259.8 P: 243.9 Y: 0.1	DAYLIGHT (SR + 22 MIN)	ΔVX: ΔVY: ΔVZ: ΔV REQ: 4.8	—	MANUAL	LIFT OFF	WT: 5825 HP: 56.6 HA: 61.0	RCS - Z 2 JET BURN
5th BRAKING MNVR	125:48:14 4.2 SEC 4.7	R: 0.1 P: 226.8 Y: 259.9	R: 259.9 P: 244.4 Y: 0.1	DAYLIGHT (SR + 23 MIN)	ΔVX: ΔVY: ΔVZ: ΔV REQ: 4.7	—	MANUAL	LIFT OFF	WT: 5822 HP: 59.1 HA: 60.9	RCS - Z 2 JET BURN

TABLE 1-3 LUNAR LANDING SITE DATA

DAY	SITE DESIG.	LAT.	LONG.	SUN ELEVATION ANGLES*	
				(72^{0}L.AZ.)	(108^{0}L.AZ.)
JULY 16	2(II P6)	0^{0}43'N.	23^{0}42'E.	10^{0}	13^{0}
JULY 18	3(II P8)	0^{0}21'N.	1^{0}18'W.	8^{0}	11^{0}
JULY 21	5(II P13)	1^{0}42'N.	41^{0}54'W.	6^{0}	9^{0}

*Sun elevation angles are for approximately 25 hours after LOI_1.

TABLE 1-4 LANDMARK TRACKING DATA
(JULY 16 LAUNCH)

SITE DESIG.	LAT.	LONG.	SUN EL.	GET
IP (F1)	1^{0}17'N.	93^{0}50'E.	69^{0}	82:40
F1 (Pseudo)	1^{0}40'N.	86^{0}53'E.	62^{0}	82:42
IP (130)	1^{0}53'N.	28^{0}42'E.	12^{0}	96:48
LDMK 130 (LDG SITE 2)	1^{0}16'N.	23^{0}41'E.	7^{0}	96:50

Correc DATA

CSM FLIGHT PLAN NOTES

A. Crew

1. Crew designations are as follows:

Designation	Prime	Backup
Commander (CDR)	Armstrong	Lovell
Command Module Pilot (CMP)	Collins	Anders
Lunar Module Pilot (LMP)	Aldrin	Haise

2. Couch positions during the mission are as follows:

	Left	Center	Right
Launch	CDR	LMP	CMP
EPO	CDR	LMP	CMP
TLI	CDR	LMP	CMP
T&D	CMP	CDR	LMP
MCC's	CMP	CDR	LMP
LOI_1 + LOI_2	CMP	CDR	LMP
TEI	CMP	CDR	LMP
MCC's	CMP	CDR	LMP
ENTRY	CMP	CDR	LMP

3. All crewmen will sleep simultaneously during TLC and be awake during all major burns. The crew will follow a staggered sleep period during TEC.
   Two crewmen will normally be in the sleep stations under the couches and one in the left couch. During the LOI Day sleep period, two crewmen will be in the couches because the probe and drogue will be stored in one of the sleep stations.

4. The crew will eat together when possible during meal periods (normally of 1-hour duration). Additional activities will be held to a minimum during meals.

5. PGA's will be worn during the following periods, but will not be "hard suited".

(a) Launch - With helmet and gloves

(b) Earth Orbit - without helmet and gloves

(c) TLI - With helmet and gloves

(d) Undocking and docking - With helmet and gloves

PGA's will not be worn for entry

6. During the mission, two crew status reports via air-to-ground communications will be made by the flight crew during each activity day. The first report will be given after the first meal of the day and will concern the sleep obtained during the previous sleep period. The second report will be given following the final meal of the day and will concern the radiation dose received during the previous 24 hours. The following information should be transmitted or logged as indicated:
   (a) A daily report of each crewman's best estimate as to sleep quantity and quality.
   (b) A daily report of the integrated radiation dose each crewman receives.
   (c) An onboard record of food and water consumption and exercise (no voice report required).
   (d) Used fecal bags will be marked as to crewman and GET.

7. General flight plan updates containing changes to the scheduled next day's activities will be voiced up once a day.

8. Negative reporting will be used in reporting completion of each checklist.

9. No CSM biomedical switching is required. Continuous biomedical data are automatically transmitted to the ground simultaneously for all crewmen.

10. One crewman will wear headsets at all times during the mission.

11. All onboard gage readings will be read directly from the gages and will not be corrected by the appropriate calibration factors.

12. Periodic spacecraft systems monitoring is a continuing task and is not specifically scheduled in the flight plan timeline.

3. Maneuvers

1. CSM/LM and CSM attitude maneuvers will normally be at a rate of 0.2^{0}/sec. or 0.5^{0} sec. unless other rates are required.
NOTE: At 0.2^{0}/sec 15 minutes is required to maneuver 180^{0}. At 0.5^{0}/sec, 6 minutes is required to maneuver 180^{0}.

2. Passive thermal control mode will be initiated before MCC_1 and maintained throughout the mission (except in lunar orbit) until at least three hours before entry except for interruptions for midcourse corrections, communications orientation (maximum interruption of three hours). PTC will not be initiated until approximately 7:00 GET.

3. In order to conserve SM RCS, the SPS engine will be used to "back-up" all LM rendezvous burns. The SPS gimbal motors will not be turned on during the "back-up" maneuver preparation. The CSM backup burn will be delayed 3 min. for the LM insertion burn only.

4. The first SPS burn will be on engine valves BANK "A" and the second burn will be on BANK "B".

C. Electrical Power System and Water Management

1. Spacecraft lift-off switch positions are listed in the Apollo Operations Handbook (Volume 2) for CSM 107.

2. The CSM will remain fully powered up throughout the mission (CMC, IMU and SCS in the "operate" configuration and optics power-up as required).

3. Fuel cell H_2 and O_2 purging is scheduled as follows: H_2 approximately every 24 hours and O_2 approximately every 48 hours.

4. Hydrogen VAC ION pumps will be inactive throughout the mission. The fuses will be pulled.

5. The O_2 VAC ION PUMP MAIN A/MAIN B CB (2) (Panel No. 229) will be open for launch but will be closed at 85% - 90% QTY (after pressure about VAC ION pump circuitry has decreased to vacuum and before pressure about the VAC ION pump increases significantly).

6. Potable water will be chlorinated once a day before each sleep period.

7. FC purges or waste water dumps will not be scheduled within one hour prior to optical sightings.

8. Waste H_2O dumping will be managed to allow:

   (a) Maximum QTY:85-90%
   (b) Minimum QTY:25%
   (c) At LOI:QTY = 75%
   (d) At CM-SM SEP:QTY = 90%
   (e) No dumping after MCC until after LOI.
   (f) Dumps will be performed (if required) within 2 hours preceding MCC maneuvers.
   (g) In lunar orbit if dumping is required, dumps will be performed immediately prior to sleep periods
   (h) The water dump will not be operated in the automatic mode at anytime during the mission.

9. The cryogenic heaters will be in AUTO during the mission and the fans will be operated manually. The fans will be cycled for one minute before and after each sleep cycle.

10. The batteries will be charged after TLI, LOI_2 and TEI. It is desirable to charge batteries during crew sleep period in order to get uninterrupted charge.

D. Environmental Control System and Cabin Pressurization

1. One CO_2 odor absorber filter (LiOH canister) is changed approximately every 12 hours or if CO_2 partial pressure is greater than 7.6mm Hg. There are 20 filters (2 in the canisters onboard and 18 stowed). The filter schedule is shown on Figure 1-4

2. An ECS redundant component check including the secondary evaporator operation, is performed at 24-hour intervals (in order to prevent secondary evaporator dry out), and prior to TLI, LOI (approximately 7 hours before), and entry (approximately 6 hours before). The secondary evaporator water control valves will be turned "OFF" after the check.

3. The evaporator operation will be as follows:

   (a) Launch - primary loop operation
   (b) Earth Orbit - primary loop operation and secondary loop test plus redundant operation test
   (c) Post TLI - deactivate both evaporators
   (d) LOI Minus 2 hours - activate primary evaporator
   (e) Post TEI - deactivate primary evaporator
   (f) Entry interface Minus 1.5 hours - activate primary evaporator
   (g) Secondary evaporator may be activated (EI - 1 hour) at crew option for cold soak.

4. At lift-off the cabin will contain a 60% O_2/40% N_2 gas mixture. Cabin O_2 purge will be initiated after launch and will be terminated after TLI and prior to LM pressurization.

5. After the LM is pressurized (before ejection from the SIVB), the CSM maintains LM pressure by placing the LM/CM pressurization valve in the LM position (panel 12). This allows a maximum of 1.2 pounds per hour of O_2 flow into the LM. MCC-H will monitor O_2 usage and determine if excessive leak rates are being experienced by the combined CSM and LM.

6. The CM tunnel hatch will be installed during the docked lunar orbit sleep period and the probe and drogue will be stored in one of the sleep stations.

7. There is no CSM PTC mode required in lunar orbit, but a special attitude (see Communications Notes) will be maintained during the sleep period.

E. Guidance and Navigation

1. During lunar orbit, the CSM and LM will utilize the same landing site REFSMMAT such that the gimbal angles would be 0,0,0 at GET 100:50:50 (CSM) with the LM sitting face forward on landing site number two and the CSM over the landing site pitched up 90° from local horizontal "heads up".

2. The IMU will be pulse-torqued to a PTC REFSMMAT Prior to setting up the PTC mode in order to avoid gimbal lock. Prior to a ΔV maneuver or midcourse navigation sightings, if yaw gimbal angle exceeds 60°, the IMU will be pulse-torqued back to the pad or landing site REFSMMAT and an IMU fine align (P52) will be performed. Pulse rate per axis is $1/2^{\circ}$/second. The accuracy for pulse-torquing the platform is 0.002 times the total angle.

3. The CMC will use the COLOSSUS 2A COMANCHE 51 flight program.

4. The CSM tracking light will be on continuously from undocking to landing and from LM lift-off to docking.

F. Procedures

1. Crew procedures called out in the flight plan may be found in the following documents:

   (a) Apollo Operations Handbook - CSM-107 (AOH), Volume 2
   (b) Apollo Operations Handbook - LM-5 (AOH), Volume 2
   (c) Crew Checklist
   (d) Rendezvous Procedure document
   (e) Abort Summary document
   (f) Reentry Procedures document
   (g) Photography and TV Operations Plan
   (h) Descent Procedures document
   (i) Lunar Surface Operations Plan

G. Photography

1. There are requirements for photography and TV. These will be scheduled with other mission activities in the timeline (Section III).

2. Cameras and film are provided to photograph the following activities:

   (a) Transposition/Docking
   (b) Distance Earth Photography
   (c) Long Distance Lunar Photography
   (d) LM Undocking and Inspection
   (e) LM Tracking During Descent
   (f) Lunar Mapping Photography
   (g) Crew Activities Evaluation
   (h) Crew Observations
   (i) LM Tracking During Ascent and Rendezvous

3. <u>Landmark Tracking</u>

The following assumption and data requirements were used in developing the landmark tracking procedures.

(a) IMU to be realigned on the dark side preceding each tracking period.

(b) MSFN coverage is reacquired after each tracking period. The tracking data will be acquired by MSFN after all the marks have been made and while N49 (ΔR,ΔV) is displayed. MSFN will give a GO when data acquisition has been verified.

(c) The first mark will be taken with the spacecraft 30° to 40° above local horizontal. The time between marks should be a minimum of 25 seconds.

(d) The pseudo landmark tracking will be used to determine the altitude of an area in which the LM will be making altitude checks after DOI. The data will be processed during the sleep period after the trackings and relayed to the LM prior to undocking.

(e) The PRN range code will be transmitted and reacquired twice at AOS on the tracking revs to increase accuracy.

Table 1-4

LiOH CANISTER CHANGE SCHEDULE

CHANGE NUMBER	GET OF CHANGE	INTERVAL BETWEEN CHANGE (HRS:MIN)	ABSORBER USE TIME (CAN. NO.-HRS:MIN)
-	PRELAUNCH	-	-
1	10:30		*1 - 14:30
		12:00	
2	22:30		*2 - 26:30
		13:00	
3	35:30		3 - 25:00
		12:30	
4	48:00		4 - 25:30
		11:00	
5	59:00		5 - 23:30
		11:30	
6	71:30		6 - 22:30
		12:30	
7	84:00		7 - 24:00
		12:00	
8	96:00		8 - 24:30
		13:30	
9	109:30		9 - 25:30
		11:30	
10	121:00		10 - 25:00
		12:00	
11	133:00		11 - 23:30
		12:00	
12	145:00		12 - 24:00
		11:30	
13	156:30		13 - 23:30
		11:30	
14	168:00		14 - 23:00
		12:00	
15	180:00		15 - 23:30
		11:00	
16	191:00		16 - 23:00
		-	
17	-		17 - 15:00
		-	
18	-		18 - 04:00
			19 - NOT USED
			20 - NOT USED

* ASSUMES 4HR PRE LAUNCH USE

LUNAR MODULE FLIGHT PLAN NOTES

A. Crew

1. There will be two entries to the LM scheduled prior to LM activation and checkout. The first will be for crew familiarization scheduled at 56:00 GET, after MCC_3, and will be performed by the CDR and LMP in flight coveralls. The second IVT is scheduled at 81:30 GET, after LOI_2 and will be performed by the LMP in flight coveralls.

2. During the initial IVT (crew familiarization) the LM will not be powered up. To insure the switch settings as specified by the prelaunch configuration (LM-5 AOH Volume II) the Docking Hatch Switch will be secured "off".

3. The LMP will initiate the final LM activation and checkout in coveralls. The CDR will enter the LM in his PGA (without donning helmet and gloves). The LMP will return to the CM and don his PGA (without helmet and gloves). The LMP and CDR will don helmets and gloves and perform a PGA/ARS pressure integrity check just prior to the LM cabin regulator check.

4. The LM switch settings at the initial entry will be specified in the LM-5 AOH Volume II.

5. Two PLSS's and two OPS will be carried in the LM. The OPS's will be checked out prior to undocking during the housekeeping activities.

6. The CM transfer umbilical will not be used during LM activation and checkout.

7. The LM crew will be suited (without helmet and gloves) during the undocked portion of the mission. For undocking, staging, descent, ascent, and rendezvous the LM crew will be fully suited.

B. Guidance and Navigation

1. The LGC will use the LUMINARY-1A Revision 96 Flight Program.

2. The LM AGS will use Flight Program X.

3. Two LGC erasable memory dumps and MCC-H verifications will be accomplished prior to DOI. If a significant number of errors are found, memory correction and re-verification will be performed before DOI.

4. The LM IMU will be manually aligned to the CSM IMU during the DOI Day LM activation and checkout. P-52/AOT alignments will be performed as soon as possible prior to DOI.

5. All maneuvers during the undocked manned LM operations will be under PGNCS control.

6. The capability for MCC-H to update the LGC via uplink will normally be blocked by the LMP UP-DATA LINK switch (panel 12).

7. A LM COAS star sighting will be used during the DOI maneuver to check IMU drift rates. The star should remain within 2° of the initial COAS position during the maneuver. The AOT will not be used for this purpose. The lunar horizon will not be visible during the DOI maneuver.

C. RCS Operation and Interface Constraints

1. During CSM/LM docked checkout operations, the LM steerable and/or RR antennas will not be powered down once they have been activated.

The SM B3(-x) thruster will be deactivated before the LM steerable and/or RR antennas have been unstowed in order to prevent SM-RCS impingement on these antennas.

2. LM RCS "+x" two jet ullage (System B) will be used for unstaged ullage maneuvers in order to prevent asymetrical RCS thrust caused by impingement on the descent stage.

3. The RCS interconnect will be used during the APS lift-off and ascent, but will not be used during the rendezvous maneuvers because of helium injestion.

D. Passive Thermal Control Maneuvers

1. There is no requirement to perform any LM passive thermal control maneuvers during lunar orbit.

2. There will be no telemetry or crew monitoring of LM temperatures (or any other LM data) between LM pre-launch checkout and the post LOI-2 LM entry and inspection.

E. Rendezvous Radar

1. The turn-on and turn-off times for the rendezvous radar will be scheduled in such a manner as to prevent overheating of the rendezvous radar antenna.

2. Accurate RR range and range rate telemetry data will not be obtained on the lunar farside because a HBR TLM capability is not available between the LM and CSM for subsequent DSE dump after AOS. This situation prevents MSFN from analyzing the RR systems operation and LM RR LGC state vector update. Therefore, MSFN will check the accuracy of the update against ground

computation after AOS and update the LM state vector if required.

3. The RR shaft and trunion angles will be at zero during each AGS RR update.

F. Rendezvous

1. The LM tracking light will be on continuously between separation and touchdown and between launch and docking (except during PGNCS/AOT alignments). During PGNCS/AOT alignments (LM P52), the CSM will not be able to optically track the LM.

G. LM Pressurization

The LM cabin will contain N_2 and some ambient air at launch and will bleed down to zero pressure psi during the launch.
The LM will be pressurized after transposition and docking and will remain pressurized until jettisoned.

H. LM Activation and Checkout Notes

The following activities will be performed during the periods as shown:

1. Post MCC_3

Perform general housekeeping chores
LM will not be powered up
Transfer equipment to LM (crew option)

2. Post LOI-2:

LM entry status check
Transfer from CSM to LM power for 10 minutes
Activate VHF-B LBR telemetry for 10 minutes
OPS check
Transfer all or remaining equipment to the LM
Perform general housekeeping chores

3. Docked Pre-DOI:

Verify CSM to LM roll calibration angle
LM entry status check
EPS activation - descent and ascent stage battery checkout
Inverter No. 2 checkout
Primary glycol loop activation
Caution and warning system checkout
Circuit breaker activation
Talkback system verification
ECS activation and checkout
Glycol pump checks (1, 2 and secondary)
VHF-B Simplex activation and C/O
VHF-A Simplex activation and C/O
Suit fan and water separation check
S-Band steerable antenna checks (TLM-HBR Mode 6.2)
PGNCS turn on and self test
S-Band secondary transeiver and amplifier checks (Mode 6.2)
LGC erasable memory dumps (two) and MSFN verification

LGC/CMC clock set and T-EPHEM update
LM docked-manual IMU alignment
AGS activation and self test
ARS/PGA pressure integrity checks
Cabin regulator checks
ORDEAL initialization
Rate gyro check
LGC DAP data load
Uplink the LM state vector, AGS "K" factor and REFSMMAT
DPS gimbal drive and throttle test
RCS Pressurization
RCS checkout (cold and hot fire)
AGS accelerometer and gyro calibration
DPS pressurization and checkout
Deploy landing gear
Update and align AGS to PGNCS
Unstow RR antenna and perform self test

4. Undocked Pre-DOI

LM inspection by CSM
Rendezvous radar tracking (P20)
VHF ranging operations
LM tracking light operation
IMU/AOT alignment
AGS initialization and update
Landing radar self test
AGS accelerometer and gyro calibration
Parallel ascent and descent stage batteries

5. DOI to Touchdown

Maneuver to PDI attitude

Mode II Rendezvous Radar lock - on

Update, align, and configure LM AGS's

MCC-H dump DSE

LM pitch over at P64

Manual attitude control to touchdown

CSM P20 auto maneuver for sextant track of the LM

6. Touchdown to Lift Off

Go/no go for 7 minutes

CSM P52 realign option 3 REFSMMAT

GO/no go for one CSM revolution

Simulated countdown

Calibrate AGS gyros

Ascent power - off

Initiate DPS venting

Load AGS ascent targeting

P57 gravity measure

AGS lunar align

P57 IMU realign, REFSMMAT option, 2, celestial body option, update RLS

P22 auto optics lunar optics

Align AGS to PGNCS

P27 update

P57 IMU realign T-align, gravity and one celestial body

PGNCS drift test

Go/no go for lunar stay

Initiate AGS

Align AGS to PGNCS

P22 orbital navigation

Select P12 ascent

End simulated countdown
AGS power down
P52 IMU realign option/preferred plan change REFSMMAT
Eat period (CSM & LM)
Rest period (CSM & LM)
SPS plane change
P52 IMU realign option 1 preferred
Landing site REFSMMAT
Systems preparation for egress
Preparation for egress
Pressure integrity check
Depressurize cabin, open hatch
EVA
Post EVA systems configuration
Rest period

7. <u>Preparation for Lift Off</u>
LGC self test
AGS turn on, self test & systems test
Turn on RR & self test
P57 IMU realign REFSMMAT gravity vector and celestial body
P22 lunar surface navigation
AGS lunar align
Eat period (CSM & LM)
DAP load
EPS, ED, ECS prestaging checks
APS pressurization and checkout
P57 IMU realign, T-align, gravity and initialize AGS SV
Enter P12
Prelaunch systems check
RR to operate
Align AGS to PGNCS
APS, lift-off

I. LM Procedures

Crew procedures called out in the flight plan may be found in the following documents:

(a) Apollo Operations Handbook LM-5, Vol. 2
(b) Crew Checklist
(c) LM Rendezvous Procedures Document
(d) LM Descent/Ascent Summary Document
(e) Photography and TV Operations Plan

J. Photography

Cameras and film will be carried aboard the LM to photograph the following activities:

(a) Record the movements of the astronauts during the LM egress on the lunar surface for crew integration studies in preparation for future missions.
(b) Obtain photographs of the astronauts environment relative to his ability to function on the lunar surface.
(c) Obtain photographs of the LM and LM subsystems for engineering post flight analysis.
(d) Obtain photographs of the lunar science experiments state after development to be used for data reduction and post flight analysis of the findings.
(e) Obtain photographs of the moon and its environment for subsequent scientific analysis.

COMMUNICATIONS PLAN

General mission notes and mission phase operational philosophies are presented in this section. The communications considerations include voice, data, ranging and recording by both spacecraft.

A basic communications switch configuration for both spacecraft is presented. Variations from the basic communications required during the mission phases are identified under the appropriate mission phase.

A. General Notes

1. All voice communications, CSM and LM HBR data transmissions at lunar distance will normally require the use of the high gain or steerable antennas with 85-ft. and 30-ft. "cooled" MSFN antennas.

2. During communications, the spacecraft will be referred to by name (Apollo 11) and MCC-H will be referred to as Houston. Code names may be assigned to the CSM and LM for undocked operations.

3. The timeline will show when the CAP-COMM should send voice data simultaneously to the CSM and LM. Only one MCC-H CAP-COMM will normally be used for all CSM and LM communications.

4. It is desirable that LM/CSM be configured to HBR during any MSFN uplinks so that MSFN can verify data was received by the spacecraft.

5. The preferred inflight S-Band communications mode for CSM and LM are:

   (a) Uplink Mode 6 (Voice, PRN and Updata)
   (b) Downlink Mode 2 (Voice, PRN, TLM-HBR)

6. A basic communications switch configuration for the LM and CSM is as follows:

CSM

Audio panel (3)
- MODE (3) - INTERCOM/PTT
- S BD (3) - T/R
- SUIT PWR (3) - on (up)
- AUDIO CONT (3) - NORM
- PWR (3) - AUDIO/TONE
- VHF AM (3) - T/R
- INTERCOM (3) - T/R
- PAD COMM (3) - OFF

S-band normal
- S BD XPNDR - PRIM
- S BD PWR AMPL PRIM - PRIM
- S BD PWR AMPL HI - HI
- S BD MODE VOICE - VOICE
- S BD MODE PCM - PCM
- S BD MODE RNG - RNG

VHF AM
- VHF AM A - OFF
- VHF AM B - off (ctr)
- VHF AM RCV - off (ctr)

VHF BCN - OFF

VHF RNG - OFF

TAPE recorder
- TAPE RCDR PCM - PCM/ANLG
- TAPE RCDR RCD - RCD
- TAPE RCDR FWD - FWD

S band aux
- S BD AUX TAPE - off (ctr)
- S BD AUX TV - off (ctr)

Up TLM
- UP TLM DATA - DATA
- UP TLM CMD - NORM
- PWR AMPL tb - gray
  (indicates pwr to amplifier)
- TAPE MOTION tb - gray
  (indicates tape motion)

S Band Antenna
- S BD ANT OMNI A - A
- S BD ANT OMNI - OMNI

Power
- SCE - NORM
- PMP - NORM

TLM inputs
- PCM BIT RATE - LO

VHF ANT - SM LEFT

RNDZ XPNDR - OFF (PNL 100)

RNDZ XPNDR - OPR (PNL 101)

S BD SQLCH - OFF

UP TLM - BLOCK (MDC-2)

UP TLM - ACCEPT (PNL 122)

LM

CB/AC BUS B = S BD ANT - close

CB/AC BUS A: TAPE RCDR - close

CB COMM:

UP DATA LINK - close

COMM: UPLINK SQUELCH sw - ENABLE

UP DATA LINK sw - OFF

SEC S BD XMTR/RCVR - close

SEC S BD PWR/AMPL - close

VHF B XMTR - close

VHF A RCVR - close

CDR AUDIO - close

AUDIO: (CDR)

S-BAND T/R sw - S BAND T/R

ICS T/R sw - ICS T/R

RELAY ON sw - RELAY OFF

MODE sw - ICS/PTT

AUDIO CONT sw - NORM

VHF A sw - T/R

VHF B sw - OFF

CB COMM:

DISP - close

SE AUDIO - close

VHF A XMTR - close

VHF B RCVR - close

PRIM S BD PWR AMPL - close

PRIM S BD XMTR/RCVR - close

S BD ANT - close

PMP - close

TV - open

CB HTR: S BD ANT - close

CB CAMR: SEQ - open

AUDIO: (LMP)

S BAND T/R sw - S BAND T/R

ICS T/R sw - ICS T/R

RELAY ON sw - RELAY OFF

MODE sw - ICS/PTT

AUDIO CONT sw - NORM

VHF A sw - T/R

VHF B sw - OFF

COMM:

S BAND MODULATE sw - PM

S BAND XMTR/RCVR sw - PRIM

S BAND PWR AMPL sw - PRIM

S BAND VOICE sw - VOICE

S BAND PCM sw - PCM

S BAND RANGE sw - RANGE

VHF A XMTR sw - VOICE

VHF A RCVR sw - ON

VHF B XMTR sw - DATA

VHF B RCVR sw - OFF

TLM BIOMED sw - as required

TLM PCM sw - HI

RECORD sw - OFF

COMM ANT:

VHF ANTENNA - FWD/AFT

TRACK MODE sw - AUTO

S-Band sel - SLEW

7. MSFN will not switch CSM or LM antennas - this will be a crew action (except during sleep - if required).

8. CSM recording of LM VHF B LBR TM is not possible during periods when VHF ranging between the vehicles is taking place.

9. CSM S-Band backup communication modes checks will not be made. The LM communication system will be used as a backup communication system.

10. CSM FM modes are used for DSE playbacks, TV and backup TM. The high gain antenna will be required for FM operations after TLI.

11. CSM-TV can be scheduled in real time if the Goldstone 85-ft. antenna is in view of the spacecraft. CSM-TV via the Madrid 85-ft. antenna should be scheduled approximately 15 hours in advance in order to reserve communications satellite time.

12. The CM communications system switches will be configured to permit MCC-H real time control of routine communications switching and maximum crew control of the communications without the crew having to use CMD RESET.

13. The CSM updata link will normally be blocked by the crew Up TLM ACCEPT/BLOCK switch on MDC 2. This will not prevent MCC-H from using real time comm and from controlling the communication system.

14. The S-Band "squelch" will be on during the simultaneous sleep period in order to prevent MSFN fade-out noise from disturbing the crew.

15. LM voice recorder has a maximum utilization of 10 hours. This recorder will be used during LM operations to record all LM voice data during undocked operations (27 hours 42 minutes). The recorder will be operated in the VOX mode.

16. A small portable voice recorder will be carried in the CM to be used at the discretion of the crew as a voice recorder backup. This recorder will not be transferred to the LM for use during undocked operations.

17. LM AGS initialization requires HBR because the AGS uses the PGNCS TLM downlink state vector and times as the data source.

18. CSM DSE will be operated as follows:

   . The DSE will normally be operated via ground command except for special cases where the operation is time limited. In these cases the crew may be asked (either by voice or flight plan update) to rewind the tape.

   . DSE will be operated HBR during the launch phase. These data will be dumped if real time launch data are lost.

   . During the earth orbit period when the CSM is not over a MSFN station, CSM TLM-LBR data will be recorded on the DSE and will be dumped during the pass over the US and over CRO prior to TLI,if possible.

   . DSE will be used for CSM HBR and voice recording during all CSM engine burns.

   . DSE data and voice recordings will be made in CSM LBR mode whenever possible in order to minimize the DSE dump time.

- All critical data will be hand recorded by the crew when not in voice contact with MSFN if at all possible. DSE voice recording will be used as backup for recording critical data.

- During translunar PTC simultaneous sleep periods using the HGA REACQ communications mode the DSE will be used to record LBR data when the HGA is not in the MSFN field of view.

- During lunar orbit LM operations, the DSE will be used to record LM-TLM-LBR data during all LM phases/events that occur on the lunar farside (unless VHF ranging is required).

- During lunar orbit, time (in the attitude hold control mode) will be provided in the flight timeline to allow for MCC-H DSE dump, rewind and start of DSE after each MSFN AOS (acquisition of signal) except where a DSE dump would interfere with DSE recording of critical CSM backup TLM data or the HGA is not visible to MSFN.

- Twenty-five minutes will normally be allowed for the complete data dump cycle for CSM and LM LBR data recorded on the lunar farside. HBR data will require additional dump time depending on the length of the recording.

- DSE will be used to record all HBR entry data during the blackout region.

B. Launch - Earth Orbit Phase

1. OMNI B and VHF LEFT will be selected for launch. OMNI D will be selected by the crew during boost phase if the launch azimuth is less than 96° or OMNI C if the launch azimuth is azimuth is greater than 96°. OMNI D will probably be the best antenna for earth orbit.

2. VHF Duplex B will be used for launch, and Simplex A for earth orbit operations.

3. VHF Simplex A will be used for entry to be compatible with recovery forces communications.

C. Translunar and Transearth Coast Phase

1. The translunar and transearth sleep communications mode will be as follows: The CSM x-axis will be placed normal to the ecliptic plane. The CSM will be placed in GNCS $\pm 20°$ pitch and yaw attitude hold. All four SM RCS quads will be used. The CSM will be rolled at a rate of approximately one revolution per hour. During the near earth sleep periods prior to 30 hours GET (range less than 120Knm) omni antennas B and D can be used. During the other sleep periods (beyond 120Knm) the high gain antenna can be used in the REACQ mode (panel 2). The REACQ configuration will provide approximately 210 degrees of HGA coverage per CSM/LM revolution or 35 minutes of MSFN coverage per hour, (for a CSM spin rate of one revolution per hour). The REACQ configuration will also allow MCC-H to use real time control to select TLM HBR or LBR and to dump the DSE during each spacecraft revolution. The REACQ sleep mode will be checked before the second translunar coast sleep period.

2. During translunar and transearth coast PTC mode crew awake periods, the crew will use manual antenna switching to maintain continuous communications with MSFN via OMNI and/or HGA. If OMNI's are used the S-Band squelch will be disabled to allow the crew to use the upvoice discriminator noise as a cue to indicate when to switch to another OMNI.

3. All CSM communications checkouts may be performed during translunar coast (post TD&E to pre-LOI), however, the lunar sleep comm mode will be checked during lunar orbit prior to sleep.

D. <u>Lunar Orbit Phase</u>

1. During CSM/LM lunar orbit, docked, crew awake, coasting flight operations, one standard attitude (referenced to the landing site REFSMMAT) will be used in order to allow MSFN to acquire either the CSM HGA or LM steerable antenna without crew assistance.

2. After each AOS in lunar orbit, MSFN will send the PRN range code to acquire and lock-on the spacecraft for ranging determination. Upon acquisition the Clock Doppler System is also utilized for incremental ranging determination. The time required for PRN lock-on and ranging is approximately 6 minutes and is a continuous operation until LOS.

3. During lunar orbit, the CSM and LM S-Bands will remain operational on the lunar farside.

4. The LM steerable antenna and the CSM HGA will not be in view of MSFN during CSM tracking of the landing site while docked. The CSM HGA will not be in view of MSFN when undocked during CSM tracking. To allow communications with MSFN, the CSM and LM omni antennas and LBR are selected.

5. VHF Ranging/Data switching will be performed along with CSM sextant tracking of the LM. Voice silence between vehicles should be maintained for approximately 10 seconds while acquiring VHF ranging.

6. VHF A Simplex is normally used for all VHF Voice Communications except during VHF ranging when VHF B Duplex is being used.

7. At LOS the CSM crew will initiate Up TLM CMD RESET then NORMAL if DSE motion is not noted. This indicates that MSFN lost contact prior to reconfiguring DSE after a dump.

8. The communications mode for the lunar orbit sleep period will be as follows:
   The CSM will be referenced to landing site number two and will be in an attitude which will place two RCS quads toward the sun and two RCS quads toward the lunar surface. The SPS engine will be pointed toward the earth, and the spacecraft pitched to allow the HGA to acquire MSFN without interference from the SPS engine bell. The HGA will be in the REACQ mode and S-Band squelch will be enabled. The S-Band system will be controlled by RTC at MCC-H and will be in TLM-HBR on the lunar earthside and LBR/DSE recording on the lunar farside. This procedure will provide approximately 75 minutes of HBR for each lunar orbit and will permit MCC-H real time control of the DSE and playback of LBR data recorded on the lunar farside. This communication mode will be checked for suitability just prior to the lunar orbit sleep period.

9. In lunar orbit, MSFN will acquire the CSM high gain antenna/LM steerable antenna for each AOS unless specified differently in the flight plan timeline.

10. LM TLM will be switched to LBR at each LOS and to HBR at AOS by the LMP unless specified otherwise in the flight plan timeline.

11. LM Bio-Med switching will be checked out in lunar orbit and will begin whe- the CDR enters the LM for activation and checkout (approximately 94:50 GET). The LMP will switch the Bio-Med telemetry from the CDR to the LMP at a convenient time in the flight plan (approximately 99:10 GET). The crewman will be monitored continuously beginning with LM ingress and lunar stay, through docking and LM egress. While both crewmen are in the LM the LMP will manually switch the Bio-Med monitor system every two hours except during the sleep period. During EVA the crewman will monitored simultaneously through the Extra Vehicular Communications Systems EVCS) relayed to MCC-H via LM S-Band telemetry.

E. Lunar Exploration Phase

1. Normal CSM communications between MSFN/LM will be by S-Band during the lunar exploration period.

2. If additional communications capability is required the S-Band erectable antenna will be deployed by the EVA crewman and will be utilized for all LM/MSFN/CSM communications.

3. During periods when both crewmen are EVA, the "AR" position (Relay Mode) will be the normal communicatin mode on each of the Extravehicular Communication Sustem (EVCS). The CDR will relay teh LMP VHF voice and Data to the LM which in turn will relay to MCC-H via S-Band.

4. When both crewmen are EVA, the LM will be configured to the basic communications except for the following:

   S BAND MODULATE sw - FM
   VHF ANTENNA - EVA
   S BAND sel - LUNAR STAY
   AUDIO: MODE sw - VOX (both)
   AUDIO: RELAY ON sw - RELAY ON (LMP)

SECTION II

SECTION II - UPDATE FORMS

MANEUVER UPDATE FORMS

This section contains samples of the update pads which are contained in the In Flight Data File onboard the spacecraft. The CSM forms are as follows:

1. TLI Maneuver
2. P37 Block Data
3. P27 Update
4. P30 Maneuver (External ΔV)
5. Entry
6. Earth Orbit Entry Update
7. Earth Orbit Block Data
8. CSM SEP Pad
9. CSM Rescue One
10. DOI P76 Pad
11. CSI
12. CDH
13. TPI

The LM forms are:

1. P30 LM Maneuver (External ΔV)
2. P27 Update
3. P76 Update
4. P32 CSI Update
5. P33 CDH Update
6. P34 TPI Update
7. AGS State Vector Update
8. PDI Pad
9. Lunar Interface Pad
10. LM Ascent Pad

TLI

X						X						TB6p	
X	X	X				X	X	X				R	
X	X	X				X	X	X				P	TLI
X	X	X				X	X	X				Y	
X	X	X				X	X	X				BT	
												ΔVC'	
+						+						VI	
X	X	X				X	X	X				R	
X	X	X				X	X	X				P	SEP
X	X	X				X	X	X				Y	
X	X	X				X	X	X				R	
X	X	X				X	X	X				P	EXTRACTION
X	X	X				X	X	X				Y	

TLI 10 MIN ABORT P = __ __ __

APRIL 1, 1969

TLI PAD

TB 6p	X:XX:XX(HRS:MIN:SEC)	PREDICTED TIME OF BEGINNING OF S-IVB RESTART PREPARATION FOR TLI (TB6 = TLI IGN -9 MIN)
R P Y	XXX (DEG) XXX (DEG) XXX (DEG)	PREDICTED SPACECRAFT IMU GIMBAL ANGLES AT TLI IGNITION
BT	XX:XX (MIN:SEC)	DURATION OF TLI BURN
Δ VC'	XXXXX.X (fps)	NOMINAL TLI ΔV SET INTO EMS ΔV CONTROL
VI	+XXXXX fps)	NOMINAL INERTIAL VELOCITY DISPLAYED ON DSKY AT TLI CUTOFF
R SEP P SEP Y SEP	XXX (DEG) XXX (DEG) XXX (DEG)	PREDICTED SPACECRAFT IMU GIMBAL ANGLES AT COMPLETION OF S-IVB MNVR TO CSM/S-IVB SEP ATTITUDE
TLI 10 MIN ABORT P		PITCH ANGLE TO PERFORM TLI ABORT MANEUVER

P37 BLOCK DATA

										GETI
X					X					ΔVT
X					X					LONG
										GET_{400K}
										GETI
X					X					ΔVT
X					X					LONG
										GET_{400K}
										GETI
X					X					ΔVT
X					X					LONG
										GET_{400K}
										GETI
X					X					ΔVT
X					X					LONG
										GET_{400K}
										GETI
X					X					ΔVT
X					X					LONG
										GET_{400K}
										GETI
X					X					ΔVT
X					X					LONG
										GET_{400K}
										GETI
X					X					ΔVT
X					X					LONG
										GET_{400K}

P37 BLOCK DATA

GETI	XXX:XX	TIME OF IGNITION (HR. MIN.)
ΔVT	XXXX (FPS)	DELTA V REQUIRED AT GETI.
LONG	± XXX (DEG)	LONGITUDE OF LANDING SITE
GET_{400K}	XXX:XX	TIME OF ENTRY INTERFACE

P27

P27

P27

APRIL 1, 1969

P27 UPDATE

PURP			V					V					V		
GET		:	:				:	:				:	:		
304 01	INDEX					INDEX					INDEX				
02															
03															
04															
05															
06															
07															
10															
11															
12															
13															
14															
15															
16															
17															
20															
21															
22															
23															
24															

N34 HRS	X	X	X				X	X	X			
MIN	X	X	X	X			X	X	X	X		
NAV CHECK SEC	X	X					X	X				
N43 LAT		0						0				
LONG												
ALT	+	0					+	0				

P27 UPDATE

PURP	XXX	TYPE OF DATA TO BE RECEIVED (SUCH AS: NAV - LIFT-OFF TIME)
V	XX	TYPE OF COMMAND LOAD (70 - 71 - 72 - 73)
GET	XXX:XX:XX(HR:MIN:SEC)	TIME DATA RECORDED
01	XX (OCTAL)	INDEX NO. OF COMMAND WORDS IN LOAD
02-24	XXXXX	NO. OF CORRECTION COMMAND WORDS
NAV CHECK		TO CONFIRM POINT ABOVE GROUND TRACK FOR A GIVEN TIME
T	XX:XX:XX(HRS:MIN:SEC)	TIME
LAT	XX:XX (DEG)	LATITUDE
LONG	XXX:XX (DEG)	LONGITUDE
ALT	XXX.X (nm)	ALTITUDE

P30 MANEUVER

SET STARS

^{R}ALIGN ___ ___ ___

^{P}ALIGN ___ ___ ___

^{Y}ALIGN ___ ___ ___

ULLAGE ______

HORIZON/WINDOW ___

OTHER ______

							PURPOSE
							PROP/GUID
	+						WT N47
		0	0	•			P_{TRIM} N48
		0	0	•			Y_{TRIM}
	+	0	0				HRS GETI
	+	0	0	0			MIN N33
	+	0		•			SEC
					•		ΔV_X N81
					•		ΔV_Y
					•		ΔV_Z
	X	X	X				R
	X	X	X				P
	X	X	X				Y
	+				•		H_A N44
					•		H_P
	+				•		ΔVT
	X	X	X	:			BT
	X				•		ΔVC
	X	X	X	X			SXTS
	+			•		0	SFT
	+		•		0	0	TRN
	X	X	X				BSS
	X	X	☐		•		SPA
	X	X	X	☐	•		SXP
		0		•			LAT N61
				•			LONG
	+				•		RTGO EMS
	+						VIO
			:		:		GET 0.05G

P30

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P30 MANEUVER

PURPOSE	XXXXXX	TYPE OF MNVR TO BE PERFORMED
PROP/GUID		PROPULSION SYSTEM (SPS/RCS)/ GUIDANCE (SCS/G&N)
WT	XXXXX (lbs)	PREMANEUVER VEHICLE WEIGHT
P TRIM	X.XX (DEG)	SPS PITCH GIMBAL OFFSET TO PLACE THRUST THROUGH THE CG
Y TRIM	X.XX (DEG)	SPS YAW GIMBAL OFFSET TO PLACE THRUST THROUGH THE CG
GETI	XX:XX:XX (HRS:MIN:SEC)	TIME OF MNVR IGNITION
ΔVX ΔVY ΔVZ	XXXX.X (fps) XXXX.X (fps) XXXX.X (fps)	P30 VELOCITY TO BE GAINED COMPONENTS IN LOCAL VERTICAL COORDINATES
R P Y	XXX (DEG) XXX (DEG) XXX (DEG)	IMU GIMBAL ANGLES OF MANEUVER ATTITUDE
H_A	XXXX.X (nm)	PREDICTED APOGEE ALTITUDE AFTER MANEUVER
H_P	XXXX.X (nm)	PREDICTED PERIGEE ALTITUDE AFTER MANEUVER
ΔVT	XXXX.X	TOTAL VELOCITY OF MANEUVER
BT	X:XX (MIN:SEC)	MANEUVER DURATION
ΔVC	XXXX.X (fps)	PREMANEUVER ΔV SETTING IN EMS ΔV COUNTER
SXTS	XX (OCTAL)	SEXTANT STAR FOR MANEUVER ATTITUDE CK
SFT	XXX.X (DEG)	SEXTANT SHAFT SETTING FOR MANEUVER ATTITUDE CK
TRN	XX.X (DEG)	SEXTANT TRUNNION SETTING FOR MANEUVER ATTITUDE CK
BSS	XXX (OCTAL)	BORESIGHT STAR FOR MANEUVER ATTITUDE CK USING THE COAS
SPA	XX.X (DEG)	BSS PITCH ANGLE ON COAS

MANEUVER PAD (cont'd)

SXP	X.X (DEG)	BSS X POSITION ON COAS
LAT LONG	XX.XX XXX.XX	LATITUDE AND LONGITUDE OF THE LANDING POINT FOR ENTRY GUIDANCE
RTGO	XXXX.X	RANGE TO GO FOR EMS INITIALIZATION
VIO	XXXXXX (fps)	INERTIAL VELOCITY AT .05G FOR EMS INITIALIZATION
GET(.05G)	XX:XX:XX	TIME OF .05G
SET STARS		STARS FOR TELESCOPE FOR BACKUP GDC ALIGN
R, P, Y (ALIGN)		ATTITUDE TO BE SET IN ATTITUDE SET TW FOR BACKUP GDC ALIGN
ULLAGE		NO. OF SM RCS JETS USED AND LENGTH OF TIME OF USSAGE
HORIZON WINDOW		WINDOW MARKING AT WHICH HORIZON IS PLACED AT A SPECIFIED TIG (ATT CK)
OTHER		ADDITIONAL REMARKS VOICE UP BY MCC-H

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ENTRY

												AREA
X	X	X				X	X	X				R 0.05 G
X	X	X				X	X	X				P 0.05G
X	X	X				X	X	X				Y 0.05G
		:		:				:		:		GET HOR CK
X	X	X				X	X	X				P EI-17
☐	0		.			☐	0		.			LAT N61
☐			.			☐			.			LONG
X	X	X		.		X	X	X		.		MAX G
+						+						V_{400K} N60
-	0	0	.			-	0	0	.			γ 400K
+				.		+				.		RTGO EMS
+						+						V10
		:	:					:	:			RRT
X	X		:			X	X		:			RET 0.05G
+	0	0	.			+	0	0	.			D_L MAX N69
+	0	0	.			+	0	0	.			D_L MIN
+						+						V_L MAX
+						+						V_L MIN
X	X	X	.			X	X	X	.			D_O
X	X		:			X	X		:			RET V_{CIRC}
X	X		:			X	X		:			RETBBO
X	X		:			X	X		:			RETEBO
X	X		:			X	X		:			RETDRO
X	X	X	X			X	X	X	X			SXTS
+			.		0	+			.		0	SFT EI-2
+		.		0	0	+		.		0	0	TRN
X	X	X				X	X	X				BSS
X	X	☐		.		X	X	☐		.		SPA EI-2
X	X	X	☐	.		X	X	X	☐	.		SXP
X	X	X	X			X	X	X	X			LIFT VECTOR

LUNAR ENTRY

APRIL 1, 1969

LUNAR ENTRY

ENTRY PAD

AREA	XXX	SPLASHDOWN AREA DEFINED BY TARGET LINE
R .05G P .05G Y .05G	XXX(DEG) XXX(DEG) XXX(DEG)	SPACECRAFT IMU GIMBAL ANGLES REQUIRED FOR AERODYNAMIC TRIM AT .05G
GET (HOR CK)	XX:XX:XX (HRS:MIN:SEC)	TIME OF ENTRY ATTITUDE HORIZ CHECK AT EI -17 MIN.
P (HOR CK)	XXX(DEG)	PITCH ATTITUDE FOR HORIZON CHECK AT EI -17 MIN
LAT	±XX.XX(DEG)	LATITUDE OF TARGET POINT
LONG	±XXX.XX(DEG)	LONGITUDE OF TARGET POINT
MAX G	XX.X (G's)	PREDICTED MAXIMUM REENTRY ACCELERATION
V_{400K}	XXXXX (fps)	INERTIAL VELOCITY AT ENTRY INTERFACE
γ_{400K}	X.XX(DEG)	INERTIAL FLIGHT PATH ANGLE AT ENTRY INTERFACE
RTGO	+XXXX.X(nm)	RANGE TO GO FROM .05G TO TARGET FOR EMS INITIALIZATION
VIO	+XXXXX.(fps)	INERTIAL VELOCITY AT .05G FOR EMS INITIALIZATION
RRT	XX:XX:XX (HRS:MIN:SEC)	REENTRY REFERENCE TIME BASED ON GET OF PREDICTED 400K (DET START)
RET .05G	XX:XX (MIN:SEC)	TIME OF .05G FROM 400K (RRT)
D_L MAX	X.XX (G's)	MAXIMUM ACCEPTABLE VALUE OF PREDICTED DRAG LEVEL (FROM CMC)
D_L MIN	X.XX (G's)	MINIMUM ACCEPTABLE VALUE OF PREDICTED DRAG LEVEL (FROM CMC)
V_L MAX	XXXXX (fps)	MAXIMUM ACCEPTABLE VALUE OF EXIT VELOCITY (FROM CMC)
V_L MIN	XXXXX (fps)	MINIMUM ACCEPTABLE VALUE OF EXIT VELOCITY (FROM CMC)

ENTRY PAD (cont'd)

DO	X.XX (G's)	PLANNED DRAG LEVEL DURING CONSTANT G
RET V_{CIRC}	XX:XX (MIN:SEC)	TIME FROM EI THAT S/C VELOCITY BECOMES CIRCULAR
RETBBO	XX:XX (MIN:SEC)	TIME FROM EI TO THE BEGINNING OF BLACKOUT
RETEBO	XX:XX (MIN:SEC)	TIME FROM EI TO THE END OF BLACKOUT
RETDRO	XX:XX (MIN:SEC)	TIME FROM EI TO DROGUE DEPLOY
SXTS	XX(OCTAL)	SEXTANT STAR FOR ENTRY ATTITUDE CHECK
SFT	XXX.X(DEG)	SEXTANT SHAFT SETTING FOR ENTRY ATTITUDE CHECK
TRN	XX.X(DEG)	SEXTANT TRUNNION SETTING FOR ENTRY ATTITUDE CHECK
BSS	XXX(OCTAL)	BORESIGHT STAR FOR ENTRY ATTITUDE CHECK USING THE COAS
SPA	XX.X(DEG)	BSS PITCH ANGLE ON COAS
SXP	X.X(DEG)	BSS X POSITION ON COAS
LIFT VECTOR	XX	LIFT VECTOR DESIRED AT .05G's BASED ON ENTRY CORRIDOR

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EARTH ORBIT ENTRY UPDATE												
X			.			X			.			AREA
X	X	-		.		X	X	-		.		ΔV TO
X	X	X				X	X	X				R 0.05G EMS
X	X	X				X	X	X				P 0.05G
X	X	X				X	X	X				Y 0.05G
+				.		+				.		RTGO EMS
+						+						V10
X	X		:			X	X		:			RET 0.05G
	0		.				0		.			LAT N61
			.						.			LONG
X	X		:			X	X		:			RET 0.2G
				.						.		DRE (55°) N66
R	R		/			R	R		/			BANK AN
X	X		:			X	X		:			RET RB
X	X		:			X	X		:			RETBBO
X	X		:			X	X		:			RETEBO
X	X		:			X	X		:			RETDROG
X	X	X				X	X	X				(90°/fps) CHART
X	X					X	X					DRE (90°) UPDATE
POST BURN												
X	X	X				X	X	X				P 0.05G
+				.		+				.		RTGO EMS
+						+						VI0
X	X		:			X	X		:			RET 0.05G
X	X		:			X	X		:			RET 0.2G
				.						.		DRE ±100 nm N66
R	R		/			R	R		/			BANK AN
X	X		:			X	X		:			RETRB
X	X		:			X	X		:			RETBBO
X	X		:			X	X		:			RETEBO + 46 SEC
X	X		:			X	X		:			RETDROG TO MAIN

E.O. ENTRY

E.O. ENTRY

ENTRY UPDATE AND POSTBURN UPDATE

AREA	XXX-X	RECOVERY AREA FIRST 3 DIGITS - LANDING REVOLUTION LAST DIGIT - RECOVERY AREA AND SUPPORT CAPABILITIES
ΔV TO		
R,P,Y .05G	XXX (DEG)	
RTGO	XXXX.X (nm)	RANGE TO GO FROM .05G TO TARGET
VIO	XXXXX. (fps)	INERTIAL VELOCITY AT .05G
RET	XX:XX (MIN:SEC)	TIME FROM RETROFIRE TO .05G
LAT	±XX.XX (DEG)	LATITUDE OF LANDING TARGET POINT
LONG	±XXX.XX (DEG)	LONGITUDE OF LANDING TARGET POINT
RET .2G	XX:XX (MIN:SEC)	TIME FROM RETROFIRE TO .2G
DRE	±XXXXX. (nm)	DOWNRANGE ERROR AT .2G
BANK AN	XX/XX (DEG/DEG)	BACKUP BANK ANGLE FOR SCS ENTRY: ROLL RIGHT/ROLL LEFT
RETRB	XX:XX (MIN:SEC)	TIME FROM RETROFIRE TO REVERSE BACKUP BANK ANGLE
RETBBO	XX:XX (MIN:SEC)	TIME FROM RETROFIRE TO BEGINNING OF COMMUNICATIONS BLACKOUT
RETEBO	XX:XX (MIN:SEC)	TIME FROM RETROFIRE TO END OF COMMUNICATIONS BLACKOUT
RETDROG	XX:XX (MIN:SEC)	TIME FROM RETROFIRE TO DROGUE CHUTE DEPLOYMENT

ENTRY UPDATE AND POSTBURN UPDATE (Cont'd)

CHART UPDATE

90^{o}/fps	+XX	VALUES USED TO RE-PLOT BACKUP ENTRY CHART -
DRE (90^{o})		ΔV AND DOWN RANGE ERROR @ 90^{o} BANK ANGLE

POST BURN

P 0.05G	xxx (DEG)	PITCH ANGLE @ ENTRY INTERFACE
RTGO	+XXXX.X (NM)	RANGE TO GO FROM .0.05G TO TARGET FOR EMS COUNTER
VIO	+XXXXX (fps)	INERTIAL VELOCITY @ 0.05G
RET 0.05G	XX:XX(NM:SEC)	TIME FROM RETROFIRE TO 0.05G
RET 0.2G	XX:XX(MIN:SEC)	TIME FROM RETROFIRE TO 0.2G
DRE	±XXXX.X(NM)	DOWN RANGE ERROR (+ OVERSHOOT)
BANK AN	XX/XX (DEG/DEG)	BACKUP BANK ANGLE FOR SCS ENGRY: ROLL RIGHT/ROLL LEFT
RETRB	XX:XX(MIN:SEC)	TIME FROM RETROFIRE TO REVERSE BACK UP ANGLE
RETBBO	XX:XX (MIN:SEC)	TIME FROM RETROFIRE TO BEGINNING OF COMMUNICATIONS BLACKOUT
RETEBO	XX:XX (NM=SEC)	TIME FROM RETROFIRE TO END OF COMMUNICATIONS BLACKOUT
RETDROG	XX=XX	TIME FROM RETROFIRE TO DROGUE CHUTE DEPLOYMENT

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E.O. BLOCK

EARTH ORBIT BLOCK DATA

X	X						X	X						AREA
X	X	X					X	X	X					LAT
X	X						X	X						LONG
														GETI
X	X	X					X	X	X					ΔV_C
X	X						X	X						AREA
X	X	X					X	X	X					LAT
X	X						X	X						LONG
														GETI
X	X	X					X	X	X					ΔV_C
X	X						X	X						AREA
X	X	X					X	X	X					LAT
X	X						X	X						LONG
														GETI
X	X	X					X	X	X					ΔV_C
X	X						X	X						AREA
X	X	X					X	X	X					LAT
X	X						X	X						LONG
														GETI
X	X	X					X	X	X					ΔV_C
X	X						X	X						AREA
X	X	X					X	X	X					LAT
X	X						X	X						LONG
														GETI
X	X	X					X	X	X					ΔV_C

REMARKS:

E.O. BLOCK

EARTH ORBIT BLOCK DATA

AREA	XXX-X	RECOVERY AREA FIRST THREE DIGITS - LANDING REVOLUTION LAST DIGIT - RECOVERY AREA AND SUPPORT CAPABILITIES
LAT	$\pm$XX.X	COORDINATES OF THE DESIRED LANDING AREA
GETI	XXX:XX:XX (HR:MIN:SEC)	DEORBIT IGNITION TIME FOR THE DESIRED LANDING AREA
ΔVC	XXX.X (fps)	DEORBIT MANEUVER ΔV TO BE LOADED INTO THE EMS COUNTER

CSM RENDEZVOUS RESCUE PAD

CSM SEP PAD

33		:	:
81	X	X	2.5
22	0	18	0

CSM RESCUE ONE

33		:	:
81	.	X	X
22	180		0
ΔV_C	.	X	X
37 11		:	:
		:	:

DOI P76 PAD

33		:	:
84	.	.	.

CSI

11		:	:
81	.	.	.
N			

CDH

13		:	:
81	.	.	.

TPI

37		:	:
81	.	.	.
59	.	.	.

CSM SEP

33	GETI	XX:XX:XX	TIME OF IGNITION OF SEP (HR.MIN.SEC.)
81	DELTA VX DELTA VY DELTA VZ	XX.X (FPS) XX.X (FPS) XX.X (FPS)	LOCAL VERTICAL COMPONENTS OF VELOCITY
22	R P Y	XXX.XX (DEG) XXX.XX (DEG) XXX.XX (DEG)	NEW ICDU ANGLES

CSM RESCUE ONE

33	GETI	XX:XX:XX	TIME OF IGNITION (HR.MIN.SEC.)
81	SAME AS ABOVE		
22	SAME AS ABOVE		
ΔV_c		XX.X (FPS)	VELOCITY TO BE SET IN EMS COUNTER
11	GETI	XX:XX:XX	TIME OF IGNITION OF CSI (HR.MIN.SEC.)
37	GETI	XX:XX:XX	TIME OF IGNITION OF TPI (HR.MIN.SEC.)

DOI P76 PAD

33	GETI	XX:XX:XX	TIME OF IGNITION (HR.MIN.SEC.)
84	DELTA VX(O VEH) DELTA VY(O VEH) DELTA VZ(O VEH)	XX.X (FPS) XX.X (FPS) XX.X (FPS)	COMPONENTS OF ΔV APPLIED ALONG LOCAL VERTICAL AXIS AT TIG

CSI

11	GETI	XX:XX:XX	TIME OF IGNITION OF CSI (HR.MIN.SEC.)
81	DELTA VX DELTA VY DELTA VZ	XX.X (FPS) XX.X (FPS) XX.X (FPS)	LOCAL VERTICAL COMPONENTS OF VELOCITY.
N		XX	THE FUTURE APSIDAL CROSSING (APOLUNE OR PERILUNE) OF THE ACTIVE VEHICLE AT WHICH CDH SHOULD OCCUR

CDH

13	GETI	XX:XX:XX	TIME OF IGNITION OF CDH (HR.MIN.SEC.)
81	DELTA VX DELTA VY DELTA VZ	XX.X (FPS) XX.X (FPS) XX.X (FPS)	LOCAL VERTICAL COMPONENTS OF VELOCITY

TPI

37	GETI	XX:XX:XX	TIME OF IGNITION OF TPI (HR.MIN.SEC.)
81	DELTA VX DELTA VY DELTA VZ	XX.X (FPS) XX.X (FPS) XX.X (FPS)	LOCAL VERTICAL COMPONENTS OF VELOCITY
59	DELTA V LOS DELTA V LOS 2 DELTA V LOS 3	XX.X (FPS) XX.X (FPS) XX.X (FPS)	DELTA V LINE OF SIGHT COMPONENTS

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P30 LM MANEUVER

												PURPOSE
+	0	0				+	0	0				HR N33
+	0	0	0			+	0	0	0			MIN TIG
+	0					+	0					SEC
												ΔVX N81
												ΔVY LOCAL
												ΔVZ VERT
+						+						ΔVR
X	X	X				X	X	X				BT
X	X	X				X	X	X				R FDAI
X	X	X				X	X	X				P INER
												ΔVX AGS N86
												ΔVY AGS
												ΔVZ AGS
X	X	X	X			X	X	X	X			COAS
X	X					X	X					AZ
X	X					X	X					EL

REMARKS:

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P30 LM MANEUVER

PURPOSE		PURPOSE OF MANEUVER (SUCH AS DOI TARGETING)
TIG N33		
HR	XXX	
MIN	XX	IGNITION TIME FOR THE MANEUVER
SEC	XX.XX	
LOCAL VERT		
VX	±XXXX.X (fps)	LOCAL VERTICAL ΔV COMPONENTS OF THE MANEUVER
ΔVY	± XXXX.X(FPS)	
ΔV	±XXXX.X(fps)	
ΔVR	+XXXX.X(fps)	TOTAL ΔV REQUIRED FOR THE MANEUVER
BT	X:XX(MIN:SEC)	DURATION OF THE MANEUVER
FDAI INER		
R	XXX (DEG)	INERTIAL FDAI ANGLES AT THE BURN ATTITUDE
P	XXX (DEG)	
N86		
VX AGS	±XXXX.X(fps)	LOCAL VERTICAL ΔV COMPONENTS OF THE MANEUVER USED TO TARGET THE AGS: ROTATED THROUGH THE HALF-ANGLE OF THE BURN
VY AGS	±XXXX.X(fps)	
VZ AGS	±XXXX.X(fps)	
COAS	XX(OCTAL)	IDENTIFIER FOR COAS STAR USED TO VERIFY SPACECRAFT ATTITUDE AT THE BURN ATTITUDE
AX	±XX.X (DEG)	THE AZIMUTH AND ELEVATION ANGLES OF THE COAS STAR
EL	±XX.X (DEG)	

P27 UPDATE

PURP	V	V	V
GET	: :	: :	: :
306 01	INDEX	INDEX	INDEX
02			
03			
04			
05			
06			
07			
10			
11			
12			
13			
14			
15			
16			
17			
20			
21			
22			
23			
24			

N34	HRS	X	X	X				X	X	X			
	MIN	X	X	X	X			X	X	X	X		
NAV CHECK	SEC	X	X					X	X				
N43	LAT		0						0				
	LONG												
	ALT	+	0					+	0				

P27

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P27

P27

MISSION APOLLO 11 SOURCE FC/BALES

P27 UPDATE

PURP	XXX	TYPE OF DATA TO BE RECEIVED (SUCH AS: NAV-LIFT-OFF TIME)
V	XX	TYPE OF COMMAND LOAD (70 - 71 - 72 - 73)
GET	XXX:XX:XX(HR:MIN:SEC)	TIME DATA RECORDED
306 01	XX(OCTAL)	INDEX NO. OF COMMAND WORDS IN LOAD
02 24	XXXXX	NO. OF CORRECTION COMMAND WORDS
N34 NAV CHECK		TO CONFIRM POINT ABOVE GROUND TRACK FOR A GIVEN TIME
N43	XX:XX:XX(HRS:MIN:SEC)	TIME
LAT	XX:XX(DEG)	LATITUDE
LONG	XXX:XX(DEG)	LONGITUDE
ALT	XXX.X(nm)	ALTITUDE

P76 UPDATE PAD

												PURPOSE	
+	0	0				+	0	0				HR	N33
+	0	0	0			+	0	0	0			MIN	TIG
+	0		•			+	0		•			SEC	
				•						•		ΔVX	N84
				•						•		ΔVY	
				•						•		ΔVZ	
												PURPOSE	
+	0	0				+	0	0				HR	N33
+	0	0	0			+	0	0	0			MIN	TIG
+	0		•			+	0		•			SEC	
				•						•		ΔVX	N84
				•						•		ΔVY	TIG
				•						•		ΔVZ	
												PURPOSE	
+	0	0				+	0	0				HR	N33
+	0	0	0			+	0	0	0			MIN	TIG
+	0		•			+	0		•			SEC	
				•						•		ΔVX	N84
				•						•		ΔVY	
				•						•		ΔVZ	
												PURPOSE	
+	0	0				+	0	0				HR	N33
+	0	0	0			+	0	0	0			MIN	TIG
+	0		•			+	0		•			SEC	
				•						•		ΔVX	N84
				•						•		ΔVY	
				•						•		ΔVZ	

P76 UPDATE PAD

PURPOSE	XXXXXX	PURPOSE OF MANEUVER
N33 GETI	XX:XX:XX	TIME OF IGNITION (HR:MIN:SEC)
N84 DELTA VX(O VEH) DELTA VY(O VEH) DELTA VZ(O VEH)	XX.X (FPS) XX.X (FPS) XX.X (FPS)	COMPONENTS OF V APPLIED ALONG LOCAL VERTICAL AXIS AT TIG (LM VEH)

P32 CSI UPDATE

+	0	0				+	0	0				HR TIG CSI
+	0	0	0			+	0	0	0			MIN
+	0					+	0					SEC
+	0	0				+	0	0				HR TIG TPI N37
+	0	0	0			+	0	0	0			MIN
+	0					+	0					SEC
	0						0					ΔVX LOCAL N81
	0	0					0	0				ΔVY VERT
X	X	X				X	X	X				PLM FDAI
	0	0					0	0				ΔVX AGS N86
	0	0					0	0				ΔVY AGS
	0	0					0	0				ΔVZ AGS
	0	0					0	0				ΔVX PGNCS LOCAL VERT N81
	0	0					0	0				ΔVY
	0	0					0	0				ΔVZ
	0	0					0	0				ΔVX CHARTS LOCAL VERT N81
X	X	X	X	X	X	X	X	X	X	X	X	ΔVY
X	X	X	X	X	X	X	X	X	X	X	X	ΔVZ

REMARKS:

CSI

P32 CSI UPDATE

N11 TIG CSI		IGNITION TIME FOR THE CSI MANEUVER
HR	XXX	
MIN	XX	
SEC	XX.XX	
N37 TIG TPI		IGNITION TIME FOR THE TPI MANEUVER
HR	XXX	
MIN	XX	
SEC	XX.XX	
N81 LOCAL VERT		
ΔVX	±XX.X (fps)	LOCAL VERTICAL ΔV COMPONENTS OF THE CSI MANEUVER
ΔVY	±XX.X (fps)	
PLM FDAI	XXX(DEG)	LM FDAI INERTIAL PITCH ANGLE AT CSI BURN ATTITUDE
N86		
ΔVX AGS	±XX.X (fps)	LOCAL VERTICAL ΔV COMPONENTS OF CSI USED TO TARGET AGS EXT ΔV: ROTATED THROUGH THE HALF-ANGLE OF THE BURN
ΔVY AGS	±XX.X (fps)	
ΔVZ AGS	±XX.X (fps)	

ONBOARD LOG

N81 PGNCS LOCAL VERT	
ΔVX	±XX.X
ΔVY	±XX.X
ΔVZ	±XX.X
N81 CHARTS LOCAL VERT	
ΔVX	±XX.X

P33 CDH UPDATE

+	0	0				+	0	0				HR	TIG CDH
+	0	0	0			+	0	0	0			MIN	
+	0					+	0					SEC	
	0						0					ΔVX	LOCAL VERT N81
	0	0					0	0				ΔVY	
	0	0					0	0				ΔVZ	
X	X	X				X	X	X				PLM	FDAI
	0						0					ΔVX	AGS N86
	0	0					0	0				ΔVY	AGS
	0	0					0	0				ΔVZ	AGS

ONBOARD LOG

	0	0					0	0				ΔVX	PGNCS LOCAL VERT N81
	0	0					0	0				ΔVY	
	0	0					0	0				ΔVZ	
	0	0					0	0				ΔVX	CHARTS LOCAL VERT N81
X	X	X	X	X	X	X	X	X	X	X	X		
	0	0					0	0				ΔVZ	

REMARKS:

CDH

CDH

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P33 CDH UPDATE

N13 TIG CDH		IGNITION TIME FOR THE CDH MANEUVER
HR	XXX	
MIN	XX	
SEC	XX.XX	
N81 LOCAL VERT		
ΔVX	±XX.X (fps)	LOCAL VERTICAL ΔV COMPONENTS OF THE CDH MANEUVER
ΔVY	±XX.X (fps)	
ΔVZ	±XX.X (fps)	
PLM FDAI	XXX (DEG)	LM FDAI INERTIAL PITCH ANGLE AT CDH BURN ATTITUDE
N86		
ΔVX AGS	±XX.X (fps)	LOCAL VERTICAL ΔV COMPONENTS OF CDH USED TO TARGET AGS EXT ΔV; ROTATED THROUGH THE HALF-ANGLE OF THE BURN
ΔVY AGS	±XX.X (fps)	
ΔVZ AGS	±XX.X (fps)	

ONBOARD LOG

N81 PGNCS LOCAL VERT		
ΔVX	±XX.X (fps)	
ΔVY	±XX.X (fps)	
ΔVZ	±XX.X (fps)	
N81 CHARTS LOCAL VERT		
ΔVX	±XX.X (fps)	
ΔVZ	±XX.X (fps)	

P34 TPI UPDATE

+	0	0				+	0	0				HR — TIG TPI
+	0	0	0			+	0	0	0			MIN
+	0					+	0					SEC
												ΔVX — N81
												ΔVY — LOCAL
												ΔVZ — VERT
+	0	0				+	0	0				ΔVR
X	X	X				X	X	X				RLM — FDAI N42
X	X	X				X	X	X				PLM — INER
+	0					+	0					R TPI — N54
	0						0					R TPI — TIG-5
	0	0					0	0				F/A(+/-) — N59
	0	0					0	0				R/L(+/-) — ΔV
	0	0					0	0				D/U (+/-) — LOS
X	X					X	X					BT

ONBOARD LOG

	0	0					0	0				F/A — PGNCS N59
	0	0					0	0				R/L — ΔV
	0	0					0	0				D/U — LOS
	0	0					0	0				F/A — CHARTS N59
X	X	X	X	X	X	X	X	X	X	X	X	R/L — ΔV
	0	0					0	0				D/U — LOS

REMARKS:

TPI

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TPI

P34 UPDATE

N37 TIG TPI		IGNITION TIME FOR THE TPI MANEUVER
HR	XXX	
MIN	XX	
SEC	XX.XX	
N81 LOCAL VERT		
ΔVX	±XX.X (fps)	LOCAL VERTICAL ΔV COMPONENTS OF THE TPI MANEUVER
ΔVY	±XX.X (fps)	
ΔVZ	±XX.X (fps)	
ΔVR	XX.X (fps)	TOTAL ΔV REQUIRED FOR THE MANEUVER
N42 FDAI INER		
R LM	XXX (DEG)	LM FDAI ROLL & PITCH ANGLE AT TPI BURN ATTITUDE
P LM	XXX (DEG)	
N54 TIG-5		
R TPI	XX.XX (FT)	RANGE AT TPI TIG -5 MIN
R TPI	±XXX.X (fps)	RANGE RATE AT TPI TIG -5 MIN
N59 ΔV LOS		
F/A	±XX.X (fps)	LINE-OF-SIGHT ΔV COMPONENTS OF THE TPI MANEUVER
R/L	±XX.X (fps)	
D/U	±XX.X (fps)	
B/T	XX:XX	DURATION OF THE MANEUVER (MINUTES:SECONDS)

ONBOARD LOG

N59 PGNCS ΔV LOS		
F/A	±XX.X (fps)	
R/L	±XX.X (fps)	
D/U	±XX.X (fps)	
N59 CHARTS ΔV LOS		
F/A	±XX.X (fps)	
R/L		
D/U	±XX.X (fps)	

AGS STATE VECTOR UPDATE

												PURP	
												240	
												241	
												242	
												260	
												261	
												262	
+						+						254	
												244	
												245	
												246	
												264	
												265	
												266	
+						+						272	

REMARKS:

AGS SV

AGS STATE VECTOR UPDATE

PURP		PURPOSE FOR AGS STATE VECTOR UPDATE
240	XXXXX	LM STATEVECTOR-POSITION COMPONENTS
241	XXXXX	
242	XXXXX	
260	XXXXX	LM STATE VECTOR-VELOCITY COMPONENTS
261	XXXXX	
262	XXXXX	
254	XXXXX	LM TIME FOR WHICH THE STATE VECTOR IS ACCURATE
244	XXXXX	CSM STATE VECTOR-POSITION COMPONENTS
245	XXXXX	
246	XXXXX	
264	XXXXX	CSM STATE VECTOR-VELOCITY COMPONENTS
265	XXXXX	
266		
272	XXXXX	CSM TIME FOR WHICH THE STATE VECTOR IS ACCURATE

PDI PAD

+	0	0				+	0	0				HRS TIG
+	0	0	0			+	0	0	0			MIN PDI
+	0					+	0					SEC
X	X					X	X					TGO N61
												CROSSRANGE
X	X	X				X	X	X				R FDAI
X	X	X				X	X	X				P AT TIG
X	X	X				X	X	X				Y
												DEDA 231 IF RQD

+	0	0				+	0	0				HRS TIG
+	0	0	0			+	0	0	0			MIN PDI
+	0					+	0					SEC
X	X					X	X					TGO N61
												CROSSRANGE
X	X	X				X	X	X				R FDAI
X	X	X				X	X	X				P AT TIG
X	X	X				X	X	X				Y
												DEDA 231 IF RQD

REMARKS:

PDI PAD

TIG PDI		TIME OF IGNITION FOR PDI
HRS	XXX	
MIN	XX	
SEC	XX.XX	
N61 TGO	XX:XX(HRS:MIN)	TIME TO HIGH GATE
CROSSRANGE	±XXXX.X (N.M.)	OUT OF PLANE DISTANCE BETWEEN LM ORBITAL PLANE AND LANDING SITE (POSITIVE INDICATES LANDING SITE IS NORTH OF ORBITAL PLANE)
FDAI AT TIG		
R	XXX (DEG)	INERTIAL FDAI ANGLES AT IGNITION
P	XXX (DEG)	
Y	XXX (DEG)	
DEDA 231	XXXXX (100's FT)	LUNAR RADIUS AT THE LANDING SITE

LUNAR SURFACE

LUNAR SURFACE PAD

+	0	0	0				+	0	0	0				HRS	T1
+	0	0	0	0			+	0	0	0	0			MIN	
+	0	0					+	0	0					SEC	
+	0	0	0				+	0	0	0				HRS	T2
+	0	0	0	0			+	0	0	0	0			MIN	
+	0	0					+	0	0					SEC	
+	0	0	0				+	0	0	0				HRS	T3
+	0	0	0	0			+	0	0	0	0			MIN	
+	0	0					+	0	0					SEC	
															P
															(P + Δt)
+	0	0	0				+	0	0	0				HRS	TPI
+	0	0	0	0			+	0	0	0	0			MIN	N37
+	0	0					+	0	0					SEC	
+	0	0	0				+	0	0	0				HRS	T1
+	0	0	0	0			+	0	0	0	0			MIN	
+	0	0					+	0	0					SEC	
+	0	0	0				+	0	0	0				HRS	T2
+	0	0	0	0			+	0	0	0	0			MIN	
+	0	0					+	0	0					SEC	
+	0	0	0				+	0	0	0				HRS	T3
+	0	0	0	0			+	0	0	0	0			MIN	
+	0	0					+	0	0					SEC	
															P
															(P + Δt)
+	0	0	0				+	0	0	0	0			HRS	TPI
+	0	0	0	0			+	0	0	0	0			MIN	N37
+	0	0					+	0	0					SEC	

LUNAR SURFACE

APRIL 1, 1969

LUNAR SURFACE PAD

T1		
HRS	XXX	LIFT OFF TIME-FIRST PREFERRED TIME AFTER TOUCHDOWN (≈T.D.+4 MIN)
MIN	XX	
SEC	XX.XX	
T2		
HRS	XXX	LIFT OFF TIME -SECOND PREFERRED TIME AFTER TOUCHDOWN (≈T.D. + 11 MIN)
MIN	XX	
SEC	XX.XX	
T3		
HRS	XXX	LIFT OFF TIME -AFTER FIRST CSM REVOLUTION
MIN	XX	
SEC	XX.XX	
P	XXX:XX:XX (HRS:MIN:SEC)	CSM PERIOD
P + Δt	XXX:XX:XX (HRS:MIN:SEC)	CSM PERIOD PLUS THE TIME INTERVAL BETWEEN CLOSEST APPROACH AND LIFT OFF TIME
TPI		
HRS	XXX	TIME OF IGNITION FOR TPI AFTER ABORT FROM POWER DESCENT
MIN	XX	
SEC	XX.XX	

ASCENT

LM ASCENT PAD

+	0	0				+	0	0				HRS	
+	0	0	0			+	0	0	0			MIN	TIG
+	0					+	0					SEC	
												*CROSSRANGE N76	
X	X	X				X	X	X				R	
X	X	X				X	X	X				P	FDAI
X	X	X				X	X	X				Y	AT TIG
+	0	0				+	0	0				HRS	N11
+	0	0	0			+	0	0	0			MIN	CSI
+	0					+	0					SEC	
+	0	0				+	0	0				HRS	N37
+	0	0	0			+	0	0	0			MIN	TPI
+	0					+	0					SEC	
												DEDA 47	
												DEDA 53	

*NOTE: LOAD 8 MI IF CROSSRANGE IS GREATER THAN 8

COMMENTS:

ASCENT

APRIL 1, 1969

LM ASCENT PAD

N33 TIG		
HRS	XXX	TIME OF IGNITION FOR LM ASCENT
MIN	XX	
SEC	XX.XX	
N76 CROSSRANGE	±XXXX.X (N.M.)	DISTANCE BETWEEN CSM ORBITAL PLANE AND LM POSITION VECTOR ON LUNAR SURFACE (POSITIVE IS PLANE NORTH OF VECTOR)
FDAI ANGLES AT TIG		
R	XXX.XX (DEG)	
P	XXX.XX (DEG)	ROLL PITCH AND YAW FDAI ANGLES AT TIG
Y	XXX.XX (DEG)	
N11 CSI		
HRS	XXX	TIME OF IGNITION FOR CSI
MIN	XX	
SEC	XX.XX	
N37 TPI		
HRS	XXX	TIME OF IGNITION FOR TPI
MIN	XX	
SEC	XX.XX	
DEDA 47	+XXXXX	SINE OF AZIMUTH ANGLE
DEDA 53	+XXXXX	COSINE OF AZIMUTH ANGLE

SECTION III - DETAILED TIMELINE

FLIGHT PLAN

TIME	EVENT	REMARKS
-00:09	LCC: REPORT IGNITION	
00:00	LCC: CDR: REPORT LIFT-OFF	LIFTOFF AT 09:32 EDT, JULY 16, 1969, 72° L.A.
00:02	CDR: REPORT YAW MNVR	
00:11	CDR: REPORT ROLL AND PITCH PROGRAM INITIATE	
00:28	CDR: REPORT ROLL COMPLETE	
00:42	MCC: REPORT MARK MODE IB	
00:50	LMP: REPORT CABIN PRESS DECREASING	
01:17	MAX Q	
01:50	MCC: REPORT MARK MODE IC	
02:00	MCC: CDR: REPORT GO/NO-GO FOR STAGING	
02:14	CDR: REPORT INBOARD ENGINES CUTOFF	
02:40	CDR: REPORT OUTBOARD ENGINES CUTOFF	
02:41	CDR: REPORT STAGING	
02:42	CDR: REPORT S-II IGNITION	
	CMP: REPORT TOWER JETT	
	MCC: REPORT MODE II	
	CDR: REPORT S/C GO/NO-GO	
	MCC: REPORT TRAJECTORY GO/NO-GO	

MSC FORM 2114C (JUL 67)

FLIGHT PLAN

TIME	EVENT	REMARKS
	CMP: REPORT S/C GO/NO-GO	
	LMP: REPORT S/C GO/NO-GO	
	MCC: REPORT S-IVB TO ORBIT CAPABILITY	
	CDR: REPORT S/C GO/NO-GO	
	CDR: REPORT S/C GO/NO-GO	
	MCC: CDR: REPORT S/C GO/NO-GO FOR STAGING	
08:50	CDR: REPORT S-II CUTOFF & S-II S-IVB STAGING	
08:51	CDR: REPORT S-IVB IGNITION	
	CDR: REPORT S/C GO/NO-GO	
	MCC: REPORT TRAJECTORY AND GUIDANCE GO/NO-GO	
	MCC: REPORT MARK MODE IV	
	MCC: CDR: REPORT GO/NO-GO FOR ORBIT	
	MCC: REPORT PREDICTED SECO	
11:21	CDR: REPORT SECO & HP	

FLIGHT PLAN

MCC-H
9:30 AM EDT

NOTES

GET	Comm	Activities
00:00	US	LIFTOFF
		SECO
		POST INSERTION CONFIGURATION
		LMP-CM RCS CK, SM RCS CK, C&W CK
		REMOVE & STOW HELMET & GLOVES
	CYI	CMP-TRANS TO LEB-O_2 MAIN REG CK
		CMP/LMP-SEC RAD LEAK CK
		CDR/CMP-ECS POST INSERTION CONFIG
		CMP-REMOVE CAMERA BRACKET & ORDEAL
		CMP-EPS PER MON, ECS MON CK, SPS MON CK, ECS REDUND COMP CK, FC PURGE CK
00:30		GDC ALIGN TO IMU
		MOUNT ORDEAL AND COAS
	TAN	JETTISON OPTICS COVER (DIRECT, HIGH, SHAFT RIGHT)
		RECORD ΔAZ CORRECTION
		IMU REALIGN - P52 OPTION 3 - REFSMMAT (OPTIONAL)
	CRO	
01:00		S-BAND VOL-UP(HSK) GO/NO-GO FOR 2-1

VOICE UPDATE:
ΔAZ CORR

GO/NO-GO

LIFTOFF CREW POSITIONS:
LEFT COUCH - CDR
CENTER COUCH - LMP
RIGHT COUCH - CMP

AT SECO +20 SIV-B MNVRS TO LH AND INITIALIZES ORB RATE (HEADS DOWN)

COOLANT CONTROL ATTENTUATION PANEL NOT OPENED
H_2 PURGE LINE HTR-ON 20 MIN BEFORE FC PURGE CK

P52 - (PAD REFSMMAT)
N71: __ __ , __ __
N05: __ __ __ . __ __
N93:
X __ __ . __ __ __
Y __ __ . __ __ __
Z __ __ . __ __ __

MISSION	EDITION	DATE	TIME	DAY/REV	PAGE
APOLLO 11	PRELIMINARY	APRIL 15, 1969	00:00 - 01:00	1/1	3-1

FLIGHT PLANNING BRANCH

FLIGHT PLAN

MCC-H
10:30 AM EDT

NOTES

01:00

H S K

P52 - CONT'D

GDC ALIGN TO IMU

01:30

P27 UPDATE:
STATE VECTOR
(CSM & LM)

VOICE UPDATE:
PAD DATA

MON SM RCS HOT FIRE

U S

SCS ATT REF COMPARISON CK

RECORD PAD DATA
(TLI, TLI + 90 MIN ABORT, AND
P37 - TLI + 5 HR ABORT)

SM RCS HOT FIRE
(MIN IMPULSE-ALL JETS)

T C Y I

BEGIN TLI PREP CHECK LIST PG. _____

02:00

MISSION	EDITION	DATE	TIME	DAY/REV	PAGE
APOLLO 11	PRELIMINARY	APRIL 15, 1969	01:00-02:00	1/1	3-2

FLIGHT PLANNING BRANCH

MSC Form 29 OT (Mar. 69)

TLI
BURN CHART

	P OR Y RATES	ATT DEVIATION	SHUTDOWN TIME	RESIDUALS
TLI	10°/SEC SHUTDOWN	±45° SHUTDOWN	B/T + 6 SEC & V_i = PAD VALUE	NO TRIM

FLIGHT PLAN

MCC-H

NOTES

11:30 AM EDT

02:00

EMS ΔV TEST

DON HELMET AND GLOVES

TAN

CRO

GO/NO-GO

02:30

GO/NO GO FOR TLI & PYRO ARM

GDC ALIGN & DRIFT CK

P47 - THRUST MONITOR

TLI

GETI: 2:44:18
BT: 5:21
ΔV:

AT SECO: SIVB INERTIAL
AT SECO + 20 SEC: SIVB TO LH, ORB RATE, HEADS DOWN

V66-TRANS CSM STATE VECTOR TO LM SLOT
TLI BURN STATUS REPORT
CDR-TRANS TO CENTER COUCH, CMP-LEFT COUCH, LMP-RIGHT COUCH

MSFN

CREW POSITIONS:
LEFT COUCH - CMP
CENTER COUCH - CDR
RIGHT COUCH - LMP

CMP-UNSTOW AND PREPARE CAMERA EQUIP

SEQ/18/CEX-BRKT
(F11,250,INF) 6 fps
1 MAG
EL/80/CEX(F11,250,INF)
(fps AT CREW OPTION)

WASTE VENT VALVE - CLOSED
PRESS CM TO 5.7 PSIA

03:00

MISSION	EDITION	DATE	TIME	DAY/REV	PAGE
APOLLO 11	PRELIMINARY	APRIL 15, 1969	02:00-03:00	1/2	3-3