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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

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APOLLO ENTRY SUMMARY DOCUMENT

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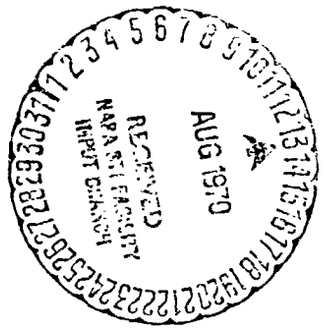

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1.0 INTRODUCTION

The purpose of the Entry Summary Document is to provide a single source of entry crew procedures information for use in flight planing, crew trainirg and preparing onboard data. This document describes these crew procedures for the C-Prime Mission.

The procedures contained in this document are divided into lunar return entry procedures and earth orbital entry procedures. The lunar return entry procedures are presented in a continuous timeline while the earth orbital entry procedures are subdivided into deorbit preparation, deorbit, and entry procedures. This subdivision of the procedures is necessary to include the two types of deorbit burns (PGNCS/SCS SPS burn, PGNCS/SCS RCS (Including Hybrid) burn). The deorbit preparation procedures and the entry procedures are compatible with each of the deorbit burn procedures. Preceding each set of procedures is a description of the major events that occur during the normal step by step execution of the procedures.

The procedures which are contained in this document were derived almost entirely from other documentation (see Section 7.0 REFERENCES). The procedures have not been verified on man-in-the-loop simulators such as the CMS to the extent of making numerous engineering runs. Four engineering runs were made on the CMS relative to entry procedures for the lunar return case (Section 3.0). There were no engineering runs made to verify the earth orbital deorbit preparation, deorbit and entry procedures (Section 4.0, 5.0 and 6.0).

This is a control document, subject to review by all elements of the Apollo Program and to approval by the Crew Procedures Control Board. Comments should be directed to Mr. James O. Rippey, Flight Procedures Branch, Flight Crew Support Division, Extension 3436 or to Mr. Willis W. Hinton, Jr., Apollo Flight Crew Support Group, Houston Operations, McDonnell Douglas Astronautics Company, Extension 6101.

ENTRY SUMMARY DOCUMENT

2.0 LIST OF ACRONYMS AND ABBREVIATIONS

ACCUM	Accumulator
ADR	Address
AMP	Amplifier
ANT	Antenna
AOH	Apollo Operations Handbook
ASSIST	Assistance
BBA	Backup Bank Angle
BCN	Beacon
BEF	Blunt End Forward
BETA	CMC Commanded Bank Angle
BMAG	Body Mounted Attitude Gyro
CBN	Cabin
CDR	Commander
CDU	Coupling Data Unit
CKT	Circuit
CM	Command Module
CMC	Command Module Computer
CMD	Command
CMP	Command Module Pilot
COAS	Crew Optical Alignment Sight
COMM	Communications
COMP	Computer
CMPS	Command Module Procedures Simulator
CMS	Command Module Simulator
CRYO	Cryogenic
CSS	Computer Subsystem
CSM	Command Service Module
CTR	Counter
C/WS	Caution Warning System
DAP	Digital Auto Pilot
DET	Digital Event Timer
DISCH	Discharge
DL	Drag Acceleration at Skipout
DSKY	Display and Keyboard
E	DSKY Enter
ECA	Electronic Control Assembly
ECS	Environment Control Subsystem
EI	Entry Interface
EMER	Emergency
EMS	Entry Monitor System
EPS	Electrical Power Subsystem
ESS	Essential
EST	Establish
EVAP	Evaporator
EXCH	Exchange

2.0 LIST OF ACRONYMS AND ABBREVIATIONS (continued)

FCSM	Flight Combustion Stability Monitor
FDAI	Flight Director Attitude Indicator
FLT	Flight
FUNC	Function
FWD	Forward
G	Acceleration in Earth Gravitational Units
G&C	Guidance and Control
GET	Ground Elapsed Time
GDC	Gyro Display Coupler
GLY	Glycol
GMBL	Gimbal
G&N, G/N	Guidance and Navigation
GND	Ground
GPI	Gimbal Position Indicator
G-V	Acceleration-Velocity
HA	Height of Apogee
HE	Helium
HP	Height of Perigee
HTR	Heater
IMP	Impulse
IMU	Inertial Measurement Unit
L/D	Lift to Drag Ratio
LDG	Landing
LEB	Lower Equipment Bay
LMP	Lunar Module Pilot
LV	Local Vertical
MAN	Manual
MCC	Midcourse Correction
MESC	Master Event Sequence Controller
MGA	Middle Gimbal Angle
MK	Mark
MNVR	Maneuver
MON	Monitor
MTR	Motor
MTVC	Manual Thrust Vector Control
N	DSKY Noun
OPT	Option, Optics
ORIEN	Orientation
O2	Oxygen
P	Pitch or CMC Program
PGA	Pressure Garment Assembly
PGNCS	Primary Guidance, Navigation and Control System
PIPA	Pulse Integrating Pendulous Accelerometer
PL	Planet
PLSS	Portable Life Support System
POSS	Possible

2.0 LIST OF ACRONYMS AND ABBREVIATIONS (continued)

PRIM	Primary
PRPLNT	Propellant
PSIA	Pounds Per Square Inch Absolute
PTT	Push to Talk
PWR	Power
R	Roll or CMC Routine
R1, R2, R3	Register 1, 2, 3
RAD	Radiator
RCDR	Recorder
RCS	Reaction Control System
REFSMMAT	Reference to Stable Member Matrix
REL	Relief
RET	Reentry Elapsed Time (Lunar Return Case) or Retro Elapsed Time (Earth Orbital Case). For lunar returns RET is zero at RRT. For earth orbital entries RET is zero at the deorbit burn time.
RHC	Rotational Hand Controller
RNG	Range
ROU	Routine
RRT	Reentry Reference Time (Nearest whole minute prior to 400K' altitude)
RSI	Roll Stability Indicator
RTGO	Range to Go
SA	Shaft Angle
SCS	Stabilization and Control System
SEC	Secondary
SECS	Sequential Events Control Subsystem
SEL	Select
SEP	Separation
SEQ	Sequential
SM, S/M	Service Module
SPS	Service Propulsion System
STBY	Standby
TA	Trunnion Angle
TB	Talkback Display
TBD	To Be Determined
TERM	Terminate
TF	Time From
TFF	Time of Freefall
TFI	Time From Ignition
THBWLS	Thumbwheels
THC	Translational Hand Controller
TIG	Time of Ignition
TK	Tank
TLM	Telemetry
TRNFR	Transfer
TVC	Thrust Vector Control

2.0 LIST OF ACRONYMS AND ABBREVIATIONS (continued)

V	Velocity or DSKY Verb
VDC	Volts Direct Current
VG	Velocity To Be Gained
VIO	Inertial Velocity
VL	Skipout Velocity
VLV	Valve
VM	Velocity Measured
Y	Yaw

3.0 LUNAR RETURN ENTRY

The lunar return entry procedures presented in this document begin at the completion of the final transearth MCC two hours prior to reaching EI and continue through earth landing. A major portion of the rationale used in developing these procedures was obtained from References (1) through (5). Reference (6) contains the procedures prior to and including the final MCC.

3.1 Major Events

Following the final transearth MCC, system checks and entry preparations are made, the PAD data and the CMC are updated, and the entry sequence is initiated followed by CM/SM separation and entry. An entry timeline illustrating these events is shown in Figure (1) and covers the time period following the final transearth MCC through earth landing. A discussion of each of the major events in the entry timeline follows.

3.1.1 Establish Post Burn Attitude Control Mode

The DAP data load routine is called and an attitude deadband of 5.0 degrees and a rate deadband of 0.5 degrees per second are established in order to conserve RCS propellant. The DET is set to count up/down (crew preference) to RRT. The time tags given in the procedures (Section 3.2) are shown as negative prior to RRT.

3.1.2 ECS Monitoring Check

This check is included as part of the entry vehicle preparation as outlined in the AOH, Reference (7). The procedures for performing this check were copied verbatim from the AOH and no attempt will be made to validate the procedures on the CMS.

FIGURE I

LUNAR RETURN ENTRY TIMELINE

TIME FROM ENTRY INTERFACE hr: min	STEP	MAJOR EVENT
-2:00		LAST MIDCOURSE CORRECTION
	1	ESTABLISH POST BURN ATTITUDE CONTROL MODE
	2	ECS MONITORING CHECK
	3	PRESSURE SUIT CIRCUIT AND PGA CHECK AT 5.0 PSIA
-1:50		
-1:40		
	4	CM PROPULSION SYSTEM CHECK
	5	C/MS OPERATIONAL CHECK
	6	STOW LOOSE GEAR
-1:30	7	IMU REALIGNMENT
-1:20	8	GDC DRIFT CHECK
	9	MANEUVER TO ENTRY ATTITUDE
	10	PYRO BATTERY CHECK
	11	PANEL 8 CIRCUIT BREAKER CHECK
-1:10	12	CM RCS PREHEATING PREPARATION
	13	EMS SELF TEST
-1:00		
	14	GDC DRIFT CHECK
-0:50	15	CM RCS HEATING COMPLETION
	16	CM RCS CHECK
	17	CMC AND PAD DATA UPDATE
-0:40		
	18	EMS INITIALIZATION (RANGE AND VELOCITY)
	19	PSI TEST AND ALIGNMENT
-0:30		
	20	SEPARATION CHECKLIST
-0:20	21	P61 (ENTRY PREPARATION PROGRAM)
	22	P62 (CM/SM SEPARATION AND PRE-ENTRY MANEUVER PROGRAM)
	23	MANEUVER TO CM/SM SEPARATION ATTITUDE
	24	CM/SM SEPARATION
	25	MANEUVER TO HORIZON TRACK ATTITUDE
-0:10	26	ESTABLISH HORIZON TRACK ATTITUDE CONTROL MODE
	27	P63(ENTRY INITIALIZATION PROGRAM)
	28	HORIZON CHECK
-0:00		
	29	0.05G SWITCHING AND P64 (ENTRY POST 0.05G PROGRAM)
	30	PGNCS 0.05G CHECK
	31	0.05G CORRIDOR VERIFICATION CHECK
	32	EMS GO/NO GO DECISION
	33	PGNCS GO/NO GO CHECK
	34	P65 (ENTRY UP CONTROL PROGRAM)
	35	P66 (ENTRY BALLISTIC PROGRAM)
	36	P67 (ENTRY FINAL PHASE PROGRAM)
	37	EARTH LANDING PHASE.

3.1.3 Pressure Suit Circuit and PGA Check at 5.0 PSIA

The comments in Section 3.1.2 apply to this section also.

3.1.4 CM Propulsion System Check

The comments in Section 3.1.2 apply to this section also.

3.1.5 C/WS Operational Check

The comments in Section 3.1.2 apply to this section also.

3.1.6 Stow Loose Gear

The comments in Section 3.1.2 apply to this section also.

3.1.7 IMU Realignment

The IMU is realigned to REFSMMAT (option code 3) via P52 (IMU Realignment Program). If the gyro torquing angles are greater than one degree and a subsequent fine align check confirms the IMU attitude, then the IMU has drifted excessively since the last alignment and should not be used for entry. In this case, an EMS entry should be flown under SCS control.

3.1.8 GDC Drift Check

The GDC is checked for excessive drift by comparing the two FDAI's. If the drift rate is greater than 10 degrees per hour, then the rate source is switched from BMAG's 2 to BMAG's 1. The GDC is realigned to the IMU in preparation for another drift check (step 14 in the procedures).

3.1.9 Maneuver to Entry Attitude

The CSM is rolled to a heads down orientation and is pitched and yawed to the pad values for entry gimbal angles. The maneuver is performed under SCS control while the control mode is selected real time by the CDR. An option is given which allows the DAP to perform the maneuver if desired.

3.1.10 Pyro Battery Check

The comments in Section 3.1.2 apply to this section also.

3.1.11 Panel 8 Circuit Breaker Check

The comments in Section 3.1.2 apply to this section also.

3.1.12 CM RCS Preheating Preparation

The comments in Section 3.1.2 apply to this section also.

3.1.13 EMS Self Test

The EMS self test routine is used prior to entry to assure maximum confidence in EMS operation. The tests are:

(1) Checks lower trip point of .05g comparator
(2) Checks upper trip point of .05g comparator
(3) Checks lower trip point of corridor verification comparator
(4) Checks range-to-go integrator circuits, g-servo circuit, G-V plotter, and range-to-go circuits
(5) Checks the high trip point of the corridor verification comparator.

The EMS malfunction procedures in the AOH will be referred to if the EMS fails any of the self tests.

3.1.14 GDC Drift Check

A second GDC drift check is performed since the rate source may have been changed from BMAG's 2 to BMAG's 1 in the first drift check. If both drift checks fail, the GDC has failed. If the first check fails and the second check passes, BMAG's 2 have failed and BMAG's 1 are used for the rate source.

3.1.15 CM-RCS Heating Completion

The comments in Section 3.1.2 apply to this section also.

3.1.16 CM-RCS Check

A CM RCS check of each thruster ring is performed.

3.1.17 CMC and PAD Data Update

At -00:45 the CMC update program is selected to permit update of the landing point location and the state vector (time tagged at EI). Voice communication is used to update the entry PAD data. Also, the Mae West, helmets and gloves are donned at this time.

3.1.18 EMS Initialization (Range and Velocity)

The EMS is initialized with the latest entry PAD values of velocity and range to go. If voice communication failed for the PAD update, the previous PAD values are used. If no PAD values of the EMS initialization parameters are available, the range-to-go and velocity computed in P-61 will be used to initialize the EMS.

3.1.19 RSI Test and Alignment

Before aligning the RSI, a test on the RSI servo gain is performed by moving the yaw attitude set thumbwheel through 45 degrees and observing the RSI track through the same angle. The RSI is then aligned to zero degrees (lift up) to coincide with the planned lift vector orientation at 0.05g. The attitude set thumbwheels must be reset to the present IMU gimbal angles in order to realign the GDC.

3.1.20 Separation Checklist

At -00:25:00, the required system switches necessary for CM/SM separation are positioned.

3.1.21 P61 (Entry Preparation Program)

At -00:19:00, P61 is selected by the CMP. Target latitude and longitude and entry roll attitude are displayed and checked with PAD data. Parameters in the next two DSKY displays are recorded and checked with entry PAD data. If there was no entry PAD data (voice lost), the EMS initialization data displayed (velocity and range-to-go) are used to initialize the EMS.

3.1.22 P62 (CM/SM Separation and Pre-Entry Maneuver Program)

After the last PROCEED in P61, P62 will be entered automatically. The DSKY will flash a separation request at this time.

3.1.23 Maneuver to CM/SM Separation Attitude

A pitch up maneuver of approximately 110 degrees from the 0.05g trim attitude is required in order to put the horizon on the 31.7 degree window mark. With the CSM under SCS control the CDR selects the proper control mode for performing the maneuver. Upon completion of the maneuver and at -00:17:00, a horizon check is made. If the pitch gimbal angle is not within five degrees of the expected value, the IMU has failed and is No Go for entry. After the check, the CSM is manually yawed 45 degrees out of plane, and an SCS attitude hold mode is established in preparation for CM/SM separation.

3.1.24 CM/SM Separation

CM/SM separation occurs at -00:15:00. Following separation, single ring RCS is selected for attitude control.

3.1.25 Maneuver to Horizon Track Attitude

The CM is manually maneuvered to the horizon track attitude which is defined as follows: zero yaw, blunt end forward, zero roll (heads down/lift up), and pitch such that the horizon is on the 31.7 degree window mark.

3.1.26 Establish Horizon Track

The horizon view is maintained in the window during the final minutes before EI by establishing a pitch rate with the RHC. After the desired pitch rate is established, the entry DAP is activated by a PROCEED from the DSKY V50N25 flash, but the SC control remains in SCS. The DSKY flashes target latitude and longitude and entry roll attitude again for a final check with PAD data. A PROCEED from this DSKY flash results in a final trim attitude display only if the CM X-axis is more than 45 degrees away from the negative velocity vector. When tracking the horizon, the CM X-axis will normally be within 45 degrees of the negative velocity vector after approximately 12 minutes before EI.

3.1.27 P63 (Entry Initialization Program)

After the last PROCEED in P62, P63 will be entered automatically after the CM X-axis is within 45 degrees of the negative velocity vector. P63 initializes the entry equations and checks accelerometer outputs for 0.05g. The DSKY displays acceleration, inertial velocity and range to the target.

3.1.28 Horizon Check

A horizon check is made while approaching 0.05g. The FDAI scale is switched to 50/15 in order to display a maximum attitude error of 15 degrees on the error needles. While tracking the horizon, the pitch error needle should come off the peg shortly before two minutes before 0.05g. The pitch error needle should drive toward zero while approaching the time of 0.05g. After confidence is established in the PGNCS, the SC control switch is placed in the CMC position to relinquish CM attitude control to the DAP. If

the DAP does not respond properly, SCS control is again established and the CDR may fly to the commanded roll angle in DSKY register 1 when it becomes available in P64.

Note that the procedures call for turning on both direct RCS switches before switching to CMC control. This gives the CDR the capability to assume manual attitude control by deflecting the RHC to the hard stop thus firing both RCS jets in the desired direction. In this mode, the DAP will not fire jets in the channel that has the RHC against the hard stop. However, as soon as the RHC is released, the DAP will again assume control in that channel. Therefore, whenever possible, SCS control should be established before taking over manual control of the spacecraft.

3.1.29 0.05g Switching and P64 (Entry Post 0.05g Program)

If the EMS does not start at the RET of 0.05g + three seconds it is started manually. The EMS roll and 0.05g switch are turned on. P64 displays commanded bank angle, inertial velocity and altitude rate.

3.1.30 PGNCS 0.05g Check

The DSKY should change from P63 to P64 at the RET of 0.05g plus or minus five seconds. It not, the PGNCS is suspected of a malfunction.

3.1.31 Corridor Verification Check

If either the PGNCS of the PAD data indicates that the lift vector should be lift down at 0.05g, the CM should be immediately maneuvered to a lift vector down orientation (heads up). If the PGNCS indicates lift down the DAP will maneuver the CM to the lift down attitude. If the PAD indicates lift down and the PGNCS indicates lift up, then the CDR must establish SCS control and manually maneuver to the lift

down attitude. It should be noted that prior to 0.05g the CM will be in a lift vector up attitude because of the requirement for tracking the horizon at this attitude.

3.1.32 EMS Go/No-Go Decision

Ten seconds after the EMS starts operating, the EMS range counter should have counted down 60 ± 7 nautical miles. If not, the range counter indications should be ignored.

Immediately following 0.05g, continuous monitoring of several indicators is required. The EMS trace g level is continually compared with the independent g-meter. If at any time they do not compare within reason, the PGNCS g indication (N64) is used as a third vote to identify the failed component.

The roll gimbal angle as indicated by the roll bug on the FDAI should be monitored to verify that the DAP is responding to the CMC roll commands in DSKY register 1. If the DAP is not responding and the FDAI roll attitude is verified by the other FDAI (GDC roll angle) and the RSI, SCS control should be established and the CDR should fly the CMC roll commands.

The g-v trace should be monitored for skipout or excessive g indications. If the EMS indicates the need to reverse the lift vector orientation, the CM is immediately oriented per the EMS indication and the independent g-meter is used to verify the EMS indication. If manual control is established, the PGNCS roll command (after 1.4g) is checked for compatibility with the EMS trace, and if they differ, the PGNCS g indication is used as a third vote to either return control to or fail the PGNCS. The PGNCS should maintain the initial full lift up or down ± 15 degrees until the acceleration level reaches KA (a guidance constant with nominal value of 1.384 g-units).

In the event of a PGNCS failure, the EMS is to be used for entry control. The procedures in Section 3.2 are designed so that a switchover from the PGNCS to the EMS may be accomplished at any time during the entry. Procedurally this involves establishing SCS control (moving the spacecraft control switch from CMC to SCS or turning the THC clockwise) and using the RHC to roll the spacecraft (i.e., reorient the lift vector) in response to visual cues generated by the EMS. The following paragraphs present recommended piloting procedures for responding to the EMS visual cues.

An entry can be thought of as consisting of two parts; a supercircular part (velocity greater than 25,500 feet per second) and a subcircular part (velocity less than 25,500 feet per second). During the supercircular portion of an EMS entry there are two important considerations: (1) that the spacecraft will be captured by the earth's atmosphere and (2) that excessive g-loads will not be encountered. Initial atmospheric capture is insured for most points in the entry corridor with the lift vector up until after peak g. For shallow flight path angles (this information will be on PAD data) it is necessary to fly lift down until capture is insured and then fly lift up. After peak g is reached, the pilot should roll the spacecraft (modulate the lift vector) to attempt to fly a constant 4 g's during the supercircular portion of the entry. The bank angle should be such that the out-of-plane component of the lift vector is always to the north of the orbit plane. The bank angle profile required to accomplish a constant 4-g trajectory varies as a function of the conditions at EI and the L/D of the spacecraft. However, once a steady state 4-g condition has been established some lift down is required to maintain this condition. A good rule of thumb is "For higher velocities more lift down is required to maintain a constant g level". As the velocity

approaches 25,500 feet per second the bank angle should approach 90 degrees (zero lift down). During the supercircular part of the EMS entry, the pilot should be concentrating primarily on flying a constant 4-g trajectory. The g onset and g offset lines on the EMS scroll should also be monitored to insure that the EMS trace never becomes tangent to either (this prevents excessive g-loads and skipout).

During the subcircular part of an EMS entry the pilot should be concerned with ranging to the target and monitoring the G-V trace for tangency to the g onset lines (to prevent excessive g-loads). Based on CMPS experience a good piloting procedures is as follows: (1) as soon as the 25,500 feet per second line is crossed roll to a full lift up orientation, (2) modulate the lift vector to try to smooth the G-V trace into the equilibrium glide slope line, then (3) modulate the lift vector to achieve correlation between the range potential lines and the range counter.

3.1.33 PGNCS Go/No Go Check

After the constant drag phase has been entered, a check is made to determine if the PGNCS is trying to maintain the g level at D_0 (pad data). If the g level is not converging to D_0, the PGNCS has failed.

3.1.34 P65 (Entry - Up Control Program)

Current mission planning is to select a target that will result in an EMS range of about 1,350 nautical miles. Because of the short range of the target a skip trajectory will probably not be required and P65 and P66 will normally not be entered. P65, if entered, is entered automatically from P64 when the predicted range is within 25 nautical

miles of the desired range. The predicted skip conditions (DL and VL) are displayed and checked with PAD data. If they are within the entry PAD limits, control of the spacecraft is given to the PGNCS even if an earlier manual takeover was necessary. If the skip conditions displayed are not within PAD limits, the EMS is used to range to the target. A PROCEED (optional) via DSKY entry results in a DSKY display of roll command, inertial velocity and altitude rate. If DL < .19 g a skipout has been planned and the G-V trace should be monitored to see that the trace approaches the DL and VL at skipout. If it does not, manual control is assumed and the EMS is used for ranging to the target.

3.1.35 P66 (Entry - Ballistic Program)

If a skip phase has been planned, P66 will be entered automatically from P65 when the drag acceleration is less than 0.19 g's. The ballistic program maintains CM attitude for atmospheric reentry during skipout and monitors drag acceleration for entering the final phase of entry. Entry gimbal angles are displayed on the DSKY. The computed entry gimbal angles for the second entry are checked by observing the horizon view. When drag acceleration reaches 0.2 g, the entry final phase program is entered.

3.1.36 P67 (Entry - Final Phase Program)

P67 can be entered automatically from P64, P65 or P66. P67 performs entry guidance until the CM relative velocity is 1,000 feet per second. Commanded bank angle, cross range error and down range error are displayed, followed by range to target and present CM latitude and longitude when the CM relative velocity equals 1,000 feet per second.

3.1.37 Earth Landing Phase

The comments in Section 3.1.2 apply to this section also.

3.2 ENTRY PROCEDURES

C PRIME ENTRY PROCEDURES

ALT/ PROG/ TIME	S T F D STA	ACTION/ENTRY	V-N/ DISPLAY	OPTION/ENTRIES
		ASSUMPTIONS:		
		(1) CMC-ON (REQUIRED)		
		(2) ISS-ON WITH ORIENTATION KNOWN (REQUIRED)		
		(3) SCS-ON (REQUIRED)		
		(4) T/C BASIC PERFORMED EXCEPT: S BD ANT OMNI A-C TAPE RCDR FWD-OFF TLM INPTS PCM-HIGH CB PANEL 277-ALL CLOSED		
		(5) CMC IN DSKY IDLE PROGRAM (P-00)		
		(6) PROCEDURES CONTINUE FROM THE LAST PROCEDURAL STEP IN REFERENCE 1.		
-01:55:00 P-00	1	ESTABLISH POST-BURN ATTITUDE CONTROL MODE		
	CMP	KEY (V48E) DAP DATA LOAD ROLL (R03)	F 04 46 XXXXX XXXXX BLANK	
		KEY (V22E11112E,11111E)	F 04 46 11112 11111 BLANK	
		PROCEED	F 06 47	
		CSM WT	XXXXX.LB	
		LM WT	XXXXX.LB BLANK	

C PRIME ENTRY PROCEDURES

ALT/ PROG/ TIME	T E P STA	ACTION/ENTRY	V-N/ DISPLAY	OPTION/ENTRIES
		PROCEED		
			F 06 48	
		P TRIM	XXX.XXDEG	
		Y TRIM	XXX.XXDEG	
			BLANK	
		PROCEED		
			BLANK	
			BLANK	
			BLANK	
	CDR	SET DET		
	>	ECS MONITORING CHECK		
	LMP	SUIT CAB DELTA P IND= -1.0 TO -3.5 IN. H2O		
		O2 FLOW IND=0.2-0.45 LB/HR		
		O2 PRESS IND SW=SURGE TANK		
		CYRO TK1 O2 PRESS IND=865-935 PSIA		
		O2 PRESS IND SW=TK1		
		ECS RAD TB=GRAY		
		ECS IND SEL=PRIM		
		ECS RAD PRIM IN TEMP IND=65-105 DEG F		
		ECS RAD PRIM OUT TEMP IND= -20 TO +102 DEG F		
		GLY EVAP PRIM OUT TEMP IND= 40-50.5 DEG F		
		GLY EVAP PRIM STM PRESS IND= 0.097-0.135 PSIA		
		GLY DISCH PRIM PRESS IND=40-52 PSIG		
		SUIT TEMP IND=45-55 DEG F		
		CAB TEMP IND=70-80 DEG F		
		SUIT PRESS IND=4.7-5.3 PSIA		
		CAB PRESS IND=4.8-5.2 PSIA		
		PART CO2 PRESS IND=<7.6 MM HG		
		SUIT COMPR P IND=0.3-0.4 PSI		
		ACCUM PRIM QTY IND=30-70%		
		IF QUANTITY <30%		
		PRIM ACCUM FILL VLV=ON UNTIL 40-70% IS REACHED		
		H2O QTY IND SW=POT		
		H2O QTY IND=10-100%		
		H2O QTY IND SW=WASTE		
		H2O QTY IND=20-100%		

C PRIME ENTRY PROCEDURES

ALT/ PROG/ TIME	STEP STA	ACTION/ENTRY	V-N/ DISPLAY	OPTION/ENTRIES
	3	PRESSURE SUIT CIRCUIT AND PGA CHECK AT 5.0 PSIA		
	CDR	DIRECT O2 VLV-CLOSED (CW)		
	CMP	SUIT PRESS IND-4.8-5.2 PSIA O2 FLOW IND-0.2-0.4 LB/HR		
	CDR	SUIT TEST VLV-PRESS		
	CMP	O2 FLOW IND-1.0 LB/HR (PEGGED) O2 FLOW HI LT-ON		
	ALL	MASTER ALARM PB/LT(3)-ON (PUSH)		
	CMP	SUIT PRESS IND-8.8-9.7 PSIA		
	ALL	PGA PRESS IND (3)-4.1-4.9 PSIG		
	CDR	O2 DEMAND REG VLV-OFF		
	CMP	O2 FLOW IND-0.2 LB/HR (PEGGED) O2 FLOW HI LT-OFF		
	ALL	PGA PRESS IND (3)-<0.5 PSI/MIN (PRESSURE DECAY)		
	CDR	O2 DEMAND REG VLV-BOTH SUIT TEST VLV-DEPRESS		
	CMP	O2 FLOW IND-0.2-0.4 LB/HR SUIT PRESS IND-SLIGHTLY>CAB PRESS IND		
	CDR	SUIT TEST VLV-OFF		
	4	CM PROPULSION SYSTEM CHECK		
	CMP	CM RCS PROPLNT TB (2)-AP RCS IND SEL-CM1, CM2 MONITOR: •CM RCS HE TEMP IND-40-90 DEG F •CM RCS HE PRESS IND-4000-4450 PSIA •CM RCS FUEL PRESS IND -25-200 PSIA •CM RCS OXID PRESS IND -25-200 PSIA		
	5	C/WS OPERATIONAL CHECK		
	CMP	C/W LAMP TEST-1		
	CDR	MASTER ALARM PB/LT-ON		
	CMP	LH C/W LT (16)-ON C/W LAMP TEST-2		
	CDR	MASTER ALARM PB/LT-OFF		
	CMP	LH C/W LT (16)-OFF		
	LMP	MASTER ALARM PB/LT-ON		
	CMP	RH C/W LT (23)-ON C/W LAMP TEST-OFF (CENTER)		
	LMP	MASTER ALARM PB/LT-OFF		

C PRIME ENTRY PROCEDURES

ALT/PROG/TIME	P	STA	ACTION/ENTRY	V-N/DISPLAY	OPTION/ENTRIES
		CMP	RH C/W LT (23)-OFF		
			C/W CSM-CM		
			CM RCS LT(BOTH)-ON		
		ALL	MASTER ALARM TONE AND LT(3)-ON		
			MASTER ALARM PB/LT-PUSH		
			MASTER ALARM TONE AND LT(3)-OFF		
		CMP	C/W CSM-CSM		
			CM RCS LT (BOTH)-OFF		
	6	ALL	STOW LOOSE GEAR (INCL COAS)		
-01:30:00	7		IMU REALIGNMENT		
		LFB	G/N OPT PWR-ON		
		LMP	G/N PWR-ACT OR ACP		
		LFR	OPT MODE-MAN		
			OPT ZERO-ZERO (15 SEC)		
			OPT ZERO-OFF		
	P-52		KEY (V37E52E)	F 04 06	
			OPTION CODE	00001	
			OPTION	0000X	
				BLANK	
			KEY (V22E33E)	F 04 06	
				00001	
				00003	
				BLANK	
			PROCEED		
			TARGET ACQUISTION	F 50 25	
				00015	
				BLANK	
				BLANK	
			PROCEED		
			IF TWO STARS ARE NOT AVAILABLE (ALARM CODE 00405), KEY (V32E) TO RECYCLE TO F 50 25	F 05 09 00405	
				F 01 70	
			TARGET CODE	000XX	
				BLANK	
				BLANK	
			OPT MODE-CMC		
			PROCEED		
			DESIRED OPTICS ANGLES	06 92	
			SA	XXX.XXDEG	
			TA	XXX.XXDEG	
				BLANK	
			OPT MODE-MAN		

C PRIME ENTRY PROCEDURES

ALT/ PROG/ TIME	STEP STA	ACTION/ENTRY	V-N/ DISPLAY	OPTION/ENTRIES
		(PLEASE MARK)	F 51 BLANK BLANK BLANK	
		MARK ON STAR (TERMINATE MARKS)	F 50 25 00016 BLANK BLANK	
		PROCEED TARGET CODE (STAR JUST MARKED)	F 01 70 000XX BLANK BLANK	
		PROCEED TARGET CODE (STAR TO BE MARKED)	F 01 70 000XX BLANK BLANK	
		OPT ZERO-ZERO (15 SEC) OPT ZERO-OFF OPT MODE-CMC PROCEED DESIRED OPTICS ANGLES SA TA	06 92 XXX.XXDEG XX.XXXDEG BLANK	
		OPT MODE-MAN (PLEASE MARK)	F51 BLANK BLANK BLANK	
		MARK ON STAR (TERMINATE MARKS)	F 50 25 00016 BLANK BLANK	
		PROCEED		
		TARGET CODE (STAR JUST MARKED)	F 01 70 000XX BLANK BLANK	
		PROCEED		

C PRIME ENTRY PROCEDURES

ALT/ PROG/ TIME	S T F P STA	ACTION/ENTRY	V=N/ DISPLAY	OPTION/ENTRIES
			F 06 05	
		SIGHTING ANG DIFF	XXX.XXDEG	
			BLANK	
			BLANK	
		PROCEED		
			06 93	
		X	XX.XXXDEG	
		Y	XX.XXXDEG	
		Z	XX.XXXDEG	
		NOTE:		
		GYRO TORQUING ANGLES FOR DRIFT		
		SINCE LAST ALIGNMENT		
		IF THESE ANGLES>1 DEG OR FIRST PASS		
		THROUGH P52 AND FINE ALIGN CHECK		
		CONFIRMS IMU ATTITUDE THEN IMU HAS		
		DRIFTED EXCESSIVELY SINCE LAST		
		ALIGNMENT.		
		USE SCS FOR EMS ENTRY.		
		PROCEED		V32E (DO NOT
			F 50 25	TORQUE GYROS)
		FINE ALIGN CHECK	00014	
			BLANK	
			BLANK	
		ENTER		PROCEED (FINE
		CHANGE MAJOR MODE REQUEST	F 37	ALIGN CHECK)
				RETURN TO
				FIRST V50 N25
P=00		KEY (00E)		FLASH IN P=52
		OPT ZERO=ZER		
		G/N OPT PWR=OFF		
	LMP	G/N PWR=OFF		
	R	GDC DRIFT CHECK		
		IF GDC DRIFT RATE > 10 DEG/HR		
	CDR	.HMAG MODE (3)=RATE 1		
		FDAI SOURCE=ATT SET		
	LER	KEY (V16N20)	F 16 20	
		ROLL	XXX.XXDEG	
		PITCH	XXX.XXDEG	
		YAW	XXX.XXDEG	
	CDR	ATT SET TW (3)=NOUN 20		
		FDAI SEL=1		
		ATT SET =IMU		
		NULL ERR NEEDLES WITH		
		ATT SET TW		
		FDAI SEL=1/2		
		ATT SET=GDC		
		GDC ALIGN PB=PUSH		

C PRIME ENTRY PROCEDURES

ALT/ PROG/ TIME	STEP STA	ACTION/ENTRY	V-N/ DISPLAY	OPTION/ENTRIES
	LEB	PROCEED		
	9	MANEUVER TO ENTRY ATT •ROLL-HEADS DOWN •PITCH-PAD DATA •YAW-PAD DATA MANUAL MANEUVER		AUTO MANEUVER
	CDR	SC CONT-SCS SELECT ATTITUDE CONTROL MODE COMPATIBLE WITH THE MAGNITUDE OF THE MANEUVER-F.G. RATE COMMAND, ACCEL COMMAND OR-MINIMUM IMPULSE AND THE DESIRED RATES. PERFORM MANEUVER WITH RHC MAN ATT (3)-RATE CMD SC CONT-CMC		BMAG MODE-RATE OR RATE KEY (V49E) F 06 22 ROLL PITCH YAW KEY DESIRED COMMANDS AND PROCEED F 50 18 ROLL PITCH YAW PROCEED 50 18 ROLL PITCH YAW WHEN MANEUVER IS COMPLETE ENTER BMAG MODE (3)-ATT1 RATE2
	10	PYRO BATTERY CHECK CB PYRO A SEQ A-CLOSED CB PYRO B SEQ B-CLOSED		
	LMP	IF PYRO BAT A (B) <35 VDC •CB PYRO A(B) SEQ A(B)-OPEN •CB PYRO A(B) TIE TO BAT BUS A(B)-CLOSED CB MNA BAT C-CLOSE CB MNB BAT C-CLOSE		
	11	PANEL 8 CIRCUIT BREAKER CHECK		
	CDR	CLOSE ALL CB ON PANEL A EXCEPT CB PL VENT FLT/PL-OPEN CB FLOAT BAG (ALL)-OPEN		

C PRIME ENTRY PROCEDURES

ALT/ PROG/ TIME	T F P STA	ACTION/ENTRY	V-N/ DISPLAY	OPTION/ENTRIES
-01:10:00	12	CM RCS PREHEATING PREPARATION		
	CDR	CM RCS LOGIC-ON (UP)		
	LEB	CM RCS HTRS-ON (UP) (UNTIL LOWEST READING IS 4.9 VDC OR 20 MIN)		
		MONITOR:		
		SYSTEM TEST (5-C, 5-D, 6-A, 6-B, 6-C, 6-D)		
		IF ANY CM ENGINES INDICATE NO HEATING		
		•RCS TRNSFR-CM		
		•RHC (2)-ENERGIZE ENGINES NOT HEATING TO ACCOMPLISH HEATING		
		•RCS TRNSFR-SM		
		UR DUMP-OFF		
		REMOVE NEEDLE ASSEMBLY FROM INJECT PORT		
	13	EMS SELF TEST		
	CDR	EMS FUNC-OFF (VERIFY)		
		EMS MODE-STBY		
		EMS FUNC-EMS TEST 1 (SW THROUGH OFF)		
		WAIT 5 SECONDS		
		EMS MODE-AUTO		
		MONITOR: (WAIT 10 SEC)		
		•IND LTS-OFF, AND		
		•RANGE IND=0.0		
		SLEW SCROLL UNTIL HAIRLINE IS SUPERIMPOSED ON NOTCH IN SELF-TEST PATTERN		
		EMS FUNC-EMS TEST 2		
		WAIT 10 SEC AND MONITOR:		
		0.05G LT-ON (ALL OTHERS OFF)		
		EMS FUNC-EMS TEST 3		
		NOTE:		
		•0.05G LT-ON, AND		
		•RSI LOWER LT-ON (10 SEC LATER)		
		SET RANGE IND TO 66 NM		
		EMS FUNC-EMS TEST 4		
		MONITOR:		
		0.05G LT-ON (ALL OTHERS OFF)		
		IN 10 SEC		
		•SCROLL ADVANCES TO RIGHT CORNER OF TEST PATTERN AT 9G, AND		
		•RANGE IND COUNTS TO ZERO		

C PRIME ENTRY PROCEDURES

ALT/ PROG/ TIME	STEP STA	ACTION/ENTRY	V-N/ DISPLAY	OPTION/ENTRIES
		EMS FUNC-EMS TEST 5 MONITOR: •0.05G LT-ON •RSI UPPER LT-ON (10 SEC LATER) •RANGE IND =0.0, AND G-V PLOTTER-VERTICAL LINE FROM 9G TO 0.2 EMS MODE-STBY SLEW SCROLL UNTIL HATCHLINE IS SUPERIMPOSED ON 37000 FT/SEC MARK EMS FUNC-RNG SET NOTE: G-V PLOTTER-VERTICAL LINE FROM 0.2 TO 0.1 IF ANY EMS TEST FAILED REFER TO EMS MALFUNCTION PROCEDURES IN APOLLO OPERATIONS HAND BOOK		
-00:55:00	14	GDC DRIFT CHECK IF GDC DRIFT RATE > 10 DEG/HR AND DRIFT CHECK IN STEP 8 FAILED, THEN GDC HAS FAILED AND SHOULD NOT BE RELIED ON FOR ATT. REFERENCE. IF GDC DRIFT RATE <10 DEG/HR AND DRIFT CHECK IN STEP 8 FAILED, THEN BMAG'S 2 HAVE FAILED. CONTINUE TO USE BMAG'S 1 FOR RATE SOURCE.		
-00:50:00	15	CM RCS HEATING COMPLETION		
	LEB	CM RCS HTRS-OFF		

C PRIME ENTRY PROCEDURES

ALT/ PROG/ TIME	S T F P STA	ACTION/ENTRY	V-N/ DISPLAY	OPTION/ENTRIES
	14	CM RCS CHECK		
		AFTER MSFN AOS		
	CDR	SECS LOGIC (2)-ON (UP)		
		REPORT LOGIC ARMED TO MSFN		
		AFTER GO FROM MSFN		
		SECS PYRO ARM (2)-ON (UP)		
		RCS TRANFR-CM		
		CM RCS PRESS-ON (UP)		
		CM RCS PRPLNT 1 -ON (UP)		
		CM RCS PRPLNT TB 1 -GRAY		
		TEST THRUSTERS CM1 (WITH RHC)		
		CM RCS PRPLNT 1-OFF		
		CM RCS PRPLNT TB 1-BP		
		CM RCS PRPLNT 2 -ON (UP)		
		CM RCS PRPLNT TB 2 -GRAY		
		TEST THRUSTERS CM2 (WITH RHC)		
		CM RCS PRPLNT 1-ON		
		CM RCS PRPLNT TB1-GRAY		
		RCS IND SEL-CM1, THEN 2		
		.CM RCS HE PRESS IND-4000-4450 PSIA		
		.CM RCS FUEL PRESS IND-285-302 PSIA		
		.CM RCS OXID PRESS IND-285-302 PSIA		
		RCS TRANFR-SM		
	CDR	SECS PYRO ARM (2)-SAFE		
		SECS LOGIC (2)-OFF		
-00145:00	17	CMC AND PAD DATA UPDATE		
P-27		CMC UPDATE PROGRAM P-27		
		UP TLM SW (2)-ACCEPT		
		UPLINK ACTY LT-ON		
		UPLINK ACTY LT-OFF (CMPLT)		
P-00		UP TLM SW (EITHER)-BLOCK		
		VOICE UPDATE		
		RECORD ENTRY PAD DATA		
	ALL	MAE WEST, HELMETS, GLOVES-DONNED		
		SUIT RET AIR VLV-CLOSED (PUSH) SUIT RET AIR VLV		
	LEB	EMER CAB PRESS VLV-OFF (DOWN)		
	18	EMS INITIALIZATION (RANGE AND VELOCITY)		
	CDR	SET RNG IND-PAD DATA RANGE		
		EMS FUNC-V0 SET		
		SLEW SCROLL TO PAD DATA V0		
		EMS FUNC-ENTRY		

C PRIME ENTRY PROCEDURES

ALT/ PROG/ TIME	S T F P	STA	ACTION/ENTRY	V-N/ DISPLAY	OPTION/ENTRIES
		19	RSI TEST AND ALIGNMENT		
			FDAI SOURCE-ATT SET		
			ATT SET-GDC		
			EMS ROLL ON		
			GDC ALIGN PB-PUSH, HOLD		
			ATT SET YAW TW-ADJUST THRU HIGH 45 DEG		
			OBSERVE RSI TRACK 45 DEG		
			ATT SET YAW TW-POSITION RSI (LIFT UP)		
			GDC ALIGN PB-REL		
			EMS ROLL-OFF		
			ATT SET TW (3)- RESET (GDC)		
			TO PRESENT GIMBAL ANGLES		
			GDC ALIGN PB-PUSH		
-00:25:00		20	SEPARATION CHECKLIST		
		LMP	MN BUS TIE (2)-ON (UP)		
		CDR	PRIM GLY TO RAD-PULL TO BYPASS		
			O2 PLSS VLV-ON		
			O2 SM SUPPLY VLV-OFF		
			CAB PRESS RELF (2)-BOOST/ENTRY		
		LMP	VHF AM (2)-OFF (CENTER)		
		CMP	SM RCS PRIM PRPLNT A(BCD)-ON		
			SM RCS PRIM PRPLNT A(BCD)TB-GRAY		
			FLT RCDR-RECORD		
		CDR	AFTER MSFN AOS		
			SECS LOGIC (ROTH)-ON (UP)		
			REPORT LOGIC ARMED		
			AFTER GO FROM MSFN		
			SECS PYRO ARM (2)-ON (UP)		
		CMP	ABORT SYS PRPLNT-RCS CMD		
-00:19:00		21	ENTRY PREPARATION PROGRAM		
	P-61	CMP	KEY (V37E61E)		
				F 06 61	
			IMPACT LAT (+NORTH)	XXX.XXDEG	VERIFY / LOAD
			IMPACT LONG (+EAST)	XXX.XXDEG	DESIRED DATA
			HDS UP/DN (+/-)	-00001	
			PROCEED		
				F 06 60	
			G MAX	XXX.XX G	
			V PRED	XXXXX.FPS	
			GAMMA EI	XXX.XXDEG	
		LMP	RECORD VALUES		
		CMP	PROCEED		

C PRIME ENTRY PROCEDURES

ALT/ PROG/ TIME	S T F P STA	ACTION/ENTRY	V-N/ DISPLAY	OPTION/ENTRIES
			F 06 63	
		RTOGO (.05G TO SPLASH)	XXXX.X NM	
		VIO (AT .05G)	XXXXX.FPS	
		TFE (TIME FROM .05G)	XXXXX M/S	
	LMP	RECORD AND COMPARE WITH PAD FOR PGNCS GO/NO GO (LIMITS TBD)		
	CMP	PROCEED		
P-62	22	CM/SM SEPARATION AND PRE-ENTRY MANEUVER PROGRAM		
		REQUEST CM/SM SEPARATION	F 50 25 00041 BLANK BLANK	
	23	MANEUVER TO CM/SM SEP ATT .ROLL-HEADS DOWN .PITCH-HORIZON ON 31.7 WINDOW LINE .YAW-45 DEG OUT-OF-PLANE SC CONT-SCS SELECT ATTITUDE CONTROL MODE COMPATIBLE WITH THE MAGNITUDE OF THE MANEUVER-E.G. RATE COMMAND, ACCEL COMMAND OR MINIMUM IMPULSE AND THE DESIRED RATES. PERFORM PITCH MANEUVER WITH RHC		
-00:17:00		COMPARE PITCH ATT WITH PAD DATA WITHIN 5 DEG		
		PERFORM YAW MANEUVER WITH RHC RATE-HIGH ATT DBD-MIN MANUAL ATT (3)-RATE CMD RMAG MODE-ATT1 RATE2 (DESIRED)		
-00:15:00	24	CM/SM SEPARATION CM/SM SEP (BOTH)-ON (UP) SM C/W LTS-ON		
	CDR	MASTER ALARM PB/LT-ON, PUSH		
	CMP	C/W CSM-CM SM C/W LTS-OFF CM RCS FUEL PRESS-285-302 PSIA CM RCS OXID PRESS-285-302 PSIA		

C PRIME ENTRY PROCEDURES

ALT/ PROG/ TIME	S T E P	STA	ACTION/ENTRY	V-N/ DISPLAY	OPTION/ENTRIES
		CDR	RCS TRNFR-CM CM RCS LOGIC-OFF AUTO RCS SEL A/C ROLL (4)-OFF AUTO RCS SEL CM 1 (6)-MNA OR MNB AUTO RCS SEL CM2 (6)-OFF		
	25		MANEUVER TO HORIZON TRACK ATTITUDE .ROLL-HEADS DOWN .YAW-PAD DATA .PITCH-HORIZON ON 31.7 WINDOW LINE MAINTAIN HORIZON WITH PITCH RATE SELECT ATTITUDE CONTROL MODE COMPATIBLE WITH THE MAGNITUDE OF THE MANEUVER-F.G. RATE COMMAND ACCEL COMMAND OR-MINIMUM IMPULSE AND THE DESIRED RATES. PERFORM MANEUVER WITH RHC.		
	24		ESTABLISH HORIZON TRACK SELECT DESIRED ATTITUDE CONTROL MODE FOR HORIZON TRACK-F.G. RATE COMMAND ACCEL COMMAND OR MINIMUM IMPULS. RATES-HIGH PERFORM TRACK WITH RHC. EMS MODE-AUTO		
		CMP	PROCEED (ACTIVATES ENTRY DAP)		
				F 06 61	
			IMPACT LAT (+NORTH)	XXX.XXDEG	VERIFY / LOAD
			IMPACT LONG (+EAST)	XXX.XXDEG	DESIRED DATA
			HDS ON	-00001	
		CMP	PROCEED		
			FINAL ATT DISP (ONLY IF X-AXIS NOT WITHIN 45 DEG OF-VELOCITY VECTOR)	06 22	
			R	XXX.XXDEG	
			P	XXX.XXDEG	
			Y	XXX.XXDEG	

C PRIME ENTRY PROCEDURES

ALT/ PROG/ TIME	R T F P STA	ACTION/ENTRY	V-N/ DISPLAY	OPTION/ENTRIES
P-63	27	ENTRY INITIALIZATION PROGRAM (P-62 CHANGES TO P-63 WHEN CM IS WITHIN 45 DEG OF TRIM ATT)	06 64	(V06N68F)
		G	XXX.XXG	BETA
		VI	XXXXX.FPS	VI
		RTOGO TO TARGET (+0 OVERSHOOT)	XXXX.XNM	H DOT
		PITCH ERR NEEDLE WILL ZERO ON NO. 1 BALL BEFORE 400K		KEY REL
-00:02:00	2R	HORIZON CHECK		
	CDR	FDAI SCALE-50/15		
		RMAG MODE (3)-RATE 2 (DESIRED)		
		DIRECT RCS (2)-MNA/MNB (UP)		
		MAN ATT (3)-RATE CMD		
		WATCH PITCH ERROR NEEDLE GO TO ZERO WHILE APPROCHING 0.05G TIME. ESTABLISH CMC CONTROL WHEN CONFIDENCE IS ESTABLISHED: .SC CONT-CMC		
		IF DAP NOT ACCEPTABLE .SC CONT-SCS AND FLY DSKY ROLL COMMANDS IN R1 (NEXT DSKY DISPLAY)		
.05G TIME	29	0.05G STITCHING		
	CDR	EMS MODE-MAN (IF EMS DOES NOT START WITHIN 3 SEC OF 0.05G TIME)		
		EMS ROLL-ON (UP)		
		.05G SW-ON (UP)		
P-64		ENTRY-POST 0.05G PROGRAM	06 68	(V06N64E)
		BETA	XXX.XXDEG	G
		VI	XXXXX.FPS	VI
		H DOT	XXXXX.FPS	RTOGO
				KEY REL
	30	PGNCS 0.05 G CHECK IF PGNCS DID NOT INDICATE 0.05G WITHIN 5 SEC OF DET 0.05G SUSPECT PGNCS		
	31	0.05G CORRIDOR VERIFICATION CHECK IF EITHER PGNCS OR PAD DATA DESIRES LIFT VECTOR DOWN MANEUVER TO LIFT VECTOR DOWN		

C PRIME ENTRY PROCEDURES

ALT/PROG/TIME	T/P	STA	ACTION/ENTRY	V-N/DISPLAY	OPTION/ENTRIES
		32	EMS GO/NO GO DECISION IF EMS RANGE COUNTER DOES NOT COUNT DOWN 60 PLUS OR MINUS 7 NM DURING 10 SEC PERIOD DO NOT USE EMS RANGE COUNTER TO MONITOR ENTRY		

CONTINUOUS MONITOR:

```
X1 EMS FOR SKIPOUT AND EXCESSIVE G'S.
X   .IF SKIPOUT IMMEDIATELY ROLL LEFT DOWN
X   .IF EXCESSIVE G'S ROLL LEFT UP
X2 EMS FOR FAILURE
X   .SMOOTH G-V TRACE
X   .EMS G'S WITHIN 1 G OF G METER (V16N64E
X   MAY BE PERFORMED TO MONITOR PGNCS G'S
X3 ROLL GIMBAL ON FDAI RESPONDING TO ROLL
X    COMMANDS IN DSKY REGISTER 1.
X    IF NO. BELIEVE PGNCS FDAI (IF CONFIRMED
X    BY SCS FDAI) ESTABLISH SCS CONTROL.
X    AND MANUALLY FLY CMC COMMANDS
X4 PGNCS FOR FAILURE
X   .IF MANUAL CONTROL ASSUMED EARLIER
X    CHECK EMS G-V TRACE AND DSKY ROLL
X    COMMANDS FOR COMPATIBILITY AFTER 1.4G.
X    IF THEY DIFFER, USE PGNCS G (N64) AS
X    A THIRD VOTE TO EITHER RETURN CONTROL
X    TO OR FAIL PGNCS.
X   .IF PGNCS FAILS ESTABLISH SCS CONTROL
X    AND FLY EMS (SEE SECTION 3.1.32
X    FOR RECOMMENDED PILOTING TECHNIQUE).
```

		33	PGNCS GO/NO GO CHECK MONITOR G S FOR CONVERGENCE TO PAD DO VALUE IF CONVERGENCE NOT APPARENT PGNCS FAILED IF DSKY DISPLAYS P67 GO TO STEP 36		

C PRIME ENTRY PROCEDURES

ALT/ PROG/ TIME	S T F P STA	ACTION/ENTRY	V-N/ DISPLAY	OPTION/ENTRIES
P-65 34		ENTRY UP-CONTROL PROGRAM		
		RETA	F 16 69	(V06N64E)
		DL	XXX.XXDEG	G
		VL	XXX.XX G	VI
		IF VL AND DL ARE NOT WITHIN PAD LIMITS, ESTABLISH SPS CONTROL, AND FLY EMS	XXXXX.FPS	RTOGO KEY REL PROCFED 06 68 BETA VI HDOT
		IF DSKY DISPLAYS P67 GO TO STEP 36		
P-66 35		ENTRY BALLISTIC PROGRAM		
			06 22	
		R	XXX.XXDEG	
		P	XXX.XXDEG	
		Y	XXX.XXDEG	
		MONITOR: .DRAG FOR 0.2G THEN P67		
P-67 34		FINAL ENTRY PHASE PROGRAM		
			06 66	(V06N64F)
		RETA	XXX.XXDEG	G
		CRSRNG ERR	XXXX.XNM	VI
		DWNRNG ERR	XXXX.XNM	RTOGO KEY REL XXXXXXXXXXXXX (V06N68E) BETA VI H DOT
		IF PGNCS IS NOT TRYING TO MAKE DOWNRANGE ERROR CONVERGE TO ZERO PGNCS HAS FAILED		
			16 67	
		RTOGO	XXXX.XNM	KEY REL
		LAT	XXX.XXDEG	
		LONG	XXX.XXDEG	

C PRIME ENTRY PROCEDURES

ALT/ PROG/ TIME	S T E P	STA	ACTION/ENTRY	V-N/ DISPLAY	OPTION/ENTRIES
	37		EARTH LANDING PHASE		
30K		CDR	ELS LOGIC-ON		
			ELS AUTO-ON		
			REPORT CM STABLE		
			IF CM UNSTABLE		
		CMP	•RCS CMD-OFF		
24K		CDR	•APEX COVER JETT PB-PUSH		
			•DROG DPLY PB PUSH (2 SEC AFTER APEX COVER JETT)		
		CDR	EMS FUNC-OFF		
		CMP	SEC COOL LOOP EVAP-OFF		
			GLY EVAP H2O FLOW-OFF		
24K			SCS RCS DISABLE (AUTO)		
			IF NOT, RCS CMD-OFF		
			APEX COVER JETT (AUTO)		
		CDR	IF NOT, APEX COVER JETT PB-PUSH		
			DROGUE PARACHUTES DEPLOYED (AUTO)		
			IF NOT, DROG DPLY PB-PUSH		
23.5K		CMP	MONITOR CAB PRESS IND (STARTS INCR)		
		CDR	IF NO INCREASE BY 17K CAB PRESS RELF (RH)-DUMP		
10K			MAIN PARACHUTES AND VHF RECOVERY ANTENNA DEPLOY (AUTO)		
			MN DPLY PB-PUSH (WITHIN 1 SEC)		
		CMP	SEC COOL LOOP EVAP-RESET FOR 45 SEC, THEN OFF		
			GLY EVAP STM PRESS AUTO-MAN		
			GLY EVAP STM PRESS INCR-INCR (FOR 45 SEC MIN)		
		LMP	VHF ANT-RECV		
			VHF AM (2)-SIMPLEX		
			VHF BCN-ON		
			TRANSMIT VOICE REPORTING:		
			•POSITION		
			•MAIN CHUTES DISREFED		
			•SPLASH ERROR		
			•CREW STATUS		
		CMP	PROCEED	F37	
P-00			KEY (00E)		

C PRIME ENTRY PROCEDURES

ALT/ PROG/ TIME	S T F P STA	ACTION/ENTRY	V-N/ DISPLAY	OPTION/ENTRIES
	CDR	CM RCS LOGIC-ON		
		CM PRPLNT DUMP-ON		
	CMP	RCS IND SEL-CM1		
		CM RCS PRESS HE IND-DECREASING, THEN CM 2		
		IF NOT DECREASING FIRE ALL RCS JETS EXCEPT PITCH UNTIL PROPELLANTS ARE DEPLETED (USE BOTH RHC)		
	CDR	CM PRPLNT PURG-ON (AFTER PROP DMP COMPLETED)		
		CM RCS HE DUMP PB-PUSH		
		IF RHC (2) USED FOR PROPELLANT DUMP USE RHC (2) TO FIRE ROLL AND YAW JETS NOT PITCH.		
	LMP	CB FLT/PL BAT BUS A, B, AND C (3)-CLOSED		
		CB FLT/PL MNA-OPEN		
		CB FLT/PL MNB-OPEN		
		CB ECS RAD HTRS OVLD (2)-OPEN		
	CDR	CB SPS PITCH (2)-OPEN		
	CDR	CB SPS YAW (2)-OPEN		
		CAB PRESS RELF (RH)-DUMP		
3K				
		FLOOD FIXED-POST LDG		
		FLOOD DIM-1 OR 2		
800		CAB PRESS RELF (2)-CLOSED		
	CMP	CM RCS PRPLNT (BOTH)-OFF		
		CM RCS PRPLNT TK (BOTH)-RP		
	CDR	DIRECT O2 VLV-OPEN		
	LMP	MN BUS TIE (2)-OFF		
		GO TO POST LANDING CHECK		

4.0 EARTH ORBITAL DEORBIT PREPARATION

4.1 Deorbit Preparation Major Events

This section will be included at a later date.

4.2 ORBIT PREPARATION PROCEDURES

PROG TIME	STEP	STA	ACTION/ENTRY	V-N DISPLAY	REGISTER DISPLAY	OPTION/ENTRIES
	1	LEB	Computer Preparations Perform GNCS startup procedure CMC startup PROCEED STBY LT - OUT (if not, repeat PROCEED until STBY LT - OUT) DSKY displays - P06			
P00			Key V37E00E MON DSKY display of P00			
			ISS start up G&N IMU PWR - ON (UP) NO ATT LT - ON (90sec) NO ATT LT - OUT			
	2	CDR	SCS POWER UP AUTO RCS SEL (16) - OFF BMAG MODE (3) - RATE 2 FDAI/GPI PWR - OFF LOGIC 2/3 PWR - ON (up) SCS ELEC PWR - GDC/ECA SCS SIG CONDR/DR BIAS (both) AC1 OR AC2 BMAG PWR (2) - ON FDAI/GPI PWR - BOTH RHC PWR NORM (both) - AC/DC CMC MODE - FREE			
		CMP	*Estab ullage select Call DAP data load Rou (R03) Key V48E (Load R1 11112 and R2 01111)	F 04 46	XXXXX XXXXX BLANK	Load desired DAP
		CMP	PROCEED CSM Weight LM Weight (NO LM so PAD will be 00000)	F 06 47	XXXXX. LB 00000 LB BLANK	Verify/ Load desired DAP

PROG TIME	STEP	STA	ACTION/ENTRY	V-N DISPLAY	REGISTER DISPLAY	OPTION/ENTRIES
			CMP PROCEED			
			P Trim	F 06 48	XXX.XX DEG	Verify/
			Y Trim		XXX.XX DEG	Load desired DAP
					BLANK	
			CMP PROCEED			
			CMP Key V46E (activates DAP)			
			MANUAL ATT (3) - RATE CMD			
			CDR CMC MODE - AUTO			
			AUTO RCS SEL (16) - MNA or MNB			
			BMAG MODE (3) ATT 1/RATE 2			
			CMC ATT - IMU			
			SC CONT - CMC			
			LMP G/N PWR - AC1 or AC2			
			LEB G/N OPTICS POWER - OPTICS			
			OPTICS MODE - MAN			
			CDR FDAI sel - 1/2			
			OPTICS ZERO - ZERO (15 secs)			
			OPTICS ZERO - OFF			
	3		IMU Orientation Determination Program P-51			
			LEB Key V37E51E			
			DSKY DISPL - P-51			
	A		Star acquisition	F 50 25	00015	Coarse align GMBLS
			(Manvr. to acquire target		BLANK	ENTER
			if necessary)		BLANK	V41N22
						NO ATT LIGHT-ON then OFF
						Ret to step A
			LEB PROCEED			
			Sighting Mark Rou R53			
	B		Please mark	F 51	BLANK	
					BLANK	
					BLANK	
			LEB MARK			
			Terminate mark	F 50 25	00016	
					BLANK	
					BLANK	
			LEB PROCEED			Mark reject PB - PUSH
						Ret to step B
			Target code	F 01 71	000XX	
			(Targ code for PL 00)		BLANK	
					BLANK	

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STEP	STA	ACTION/ENTRY	V-N DISPLAY	REGISTER DISPLAY	OPTION/ENTRIES
	LEB	PROCEED			Key V21E Load target code
		If target code is other than 00, return to step B for 2nd target.			
		Planet only X,Y,Z PL	F 06 88	.XXXXX .XXXXX .XXXXX	
	LEB	PROCEED			Key V25E
		RETURN TO STEP B for 2nd target			Load desired data
		Sighting Data Displ. Rou. R54			
		Sighting angle diff	F 06 05	XXX.XX DEG BLANK BLANK	
	LEB	PROCEED	F 37		Key V32E
	LEB	Key 00E			
	LEB	Optics pwr down OPT ZERO - ZERO (15 sec) G/N OPT PWR - OFF			Ret to step A
	LMP	G/N PWR - OFF			
4		CMC and PAD Data Update			
	LEB	CMC Update Program P-27 UP TLM CM - ACCEPT UP TLM - ACCEPT UPLINK ACTY LT - ON UPLINK ACTY LT - OFF (CMPLT)			
					P-21 NAV Check Key V37E21E
		UP TLM CM OR UP TLM - BLOCK			
	LEB	Voice Update			
5	ALL	Perform ECS Monitoring Checks			
6		Perform EPS DC and AC Voltage Checks			
	LMP	D-C Voltage - Amperage Check MN BUS TIE (2) - OFF FC MN BUS A tb (3) - FC 1&2 gray, FC 3 bp FC MN BUS B tb (3) - FC 1 bp FC 2&3 gray D-C IND sel - FUEL CELL 1,2,3 DC AMPS ind - record			

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PROG TIME	STEP	STA	ACTION/ENTRY	V-N DISPLAY	REGISTER DISPLAY	OPTION/ENTRIES
			D-C IND sel - MAIN BUS A,B DC VOLTS ind - 26.5-31 vdc (record) D-C IND sel - BAT BUS A,B & BAT-C DC VOLTS ind - 34-38 vdc DC AMPS ind - <3.0 amps			
		CMP	SYS TEST (2) - 4 SYS TEST IND - 3.7-4.1 vdc			
		LMP	D-C IND SEL - PYRO BAT A,B CAUTION: PYRO Check Momentary because of power drain DC VOLTS ind - 37.0-37.5 vdc DC IND sel - MAIN BUS A A-C Voltage Check AC IND sel - BUS 1,2, A,B,C AC VOLTS ind - 113-117 vac			
	7		SPS Monitoring Check			
		LMP	SPS PRPLNT TK TEMP ind - + 45 to 75°F If <45°F, SPS LINE HTRS - A If >75°F, SPS LINE HTRS - OFF SPS PRESS IND sw - He, N2A and N2B SPS PRPLNT TK PRESS ind He 3900 psia max N2A 2900 psia max N2B 2900 psia max SPS PRESS IND sw - He SPS FUEL PRESS ind - 170-195 psia SPS OXID PRESS ind - 170-195 psia CAUTION ΔP between fuel & oxid should not exceed 15 psi during a burn or degraded performance, rough combustion, and/or engine failure may result. SPS ENG INJ VLV ind (4) - CLOSE SPS QTY% OXID ind - record SPS QTY% FUEL ind - record SPS QTY OXID UNBAL ind - record			

PROG TIME	STEP	STA	ACTION/ENTRY	V-N DISPLAY	REGISTER DISPLAY	OPTION/ENTRIES
			OXID FLOW VLV PRIM - PRIM SPS He VLV (both) - AUTO SPS He VLV tb (both) - bp			
	8		RCS Monitoring Checks			
		CMP	RCS CHECKS A. SM RCS Mon Check SM RCS He tb (8) - gray SM RCS PRIM PRPLNT tb (4) - gray SM RCS SEC PRPLNT tb (4) - gray RCS IND sel - SM A,B,C,D Check Quads A,B,C,D SM RCS PKG TEMP ind - 105-195°F SM RCS He PRESS ind - Record SM RCS IND sw - PRPLNT QTY SM RCS PRPLNT QTY ind - Record SM RCS SEC FUEL PRESS ind - 178-192 psia When SM RCS MANF PRESS IND < 150 psia RCS SEC FUEL PRESS A,(B,C,D) -OPEN B. CM RCS Mon Check CM RCS PRPLNT tb (both) - bp RCS IND SEL - CM1, CM2 CM RCS He TEMP ind - 60-90°F CM RCS He PRESS ind - 4000-4450 psia Prior to CM RCS Activation: CM RCS MANF PRESS ind - 25-200 psia After CM RCS ACTIVATION: CM RCS MANF PRESS IND - 287-302 psia			
	9		IMU Realignment Program P-52			
		LEB	G/N OPT PWR - OPTICS			
		LMP	G/N PWR - AC1 or AC2 OPT MODE - MAN OPT ZERO - ZERO (15 sec) OPT ZERO - OFF			
		LEB	Key V37E52E DSKY displays P-52			Poss prog alarm key V05 N09E R1 00210 (ISS not on) or R1 00220 (IMU orient unknown)

PROG TIME	STEP	STA	ACTION/ENTRY	V-N DISPLAY	REGISTER DISPLAY	OPTION/ENTRIES
						F V37.
						Perform ISS start-up and/or P-51
	A		IMU Orien. Option Code (preferred is 00001)	F 04 06	00001	Poss F 05 09, R1 00215
					0000X	Key V3?E
					BLANK	Recycle step A
		LEB	PROCEED			Key V22E
						Load desired option
			DSKY Displays R,P,Y	F 06 22	XXX.XX DEG	
					XXX.XX DEG	
					XXX.XX DEG	
		LEB	PROCEED			Select desired ATT CONTROL MODE MNVR S/C Key V32E
			(Coarse Align Rou R-50) Verify Coarse Align Complt NO ATT LT - ON then OFF Monitor Ball Motion			
	B		Target Acquisition	F 50 25	00015	
					BLANK	
					BLANK	
			CMC Assists in Selection select desired Att Control Mode Mnvr S/C			Crew manually acquired targ ENTER
		LEB	PROCEED			
			Possible DSKY display (2 targets not available) Manvr S/C until suitable target acquired	F 05 09	00405	
		LEB	PROCEED			Key V32E Recycle step B
	C		Target Code	F 01 70	000XX	
					BLANK	
					BLANK	
		LEB	OPT MODE - CMC PROCEED			Key V21E Load desired code

STEP	STA	ACTION/ENTRY	V-N DISPLAY	REGISTER DISPLAY	OPTION/ENTRIES
		If target not a planet go to step D			
		Planet only X,Y,Z PL	F 06 88	.XXXXX .XXXXX .XXXXX	
	LEB	PROCEED			KEY V25E Load desired data
		Auto Opt Positioning Rou R-52			
D		Desired opt angles SA,TA	06 92	XXX.XX DEG XX.XXX DEG	Poss F 05 09 00404(TA>90°) Mnvr to reduce TA PROCEED or Poss PROG alarm Key V05N09E 00407(TA>50°) Key RLSE,Mnvr to reduce TA
	LEB	PROCEED			
		When sighting marks are desired			
	LEB	OPT MODE - MAN			
		Sighting Mark Rou R-53			
E		Please mark center target in SXT	F 51		
	LEB	MARK (on target)			
		Terminate marks	F 50 25	00016	
	LEB	PROCEED			Mark rej PB-PUSH Ret to step E
		Target code (Targ code for PL 00)	F 01 71	000XX	
	LEB	PROCEED			Key V21E Load target code
		If target code other than 00, Ret to Step C for 2nd target			
		Planet only X,Y,Z, PL	F 06 88	.XXXXX .XXXXX .XXXXX	
	LEB	PROCEED			KEY V25E Load desired data

PROG TIME	STEP	STA	ACTION/ENTRY	V-N DISPLAY	REGISTER DISPLAY	OPTION/ENTRIES
			Ret to Step C for 2nd target			
			Sighting Data Display Rou R-54			
			Sighting ang diff	F 06 05	XXX.XX DEG BLANK BLANK	
		LEB	PROCEED			Key V32E go to step F
			Gyro Torquing Rou R-55			
			Δ GYRO ANG X,Y,Z	F 06 93	XX.XXX DEG XX.XXX DEG XX.XXX DEG	
		LEB	PROCEED (Gyros torqued)			Key V32E
	F		Fine Align Check	F 50 25	00014	
		LEB	PROCEED Ret to step B			ENTER
			DSKY displays	F 37		
		LEB	OPT MODE - MAN OPTICS ZERO - ZERO G/N OPT PWR - OFF			
		LMP	G/N PWR - OFF			
	10	CDR*	Perform EMS Deorbit Test EMS FUNCTION - OFF CB EMS (2) - CLOSE EMS MODE - STBY (wait 5 sec) EMS FUNCTION - EMS TEST 1 Slew scroll to start of test pattern (>5 sec) EMS MODE - AUTO (wait 10 sec) CHECK IND LTS - OFF RANGE COUNTER - 0.0 EMS FUNCTION - TEST 2 (wait 10 sec) EMS 0.05 G LT - ON (all others out) EMS FUNCTION - TEST 3 EMS 0.05 G LT - ON DWN LT - ON (10 sec after 0.05 G Lt)			

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PROG TIME	STEP	STA	ACTION/ENTRY	V-N DISPLAY	REGISTER DISPLAY	OPTION/ENTRIES
			Set range counter to 58 ± 0.0			
			EMS FUNCTION - TEST 4			
			EMS 0.05 G LT - ON (all others out)			
			G and V trace within test pattern for 10 sec then stops at lower right corner			
			Range counter counts toward zero for 10 sec, then stops at 0.±0.2			
			EMS FUNCTION - TEST 5			
			EMS 0.05 G LT - ON			
			RSI UP LT - ON (10 sec after 0.05 G Lt)			
			Range Counter - 0.0			
			Scribe traces vertical line 9 G to 0.2 G and stops within test pattern			
			Align scroll to 37K			
			EMS FUNCTION - RNG SET			
			G-V scroll assembly traces vertical line 0.22 G to 0 (±0.1) and stops			
			EMS FUNCTION - Vo SET			
			Slew scroll to entry velocity			
			EMS FUNCTION - ΔV SET (CCW)			
			Set ΔV ind to +1586.8 fps			
			EMS FUNCTION - ΔV Test			
			SPS THRUST LT - ON			
			ΔV Counter decreases (10 secs)			If any EMS test failed refer to MALFUNCTION procedures in AOH
			SPS THRUST Lt - OFF at -0.1 on ΔV Counter			
			ΔV Counter stops at -20.8 ± 20.7			
			EMS MODE - STBY			
11			CDR*Set RSI			
			FDAI SELECT - 1/2			
			FDAI SOURCE - ATT SET			
			ATT SET - GDC			
			EMS ROLL - ON			
			GDC ALIGN PB - Push until RSI aligned			
			Adjust yaw thbwl, align RSI			
			EMS ROLL - OFF			

PROG TIME	STEP	STA	ACTION/ENTRY	V-N DISPLAY	REGISTER DISPLAY	OPTION/ENTRIES
	12		CDR*ALIGN GDC TO IMU			Key V16N20
			FDAI SELECT - 1			ATT SET thbwls--adjust to IMU gmbl angs on DSKY
			FDAI SOURCE - ATT SET			
			ATT SET - IMU			
			Null error needles W/3 Thbwls			
			FDAI SELECT - 1/2			ATT SET - GDC
			ATT SET - GDC			GDC ALIGN PB - PUSH, hold
			GDC ALIGN - PRESS			
	13		CSM External ΔV Program P-30			
P-30		LEB	KEY V37E30E	F 06 33	00XXX. HRS	Load desired data
			GETI		000XX. MIN	
					0XX.XX SEC	
		LMP	Record values			
		LEB	PROCEED			
			LV ΔVG AT GETI(X,Y,Z)	F 06 81	XXXX.X FPS	Load desired data
					XXXX.X FPS	
					XXXX.X FPS	
		LEB	PROCEED			
			Thrusting parameters	F 06 42	XXXX.X NM	
			(HA,HP,ΔVR)		XXXX.X NM	
					XXXX.X FPS	
		LEB	Record and coordinate W/GND			Reselect P-30 or P-27 load new data
		CMP	*Set ΔV ctr			
		LEB	PROCEED			
			Mark ctrs	F 16 45	00BXX OPT	
			TFI		XXBXX M/S	
			MGA (at thrust)		XXX.XX DEG	
		LMP	Record values			
		CMP	*Set DET			
		LEB	PROCEED			Reselect P-52
			DSKY displays	F 37		
		LEB	KEY V37E00E	P00		
	14		Prethrusting Entry Checks			
		ALL	*Config for Sep and Entry			
			Suit Loop Verification			
			Mae Wests - Donned			
		CDR	*SUIT RET AIR VLV - PUSH (close)			
		CDR	*Strap in couch			

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PROG TIME	STEP	STA	ACTION/ENTRY	V-N DISPLAY	REGISTER DISPLAY	OPTION/ENTRIES
			LMP*Strap in couch			
			LEB*EMERG CAB PRESS SEL - OFF			
			CDR*CB RCS LOGIC (BOTH) - CLOSE			
			*CM RCS LOGIC - ON			
			LEB*CM RCS HTRS - ON (until min Rdg is 4.9 VDC or 20 min) (Sys Test 5C,D,6A,B,C,D)			
			*URINE DUMP - OFF			
			SET FDAI 2 on orb rate and restow			
			LMP*Test C/W lamps			
			Dump and rewind tape Rcdr (CRO)			
			ALL*COMM MODE - LAUNCH/ENTRY			
			LEB*CM RCS HTRS - OFF			
			*CB PYRO A SEQ A - CLOSE			
			*CB PYRO B SEQ B - CLOSE			
			If PYRO BAT A/B <35 VDC:			
			CB PYRO A/B SEQ A/B - OPEN			
			CB PYRO A/B BAT BUS A/B TO PYRO TIE - CLOSE			
			CMP*Strap in couch			
			LMP*CB MN A BAT C - CLOSE			
			*CB MN B BAT C - CLOSE			
			LMP*Panel 277 CB'S - all closed			
			*UTILITY PWR PANEL 16 - OFF			
			CDR*UTILITY PWR PANEL 15 - OFF			
			*Panel 8 - CB all closed except:			
			PL VENT FLT/PL - OPEN			
			FLOAT BAGS (3) - OPEN			
			AFTER MSFN AOS:			
			* SECS LOGIC (BOTH) - ON			
			Report LOGIC ON, GET PYRO ARM GO from MSFN			
			* SECS PYRO (BOTH) - ARM			
			*PRPLNT DUMP - RCS CMD (Verify)			
			*CM RCS PRESS - ON (UP)			
			*CM RCS PRPLNT 1 - ON			
			*CM ACS PRPLNT 1 - OFF			
			*CM RCS PRPLNT 2 - ON			
			*RCS IND SW - CM1, then 2			
			He Press - 4000-4450 PSIA			
			Fuel & OX Press - 285-302 PSIA			

PROG TIME	STEP	STA	ACTION/ENTRY	V-N DISPLAY	REGISTER DISPLAY	OPTION/ENTRIES
			*SECS PYRO (BOTH) - SAFE			
			*SECS LOGIC (BOTH) - OFF			SCS/Select P00
			CDR EMS FUNC - ΔV Set			
			Set PAD ΔV			
			EMS FUNC - ΔV			
			CMP Go To Earth Orbital Deorbit Procedures			

5.0 EARTH ORBITAL DEORBIT PROCEDURES

5.1 PGNCS/SCS SPS DEORBIT MAJOR EVENTS

This Section will be included at a later date.

5.2 PGNCS/SCS SPS DEORBIT PROCEDURES

PROG TIME	STEP	STA	ACTION/ENTRY	V-N DISPLAY	REGISTER DISPLAY	OPTION/ENTRIES
	1		CSM-SPS Thrusting Program P-40			
P-40		CMP	Key V37E40E			Poss Prog Alarm Key V05N09E R1 00210 (ISS not on) or R1 00220 (IMU orient unknown) Perform ISS startup and/or P-51
		CMP	If VG displ desired Key V06N81E VGX,Y&Z(LV at GETI)	F 06 81	XXXX.X FPS XXXX.X FPS XXXX.X FPS	*SCS/Thrust Mon Program Key V37E47E
	2		Attitude Maneuver Rou (R60)			
		CDR	PERFORM CMC - AUTO (R,P,Y)	F 50 18	XXX.XX DEG XXX.XX DEG XXX.XX DEG	*SCS/MAN MNVR
			BMAG MODE (3) - RATE 2 CMC ATT CONTROL - AUTO			Sel desired att control
		CMP	PROCEED			ENTER Go to step 2A
			Auto maneuver final att R,P,Y	06 18	XXX.XX DEG XXX.XX DEG XXX.XX DEG	*SCS/ATT man to thrusting attitude
		CMP	Monitor FDAI			
	A		Att trim enable R,P,Y	F 50 18	XXX.XX DEG XXX.XX DEG XXX.XX DEG	*Est SCS att hold
	3		Ignition Preparation			
		LMP	*MN BUS TIE (2) - ON *SPS HE VLV TB (2) - BP *SPS HE VLV (both) - AUTO			
		CDR	*RHC PWR DIRECT (2) - OFF SC CONT - CMC CMC MODE - AUTO			

PROG TIME	STEP	STA	ACTION/ENTRY	V-N DISPLAY	REGISTER DISPLAY	OPTION/ENTRIES
			SCS TVC (2) - RATE CMD			*SCS TVC (2)-AUTO
			LV/SPS IND SII/SIVB-GPI			
			*TVC GMBL DRIVE (2) - AUTO			
			*ΔV CG - CSM			
			*FCSM SPS A - ON (UP)			
			Gimbal Drive and Trim Check			
		CDR	*TVC SERVO PWR 1 - AC1/MNA			
			*TVC SERVO PWR 2 - AC2/MNB			
			*TRANS CONTR PWR - ON (UP)			
			*RHC PWR NORM 2 - AC			
			*RHC 2 - ARMED			
			If RATE 1 ΔV planned			
			BMAG MODE PITCH - RATE 1			
			BMAG MODE YAW - RATE 1			
			or			
			BMAG MODE (IN AXIS) - RATE 1			
			*SPS GMBL MOT PITCH 1 - START			
			*SPS GMBL MOT YAW 1 - START			
			Auto Switchover Check			
			*THC - CW			
			*RHC - verify no MTVC control			
			SPS GMBL IND (2) - NO MOTION			
			Secondary TVC check			
			*SPS GMBL MOT PITCH 2 - START			
			*SPS GMBL MOT YAW 2 - START			
			*Confirm and set trim control			
			SPS GMBAL thbwls(2)-+ and - and set to c.g. trim values			*SPS GMBL thbwls(2) -set and confirm final desired gmbl position
			*RHC 2 - verify MTVC Control			
		CDR	*THC - NEUTRAL			
			*RHC PWR NORM 2 - AC/DC			
			BMAG MODE (3) - RATE 2			Select att control desired
			Align CSM in roll			Verify/Man to Thrust att
			CMC att control - AUTO			(V62E for total att error display)
			PROCEED (For Auto Trim)			*For MANUAL TRIM:
			DSKY Displays V06 N18			ROT CONTR PWR DIR (2) MAN/MNB
			then F 50 18			MAN ATT (3) - RATE CMD
						RATE - HIGH
						BMAG MODE (3) - ATT 1/RATE 2
						ENTER

PROG TIME	STEP	STA	ACTION/ENTRY	V-N DISPLAY	REGISTER DISPLAY	OPTION/ENTRIES
			CMP ENTER			*RHC(2)-Null att errors
			CMC GMBL Drive test	F 50 25 00204		
			CMP PROCEED Monitor GMBL drive sequence			ENTER GMBL drive to trim position (after 4 sec) POSS F 05 09 R1 01703 (TF GETI<45 SEC) PROCEED (Slips GETI 45 SEC from proceed) or V34E, terminate
			CMP DSKY displays TF GETI,VG,ΔVM	06 40	XXBXX M/S XXXX.X FPS XXXX.X FPS	
-02:00			CDR*2-min countdown *Report TTI=2 MIN *FDAI SCALE - 5/5 *ΔV THRUST (2) - NORMAL *THC - ARMED RHC (2) - ARMED			*SCS/LIMIT CYLCE - OFF
	4		State Vector Integration Rou R41			
			CMP If PROG LT - ON, CMC slipped TIG DSKY R1 counts to former TIG DSKY clears at new TIG-35 SEC COMP ACTY LT - OFF			
-00:35			DSKY display BLANKS			
-00:30			Avg G on (static displ)	06 40		
-00:25			CMP*Check ΔVM for PIPA bias R3≤000 1.0 FPS LMP*TAPE RCDR FWD - FWD CDR*EMS MODE - AUTO			R3>1.0 FPS,discont G/N thrust
-00:15			*4 jet ullage *CONT ATT WITH RHC *MONITOR ΔVM COUNTING UP			*Backup - DIRECT ULLAGE PB
-00:05			CMP ENGINE ENABLE TF GETI,VG,ΔVM	F 99 40	XXBXX M/S XXXX.X FPS XXXX.X FPS	NO GO/V34E

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PROG TIME	STEP	STA	ACTION/ENTRY	V-N DISPLAY	REGISTER DISPLAY	OPTION/ENTRIES
			CMP PROCEED			*SCS/THRUST ON
00:00			Ignition			PB - PUSH
			CDR Monitor			
			THRUST LT - ON			
			EMS ΔV CTR - DECREASING			
			CMP MONITOR (TFI INCREASING)	06 40	XXBXX M/S	
			(VG DECREASING)		XXXX.X FPS	
			(ΔVM INCREASING)		XXXX.X FPS	
			CDR After cutoff	16 40		3.7 Sec after cutoff
			*ΔV THRUST A AND B - OFF			PROCEED
			*Verify all thrust off cues			
			*GMBL MTRS (4) - OFF			
			*TVC SERVO PWR 1 and 2 - OFF			
			*RHC #1 - locked			
			CMP PROCEED			
			Monitor (VGX,Y,Z)	F 16 85	XXXX.X FPS	If VG's to be
					XXXX.X FPS	nulled RHC/THC
					XXXX.X FPS	- null out VG's
						THC - neutral,
						locked
			CMP If orbital parameter disp			
			desired (R-30)			
			Key V82E	F 16 44	XXXX.X NM	
			HA,HP,TFF		XXXX.X NM	
					XXBXX M/S	
			If HP>49.4 NM			
			R3=59B59			
			CMP PROCEED (2ND PROCEED IF R-30)	F 37		
			CMP Record burn data			
	5		CM/SM Separation Functions			
			LMP*MN BUS TIE (2) - ON (UP)			
			CDR*CB SECS ARM (2) - CLOSE			
			*CB SECS LOGIC (2) - CLOSE			
			*CB ELS (2) - CLOSE			
			*PRIM GLY TO RAD - PULL TO BYPASS			
			*02 PLSS VLV - FILL			
			CMP*02 PRESS IND sw - SURGE TK			
			*CRYO TK 1 02 PRESS 865-982 psia			
			CDR*02 PLSS vlv - ON			
			*02 SM SUPPLY VLV - OFF			
			*CAB PRESS RELF(2) - BOOST/ENTRY			
			*SELECT ATT CONTROL MODE			
			*MNVR TO SEP ATT			

PROG TIME	STEP	STA	ACTION/ENTRY	V-N DISPLAY	REGISTER DISPLAY	OPTION/ENTRIES
			LMP*VHF AM (BOTH) - OFF			
			*VHF ANT-RECY			
			*S BD ANT OMNI A-C			
			*S BD ANT OMNI - OMNI			
			CMP*SM RCS PRIM PRPLNT TB(4) - GRAY			
			*SM RCS SEC PRPLNT TB(4) - GRAY			
			After MSFN AOS:			
			CDR* SECS LOGIC (BOTH) - ON (UP)			
			Report logic arm			
			After GO from MSFN:			
			* SECS PYRO ARM (2) - ON (UP)			
			*ABRT SYS PRPLNT - RCS CMD			
			CMP*CM/SM SEP (BOTH) - ON (UP)			
			*C/W CSM - CM			
			CDR*RCS TRNFR - CM			
			*CM RCS LOGIC - OFF			
			*MNVR TO ENTRY ATT			
			R_____,P_____,Y 0°			
			*AUTO RCS SEL A/C ROLL (4) - OFF			
			*AUTO RCS SEL CM 1(6)-MNA or MNB			
			*AUTO RCS SEL CM 2(6) - OFF			
			CMP Go to Earth Orbital Entry Procedures			

5.3 PGNCS/SCS RCS (Including Hybrid) Deorbit Major Events

The procedures for performing RCS deorbit burns are described in this section. Options are given for either PGNCS control or SCS control of the burn. Also, the burn may be performed using only the SM RCS jets or it may be a hybrid burn (i.e. a SM RCS burn followed by CM/SM separation and a CM RCS burn which uses the CM pitch thrusters for translation). The procedures described in this section are entered directly from the deorbit preparation procedures delineated in Section 4.2.

5.3.1 P41 (RCS Thrusting Program)

The CMC's RCS thrusting program is called. A request to perform an auto attitude maneuver to the burn attitude is flashed along with the final gimbal angles (not constrained in roll) for the burn. The roll gimbal angle to be used for the burn is obtained from pad data and should give a heads down orientation for the burn. In the event the burn is not hybrid, the next procedural step (separation preparation) is deleted.

5.3.2 Separation Preparation

In the event a hybrid burn is planned, some separation preparation procedures are performed 10 minutes prior to the burn in order to alleviate the work load during the time critical period between the SM burn and the CM burn. Also, the gimbal angles for the CM portion of the burn are loaded in noun 17 and are set on the attitude set thumbwheels. This allows an error needle display during the CM portion of the burn for either PGNCS controlled burns or SCS controlled burns.

5.3.3 Reject Auto Maneuver

The auto maneuver to the burn attitude is rejected because the roll gimbal angle computed in P41 is not constrained and a heads down orientation is desired. This orientation is desirable because a simple pitch maneuver is required to get from this attitude to the CM burn attitude. Also, this orientation provides a horizon view in the command window during the SM portion of the burn. The maneuver is performed manually with the commander selecting the desired control mode. Pitch and yaw error needles are provided if the CMC is on by keying V62E.

5.3.4 Reject Auto Trim

After the manual maneuver to the SM burn attitude, the spacecraft attitude may be trimmed either manually or automatically. The nominal procedures call for a manual trim maneuver, however, an option for performing the maneuver automatically is provided. Roll is not constrained for the auto trim maneuver, therefore roll should be trimmed manually.

5.3.5 Establish Attitude Hold

If the CMC is on, the SC control switch is placed in the CMC position to provide DAP attitude control for the SM burn. Also some preliminary SCS switching is done in order to be able to switch quickly to SCS control if required. If possible, the burn should be done under CMC control since this control mode requires less fuel for the burn than the SCS control mode. At five minutes before the burn, the CMP keys ENTER and the DSKY flashes the velocity to be gained along each CSM based on the present CSM attitude.

5.3.6 Ignition Preparation

A star check is made to verify that the CSM burn attitude is correct and the EMS is set up to monitor the burn. At two minutes before ignition an option is provided for calling P47 (Thrust Monitor Program) and, if exercised, the DSKY flashes the delta velocity change along each CSM axis until R30 (Orbital Parameter Display) is called in step 13. Otherwise, at 35 seconds before ignition the DSKY goes blank and at 30 seconds before ignition the DSKY displays the velocity to be gained along each CSM axis. The rotational and translation hand controllers are armed, the flight recorders are turned on and the EMS is switched to auto. The limit cycle switch is placed in the off position and the attitude deadband is switched to minimum to allow switchover from CMC to SCS control if required.

5.3.7 SM Burn

At time of ignition the DSKY begins flashing the velocity to be gained along each CSM axis, and the SM portion of the burn is performed with the THC. Burn procedures call for thrusting until the EMS delta velocity counter goes to zero. For a hybrid burn, the DSKY will indicate additional velocity to be gained when the EMS delta velocity counter indicates zero. After the burn has been completed, the event timer is reset and started counting up. If the burn is not a hybrid burn, a skip to step 13 (check perigee altitude) is required to bypass the procedures for the CM RCS burn.

5.3.8 CM/SM Separation

After the SM portion of a hybrid burn has been completed, high rates are selected and spacecraft control is turned over to the SCS. The CMC cannot control the CM because the CSM DAP will be active until a PROCEED from the separation request in program P62 (CM/SM Separation and Pre-Entry Maneuver Program). Separation is initiated by throwing the two CM/SM SEP switches.

5.3.9 Establish Attitude Display for CM Burn

These procedures provide an attitude error needle display on FDAI 1 or 2 (depending on which is selected) for the CM portion of the hybrid burn. If the SM portion of the burn was done under CMC control, the error needles will be driven by the CMC; otherwise they will be driven by the SCS.

5.3.10 Maneuver to CM Burn Attitude

A simple pitch up maneuver through approximately 108 degrees is required to get from the SM burn attitude to the CM burn attitude. As for all attitude maneuvers, the control mode is selected real time by the CDR.

5.3.11 Establish Attitude Control

After the attitude maneuver has been completed, the procedures call for establishing attitude control for the CM RCS burn. The roll and yaw channels should be placed in the rate command mode. The pitch channel must be in the acceleration command mode in order to fire both the positive and negative pitch thrusters simultaneously. Reference (8) recommends the use of high rate and minimum attitude deadband for the CM burn.

5.3.12 Perform CM RCS Burn

The CM burn should begin when the DET is equal to one minute. Both RHC's are used to perform the burn. The CMP should initiate a continuous pitch down command with the number one RHC while the CDR maintains the CM attitude by pulsing the number two RHC with pitch up commands. Reference (9) recommends that the minimum jet on time, for the CM-RCS pitch thrusters, during CM-RCS deorbit always be greater than or equal to one second in order to maintain propellant

efficiency. If P41 (RCS Thrusting Program) is running, the burn should be terminated when register three of the DSKY (velocity to be gained along the Z-axis of the CM) reaches zero. If P41 is not running, the EMS delta V counter is used as the burn termination cue. During the CM portion of the burn the EMS delta V counter will be counting up. When it reaches the pad value for burn termination, the burn is terminated.

5.3.13 Perform HP Check

R30 (Orbital Parameter Display Routine) is called to monitor the height of perigee (HP). In the event HP is larger than the pad value, additional thrusting is required until HP is less than or equal to the pad value. After thrusting is completed, the EMS is turned off and the THC is locked

5.3.14 Maneuver to SM Burn Attitude

If the CMC is on, the spacecraft is maneuvered to the SM burn attitude to obtain the velocity to be gained residuals at this attitude. If the CMC is off, this maneuver is not necessary.

5.3.15 Read VG Residuals to Ground

The LMP reads the velocity to be gained residuals and the EMS delta V to ground if the CMC is on. Otherwise, only the EMS delta V is read to ground. If the burn was a hybrid burn a skip to step 17 is required to bypass the CM/SM separation procedures since separation for a hybrid burn occurs between the SM burn and the CM burn.

5.3.16 Maneuver to Separation Attitude

The spacecraft is manually maneuvered to the separation attitude. At present, this attitude is undefined. It may turn out that the separation attitude will be the same as the burn attitude and no

maneuver will be required. The procedures will be changed to reflect the correct separation attitude as soon as this attitude is defined.

The rate switch is placed in the high position in anticipation of CM/SM separation. Low rates are not recommended for CM attitude control because of excessive RCS fuel consumption.

5.3.17 CM/SM Separation

CM/SM separation is performed before exiting P41 in order that any velocity change imparted by the separation maneuver will be incorporated into the onboard state vector and so that the crew may monitor any velocity change via the DSKY if desired.

5.3.18 Maneuver to Entry Attitude

The CMP keys PROCEED to terminate P41 or P47, whichever is running. Single ring RCS is selected before maneuvering to the entry attitude. The maneuver is performed manually under SCS control. The control mode (e.g. acceleration command, rate command, or minimum impulse) is selected real time by the CDR with the only restriction being that the rate switch should be in the high position. Low rates are not recommended for CM attitude control because of excessive RCS fuel consumption.

There is a possibility that P00 (CMC Idling Program) may or may not be called before going to the Earth Orbital Entry Procedures. If called, P00 will turn off the average g routine (quit processing accelerometer inputs) and subsequent state vector integration will be performed by the coasting flight integration routine. The average g routine is inherently more inaccurate than the coasting flight integration routine, however, if the average g routine is turned off

the CM velocity changes resulting from CM RCS thruster activity do not get incorporated into the onboard state vector. A study is required in order to determine which procedure results in the more accurate onboard state vector. The procedures will be changed to reflect the recommendation of the Mission Planning and Analysis Division on this item when it becomes available.

5.4 PGNCS/SCS RCS (INCLUDING HYBRID) DEORBIT PROCEDURES

P PRIME PGNCS/SCS RCS (INCLUDING HYBRID) DEORBIT PROCEDURES

ALT/ PROG/ TIME	S T F P STA	ACTION/ENTRY	V-N/ DISPLAY	OPTION/ENTRIES
		ASSUMPTIONS:		
		(1) SCS-ON (REQUIRED)		
		(2) CMC IN DSKY IDLE PROGRAM (P-00) IF CMC IS ON		
		(3) PROCEDURES CONTINUE FROM THE LAST PROCEDURAL STEP IN SECTION 4.2		
P-41	1 CMP	KEY RCS THRUSTING PROG (V37E41E)		
		CMC - AUTO REQUEST		F 50 18
		PREFERRED ATTITUDE (R,P,Y)		XXX.XXDEG
				XXX.XXDEG
				XXX.XXDEG
		IF SM BURN ONLY GO TO STEP 3		
-00:10:00	2	SEPARATION PREPARATION		
	CDR	CB SECS ARM (2) - CLOSED		
		CB SECS LOGIC (2) - CLOSED		
		CB ELS (2) - CLOSED		
		PRIM GLY TO RAD-PULL TO BYPASS		
		O2 PLSS VLV-ON		
		O2 SM SUPPLY VLV-OFF		
		CAB PRESS REL (2)-BOOST/ENTRY		
	CMP	SM RCS PRIM PRPLNT (4) - [illegible]		
		SM RCS PRIM PRPLNT TB (4)-GRAY		
		AFTER MSFN AOS		
	CDR	SECS LOGIC (BOTH) - ON (UP)		
		REPORT LOGIC ARMED		
		AFTER GO FROM MSFN		
		SECS PYRO ARM (2) - ON (UP)		
	CMP	PROP DUMP - RCS CMD		

C PRIME PGNCS/SCS RCS (INCLUDING HYBRID) DEORBIT PROCEDURES

ALT/ PROG/ TIME	S T E P STA	ACTION/ENTRY	V-N/ DISPLAY	OPTION/ENTRIES
		KEY (V25N17E)	F 21 17	
		LOAD GIMBAL ANGLES FOR CM PORTION OF BURN USING PAD DATA	BLANK XXX.XXDEG XXX.XXDEG	
		KEY REL PB - PUSH		
		CMC-AUTO REQUEST	F 50 18 XXX.XXDEG XXX.XXDEG XXX.XXDEG	
	CDR	ATT SET TW-ADJUST TO CM GIMBAL ANGLES FOR THE CM PORTION OF THE BURN USING PAD DATA		
	3 CDR	REJECT AUTO MANVR - KEY (V62E) N22-N20 ON ERR NDL SELECT ATTITUDE CONTROL MODE COMPATIBLE WITH THE MAGNITUDE OF THE MANEUVER - E.G. RATE COMMAND, ACCEL COMMAND OR MINIMUM IMPULSE AND THE DESIRED RATES. USE RECORDED PAD DATA FOR R= P= Y= PERFORM MANEUVER WITH RHC.		
	4	REJECT AUTO TRIM - SELECT ATTITUDE CONTROL MODE COMPATIBLE WITH THE MAGNITUDE OF THE MANEUVER - E.G. RATE COMMAND, ACCEL COMMAND OR MINIMUM IMPULSE AND THE DESIRED RATES. PERFORM MANEUVER WITH RHC.		ACCEPT AUTO TRI BMAG MODE (3)= RATE 2 SC CONT-CMC CMC MODE-AUTO PROCEED V06 N18 MONITOR AUTO TRIM
	5 CDR	ESTABLISH ATT HOLD BMAG MODE(3) - ATT1 RATE2 MANUAL ATT (3)-RATE CMD SC CONT - CMC, IF CMC-ON, OTHERWISE SCS CMC MODE - AUTO OR HOLD RATE-LOW ATT DBD-MAX		

C PRIME PGNCS/SCS RCS (INCLUDING HYBRID) DEORBIT PROCEDURES

ALT/ PROG/ TIME	STEP STA	ACTION/ENTRY	V-N/ DISPLAY	OPTION/ENTRIES
-00:05:00	CMP	ENTER	06 85	
		VGX	XXXX.XFPS	IF TTI < 30
		VGY	XXXX.XFPS	SEC THEN GETI
		VGZ	XXXX.XFPS	IS SLIPPED
	6	IGNITION PREPARATION		
	CDR	CHECK BORESIGHT STAR		
		THC PWR - ON (UP)		
		EMS MODE - STBY		
		EMS FUNC - DELTA V SET		
		SET DELTA V IND TO SM PORTION OF BURN		
		EMS FUNC - DELTA V		
-00:02:00				THRUST MONITOR PROGRAM P-47 KEY (V37E47E) AFTER 15 SEC F 16 83 DELTA V X DELTA V Y DELTA V Z CHECK COMPONENTS FOR PIPA BIAS UNTIL THRUST APPLIED
-00:00:35			BLANK	
			BLANK	
			BLANK	
-00:00:30			16 85	
		VGX	XXXX.XFPS	
		VGY	XXXX.XFPS	
		VGZ	XXXX.XFPS	
		THC - ARMED		
		RHC (BOTH) - ARMED		
		LIMIT CYCLE - OFF		
		ATT DBD-MIN		
	CMP	FLT RCRD - RECORD		
	LMP	TAPE RCDR FWD-FWD		
	CDR	EMS MODE - AUTO		

C PRIME PGNCS/SCS RCS (INCLUDING HYBRID) DEORBIT PROCEDURES

ALT/ PROG/ TIME	S T E P	STA	ACTION/ENTRY	V-N/ DISPLAY	OPTION/ENTRIES
00:00:00	7		SM BURN	F 16 85	
			VGX	XXXX.XFPS	
			VGY	XXXX.XFPS	
			VGZ	XXXX.XFPS	
			THC-BURN EMS DELTA V TO ZERO		
			EVENT TIMER - RESET - START		
			IF SM BURN ONLY GO TO STEP 13		
	8		CM/SM SEPARATION		
			RATE - HIGH		
			SC CONT - SCS		
		LMP	MN BUS TIE (2)-ON		
			VHF AM (2)-OFF		
		CMP	CM/SM SEP (BOTH) - ON (UP)		
			C/W CSM - CM		
		CDR	CM RCS LOGIC-OFF		
			RCS TRANFR - CM (VERIFY)		
	9		ESTABLISH ATT DISP FOR CM BURN		
		CMP	KEY (V63E) N17-N20 ON ERR NDL		
		CDR	IF CMC FAILED		
			.FDAI SELECT-1 OR 2		
			.FDAI SOURCE-ATT SET		
			.ATT SET-GDC		
	10		MANEUVER TO CM BURN ATTITUDE		
			USE RECORDED PAD DATA FOR		
			R= P= Y=		
			SELECT ATTITUDE CONTROL MODE COMPATIBLE WITH THE MAGNITUDE OF THE MANEUVER - E.G. RATE COMMAND, ACCEL COMMAND OR- MINIMUM IMPULSE AND THE DESIRED RATES.		
			PERFORM MANEUVER WITH RHC BY NULLING ERR NEEDLES.		
	11		ESTABLISH ATT CONTROL		
		CDR	ROLL, YAW - RATE CMD		
			PITCH - ACC CMD		
			RATE - HIGH		
			ATT DEADBAND - MIN		
			LIMIT CYCLE - OFF		
			FDAI SCALE - 5/5 (DESIRED)		

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C PRIME PGNCS/SCS RCS (INCLUDING HYBRID) DEORBIT PROCEDURES

ALT/ PROG/ TIME	S T E P	STA	ACTION/ENTRY	V-N/ DISPLAY	OPTION/ENTRIES
+00101?00	12		PERFORM CM RCS BURN		
		CMP	RHC - 1. INITIATE CONTINUOUS NEG PITCH		
		CDR	RHC - 2. PULSE PLUS PITCH TO MAINTAIN ATTITUDE (FDAI 1) IN 3 AXIS BURN VGZ TO ZERO UNLESS CMC FAILED IN WHICH CASE: .BURN EMS DELTA V TO PAD VALUE OR UNTIL DET=PAD VALUE		
	13		PERFORM HP CHECK		
		CMP	KEY (V82E) CALL ORBITAL PARAMETER DISPLAY (R=30)	F 16 44	
			HA	XXXX.XNM	
			HP	XXXX.XNM	
			TFF	XXBXX M/S	
			CHECK HP IF HP>PAD DATA, CONTINUE BURN UNTIL HP<PAD DATA		
			PROCEED		IF P=47 RUNNING
			VECTOR COMPONENTS	F 16 85	F 16 83
			VGX	XXXX.XFPS	DELTA V X
			VGY	XXXX.XFPS	DELTA V Y
			VGZ	XXXX.XFPS	DELTA V Z
		CDR	EMS MODE - STBY EMS FUNC-OFF THC - NEUTRAL - LOCKED		
	14		MANEUVER TO SM BURN ATTITUDE IF CMC OFF GO TO STEP 15 KEY (V62E) N22-N20 ON ERR NDL USE RECORDED PAD DATA FOR R= P= Y=		
		CDR	SELECT ATTITUDE CONTROL MODE COMPATIBLE WITH THE MAGNITUDE OF THE MANEUVER - E.G. RATE COMMAND, ACCEL COMMAND OR MINIMUM IMPULSE AND THE DESIRED RATES. PERFORM MANEUVER WITH RHC, AND NULL ERROR NEEDLES.		

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C PRIME PGNCS/SCS RCS (INCLUDING HYBRID) DEORBIT PROCEDURES

ALT/ PROG/ TIME	S T E P	STA	ACTION/ENTRY	V-N/ DISPLAY	OPTION/ENTRIES
	15	LMP	READ VG RESIDUALS AND EMS DELTA V TO GROUND IF HYBRID BURN GO TO STEP 18		
	16		MANEUVER TO SEPARATION ATTITUDE		
		CDR	SC CONT=SCS SELECT ATTITUDE CONTROL MODE COMPATIBLE WITH THE MAGNITUDE OF THE MANEUVER - E.G. RATE COMMAND, ACCEL COMMAND OR MINIMUM IMPULSE AND THE DESIRED RATES. PERFORM MANEUVER WITH RHC.		
			MAN ATT (3)=RATE CMD RATE=HIGH		
	17		CM/SM SEPARATION		
		CDR	CB SECS ARM (2) - CLOSED CB SECS LOGIC (2) - CLOSED CB ELS (2) - CLOSED PRIM GLY TO RAD=PULL TO BYPASS O2 PLSS VLV=ON O2 SM SUPPLY VLV=OFF CAB PRESS REL (2)=BOOST/ENTRY		
		CMP	SM RCS PRIM PRPLNT (4) - ON SM RCS PRIM PRPLNT TB (4)=GRAY AFTER MSFN AOS		
		CDR	SECS LOGIC (BOTH) - ON (UP) REPORT LOGIC ARMED AFTER GO FROM MSFN SECS PYRO ARM (2) - ON (UP)		
		CMP	PROP DUMP - RCS CMD		
		LMP	MN BUS TIE (2)=ON VHF AM (2)=OFF		
		CMP	CM/SM SEP (BOTH) - ON (UP) C/W CSM - CM		
		CDR	CM RCS LOGIC=OFF RCS TRANFR - CM (VERIFY)		
	18		MANEUVER TO ENTRY ATTITUDE		
		CMP	PROCEED	F 37	
		CMP	FTL RCDR - OFF (CENTER)		
		CDR	AUTO RCS SEL A/C ROLL (4)=OFF AUTO RCS SEL CM1 (6)=MNA OR MNB AUTO RCS SEL CM2 (6)=OFF		

C PRIME PGNCS/SCS RCS (INCLUDING HYBRID) DEORBIT PROCEDURES

ALT/ PROG/ TIME	S T E P STA	ACTION/ENTRY	V-N/ DISPLAY	OPTION/ENTRIES
		USE RECORDED PAD DATA FOR R= P= Y=		
	CDR	SELECT ATTITUDE CONTROL MODE COMPATIBLE WITH THE MAGNITUDE OF THE MANEUVER - E.G. RATE COMMAND, ACCEL COMMAND OR MINIMUM IMPULSE. RATE-HIGH PERFORM MANEUVER WITH RHC.		
	CMP	(KEY/DO NOT KEY) ONE (TBD) GO TO EARTH ORBITAL ENTRY PROCEDURES (SECTION 6.2)		

6.0 EARTH ORBITAL ENTRY

6.1 Entry Major Events

This section will be included at a later date.

6.2 ENTRY PROCEDURES

6.2.1 ENTRY PREPARATION PROGRAM P-61

PROG TIME	STEP	STA	ACTION/ENTRY	V-N DISPLAY	REGISTER DISPLAY	OPTION/ENTRIES
	1		Entry Preparation Program P-61			
			CMC - ON (req)			
			IMU - ON (req)			
			SCS - ON			
			CMC ATT - IMU			
			0.05G sw - OFF			
P-61		CMP	Key V37E61E			
			(Select at end of deorbit)			
			(State Vector Integration Rou R-41)			
			COMP ACTY LT - FLASHES every 2 seconds			
			COMP ACTY LT - OUT (R-41 complt)			
			Program 61 displays			
			IMPACT LAT (+north)	F 06 61	XXX.XX DEG	
			IMPACT LONG (+east)		XXX.XX DEG	
			HDS UP/DN (+up)		+/-00001	
		CMP	PROCEED			Key V25E Load desired values
			Entry data Gmax,Vpred,Gamma EI	F 06 60	XXX.XX G XXXXX. FPS XXX.XX DEG	
		LMP	Record values			
		CMP	PROCEED			
			RTGO,VIO,TFE	F 06 63	XXXX.X NM XXXXX. FPS XXBXX M/S	
		LMP	Record			
		CMP	PROCEED			
			(DSKY DISPLAYS P-62)			
	2		Separation & Preentry Maneuver Program P-62			
P-62		CMP	DSKY Displays P-62			Poss prog alarms 1427&1426-RESET
			Request CM/SM Separation	F 50 25	00041	
		CMP	PROCEED			
			Program displays			
			IMPACT LAT (+north)	F 06 61	XXX.XX DEG	
			IMPACT LONG (+east)		XXX.XX DEG	
			HDS UP/DN (+up)		+/-00001	

PROG ID	STEP	STA	ACTION/ENTRY	V-N DISPLAY	REGISTER DISPLAY	OPTION/ENTRIES
			CMP PROCEED			Key V25E Load new data
			(Final attitude R,P,Y)	06 22	XXX.XX DEG XXX.XX DEG XXX.XX DEG	
			LMP Record postburn data from GND Roll gmbl angle at 400K ft RTGO (0.05G) VIO (0.05G) RET 0.05G BBA RET RB (retro elapsed time of reverse bank angle) RET 0.2G Down range error RET BBO (retro elapsed time of blackout) RET EBO (retro elapsed time of end blackout) RET DROG			Use backup chart if GND data not available
			CDR*EMS FCN - CW TO RNG SET *Set Rng Counter for RTGO *EMS FCN - VO SET *Align scroll VO to VIO *EMS FCN - ENTRY *EMS MODE - MAN at RET of 0.05G *ATT DEADBAND - MAX *RATE - HIGH ORDEAL PITCH (HDS-UP) 203° ORDEAL PITCH (HDS-DN) 157°			Use GND data only
			CMP Monitor DSKY - Display of P-63			Called when S/C +X within 45° of V vector
	3		Entry Initialization Program P-63			
P-63			*Horizon Check CDR *BMAG MODE (3) - RATE 2 (in proper roll attitude) *MAN ATT ROL - ACCEL CMD *MAN ATT P AND Y - RATE CMD			
			CMP Monitor DSKY - Display of P-63 G,VI,R TO TARG (+overshoot)	06 64	XXX.XX G XXXXX. FPS XXXX.X NM	
			CMP *Note R3 (approx.) agrees with EMS range counter at RET of 0.05G At RET 0.05G EMS MODE-MAN CDR*0.05G sw - ON (up) *EMS ROLL - ON (up)			
			CMP Monitor DSKY - Display of P-64			P-64 auto at 0.05G

PROG TIME	STEP	STA	ACTION/ENTRY	V-N DISPLAY	REGISTER DISPLAY	OPTION/ENTRIES
	4		Post 0.05 G Program P-64			
P-64		CMP	Monitor DSKY - Display BETA, VI, H DOT	06 68	XXX.XX DEG XXXXX. FPS XXXXX. FPS	
			*Fly Lift Vector up until RET 0.2G time, then BBA			Lift down til 1G if RCS Deorbit
		CMP	Monitor DSKY - Display of P-67			P-67 auto at 0.2G
P-67	5		Entry Final Phase Program P-67 (Entry DAP Control Mode)			
			BETA	06 66	XXX.XX DEG	PUSd-VERB pb
			CROSS RANGE ERR		XXXX.X NM	To Hold Displ
			DOWN RANGE ERR		XXXX.X NM	then KEY RLSE
			Compare R3 with Gnd and/or chart data			
		CDR	At RET 0.2G PGNCS (comp) Verified			SCS/If PGNCS (comp) no go fly EMS
		CDR	PGNCS/Go - Fly PGNCS (DAP)			If RCS Deorbit
			MAN ATT ROLL - RATE CMD			lift vector down
			SC CONT - CMC			until 1.0G
			*Mon RSI and FDAI roll and R3, When R3 0, CMC commands			
			*Mon EMS g-onset line			
			*Establish Comm W/Gnd as soon as possible			
			When V REL = 1000 FT/SEC (65K')			
			RTGO	F 16 67	XXXX.X NM	
			LAT (+NORTH)		XXX.XX DEG	
			LONG (+EAST)		XXX.XX DEG	
			IF R =-, L UP. IF R =+, L DN.			
		CMP	*Monitor Altimeter			
		ALL	*Go to Earth Landing Phase at 50K'			

6.3 BACKUP ENTRY PROCEDURES

6.3.1 EMS FLIGHT TECHNIQUE

PROG TIME	STEP	STA	ACTION/ENTRY	DISPLAY	DISPLAY	OPTION/ENTRIES
P-67	1	CMP	Monitor DSKY - Display of P-67 BETA CROSS RANGE ERR DOWN RANGE ERR Compare R with Gnd and/or chart data	06 66	XXX.XX DEG XXXX.X NM XXXX.X NM	PUSH-VERB pb To Hold Displ then KEY RLSE
	2	CDR	AT RET 0.2G PGNCS (COMP) verified			
	3	CDR	PGNCS/No Go - Fly EMS Technique: A. ROLL TO -BBA B. At time to reverse bank (TRB), roll from -BBA to +BBA. C. Pilot adjusts +BBA so range potential lines and range-to-go counter are in agreement.			
	4	CDR	Mon RSI and FDAI roll Establish Comm W/Gnd as soon as possible			
	5	CMP	Monitor Altimeter			
	6	ALL	Go to Earth Landing Phase at 50K'			

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6.3.2 BBA FLIGHT TECHNIQUE

PROG TIME	STEP	STA	ACTION/ENTRY	V-N DISPLAY	REGISTER DISPLAY	OPTION/ENTRIES
P-67	1	CMP	Monitor DSKY - Display of P-67			
			BETA	06 66	XXX.XX DEG	PUSH-VERB pb
			CROSS RANGE ERR		XXXX X NM	To Hold Displ
			DOWN RANGE ERR		XXXX.X NM	then KEY RLSE
			Compare R3 with Gnd and/or chart data			
	2	CDR	Maintain -BBA until time to reverse bank angle (TRB)			
	3	CDR	Fly +BBA till drogue deploy			
			Maintain BEF			
			Mon RSI and FDAI roll			
			Establish Comm W/Gnd as soon as possible			
	4		When V REL = 1000 FT/SEC (65K')			
			RTGO	F 16 67	XXXX.X NM	
			LAT (+NORTH)		XXX.XX DEG	
			LONG (+EAST)		XXX.XX DEG	
			If R1=-, L UP, If R1=+, L DN.			
	5	CMP	Monitor Altimeter			
	6	ALL	Go to Earth Landing Phase at 50K'			

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7.0 REFERENCES

(1) Draft of MSC Internal Note, "Apollo Mission Techniques Mission F/G Transearth Midcourse Correction and Entry", Volume 1, Techniques Description, dated 12 August 1968

(2) Notes from Data Priority Panel Meeting on 13 September 1968

(3) Draft of MSC Internal Note, "Apollo Mission Techniques Mission C-Prime TEI, Transearth Midcourse Corrections and Entry", Volume 1, Techniques Description, dated 9 October 1968

(4) Notes from meeting with C-Prime Flight Crew at Kennedy Space Center on 23 October 1968

(5) MSC Internal Note No. S-PA-8T-028, "Apollo Mission Techniques Mission C-Prime Lunar (Alternate 1) Transearth Injection, Midcourse Corrections and Entry", Volume 1, Techniques Description, dated 28 October 1968

(6) Translunar, Lunar Parking Orbit, and Transearth Procedures C-Prime Mission, dated 1 October 1968

(7) Apollo Operations Handbook, Command and Service Modules, Volume II Operational Procedures, CSM 103, dated 1 April 1968, changed 1 June 1968 and 1 August 1968

(8) North American Presentation of ME 101 Simulation Results at a meeting on 2 July 1968

(9) United States Government Memorandum, "Recommended Hybrid Deorbit Procedures for Missions C and D", 68-FM2-148, dated 1 October 1968

8.0 APPENDIX

8.1 LUNAR RETURN ENTRY PAD

ENTRY												
												AREA
X	X	X				X	X	X				R .05G
X	X	X				X	X	X				P .05G
X	X	X				X	X	X				Y .05G
	0						0					LAT N61
												LONG
	0	0	0	0	1		0	0	0	0	1	LIFT VECTOR
+						+						V 400K N60
-	0	0				-	0	0				γ 400K
+						+						RTGO N63
+						+						VIO
												RET .05G
X	X	X				X	X	X				MAX G
+	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			X	X	X	X			CONST G
X	X					X	X					RETBBO
X	X					X	X					RETEBO
X	X					X	X					RETDRO

8.2 EARTH ORBITAL DEORBIT BURN PAD

															PURPOSE	
	+	0	0				+	0	0						HR GETI	N33
	+	0	0	0			+	0	0	0					MIN	
	+	0					+	0							SEC	
															ΔVX	N82
															ΔVY	
															ΔVZ	
	+	0					+	0							HA	N42
		0						0							HP	
	+						+								VC=ΔV-T.O.	
	+						+								WGT	N47
		0	0					0	0						PTRM	N48
		0	0					0	0						YTRM	
	X	X	X				X	X	X						BT(MIN:SEC)	
	X	X	X	X			X	X	X	X					SXTS	
	X	X					X	X							SFT	
	X	X	X				X	X	X						TRN	
AS REQUIRED																
	X	X	X				X	X	X						R	
	X	X	X				X	X	X						P	
	X	X	X				X	X	X						Y	
	+	0	0				+	0	0						HR	N34
	+	0	0	0			+	0	0	0					MIN	
	+	0					+	0							SEC	
		0						0							Φ	N43
															λ	
	+	0					+	0							H	

MANEUVER

(ADDITIONAL DATA FOR HYBRID DEORBITS)

GET I CM HR:MIN:Sec / CM PITCH IMU° / CM ΔT_B MIN:Sec / CM-Xsc ΔVc

8.3 EARTH ORBITAL ENTRY PAD

ENTRY UPDATE (PREBURN)													
X						X						AREA	
X	X					X	X					ΔV TO	
X	X	X				X	X	X				R 400K	
X	X	X				X	X	X				P 400K	
X	X	X				X	X	X				Y 400K	
+						+						RTGO .05G	63
+						+						VI .05G	
X	X					X	X					RET .05G	
												LAT	67
												LONG	
X	X					X	X					RET .20	
												DRE	66
R	L					R	L					BANK ANGLE	
X	X					X	X					RET RB	
X	X					X	X					RETBBO	
X	X					X	X					RETEBO	
X	X					X	X					RETDROG	
ENTRY UPDATE (POSTBURN)													
X	X	X				X	X	X				R 400K	
+						+						RTGO .05G	63
+						+						VI .05G	
X	X					X	X					RET .05G	
X	X					X	X					RET .2G	
												DRE	66
R	L					R	L					BANK ANGLE	
X	X					X	X					RETRB	
X	X					X	X					RETBBO	
X	X					X	X					RETEBO	
X	X					X	X					RET DROG	