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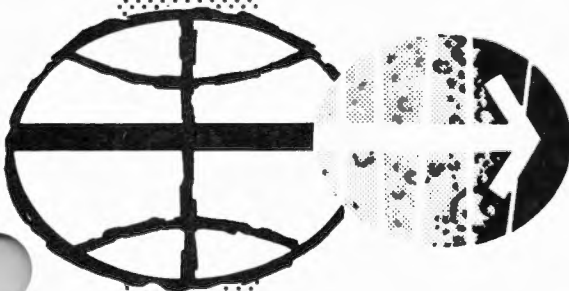
APOLLO 17
MISSION J-3

FINAL

**CSM
RENDEZVOUS
PROCEDURES**

PREPARED BY

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HOUSTON, TEXAS

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PROJECT APOLLO
CSM RENDEZVOUS PROCEDURES
MISSION J-3, APOLLO 17, CSM 114

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PREPARED FOR
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1.0 INTRODUCTION

The purpose of the CSM Rendezvous Procedures Document is to provide a single source of CSM Guidance and Navigation procedures information to be used in flight planning, crew training, and in preparing onboard data for the nominal and abort CSM/LM Apollo 17 rendezvous.

The procedures presented in this document are for the third J mission which will be flown with the CSM 114 spacecraft. Trajectory dependent information contained in this document is based on the prime launch date of 7 December 1972 (GMT) and a LM lunar lift-off GET of 188:03:14.6.

Five appendices are contained in this document. They contain information which is of special interest for purposes of training, analysis or CSM interface discussion. Also included are the CSM onboard data as used during the nominal rendezvous and in case of LM abort.

This is a control document, subject to review by all elements of the Apollo Program and approval by the Crew Procedures Control Board. All comments, suggestions or questions concerning this document should be directed to D. C. Wammack, CSM Rendezvous Procedures Group, McDonnell Douglas Astronautics Company, phone 483-3433.

2.0 CMP NOMINAL RENDEZVOUS PROCEDURES

The G&N procedures employed by the Command Module Pilot during the Apollo 17 nominal rendezvous are presented in this section. These procedures are divided into groups of congruous operations called Steps.

The mission plan is discussed in subsection 2.1; the rendezvous Steps are listed and the purpose of each Step is discussed in subsection 2.2; and the detailed procedures for performing each Step are presented in subsection 2.3.

2.1 MISSION PLAN

The Command Module Pilot is scheduled to begin preparations for rendezvous approximately two hours prior to LM lift-off when he maneuvers the CSM to the COAS calibration attitude. The rendezvous is completed approximately two hours after lift-off when all docking activities are completed. The nominal GET for each major event during this period is listed below:

BEGIN RNDZ PREPARATION	186:10:00
LM LIFT-OFF	188:03:14.6
LM INSERTION	188:10:32.3
LM TPI	188:57:32.3
LM TPF	189:40:28.1
DOCKING	190:05:00

The Apollo 17 nominal rendezvous will utilize the Direct Ascent rendezvous technique which was first employed by Apollo 14. This two-impulse technique requires 90 minutes from LM insertion to LM/CSM station-keeping. The LM is scheduled to apply the TPI burn 47 minutes after insertion and to apply the graduated braking burns approximately 130° of orbital travel after TPI. Two nominally zero DV midcourse corrections are scheduled at

15-minute intervals after TPI. These burns adjust the relative trajectory between the two vehicles in case post-TPI trajectory dispersions exist. All post-insertion burns will be applied by the CSM if the LM is unable to apply them. The CSM will perform the rendezvous with a roll of 180°.

Although Apollo 17 will utilize the same rendezvous technique as used for Apollo 16, several procedural changes have been made. The major changes affecting the CMP are listed below:

- A. The CMP will not attempt to take sextant marks prior to the darkness interval following LM insertion.
- B. An uplink of the CMC LM state vector after insertion is scheduled to be performed. This uplink will be over an OMNI antenna instead of the high gain antenna.
- C. A TPI recycle will be performed.
- D. A one-half degree deadband will be used for tracking.

Orbital motion and relative motion plots for the nominal Apollo 17 rendezvous are contained in Figures (1) and (2). The orbital motion plot presents the CSM and LM inertial positions at each burn during the rendezvous. The relative motion plot presents the CSM position at each burn and major CSM event in a curvilinear coordinate system referenced to the LM.

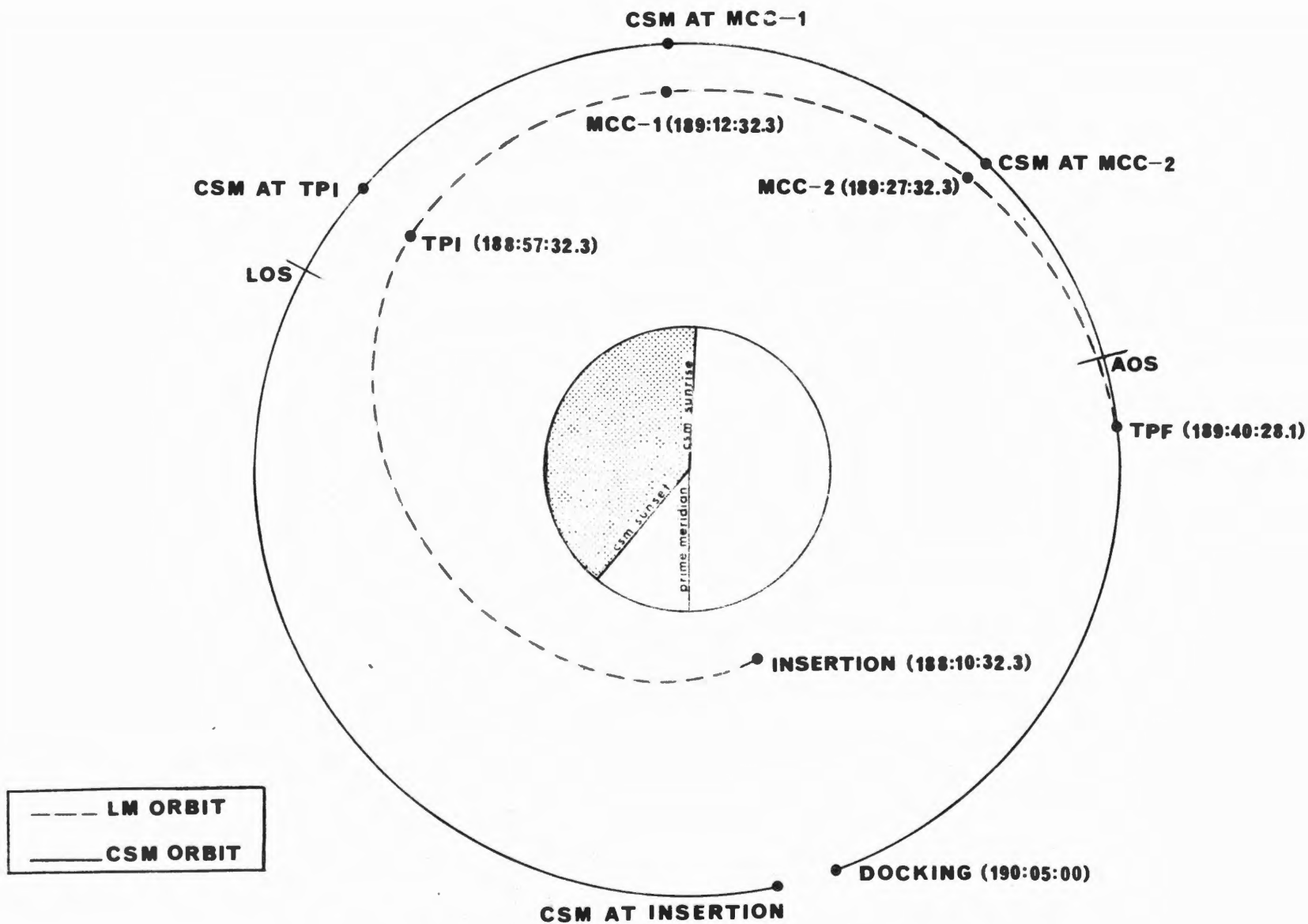


FIGURE 1. POST-INSERTION ORBITAL MOTION PLOT FOR
THE DIRECT ASCENT RENDEZVOUS

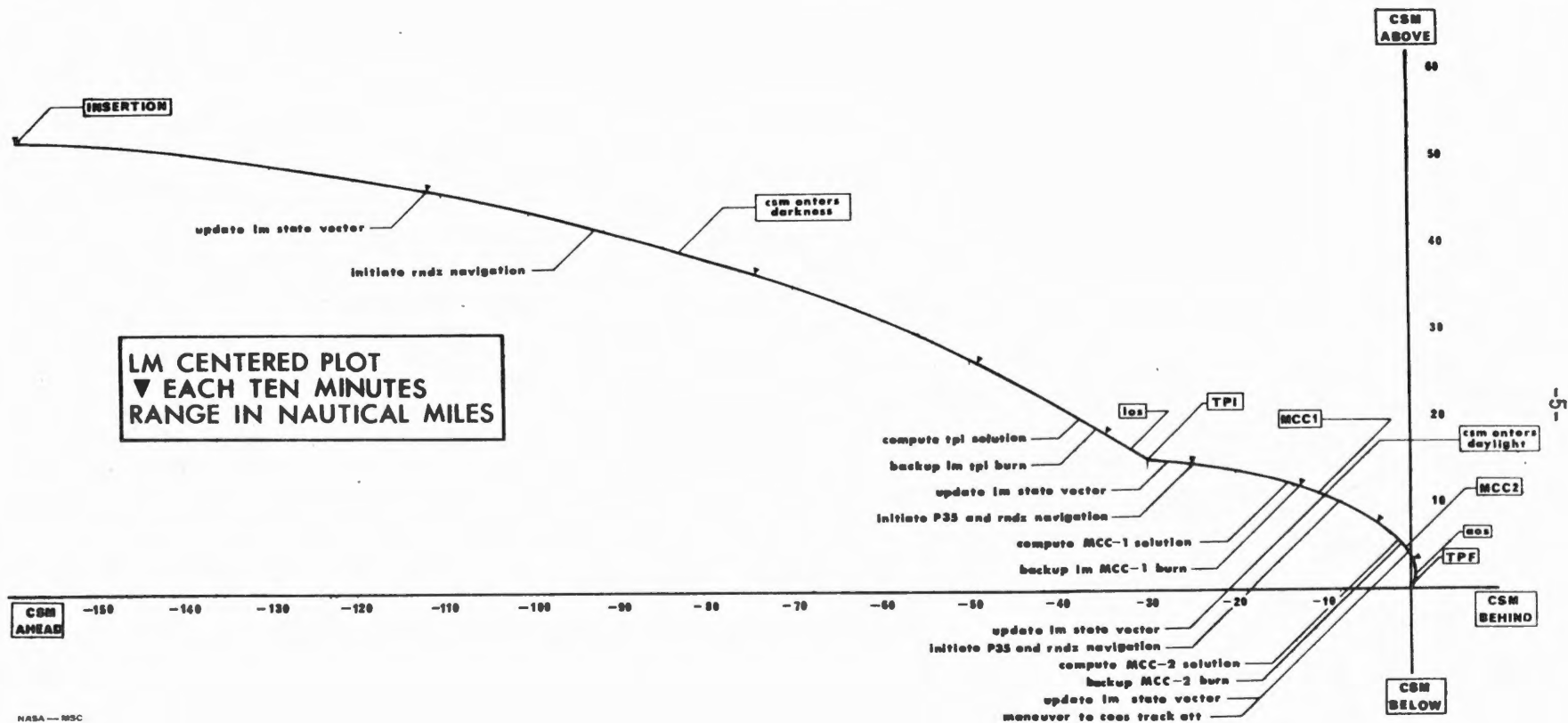


FIGURE 2. POST-INSERTION RELATIVE MOTION PLOT FOR THE DIRECT ASCENT RENDEZVOUS

2.2 NOMINAL PROCEDURES RATIONALE

This subsection presents the purpose and any constraints considered for each rendezvous Step. Only the CMP procedures for the nominal rendezvous are considered.

- STEP 1 Reconfigure DAP. The DAP is reconfigured to provide a faster rate for DAP attitude maneuvers. The DAP is assumed to be configured for narrow deadband at this time.
- STEP 2 Maneuver to COAS Calibration Attitude. The maneuver to this attitude will center a star in the COAS in preparation for COAS alignment calibration. This attitude will allow HGA coverage and also position the CSM for the IMU alignment option of P52.
- STEP 3 Acquire STDN with HGA. The HGA is necessary to establish communication with the STDN in order to receive an uplink of state vectors and a rendezvous information update.
- STEP 4 Accept STDN Uplink and Copy Update. A predicted CSM state vector at lift-off based on ground tracking is uplinked to improve the CMC knowledge of the CSM state vector. The predicted LM state vector at insertion +5 minutes is uplinked to furnish the CMC with a LM state vector valid after insertion. The Surface Flag Reset command is uplinked to allow CMC use of the LM state vector while the LM is still on the surface.

The pads for both the Direct Ascent and Coelliptic rendezvous are supplied by MCC-H so that the CMC pre-thrust program(s) may be initialized. The CSM weight is supplied so that the DAP's estimate of

the weight may be updated to include expended RCS propellant.

The ground supplies the predicted CSM and LM state vector at insertion +1 minute in case the CMC's knowledge of the state vectors is degraded and there is no communication between the CSM and MCC-H.

The CSM consumables status is also relayed to the CMP. If required, the consumables pad will be updated.

- STEP 5 Realign IMU. The IMU must be periodically fine-aligned in order to provide an accurate attitude reference for navigation computations and burn maneuvers.
- STEP 6 Calibrate COAS. The COAS alignment must be calibrated in case COAS marking is required due to a sextant failure.
- STEP 7 Align GDC. The GDC is aligned as a standard procedure after P52 completion to provide a backup attitude reference.
- STEP 8 Verify DSE Tape Motion. The data storage equipment operation should be checked to assure the acquisition of systems data while the CSM is behind the moon. The S-Band relay is activated at this time.
- STEP 9 Acquire STDN with HGA. HGA coverage is necessary to downlink the DSE record at a high bit rate.
- STEP 10 Load CSM and LM Weights. The DAP's knowledge of the CSM weight is updated to include expended RCS propellant. The DAP's knowledge of the LM weight is updated to the predicted LM weight at docking.

- STEP 11 Maneuver to Post-Insertion Track Attitude. The CSM maneuvers to this attitude in order to be prepared for LM tracking after insertion. This attitude does not allow HGA coverage, therefore the post-insertion uplink will be performed using an OMNI.
- STEP 12 Configure VHF and EMS for Ranging. The VHF system and EMS should be configured for ranging during the rendezvous. They should be in this configuration prior to lift-off.
- STEP 13 Configure Rendezvous Lights. The CSM exterior rendezvous lights should be activated so that the CDR may boresight the CSM in the AOT during darkness if the RR fails. The CSM running lights should be activated prior to TPF so that the CDR may visually determine the CSM attitude during docking.
- STEP 14 Align GDC. The GDC is aligned to the IMU prior to lift-off to provide an accurate backup attitude reference during rendezvous.
- STEP 15 Initiate VHF Ranging. VHF ranging is necessary after LM insertion to monitor range between the CSM and LM and to allow ranging navigation marks to be taken.
- STEP 16 Accept STDN Uplink. The LM state vector must be uplinked to the CSM to furnish the CMC with a better estimate of LM state after insertion.
- STEP 17 Initiate P34 and Rendezvous Navigation. The TPI pre-thrust program is entered in order to accomplish the following:
- A. Initiate P20

- B. Initiate the automatic rendezvous program sequence (MINKEY).
- C. Initialize the program for the recycle.
- D. Display the time until TPI.
- E. Initiate VHF marking.
- F. Display the number of sextant and VHF marks taken.

The CSM attitude is within 10° of the preferred track attitude so that only a trim maneuver is required to start rate tracking.

Sextant marking is started when the LM enters darkness.

- STEP 18 Compute P34 Recycle. The TPI burn components are computed to verify the convergence of the solution and for comparison with the LGC solution.
- STEP 19 Compute TPI Solution and Terminate Nav. The TPI burn components are computed and supplied to the CDR to be biased and compared with the LGC solution. The burn solution is also used by P40 for a possible CSM active TPI burn. The final comp terminates rendezvous navigation until after TPI.
- STEP 20 Backup LM TPI Burn. The CSM is maneuvered to the TPI burn attitude and is configured to perform the TPI burn in the event the LM cannot apply it.

The data storage equipment operation should be checked during this period to assure the acquisition of systems data while the CSM is behind the moon.

- STEP 21 Update LM S.V. in the CMC. The CMC's knowledge of the LM state vector should be updated to include the LM TPI burn in order to minimize excessive updates during the next navigation period.
- STEP 22 Initiate P35 and Rendezvous Navigation. The MCC pre-thrust program is entered at this time in order to:
- A. Initiate LM tracking
 - B. Initiate VHF and sextant marking on the LM
 - C. Display the time since TPI
 - D. Display the number of sextant and VHF marks taken
- STEP 23 Compute MCC-1 Solution and Terminate Navigation. The computed MCC solution is supplied to the CDR for a CMC and LGC solution comparison. The solution is also necessary in order for the CMP to back up the burn. MCC-1 is scheduled for TPI+15 minutes, so final comp initiation should be at TPI+12 minutes. The final comp terminates rendezvous navigation until after MCC-1.
- STEP 24 Backup LM MCC-1 Burn. In the event the LM cannot apply the MCC-1 burn, it should be applied by the CSM to refine the intercept trajectory.
- STEP 25 Update LM S.V. in the CMC. If the LM applies MCC-1, the CMC's knowledge of the LM state vector should be updated to include the burn in order to minimize excessive updates during the next navigation period.
- STEP 26 Initiate P35 and Rendezvous Navigation. The MCC pre-thrust program is entered at this time in order to:

- A. Initiate LM tracking
- B. Initiate VHF and sextant marking on the LM
- C. Display the time since MCC-1
- D. Display the number of sextant and VHF marks taken

- STEP 27 Compute MCC-2 Solution and Terminate Navigation. The computed MCC solution is supplied to the CDR for a CMC and LGC solution comparison. The solution is also necessary in order for the CMP to backup the burn. MCC-2 is scheduled for TPI+30 minutes so final comp initiation should be at TPI+27 minutes. The final comp terminates rendezvous navigation.
- STEP 28 Backup LM MCC-2 Burn. In the event the LM cannot apply the MCC-2 burn, it should be applied by the CSM to refine the intercept trajectory.
- STEP 29 Update LM S.V. in the CMC. If the LM applies MCC-2, the CMC's knowledge of the LM state vector should be updated to include the burn to provide accurate CMC range and range rate information.
- STEP 30 Maneuver to COAS Track Attitude. The CMP must monitor line-of-sight rate in order to backup the LM during braking. P79 is terminated; V49 uses the attitude calculated by P79.
- STEP 31 Perform Docking Preparation Activities. These operations include configuring switches for docking and initiating LM photography.
- STEP 32 Acquire STDN with HGA. Ground communication is necessary to arm the pyros, for television transmission, and for the ground to monitor the docking.

- STEP 33 Perform TPF Activities and Photograph LM. These activities include configuring switches for post-TPF conditions and photographing the LM.
- STEP 34 Maneuver for CSM Inspection. A maneuver is scheduled so that the CDR may observe the condition of the CSM SIM Bay. CMP communication with MCC-H is temporarily suspended.
- STEP 35 Maneuver to Docking Attitude. The CSM must maneuver to an attitude favorable for docking. HGA coverage is reacquired.
- STEP 36 Arm Pyros. The pyros must be armed in order to retract the docking probe. The status of the SECS LOGIC and SECS PYRO ARM switches must be obtained from the ground since there is no onboard indication of their positions.
- STEP 37 Perform Docking Activities. These operations are necessary in order to capture the LM latch and achieve hard docking. After docking is confirmed, the docking checklist is performed.
- STEP 38 Reconfigure DAP. The DAP is reloaded to specify the docked CSM/LM configuration.
- STEP 39 Configure Switches for Post-Docking. Spacecraft control is returned to the CMC after docking.

2.3 DETAILED PROCEDURES

The detailed procedures for the LM active nominal rendezvous are contained in this subsection. If the CSM is required to become active during the rendezvous, the supplementary detailed procedures presented in section 4.0 will be used.

These detailed procedures basically consider only the G&N requirements, although some non-G&N procedures are included for purposes of information and continuity.

Detailed procedures specify each change in the switch settings and the sequential changes in the DSKY displays.

The format of the detailed procedures is tabular. The GET column specifies the time associated with each Step and each time-critical event. Approximate times are indicated by an entry to the nearest minute (e.g., 186:10:XX) or by reference to the nearest minute to a time-critical event (e.g., TPI-10 MIN). Exact times are specified to the nearest second (e.g., 186:27:53). The LTNG column indicates the CSM in daylight (blank) or darkness (black); and the STDN column indicates the CSM has STDN coverage (dashed) or no STDN coverage (blank).

The OPERATIONS column lists the Step and substep headings, which are underlined, and the set of operations necessary to complete each Step. The DSKY keystroke operations are left-justified and the switch-setting operations are indented. When a switch position is not specifically labeled on the panel, the position is specified as (CTR), (UP), or (DOWN). The panel on which each switch is located is shown in the STA/PANEL column.

The PROG, V-N DISPLAY and REGISTER DISPLAYS columns specify the status of the DSKY display. Entries into these columns are made for all changes of the Verbs, Nouns, or Programs

and the associated values in the three registers. Blanks in any individual digits are indicated by the letter "B". If a complete register is blank, it is omitted and only the remaining non-blank registers are shown. If the contents of any register display are known, the nominal design data are shown with the proper decimal place; if the contents are unknown, X's with the proper decimal place are shown.

The COMMENTS column contains supplemental information in order to clarify the procedures or indicate contingency options. All register display contents and information passed by the STDN updates are defined. Additional STDN or LM operations which involve the CMP and some internal computer routines (e.g., average-G) are noted. Information concerning marking schedules, AOS, LOS, and other events are provided for completeness.

The nominal detailed procedures begin 186 hours 10 minutes into the mission and continue through the post-docking switch configuration at 190 hours 08 minutes.

These procedures are presented in pages 15 through 41, with the first three and one-half pages containing assumed initial switch settings.

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
					<u>ASSUMED SWITCH SETTINGS:</u> THC-LOCKED RHC 1-LOCKED RHC 2-LOCKED EMS FUNCTION-OFF MODE-STBY CMC ATT-IMU FDAI SCALE-5/1 SELECT-1/2 SOURCE-ATT SET ATT SET-GDC MANUAL ATTITUDE(3)-RATE CMD LIMIT CYCLE-OFF ATT DEADBAND-MAX RATE-LOW TRANS CONTR PWR-OFF ROT CONTR PWR NORMAL 1-OFF 2-AC/DC DIRECT(BOTH)-OFF SC CONT-CMC CMC MODE-AUTO BMAG MODE(3)-RATE 2 SPS THRUST DIRECT-NORMAL DV THRUST(2)-OFF SCS TVC(2)-RATE CMD SPS GIMBAL MOTORS(4)-OFF DV CG-CSM IMU CAGE-OFF ENTRY EMS ROLL-OFF ENTRY .05G-OFF LV/SPS IND -PC LV/SPS IND SII/SIVB-GPI TVC GMBL DRIVE(BOTH)-AUTO				

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
					DOCKING PROBE-OFF			2	
					DOCKING PROBE RETRACT(BOTH)-OFF(CTR)			2	
					EXTERIOR LIGHTS RUN/EVA-OFF			2	
					RNDZ-OFF(CTR)			2	
					CAUTION/WARNING NORMAL-NORMAL			2	
					CSM-CSM			2	
					POWER-1			2	
					UP TLM(2)-BLOCK			2	
					RCS TRNFR-SM			2	
					SM RCS SEC PRPLNT FUEL PRESS(4)-CLOSED			2	
					HIGH GAIN ANTENNA TRACK-REACQ			2	
					BEAM-NARROW			2	
					HIGH GAIN ANT POWER-POWER			2	
					SERVO ELEC-PRIM			2	
					VHF ANTENNA-RIGHT			3	
					SPS HE VLV(BOTH)-AUTO			3	
					SPS HE VLV TB(BOTH)-BP			3	
					S BAND NORMAL XPNDR-PRIM			3	
					PWR AMPL PRIM-PRIM			3	
					HIGH-HIGH			3	
					MODE VOICE-VOICE			3	
					PCM-PCM			3	
					RANGING-RANGING			3	
					S BAND AUX TAPE-DN VOICE BU			3	
					TV-OFF(CTR)			3	
					UP TLM DATA-DATA			3	
					CMD-RESET			3	
					S BAND ANTENNA OMNI-C			3	
					S BAND ANTENNA-OMNI D			3	
					VHF AM A-OFF			3	
					B-OFF			3	
					RCV ONLY-B DATA			3	
					VHF RANGING-OFF			3	
					S BAND SQUELCH-OFF			3	
					TAPE RECORDER-PCM/ANLG			3	
					-RECORD			3	
					-FWD			3	
					PCM BIT RATE-HIGH			3	

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
					G/N PWR-AC1 MAIN BUS TIE(2)-OFF NONESS BUS-OFF CB GUIDANCE/NAVIGATION(10)-CLOSED SCS TVC SERVO POWER(BOTH)-OFF FDAI/GPI POWER-BOTH LOGIC POWER 2/3-ON(UP) SCS ELECTRONICS POWER-GDC/ECA SIG CONDR/DRIVER BIAS PWR(BOTH)-AC1 BMAG POWER(BOTH)-ON AUTO RCS SELECT(16)-MNA/MNB EXCEPT: ROLL(4)-OFF SEQ EVENTS CONT SYSTEM LOGIC(BOTH)-OFF PYRO ARM(BOTH)-SAFE ALL CB-CLOSED EXCEPT: DIRECT ULL(2)-OPEN REACTION CONTROL SYSTEM RCS LOGIC(2)-OPEN DOCK PROBE(2)-OPEN SPS PITCH 1 AND YAW 1-OPEN FLOAT BAG(3)-OPEN SEQ EVENTS CONT SYS (4)-OPEN ELS/CM-SM SEP(2)-OPEN PL VENT FLT/PL-OPEN VHF AM T/R-RCV VHF RNG-NORM FDAI 1-INRTL FDAI 2-INRTL EARTH/LUNAR-LUNAR ALT SET-60 NM MODE-OPR/SLOW COAS POWER-ON(UP) UTILITY POWER-ON(UP)			5 5 5 5 7 7 7 7 7 7 8 8 8 8 8 8 8 8 8 8 8 9 9 13 13 13 13 13 15 15	

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
					G/N POWER(2)-ON(UP) RNDZ XPNDR-HEATER			100 100	
					OPTICS ZERO-ZERO			122	
					TEL TRUN-SLAVE TO SXT			122	
					COUPLING-RSLV			122	
					MODE-CMC			122	
					SPEED-LO			122	
					CONDITION LAMPS-ON			122	
					UP TELEMETRY-ACCEPT			122	
					CB HI GAIN ANT(BOTH)-CLOSED			225	
					ALL CB-CLOSED			229	
					EXCEPT:				
					MAIN RELEASE(2)-OPEN			229	

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
186:10:XX			01	P00	RECONFIGURE DAP V48E	F 04 46	11101 X1111		R1-DAP CONFIGURATION R2-DAP CONFIGURATION
					V21E 11102E	F 04 46	11102 X1111		
					PRO	F 06 47	+36844 +XXXXX.		R1-CSM WEIGHT (LBS) R2-LM WEIGHT (LBS)
					PRO	F 06 48	+000.43 +001.02		R1-GIMBAL PITCH TRIM(DEG) R2-GIMBAL YAW TRIM(DEG)
					PRO	BB BB			
186:12:XX			02	P00	MANEUVER TO COAS CALIB ATTITUDE V49E	F 06 22	+XXX.XX +XXX.XX +XXX.XX		R1-DESIRED ICDU ANG; ROLL(DEG) R2-DESIRED ICDU ANG; PITCH(DEG) R3-DESIRED ICDU ANG; YAW(DEG)
					V25E +18000E +24400E +34100E	F 06 22	+180.00 +244.00 +341.00		
					PRO	F 50 18	+180.00 +244.00 +341.00		R1-AUTO ATT MNVR; ROLL(DEG) R2-AUTO ATT MNVR; PITCH(DEG) R3-AUTO ATT MNVR; YAW(DEG)
					PRO	06 18	+180.00 +244.00 +341.00		
					MONITOR MANEUVER	F 50 18	+180.00 +244.00 +341.00		
					ENTER	BB BB			

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
186:18:XX			03	P00	ACQUIRE STDN WITH HGA V64E HIGH GAIN ANTENNA TRACK-MAN HGA PITCH POSITION-SET PITCH POSITION HGA YAW POSITION-SET YAW POSITION S BAND ANTENNA-HI GAIN HIGH GAIN ANTENNA TRACK-AUTO PRO	F 06 51	-058.XX +052.XX	2 2 2 3 2	R1-HGA ANG; RHO(DEG) R2-HGA ANG; GAMMA(DEG) RHO=-58 GAMMA=+52
186:21:XX			04	P00 P27	ACCEPT STDN UPLINK AND COPY UPDATE UP TLM CM-ACCEPT VERIFY UPLINK ACTIVITY LT-ON MONITOR UPLINK COPY UPDATE	BB BB XX XX	XXXXX XXXXX XXXXX	2	UPLINK ACT LT-ON LM S.V.(INS+5) CSM S.V.(L/O) RESET SURFACE FLAG CONSUMABLES(IF REQ'D) CSM S.V. (L/O) ASCENT PADS CSM WEIGHT UPLINK ACT LT-OFF
186:27:53				P00	VERIFY UPLINK ACTIVITY LT-OFF UP TLM CM-BLOCK	BB BB		2	CSM ENTERS MOON SHADOW
186:28:XX			05	P00 P52	REALIGN IMU V37E 52E PRO	F 04 06 F 50 25	00001 00003 00015		R1-IMU ORIENTATION OPTION R2-REFSMAT R1-CELESTIAL BODY ACQUISITION

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
					PRO	F 01 70	00022		R1-CELESTIAL BODY CODE (BEFORE MARK)
					OPTICS ZERO-OFF CHECK FIRST STAR CODE			122	
					PRO	06 92	+007.XX +020.XXX		R1-NEW OCDU ANG; SHAFT (DEG) R2-NEW OCDU ANG; TRUNNION (DEG)
					OPTICS MODE-MAN			122	
					OHC-CENTER STAR IN SXT MARK BUTTON-DEPRESS	F 51 BB		122	PLEASE MARK
					PRO	F 50 25	00016	122	R1-TERMINATE MARK SEQUENCE
					PRO	F 01 71	00022		R1-CELESTIAL BODY CODE (AFTER MARK)
					PRO	F 01 70	00024		R1-CELESTIAL BODY CODE (BEFORE MARK)
					CHECK SECOND STAR CODE OPTICS MODE-CMC			122	
					PRO	06 92	+104.XX +36.XXX		R1-NEW OCDU ANG; SHAFT(DEG) R2-NEW OCDU ANG; TRUNNION(DEG)
					OPTICS MODE-MAN			122	
					OHC-CENTER STAR IN SXT MARK BUTTON-DEPRESS	F 51 BB		122	PLEASE MARK
					PRO	F 50 25	00016	122	R1-TERMINATE MARK SEQUENCE
					PRO	F 01 71	00024		R1-CELESTIAL BODY CODE (AFTER MARK)
					PRO	F 06 05	+000.XX		R1-ANG ERROR DIFFERENCE(DEG)
					RECORD DATA				

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
186:34:XX					PRO	F 06 93	+00.XXX +00.XXX +00.XXX	1	R1-DELTA GYRO ANG; X(DEG) R2-DELTA GYRO ANG; Y(DEG) R3-DELTA GYRO ANG; Z(DEG)
					RECORD DATA CMC MODE-FREE				
					PRO	F 50 25	00014		R1-FINE ALIGNMENT
					PRO	F 50 25	00015		R1-CELESTIAL BODY ACQUISITION
					ENTER	F 01 70	00022		R1-CELESTIAL BODY CODE (BEFORE MARK)
					V21E 21E	F 01 70	00021	122	
					OPTICS MODE-CMC				
					PRO	06 92	+035.XX +036.XX		R1-NEW OCDU ANG; SHAFT(DEG) R2-NEW OCDU ANG; TRUNNION(DEG)
					VERIFY STAR CENTERED IN SXT OPTICS MODE-MAN	F 51 BB		122	
					OPTICS SPEED-HI			122	
					OHC-DRIVE TRUNNION TO LESS THAN 10 DEG			122	
					OPTICS ZERO-ZERO			122	
					OPTICS SPEED-LO			122	
					OPTICS MODE-CMC			122	
					CALIBRATE COAS V37E 52E	F 04 06	00001 00003		R1-IMU ORIENTATION OPTION R2-REFSMMAT
					PRO	F 50 25	00015		R1-CELESTIAL BODY ACQUISITION
					ENTER	F 01 70	00022		R1-CELESTIAL BODY CODE (BEFORE MARK)

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
					V21E 16E OPTICS ZERO-OFF			122	
					PRO	F 01 70	00016		
					RHC 2-ARMED RHC 2-CENTER STAR IN COAS KEY VERB	06 92	+357.XX +57.XXX		R1-NEW OCDU ANG; SHAFT(DEG) R2-NEW OCDU ANG; TRUNNION(DEG)
					RECORD SHAFT AND TRUNNION RHC 2-LOCKED CMC MODE-AUTO OPTICS ZERO-ZERO	BB 92	+XXX.XX +XX.XXX		FREEZE DKSX DISPLAY KEY RELEASE LIGHT-ON
					37E 00E			1 122	
				P00		BB BB			KEY RELEASE LIGHT-OFF
186:40:XX			07	P00	ALIGN GDC			1	
					ATT SET TW-SET TO IMU ANGLES ON FDAI 1			1	
					FDAI SELECT-1			1	
					FDAI SOURCE-ATT SET(VERIFY)			1	
					ATT SET-IMU			1	
					ATT SET TW-NUL FDAI 1 ERROR NEEDLES			1	
					ATT SET-GDC			1	
					GDC ALIGN PB-PUSH UNTIL NEEDLES NULLED			1	
					FDAI SELECT-1/2			1	
186:54:XX			08	P00	VERIFY DSE TAPE MOTION				
					HIGH GAIN ANTENNA TRACK-MAN			2	STDN ENABLES S-BAND RELAY
					HGA PITCH POSITION-SET PITCH POSITION			2	RHO=-58
					HGA YAW POSITION-SET YAW POSITION			2	GAMMA=+52
					HIGH GAIN ANTENNA TRACK-AUTO			2	
186:54:30									LOSS OF SIGNAL
187:14:13									CSM LEAVES MOON SHADOW

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
187:38:45			09	P00	<u>ACQUIRE STDN WITH HGA</u>				ACQUISITION OF SIGNAL
187:41:XX			10	P00	<u>LOAD CSM AND LM WT</u> V48E	F 04 46	11102 X1111		
					PRO	F 06 47	+36844. +XXXXX.		
					V24E +XXXXXE +5935E	F 06 47	+XXXXX. +05935.		
					PRO	F 06 48	+000.43 +001.02		
					PRO	BB BB			
187:42:XX			11	P00	<u>MANEUVER TO POST INSERTION TRACK ATTITUDE</u> V49E	F 06 22	+180.00 +244.00 +341.00		
					V25E +18000E +2600E +E	F 06 22	+180.00 +026.00 +000.00		
					PRO	F 50 18	+180.00 +026.00 +000.00		
					PRO	06 18	+180.00 +026.00 +000.00		
					MONITOR MANEUVER	F 50 18	+180.00 +026.00 +000.00		

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
187:49:XX			12	P00	ENTER <u>CONFIGURE VHF AND EMS FOR RANGING</u> VHF AM T/R-OFF VHF AM B-DUPLEX A-OFF(VERIFY) VHF RANGING-ON(UP) VHF ANT-RIGHT(VERIFY) EMS FUNCTION-DV SET/VHF RNG EMS MODE-BACKUP/VHF RNG RNDZ XPNDR-PWR	BB BB		9 3 3 3 3 1 1 100	
187:52:XX			13	P00	<u>CONFIGURE RNDZ LIGHTS</u> EXTERIOR LIGHTS(2)-ON(UP)			2	
187:57:XX			14	P00	<u>ALIGN GDC</u> ATT SET TW-SET TO IMU ANGLES ON FDAI 1 FDAI SELECT-1 FDAI SOURCE-ATT SET(VERIFY) ATT SET-IMU ATT SET TW-NULLED FDAI 1 ERROR NEEDLES ATT SET-GDC GDC ALIGN PB-PUSH UNTIL NEEDLES NULLED FDAI SELECT-1/2			1 1 1 1 1 1 1 1	
188:03:15									LM LIFT-OFF
188:09:XX			15	P00	<u>INITIATE VHF RANGING</u> VHF RNG-RESET			9	
188:10:32									LM INSERTION
188:13:XX					<u>VHF VOICE CHECK</u> VHF AM T/R-T/R VERIFY VHF VOICE VHF AM T/R-OFF			9 9	LM TWEAK

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
188:19:32			16	P00	ACCEPT STDN UPLINK				
				P27	UP TLM CM-ACCEPT VERIFY UPLINK ACTIVITY LT-ON MONITOR UPLINK	XX XX	XXXXX XXXXX XXXXX	2	UPLINK ACT LT-ON LM S.V. (INS+5) CSM S.V. (L/O)
				P00	VERIFY UPLINK ACTIVITY LT-OFF UP TLM CM-BLOCK	BB BB		2	UPLINK ACT LT-OFF
188:23:32			17	P00	INITIATE P34 AND RNDZ NAVIGATION V37E 34E				
				P20 P34	PRO	F 50 25	00017		R1-MINKEY SELECTION OPTION
					MONITOR TRIM MANEUVER	F 06 37	+00XXX. +000XX. +0XX.XX		R1-GETI TPI (HRS) R2- (MIN) R3- (SEC)
					V25E +188E +57E +3230E	F 06 37	+00188. +00057. +032.30		
				PRO		F 06 55	+00000. +000.00 +130.00		R1-PRECISION OFFSETS R2-ELEVATION ANG(DEG) R3-TPI/TPF TRANSFER ANG(DEG)
					BEGIN VHF MARKING				
				PRO		F 16 45	+XXB00 -33BXX -00001		R1-MARKS (VHF/OPTICS) R2-TFI (MIN/SEC) R3-NO FINAL COMP CODE
					SET MDC DET COUNTING UP TO TPI			1	
					SET LEB DET COUNTING UP TO TPI			306	

[illegible]

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS	
TPI-10MIN			19	P34	COMPUTE TPI SOLUTION AND TERMINATE NAV					
					OPTICS SPEED-HI				122	
					OHC-DRIVE TRUNNION TO LESS THAN 10 DEG				122	
					OPTICS ZERO-ZERO				122	
					OPTICS SPEED-LO				122	
					OPTICS MODE-CMC				122	
					PRO					
						F 06 55	+00000. +208.30 +130.00		R1-PRECISION OFFSETS R2-ELEVATION ANG(DEG) R3-TPI/TPF TRANSFER ANG(DEG)	
					RECORD DATA					
					PRO					
	F 06 58	+0008.3 +0077.1 +0033.6		R1-PERILUNE ALT(POST TPI)(NM) R2-DELTA V (TPI)(FPS) R3-DELTA V (TPF)(FPS)						
</										

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
					MONITOR MANEUVER	F 50 18	+180.XX +279.XX +000.XX		
					ALIGN GDC				
					ATT SET TW-SET TO IMU ANGLES ON FDAI 1			1	
					FDAI SELECT-1			1	
					FDAI SOURCE-ATT SET (VERIFY)			1	
					ATT SET-IMU			1	
					ATT SET TW-NULL FDAI 1 ERROR NEEDLES			1	
					ATT SET-GDC			1	
					GDC ALIGN PB-PUSH UNTIL NEEDLES				
					NULLED			1	
					FDAI SELECT-1/2			1	
					<u>RECORD P76 DATA</u>				OBTAIN TPI P76 FROM CDR
188:51:XX					<u>VERIFY DSE TAPE MOTION</u>				
188:52:59					<u>VHF AM T/R-T/R</u>			9	USE VHF COMM LOSS OF SIGNAL
					<u>CONFIGURE EMS</u>				
					<u>EMS MODE-STBY</u>			1	
					EMS FUNCTION-OFF			1	
					EMS FUNCTION-DV SET/VHF RNG			1	
					LOAD 66.1 INTO EMS			1	
					EMS FUNCTION-DV			1	TPI DV MINUS TAIL OFF
					<u>CONFIGURE SCS</u>				
					CB STAB CONT SYS(ALL)-CLOSE			8	
					CB SPS (12)-CLOSE			8	
					MANUAL ATTITUDE(3)-RATE CMD(VERIFY)			1	
					RATE-LOW(VERIFY)			1	
					DV CG-CSM(VERIFY)			1	
					SPS HE VLVS(BOTH)-AUTO(VERIFY)			3	
					CHECK N2 A AND N2 B			3	

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
					PRO	06 18	+180.XX +279.XX +000.XX		R1-AUTO ATT MNVR; ROLL(DEG) R2-AUTO ATT MNVR; PITCH(DEG) R3-AUTO ATT MNVR; YAW(DEG)
					MONITOR TRIM MANEUVER	F 50 18	+180.XX +279.XX +000.XX		
					ENTER	F 50 25	00204		R1-SPS GIMBAL TEST OPTION
					ENTER	06 40	-XXBXX +0077.1 +0000.0		R1-TFI(MIN/SEC) R2-VG (FPS) R3-DELTA V ACCUMULATED(FPS)
					FDAI SCALE-5/1 (VERIFY) VERIFY MDC DET SET			1 1	
TPI-35SEC					MONITOR DSKY BLANK	BB BB			
TPI-30SEC						06 40	-00B29 +0077.1 +0000.0		AVE G ON
TPI-05SEC					CHECK PIPA BIAS LESS THAN 2 FPS FOR 5 SEC	F 99 40	-00B05 +0077.1 +0000.0		ENGINE ON ENABLE REQUEST
188:57:32					CONFIRM LM BURN COMPLETE				LM TPI IF THE LM DID NOT APPLY THE TPI BURN, SEE SECTION 4.2.1

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
TPI+01MIN			21	P40 P76	ENTER	F 16 85	+XXXX.X +XXXX.X +XXXX.X	1 8	R1-BODY VGX(FPS) R2-BODY VGY(FPS) R3-BODY VGZ(FPS)
					EMS FUNCTION-OFF CB SPS PITCH 1 AND YAW 1-OPEN				
					UPDATE LM S.V. IN THE CMC PRO	F 06 33	+00188. +00057. +032.30		R1-GETI TPI(HRS) R1- (MIN) R3 (SEC)
TPI+03MIN			22	P76 P35	PRO	F 06 84	+0075.1 -0000.5 +0014.1	1 1 9	R1-LM DELTA VX(LV)(FPS) R2-LM DELTA VY(LV)(FPS) R3-LM DELTA VZ(LV)(FPS)
					INITIATE P35 AND RNDZ NAVIGATION				
					CONFIGURE EMS FOR RANGING EMS FUNCTION-DV SET/VHF RNG EMS MODE-BACKUP/VHF RNG VHF RNG-RESET PRO				
						F 16 45	+26B23 +03BXX -00001	122 122 122 122	R1-MARKS(VHF/OPTICS) R2-TFI(MIN/SEC) R3-NO FINAL COMP CODE
					START SEXTANT MARKING OPTICS ZERO-OFF OPTICS MODE-MAN OHC-CENTER LM IN SXT TAKE ONE SXT MARK PER MINUTE OPTICS MODE-CMC				

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
TPI+12MIN			23	P35	COMPUTE MCC1 SOLUTION AND TERMINATE NAV PRO RECORD DATA PRO	F 06 81	+XXXX.X +XXXX.X +XXXX.X		R1-DELTA VX(LV)(FPS) R2-DELTA VY(LV)(FPS) R3-DELTA VZ(LV)(FPS)
TPI+13MIN			24	P35 P41	BACKUP LM MCC1 BURN PRO ENTER MONITOR DSKY BLANK	F 50 18 06 85 BB BB	+XXX.XX +XXX.XX +XXX.XX +XXXX.X +XXXX.X +XXXX.X		R1-AUTO ATT MNVR; ROLL(DEG) R2-AUTO ATT MNVR; PITCH(DEG) R3-AUTO ATT MNVR; YAW(DEG) R1-BODY VGX(FPS) R2-BODY VGY(FPS) R3-BODY VGZ(FPS)
MCC-35SEC						16 85	+XXXX.X +XXXX.X +XXXX.X		AVE G ON
MCC-30SEC						F 16 85	-0000.8 -0000.0 +0000.6		LM MCC1
189:12:32					VERIFY LM BURN COMPLETE				IF THE LM CANNOT APPLY THE MCC1 BURN,SEE SECTION 4.2.2
189:13:06									CSM LEAVES MOON SHADOW

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
TPI+16MIN			25	P41 P76	UPDATE LM S.V. IN THE CMC PRO PRO	F 06 33 F 06 84	+00189. +00012. +032.XX +XXXX.X +XXXX.X +XXXX.X _		R1-GETI MCC1(HRS) R2- (MIN) R3- (SEC) R1-LM DELTA VX(LV)(FPS) R1-LM DELTA VY(LV)(FPS) R3-LM DELTA VZ(LV)(FPS)
TPI+17MIN			26	P76 P35	INITIATE P35 AND RNDZ NAVIGATION PRO START SEXTANT MARKING OPTICS MODE-MAN OHC-CENTER LM IN SXT TAKE ONE SXT MARK PER MINUTE	F 16 45	+09B09 +03BXX -00001	122 122	IF CSM ACTIVE AND TPF DELTA V > 55 FPS, SEE SECTION 4.2.3. R1-MARKS(VHF/OPTICS) R2-TFI(MIN/SEC) R3-NO FINAL COMP CODE
TPI+27MIN			27	P35	COMPUTE MCC2 SOLUTION AND TERMINATE NAV PRO OPTICS SPEED-HI OHC-DRIVE TRUNNION TO LESS THAN 10 DEG OPTICS ZERO-ZERO OPTICS SPEED-LO OPTICS MODE-CMC	F 06 81	-0000.0 -0000.0 +0003.3	122 122 122 122 122	R1-DELTA VX(LV)(FPS) R2-DELTA VY(LV)(FPS) R3-DELTA VZ(LV)(FPS)

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
TPI+28MIN			28	P35 P41	RECORD DATA PRO	F 16 45	+09B09 -03BXX +XXX.XX		R1-MARKS(VHF/OPTICS) R2-TFI (MIN/SEC) R3-MGA(DEG)
					BACKUP LM MCC2 BURN PRO	F 50 18	+XXX.XX +XXX.XX +XXX.XX		R1-AUTO ATT MNVR; ROLL(DEG) R2-AUTO ATT MNVR; PITCH(DEG) R3-AUTO ATT MNVR; YAW(DEG)
					ENTER	06 85	+XXXX.X +XXXX.X +XXXX.X		R1-BODY VGX(FPS) R2-BODY VGY(FPS) R3-BODY VGZ(FPS)
					MONITOR DSKY BLANK	BB BB			
MCC-35SEC									
MCC-30SEC						16 85	+XXXX.X +XXXX.X +XXXX.X		AVE G ON
189:27:32									
TPI+31MIN			29	P41 P76	VERIFY LM BURN COMPLETE	F 16 85	+XXXX.X +XXXX.X +XXXX.X		LM MCC2
					UPDATE LM S.V. IN THE CMC PRO	F 06 33	+00189. +00027. +032.XX		IF THE LM CANNOT APPLY THE MCC2 BURN,SEE SECTION 4.2.2
					PRO				
						F 06 84	+XXXX.X +XXXX.X +XXXX.X		R1-LM DELTA VX(LV)(FPS) R2-LM DELTA VY(LV)(FPS) R3-LM DELTA VZ(LV)(FPS)

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
TPI+32MIN			30	P76	MANEUVER TO COAS TRACK ATTITUDE				
				P79	PRO	F 50 18	+180.XX +282.XX +000.XX		R1-AUTO ATT MNVR; ROLL(DEG) R2-AUTO ATT MNVR; PITCH(DEG) R3-AUTO ATT MNVR; YAW(DEG)
				P00	V37E 00E	BB BB			
					V49E	F 06 22	+180.XX +282.XX +000.XX		R1-DESIRED ICDU ANG; ROLL(DEG) R2-DESIRED ICDU ANG; PITCH(DEG) R3-DESIRED ICDU ANG; YAW(DEG)
					PRO	F 50 18	+180.XX +282.XX +000.XX		R1-AUTO ATT MNVR; ROLL(DEG) R2-AUTO ATT MNVR; PITCH(DEG) R3-AUTO ATT MNVR; YAW(DEG)
					PRO	06 18	+180.XX +282.XX +000.XX		
					MONITOR MANEUVER	F 50 18	+180.XX +282.XX +000.XX		
					ENTER	BB BB			
					V83E	F 16 54	+XXX.XX -XXXX.X +XXX.XX		R1-RANGE(NM) R2-RANGE RATE(FPS) R3-THETA(DEG)

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
189:30:XX			31	P00	PERFORM DOCKING PREPARATION ACTIVITIES PERFORM PRE-DOCK CHECKLIST MANUAL ATTITUDE (3)-RATE CMD (VERIFY) LIMIT CYCLE-OFF (VERIFY) ATT DEADBAND-MIN RATE-LOW(VERIFY) TRANS CONTR PWR-ON ROT CONTR PWR DIRECT (BOTH)-MNA/MNB SC CONT-CMC (VERIFY) AUTO RCS SELECT (16)-MNA/MNB CB DOCK PROBE(2)-CLOSE DOCKING PROBE RETRACT(BOTH)-OFF(CTR) (VERIFY) DOCKING PROBE-RETRACT DOCKING PROBE EXTD/REL TB(2)-GRAY (VERIFY) CB SEQ EVENTS CONT SYS(4)-CLOSE COAS POWER-ON(UP)(VERIFY) EXTERIOR LIGHTS RUN/EVA-ON(UP)(VERIFY)			1 1 1 1 1 1 1 8 8 2 2 2 8 15 2	IF CSM ACTIVE BRAKING, SEE SECTION 4.2.4 ACQUISITION OF SIGNAL
189:37:13									
189:37:XX			32	P00	ACQUIRE STDN WITH HGA HIGH GAIN ANTENNA TRACK-MAN HGA PITCH POSITION-SET PITCH POSITION HGA YAW POSITION-SET YAW POSITION S BAND ANTENNA-HI GAIN HIGH GAIN ANTENNA TRACK-AUTO			2 2 2 3 2	RHO=-35 GAMMA=+37

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
189:38:XX			33	P00	<u>PERFORM TPF ACTIVITIES AND PHOTOGRAPH LM</u> PHOTOGRAPH LM UTILITY POWER-ON(UP)(VERIFY) TV-ON DAC-ON BEGIN PHOTOS WITH DAC AND TV			15	TPF
189:40:28					<u>CONFIGURE SWITCHES FOR POST TPF</u> EMS MODE-STBY EMS FUNCTION-OFF EXTERIOR LIGHTS RNDZ-OFF(CTR)			1 1 2	
189:44:XX					<u>TERMINATE LM PHOTOS</u> PRO DAC-OFF TV-OFF	BB BB			
189:46:XX			34	P00	<u>MANEUVER FOR CSM INSPECTION</u> V49E V25E +31900E +25400E +E PRO	F 06 22 F 06 22 F 50 18	+180.XX +282.XX +000.XX +319.00 +254.00 +000.00 +319.00 +254.00 +000.00		R1-DESIRED ICDU ANG; ROLL(DEG) R2-DESIRED ICDU ANG; PITCH(DEG) R3-DESIRED ICDU ANG; YAW(DEG) R1-AUTO ATT MNVR; ROLL(DEG) R2-AUTO ATT MNVR; PITCH(DEG) R3-AUTO ATT MNVR; YAW(DEG)

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
189:55:XX					PRO	06 18	+319.00 +254.00 +000.00		
					MONITOR MANEUVER	F 50 18	+319.00 +254.00 +000.00		
					ENTER	BB BB			
					MANEUVER TO DOCKING ATTITUDE				
					V49E	F 06 22	+319.00 +254.00 +000.00		
					V25E +18000E +28200E +E	F 06 22	+180.00 +282.00 +000.00		
					PRO	F 50 18	+180.00 +282.00 +000.00		
					PRO	06 18	+180.00 +282.00 +000.00		
					MONITOR MANEUVER	F 50 18	+180.00 +282.00 +000.00		
					ENTER	BB BB			
					REACQUIRE STDN HGA				

R1-DESIRED ICDU ANG; ROLL(DEG)
R2-DESIRED ICDU ANG; PITCH(DEG)
R3-DESIRED ICDU ANG; YAW(DEG)

R1-AUTO ATT MNVR; ROLL(DEG)
R2-AUTO ATT MNVR; PITCH(DEG)
R3-AUTO ATT MNVR; YAW(DEG)

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
189:57:XX	■	■	36	P00	<u>ARM PYROS</u> CUE STDN FOR LOGIC ARM SEQ EVENTS CONT SYSTEM LOGIC(BOTH)- ON(UP) SEQ EVENTS CONT SYSTEM PYRO ARM(BOTH)- ON(UP)			8 8	STDN GO FOR PYRO ARM
190:00:XX	■	■	37	P00 P47	<u>PERFORM DOCKING ACTIVITIES</u> <u>V37E 47E</u> <u>INITIATE LM PHOTOGRAPHY</u> DAC-ON TV-ON PHOTOGRAPH LM MNVR <u>TRANSLATE TO CAPTURE LATCH</u> THC-ARMED THC-MINIMUM THRUST FORWARD THC-LOCKED <u>PERFORM AT CAPTURE</u> DOCKING PROBE EXT/REL TB(2)-BP(VERIFY) REPORT CAPTURE TO LM SC CONT-CMC(VERIFY) CMC MODE-FREE ALLOW PROBE TO DAMP S/C MOTION (10 SEC) DOCKING PROBE RETRACT SEC-1 PRIM-2 (IF REQ'D)	F 16 83 F 16 83	+0000.0 +0000.0 +0000.0 +XXXX.X +XXXX.X +XXXX.X	R1-DELTA VX(FPS) R2-DELTA VY(FPS) R3-DELTA VZ(FPS)	
190:05:XX	■	■						2 1 1 2 2	DOCKING WHEN WITHIN <u>+3°</u> OF DOCKING ATTITUDE

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
190:06:XX					PERFORM AT DOCK LATCH				
					DOCKING PROBE EXTD/REL TB(2)-GRAY (VERIFY)			2	
					PERFORM AT HARD DOCK				
					SEQ EVENT CONT SYS PYRO ARM(BOTH)-SAFE			8	
					LOGIC(BOTH)-OFF			8	
					CB SEQ EVENTS CONT SYS(4)-OPEN			8	
					THC-LOCKED(VERIFY)				
					RHC 2-LOCKED(VERIFY)				
					BMAG MODE(3)-RATE 2(VERIFY)			1	
					DOCKING PROBE-OFF			2	
					DOCKING PROBE RETRACT(BOTH)-OFF(CTR)			2	
					EXTERIOR LIGHTS RUN/EVA-OFF			2	
					COAS POWER-OFF			15	
					AUTO RCS SELECT ROLL(4)-OFF			8	
					TRANS CONTR PWR-OFF			1	
					ROT CONTR PWR DIRECT (BOTH)-OFF			1	
					VHF RANGING-OFF			3	
					TERMINATE LM PHOTOGRAPHY AND P47				
					DAC-OFF				
					TV-OFF				
				PRO					
				OOE					
				P00					
					F 37 BB				
					BB BB				

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
190:07:XX	■	■	38	P00	RECONFIGURE DAP V48E	F 04 46	11102 X1111		R1-DAP CONFIGURATION R2-DAP CONFIGURATION
	■	■			V21E 61111E	F 04 46	61111 X1111		
	■	■			PRO	F 06 47	+XXXXX. +05935.		R1-CSM WEIGHT(LBS) R2-LM WEIGHT(LBS)
	■	■			PRO	F 06 48	+000.43 +001.02		R1-GIMBAL PITCH TRIM(DEG) R2-GIMBAL YAW TRIM(DEG)
	■	■			PRO	BB BB			
190:08:XX	■	■	39	P00	CONFIGURE SWITCHES FOR POST DOCKING CMC MODE-AUTO RNDZ XPNDR-OFF			1 100	

3.0 CMP ABORT RENDEZVOUS PROCEDURES

During the period of CSM and LM separation, an abort may be initiated at a pre-determined time and the rendezvous completed by using one of several techniques. The LM active Direct Ascent, One Rev, or Two Rev technique will be used to complete the rendezvous if the LM obtains the desired insertion conditions or if the LM makes an accurate abort initiation maneuver.

The procedures for the Direct Ascent rendezvous are similar to those presented in the previous section. This section discusses the CMP procedures necessary to support the other two LM active rendezvous techniques.

3.1 ABORT PLAN

The abort plan defines pre-determined abort points and regions during CSM and LM separation and the rendezvous technique to be used after the abort. The two basic rendezvous techniques of the abort plan are discussed in subsection 3.1.1 and the abort points and regions are discussed in subsection 3.1.2. Detailed discussion of the abort plan may be found in Reference 9.

3.1.1 RENDEZVOUS TECHNIQUES

One Rev Rendezvous. The One Rev rendezvous consists of four LM burns with station-keeping occurring approximately 3.5 hours after the abort. The CMP will backup all maneuvers in case the LM is unable to apply them.

The first maneuver, CSI, is applied one-half rev after insertion at approximately LM apolune and establishes the desired catch-up or fall-back rate between the CSM and LM. Also, the out-of-plane velocity will be nulled at CSI, establishing a node

approximately 30 minutes before CDH. The second maneuver, CDH, is applied one-half rev after the CSI burn and establishes a constant LM catch-up rate by establishing a constant 15 nm differential altitude between the orbits of the two vehicles. The third maneuver, TPI, is applied approximately 42 minutes after CDH at a LM elevation angle of 26.6° (the CSM elevation angle is 208.3°). This should occur anywhere from 22 to 16 minutes prior to sunrise. The TPI maneuver establishes a trajectory which intercepts the target 130° after the TPI burn. Nominally zero DV midcourse corrections are scheduled at 15 and 30 minutes after TPI to refine the intercept trajectory. The fourth maneuver, TPF, is actually divided into five braking gates which establish desired relative velocities at specified ranges. These braking gates are defined as follows:

at 1.50 nm	45 fps,
at 1.00 nm	30 fps (nominally the first braking gate),
at 0.50 nm	20 fps,
at 0.25 nm	10 fps,
at 0.08 nm	5 fps.

A plane change burn will be applied 30 minutes prior to CDH if the magnitude of the burn is greater than five feet per second. This burn, and the out-of-plane burn at CSI, remove most of the out-of-plane dispersions.

A generalized orbital motion plot is contained in Appendix E, page two. A family of relative motion curves is defined by the various abort insertion points. These curves are contained in Appendix E, page three.

Two Rev Rendezvous. The Two Rev rendezvous consists of six LM burns with station-keeping occurring approximately 5.5 hours after insertion. The CMP will backup all maneuvers except the LM boost burn.

The LM applies the boost burn one-half rev after insertion. It is

a 10.0 feet per second burn which raises the LM perilune altitude. One rev after insertion a HAM burn is applied by the LM so that the post-CDH DH will be 15 nm. The coelliptic sequence (CSI, CDH, TPI, TPF) is then initiated one and one-half revs after insertion.

A generalized orbital motion plot is contained in Appendix E, page six and the family of relative motion plots defined by the time of abort is contained in Appendix E, page seven. As shown in the third figure, a large range at insertion necessitates adding an additional rev between the boost burn and HAM for the T2-1 case.

3.1.2 ABORT POINTS

Separation to Circularization. In case of a "NO-GO" decision for the CSM circularization burn the LM will achieve station-keeping by applying a chart computed maneuver. There is no discrete abort point during this period.

Circularization to PDI. If a "NO-GO" decision is made for PDI, the LM applies an abort initiation maneuver 12 minutes after the scheduled PDI time. If the abort burn is applied after the first PDI opportunity, the One Rev technique is used for rendezvous. If the abort burn is made after the second PDI opportunity, the Two Rev technique is used.

PDI to T1 Time. The CDR may initiate an abort at any time between Powered Descent Initiation and T1 (T1 being the time when a LM abort would result in the minimum LM apolune of 30 nm). T1 time for the first PDI opportunity is approximately $PDI_1 + 17$ minutes and T1 for the second opportunity is approximately $PDI_2 + 16$ minutes.

An abort during this region is classified as either a "PDI early abort" or an "PDI late abort". The crossover point between the early and

late aborts is determined by the phase angle between the LM and CSM. The approximate crossover times are $PDI_1 + 10$ minutes and $PDI_2 + 6$ minutes.

The One Rev rendezvous technique is used for a PDI_1 early abort and a PDI_2 late abort. The Two Rev technique is used for a PDI_1 late abort and a PDI_2 early abort.

T1 to T2. If a failure requiring an abort is found after T1, the abort will be initiated at a discrete time designated T2. (T2 being the first time after T1 when the LM apolune would be 30 nm). The approximate T2 times for the first two powered descent opportunities are $PDI_1 + 25$ minutes and $PDI_2 + 22$ minutes.

The Two Rev rendezvous technique will be used for an abort at the T2 time. In the event of a T2 abort from the first PDI opportunity, an additional rev is required between the boost and the HAM burns.

T2 to Nominal Lift-Off - 10 Minutes. For each CSM rev that the LM is on the surface, MCC-H computes an abort lift-off time which will result in either a Direct Ascent rendezvous or a One Rev rendezvous. This time is designated as "T3".

If the CDR initiates an abort at a T3 time, the Direct Ascent rendezvous will be used whenever possible. If, however, trajectory or systems limitations prevent using the Direct Ascent technique, then the rendezvous will be performed using the One Rev technique with lift-off time delayed approximately two and one-half minutes.

Nominal Lift-Off Time - 10 Minutes to Nominal Lift-Off Time. An APS leak during APS pressurization is cause for an immediate LM lift-off. This may occur as early as 10 minutes prior to nominal lift-off time and is designated as the "early coelliptic abort region". The Two Rev technique is used for rendezvous for aborts prior to eight minutes before

lift-off and the One Rev technique is used for aborts after eight minutes.

LM or CSM system failures may make the One Rev technique more desirable than the Direct Ascent technique for rendezvous. If these failures are determined before lift-off, then the lift-off is delayed approximately two and one-half minutes and the One Rev rendezvous is then performed. The abort is designated as a "coelliptic abort".

Nominal Lift-Off Time to Docking. If the LM inserts with an unacceptable trajectory dispersion which cannot be adjusted with a LM tweak maneuver, the rendezvous technique to be used is changed from the Direct Ascent to the One Rev technique. This is accomplished at five minutes after insertion when the LM applies a bailout burn which adjusts LM phasing to be compatible with the One Rev rendezvous requirements. The CMP backs up the bailout burn but would apply it at insertion +12 minutes.

Separation to Docking. A summary of the LM abort points and rendezvous techniques is contained in Figure 3.

PERIOD	ABORT NAME	RENDEZVOUS TECHNIQUE
FIRST POWERED DESCENT OPPORTUNITY	NO PDI+12 ABORT PDI, EARLY ABORT PDI, LATE ABORT T2 ABORT	ONE REV RENDEZVOUS ONE REV RENDEZVOUS TWO REV RENDEZVOUS MODIFIED TWO REV RENDEZVOUS
SECOND POWERED DESCENT OPPORTUNITY	NO PDI+12 ABORT PDI, EARLY ABORT PDI, LATE ABORT T2 ABORT	TWO REV RENDEZVOUS TWO REV RENDEZVOUS ONE REV RENDEZVOUS TWO REV RENDEZVOUS
POST-LANDING	T3 ABORT COELLIPTIC ABORT (8-10 MIN EARLY) COELLIPTIC ABORT (2-8 MIN EARLY) COELLIPTIC ABORT (NOM L/O +2.5 MIN)	DIRECT ASCENT RENDEZVOUS (ALTERNATE-ONE REV RENDEZVOUS) TWO REV RENDEZVOUS ONE REV RENDEZVOUS ONE REV RENDEZVOUS
POST-LIFT-OFF	LM BAILOUT	ONE REV RENDEZVOUS

FIGURE 3. APOLLO 17 ABORT POINT AND RENDEZVOUS TECHNIQUE SUMMARY

3.2 ABORT PROCEDURES RATIONALE

Rationale for the Coelliptic rendezvous procedures after the TPI final comp is the same as for the Direct Ascent rendezvous. Rationale for additional procedures prior to the final comp necessary for performing a coelliptic rendezvous are contained in this section.

Reconfigure DAP. The DAP is reconfigured to change the vehicle's attitude maneuver rate and deadband.

A .5 degree/second attitude maneuver rate is used for rendezvous. This rate gives acceptable maneuver times without excessive fuel expenditures.

The R03 deadband is set to 0.5 degrees for rendezvous because:

- A. P40/P41 will select the R03 deadband if P20 is running when P40/P41 is selected.
- B. Line-of-sight monitoring after MCC-2 will be done with the R03 narrow deadband.

If a tracking deadband larger than .5 degrees is desired, it should be loaded via N79.

Manually narrowing the deadband in R03 does not change the attitude reference; therefore, when switching to the minimum deadband, the mode switch should be cycled to FREE and back to AUTO to re-establish the attitude hold reference.

Accept STDN Uplink. The One Rev and Two Rev detailed procedures were developed assuming that the LM aborted after PDI. The STDN uplink supplies the CMC with an initial LM state vector. If, however, the LM aborts without initiating PDI, P76 would be used to update the CMC LM state vector with the LM abort burn.

An additional STDN uplink is scheduled prior to the HAM in the Two Rev rendezvous. This uplink will improve the CMC's knowledge of the CSM and LM state vectors and will give the CMC the capability to compute an accurate HAM if there has been no navigation prior to the HAM.

Update LM State Vector in the CMC. P76 is used to update the CMC's knowledge of the LM state vector to include any burn that the LM may apply to accomplish rendezvous.

Configure VHF and EMS for Ranging. The VHF and EMS are configured for ranging so that VHF marks may be taken.

Initiate Pre-Thrust Program and Rendezvous Navigation. The pre-thrust program is entered in order to:

- A. Initiate P20 and LM tracking
- B. Initiate VHF marking on the LM
- C. Display the time to the burn
- D. Display the number of sextant and VHF marks taken
- E. Initialize the program for the upcoming recycle and final comp
- F. To initiate the MINKEY sequence if this is the first pre-thrust program

Start Recycle Sequence. The burn components are computed for comparison with the LGC solution.

Compute Burn Solution and Terminate Navigation. The burn solution is used in the CMC for a possible CSM active burn. The final comp terminates rendezvous navigation until the next marking period.

Backup LM Burn. The CMP backs up the LM HAM, CSI, PC and CDH burns. If the LM fails to apply any of these burns, the CSM would become the active vehicle and perform the CMC computed burn.

A. Backup LM RCS Burn

The MINKEY logic specifies an RCS burn if the computed DV is less than seven feet per second. The CMP configures the CSM for an RCS burn but does not actually apply the burn. If the LM fails to apply the burn, the CMP would apply the burn by zeroing the burn components in the CMC P41 N85 display with the THC.

B. Backup LM SPS Burn

The MINKEY logic specifies an SPS burn if the computed DV is greater than or equal to seven feet per second. Except for arming the SPS engine and applying ullage, the CMP configures the CSM for an SPS burn. In the event the LM cannot apply the burn, the CMP would burn the CMC solution by:

- (1) Arming the SPS engine
- (2) Applying ullage for 11 seconds
- (3) Proceeding on the flashing V99 N40 display

3.3 DETAILED PROCEDURES

The CSM detailed procedures for the LM active abort rendezvous are contained in subsection 3.3.1, 3.3.2, and 3.3.3. These detailed procedures consider primarily the G&N requirements, although some non-G&N procedures are included for purposes of information and continuity. The format for presenting the abort procedures is the same as the format used for presenting the nominal direct ascent rendezvous procedures (subsection 2.3). However, since the procedures cover generalized cases, no trajectory dependent data such as GET and DSKY register displays are shown.

3.3.1 TWO REV SEQUENCE

The Two Rev procedures begin five minutes before insertion and assume an abort after PDI. In the event of a no PDI abort, the procedures would contain a P76 velocity update rather than a STDN state vector

uplink. The procedures continue through the CSI final comp which is the starting point for the common Coelliptic sequence (subsection 3.3.3).

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
INS-05MIN			1	P00	* * * * * TWO REV SEQUENCE * * * * * RECONFIGURE DAP V37E 00E CYCLE CMC MODE-FREE/AUTO V48E V21E 11102E PRO PRO PRO	BB BB F 04 46 F 04 46 F 06 47 F 06 48 BB BB	1111 0111 11102 0111 +XXXXX. +XXXXX. +XXX.XX +XXX.XX	1	
INS+05MIN			2	P00 P27 P00	ACCEPT STDN UPLINK UP TLM CM-ACCEPT VERIFY UPLINK ACTIVITY LT-ON . MONITOR UPLINK: VERIFY UPLINK ACTIVITY LT-OFF UP TLM CM-BLOCK	XX XX BB BB	XXXXX XXXXX XXXXX	2 2	INSERTION OR AIM UPLINK ACT LT-ON UPLINK ACT LT-OFF

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-H DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
HAM-60MIN									OBTAIN LM BOOST TIG & DV FROM LM
HAM-59MIN			3	P00	<u>UPDATE LM STATE VECTORS</u> V37E 76E	F 06 33	+00XXX. +000XX. +0XX.XX		LM BOOST
				P76	V25E +XXXE +XXE +XXXE	F 06 33	+00XXX. +000XX. +0XX.XX		LOAD BOOST TIG
				PRO		F 06 84	+XXXX.X +XXXX.X +XXXX.X		
					V25E +100E +E +E	F 06 84	+0010.0 +0000.0 +0000.0		
				PRO		F 37 BB			
			4	P76	<u>CONFIGURE VHF AND EMS FOR RANGING</u> VHF AM T/R-T/R VHF ANTENNA-RIGHT EMS FUNCTION - DV SET/VHF RNG EMS MODE - BACKUP/VHF RNG			9 3 1 1	

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
HAM-40MIN			5	P76	ACCEPT STDN UPLINK OOE				2
				P00		BB BB			
				P27	UP TLM CM-ACCEPT VERIFY UPLINK ACTIVITY LT-ON MONITOR UPLINK	XX XX	XXXXX XXXXX XXXXX		
				P00	VERIFY UPLINK ACTIVITY LT-OFF UP TLM CM-BLOCK	BB BB			
			6	P00	INITIATE P31 AND RNDZ NAVIGATION V37E 31E				2
				P20 P31		F 50 25	00017		
				PRO		F 50 18	+XXX.XX +XXX.XX +XXX.XX		
				PRO		06 18	+XXX.XX +XXX.XX +XXX.XX		
					MONITOR AUTO MNVR VHF RNG-RESET				
						F 06 11	+00XXX. +000XX. +0XX.XX		
					V25E +XXXE +XXE +XXXXE	F 06 11	+00XXX. +000XX. +0XX.XX		
								9	LOAD CSI TIG

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
HAM-20MIN					PRO	F 06 55	+00001 +208.30 +130.00		LOAD TPI TIG
					PRO	F 06 37	+00XXX. +000XX. +0XX.XX		
					V25E +XXE +XXE +XXXXE	F 06 37	+00XXX. +000XX. +0XX.XX		
					PRO	F 06 33	+00XXX. +000XX. +0XX.XX		
					V25E +XXE +XXE +XXXXE	F 06 33	+00XXX. +000XX. +0XX.XX		LOAD HAM TIG
					PRO	F 16 45	+0XB00 -XXBXX -00001		
					START RECYCLE SEQUENCE V32E	F 06 90	+XXX.XX +XXXX.X +XXXX.X		
					RECORD DATA				

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
HAM-12MIN			8	P31	PRO	F 06 81	+XXXX.X +XXXX.X +0000.0		ZERO DVY
					RECORD DATA PRO				
						F 16 45	+XXB00 -19BXX -00001		
					COMPUTE HAM SOLUTION AND TERMINATE NAV PRO	F 06 90	+XXX.XX +XXXX.X +XXXX.X		
					RECORD DATA PRO				
					RECORD DATA V22E +E	F 06 81	+XXXX.X +XXXX.X +0000.0		
					PRO	F 06 81	+XXXX.X +0000.0 +0000.0		
						F 16 45	+XXB00 -11BXX +XXX.XX		

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
HAM-11MIN			9	P31 P41	BACKUP LM HAM BURN PRO ENTER	F 50 18	+XXX.XX +XXX.XX +XXX.XX		
HAM-35SEC HAM-30SEC					MONITOR DSKY BLANK	06 85	+XXXX.X +XXXX.X +XXXX.X		
						BB BB			AVE G ON
HAM TIG						16 85	+XXXX.X +XXXX.X +XXXX.X		
					VERIFY LM HAM BURN COMPLETE	F 16 85	+XXXX.X +XXXX.X +XXXX.X		LM HAM
HAM+01MIN			10	P41 P76	UPDATE LM STATE VECTOR IN THE CMC PRO PRO	F 06 33	+00XXX. +000XX. +0XX.XX		
						F 06 84	+XXXX.X +0000.0 +0000.0		

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
HAM+02MIN			11	P76 P32	INITIATE P32 AND RNDZ NAVIGATION PRO PRO MONITOR AUTO MNVR PRO PRO PRO START SEXTANT MARKING <u>OPTICS ZERO-OFF</u> OPTICS MODE-MAN OHC-CENTER LM IN SXT TAKE ONE SXT MARK PER MIN	F 50 18 06 18 F 06 11 F 06 55 F 06 37 F 16 45	+XXX.XX +XXX.XX +XXX.XX +XXX.XX +XXX.XX +XXX.XX +00XXX. +000XX. +0XX.XX +00001 +208.30 +130.00 +00XXX. +000XX. +0XX.XX +XXB00 -XXBXX -00001	122 122 122	

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
CSI-20MIN			12	P32	START RECYCLE SEQUENCE <u>OPTICS MODE-CMC</u> V32E			122	
					RECORD DATA PRO	F 06 90	+XXX.XX +XXXX.X +XXXX.X		
					RECORD DATA PRO	F 06 81	+XXXX.X +XXXX.X +0000.0		
					CONTINUE SEXTANT MARKING <u>OPTICS MODE-MAN</u> OHC-CENTER LM IN SXT TAKE ONE SXT MARK PER MIN	F 16 45	+XXBXX -19BXX -00001	122 122	
CSI-12MIN			13	P32	<u>COMPUTE CSI SOLUTION AND TERMINATE NAV</u>				
					OPTICS SPEED-HI			122	
					OHC-DRIVE TRUNNION TO LESS THAN 10 DEG			122	
					OPTICS ZERO-ZERO			122	
					OPTICS SPEED-LO			122	
					OPTICS MODE-CMC			122	

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
					PRO	F 06 90	+XXX.XX +XXXX.X +XXXX.X		
					RECORD DATA PRO	F 06 81	+XXXX.X +XXXX.X +0000.0		
					RECORD DATA PRO	F 16 45	+XXBXX -10BXX +XXX.XX		
					***** CONTINUE WITH STEP 1 OF THE COMMON COELLIPTIC SEQUENCE,SECTION 3.3.3 *****				

3.3.2 ONE REV SEQUENCE

The One Rev procedures begin five minutes before insertion and assume an abort after PDI. In the event of a no-PDI abort, the procedures would contain a P76 velocity update rather than a STDN state vector uplink. The procedures continue through CSI final comp where the common Coelliptic sequence (subsection 3.3.3) is initiated.

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-M DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
INS-01MIN			1	P00	* * * * * ONE REV SEQUENCE * * * * * <u>RECONFIGURE DAP</u> V37E 00E V48E V21E 11102E PRO PRO	BB BB F 04 46 F 04 46 F 06 47 F 06 48	11111 01111 11102 01111 +XXXXX. +XXXXX. ±XXX.XX ±XXX.XX		INSERTION OR AIM
			2	P00	<u>CONFIGURE VHF ANF EMS FOR RANGING</u> VHF AM T/R-T/R VHF ANTENNA-RIGHT EMS FUNCTION-DV SET/VHF RNG EMS MODE-BACKUP/VHF RNG			9 3 1 1	

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
INS+05MIN			3	P00	ACCEPT STDN UPLINK				
				P27	UP TLM CM-ACCEPT VERIFY UPLINK ACTIVITY LT-ON MONITOR UPLINK	XX XX	XXXXX XXXXX XXXXX	2	UPLINK ACT LT-ON
				P00	VERIFY UPLINK ACTIVITY LT-OFF UP TLM CM-BLOCK	BB BB		2	UPLINK ACT LT-OFF OBTAIN CSI&TPI TIG FROM LM
CSI-40MIN			4	P00	INITIATE P32 AND RNDZ NAVIGATION				
				P20	V37E 32E				
				P32		F 50 25	00017		
				PRO		F 50 18	+XXX.XX +XXX.XX +XXX.XX		
				PRO		06 18	+XXX.XX +XXX.XX +XXX.XX		
					MONITOR AUTO MNVR VHF RNG-RESET	F 06 11	+00XXX. +000XX. +0XX.XX	9	
					V25E +XXXE +XXE +XXXXE	F 06 11	+00XXX. +000XX. +0XX.XX		LOAD CSI TIG
				PRO		F 06 55	+00001 +208.30 +130.00		

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
CSI-20MIN			5	P32	PRO	F 06 37	+00XXX. +000XX. +0XX.XX	122 122 122 122	LOAD TPI TIG
					V25E +XXE +XXE +XXXXE	F 06 37	+00XXX. +000XX. +0XX.XX		
					PRO	F 16 45	+XXB00 -XXBXX -00001		
					<u>START SEXTANT MARKING</u> OPTICS ZERO-OFF OPTICS MODE-MAN OHC-CENTER LM IN SXT TAKE ONE SXT MARK PER MIN				
					<u>START RECYCLE SEQUENCE</u> OPTICS MODE-CMC V32E	F 06 90	+XXX.XX +XXXX.X +XXXX.X		
					RECORD DATA PRO	F 06 81	+XXXX.X +XXXX.X +0000.0		
					RECORD DATA PRO	F 16 45	+XXBXX -19BXX -00001		

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-H DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
CSI-12MIN			6	P32	<u>CONTINUE SEXTANT MARKING</u> OPTICS MODE-MAN OHC-CENTER LM IN SXT TAKE ONE SXT MARK PER MIN			122 122	
					<u>COMPUTE CSI SOLUTION AND TERMINATE NAV</u>				
					OPTICS SPEED-HI			122	
					OHC-DRIVE TRUNNION TO LESS THAN 10 DEG			122	
					OPTICS ZERO-ZERO			122	
					OPTICS SPEED-LO			122	
					OPTICS MODE-CMC			122	
					PRO	F 06 90	+XXX.XX +XXXX.X +XXXX.X		
					RECORD DATA				
					PRO	F 06 81	+XXXX.X +XXXX.X +0000.0		
					RECORD DATA				
					PRO	F 16 45	+XXBXX -10BXX +XXX.XX		
					***** CONTINUE WITH STEP 1 OF THE COMMON COELLIPTIC SEQUENCE, SECTION 3.3.3 *****				

3.3.3 COMMON COELLIPTIC SEQUENCE

The common Coelliptic sequence begins immediately after the CSI final comp and continues through the post-docking switch configuration. This sequence is common to both the One Rev and Two Rev rendezvous techniques.

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
CSI-10MIN			1	P32	***** COMMON COELLIPTIC SEQUENCE *****	F 16 45	+XXBXX -10BXX +XXX.XX		
					<u>BACKUP LM CSI BURN</u>				
					PRO	F 50 18	+XXX.XX +XXX.XX +XXX.XX		
					P40				
					PRO	06 18	+XXX.XX +XXX.XX +XXX.XX		
					MONITOR AUTO MNVR	F 50 18	+XXX.XX +XXX.XX +XXX.XX		
					ALIGN GDC TO IMU			1	
					ATT SET TW-SET TO IMU ANGLES ON FDAI 1			1	
					FDAI SELECT-1			1	
					FDAI SOURCE-ATT SET (VERIFY)			1	
					ATT SET-IMU			1	
					ATT SET TW-NULLED FDAI 1 ERROR NEEDLES			1	
					ATT SET-GDC			1	
					GDC ALIGN PB-PUSH UNTIL NEEDLES NULLED			1	
					FDAI SELECT-1/2			1	
					RECORD P76 DATA				OBTAIN CSI P76 FROM CDR

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
					CONFIGURE EMS FOR BURN EMS MODE-STBY EMS FUNCTION-OFF -DV SET/VHF RNG LOAD DV MINUS 11 FPS IN EMS EMS FUNCTION-DV CONFIGURE SCS CB STAB CONT SYS(ALL)-CLOSE CB SPS(12)-CLOSE MANUAL ATTITUDE(3)-RATE CMD(VERIFY) RATE-LOW(VERIFY) DV CG-CSM(VERIFY) SPS HE VLVS(BOTH)-AUTO(VERIFY) CHECK N2 A AND N2 B TVC PREPARATION SCS TVC(BOTH)-RATE CMD(VERIFY) TVC GIMBAL DRIVE(BOTH)-AUTO(VERIFY) MAIN BUS TIE(2)-ON TVC SERVO POWER 1-AC1/MNA TVC SERVO POWER 2-AC2/MNB ROT CONTR PWR NORMAL 2-AC ROT CONTR PWR DIRECT 2-OFF(VERIFY) ATT DEADBAND-MIN BMAG MODE(3)-ATT 1/RATE 2 SC CONT-SCS RHC 2-ARMED			1 1 1 1 1 8 8 1 1 1 3 3 1 1 5 7 7 1 1 1 1 1	

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
					PRIMARY TVC CHECK				
					SPS GIMBAL MOTORS PITCH 1-START/ON			1	
					YAW 1-START/ON			1	
					VERIFY TRIM CONTROL AND SET			1	
					VERIFY MTVC				
					SC CONT-CMC			1	
					THC-CLOCKWISE				
					VERIFY NO MTVC				
					SECONDARY TVC CHECK:				
					SPS GIMBAL MOTORS PITCH 2-START/ON			1	
					YAW 2-START/ON			1	
					SET GPI TRIM			1	
					VERIFY MTVC				
					THC-NEUTRAL				
					VERIFY NO MTVC				
					VERIFY GPI RETURNS TO 0,0				
					ROT CONTR PWR NORMAL(BOTH)-AC/DC			1	
					DIRECT(BOTH)-MNA/MNB			1	
					B MAG MODE(3)-RATE 2			1	
					PRO				
						06 18	+XXX.XX +XXX.XX +XXX.XX		
					MONITOR TRIM MANEUVER				
						F 50 18	+XXX.XX +XXX.XX +XXX.XX		
					B MAG MODE(3)-ATT 1/RATE 2			1	

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
CSI-01MIN					ENTER PRO MONITOR GPI RESPONSE: FDAI SCALE-5/1(VERIFY) VERIFY DET SET RATE-HIGH EMS MODE-NORMAL TRANS CONTR PWR-ON	F 50 25 BB BB 06 40	00204 -XXBXX +XXXX.X +0000.0	1 1 1 1 1	
CSI-35SEC CSI-30SEC					MONITOR DSKY BLANK CHECK PIPA BIAS LESS THAN 2 FPS FOR 5 SEC	BB BB 06 40	-00B29 +XXXX.X +0000.0		AVE G ON
CSI-05SEC						F 99 40	-00B05 +XXXX.X +0000.0		'ENGINE ON ENABLE REQUEST
CSI TIG					VERIFY LM BURN COMPLETE ENTER	F 16 85	+XXXX.X +XXXX.X +XXXX.X		LM CSI

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
CSI+02MIN					SPS GIMBAL MOTORS(4)-OFF SEQUENTIALLY TVC SERVO POWER(BOTH)-OFF RHC 2-LOCKED TRANS CONTR PWR-OFF ROT CONTR PWR DIRECT(BOTH)-OFF CB DIRECT ULLAGE(BOTH)-OPEN CB SPS PITCH 1 AND YAW 1-OPEN RECORD DV COUNTER AND RESIDUALS EMS FUNCTION-OFF EMS MODE-STBY			1 7 1 1 8 8 1 1	
				P40	UPDATE LM S.V. IN THE CMC				
				P76	PRO	F 06 33	+00XXX. +000XX. +0XX.XX		
					ATT DEADBAND-MAX RATE-LOW BMAG MODE(3)-RATE 2 MAIN BUS TIE(2)-OFF PRO	F 06 84	+XXXX.X +XXXX.X +XXXX.X	1 1 1 5	
									COPY LM PC TIG

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
CSI+03MIN			2	P76 P36	INITIATE P36 AND RNDZ NAVIGATION PRO PRO MONITOR AUTO MNVR RECONFIGURE EMS FOR RANGING EMS FUNCTION-DV SET/VHF RNG EMS MODE-BACKUP/VHF RNG VHF RNG-RESET V25E +XXE +XXE +XXXXE PRO	F 50 18 06 18 F 06 33 F 06 33 F 16 45	+XXX.XX +XXX.XX +XXX.XX +XXX.XX +XXX.XX +XXX.XX +00XXX. +000XX. +0XX.XX +00XXX. +000XX. +0XX.XX +XXBXX -XXBXX -00001	1 1 9	OVERWRITE WITH LM PC TIG

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
PC-09MIN			3	P36	<u>START SEXTANT MARKING</u> OPTICS ZERO-OFF OPTICS MODE-MAN OHC-CENTER LM IN SXT TAKE ONE SXT MARK PER MIN			122 122 122	
					<u>COMPUTE PC SOLUTION AND TERMINATE NAV</u> OPTICS SPEED-HI OHC-DRIVE TRUNNION TO LESS THAN 10 DEG OPTICS ZERO-ZERO OPTICS SPEED-LO OPTICS MODE-CMC PRO	F 06 90	+XXX.XX +XXXX.X +XXXX.X	122 122 122 122 122	
					RECORD DATA PRO	F 06 81	+0000.0 +XXXX.X +0000.0		
					RECORD DATA				
			4	P36	<u>BYPASS PC MANEUVER</u> V22E +E	F 06 81	+0000.0 +0000.0 +0000.0		IF DVY GREATER THAN 5 FPS, BUT LESS THAN 7 FPS, SEE SECTION 4.1.1. IF DVY GREATER THAN OR EQUAL TO 7 FPS, SEE SECTION 4.1.2.

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
					PRO	F 16 45	+XXBXX -08BXX +XXX.XX		
				P76	PRO	F 06 33	+00XXX. +000XX. +0XX.XX		
					PRO	F 06 84	+0000.0 +0000.0 +0000.0		
			5	P33	PRO <u>INITIATE P33 AND RNDZ NAVIGATION</u>	F 06 13	+00XXX. +000XX. +0XX.XX		
					V25E +XXE +XXE +XXXXE	F 06 13	+00XXX. +000XX. +0XX.XX		OVERWRITE WITH LM CDH TIG
					PRO	F 16 45	+XXBXX -XXBXX -00001		

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
CDH-20MIN			6	P33	<u>START SEXTANT MARKING</u> OPTICS ZERO-OFF OPTICS MODE-MAN OHC-CENTER LM IN SXT TAKE ONE SXT MARK PER MIN			122 122 122	
					<u>START RECYCLE SEQUENCE</u> OPTICS MODE-CMC V32E	F 06 90	+XXX.XX +XXXX.X +XXXX.X	122	
					RECORD DATA PRO	F 06 81	+XXXX.X ±XXXX.X ±XXXX.X		
					RECORD DATA PRO	F 16 45	+XXBXX -19BXX -00001		
					<u>CONTINUE SEXTANT MARKING</u> OPTICS MODE-MAN OHC-CENTER LM IN SXT TAKE ONE SXT MARK PER MIN			122 122	

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
CDH-12MIN			7	P33	<u>COMPUTE CDH SOLUTION AND TERMINATE NAV</u> OPTICS SPEED-HI OHC-DRIVE TRUNNION TO LESS THAN 10 DEG OPTICS ZERO-ZERO OPTICS SPEED-LO. OPTICS MODE-CMC PRO RECORD DATA PRO RECORD DATA PRO	 F 06 90 F 06 81 F 16 45	 +XXX.XX +XXXX.X +XXXX.X +XXXX.X +XXXX.X +XXXX.X +XXBXX -10BXX +XXX.XX	 122 122 122 122 122	

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
CDH-10MIN			8	P33	<u>BACKUP LM CDH BURN</u>				
				P40	PRO	F 50 18	+XXX.XX +XXX.XX +XXX.XX		
					PRO	06 18	+XXX.XX +XXX.XX +XXX.XX		
					MONITOR AUTO MNVR	F 50 18	+XXX.XX +XXX.XX +XXX.XX		
					<u>ALIGN GDC TO IMU</u>			1	
					ATT SET TW-SET TO IMU ANGLES ON FDAI 1			1	
					FDAI SELECT-1			1	
					FDAI SOURCE-ATT SET			1	
					ATT SET-IMU			1	
					ATT SET TW-NULLED FDAI 1 ERROR NEEDLES			1	
					ATT SET-GDC			1	
					GDC ALIGN PB-PUSH UNTIL NEEDLES NULLED			1	
					FDAI SELECT-1/2			1	
					RECORD P76 DATA				OBTAIN CDH P76 FROM CDR
					<u>CONFIGURE EMS FOR BURN</u>			1	
					EMS MODE-STBY			1	
					EMS FUNCTION-OFF			1	
					EMS FUNCTION-DV SET/VHF RNG			1	
					LOAD DV MINUS 11 FPS IN EMS			1	
					EMS FUNCTION-DV			1	

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
					CONFIGURE SCS CB STAB CONT SYS(ALL)-CLOSE CB SPS(12)-CLOSE MANUAL ATTITUDE(3)-RATE CMD(VERIFY) RATE-LOW(VERIFY) DV CG-CSM(VERIFY) SPS HE VLVS(BOTH)-AUTO(VERIFY) CHECK N2 A AND N2 B TVC PREPARATION SCS TVC(BOTH)-RATE CMD(VERIFY) TVC GIMBAL DRIVE(BOTH)-AUTO(VERIFY) MAIN BUS TIE(2)-ON TVC SERVO POWER 1-AC1/MNA TVC SERVO POWER 2-AC2/MNB ROT CONTR PWR NORMAL 2-AC ROT CONTR PWR DIRECT 2-OFF(VERIFY) ATT DEADBAND-MIN BMAG MODE(3)-ATT 1/RATE 2 SC CONT-SCS RHC 2-ARMED PRIMARY TVC CHECK SPS GIMBAL MOTORS PITCH 1-START/ON YAW 1-START/ON VERIFY TRIM CONTROL AND SET VERIFY MTVC SC CONT-CMC THC-CLOCKWISE VERIFY NO MTVC			8 8 1 1 1 3 3 1 1 5 7 7 1 1 1 1 1 1 1 1 1	

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
					SECONDARY TVC CHECK: SPS GIMBAL MOTORS PITCH 2-START/ON YAW 2-START/ON			1 1 1	
					SET GPI TRIM VERIFY MTVC THC-NEUTRAL VERIFY NO MTVC VERIFY GPI RETURNS TO 0,0 ROT CONTR PWR NORMAL(BOTH)-AC/DC ROT CONTR PWR DIRECT(BOTH)-MNA/MNB BMAG MODE(3)-RATE 2			1 1 1	
				PRO		06 18	+XXX.XX +XXX.XX +XXX.XX		
					MONITOR TRIM MANEUVER	F 50 18	+XXX.XX +XXX.XX +XXX.XX		
					BMAG MODE(3)-ATT 1/RATE 2			1	

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
CDH-01MIN					ENTER PRO MONITOR GPI RESPONSE: FDAI SCALE-5/1 (VERIFY) VERIFY DET SET RATE-HIGH EMS MODE-NORMAL TRANS CONTR PWR-ON	F 50 25 BB BB 06 40	00204 -XXBXX +XXXX.X +0000.0	1 1 1 1 1	
CDH-35SEC CDH-30SEC					MONITOR DSKY BLANK CHECK PIPA BIAS LESS THAN 2 FPS FOR 5 SEC	BB BB 06 40	-00B29 +XXXX.X +0000.0		AVE G ON
CDH-05SEC						F 99 40	-00B05 +XXXX.X +0000.0		ENGINE ON ENABLE REQUEST
CDH TIG					VERIFY LM BURN COMPLETE ENTER	F 16 85	+XXXX.X +XXXX.X +XXXX.X		LM CDH

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
CDH+01MIN			9	P40 P76	SPS GIMBAL MOTORS(4)-OFF SEQUENTIALLY TVC SERVO POWER(BOTH)-OFF RHC 2-LOCKED TRANS CONTR PWR-OFF ROT CONTR PWR DIRECT(BOTH)-OFF CB DIRECT ULLAGE(BOTH)-OPEN CB SPS PITCH 1 AND YAW 1-OPEN RECORD DV COUNTER AND RESIDUALS EMS FUNCTION-OFF EMS MODE-STBY <u>UPDATE LM S.V. IN THE CMC</u> PRO ATT DEADBAND-MAX RATE-LOW BMAG MODE(3)-RATE 2 MAIN BUS TIE(2)-OFF PRO	F 06 33 F 06 84	+00XXX. +000XX. +0XX.XX +XXXX.X +XXXX.X +XXXX.X	1 7 1 1 8 8 1 1 1 1 5	

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
CDH+03MIN			10	P76 P34	INITIATE P34 AND RNDZ NAVIGATION PRO PRO MONITOR AUTO MNVR RECONFIGURE EMS FOR RANGING EMS FUNCTION-DV SET/VHF RNG EMS MODE-BACKUP/VHF RNG VHF RNG-RESET PRO V22E +20830E PRO	F 50 18 06 18 F 06 37 F 06 55 F 06 55 F 16 45	+XXX.XX +XXX.XX +XXX.XX +XXX.XX +XXX.XX +XXX.XX +00XXX. +000XX. +0XX.XX +00000 +000.00 +130.00 +00000 +208.30 +130.00 +XXBXX -XXBXX -00001	1 1 9	SPECIFY ELEV ANG OPTION

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
TPI-20MIN			11	P34	START SEXTANT MARKING <u>OPTICS ZERO-OFF</u> OPTICS MODE-MAN OHC-CENTER LM IN SXT TAKE ONE SXT MARK PER MIN			122 122 122	
					<u>START RECYCLE SEQUENCE</u>				
					OPTICS MODE-CMC V32E			122	
					RECORD DATA PRO	F 06 37	+00XXX. +000XX. +0XX.XX		
					RECORD DATA PRO	F 06 58	+XXXX.X +XXXX.X +XXXX.X		
					RECORD DATA PRO	F 06 81	+XXXX.X +XXXX.X +XXXX.X		
					RECORD DATA PRO	F 16 45	+XXBXX -18BXX -00001		
					<u>CONTINUE SEXTANT MARKING</u> <u>OPTICS MODE-MAN</u> OHC-CENTER LM IN SXT TAKE ONE SXT MARK PER MIN			122 122	

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
TPI-12MIN			12	P34	COMPUTE TPI SOLUTION AND TERMINATE NAV				
					OPTICS SPEED-HI			122	
					OHC-DRIVE TRUNNION TO LESS THAN 10 DEG			122	
					OPTICS ZERO-ZERO			122	
					OPTICS SPEED-LO			122	
					OPTICS MODE-CMC			122	
				PRO		F 06 37	+00XXX. +000XX. +0XX.XX		OBTAIN TPI TIG FROM LM
					V25E +XXE +XXE +XXXXE	F 06 37	+00XXX. +000XX. +0XX.XX		OVERWRITE WITH LM TPI TIG
				PRO		F 06 55	+00000 +XXX.XX +130.00		
					RECORD DATA				
				PRO		F 06 58	+XXXX.X +XXXX.X +XXXX.X		
					RECORD DATA				
				PRO		F 06 81	+XXXX.X +XXXX.X +XXXX.X		
					RECORD DATA				

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
TPI-10MIN					PRO	F 16 45	+XXBXX -10BXX +XXX.XX		
			13	P34	BACKUP LM TPI BURN PRO	F 50 18	+XXX.XX +XXX.XX +XXX.XX		
				P40	PRO	06 18	+XXX.XX +XXX.XX +XXX.XX		
					MONITOR TRIM MANEUVER	F 50 18	+XXX.XX +XXX.XX +XXX.XX		
					ALIGN GDC			1	
					ATT SET TW-SET TO IMU ANGLES ON FDAI 1			1	
					FDAI SELECT-1			1	
					FDAI SOURCE-ATT SET(VERIFY)			1	
					ATT SET-IMU			1	
					ATT SET TW-NULL FDAI 1 ERROR NEEDLES			1	
					ATT SET-GDC			1	
					GDC ALIGN PB-PUSH UNTIL NEEDLES NULLED			1	
					FDAI SELECT-1/2			1	
					RECORD P76 DATA				OBTAIN TPI P76 FROM CDR

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
					CONFIGURE EMS EMS MODE-STBY EMS FUNCTION-OFF -DV SET/VHF RNG LOAD DV MINUS 11 FPS IN EMS EMS FUNCTION-DV CONFIGURE SCS CB STAB CONT SYS(ALL)-CLOSE CB SPS(12)-CLOSE MANUAL ATTITUDE(3)-RATE CMD(VERIFY) RATE-LOW(VERIFY) DV CG-CSM(VERIFY) SPS HE VLVS(BOTH)-AUTO(VERIFY) CHECK N2 A AND N2 B PRO MONITOR TRIM MANEUVER ENTER ENTER FDAI SCALE-5/1(VERIFY) VERIFY DET SET			1 1 1 1 1 8 8 1 1 1 3 3 06 18 +XXX.XX +XXX.XX +XXX.XX F 50 18 +XXX.XX +XXX.XX +XXX.XX F 50 25 00204 06 40 -XXBXX +XXXX.X +0000.0 1 1	

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
TPI-35SEC TPI-30SEC					MONITOR DSKY BLANK	BB BB			AVE G ON
					CHECK PIPA BIAS LESS THAN 2 FPS FOR 5 SEC	06 40	-00B29 +XXXX.X +0000.0		
TPI-05SEC						F 99 40	-00B05 +XXXX.X +0000.0		ENGINE ON ENABLE REQUEST
TPI TIG					CONFIRM LM BURN COMPLETE ENTER				LM TPI
					EMS FUNCTION-OFF CB SPS PITCH 1 AND YAW 1-OPEN	F 16 85	+XXXX.X +XXXX.X +XXXX.X	1 8	IF THE LM CANNOT APPLY THE TPI BURN, SEE SECTION 4.2.1.
TPI+01MIN			14	P40 P76 PRO	UPDATE LM S.V. IN THE CMC PRO	F 06 33	+00XXX. +000XX. +0XX.XX		
						F 06 84	+XXXX.X +XXXX.X +XXXX.X		

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
TPI+03MIN			15	P76	<u>INITIATE P35 AND RNDZ NAVIGATION</u> CONFIGURE EMS FOR RANGING EMS FUNCTION-DV SET/VHF RNG EMS MODE-BACKUP/VHF RNG VHF RNG-RESET PRO P35 <u>START SEXTANT MARKING</u> OPTICS ZERO-OFF OPTICS MODE-MAN OHC-CENTER LM IN SXT TAKE ONE SXT MARK PER MIN			1 1 9 122 122 122	
TPI+12MIN			16	P35	<u>COMPUTE MCC1 SOLUTION AND TERMINATE NAV</u> OPTICS MODE-CMC PRO RECORD DATA PRO	F 16 45 F 06 81 F 16 45	+XXBXX +03BXX -00001 +XXXX.X +XXXX.X +XXXX.X - +09B09 -02BXX +XXX.XX	122 122	

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
TPI+13MIN			17	P35 P41	BACKUP LM MCC1 BURN PRO ENTER MONITOR DSKY BLANK	F 50 18 06 85 BB BB 16 85	+XXX.XX +XXX.XX +XXX.XX +XXXX.X +XXXX.X +XXXX.X +XXXX.X +XXXX.X +XXXX.X		AVE G ON
MCC-35SEC MCC-30SEC									
TPI+15MIN					VERIFY LM BURN COMPLETE	F 16 85	+XXXX.X +XXXX.X +XXXX.X		LM MCC1
TPI+16MIN			18	P41 P76	UPDATE LM S.V. IN THE CMC PRO PRO	F 06 33 F 06 84	+00XXX. +000XX. +0XX.XX +XXXX.X +XXXX.X +XXXX.X		IF THE LM CANNOT APPLY THE MCC1 BURN, SEE SECTION 4.2.2

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
TPI+18MIN			19	P76	<u>INITIATE P35 AND RNDZ NAVIGATION</u>				IF THE CSM IS ACTIVE AND TPF DELTA V > 55 FPS, SEE SECTION 4.2.3
				P35	PRO	F 16 45	+09B09 +03BXX -00001		
					<u>START SEXTANT MARKING</u>			122	
					OPTICS MODE-MAN OHC-CENTER LM IN SXT TAKE ONE SXT MARK PER MIN			122	
TPI+27MIN			20	P35	<u>COMPUTE MCC2 SOLUTION AND TERMINATE NAV</u>				
					PRO	F 06 81	+XXXX.X +XXXX.X +XXXX.X		
					OPTICS SPEED-HI OHC-DRIVE TRUNNION TO LESS THAN 10 DEG OPTICS ZERO-ZERO OPTICS SPEED-LO OPTICS MODE-CMC			122	
					RECORD DATA			122	
				P35	PRO	F 16 45	+09B09 -02BXX +XXX.XX		

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
TPI+28MIN			21	P35	<u>BACKUP LM MCC2 BURN</u> PRO	F 50 18	+XXX.XX +XXX.XX +XXX.XX		
				P41	ENTER	06 85	+XXXX.X +XXXX.X +XXXX.X		
MCC-35SEC MCC-30SEC					MONITOR DSKY BLANK	BB BB			AVE G ON
						16 85	+XXXX.X +XXXX.X +XXXX.X		
TPI+30MIN					VERIFY LM BURN COMPLETE	F 16 85	+XXXX.X +XXXX.X +XXXX.X		LM MCC2
TPI+31MIN			22	P41	<u>UPDATE LM S.V. IN THE CMC</u> PRO	F 06 33	+00XXX. +000XX. +0XX.XX		IF THE LM CANNOT APPLY THE MCC2 BURN, SEE SECTION 4.2.2.
				P76	PRO	F 06 84	+XXXX.X +XXXX.X +XXXX.X		
TPI+32MIN			23	P76	<u>MANEUVER TO COAS TRACK ATTITUDE</u> PRO	F 50 18	+XXX.XX +XXX.XX +XXX.XX		
				P79					

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
				P00	V37E 00E	BB BB			
					V49E	F 06 22	+XXX.XX +XXX.XX +XXX.XX		
					PRO	F 50 18	+XXX.XX +XXX.XX +XXX.XX		
					PRO	06 18	+XXX.XX +XXX.XX +XXX.XX		
					MONITOR MANEUVER	F 50 18	+XXX.XX +XXX.XX +XXX.XX		
					ENTER	BB BB			
					V83E	F 16 54	+XXX.XX -XXXX.X +XXX.XX		
TPI+35MIN			24	P00	PERFORM DOCKING PREPARATION ACTIVITIES				
					PERFORM PRE-DOCK CHECKLIST			1	
					MANUAL ATTITUDE(3)-RATE CMD(VERIFY)			1	
					LIMIT CYCLE-OFF(VERIFY)			1	
					ATT DEADBAND-MIN			1	
					RATE-LOW(VERIFY)			1	

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
					TRANS CONTR PWR-ON ROT CONTR PWR DIRECT(BOTH)-MNA/MNB SC CONT-CMC(VERIFY) AUTO RCS SELECT(16)-MNA/MNB CB DOCK PROBE(2)-CLOSE DOCKING PROBE RETRACT(BOTH)-OFF(CTR) (VERIFY) DOCKING PROBE-RETRACT DOCKING PROBE EXTD/REL TB (2) - GRAY (VERIFY) CB SEQ EVENTS CONT SYS(4)-CLOSE COAS POWER-ON(UP)(VERIFY) EXTERIOR LIGHTS RUN/EVA-ON(UP)(VERIFY)			1 1 1 8 8 2 2 2 8 15 2	IF CSM ACTIVE BRAKING, SEE SECTION 4.2.4.
TPI+40MIN					PHOTOGRAPH LM UTILITY POWER-ON(UP)(VERIFY) TV-ON DAC-ON BEGIN PHOTOS WITH DAC AND TV			15	
TPI+42MIN					CONFIGURE SWITCHES FOR POST TPF EMS MODE-STBY EMS FUNCTION-OFF EXTERIOR LIGHTS RNDZ-OFF(CTR) <u>TERMINATE LM PHOTOS</u> PRO DAC-OFF TV-OFF	BB BB		1 1 2	TPF

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
TPI+49MIN			25	P00	<u>MANEUVER FOR CSM INSPECTION</u> V49E V25E +XXXXXE +XXXXXE +XXXXXE PRO PRO MONITOR MANEUVER ENTER	F 06 22 F 06 22 F 50 18 06 18 F 50 18 BB BB	+XXX.XX +XXX.XX +XXX.XX +XXX.XX +XXX.XX +XXX.XX +XXX.XX +XXX.XX +XXX.XX +XXX.XX +XXX.XX +XXX.XX		LOAD DESIRED ATTITUDE
TPI+60MIN			26	P00	<u>MANEUVER TO DOCKING ATTITUDE</u> V49E V25E +XXXXXE +XXXXXE +XXXXXE	F 06 22 F 06 22	+XXX.XX +XXX.XX +XXX.XX +XXX.XX +XXX.XX +XXX.XX		LOAD DOCKING ATTITUDE

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
TPI+64MIN					PRO	F 50 18	+XXX.XX +XXX.XX +XXX.XX		STDN GO FOR PYRO ARM
					PRO	06 18	+XXX.XX +XXX.XX +XXX.XX		
					MONITOR MANEUVER	F 50 18	+XXX.XX +XXX.XX +XXX.XX		
					ENTER	BB BB			
					REACQUIRE STDN HGA				
			27	P00	ARM PYROS				
					CUESTDN FOR LOGIC ARM			8	
					SEQ EVENTS CONT SYSTEM LOGIC(BOTH)- ON(UP)			8	
					SEQ EVENTS CONT SYSTEM PYRO ARM(BOTH)- ON(UP)				
			28	P00	PERFORM DOCKING ACTIVITIES				
				P47	V37E 47E	F 16 83	+0000.0 +0000.0 +0000.0		
					INITIATE LM PHOTOGRAPHY				
					DAC-ON				
					TV-ON				
					PHOTOGRAPH LM MNVR				

[illegible]

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
DOCK+2MIN					COAS POWER-OFF AUTO RCS SELECT ROLL(4)-OFF TRANS CONTR PWR-OFF ROT CONTR PWR DIRECT(BOTH)-OFF VHF RANGING-OFF <u>TERMINATE LM PHOTOGRAPHY AND P47</u> DAC-OFF TV-OFF			15 8 1 1 3	
				PRO		F 37 BB			
				OOE		BB BB			
				P00					
			29	P00	<u>RECONFIGURE DAP</u> V48E	F 04 46	11102 X1111		
					V21E 61111E	F 04 46	61111 X1111		
				PRO		F 06 47	+XXXXX. +XXXXX.		
				PRO		F 06 48	+XXX.XX <u>+XXX.XX</u>		
				PRO		BB BB			
DOCK+3MIN			30	P00	<u>CONFIGURE SWITCHES FOR POST-DOCKING</u> CMC MODE-AUTO RNDZ XPNDR-OFF			1 100	

4.0 CMP SUPPLEMENTARY PROCEDURES

The supplemental CMP procedures are non-nominal procedures for backing up a LM active plane change burn, performing a CSM active burn, or obtaining a LM insertion state vector uplink. The format used for the procedures is identical to the format used for the abort detailed procedures (Section 3.3).

4.1 PLANE CHANGE BURNS

During a coelliptic rendezvous, the LM is scheduled to apply a plane change burn 30 minutes prior to the CDH maneuver if the required PC DV is greater than five feet per second. The CMC MINKEY logic schedules either an RCS or an SPS burn to enable the CMP to backup the maneuver. The PC is not applied if it is less than five feet per second. In this event the CMP bypasses the MINKEY PC burn sequence by loading N81 with zeros.

4.1.1 RCS PLANE CHANGE

If the CMC computed CSM PC DV is less than seven feet per second, the MINKEY logic will specify that the CMP backup the LM PC with P41. To apply the burn the CMP would use the following procedures to burn the P41 N85 values to zero.

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
PC-35SEC PC-30SEC PC TIG					***** RCS PLANE CHANGE *****				
				P36		F 06 81	+0000.0 +000X.X +0000.0		
					PRO	F 16 45	+XXBXX -XXBXX +XXX.XX		
				P52	PRO	F 06 22	+XXX.XX +XXX.XX +XXX.XX		
					PRO	F 50 25	00020		
				P41	ENTER	F 50 18	+XXX.XX +XXX.XX +XXX.XX		BYPASS IMU TORQUE
					ENTER	06 85	+XXXX.X +XXXX.X +XXXX.X		BYPASS MNVR
					MONITOR DSKY BLANK	BB BB			
						16 85	+XXXX.X +XXXX.X +XXXX.X		AVE G ON
						F 16 85	+XXXX.X +XXXX.X +XXXX.X		LM PC
					VERIFY LM BURN COMPLETE				

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
				P36	<u>UPDATE LM S.V. IN CMC</u>				
				P76	PRO	F 06 33	+00XXX. +000XX. +0XX.XX		
					PRO	F 06 84	+0000.0 <u>+000X.X</u> +0000.0		
					PRO ***** CONTINUE WITH STEP 5 OF THE COMMON COELLIPTIC SEQUENCE, SECTION 3.3.3 *****				

4.1.2 SPS PLANE CHANGE

If the CMC computed CSM PC DV is equal to or greater than seven feet per second, the MINKEY logic will provide the option to torque the platform so that the PC burn can be made with the SPS engine. The following procedures for the PC include torquing the platform, backing up the burn, and torquing the platform back to its original orientation.

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
					***** SPS PLANE CHANGE *****				
				P36		F 06 81	+0000.0 +XXXX.X +0000.0		
				PRO		F 16 45	+XXBXX -XXBXX +XXX.XX		
				P52		F 06 22	+XXX.XX +XXX.XX +XXX.XX		
					ALIGN GDC ATT SET TW-SET TO ROLL-90 OR 270 DEG PITCH- 0 OR 180 DEG YAW- 0 DEG			1 1 1 1 1 1 1	
					FDAI SELECT-1 FDAI SOURCE-ATT SET(VERIFY) ATT SET-GDC(VERIFY) GDC ALIGN PB-PUSH UNTIL NEEDLES NULLED FDAI SELECT-1/2				
				CMC MODE-FREE PRO		F 50 25	00020	1	
				PRO		F 16 20	+XXX.XX +XXX.XX +XXX.XX		TORQUE PLATFORM
					MONITOR PLATFORM TORQUING				

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
				P40	CMC MODE-AUTO PRO	F 50 18	+XXX.XX +XXX.XX +XXX.XX	1	
					MONITOR MANEUVER	06 18	+XXX.XX +XXX.XX +XXX.XX		
					RECORD P76 DATA	F 50 18	+XXX.XX +XXX.XX +XXX.XX		OBTAIN TPI P76 FROM CDR
					CONFIGURE EMS				
					EMS MODE-STBY			1	
					EMS FUNCTION-OFF			1	
					EMS FUNCTION-DV SET/VHF RNG			1	
					LOAD DV MINUS 11 FPS INTO EMS			1	
					EMS FUNCTION-DV			1	
					CONFIGURE SCS				
					CB STAB CONT SYS(ALL)-CLOSE			8	
					CB SPS(12)-CLOSE			8	
					MANUAL ATTITUDE(3)-RATE CMD(VERIFY)			1	
					RATE-LOW(VERIFY)			1	
					DV CG-CSM(VERIFY)			1	
					SPS HE VLVS(BOTH)-AUTO(VERIFY)			3	
					CHECK N2 A AND N2 B			3	

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-H DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
					<u>TVC PREPARATION</u> SCS TVC(BOTH)-RATE CMD(VERIFY) TVC GIMBAL DRIVE(BOTH)-AUTO(VERIFY) MAIN BUS TIE(2)-ON TVC SERVO POWER 1-AC1/MNA TVC SERVO POWER 2-AC2/MNB ROT CONTR PWR NORMAL 2-AC ROT CONTR PWR DIRECT 2-OFF(VERIFY) ATT DEADBAND-MIN BMAG MODE(3)-ATT 1/RATE 2 SC CONT-SCS RHC 2-ARMED <u>PRIMARY TVC CHECK</u> SPS GIMBAL MOTORS PITCH 1-START/ON YAW 1-START/ON VERIFY TRIM CONTROL AND SET VERIFY MTVC SC CONT-CMC THC-CLOCKWISE VERIFY NO MTVC <u>SECONDARY TVC CHECK:</u> SPS GIMBAL MOTORS PITCH 2-START/ON YAW 2-START/ON SET GPI TRIM VERIFY MTVC THC-NEUTRAL VERIFY NO MTVC VERIFY GPI RETURNS TO 0,0 ROT CONTR PWR NORMAL(BOTH)-AC/DC ROT CONTR PWR DIRECT(BOTH)-MNA/MNB BMAG MODE(3)-RATE 2			1 1 5 7 7 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
PC-01MIN					PRO	06 18	+XXX.XX +XXX.XX +XXX.XX		
					MONITOR TRIM MANEUVER	F 50 18	+XXX.XX +XXX.XX +XXX.XX		
					BMAG MODE(3)-ATT 1/RATE 2 ENTER	F 50 25	00204	1	
					PRO				
					MONITOR GPI RESPONSE:	BB BB 06 40	-XXBXX +XXXX.X +0000.0		
					FDAI SCALE-5/1(VERIFY)			1	
					VERIFY DET SET			1	
					RATE-HIGH			1	
					EMS MODE-NORMAL			1	
					TRANS CONTR PWR-ON THC-ARMED			1	
PC-35SEC PC-30SEC					MONITOR DSKY BLANK	BB BB 06 40	-00B29 +XXXX.X +XXXX.X		AVE G ON
					CHECK PIPA BIAS LESS THAN 2 FPS FOR 5 SEC				

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
PC-05SEC						F 99 40	-00B05 +XXXX.X +0000.0		ENGINE ON ENABLE REQUEST
PC TIG					CONFIRM LM BURN COMPLETE				LM PC
					ENTER	F 16 85	+XXXX.X +XXXX.X +XXXX.X		
					SPS GIMBAL MOTORS(4)-OFF SEQUENTIALLY			1	
					TVC SERVO POWER(BOTH)-OFF			7	
					RHC 2-LOCKED				
					THC-LOCKED				
					TRANS CONTR PWR-OFF			1	
					ROT CONTR PWR DIRECT(BOTH)-OFF			1	
					CB DIRECT ULLAGE(BOTH)-OPEN			8	
					CB SPS PITCH 1 AND YAW 1-OPEN			8	
					RECORD DV COUNTER AND RESIDUALS				
					EMS FUNCTION-OFF			1	
					EMS MODE-STBY			1	
				P40	UPDATE LM S.V. IN THE CMC				
				P76	PRO	F 06 33	+00XXX. +000XX. +0XX.XX		
					ATT DEADBAND-MAX			1	
					RATE-LOW			1	
					BMAG MODE(3)-RATE 2			1	
					MAIN BUS TIE(2)-OFF			5	

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
					PRO	F 06 84	+XXX.XX +XXX.XX +XXX.XX		
					RHC-MANUALLY MANEUVER BACK TO ORIGINAL GDC ATTITUDE(IF REQUIRED)				
				P20	PRO	F 50 18	+XXX.XX +XXX.XX +XXX.XX		
					PRO	06 18	+XXX.XX +XXX.XX +XXX.XX		
				P52	MONITOR MANEUVER	F 06 22	+XXX.XX +XXX.XX +XXX.XX		
					PRO				

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
					CMC MODE-FREE PRO MONITOR PLATFORM TORQUING CMC MODE-AUTO RECONFIGURE EMS FOR RANGING EMS FUNCTION-DV SET/VHF RNG EMS MODE-BACKUP/VHF RNG VHF RNG-RESET * * * * * CONTINUE WITH STEP 5 OF THE COMMON COELLIPTIC SEQUENCE, SECTION 3.3.3 * * * * *	F 50 25 F 16 20	00020 +XXX.XX +XXX.XX +XXX.XX	1 1 1 1 9	TORQUE PLATFORM

4.2 CSM ACTIVE BURNS

The CSM active burn procedures used by the CMP to perform TPI, MCC, and braking are presented. In all cases it is assumed that the LM has lost all translation capability and did not perform any part of the burn.

4.2.1 TPI BURN

The following procedures for performing the TPI burn involve recalling P40, applying the CMC computed TPI burn and re-entering the MINKEY sequencer by calling P35.

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
					* * * * *				
					TPI BURN				
					* * * * *				
				P40	RECALL SPS THRUSTING PROGRAM				
					V37E 40E				
				P40		F 50 18	+XXX.XX +XXX.XX +XXX.XX		
					<u>TVC PREPARATION</u>				
					SCS TVC(BOTH)-RATE CMD(VERIFY)			1	
					TVC GIMBAL DRIVE(BOTH)-AUTO(VERIFY)			1	
					MAIN BUS TIE(2)-ON			5	
					TVC SERVO POWER 1-AC1/MNA			7	
					TVC SERVO POWER 2-AC2/MNB			7	
					ROT CONTR PWR NORMAL 2-AC			1	
					ROT CONTR PWR DIRECT 2-CFF(VERIFY)			1	
					ATT DEADBAND-MIN			1	
					BMAG MODE(3)-ATT 1/RATE 2			1	
					SC CONT-SCS			1	
					RHC 2-ARMED				
					<u>PRIMARY TVC CHECK</u>				
					SPS GIMBAL MOTORS PITCH 1-START/ON			1	
					YAW 1-START/ON			1	
					VERIFY TRIM CONTROL AND SET			1	
					VERIFY MTVC				
					SC CONT-CMC			1	
					THC-CLOCKWISE				
					VERIFY NO MTVC				

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
					SECONDARY TVC CHECK				
					SPS GIMBAL MOTORS PITCH 2-START/ON			1	
					YAW 2-START/ON			1	
					SET GPI TRIM			1	
					VERIFY MTV C				
					THC-NEUTRAL				
					VERIFY NO MTV C				
					VERIFY GPI RETURNS TO 0,0				
					ROT CONTR PWR NORMAL(BOTH)-AC/DC			1	
					ROT CONTR PWR DIRECT(BOTH)-MNA/MNB			1	
					B MAG MODE(3)-RATE 2			1	
				PRO		06 18	+XXX.XX +XXX.XX +XXX.XX		
					MONITOR TRIM MANEUVER	F 50 18	+XXX.XX +XXX.XX +XXX.XX		
					B MAG MODE(3)-ATT 1/RATE 2			1	
					FDAI SCALE-5/1(VERIFY)			1	
					VERIFY DET SET			1	
					RATE-HIGH			1	
					EMS MODE-NORMAL			1	
					TRANS CONTR PWR-ON			1	
					DV THRUST A(B)-NORMAL			1	
					THC-ARMED				
				ENTER		F 50 25	00204		
				PRO					
					MONITOR GPI RESPONSE	BB BB			
						06 40	+XXBXX +XXXX.X +0000.0		PROG LT-ON(SLIPPED TIG)
				RESET					PROG LT-OFF

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
TPI-35SEC TPI-30SEC					MONITOR DSKY BLANK	BB BB			AVE G ON
						06 40	-00B29 +XXXX.X +0000.0		
TPI-11SEC TPI-05SEC					CHECK PIPA BIAS LESS THAN 2 FPS FOR 5 SEC				ENGINE ON ENABLE REQUEST
					THC-APPLY ULLAGE				
					PRO	F 99 40	-00B05 +XXXX.X +XXXX.X		
						06 40	-00BXX +XXXX.X +XXXX.X		
					THC-TERMINATE ULLAGE AT TIG+1 SEC MONITOR CSM TPI BURN	F 16 40	+00BXX +XXXX.X +XXXX.X		
TPI TIG					DV THRUST A(B)-OFF PRO	F 16 85	+XXXX.X +XXXX.X +XXXX.X	1	

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
TPI+03MIN					SPS GIMBAL MOTORS(4)-OFF SEQUENTIALLY TVG SERVO POWER(BOTH)-OFF THC-NULL RESIDUALS	F 16 85	+ XXXX.X + XXXX.X + XXXX.X	1 7	
					THC-LOCKED RHC 2-LOCKED TRANS CONTR PWR-OFF ROT CONTR PWR DIRECT(BOTH)-OFF CB DIRECT ULLAGE(BOTH)-OPEN CB SPS PITCH 1 AND YAW 1-OPEN RECORD DV COUNTER AND RESIDUALS EMS FUNCTION-OFF EMS MODE-STBY			1 1 8 8	
					PRO	F 37 BB		1 1	
					P40 INITIATE P35 AND RNDZ NAVIGATION 35E	F 50 25	00017	1 1 1 5	
					P20 P35 ATT DEADBAND-MAX RATE-LOW BMAG MODE(3)-RATE 2 MAIN BUS TIE(2)-OFF				
					PRO	F 16 45	+XXBXX +03BXX -00001		

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
					CONFIGURE EMS FOR RANGING EMS FUNCTION-DV SET/VHF RNG EMS MODE-BACKUP/VHF RNG VHF RNG-RESET START SEXTANT MARKING OPTICS ZERO-OFF OPTICS MODE-MAN OHC-CENTER LM IN SXT TAKE ONE SXT MARK PER MIN ***** FOR DIRECT ASCENT RENDEZVOUS, CONTINUE WITH STEP 23 OF SECTION 2.3. FOR AN ABORT, CONTINUE WITH STEP 16 OF SECTION 3.3.3. *****			1 1 9 122 122 122	

4.2.2 MCC BURN

If the LM attempts to apply the MCC burn but fails, the CMP would use the following procedures to burn the P41 N85 values to zero.

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
MCC TIG					* * * * * MCC BURN * * * * *				
				P41	<u>VERIFY NO LM BURN</u> THC-ARMED RHC 2-ARMED TRANS CONTR PWR-ON	F 16 85	+XXXX.X +XXXX.X +XXXX.X	1	
					THC-NUL V G'S	F 16 85	+0000.0 +0000.0 +0000.0		
					THC-LOCKED RHC 2-LOCKED TRANS CONTR PWR-OFF			1	
MCC+02MIN				P41	<u>UPDATE LM S.V. IN THE CMC</u> PRO	F 06 33	+00XXX. +000XX. +0XX.XX		
				P76	PRO	F 06 84	+0000.0 +0000.0 +0000.0		
					* * * * * FOR A DIRECT ASCENT RENDEZVOUS CONTINUE WITH STEP 26(30) OF SECTION 2.3. FOR AN ABORT, CONTINUE WITH STEP 19(23) OF SECTION 3.3.3. * * * * *				

4.2.3 PRE-BRAKING SPS BURN

If the CSM is the active vehicle and an excessive TPF DV exists (Register 3 of N58 greater than 55 feet per second), the CMP should use the following procedures to perform a pre-braking burn. The burn procedures are initiated by recalling P34 after MCC-1. The burn is scheduled for TPI+37 minutes and a transfer angle equal to one-half the TPF DV in N58 is loaded into N55. The burn re-establishes the nominal closing rate at the desired range.

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
TPI+18MIN					* * * * * PRE-BRAKING SPS BURN * * * * * COMPUTE TPI(2)TIG=TPI TIG+37 MIN COMPUTE TRANSFER ANG=(TPF DELTA V)/2				
				P76	INITIATE P34 AND RNDZ NAVIGATION				
					V93E				
				P20	V37E 34E				
				P34		F 50 25	00017		
					PRO	F 06 37	+00XXX. +000XX. +0XX.XX		
					V25E +XXXE +XXE +XXXXE	F 06 37	+00XXX. +000XX. +0XX.XX		LOAD COMPUTED TPI(2)TIG
					PRO	F 06 55	+00000 +000.00 +130.00		
					V23E +XXXXXE	F 06 55	+00000 +000.00 +XXX.XX		LOAD COMPUTED TRANSFER ANGLE
					PRO	F 16 45	+XXBXX -17BXX -00001		

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-H DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
TIG-10MIN				P34	START SEXTANT MARKING OPTICS ZERO-OFF OPTICS MODE-MAN OHC-CENTER LM IN SXT TAKE ONE SXT MARK PER MIN			122 122 122	
				P34	COMPUTE P34 SOLUTION AND TERMINATE NAV OPTICS SPEED-HI OHC-DRIVE TRUNNION TO LESS THAN 10 DEG OPTICS ZERO-ZERO OPTICS SPEED-LOW OPTICS MODE-CMC			122 122 122 122 122	
				PRO		F 06 55	+00000 +XXX.XX +XXX.XX		
				RECORD DATA PRO		F 06 58	+XXXX.X +XXXX.X +XXXX.X		
				RECORD DATA PRO		F 06 81	+XXXX.X +XXXX.X +XXXX.X		
				RECORD DATA PRO		F 16 45	+XXBXX -08BXX +XXX.XX		

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
TIG-08MIN				P34	RECONFIGURE DAP V48E	F 04 46	11102 X1111		
					V21E 11103E	F 04 46	11103 X1111		
					PRO	F 06 47	+XXXXX. +05900.		
					PRO	F 06 48	+XXX.XX <u>+XXX.XX</u>		
					PRO	F 16 45	+XXBXX -07BXX +XXX.XX		
TIG-07MIN				P34	INITIATE P40 THRUSTING PROGRAM				
				P40	PRO	F 50 18	+XXX.XX +XXX.XX +XXX.XX		
					PRO	06 18	+XXX.XX +XXX.XX +XXX.XX		
					MONITOR MANEUVER	F 50 18	+XXX.XX +XXX.XX +XXX.XX		

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
TIG-05MIN					CONFIGURE EMS EMS MODE-STBY EMS FUNCTION-OFF EMS FUNCTION-DV SET/VHF RNG LOAD DV MINUS 11 FPS INTO EMS EMS FUNCTION-DV CONFIGURE SCS CB STAB CONT SYS(ALL)-CLOSE CB SPS(12)-CLOSE MANUAL ATTITUDE(3)-RATE CMD(VERIFY) RATE-LOW(VERIFY) DV CG-CSM(VERIFY) SPS HE VLVS(BOTH)-AUTO(VERIFY) CHECK N2 A AND N2 B TVC PREPARATION SCS TVC(BOTH)-RATE CMD(VERIFY) TVC GIMBAL DRIVE(BOTH)-AUTO(VERIFY) MAIN BUS TIE(2)-ON TVC SERVO POWER 1-AC1/MNA TVC SERVO POWER 2-AC2/MNB ROT CONTR PWR NORMAL 2-AC ROT CONTR PWR DIRECT 2-OFF(VERIFY) ATT DEADBAND-MIN BMAG MODE(3)-ATT 1/RATE 2 SC CONT-SCS RHC 2-ARMED			1 1 1 1 1 8 8 1 1 1 1 3 3 1 1 5 7 7 1 1 1 1 1	

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
					PRIMARY TVC CHECK: SPS GIMBAL MOTORS PITCH 1-START/ON YAW 1-START/ON VERIFY TRIM CONTROL AND SET VERIFY MTVC SC CONT-CMC THC-CLOCKWISE VERIFY NO MTVC			1 1	
					SECONDARY TVC CHECK: SPS GIMBAL MOTORS PITCH 2-START/ON YAW 2-START/ON SET GPI TRIM VERIFY MTVC THC-NEUTRAL VERIFY NO MTVC VERIFY GPI RETURN TO 0,0 ROT CONTR PWR NORMAL(BOTH)-AC/DC DIRECT(BOTH)-MNA/MNB BMAG MODE(3)-RATE 2			1 1 1	
					PRO	06 18	+XXX.XX +XXX.XX +XXX.XX		
					MONITOR TRIM MANEUVER	F 50 18	+XXX.XX +XXX.XX +XXX.XX		
					BMAG MODE(3)-ATT 1/RATE 2			1	

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
TIG-01MIN					ENTER PRO MONITOR GPI RESPONSE: FDAI SCALE-5/1(VERIFY) VERIFY DET SET RATE-HIGH EMS MODE-NORMAL TRANS CONTR PWR-ON DV THRUST A(B)-NORMAL THC-ARMED	F 50 25 BB BB 06 40	00204 -XXBXX +XXXX.X +0000.0	1 1 1 1 1 1	
TIG-35SEC TIG-30SEC					MONITOR DSKY BLANK CHECK PIPA BIAS LESS THAN 2 FPS FOR 5 SEC	BB BB 06 40	-00B29 +XXXX.X +0000.0		AVE G ON
TIG-11SEC TIG-05SEC					THC-APPLY ULLAGE PRO	F 99 40 06 40	-00B05 +XXXX.X +XXXX.X -00BXX +XXXX.X +XXXX.X		ENGINE ON ENABLE REQUEST
TPI(2)TIG					THC-TERMINATE ULLAGE AT TIG +1 SEC MONITOR CSM TPI(2) BURN				

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
TIG+02MIN					DV THRUST A(B)-OFF PRO	F 16 40	+00BXX +XXXX.X +XXXX.X	1	
					SPS GIMBAL MOTORS(4)-OFF SEQUENTIALLY TVC SERVO POWER(BOTH)-OFF THC-NULL RESIDUALS	F 16 85	+XXXX.X +XXXX.X +XXXX.X	1 7	
					RHC 2-LOCKED THC-LOCKED TRANS CONTR PWR-OFF ROT CONTR PWR DIRECT(BOTH)-OFF CB DIRECT ULLAGE(BOTH)-OPEN CB SPS PITCH 1 AND YAW 1-OPEN RECORD DV COUNTER AND RESIDUALS EMS FUNCTION-OFF EMS MODE-STBY	F 16 85	+XXXX.X +XXXX.X +XXXX.X	1 1 8 8 1 1	
				P40 P79	<u>MANEUVER TO COAS TRACK ATTITUDE</u> V37E 79E ATT DEADBAND-MAX RATE-LOW BMAG MODE(3)-RATE 2 MAIN BUS TIE(2)-OFF	F 50 18	+XXX.XX +XXX.XX +XXX.XX	1 1 1 5	

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
				P00	V37E 00E	BB BB			
					V49E	F 06 22	+XXX.XX +XXX.XX +XXX.XX		
					PRO	F 50 18	+XXX.XX +XXX.XX +XXX.XX		
					PRO	06 18	+XXX.XX +XXX.XX +XXX.XX		
					MONITOR MANEUVER	F 50 18	+XXX.XX +XXX.XX +XXX.XX		
					ENTER	BB BB			
					V83E	F 16 54	+XXX.XX -XXXX.X +XXX.XX		
					CONFIGURE EMS FOR RANGING EMS FUNCTION-DV SET/VHF RNG EMS MODE-BACKUP/VHF RNG VHF RNG-RESET			1 1 9	

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
TPI+40MIN				POO	<u>RECONFIGURE DAP</u> PRO V48E V21E 11102E PRO PRO PRO	BB BB F 04 46 F 04 46 F 06 47 F 06 48 BB BB	 11103 X1111 11102 X1111 +XXXX. +05900. +XXX.XX +XXX.XX		
				POO	<u>PERFORM DOCKING PREPARATION ACTIVITIES</u> PERFORM PRE-DOCK CHECKLIST MANUAL ATTITUDE(3)-RATE CMD(VERIFY) LIMIT CYCLE-OFF(VERIFY) ATT DEADBAND-MIN RATE-LOW(VERIFY) TRANS CONTR PWR-ON ROT CONTR PWR DIRECT(BOTH)-MNA/MNB SC CONT-CMC(VERIFY) CMC MODE-AUTO(VERIFY) AUTO RCS SELECT(16)-MNA/MNB(VERIFY) CB DOCK PROBE(2)-CLOSE			1 1 1 1 1 1 1 1 8 8	

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
					DOCKING PROBE RETRACT(BOTH)-OFF(CTR) (VERIFY)			2	
					DOCKING PROBE-RETRACT			2	
					DOCKING PROBE EXTD/REL TB(2)-GRAY (VERIFY)			2	
					CB SEQ EVENTS CONT SYS(4)-CLOSE(VERIFY)			8	
					COAS POWER-ON(UP)(VERIFY)			15	
					EXTERIOR LIGHTS RUN/EVA-ON(UP)(VERIFY)			2	
					PHOTOGRAPH LM				
					UTILITY POWER-ON(UP)(VERIFY)			15	
					TV-ON				
					DAC-ON				
					BEGIN PHOTOS WITH DAC AND TV				
					CONFIGURE SWITCHES FOR POST-TPF				
					EMS MODE-STBY			1	
					EMS FUNCTION-OFF			1	
					EXTERIOR LIGHTS RNDZ-OFF(CTR)			2	
					TERMINATE LM PHOTOS				
					DAC-OFF				
					TV-OFF				
					***** FOR DIRECT ASCENT RENDEZVOUS, CONTINUE WITH STEP 33 OF SECTION 2.3. FOR AN ABORT, CONTINUE WITH STEP 25 OF SECTION 3.3.3. *****				

4.2.4 BRAKING

If the CSM is the active vehicle, the following braking procedures are used by the CMP after MCC-2 to achieve station-keeping.

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
					***** BRAKING ***** P00 INITIATE THRUST MONITOR PROGRAM MONITOR EMS RANGE UNTIL 1.25 NM V37E 47E P47 SM RCS SEC PRPLNT FUEL PRESS(4)-OPEN V83E THC-ARMED RHC 2-ARMED MONITOR EMS RANGE UNTIL 1.11 NM (APPROX) N83E	F 16 83 F 16 54 F 16 83	+0000.0 +0000.0 +0000.0 +001.XX -XXXX.X +XXX.XX +0000.0 +0000.0 +0000.0	2	PERFORM WHEN RANGE = 1.25 NM KEY RELEASE LT-ON

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
					MONITOR F 16 83, R1 THC-THRUST AFT TO REDUCE RDOT TO -30.0 FPS AT 1.00 NM KEY "KEY RELEASE" THC-NULL LINE-OF-SIGHT RATES MONITOR EMS RANGE UNTIL 0.65 NM (APPROX) N83E MONITOR F 16 83, R1 THC-THRUST AFT TO REDUCE RDOT TO -20.0 FPS AT 0.50 NM KEY "KEY RELEASE" THC-NULL LINE-OF-SIGHT RATES MONITOR EMS RANGE UNTIL 0.35 NM (APPROX) N83E MONITOR F 16 83, R1 THC-THRUST AFT TO REDUCE RDOT TO -10.0 FPS AT 0.25 NM	F 16 54 F 16 83 F 16 54 F 16 83	+001.00 -0030.0 +XXX.XX +XXXX.X +XXXX.X +XXXX.X +000.50 -0020.0 +XXX.XX +XXXX.X +XXXX.X +XXXX.X		KEY RELEASE LT-OFF KEY RELEASE LT-ON KEY RELEASE LT-OFF KEY RELEASE LT-ON

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
					KEY "KEY RELEASE" THC-NULL LINE-OF-SIGHT RATES MONITOR EMS RANGE UNTIL .09 NM (APPROX) N83E MONITOR F 16 83, R1 THC-THRUST AFT TO REDUCE RDOT TO -5.0 FPS AT .08 NM KEY "KEY RELEASE" MONITOR LM THRU COAS RHC-CENTER LM IN COAS THC-NULL LINE-OF-SIGHT RATES MONITOR LM GROWTH IN COAS FOR RANGE AND RDOT THC-THRUST AFT TO REDUCE RDOT TO ZERO AT 100 FT(LM DIAMETER APPROX 8.5 DEG) PRO RECORD N83 VALUES	F 16 54 F 16 83 F 16 54 F 16 83	+000.25 -0010.0 +XXX.XX +XXXX.X +XXXX.X +XXXX.X +000.08 -0005.0 +XXX.XX +XXXX.X +XXXX.X +XXXX.X		KEY RELEASE LT-OFF KEY RELEASE LT-ON KEY RELEASE LT-OFF

GET H:M:S	L T N G	S T D N	S T E P	P R O G	OPERATIONS	V-II DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
				P47	<u>MAINTAIN STATION KEEPING</u>				
				P47	<u>PHOTOGRAPH LM</u> UTILITY POWER-ON(UP)(VERIFY) TV-ON DAC-ON BEGIN PHOTOS WITH DAC AND TV			15	
				P47	<u>CONFIGURE SWITCHES FOR POST-TPF</u> EMS MODE-STBY EMS FUNCTION-OFF EXTERIOR LIGHTS RNDZ-OFF(CTR)			1 1 2	
				P47	<u>TERMINATE LM PHOTOS AND P47</u> PRO				
				P00	OOE DAC-OFF TV-OFF ***** FOR DIRECT ASCENT RENDEZVOUS, CONTINUE WITH STEP 33 OF SECTION 2.3. FOR AN ABORT, CONTINUE WITH STEP 25 OF SECTION 3.3.3. *****	F 37 BB BB BB			

5.0 ACRONYMS AND ABBREVIATIONS

AC	Alternating Current
ACCEL	Acceleration
AGS	Abort Guidance System
AIM	Abort Initiation Maneuver
ALT	Altitude
AM	Amplitude Modulation
AMPL	Amplifier
ANG, ANGL	Angle
ANLG	Analog
ANT	Antenna
AOS	Acquisition of Signal
AOT	Alignment Optical Telescope
APPROX	Approximate
APS	Ascent Propulsion System
ATT	Attitude
AUTO	Automatic
AUX	Auxiliary
AVE	Average
B	Blank
BMAG	Body-Mounted Attitude Gyro
BP	Barber Pole
BU	Backup
CALIB	Calibration
CB	Circuit Breaker
CCW	Counterclockwise
CDH	Constant Delta Altitude
CDR	Commander
CG	Center of Gravity
CM	Command Module
CMC	Command Module Computer
CMD	Command
CMP	Command Module Pilot
COAS	Crew Optical Alignment Sight

COMM	Communication
COMP	Computation
CONDR	Conditioner
CONT	Control, Controller
CONTR	Control, Controller
CSI	Concentric Sequence Initiation
CSM	Command and Service Module
CTR	Center
CW	Clockwise
DAC	Data Acquisition Camera
DAP	Digital Autopilot
DC	Direct Current
DEG	Degree
DET	Digital Event Timer
DH	Delta Height
DN	Down
DPS	Descent Propulsion System
DSE	Data Storage Equipment
DSKY	Display and Keyboard
DV	Delta Velocity
E	Enter
ELEC	Electronics
ELEV	Elevation Angle
ELS	Earth Landing Subsystem
EMS	Entry Monitor System
EVA	Extravehicular Activity
EXTD	Extended
F	Flashing Verb-Noun Display
FDAI	Flight Director Attitude Indicator
FPS	Feet Per Second
FWD	Forward
G	Gravitational Acceleration
GDC	Gyro Display Coupler

GET	Ground Elapsed Time
GETI	Ground Elapsed Time of Ignition
GMBL	Gimbal
GND	Ground (Mission Control)
G&N	Guidance and Navigation
GPI	Gimbal Position Indicator
HA	Height of Apolune
HAM	Height Adjust Maneuver
HE	Helium
HGA	High Gain Antenna
HI	High
HORIZ	Horizontal
HP	Height of Perilune
HR	Hours
ICDU	Inertial Coupling Data Unit
IMU	Inertial Measurement Unit
IND	Indicator
INRTL	Inertial
INS	Insertion
LBS	Pounds
LEB	Lower Equipment Bay
LGC	Lunar Module Guidance Computer
LM	Lunar Module
LMP	Lunar Module Pilot
L/O	Lift-off
LO	Low
LOS	Loss of Signal, Line-of-Sight
LT	Light
LTNG	Lighting
LV	Local Vertical, Launch Vehicle
m	Minkey
MAN	Manual
MAX	Maximum

MCC	Midcourse Correction
MCC-H	Mission Control Center-Houston
MDC	Main Display Console
MGA	Middle Gimbal Angle
MIN	Minute, Minimum
MIN IMP	Minimum Impulse
MINKEY	Minimum Keystroke
MNA	Main Bus A
MNB	Main Bus B
MNVR	Maneuver
MSFN	Manned Space Flight Network
MTVC	Manual Thrust Vector Control
N	Noun
NASA	National Aeronautics and Space Administration
NAV	Navigation
NM	Nautical Miles
NO.	Number
NONESS	Nonessential
NORM	Normal
OCDU	Optical Coupling Data Unit
OHC	Optics Hand Controller
OMNI	Omnidirectional Antenna
OPR	Operate
OPT	Optics
ORB	Orbital
ORDEAL	Orbital Rate Drive Earth and Lunar
OSS	Optical Subsystem
P	Program, Pitch
PB	Pushbutton
PC	Plane Change, Chamber Pressure
PCM	Pulse Code Modulation
PDI	Powered Descent Initiation
PGNCS	Primary Guidance, Navigation and Control System

PHOTO	Photography, Photograph
PIPA	Pulse Integrating Pendulous Accelerometer
PL	Postlanding
PRIM	Primary
PRO	Proceed
PROG	Program
PROP, PRPLNT	Propellant
PWR	Power
PYRO	Pyrotechnic
R	Range, Register
RCS	Reaction Control System
RCV	Receive, Receiver
RDOT	Range Rate
REACQ	Reacquire
REFSMMAT	Reference Stable Member Matrix
REL	Release
REQ'D	Required
REV	Revolution
RNDZ	Rendezvous
RHC	Rotational Hand Controller
RNG	Ranging, Range
ROT	Rotation
RR	Rendezvous Radar
RSLV	Resolver
RSS	Root Sum Square
S	Shaft, Seconds
S/C, SC	Spacecraft
SCS	Stabilization and Control System
SEC	Seconds, Secondary
SECS	Sequential Events Control System
SEP	Separation
SEQ	Sequential
SIG	Signal
SIM	Scientific Instrument Module
SM	Service Module
SPS	Service Propulsion System

STA/PANEL	Station/Panel
STBY	Standby
STDN	Spacecraft Tracking and Data Network
S.V.	State Vector
SXT	Sextant
SYS	System
TB	Talkback
TEL	Telescope
TFI	Time from Ignition
TIG	Time of Ignition
THC	Translational Hand Controller
TLM	Telemetry
TPF	Terminal Phase Finalization
TPI	Terminal Phase Initiation
TRNFR	Transfer
TRUN	Trunnion
TV	Television
TVC	Thrust Vector Control
TW	Thumbwheel
V	Verb, Velocity
VG	Velocity to be Gained
VGX	Velocity to be Gained, X-Component
VGY	Velocity to be Gained, Y-Component
VGZ	Velocity to be Gained, Z-Component
VHF	Very High Frequency
VLV	Valve
VX	Velocity; X-Component
VY	Velocity; Y-Component
VZ	Velocity; Z-Component
WRI	W-Matrix Reinitialization
WT	Weight
XPNDR	Transponder
Y	Yaw

6.0 REFERENCES

1. Apollo 17 Flight Plan for 6 December 1972 Launch (Final); dated 23 October 1972.
2. Apollo 17 CSM Rescue Book (Basic); dated 18 September 1972.
3. Apollo 17 CSM G&C Checklist (Basic); dated 30 August 1972.
4. Apollo 16 CSM Rendezvous Procedures, MSC-06723; dated 16 March 1972.
5. Apollo Operations Handbook - Command and Service Module CSM 114 - Volume 2, MSC-04904 (Volume 2); dated 16 June 1972.
6. CSM/LM Spacecraft Operational Trajectory, Volume II; MSC-72-FM-187; dated 31 July 1972.
7. Guidance System Operations Plan for Manned CM Earth Orbital and Lunar Missions Using Program COLOSSUS 3, Section 4, Revision 18; dated July 1972.
8. LM Rendezvous Procedures J2 and J3 Missions (Final, Revision 1); MSC-05183; dated 16 March 1972.
9. Operational LM Abort and Rescue Plan for Apollo 13, Volume II; MSC Internal Note 70-FM-9; dated 30 January 1970.

APPENDIX A

CMP RENDEZVOUS NAVIGATION SCHEDULES

- NOMINAL RENDEZVOUS NAVIGATION SCHEDULE FOR THE DIRECT ASCENT RENDEZVOUS
- CONTINGENCY RENDEZVOUS NAVIGATION SCHEDULES FOR THE DIRECT ASCENT RENDEZVOUS
- NOMINAL RENDEZVOUS NAVIGATION SCHEDULES FOR COELLIPTIC RENDEZVOUS

APPENDIX A

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NOMINAL RENDEZVOUS NAVIGATION SCHEDULE FOR THE DIRECT ASCENT RENDEZVOUS

A STDN uplink is scheduled approximately two hours prior to lift-off and contains the predicted CSM state vector at lift-off and the predicted LM state vector at insertion +5 minutes. A LM state vector uplink will be performed at insertion +9 minutes to update the CMC LM state vector to include LM insertion dispersions.

The W-matrix reinitializations are controlled by the MINKEY logic. The logic reinitializes the W-matrix to 10,000 feet and 10 feet per second prior to the processing of the first mark of the pre-TPI marking period. After TPI the logic will reinitialize the W-matrix to 2,000 feet and two feet per second prior to the processing of the first mark after TPI and MCC-1. Figure A-1 contains the nominal rendezvous navigation schedule.

APPENDIX A

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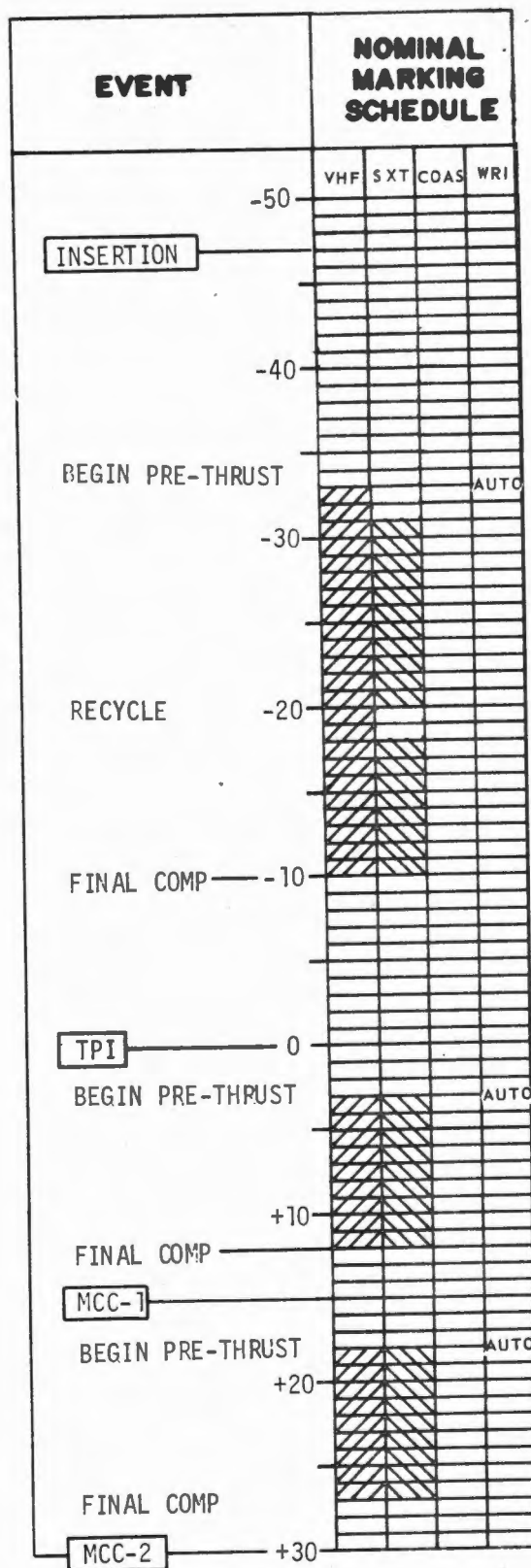


FIGURE A-1. NOMINAL NAVIGATION SCHEDULE FOR THE DIRECT ASCENT RENDEZVOUS

CONTINGENCY RENDEZVOUS NAVIGATION SCHEDULES
FOR
THE DIRECT ASCENT RENDEZVOUS

Contingency navigation procedures are required for sextant, LM tracker light, and VHF failures. A schedule for each failure is contained in Figure A-2.

SEXTANT FAILURE (USABLE). In the event of a frozen but optically usable sextant, the COAS variance is manually loaded into the CMC prior to each marking period. This is done by keying V25 N7E, 76E, 2000E, OE, V21 N1E, 301E, 3777E. The CMP must then maneuver the CSM to center the LM in the frozen sextant. Upon centering the LM the CMP presses the mark button to record the mark. The nominal WRI schedule is followed.

LM TRACKER LIGHT FAILURE. In the event of a tracker light failure, optical marks cannot be taken during periods of darkness. Optics marks are possible after the LM enters daylight immediately after MCC-1. The CMC P35 computation for MCC-2 will yield an acceptable solution if these sextant marks are taken. The WRI prior to MCC-1 is inhibited by keying V57 (R2=1) prior to TPI. A WRI is forced prior to the first mark after MCC-1 by keying V93. (The V57 would normally schedule the WRI after the third mark.)

SEXTANT FAILURE (UNUSABLE). COAS marking is required in the event of an unusable sextant. The procedure for taking COAS marks requires manual X-axis tracking and use of Routine 23 (V54). This routine will:

- A. Load the COAS variance into the CMC.
- B. Allow the CMP to load the shaft and trunnion angles that would result if the optics could be pointed along the X-axis (i.e., shaft = 0.00° and trunnion = 57.470° .)
- C. Provide a COAS marking display.

To take a COAS mark the CMP maneuvers the CSM with the RHC to center the LM in the COAS. Once the LM has been centered, a mark is taken by pressing the ENTER key. The WRI schedule described for the LM tracker light failure is followed.

VHF FAILURE. In the event of a VHF failure, the nominal sextant marking schedule is followed and the LM tracker light failure WRI schedule is followed.

APPENDIX A

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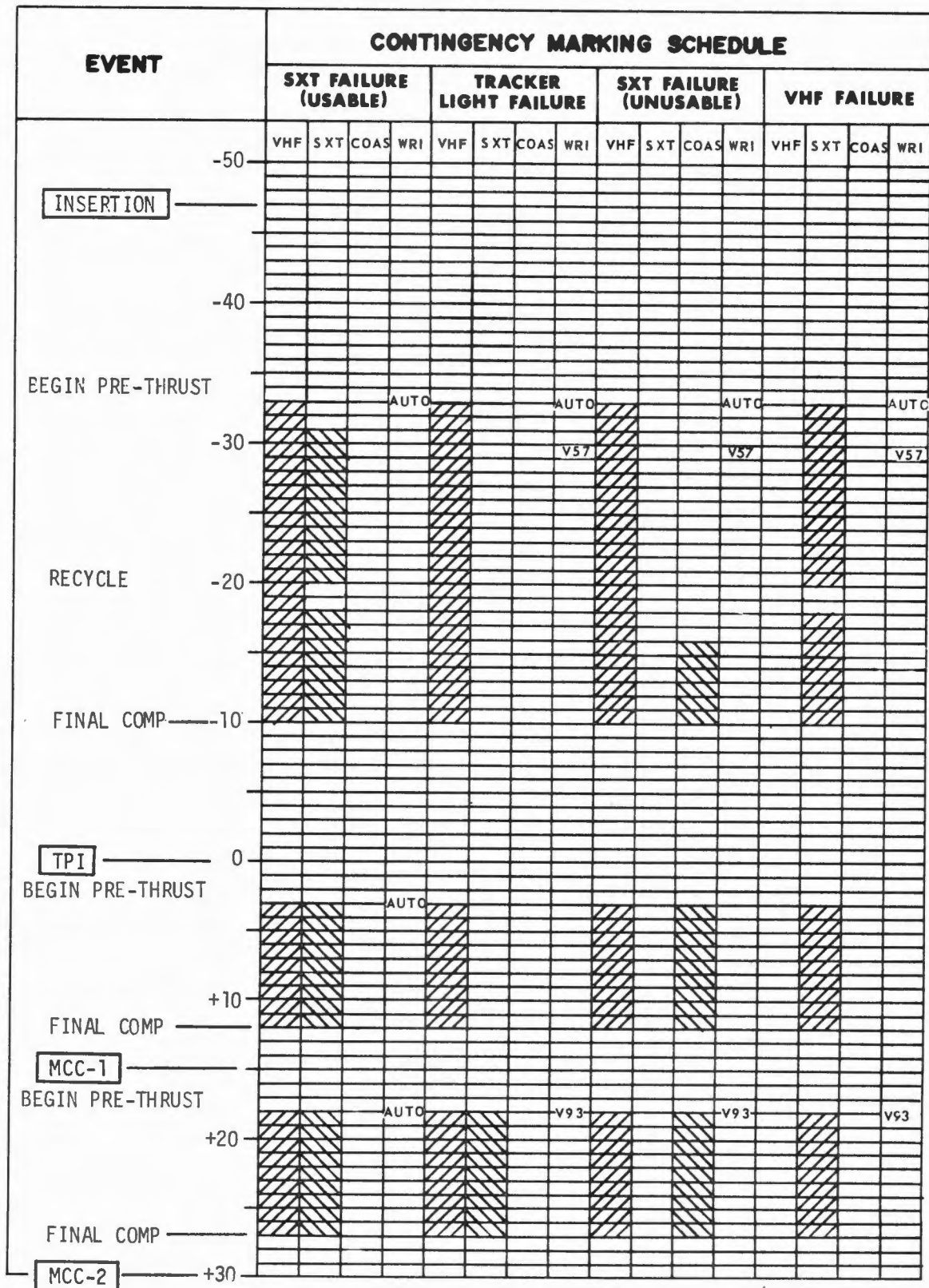


FIGURE A-2. CONTINGENCY NAVIGATION SCHEDULES FOR THE DIRECT ASCENT RENDEZVOUS

NOMINAL RENDEZVOUS NAVIGATION SCHEDULES
FOR
COELLIPTIC RENDEZVOUS

A STDN uplink of the LM state vector will be required for LM aborts after PDI. The uplink is scheduled immediately after LM insertion. In the event of a no-PDI abort, P76 (rather than the STDN uplink) is used to update the state vector. A second uplink prior to the HAM is scheduled for the Two Rev rendezvous because ranges greater than 327 nm will result in loss of CSM navigation. Ranges greater than 327 nm are probable during this period.

The W-matrix is nominally reinitialized by the MINKEY logic. This logic will reinitialize the W-matrix diagonals to 10,000 feet and 10 feet per second until a final comp has been performed; thereafter it will reinitialize to 2,000 feet and two feet per second. The diagonal values should be re-defined to 10,000 feet, 10 feet per second after HAM via V67 so that the first hybrid navigation will occur using the larger diagonals. The navigation schedule for the One Rev rendezvous through TPI is shown in Figure A-3. Figure A-4 contains the Two Rev navigation schedule through TPI. This schedule assumes the full VHF navigation period prior to HAM.

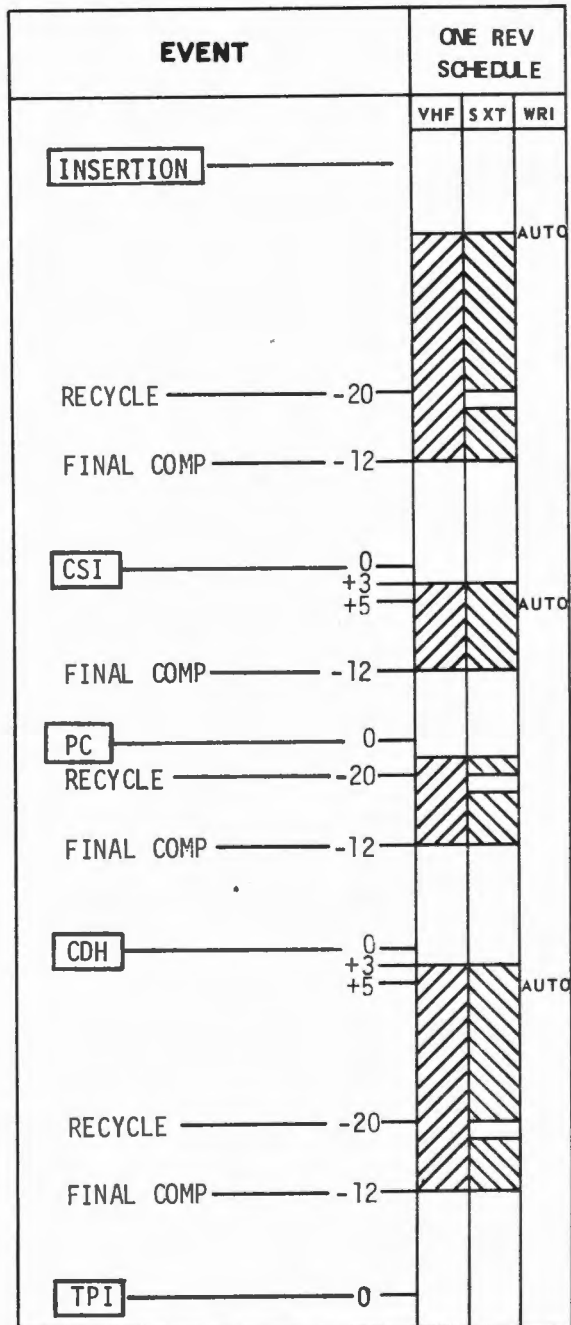


FIGURE A-3. NOMINAL NAVIGATION SCHEDULE FOR THE ONE REV RENDEZVOUS

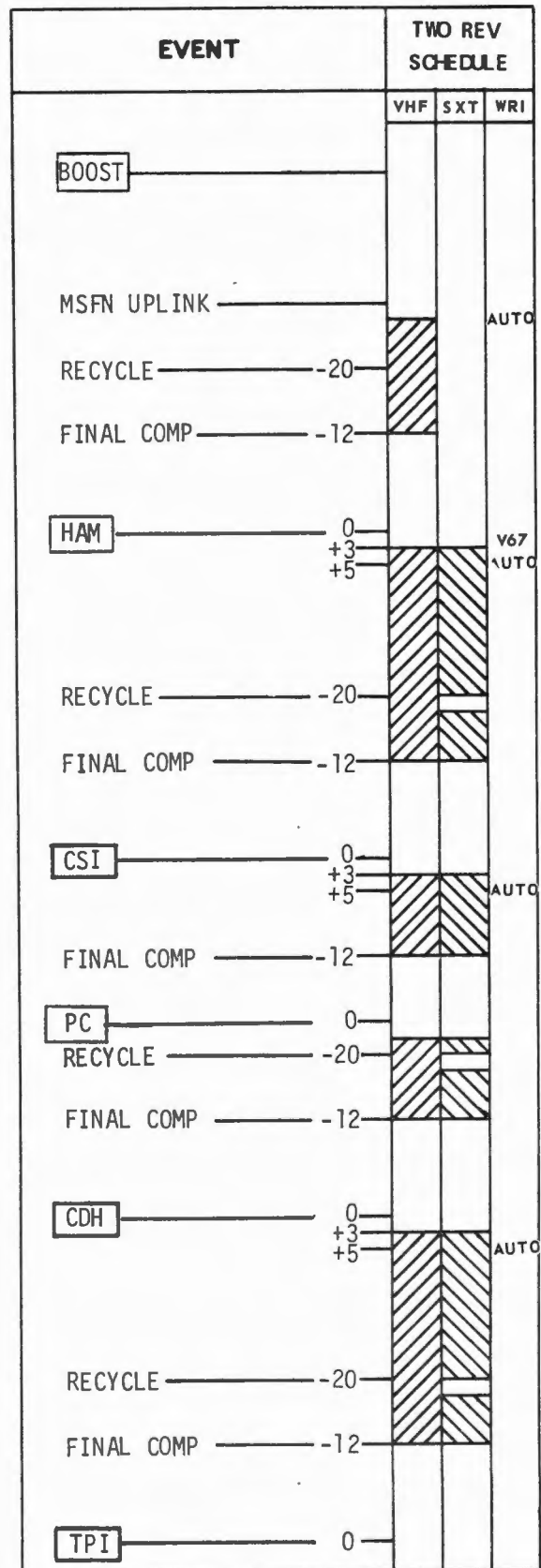


FIGURE A-4. NOMINAL NAVIGATION SCHEDULE FOR THE TWO REV RENDEZVOUS

APPENDIX B

CSM ATTITUDE REQUIREMENTS FOR THE NOMINAL APOLLO 17 RENDEZVOUS

The Apollo 17 CSM G&N rendezvous attitude requirements begin approximately two hours prior to LM lift-off and continue until docking.

The attitude maneuver and the events which impact or are impacted by CSM attitude are presented in Table B-1.

Figures B-1, B-2, and B-3 present the CSM attitude history for REV 50, 51, and 52, respectively.

GET (HR:MIN)	EVENT	INERTIAL ATTITUDE (ROLL,PITCH,YAW)		MANEUVER TIME (MIN:SEC)
		START	STOP	
186:12	MNVR TO COAS CAL ATTITUDE	(XXX,XXX,XXX)	(180,244,341)	X:XX
186:21	STDN UPLINK			
186:28	P52 (OPTION 3)			
186:34	COAS CALIBRATION			
187:42	MNVR TO P20 TRACK ATTITUDE	(180,214,341)	(180,026,000)	5:44
188:19	STDN UPLINK			
188:24	MNVR TO TRACK LM	(180,026,000)	(180,312,000)	23:00
188:49	MNVR TO TPI BURN ATTITUDE	(180,312,000)	(180,279,000)	1:06
188:57	TPI BURN			
189:00	MNVR TO TRACK LM	(180,279,000)	(180,259,000)	9:00
189:12	MCC-1*			
189:15	MNVR TO TRACK LM	(180,259,000)*	(180,246,000)	9:00
189:27	MCC-2*			
189:30	MNVR TO COAS TRACK ATTITUDE	(180,246,000)	(180,282,000)	1:12
189:40	TPF			
189:46	MNVR TO SIM BAY INSPECTION ATT	(180,282,000)	(319,254,000)	4:40
189:55	MNVR TO DOCKING ATTITUDE	(319,254,000)	(180,282,000)	4:40
190:05	DOCKING			

* The maneuver to the X-axis burn attitude is bypassed.

TABLE B-1. APOLLO 17 CSM MANEUVER REQUIREMENTS FOR DIRECT ASCENT RENDEZVOUS

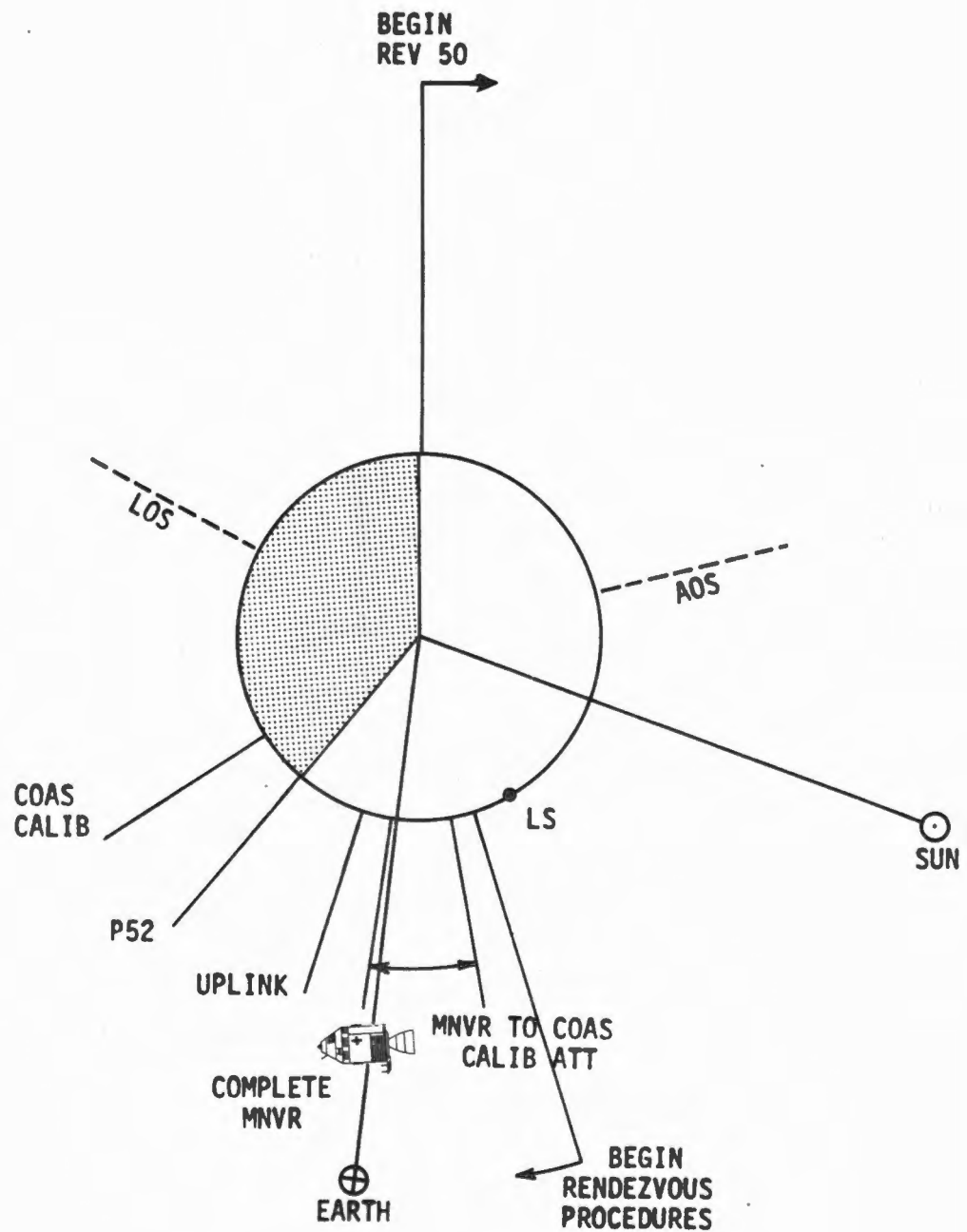


FIG. B-1 CSM ATTITUDE HISTORY FOR REV 50

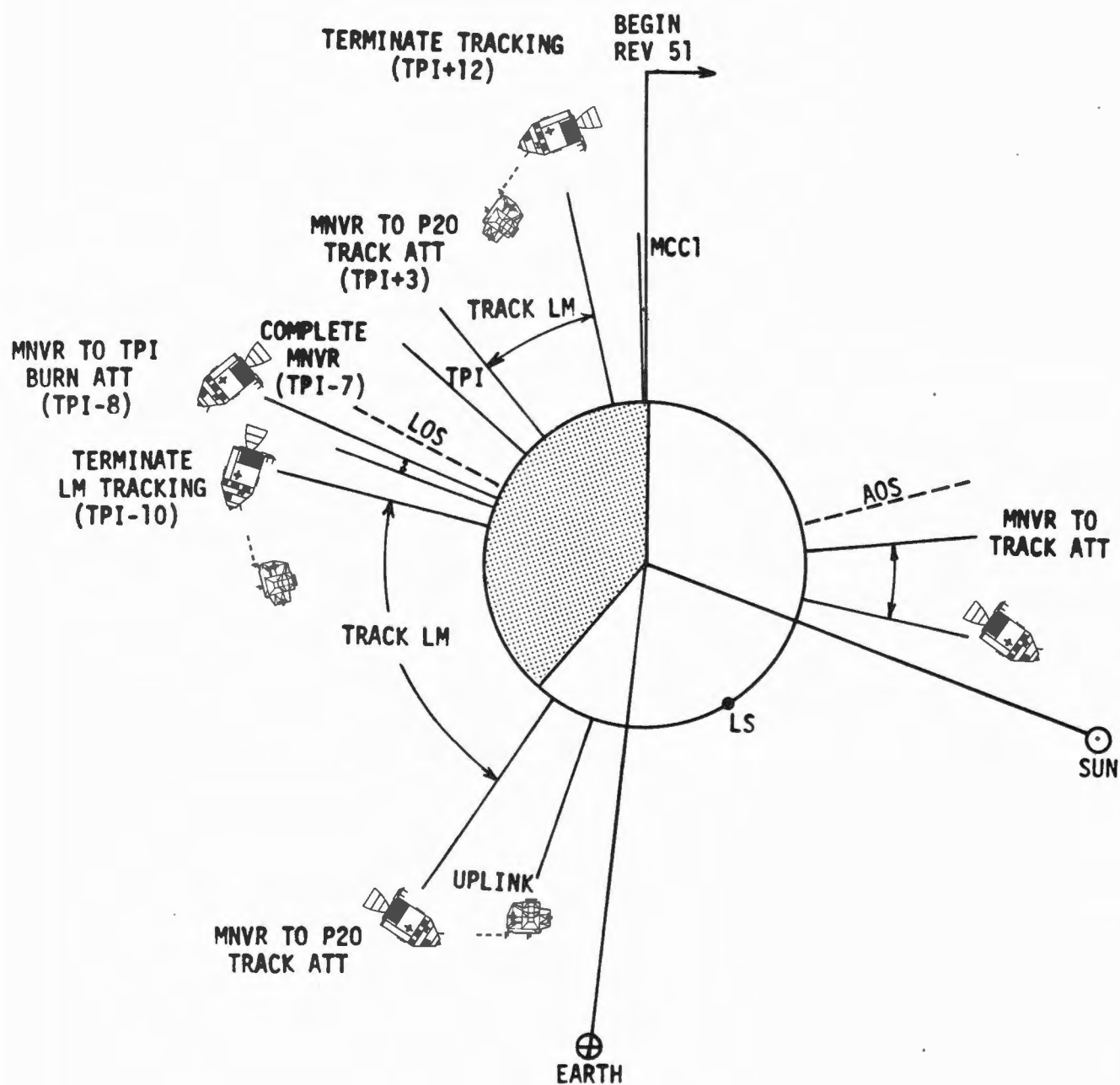


FIG. B-2 CSM ATTITUDE HISTORY FOR REV 51

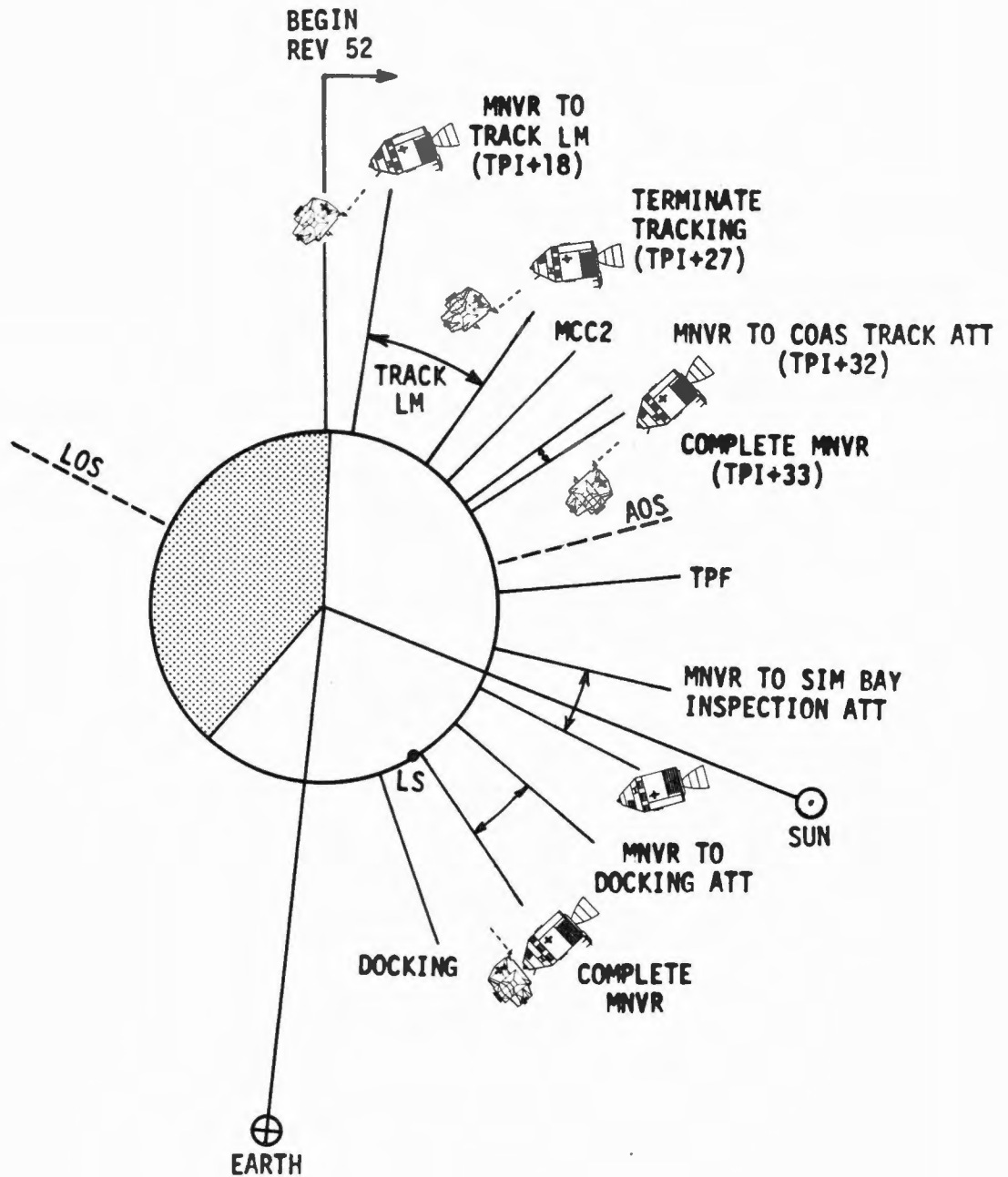


FIG. B-3 CSM ATTITUDE HISTORY FOR REV 52

APPENDIX C

CMP INTERFACE REQUIREMENTS FOR THE NOMINAL APOLLO 17 RENDEZVOUS

During a rendezvous, data must constantly be transferred between STDN, the CSM, and the LM. This appendix documents those data exchanges which concern the CMP during rendezvous.

TIME	STDN	CMP	CDR/LMP
186:18	VERIFY UPLINK TO CMC: LM S.V. FOR INS+5 CSM S.V. FOR L/O RESET SURFACE FLAG UPDATE TO CSM: CONSUMABLES STATUS CSM S.V. FOR L/O LM S.V. FOR INS+5 UPDATE TO LM: ASCENT PADS CSI PAD CSM WEIGHT	ACQUIRE STDN WITH HGA ACCEPT COPY COPY AS REQUIRED	COPY
186:25	DSE DUMP		
186:33	COPY	REPORT P52 GYRO TORQUING ANGLES	
186:52	START DSE ENABLE S-BAND RELAY		
187:00		VERIFY DSE AND S-BAND RELAY OPERATION	
187:39	DSE DUMP	ACQUIRE STDN WITH HGA	
187:56	GO/NO-GO FOR LIFT-OFF	ACKNOWLEDGE	ACKNOWLEDGE

TIME	STDN	CMP	CDR/LMP
TPI-38 MIN	UPLINK LM S.V. TO CMC	ACCEPT	
TPI-34 MIN		CHECK VHF COMM WITH LM	
		REQUEST LM TRACKER LT STATUS	VERIFY LM TRACKER LT ON
TPI-6 MIN	START DSE	VERIFY	
		SUPPLY TPI SOLUTION AT CDR REQUEST	COMPARE TPI SOLUTIONS
		REQUEST TPI P76 PAD FROM CDR	SUPPLY P76 PAD TO CMP
TPI-5 MIN	DISABLE S-BAND RELAY	GO VHF COMM	GO VHF COMM
TPI		ACKNOWLEDGE	VERIFY GOOD TPI BURN TO CMP
TPI+13 MIN		SUPPLY MCC-1 SOLUTION AT CDR REQUEST	REQUEST MCC-1 SOLUTION
		REQUEST MCC-1 P76 PAD FROM CDR	
MCC-1		ACKNOWLEDGE	VERIFY GOOD MCC-1 BURN TO CMP

TIME	STDN	CMP	CDR/LMP
TPI-28 MIN		SUPPLY MCC-2 SOLUTION AT CDR REQUEST	REQUEST MCC-2 SOLUTION
		REQUEST MCC-2 P76 PAD FROM CDR	SUPPLY P76 PAD TO CMP
MCC-2		ACKNOWLEDGE	VERIFY GOOD MCC-2 BURN TO CMP
189:57	VERIFY SWITCH POSITION	POSITION SWITCH: SECS LOGIC(BOTH)-ON	
	GO/NO-GO FOR PYRO ARM	ACKNOWLEDGE	
	VERIFY SWITCH POSITION	POSITION SWITCH: SECS PYRO ARM(2)-ON	

APPENDIX D

FLIGHT DATA FILE

NOMINAL RENDEZVOUS PROCEDURES

The Apollo 17 nominal CSM rendezvous procedures are contained in the FLIGHT PLAN for inclusion in the Flight Data File to be carried onboard the spacecraft. This appendix presents the CMP rendezvous procedures as contained in the Apollo 17 FLIGHT PLAN.

CSM FLIGHT PLAN

186:00
(P20)
(0.5°DB)

(11101)
(1111)

3:50 - DAC - ON

4:50 - T2 (LDMK ACQ) OPT MODE - MAN, TAKE MARKS TO SEC APART

6:30 - TCA

7:18 - T3 (LDMK LOSS) DAC - OFF

POO

VHF AM B - OFF (CTR)
MODE - INTERCOM/PTT
RNDZ XPNDR - HTR

:10

(11102)
(1111)

V48 (11102)
(1111)

V49 MNVR TO P52/COAS CAL ATT (186:18)
(180,244,341) HGA P -58, Y 52

:20

UPLINK:
LM S.V. (INS +5)
CSM S.V. (L/O)
RESET SURFACE FLAG

UPDATE:
CONSUMABLES STATUS
CSM S.V. (L/O)
LM S.V. (INS +5)
ASCENT PADS AND CSM WEIGHT (COPY AT 187:15)
FLIGHT PLAN

CMDS:
DSE DUMP

P52 (OPTION 3)
(LIFT-OFF ORIENT)
REPORT: GYRO TORQUING ANGLES

186:30

SIM EXP STATUS
(*0000)
(01000)

P27 UPDATE

CSM										LM									
PURP		CSM (INS+T) V		7	1	V				LM (INS+1) V		7	1	V					
GET		188 : 11 : 32				: :						188 : 11 : 32				: :			
304	01	INDEX		2	1	INDEX				INDEX		2	1	INDEX					
305	02	0	1	5	0	1				0	1	5	0	1					
306	03	0	0	0	0	2				7	7	7	7	5					
307	04	7	7	4	7	7				7	7	5	2	5					
310	05	5	1	3	7	7				7	7	7	3	2					
311	06	7	7	6	3	1				7	7	6	0	4					
312	07	6	5	3	6	1				6	4	4	7	6					
313	10	0	0	0	7	2				0	0	0	5	1					
314	11	1	0	7	2	2				1	4	2	0	4					
315	12	7	2	5	2	3				7	0	2	0	5					
316	13	7	1	7	3	3				4	6	3	3	5					
317	14	1	5	6	6	6				1	4	7	6	3					
320	15	1	5	5	3	2				1	1	6	6	2					
321	16	0	6	5	3	0				0	7	4	1	1					
322	17	1	4	0	2	4				3	2	5	0	0					
323	20	1	0	0	4	7				1	0	0	4	7					
324	21	1	0	1	0	0				1	0	1	0	0					
325	22																		
326	23																		
327	24																		

MISSION	EDITION	DATE	PAGE
APOLLO 17	FINAL (12/6)	10/23/72	3-277

CSM FLIGHT PLAN

186:30
(11102)
(1111)

SIM EXP STATUS
(*0000)
(01000)

CSM G&C CHECKLIST

P52 (COAS CALIB) (PG/7-6)
USE STAR NO. 16 (PROCYON)

P52 IMU REALIGN

N71: _____

N05: _____

N93: _____

X _____

Y _____

Z _____

GET _____

POO
GDC ALIGN

DON PGA WITHOUT HELMET AND GLOVES

COAS CALIB - N92

SHAFT: _____

TRUN: _____

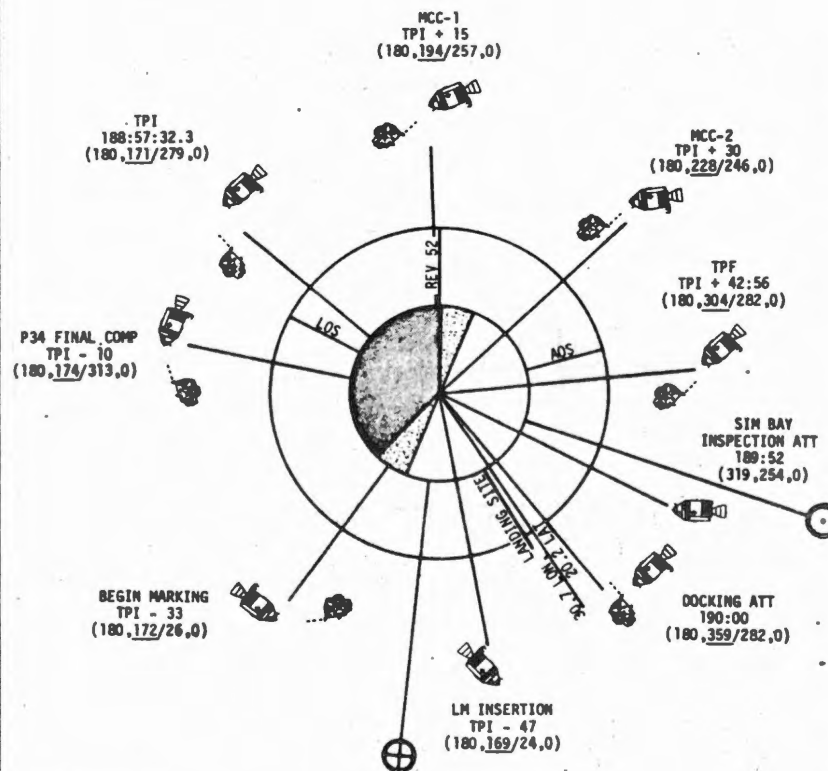
CMDS:
DSE RECORD

STON ENABLES S-BAND RELAY

VERIFY BUSS COVER INSTALLED AND SNAPPED
STOW BUSS IN PGA BAG
INSTALL INTERCONNECTS (TSB)
SUIT FLOW VALVE CMP - FULL FLOW
SUIT FLOW VALVES CDR AND LMP - OFF

VERIFY DSE TAPE MOTION (LBR/RCD/FWD/CMD RESET)
SET HGA MAN P -58 P -58, Y 52 AUTO, NARROW FOR AOS

187:00



(XXX,XXX/XXX,XXX)

YAW
PITCH
ORDEAL
ROLL

APPENDIX D
-3-

MISSION	EDITION	DATE	PAGE
APOLLO 17	FINAL (12/6)	10/23/72	3-279

CSM FLIGHT PLAN

187:00
(11102)
(1111)

SIM EXP STATUS
(*0000)
(01000)

:10

REV 51

EAT PERIOD

:20

187:30

DIRECT ASCENT RNDZ PAD						UPDATE (IF REQ)					
GETI LIFT-OFF	HRS	+	0	0			+	0	0		
	MIN	+	0	0	0		+	0	0	0	
	SEC	+	0				+	0			
GETI	HRS	+	0	0			+	0	0		
TPI	MIN	+	0	0	0		+	0	0	0	
N37	SEC	+	0				+	0			

CSM WT	+					
LM WT	+	0	5	9	3	5

COELLIPTIC RNDZ PAD						UPDATE (IF REQ)					
GETI LIFT-OFF	HRS	+	0	0			+	0	0		
	MIN	+	0	0	0		+	0	0	0	
	SEC	+	0				+	0			
GETI	HRS	+	0	0			+	0	0		
CSI	MIN	+	0	0	0		+	0	0	0	
N11	SEC	+	0				+	0			
GETI	HRS	+	0	0			+	0	0		
TPI	MIN	+	0	0	0		+	0	0	0	
N37	SEC	+	0				+	0			

MISSION	EDITION	DATE	PAGE
APOLLO 17	FINAL (12/6)	10/23/72	3-281

CSM FLIGHT PLAN

187:30
(11102)
(1111)

SIM EXP STATUS
(*0000)
(01000)

EAT PERIOD

ACQ STDN HGA P -58, Y +52 AUTO, NARROW

CMDS:
DSE DUMP

LOAD CSM AND LM WEIGHTS

V49 MNVR TO P20 ATT (187:48)
(180,026,000) OMNI D

CONFIGURE CAMERAS: (DOCKING)
CM2/DAC/18/CEX-BRKT,MIR (T8,1/250,=) 6 fps (40% MAG)
MAG (BB) , MAG %
UTILITY PWR - ON
CM/EL/80/CEX (F8,1/250,FOCUS) 10 FR
MAG (NN) , FR #
CM4/TV-BRKT
(f44,PEAK,=,150MM)

PRESSURIZE CABIN TO 5.5 PSIA

VHF AM T/R - OFF (PNL 9)
VHF AM B - DUPLEX
VHF AM A - OFF (CTR) (VERIFY)
VHF RANGING - ON (UP)
VHF ANT - RIGHT (VERIFY)
EXT LIGHTS RUN/EVA - ON (UP)
EXT LIGHTS RNDZ - RNDZ
RNDZ XPNDR - PWR

* IF VHF VOICE REQ:
* VHF AM T/R-T/R (PNL 9) *

UPDATE:
GO/NO-GO FOR LM LIFT-OFF

GDC ALIGN

EVENT	CONTINGENCY MARKING SCHEDULES															
	SXT FROZEN (USABLE)*				TRACKER LIGHT FAILURE				SXT FAILURE (UNUSABLE)				VHF FAILURE			
	VHF	SXT	COAS	WRI	VHF	SXT	COAS	WRI	VHF	SXT	COAS	WRI	VHF	SXT	COAS	WRI
-50																
INSERTION																
-40																
UPLINK																
P34																
-30																
FINAL COMP																
-20																
FINAL COMP																
-10																
TP1																
P35																
FINAL COMP																
+10																
MCC-1																
P35																
FINAL COMP																
+20																
FINAL COMP																
+30																
MCC-2																

(1) SXT MARKS ARE TAKEN BY MANEUVERING SPACECRAFT
(2) TO USE COAS VARIANCE (MUST BE DONE PRIOR TO EACH MARKING PERIOD)
V25 N7E, 76E, 20000E, 0E, V21 N1E, 301E, 3777E
(IF MARK REJECT BUTTON INADVERTANTLY PUSHED: BEFORE PROCEEDING
ON F51: V21 N1E, 1336E, 31264E)

MISSION	EDITION	DATE	PAGE
APOLLO 17	FINAL (12/6)	10/23/72	3-283

CSM FLIGHT PLAN

198:00
(11102)
(1111)

PRE-SPS BURN SIM PREP (CUE CARD)

SIM EXP STATUS
(*0000)
(01000)

LM LIFT-OFF

188:03:14.6

VHF RNG - RESET

LM INSERTION

188:10:32.3

VHF VOICE CHECK

UPLINK:
LM S.V.

P34 (TRIM) (180,172/26,0)

BEFORE STEADY STATE

PRE-TPI: N49 > (+00200,+00120) REJECT/REPEAT
POST-TPI: N49 > (+00080,+00050) REJECT/REPEAT

AFTER STEADY STATE

ANYTIME: N49 > (+00030,+00020) REJECT/REPEAT

188:13:32.3 (INS +3) TWEAK
188:15:32.3 (INS +5) LM B/O
188:22:32.3 (INS +12) CSM B/O

P30 MANUEVER

N/A SET STARS	C	S	A	B	D	O	PURPOSE
	S	P	S	G	P	I	PROP/GUID
	+			N		A	ET N47
R ALIGN N / A		O	O	N		A	P TRIM N43
P ALIGN N / A		O	O	N		A	Y TRIM
Y ALIGN N / A	+	O	O				HRS GETI
	+	O	O	O			MIN N33
	+	O					SEC
ULLAGE							ΔV_x N81
4 JET, 11 SEC							ΔV_y
							ΔV_z
	X	X	X				R
	X	X	X				P
	X	X	X				Y
ΔVC	+			N		A	H A N44
				N		A	H P

*IF LM BAILOUT REQ:
* COPY P76 DATA FROM LM

*33	:	:	.
*84	.	.	.

*GO TO RESCUE BOOK PG 4

*IF CSM BAILOUT REQ:

*UPDATE:
* CSM BAILOUT P30 PAD
*P30
*P40; SET UP EMS
*SPS BURN CUE CARD
*CSM BAILOUT BURN
*GO TO RESCUE BOOK PG 4

P34 INPUT

37	LM GETI-TPI:	:	.
55	INTEG OPT	ELEVATION	TRANSFER
	+00000	+00000	+130.00

MISSION	EDITION	DATE	PAGE
APOLLO 17	FINAL (12/6)	10/23/72	3-285

CSM FLIGHT PLAN

188:30
(11102)
(1111)

83.29
-328.4

SIM EXP STATUS
(*0000)
(31000)

-20

P34 RECYCLE

:40

STDN

46.66
-167.7

-10

P34 FINAL COMP

COMPARISON LIMITS: VGX=3, VGY=7, VGZ=9
(LM VGX + 1.0, LM VGZ -2.0)
PRIORITIES: LGC, AGS, CMC
VHF/RR COMPARISON LIMIT:
 $\Delta R = T00 + 0.5 (\Delta R \geq 1.0) \text{ NM}$

-8

P40 (27°) (180,152/279,0)

CMDS:
DSE RECORD

COMPARE SOLUTIONS; SPS BURN CUE CARD
VHF AM T/R-T/R (PNL 9)
VERIFY DSE TAPE MOTION (LBR/RCD/FWD/CMD RESET)
SET HGA MAN P -35, Y +37 AUTO, NARROW FOR AOS

STDN DISABLES S-BAND RELAY

-6

TPI

188:57:32.3
LM +75.1,-0.5,+14.1
CSM -76.1,+0.5,-12.1
(180,171/279,0)

0

P76

29.37
-129.0
189:00

P35 (TRIM) (180,176/277,0)

P34 RECYCLE

	INTEG OPT	ELEVATION	TRANSFER
55	+00000		+100.00
58	PERILUNE ALT	TPI ΔV	TPF ΔV
81	TPI ΔV-LV		
84	LM TPI ΔV-LV		

GROUND TPI FOR LM

						ΔV _X
						ΔV _Y
						ΔV _Z

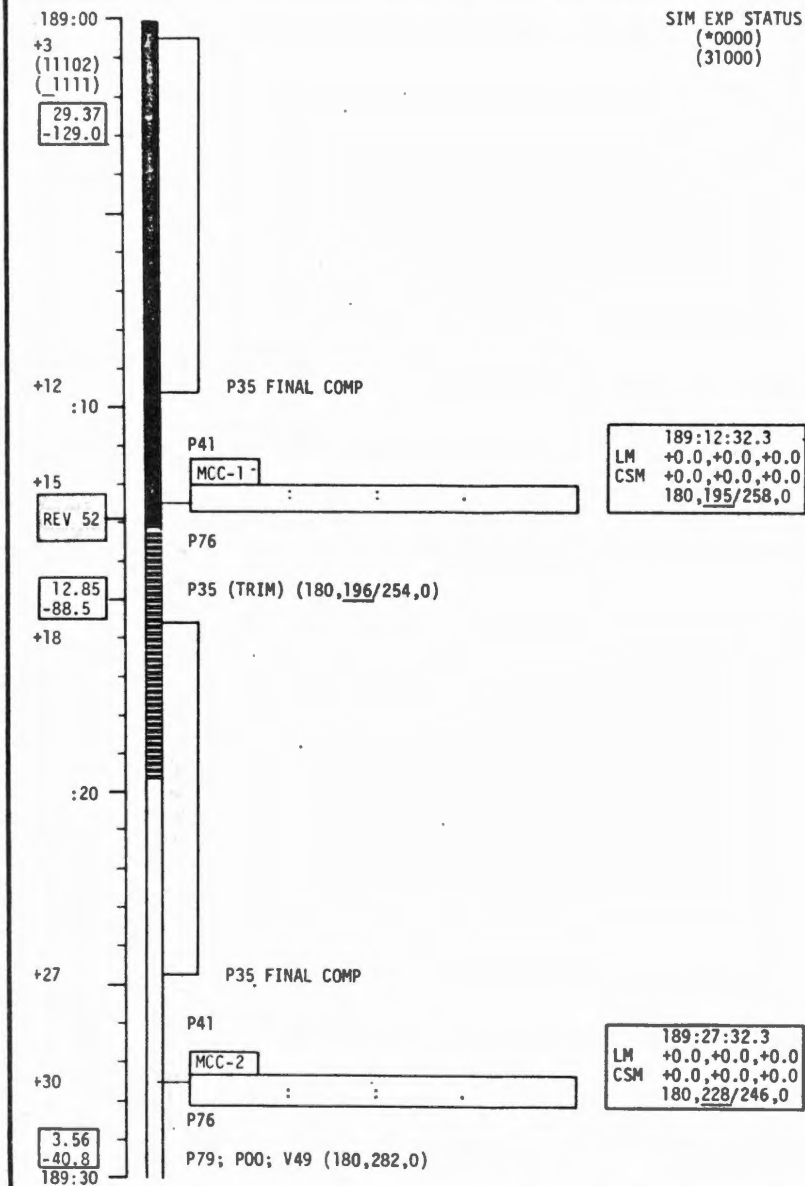
P34 FINAL COMP

	INTEG OPT	ELEVATION	TRANSFER
55	+00000		+130.00
58	PERILUNE ALT	TPI ΔV	TPF ΔV
81	TPI ΔV-LV		
84	LM TPI ΔV-LV		
84	LM TPI ΔV-LV		

P76

MISSION	EDITION	DATE	PAGE
APOLLO 17	FINAL (12/6)	10/23/72	3-287

CSM FLIGHT PLAN



P35 FINAL COMP			
81	MCC1 ΔV-LV		
94	LM MCC1 ΔV-LV		
84	LM MCC1 ΔV-LV		

 * IF CSM ACTIVE & N58 TPF ΔV >55 FPS *
 * GO TO PRE-BRAKING SPS BURN PROCEDURES *
 * (SEE RESCUE BOOK PG 40) *

P35 FINAL COMP			
81	MCC2 ΔV-LV		
84	LM MCC2 ΔV-LV		
84	LM MCC2 ΔV-LV		

MISSION	EDITION	DATE	PAGE
APOLLO 17	FINAL (12/6)	10/23/72	3-289

CSM FLIGHT PLAN

189:30

(11102)
(1111)

3.56
-40.8

PERFORM PRE-DOCK CHECKLIST

IF CSM ACTIVE:
P47 AT R=1.25 NM
SEC PRPLNT FUEL PRESS (4) - OPEN
V83E
N83E
KEY REL

ACQ STDN HGA P -35, Y +37 AUTO, NARROW
UTILITY PWR - ON (VERIFY)
DAC/TV - ON
LM PHOTOS WITH DAC/TV

TPF

EMS MODE - STBY
EMS FUNC - OFF
EXT LIGHT RNDZ - OFF

LM STATION KEEP

DAC/TV - OFF

V49 MNVR TO SIM BAY INSPECTION ATTITUDE (189:52)
(319,254,000) OMNI D

V49 MNVR TO DOCKING ATT (190:00)
(180,282,0) HGA P -35, Y +37

CUE STDN FOR LOGIC ARM
SECS LOGIC (BOTH) - ON (UP)

UPDATE:
GO/NO GO FOR PYRO ARM

SECS PYRO ARM (2) - ON (UP)

SIM EXP STATUS

(*0000)

(31000)

189:40:28.1
LM 31.5 (TOTAL)
CSM 33.6 (TOTAL)
180,304/282,0

PRE-DOCK CHECKLIST

MAN ATT (3)-RATE CMD (VERIFY)
LIMIT CYCLE - OFF (VERIFY)
ATT DB - MIN
RATE - LOW (VERIFY)
TRANS CONTR PWR - ON (UP)
ROT CONTR PWR DIRECT (BOTH) - MNA/MNB
SC CONT - CMC (VERIFY)
AUTO RCS SEL (16) - MNA/MNB
CB DOCK PROBE (2) - CLOSE
PROBE RETRACT (2) - OFF (VERIFY)
PROBE EXTD/REL - RETRACT
PROBE EXTD/REL TB (2) - GRAY (VERIFY)
(IF TB NOT GRAY, GO TO PG S/2-13,E)
CB SECS LOGIC (2) - CLOSE (VERIFY)
CB SECS ARM (2) - CLOSE
EXT LIGHTS RUN/EVA - ON (UP) (VERIFY)
COAS PWR - ON (UP) (VERIFY)

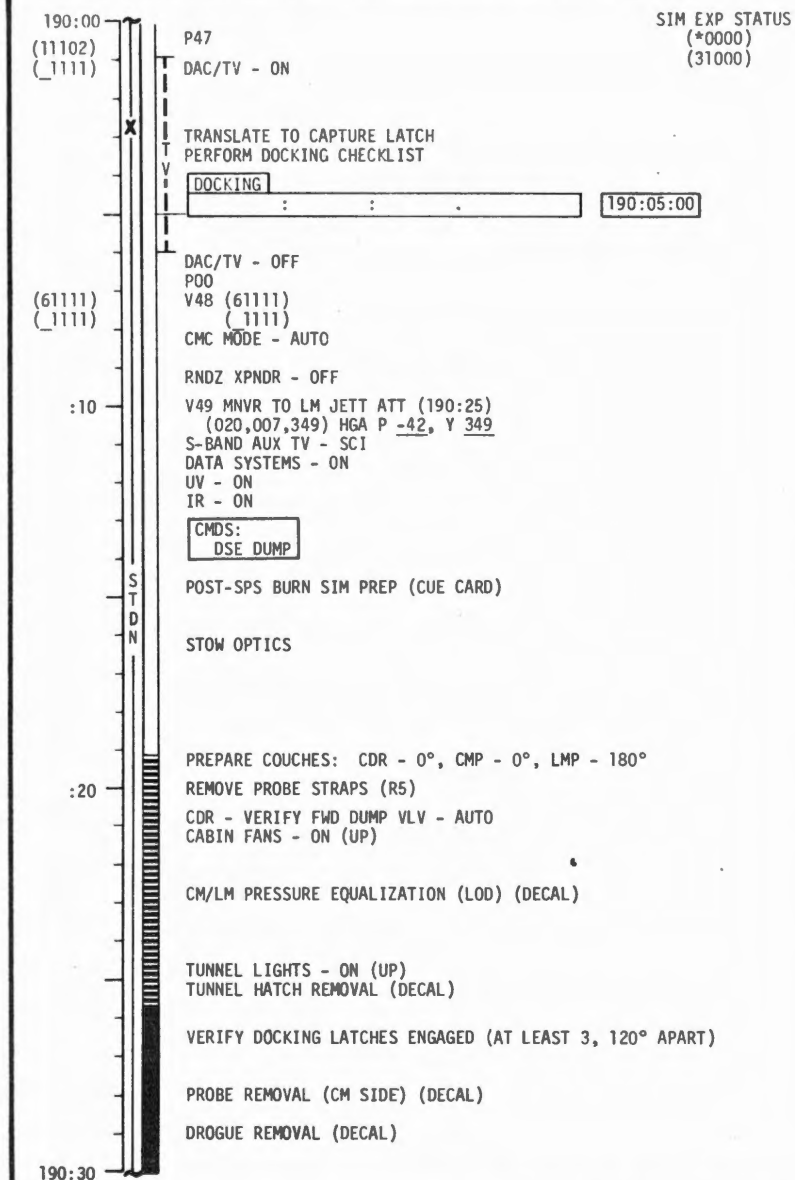
BRAKING GATES

R,NM	R,FPS	RETICLE ANG,DEG	R,FT
1.50	45	.08	9000
1.00	30	.13	6000
.50	20	.26	3000
.25	10	.54	1500
.08	5	1.60	500
.05		2.70	300
.03		4.00	200
.02		8.50	100

190:00

MISSION	EDITION	DATE	PAGE
APOLLO 17	FINAL (12/6)	10/23/72	3-291

CSM FLIGHT PLAN



DOCKING CHECKLIST

AT CAPTURE

PROBE EXTND/REL TB (2) - BP (VERIFY)
(IF TB NOT BP, GO TO PG S/2-11, A)
REPORT CAPTURE TO LM
SC CONT - CMC (VERIFY)
CMC MODE - FREE
ALLOW PROBE TO DAMP SC MOTION (10 SEC)
WHEN WITHIN +3° OF DOCKING ATTITUDE
PROBE RETRACT SEC - 1 (PRIM - 2 IF REQD)

AT DOCK LATCH

PROBE EXTND/REL TB (2) - GRAY

AT HARD DOCK

SECS PYRO ARM (2) - SAFE	EXT LIGHTS (2) - OFF
SECS LOGIC (BOTH) - OFF	COAS PWR - OFF
CB SECS ARM (2) - OPEN	AUTO RCS SEL: ROLL (4) - OFF
CB DOCK PROBE (2) - OPEN	TRANS CONTR PWR - OFF
THC - LOCKED	ROT CONTR PWR DIRECT (BOTH) - OFF
RHC - LOCKED	VHF RANGING - OFF
BMAG MODE (3) - RATE 2 (VERIFY)	
PROBE EXTND/REL - OFF	
PROBE RETRACT (2) - OFF	

MISSION	EDITION	DATE	PAGE
APOLLO 17	FINAL (12/6)	10/23/72	3-293

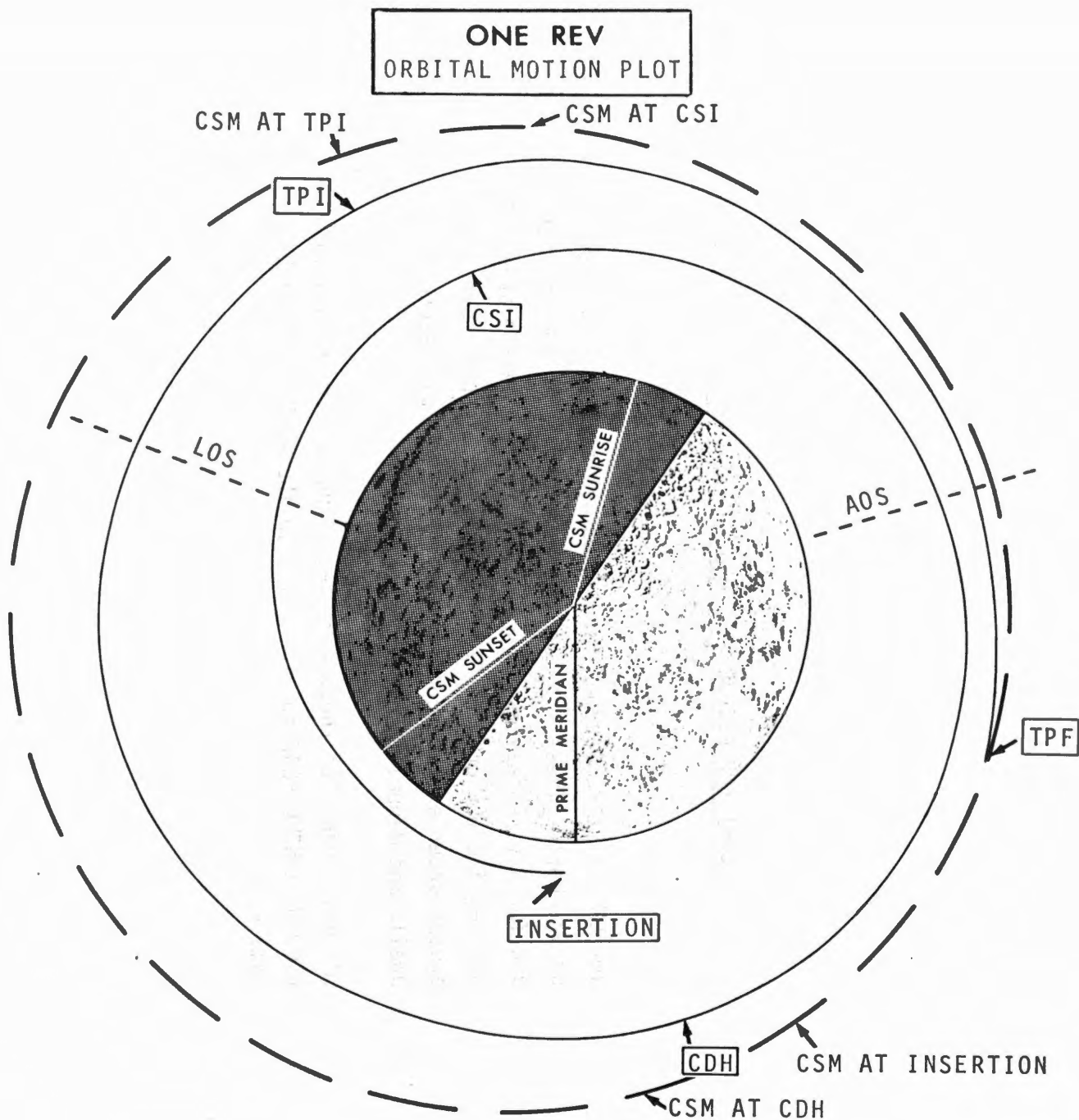
APPENDIX E

FLIGHT DATA FILE

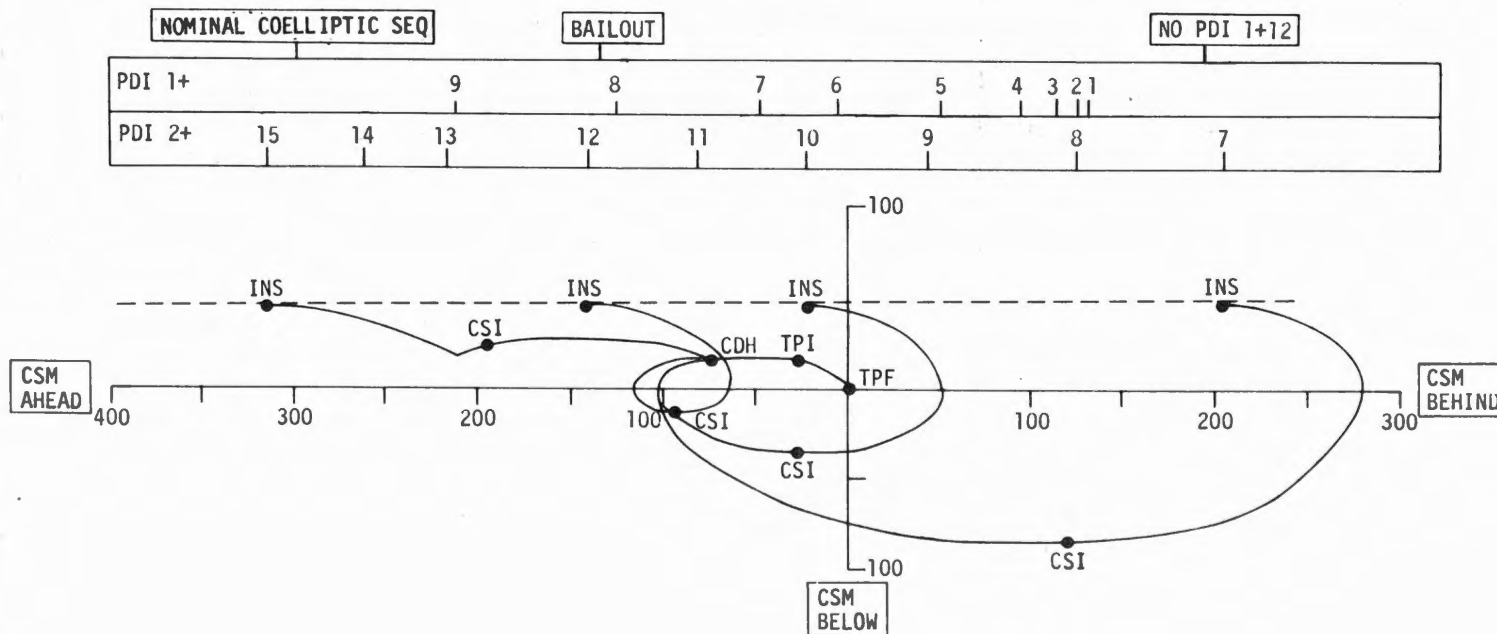
ABORT AND RESCUE RENDEZVOUS PROCEDURES

Two LM active rendezvous techniques are available in case of an abort. These are commonly referred to as the One Rev and Two Rev rendezvous. Three other techniques are available but require one or more CSM SPS burns and will not be used except under extreme conditions. These are the Rescue Two, Dwell, and Manual Insertion rendezvous.

CMP procedures for these five techniques are contained in the CSM RESCUE BOOK for inclusion in the Apollo 17 Flight Data File.



ONE REV RELATIVE MOTION PLOT LM CENTERED



ONE REV BURN TIMES

NO PDI 1+12 ABORT
CSI AT PDI TIME+67 MIN

PDI 1, EARLY ABORT
CSI AT INS +55 MIN

NOMINAL COELLIPTIC SEQUENCE
CSI AT INS +50 MIN

LM BAILOUT
CSI AT INS +55 MIN

PDI 2, LATE ABORT
CSI AT INS +55 MIN

EARLY COELLIPTIC SEQ.
FOR AP'S LEAK
CSI AT INS +60 MIN

CSM BAILOUT
CSI AT INS +55 MIN

ONE REV
REPERCUSSIONS

ONE REV
TIMELINE

POWER DOWN SIM (SEE EXPS/EVA CHECKLIST)
P00; V48 (11102,X1111)

INSERTION OR A.I.M.

MSFN UPLINK: LM S.V.
OBTAIN LM CSI AND TPI GETI'S (COPY)

P32 (SEE INPUT)

BEFORE STEADY STATE
N49>(+00200,+00120):REJECT/REPEAT
AFTER STEADY STATE
N49>(+00030,+00020):REJECT/REPEAT

RECYCLE(COPY)

FINAL COMP(COPY); OBTAIN LM CSI DV(COPY); P40m

CSI BURN

P76m; OBTAIN LM PC GETI(COPY); P36m WITH LM GETI

BEFORE STEADY STATE
N49>(+00080,+00050):REJECT/REPEAT
AFTER STEADY STATE
N49>(+00030,+00020):REJECT/REPEAT

FINAL COMP (COPY) TO BYPASS P52m AND P4Xm, ZERO DVY
OBTAIN LM PC DV (COPY)

P52m; P4Xm

TO BYPASS GYRO TORQUE: ENTER ON F 50 25
TO GYRO TORQUE: SEE P. 38

PLANE CHANGE

P76m
OBTAIN LM CDH GETI(COPY); P33m WITH LM GETI

RECYCLE(COPY)

FINAL COMP(COPY); OBTAIN LM CDH DV(COPY); P40m

CDH BURN

P76m

INSERTION		LM INSERTION TIME		
A.I.M. P76	33	LM A.I.M.GETI	:	:
	84	LM A.I.M.ΔV-LV	.	.

CSI COMPUTATION				
INPUT	11	LM CSI GETI	:	:
	55	N +00001	ELEVATION +208.30	180° OPT +130.00
	37	LM TPI GETI	:	:
RECYCLE	90	Y	Y DOT	LM Y DOT
	81	CSI ΔV-LV	.	+0000.0
	81	Y	Y DOT	LM Y DOT
FINAL COMP	90	Y	Y DOT	LM Y DOT
	81	CSI ΔV-LV	.	+0000.0
	81	Y	Y DOT	LM Y DOT
P76	84	LM CSI ΔV-LV	.	.

PLANE CHANGE COMPUTATION				
INPUT	33	LM PC GETI	:	:
FINAL COMP	90	Y	Y DOT	LM Y DOT
	81	PC ΔV-LV	.	+0000.0
	81	Y	Y DOT	LM Y DOT
P76	84	LM PC ΔV-LV	.	+0000.0

CDH COMPUTATION				
INPUT	13	LM CDH GETI	:	:
RECYCLE	90	Y	Y DOT	LM Y DOT
	81	CDH ΔV-LV	.	.
	81	Y	Y DOT	LM Y DOT
FINAL COMP	90	Y	Y DOT	LM Y DOT
	81	CDH ΔV-LV	.	.
	81	Y	Y DOT	LM Y DOT
P76	84	LM CDH ΔV-LV	.	.

P34m, OVERWRITE N55 R2.

BEFORE STEADY STATE
N49>(+00080,+00050):REJECT/REPEAT
AFTER STEADY STATE
N49>(+00030,+00020):REJECT/REPEAT

RECYCLE(COPY)

OBTAIN LM TPI GETI AND DV(COPY); FINAL
COMP, OVERWRITE N37 WITH LM TPI GETI

P40m

TPI BURN

P76m; P35m

FINAL COMP(COPY); OBTAIN LM MCC1 DV(COPY); P41m

MCC1

P76m; P35m

FINAL COMP(COPY); OBTAIN LM MCC2 DV(COPY); P41m

MCC2

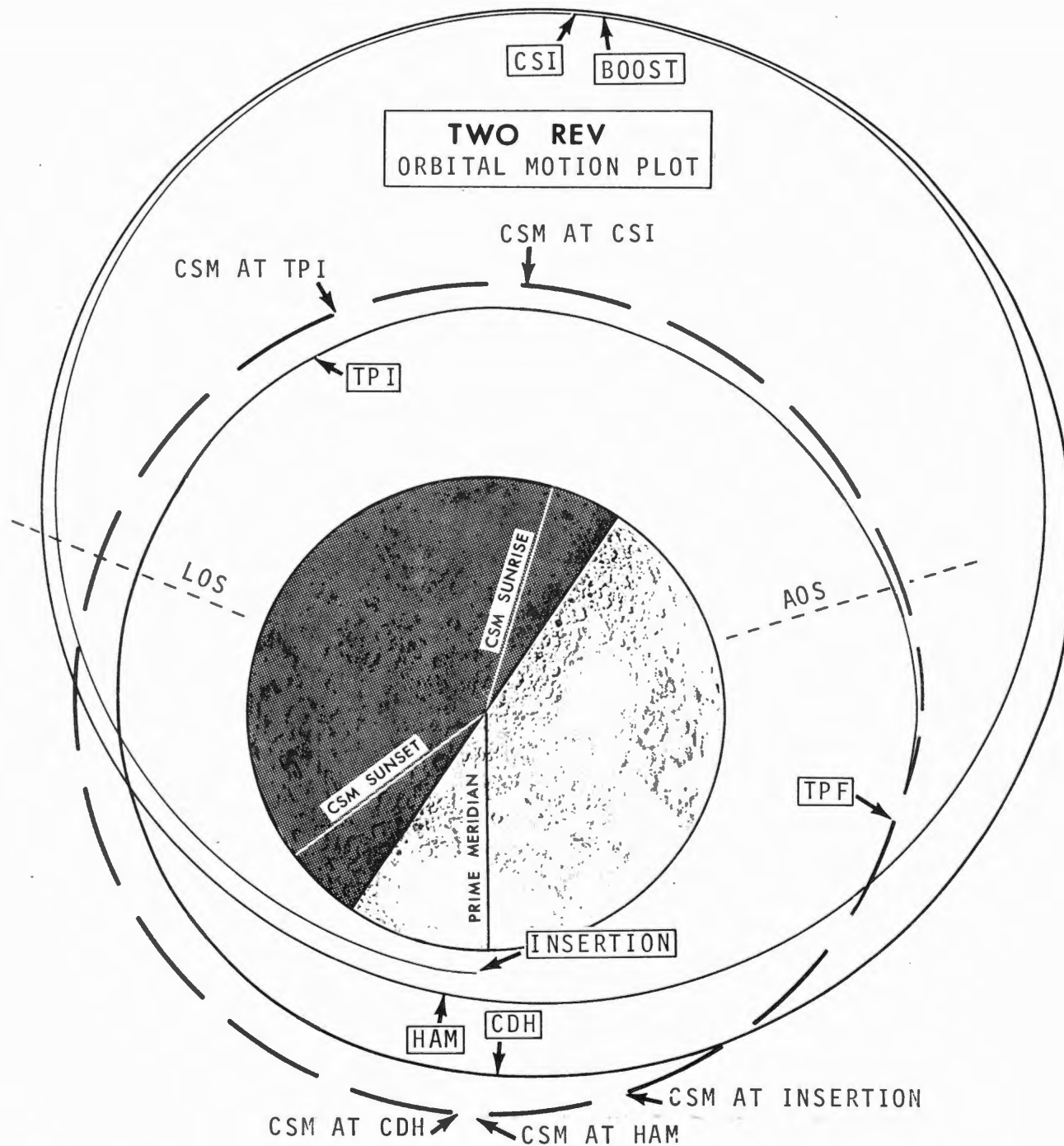
GO TO TPF ACTIVITIES(PAGE 36)

TPF

TPI-ELEVATION OPTION				
INPUT	37	TPI GETI		
	55	INTEG OPT +00000	ELEVATION +208.30	TRANSFER +130.00
RECYCLE	37	TPI GETI		
	58	PROCEED ON DISPLAYED GETI		
	81	PERILUNE ALT	TPI ΔV	TPF ΔV
FINAL COMP	37	LM TPI GETI		
	55	INTEG OPT +00000	ELEVATION .	TRANSFER +130.00
	58	PERILUNE ALT	TPI ΔV	TPF ΔV
	81	TPI ΔV-LV	.	.
P76	33	LM TPI GETI		
	84	LM TPI ΔV-LV	.	.

MCC COMPUTATION				
FIN COMP	81	MCC1 ΔV-LV	.	.
P76	84	LM MCC1 ΔV-LV	.	.

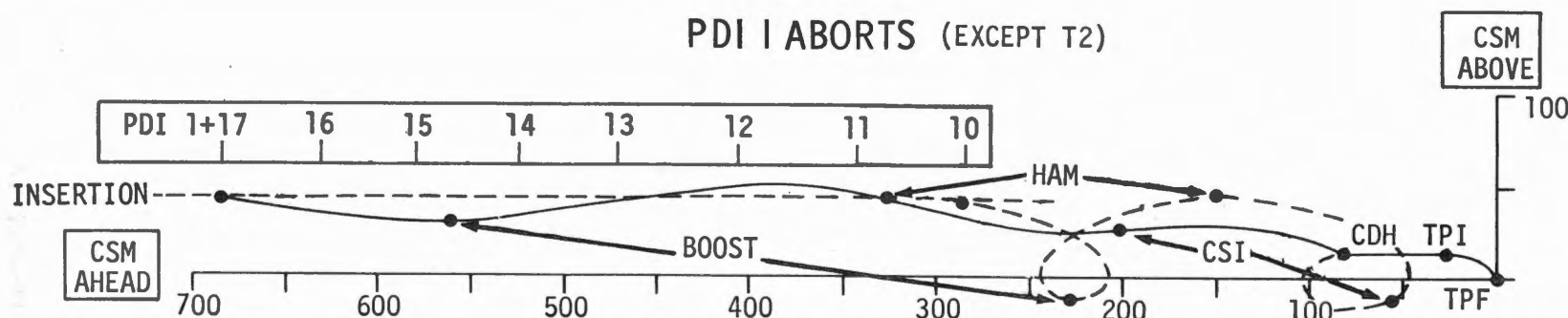
MCC COMPUTATION				
FIN COMP	81	MCC2 ΔV-LV	.	.
P76	84	LM MCC2 ΔV-LV	.	.



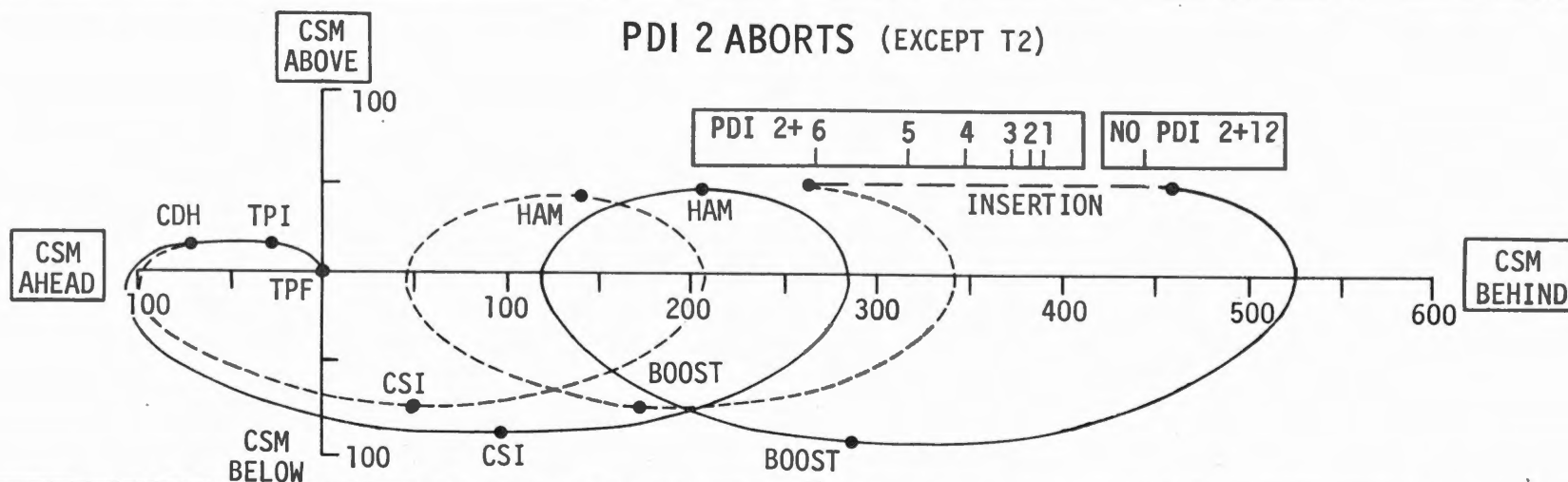
TWO REV RELATIVE MOTION PLOT

LM CENTERED

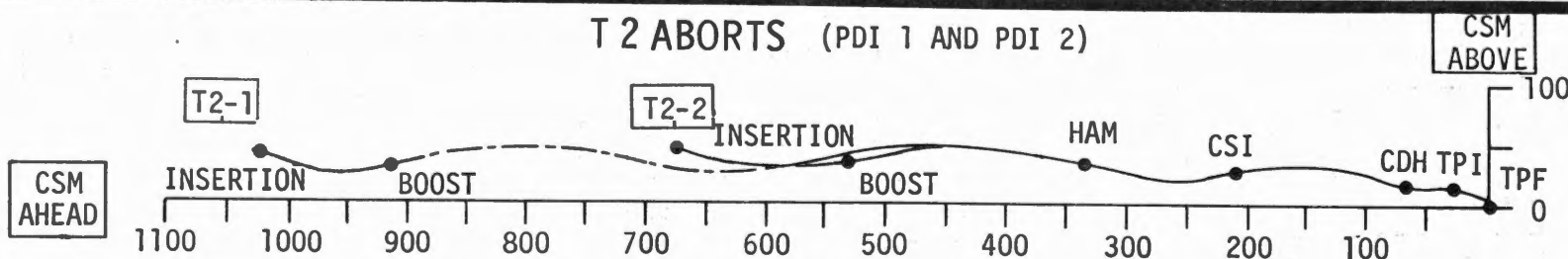
PDI 1 ABORTS (EXCEPT T2)



PDI 2 ABORTS (EXCEPT T2)



T 2 ABORTS (PDI 1 AND PDI 2)



NOTE: (-----) INDICATES THE ADDITIONAL REV NECESSARY TO MODIFY THE TWO REV TECHNIQUE FOR A T2-1 ABORT.

TWO REV

TWO REV BURN TIMES

PDI 1, LATE ABORT

BOOST AT INS + 50 MIN
HAM AT BOOST + 60 MIN
CSI AT HAM + 50 MIN

T2 ABORT, 1ST OPP

BOOST AT INS +50 MIN
HAM AT BOOST +180 MIN
CSI AT HAM + 50 MIN

NO PDI 2+12 ABORT

BOOST AT PDI TIME +72 MIN
HAM AT BOOST +60 MIN
CSI AT HAM +60 MIN

PDI 2, EARLY ABORT

BOOST AT INS +60 MIN
HAM AT BOOST +60 MIN
CSI AT HAM +60 MIN

T2 ABORT, 2ND OPP

BOOST AT INS +50 MIN
HAM AT BOOST +60 MIN
CSI AT HAM +50 MIN

TWO REV TIMELINE

POWER DOWN SIM (SEE EXPS/EVA CHECKLIST)

POO; V48(11102,X1111)

INSERTION OR A. I. M.

MSFN UPLINK: LM S.V.

INSERTION		LM INSERTION TIME		
A.I.M. P76	33	LM AIM GETI	:	:
	84	LM AIM ΔV-LV	:	:
			.	.

LM BOOST P76	33	LM BOOST GETI		
	84	LM BOOST ΔV-LV	:	:
			+0000.0	+0000.0

OBTAIN LM BOOST GETI AND DV(COPY)

LM BOOST

P76

MODIFIED TWO REV RNDZ (FOR T2-1 ABORT ONLY)

LM BOOST (FROM PREVIOUS PAGE)

P76

P52, OPT 3

MSFN UPLINK: CSM S.V.; LM S.V.
OBTAIN LM CSI, TPI AND HAM GETI (COPY BELOW)
P31 WITH LM GETI (SEE INPUT)

FINAL COMP, OVERWRITE DVY (COPY)
OBTAIN LM HAM ΔV (COPY); P41m

HAM

P76m; V67 (+10000, +00100, +00001)

GO TO PAGE 10

MSFN UPLINK: CSM S.V.; LM S.V.
OBTAIN LM CSI, TPI AND HAM GETI (COPY)
P31 WITH LM GETI

IF 15 VHF MARKS CAN NOT
BE TAKEN PRIOR TO FINAL
COMP:
V88

BEFORE STEADY STATE
N49>(+00200, +00120): REJECT/REPEAT
AFTER STEADY STATE
N49>(+00030, +00020): REJECT/REPEAT

RECYCLE (COPY)

FINAL COMP, OVERWRITE DVY (COPY);
OBTAIN LM HAM ΔV (COPY)
P41m

HAM

P76m; V67(+10000, +00100, +00001)

IF NO MARKS HAVE BEEN TAKEN:
V87

HAM COMPUTATION

INPUT	11	LM CSI GETI : : .		
	55	N +00001	ELEVATION 9 +208.30	180° OPT +130.00
	37	LM TPI GETI : : .		
	33	LM HAM GETI : : .		
RECYCLE	90	Y .	Y DOT .	LM Y DOT .
	81	HAM ΔV-LV .	+	0000.0
FINAL COMP	90	Y .	Y DOT .	LM Y DOT .
	81	HAM ΔV-LV .	+0000.0	+0000.0
P76	84	LM HAM ΔV-LV .	+	0000.0

P32m

BEFORE STEADY STATE
N49>(-00200,-00120):REJECT/REPEAT
AFTER STEADY STATE
N49>(-00030,-00020):REJECT/REPEAT

RECYCLE(COPY)

FINAL COMP(COPY); OBTAIN LM CSI DV(COPY); P40m

CSI BURN

P76m; OBTAIN LM PC GETI(COPY); P36m WITH LM GETI

FINAL COMP (COPY) TO BYPASS P52m AND P4Xm, ZERC DVY

OBTAIN LM PC DV(COPY)

P52m;P4Xm

PLANE CHANGE

TO BYPASS GYRO TORQUE: ENTER ON F 50 25
TO GYRO TORQUE: SEE P. 36

P76m

OBTAIN LM CDH GETI(COPY); P33m WITH LM GETI

RECYCLE (COPY)

FINAL COMP (COPY); OBTAIN LM CDH DV (COPY); P40m

CDH BURN

P76m

CSI COMPUTATION

INPUT	11	LM CSI GETI	:	:	:
	55	N +00001	ELEVATION 9	180° OPT	
	37	LM TPT GETI	PROCEED ON DISPLAYED GETI *		
RECYCLE	90	Y	Y DOT	LM Y DOT	
	81	CSI SV-LV			+0000.0
FINAL COMP	90	Y	Y DOT	LM Y DOT	
	81	CSI SV-LV			+0000.0
P76	84	LM CSI SV-LV			

PLANE CHANGE COMPUTATION

INPUT	33	LM PC GETI	:	:	:
FINAL COMP	90	Y	Y DOT	LM Y DOT	
	81	PC SV-LV			+0000.0
P76	84	LM PC SV-LV			+0000.0

CDH COMPUTATION

INPUT	13	LM CDH GETI	:	:	:
RECYCLE	90	Y	Y DOT	LM Y DOT	
	81	CDH SV-LV			
FINAL COMP	90	Y	Y DOT	LM Y DOT	
	81	CDH SV-LV			
P76	84	LM CDH SV-LV			

P34m, OVERWRITE N55 R2

BEFORE STEADY STATE
N49>(+00080,+00050):REJECT/REPEAT
AFTER STEADY STATE
N49>(+00030,+00020):REJECT/REPEAT

S
X
T
/
V
H
F

RECYCLE(COPY)

OBTAIN LM TPI GETI AND DV(COPY); FINAL
COMP, OVERWRITE N37 WITH LM TPI GETI

P40m

TPI BURN

S
/
V

P76m; P35m

FINAL COMP(COPY);OBTAIN LM MCC1 DV(COPY); P41m

MCC1

S
/
V

P76m; P35m

FINAL COMP(COPY); OBTAIN LM MCC2 DV(COPY); P41m

MCC2

GO TO TPF ACTIVITIES(PAGE 36)

TPF

TPI-ELEVATION OPTION

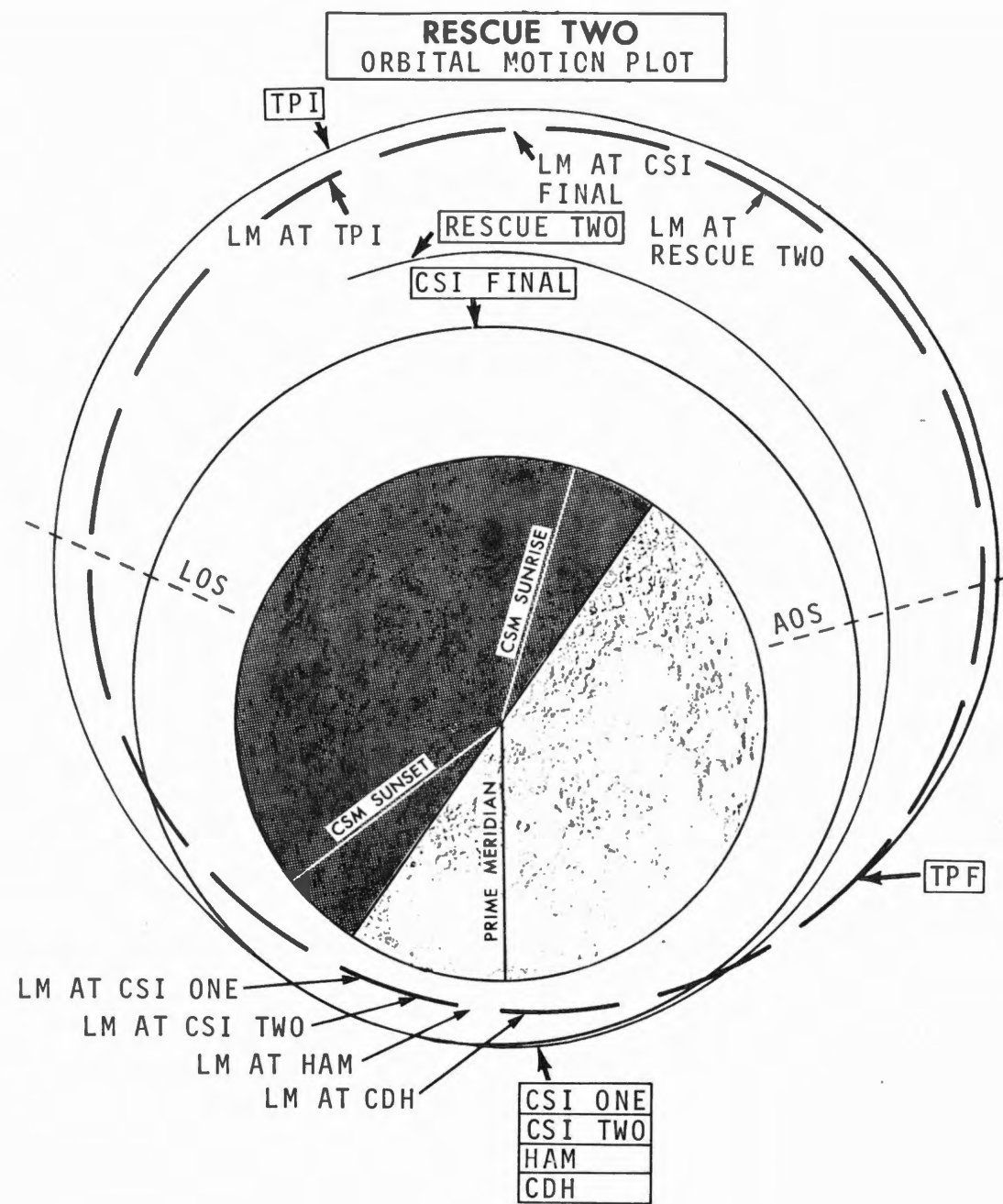
INPUT	37	TPI GETI		
	55	INTEG OPT +00000	ELEVATION +208.30	TRANSFER +130.00
RECYCLE	37	PROCEED ON DISPLAYED GETI		
	58	PERTUNE ALT	TPI ΔV	TPF ΔV
	81	TPI ΔV-LV		
FINAL COMP	37	LM TPI GETI		
	55	INTEG OPT +00000	ELEVATION .	TRANSFER +130.00
	58	PERTUNE ALT	TPI ΔV	TPF ΔV
P76	81	TPI ΔV-LV		
	33	LM TPI GETI		
	84	LM TPI ΔV-LV		

MCC COMPUTATION

FIN COMP	81	MCC1 ΔV-LV		
P76	84	LM MCC1 ΔV-LV		

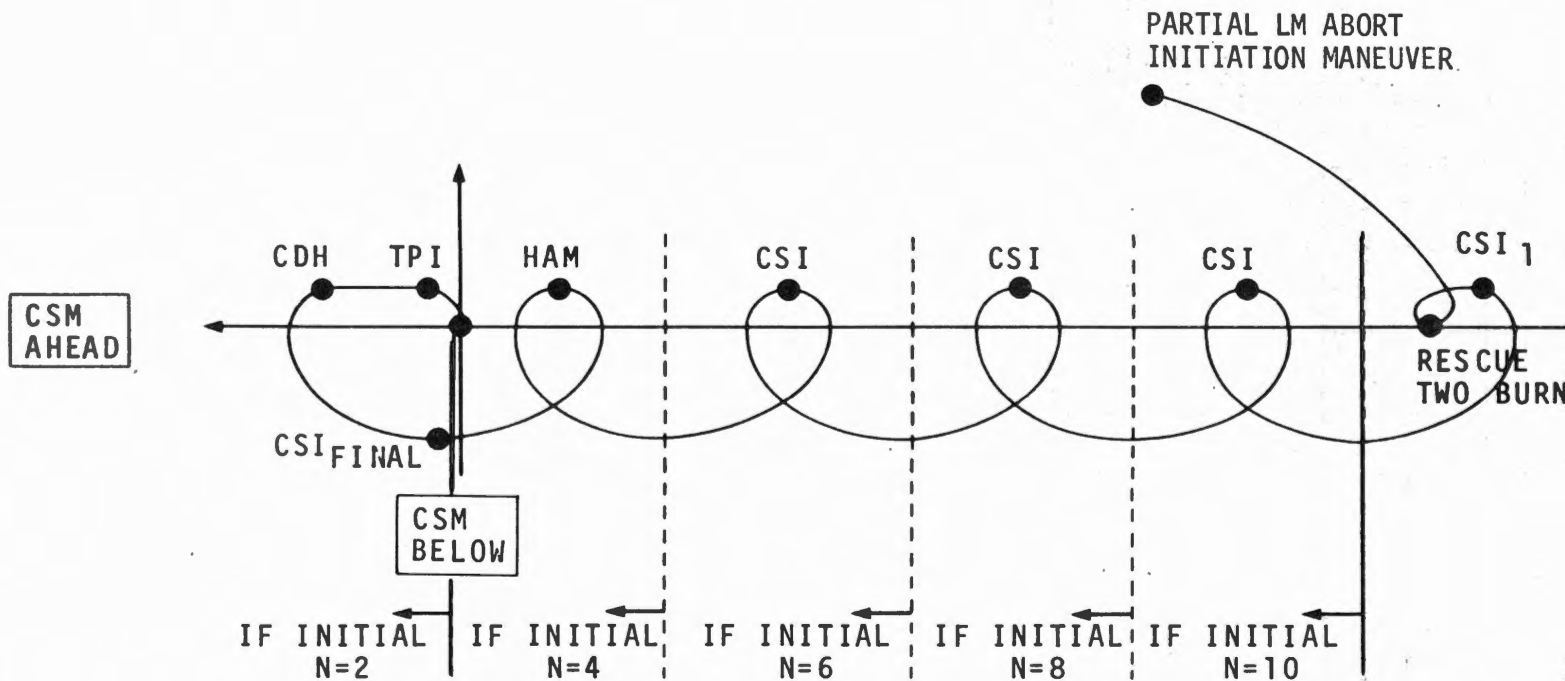
MCC COMPUTATION

FIN COMP	81	MCC2 ΔV-LV		
P76	84	LM MCC2 ΔV-LV		



RESCUE TWO RELATIVE MOTION PLOT

LM CENTERED



RESCUE TWO TIMELINE

POWER DOWN SIM (SEE EXPS/EVA CHECKLIST)
P00; V48. (11102,X1111)

INSERTION OR A.I.M.

MSFN UPLINK: LM S.V.
MSFN UPDATE: RESCUE TWO P30 PAD
P32 INITIALIZATION PAD

P30; P40

RESCUE TWO BURN

P00

RESCUE TWO P30 PAD

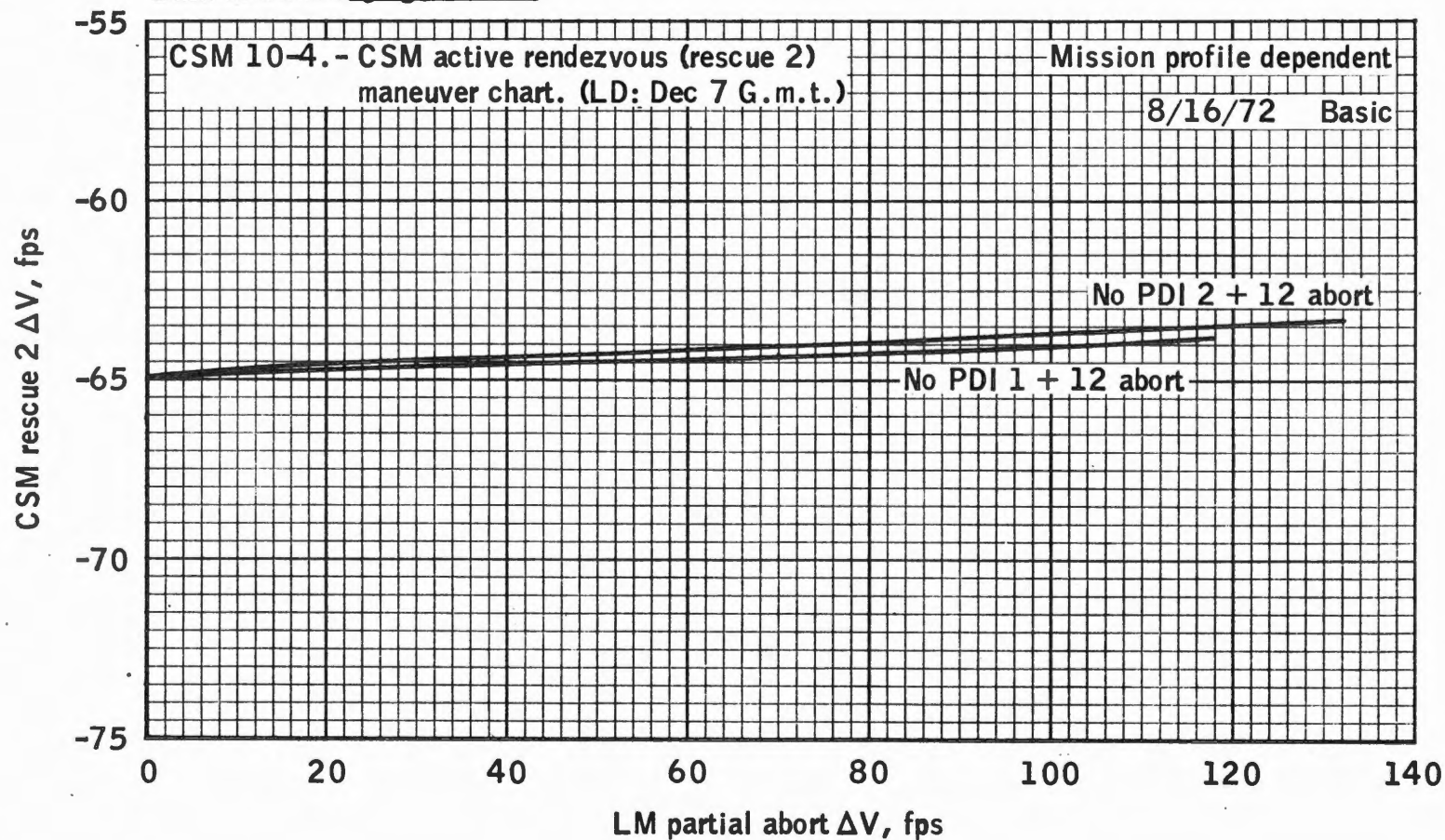
	R	2	N	=			PURPOSE
SET STARS	S	P	S	G	&	N	PROP/GUID
	+						WT N47
R ALIGN		0	0				P TRIM N48
P ALIGN		0	0				Y TRIM
Y ALIGN	+	0	0				HRS GETI
	+	0	0	0			MIN N33
	+	0					SEC
ULLAGE							ΔV_X N81
	+	0	0	0	0	0	ΔV_Y
	+	0	0	0	0	0	ΔV_Z
	X	X	X				R
	X	X	X				P
	X	X	X				Y
OTHER	+						H _A N44
							H _P
	+						ΔVT
	X	X	X				BT
	X						ΔVC

P32 INITIALIZATION PAD

N11	CSI GETI	+		:	:	.
	N	+	0	0	0	
N55	ELEV $\rightarrow$	+	2	0	8	3 0
	180° OPT	+	1	3	0	0 0
N37	TPI GETI	+		:	:	.

RESCUE TWO BURN INFORMATION

DuPont/MAB/MPAD (for CSM Rescue)

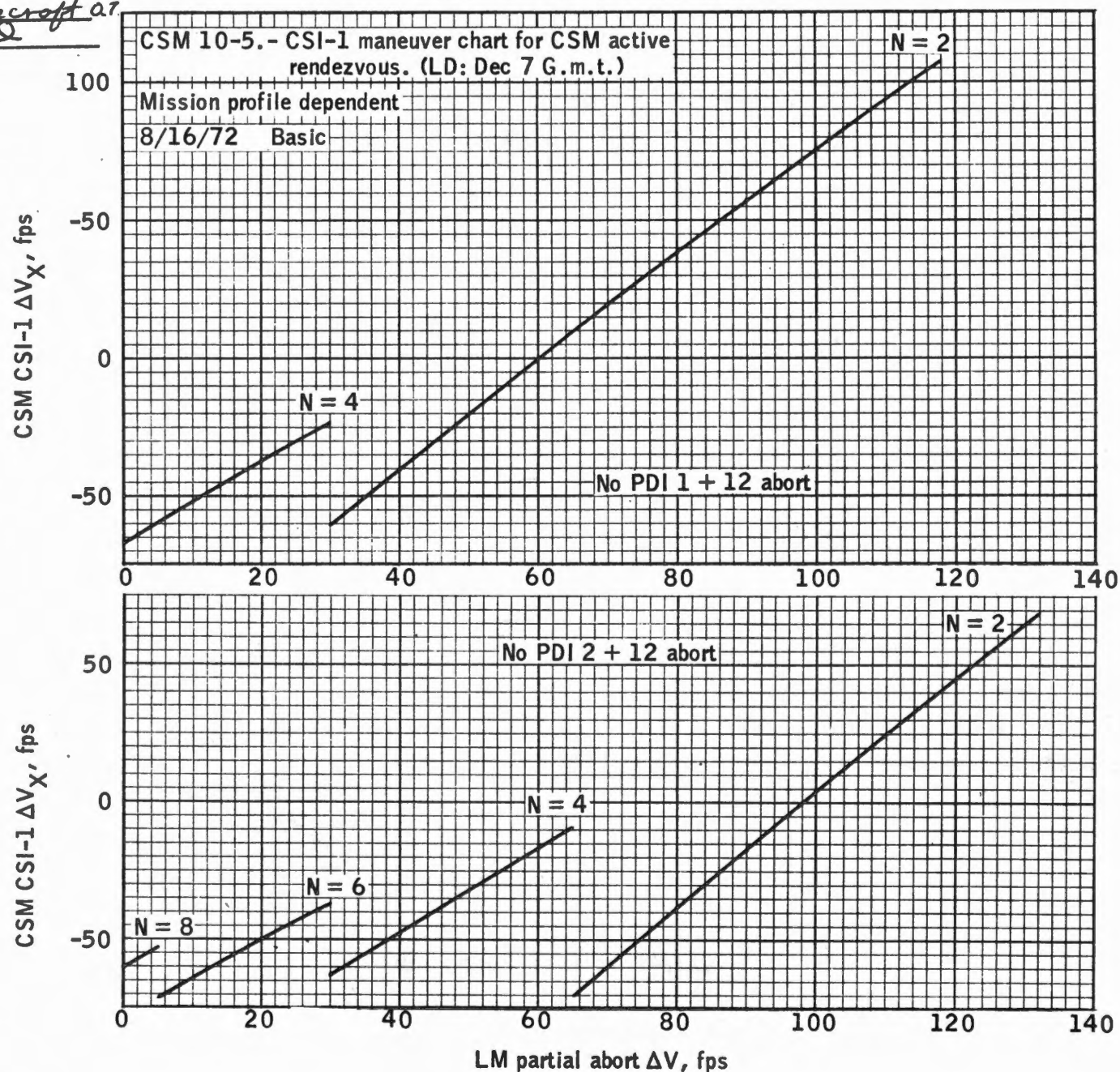
Data source Spacecraft O.T.Data confirmed LD

Pont/MAB/MPAD (for CSM Rescue)

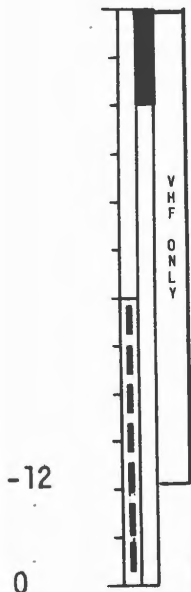
its source Spacecraft 27

its confirmed CS2

CSI ONE BURN INFORMATION



P32 (LOAD P32 INITIALIZATION PAD ON PAGE 14)



BEFORE STEADY STATE
N49>(+00200,+00120):REJECT/REPEAT
AFTER STEADY STATE
N49>(+00030,+00020):REJECT/REPEAT

FINAL COMP, OVERWRITE DVY(COPY); P40m

CSI ONE BURN

P76m; V67(+10000,+00100,+00001)

IF INITIAL N>4, CONTINUE ON PAGE 18
IF INITIAL N=4, CONTINUE ON PAGE 19
IF INITIAL N=2, CONTINUE ON PAGE 20

P32	90	Y	Y DOT	LM Y DOT
FINAL		.	.	.
COMP	81	CSI DV-LV	+0000.0	+0000.0

GROUND
 ΔV_X

.

COMPARISON
LIMIT=±3 FPS

(A)

P32m, **REDUCE PREVIOUS N BY 2**, OVERWRITE N55 R1(COPY)

P52, OPT 3; P32

BEFORE STEADY STATE
N49>(+00200,+00120):REJECT/REPEAT
AFTER STEADY STATE
N49>(+00030,+00020):REJECT/REPEAT

IF NECESSARY: MSFN UPLINK-LM S.V.
CSM S.V.

FINAL COMP, OVERWRITE DVY(COPY);

P41m

CSI BURN

P76m; V67(+10000,+00100,+00001)

RECYCLE TO (A) UNTIL
N=4 WAS INPUT FOR THE
PREVIOUS CSI BURN,
THEN CONTINUE TO PAGE 19.

FOR N=8

CSI ☐ COMPUTATION			
INPUT	11	CSI GETI	
	55	PROCEED ON DISPLAYED GETI	
	37	TPI GETI	
FINAL COMP	90	PROCEED ON DISPLAYED GETI	
	81	TPI GETI	
		CSI ΔV-LV	

FOR N=6

CSI ☐ COMPUTATION			
INPUT	11	CSI GETI	
	55	PROCEED ON DISPLAYED GETI	
	37	TPI GETI	
FINAL COMP	90	PROCEED ON DISPLAYED GETI	
	81	TPI GETI	
		CSI ΔV-LV	

FOR N=4

CSI ☐ COMPUTATION			
INPUT	11	CSI GETI	
	55	PROCEED ON DISPLAYED GETI	
	37	TPI GETI	
FINAL COMP	90	PROCEED ON DISPLAYED GETI	
	81	TPI GETI	
		CSI ΔV-LV	

P31m (COPY), LOAD $\Delta H = 10.0$

V24	N1E
2367E	
0E	
22062E	

BEFORE STEADY STATE
N49>(+00200,+00120):REJECT/REPEAT
AFTER STEADY STATE
N49>(+00030,+00020):REJECT/REPEAT

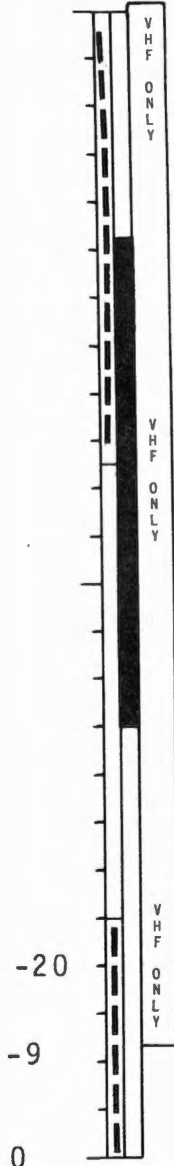
HAM COMPUTATION			
INPUT	11	CSI GETI	
		PROCEED ON DISPLAYED GETI	
	55	N +00001	ELEVATION 2 +208.30
	37	TPI GETI	180' OPT +130.00
RECYCLE	33	HAM GETI	
		PROCEED ON DISPLAYED GETI	
	90	Y	Y DOT
	81	HAM $\Delta V-LV$	LM Y DOT
FINAL COMP	90	Y	Y DOT
		PROCEED ON DISPLAYED GETI	
	81	HAM $\Delta V-LV$	LM Y DOT
		+0000.0	+0000.0

RECYCLE (COPY)

FINAL COMP, OVERWRITE DVY(COPY); P41m

HAM

P76m; V67(+10000,+00100,+00001)



P32m(COPY)

IF P36 IN MODE LITES:
OBTAIN CSI GETI FROM GRND(COPY)
P32 WITH GRND GETI

BEFORE STEADY STATE
N49>(+00200,+00120):REJECT/REPEAT
AFTER STEADY STATE
N49>(+00030,+00020):REJECT/REPEAT

SXT/VHF

RECYCLE(COPY)

FINAL COMP(COPY); P41m

CSI FINAL BURN

P76m; P36m (COPY)

SXT/VHF

FINAL COMP (COPY) TO BYPASS P52m AND P4Xm, ZERO DVY
P52m; P4Xm

PLANE CHANGE

P76m
P33m(COPY)

RECYCLE(COPY)

FINAL COMP(COPY); P40m

CDH BURN

P76m

SXT/VHF

CSI COMPUTATION

INPUT	11	CSI GETI		
	55	N	ELEVATION	180° OPT
	37	TPI GETI	PROCEED ON DISPLAYED GETI	
RECYCLE	90	Y	Y DOT	LM Y DOT
	81	CSI LV-LV		+0000.0
	81	Y	Y DOT	LM Y DOT
FINAL COMP	90	Y	Y DOT	LM Y DOT
	81	CSI DV-LV		+0000.0
	81	Y	Y DOT	LM Y DOT

PLANE CHANGE COMPUTATION

INPUT	33	PC GETI		
	90	Y	Y DOT	LM Y DOT
	81	PC AV-LV		+0000.0
FINAL COMP	90	Y	Y DOT	LM Y DOT
	81	PC DV-LV		+0000.0
	81	Y	Y DOT	LM Y DOT

CDH COMPUTATION

INPUT	13	LM CDH GETI		
	90	Y	Y DOT	LM Y DOT
	81	CDH DV-LV		
RECYCLE	90	Y	Y DOT	LM Y DOT
	81	CDH LV-LV		
	81	Y	Y DOT	LM Y DOT
FINAL COMP	90	Y	Y DOT	LM Y DOT
	81	CDH DV-LV		
	81	Y	Y DOT	LM Y DOT

TO BYPASS GYRO TORQUE: ENTER ON F 50 25
TO GYRO TORQUE: SEE P. 38

P34m, OVERWRITE N55 R2

BEFORE STEADY STATE
 N49>(+00080,+00050):REJECT/REPEAT
 AFTER STEADY STATE
 N49>(+00030,+00020):REJECT/REPEAT

RECYCLE (COPY)

FINAL COMP (COPY); P40m

TPI BURN

P76m; P35m

P35 FINAL COMP (COPY); P41m

MCC1

P76m, P35m

P35 FINAL COMP (COPY); P41m

MCC2

GO TO TPF ACTIVITIES (PAGE 36)

TPF

TPI-ELEVATION OPTION

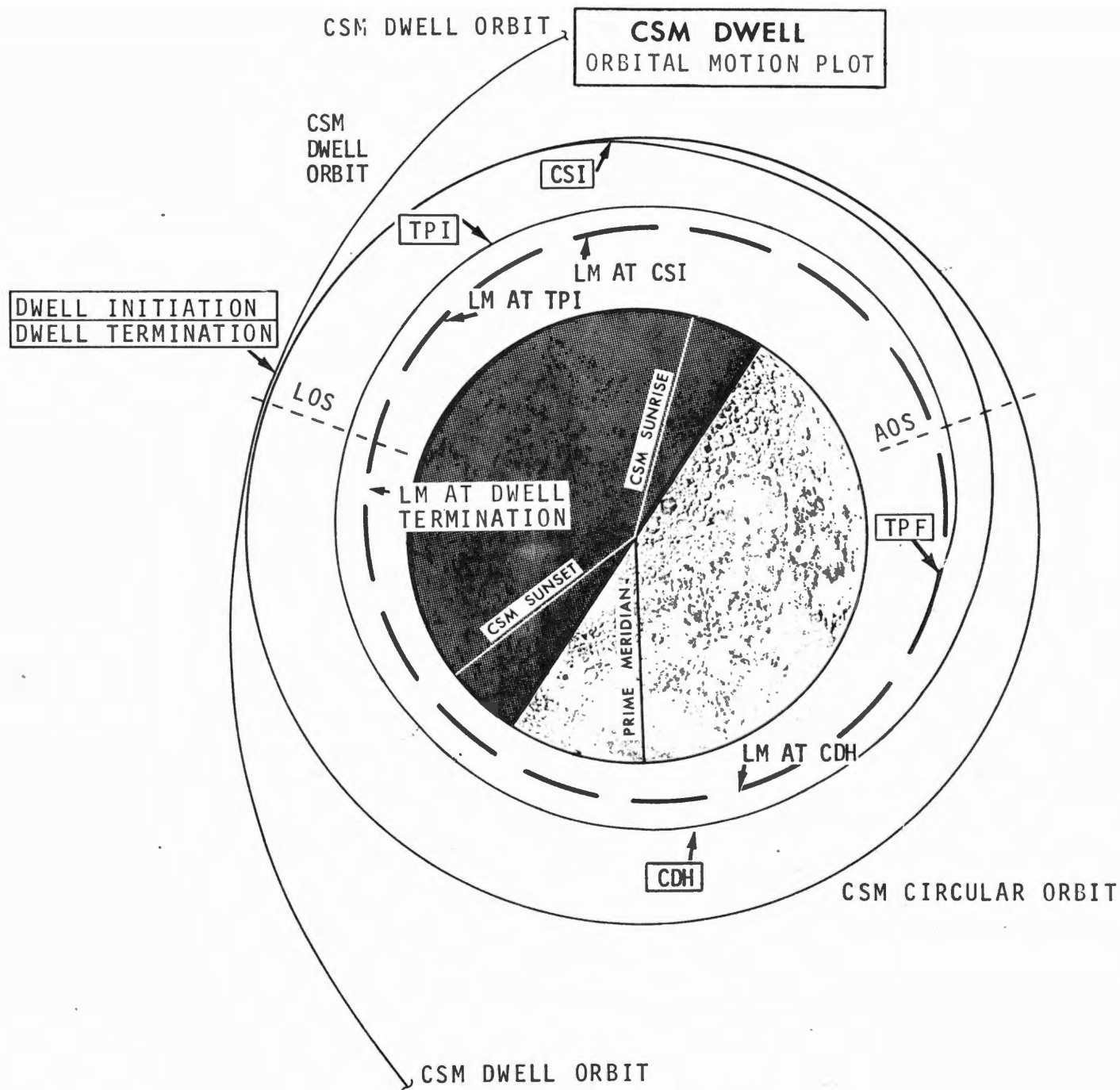
INPUT		TPI GETI		
		INTG OPT	ELEVATION *	TRANSFER *
RECYCLE	37	PROCEED ON DISPLAYED GETI		
	55	+00000	+208.30	+130.00
	81			
FINAL COMP	37	PROCEED ON DISPLAYED GETI		
	55	+00000		+130.00
	81			

MCC COMPUTATION

FIN COMP		MCC1 ΔV-LV		
81		.	.	.

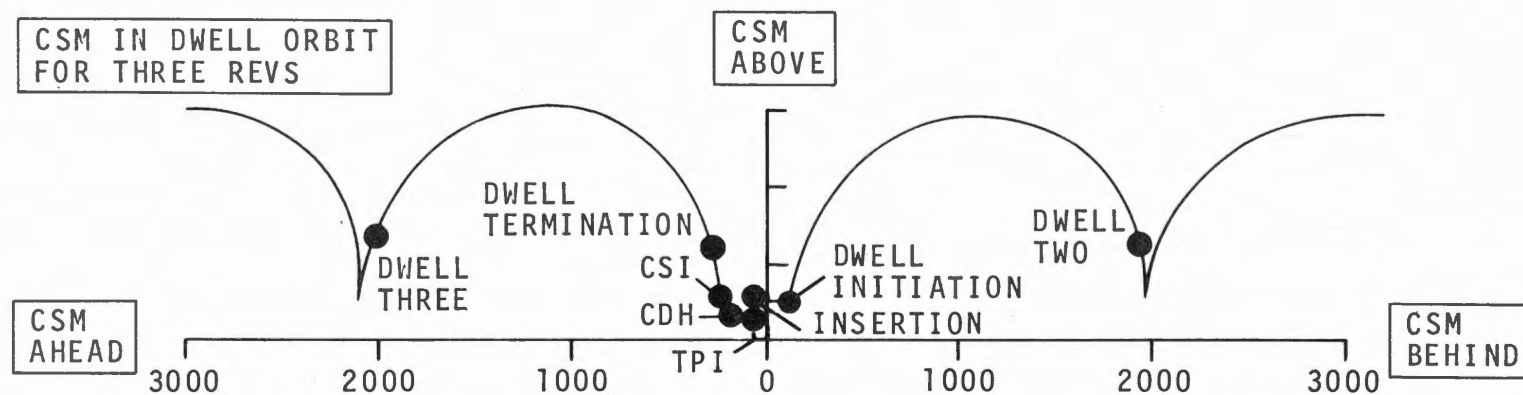
MCC COMPUTATION

FIN COMP		MCC2 ΔV-LV		
81		.	.	.



CSM DWELL RELATIVE MOTION PLOT

LM CENTERED



CSM DWELL
RENDERINGS

CSM DWELL TIMELINE

DWELL INITIATION P30 PAD

SET STARS	D	W	E	L	L	I	PURPOSE	
	S	P	S	G	&	N	PROP/GUID	
	+						WT	N47
R ALIGN		0	0				P TRIM	N48
P ALIGN		0	0				Y TRIM	
Y ALIGN	+	0	0				HRS	GETI
	+	0	0	0			MIN	N33
	+	0					SEC	
ULLAGE							ΔV_X	N81
							ΔV_Y	
							ΔV_Z	
	X	X	X				R	
	X	X	X				P	
	X	X	X				Y	
OTHER	+						H _A	N44
REMAIN IN							H _P	
THE DWELL	+						ΔV_T	
ORBIT FOR	X	X	X				BT	
REVS	X						ΔV_C	

P32 INITIALIZATION PAD

N11	CSI GETI	+		:	:	:	.
	N	+	0	0	0	0	1
N55	ELEV 4	+	2	0	8	3	0
	180° OPT	+	1	3	0	0	0
N37	TPI GETI	+		:	:	:	.

POWER DOWN SIM (SEE EXPS/EVA CHECKLIST)

INSERTION

MSFN UPLINK: LM S.V.
MSFN UPDATE: DWELL INITIATION P30 PAD (COPY)
P32 INITIALIZATION PAD (COPY)

P30; P40

DWELL INITIATION BURN

P00

-15

0

DWELL TWO P30 PAD

	D	W	E	L	L	2	PURPOSE
SET STARS				G	&	N	PROP/GUID
	+						WT N47
R ALIGN		0	0				P TRIM N48
P ALIGN		0	0				Y TRIM
Y ALIGN	+	0	0				HRS GETI
	+	0	0	0			MIN N33
	+	0					SEC
ULLAGE							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

P32 INITIALIZATION PAD

N11	CSI GETI	+	: : .					
N55	N	+	0	0	0	0	1	
	ELEV	+	2	0	8	3	0	
	180° OPT	+	1	3	0	0	0	
N37	TPI GETI	+	: : .					

MSFN UPDATE: DWELL TWO P30 PAD (COPY)
P32 INITIALIZATION PAD (COPY)

P52, OPT 3
P00

P30; P41

DWELL TWO BURN

P00

THIS PAGE IS FOR A
THREE REV DWELL
ONLY.

IF DWELL TERMINATION
IS THE NEXT BURN,
GO TO PAGE 27.

MSFN UPDATE: DWELL THREE P30 PAD(COPY)
P32 INITIALIZATION PAD(COPY)

P52, OPT 3
P00

P30; P41

DWELL THREE BURN

P00

DWELL THREE P30 PAD

	D	W	E	L	L	3	PURPOSE
SET STARS				G	&	N	PROP/GUID
	+						WT N47
R ALIGN		0	0				P TRIM N48
P ALIGN		0	0				Y TRIM
Y ALIGN	+	0	0				HRS GETI
	+	0	0	0			MIN N33
	+	0					SEC
ULLAGE							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

P32 INITIALIZATION PAD

N11	CSI GETI	+		:	:	:	.
	N	+	0	0	0	0	1
N55	ELEV &	+	2	0	8	3	0
	180° OPT	+	1	3	0	0	0
N37	TPI GETI	+		:	:	:	.

DWELL TERMINATION PAD

	D	W	E	L	T	PURPOSE
SET STARS	S	P	S	G	&	PROP/GUID
	+					WT N47
R ALIGN		0	0			P TRIM N48
P ALIGN		0	0			Y TRIM
Y ALIGN	+	0	0			HRS GETI
	+	0	0	0		MIN N33
	+	0				SEC
ULLAGE						ΔV_X N81
						ΔV_Y
						ΔV_Z
	X	X	X			R
	X	X	X			P
OTHER	X	X	X			Y
BURN INCLUDES	+					H _A N44
PLANE CHANGE						H _P
COMPONENT	+					ΔVT
	X	X	X			BT
	X					ΔVC

P32 INITIALIZATION PAD

N11	CSI GETI	+		:	:	:
	N	+	0	0	0	0 1
N55	ELEV &	+	2	0	8.3	0
	180° OPT	+	1	3	0.0	0
N37	TPI GETI	+		:	:	:

MSFN UPDATE: DWELL TERMINATION
P30 PAD INCLUDING
OUT OF PLANE COMPONENT (COPY)
P32 INITIALIZATION PAD (COPY)

P52, OPT 3
P00
V48(11102,X1111)
P30; P40

DWELL TERMINATION BURN

P32 (LOAD P32 INITIALIZATION PAD)

BEFORE STEADY STATE
N49>(+00200,+00120):REJECT/REPEAT
AFTER STEADY STATE
N49>(+00030,+00020):REJECT/REPEAT

FINAL COMP(COPY); P40m

CSI BURN

P76m; P36m(COPY)

BEFORE STEADY STATE
N49>(+00080,+00050):REJECT/REPEAT
AFTER STEADY STATE
N49>(+00030,+00020):REJECT/REPEAT

FINAL COMP(COPY), TO BYPASS P52m AND P4Xm, ZERO DVY
P52m; P4Xm

PLANE CHANGE

P76m
P33m(COPY)

RECYCLE(COPY)

FINAL COMP(COPY); P40m

CDH BURN

P76m

CSI COMPUTATION				
FINAL COMP	90 81	Y CSI ΔV-LV	Y DOT .	LM Y DOT . +0000.0

PLANE CHANGE COMPUTATION				
INPUT	33	PC GETI .	PROCEED ON DISPLAYED GETI .	
FINAL COMP	90 81	Y PC ΔV-LV +0000.0	Y DOT .	LM Y DOT . +0000.0

CDH COMPUTATION				
INPUT	13	CDH GETI .	PROCEED ON DISPLAYED GETI .	
RECYCLE	90 81	Y CDH ΔV-LV	Y DOT .	LM Y DOT .
FINAL COMP	90 81	Y CDH ΔV-LV	Y DOT .	LM Y DOT .

P34m, OVERWRITE N55 R2 .

BEFORE STEADY STATE
 N49>(+00080,+00050):REJECT/REPEAT
 AFTER STEADY STATE
 N49>(+00030,+00020):REJECT/REPEAT

 S
X
T
/
V
H
F
 RECYCLE(COPY)

FINAL COMP(COPY); P40m

TPI BURN

P76m; P35m

S
/
V
FINAL COMP (COPY); P41m

MCC1

P76m, P35m

S
/
V
FINAL COMP(COPY); P41m

MCC2

GO TO TPF ACTIVITIES (PAGE 36)

TPF

TPI ELEVATION OPTION

INPUT	37	TPI GETI PROCEED ON DISPLAYED GETI		
	55	INTEG OPT +00000	ELEVATION +208.30	TRANSFER +130.00
RECYCLE	37	TPI GETI PROCEED ON DISPLAYED GETI		
	58	PERILUNE ALT	TPI ΔV	TPF ΔV
	81	TPI ΔV-LV		
FINAL COMP	37	TPI GETI PROCEED ON DISPLAYED GETI		
	55	INTEG OPT +00000	ELEVATION .	TRANSFER +130.00
	58	PERILUNE ALT	TPI ΔV	TPF ΔV
	81	TPI ΔV-LV		

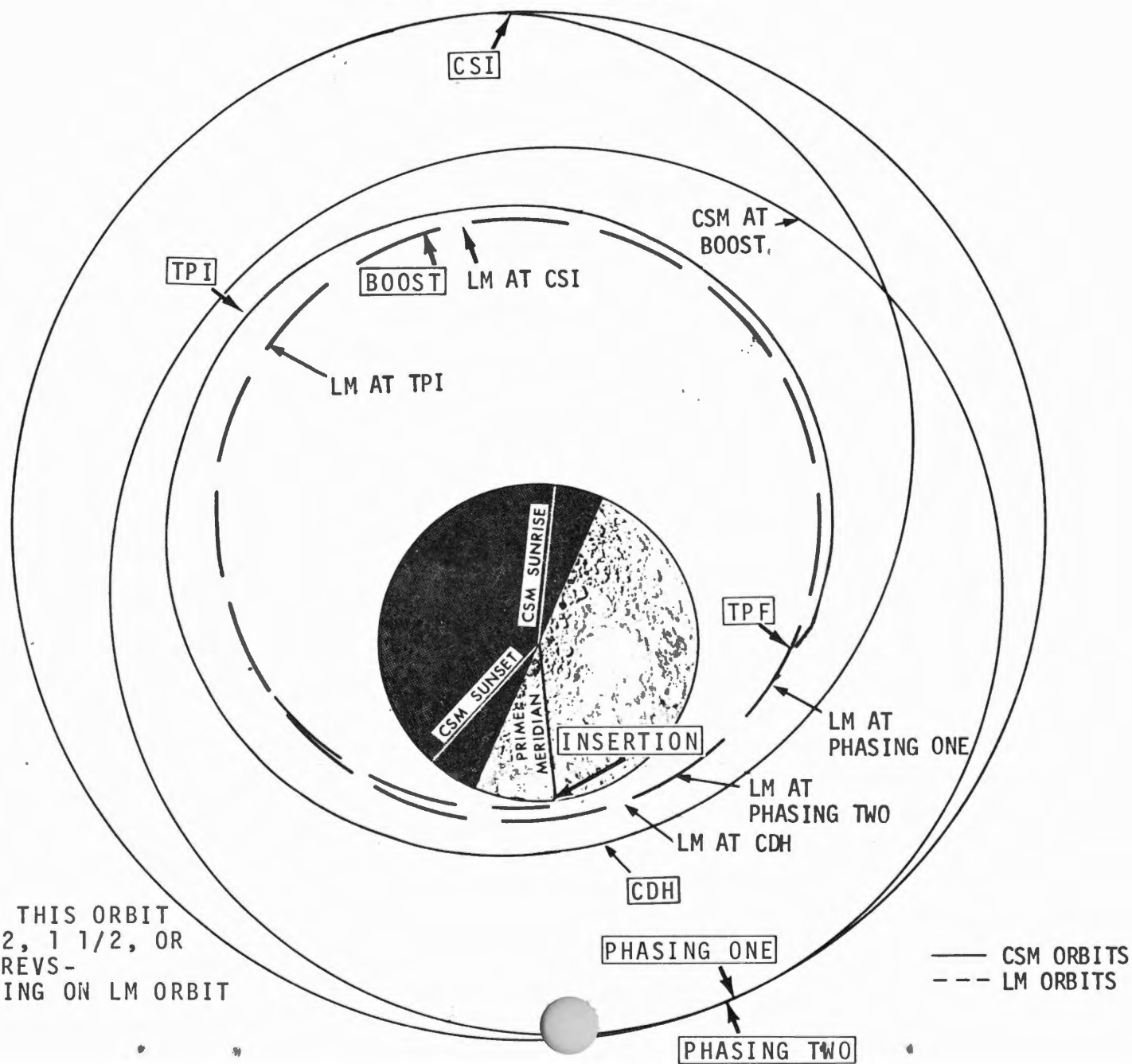
MCC COMPUTATION

FIN COMP	81	MCC1 ΔV-LV		
----------	----	------------	--	--

MCC COMPUTATION

FIN COMP	81	MCC2 ΔV-LV		
----------	----	------------	--	--

MANUAL INSERTION ORBITAL MOTION PLOT



CSM IN THIS ORBIT
FOR 1/2, 1 1/2, OR
2 1/2 REVS-
DEPENDENT ON LM ORBIT

MANUAL INSERTION RELATIVE MOTION PLOTS

LM CENTERED

APPENDIX E

PAGE 31

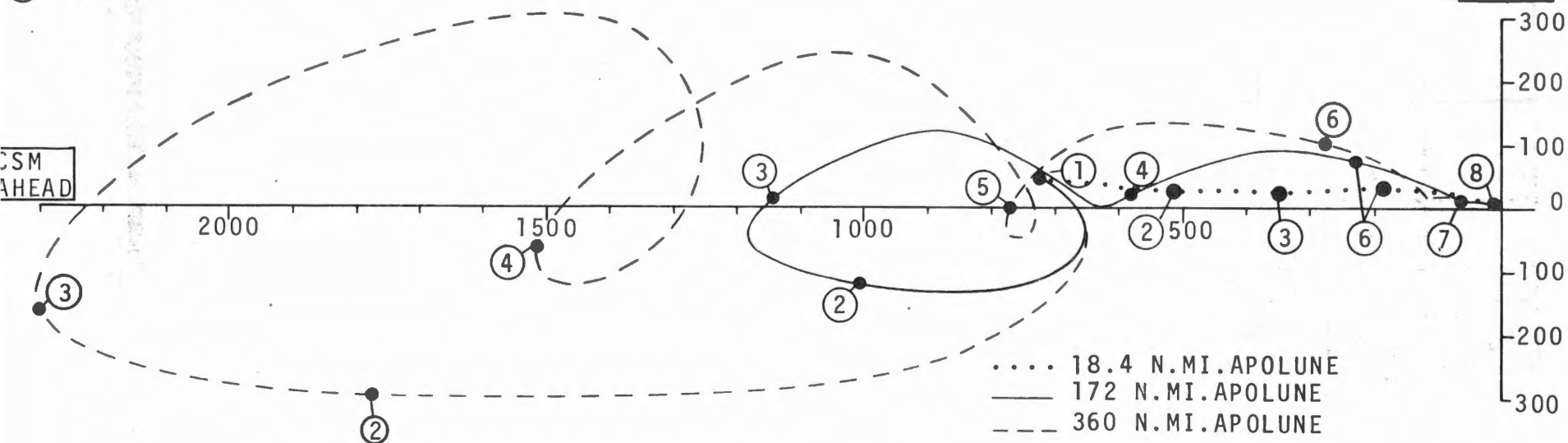
CSM
ABOVE

300
200
100
0
-100
-200
-300

..... 18.4 N.MI.APOLUNE
—— 172 N.MI.APOLUNE
--- 360 N.MI.APOLUNE

MANUAL INS
RENDEZVOUS

- ① INSERTION
- ② LM BOOST
- ③ PHASING ONE
- ④ PHASING TWO (NOMINALLY ZERO)
- ⑤ PHASING THREE (NOMINALLY ZERO)
- ⑥ CSI
- ⑦ CDH
- ⑧ TPI



**MANUAL INSERTION
TIMELINE**

POWER DOWN SIM (SEE EXPS/EVA CHECKLIST)

INSERTION

MSFN UPLINK: LM S.V.

P52, OPT 3
P00

LM BOOST P76	33 84	LM GETI-BOOST LM BOOST ΔV-LV +0010.0	:	:	:	:
		+0000.0		+0000.0		+0000.0

LM BOOST

VERIFY LM BOOST BURN
P76

MSFN UPDATE: PHASING P30 PAD (COPY)
P32 INITIALIZATION PAD (COPY)

P30; P40

PHASING ONE

PHASING P30 PAD

	P	H	A	S	E	1	PURPOSE
SET STARS	S	P	S	G	&	N	PROP/GUID
	+						WT N47
R ALIGN		0	0				P TRIM N48
P ALIGN		0	0				Y TRIM
Y ALIGN	+	0	0				HRS GETI
	+	0	0	0			MIN N33
	+	0					SEC
ULLAGE							ΔV _X N81
							ΔV _Y
							ΔV _Z
	X	X	X				R
	X	X	X				P
OTHER	X	X	X				Y
	+						H _A N44
							H _P
	+						ΔVT
	X	X	X				BT
	X						ΔVC

P32 INITIALIZATION PAD

N11	CSI GETI	+	:	:	:	:
	N	+	0	0	0	1
N55	ELEV & 180° OPT	+	2	0	8	3
		+	1	3	0	0
N37	TPI GETI	+	:	:	:	:

Ⓐ

P52, OPT 3
P00

MSFN UPDATE:
PHASING P30 PAD
(COPY)
P32 INITIALIZATION
PAD (COPY)

P30; P41

PHASING

P00

IF THE NEXT BURN IS NOT CSI,
RETURN TO Ⓐ

PHASING TWO P30 PAD

SET STARS	P	H	A	S	E	2	PURPOSE
			/G	&	N		PROP/GUID
	+						WT N47
R ALIGN		0	0				P TRIM N48
P ALIGN		0	0				Y TRIM
Y ALIGN	+	0	0				HRS GETI
	+	0	0	0			MIN N33
	+	0					SEC
ULLAGE							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

P32 INITIALIZATION PAD

N11	CSI GETI	+	: : .					
N55	N	+	0	0	0	0	1	
	ELEV 4	+	2	0	8	3	0	
	180° OPT	+	1	3	0	0	0	
N37	TPI GETI	+	: : .					

PHASING THREE P30 PAD

SET STARS	P	H	A	S	E	3	PURPOSE
			/G	&	N		PROP/GUID
	+						WT N47
R ALIGN		0	0				P TRIM N48
P ALIGN		0	0				Y TRIM
Y ALIGN	+	0	0				HRS GETI
	+	0	0	0			MIN N33
	+	0					SEC
ULLAGE							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

P32 INITIALIZATION PAD

N11	CSI GETI	+	: : .					
N55	N	+	0	0	0	0	1	
	ELEV 4	+	2	0	8	3	0	
	180° OPT	+	1	3	0	0	0	
N37	TPI GETI	+	: : .					

V48(11102,X1111)
P32 (LOAD P32 INITIALIZATION PAD)

BEFORE STEADY STATE
N49>(+00200,+00120):REJECT/REPEAT
AFTER STEADY STATE
N49>(+00030,+00020):REJECT/REPEAT

SXT/VHF

RECYCLE(COPY)

FINAL COMP(COPY); P40m

CSI BURN

P76m; P36m(COPY)

SXT/VHF

BEFORE STEADY STATE
N49>(+00080,+00050):REJECT/REPEAT
AFTER STEADY STATE
N49>(+00030,+00020):REJECT/REPEAT

FINAL COMP(COPY), TO BYPASS P52m AND P4Xm, ZERO DVY
P52m; P4Xm

PLANE CHANGE

P76m

P33m(COPY)

RECYCLE(COPY)

FINAL COMP(COPY); P40m

SXT/VHF

CDH BURN

P76m

TO BYPASS GYRO TORQUE: ENTER ON F 50 25
TO GYRO TORQUE: SEE " 38

CSI COMPUTATION

RECYCLE	90	Y	Y DOT	LM Y DOT
	81	CSI ΔV-LV	.	+0000.0
FINAL COMP	90	Y	Y DOT	LM Y DOT
	81	CSI ΔV-LV	.	+0000.0

PLANE CHANGE COMPUTATION

INPUT	33	PC GETI	PROCEED ON DISPLAYED GETI	
	90	Y	Y DOT	LM Y DOT
FINAL COMP	81	PC ΔV-LV	.	+0000.0
	81	+0000.0	.	+0000.0

CDH COMPUTATION

INPUT	13	CDH GETI	PROCEED ON DISPLAYED GETI	
	90	Y	Y DOT	LM Y DOT
RECYCLE	81	CDH ΔV-LV	.	.
	81	.	.	.
FINAL COMP	90	Y	Y DOT	LM Y DOT
	81	CDH ΔV-LV	.	.
	81	.	.	.

P34m, OVERWRITE N55 R2

RECYCLE (COPY)

FINAL COMP (COPY); P40m

TPI BURN

P76m; P35m

FINAL COMP(COPY); P41m

MCC1

P76m; P35m

FINAL COMP(COPY); P41m

MCC2

GO TO TPF ACTIVITIES (PAGE 36)

TPF

BEFORE STEADY STATE
N49>(+00080,+00050):REJECT/REPEAT
AFTER STEADY STATE
N49>(+00030,+00020):REJECT/REPEAT

TPI-ELEVATION OPTION			
INPUT	37	TPI GETI	
	55	PROCEED ON DISPLAYED GETI	
		INTEG OPT	ELEVATION
		+00000	+208.30
RECYCLE	37	TPI GETI	
	58	PROCEED ON DISPLAYED GETI	
	81	PERILUNE ALT	TPI ΔV
		.	.
		TPI ΔV-LV	.
FINAL COMP	37	TPI GETI	
	55	PROCEED ON DISPLAYED GETI	
	58	INTEG OPT	ELEVATION
		+00000	+130.00
		PERILUNE ALT	TPI ΔV
		.	.
		TPI ΔV-LV	.

MCC COMPUTATION			
FIN COMP	81	MCC1 ΔV-LV	.

MCC COMPUTATION			
FIN COMP	81	MCC2 ΔV-LV	.

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APPENDIX E

PAGE 35

TPF ACTIVITIES

PAGE 36

APPENDIX E

DATE 9/18/72

+30

(11102)
(X1111)

MCC2

P76m; P79m; P00
V49 MNVR TO X-AXIS TRACK ATTITUDE

ACQ MSFN

PERFORM PRE-DOCK CHECKLIST

IF CSM ACTIVE

P47 AT 1.25 N.M.
SEC PRPLNT FUEL PRESS(4)-OPEN

V83E

N83E

KEY REL

UTILITY PWR-ON (VERIFY)

TV-ON

DAC-ON

LM PHOTOS WITH DAC/TV

TPF

EMS MODE-STBY

EMS FUNC-OFF

EXT RNDZ LT-OFF

LM STATION KEEP

DAC/TV-OFF

PRE-DOCK CHECKLIST

MAN ATT(3)-RATE CMD(VERIFY)
LIMIT CYCLE-OFF(VERIFY)
ATT DB-MIN
RATE-LOW(VERIFY)
TRANS CONTR PWR-ON(UP)
ROT CONTR PWR DIRECT(BOTH)-MNA/MNB
SC CONT-CMC(VERIFY)

AUTO RCS SEL(16)-MNA/MNB
CB DOCK PROBE(2)-CLOSED
PROBE RETR(2)-OFF(VERIFY)
PROBE EXTD/REL-RETR
PROBE EXTD/REL TB(2)-GRAY(VERIFY)
(IF TB NOT GRAY, GO TO PG S/2-13,E)
CB SECS LOGIC(2)-CLOSED(VERIFY)
CB SECS ARM(2)-CLOSED
EXT LIGHTS RUN/EVA-ON(UP)(VERIFY)
COAS PWR-ON(UP)(VERIFY)

BRAKING GATES

R,NM	Ṙ,FPS	RETICLE ANG,DEG	R,FT
1.50	45	.08	9000
1.00	30	.13	6000
.50	20	.26	3000
.25	10	.54	1500
.08	5	1.60	500
.05		2.70	300
.03		4.00	200
.02		8.50	100

+42

V49 MNVR TO SIM BAY INSPECTION ATTITUDE (319,254,000)

V49 MNVR TO DOCKING ATTITUDE (180,285,0)

DOCKING ATTITUDE
VERIFY HGA

CUE MSFN FOR LOGIC ARM
SECS LOGIC (BOTH)-ON(UP)
MSFN GO FOR PYRO ARM
SECS PYRO ARM (2)-ON(UP)

P47
DAC/TV-ON
LM MNVR TO DOCKING ATTITUDE
TRANSLATE TO CAPTURE LATCH
PERFORM DOCKING CHECKLIST

DOCKING

DAC/TV-OFF
P00
V48

(61111)
(X1111)

CMC MODE-AUTO
RNDZ XPONDER-OFF
GO TO VOLUME II OF THE FLIGHT PLAN

DOCKING CHECKLIST

AT CAPTURE

PROBE EXTND/REL TB(2)-BP(VERIFY)
(IF TB NOT BP, GO TO PG S/2-11, A)
REPORT CAPTURE TO LM
SC CONT-CMC(VERIFY)
CMC MODE-FREE
ALLOW PROBE TO DAMP S/C MOTION(10 SEC)
WHEN WITHIN $\pm 3^\circ$ OF DOCKING ATTITUDE
PROBE RETRACT SEC-1 (PRIM-2 IF REQ)

AT DOCK LATCH

PROBE EXTND/REL TB(2)-GRAY

AT HARD DOCK

SECS PYRO ARM (2) - SAFE
SECS LOGIC (BOTH) - OFF
CB SECS ARM (2) - OPEN
CB DOCK PROBE (2) - OPEN
THC - LOCKED
RHC - LOCKED
BMAG MODE (3) - RATE 2(VERIFY)
PROBE EXTND/REL - OFF
PROBE RETRACT (2) - OFF
EXT RUN/EVA LIGHT - OFF
EXT RNDZ LIGHT - OFF
COAS PWR - OFF
AUTO RCS SEL ROLL (4)-OFF
TRANS CONTR PWR-OFF
ROT CONTR PWR DIRECT (BOTH)-OFF
VHF RANGING OFF

(61111)
(X1111)

SPS PLANE CHANGE
(G&C CHECKLIST P. G/4-2)

36.1 P52 F 06 22
PRO
F 50 25 (00020)
ALIGN GDC TO 90° OR 270° ROLL
0° OR 180° PITCH
0° YAW
LIMIT CYCLE-ON
ATT DB-MIN
RATE LOW
BMAG MODE(3)-ATT1/RATE2
SC CONT-SCS
PRO
16 20
MONITOR TORQUING

IF RESTART OCCURS: CONTINUE
ON P. 39

P40 F 50 18
BMAG MODE(3)-RATE2
SC CONT-CMC
PRO
06 18
MONITOR MNVR
PERFORM P40, STARTING AT STEP 5

36.2 P76 F 06 33
PRO
F 06 84
PRO
36.4 P20 F 50 18
SC CONT-CMC
PRO
06 18
MONITOR MNVR

IF AUTO MNVR INTERRUPTED:
MNVR TO 0° YAW ON GDC
V32E

36.5 P52 F 06 22
PRO
F 50 25 (00020)
SC CONT-SCS
BMAG MODE(3)-ATT1/RATE2
PRO
16 20
MONITOR TORQUING

IF RESTART OCCURS: CONTINUE
ON P. 39

P33 F 06 13
BMAG MODE(3)-RATE2
SC CONT-CMC
CONTINUE IN P33, STEP 3

PRE-PLANE CHANGE PULSE TORQUING
RESTART RECOVERY (EMP 518)

POST-PLANE CHANGE PULSE TORQUING
RESTART RECOVERY (EMP 518)

DATE 9/18/72

APPENDIX E

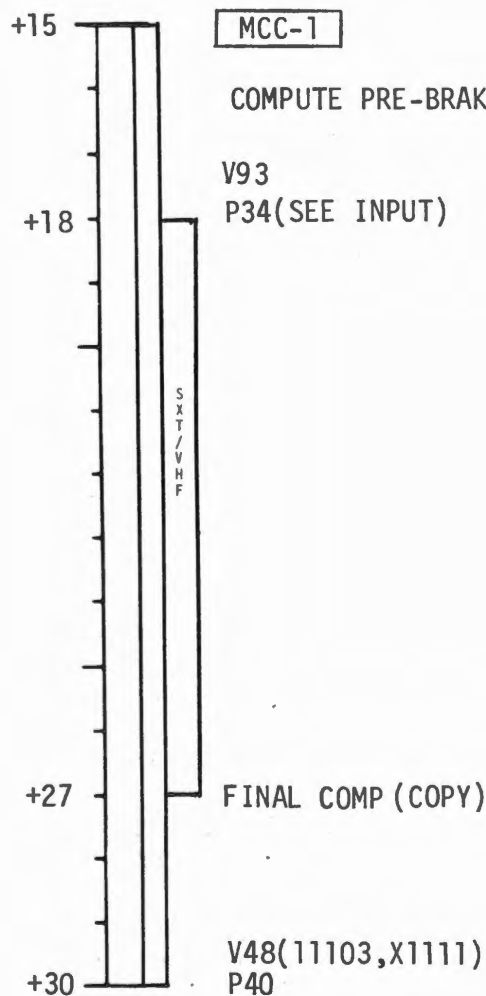
PAGE 39

P52 F 50 25 (00020)
V41 N20E
F 21 22
V33E
41 NO ATT LITE-ON
F 50 25 (00020)
V40E
NO ATT LITE-OFF
V21 N1E 1214E E
V71E 24E 1733E
V21E 303E 24E
V33E
F 50 25 (00020)
V21 N46E 11103E
V46E
PRO
P40 F 50 18
BMAG MODE(3)-RATE2
SC CONT-CMC
PRO
PERFORM P40, STARTING AT
STEP 5
P76 F 06 33
PRO
F 06 84
PRO
P20 F 50 18
SC CONT-CMC
PRO
06 18
MONITOR MNVR

P52 F 06 22
PRO
F 50 25 (00020)
V37E 52E
MNVR TO ACQUIRE STARS
PERFORM P52, OPT 1,
COURSE ALIGN
F 37
33E
P33 F 50 25 00017
PRO
F 50 18
PRO
06 18
MONITOR MNVR
F 06 13
V21 N46E 11102E
V46E
CONTINUE IN P33, STEP 3

P52 F 50 25 (00020)
V41 N20E
F 21 22
V33E
41 NO ATT LITE-ON
F 50 25 (00020)
V40E
NO ATT LITE-OFF
V21 N1E 1214E E
V71E 24E 1733E
V21E 303E 24E
V33E
F 50 25 (00020)
BMAG MODE(3)-RATE2
SC CONT-CMC
PRO
P33 06 13
V37E 52E
P52 PERFORM P52, OPT 3
F 37
33E
P33 CONTINUE IN P33

PRE-BRAKING SPS BURN PROCEDURES



GETI-TPI	:	:	.
ΔT: TPI-PRE-BRAKING	:	:	.
	:	+37	00.00
GETI- PRE-BRAKING	:	:	.

TRANSFER } COMPUTATION	
OBTAIN TPF ΔV FROM N58 OF TPI SOLUTION	
TRANSFER }	$\frac{TPF \Delta V}{2}$
	$\frac{.}{2}$
TRANSFER }	= .
LOAD INTO N55 (R3)	

PRE-BRAKING BURN COMPUTATION			
INPUT	37	COMPUTED P34 GETI:	
	55	INTEG OPT +00000	ELEVATION + +0000.0
FINAL COMP	55	INTEG OPT +00000	ELEVATION +
	58	PERILUNE ALT	P34 ΔV
	81	P34 ΔV-LV	TPF ΔV

+30

P40

SPS CHECKLIST

+37

PRE-BRAKING BURN

P79; P00; V49 MNVR TO X-AXIS TRACK ATTITUDE
 ACQ MSFN HGA
 V48(11102,X1111)
 PERFORM PRE-DOCK CHECKLIST

P47 AT R=1.25 NM
 SEC PRPLNT FUEL PRESS(4)-OPEN
 V83E ☐ KEY REL
 N83E ☐

UTIL PWR-ON (VERIFY)
 DAC/TV-ON
 LM PHOTOS WITH DAC/TV

TPF

EMS MODE-STBY
 EMS FUNC-OFF
 EXT RNDZ LT-OFF
 LM STATION KEEP
 GO TO VOL II OF FLIGHT PLAN

PRE-DOCK CHECKLIST

MAN ATT(3)-RATE CMD(VERIFY)
 LIMIT CYCLE-OFF(VERIFY)
 ATT DB-MIN
 RATE-LOW(VERIFY)
 TRANS CONTR PWR-ON(UP)
 ROT CONTR PWR DIRECT(BOTH)-MNA/MNB
 SC CONT-CMC(VERIFY)

AUTO RCS SEL(16)-MNA/MNB
 CB DOCK PROBE(2)-CLOSED
 PROBE RETR(2)-OFF(VERIFY)
 PROBE EXTD/REL-RETR
 PROBE EXTD/REL TB(2)-GRAY(VERIFY)
 (IF TB NOT GRAY, GO TO PG S/2-13,E)
 CB SECS LOGIC(2)-CLOSED(VERIFY)
 CB SECS ARM(2)-CLOSED
 EXT LIGHTS RUN/EVA-ON(UP)(VERIFY)
 COAS PWR-ON(UP)(VERIFY)

BRAKING GATES

R,NM	Ṙ,FPS	RETICLE ANG,DEG	R,FT
1.50	45	.08	9000
1.00	30	.13	6000
.50	20	.26	3000
.25	10	.54	1500
.08	5	1.60	500
.05		2.70	300
.03		4.00	200
.02		8.50	100

SPS PRE-BRAKING
 BURN PROCEDURES

IMU FAILURE RENDEZVOUS

WHEN IMU FAILURE KNOWN:
PERFORM IMU FAILURE SWITCH CHECKLIST
PERFORM GDC REFSMMAT DETERMINATION PROCEDURE(G/7-13)
(IF REQD: PERFORM GDC REFSMMAT REALIGN(P52-OPT 4)(G/7-15)

MNVR TO TRACK/STAR FIELD ATT(180,280,0), ACQ HGA
LOAD N20 AND ATT SET TW'S TO(180,280,0)
MNVR BY NULLING ERROR NEEDLES

SET REFSMMAT FLAG(VERIFY)
V25 N7E,77E,10000E,1E

PRE SPS BURN SIM PREP (CUE CARD)

IMU FAILURE SWITCH CHECKLIST

IMU POWER-OFF
FDAI SELECT-1
FDAI SOURCE-ATT SET
ATT SET-GDC
ATT DB-MIN
RATE-LOW
SC CONT-SCS
BMAG MODE(3)-ATT 1/RATE 2

DIRECT ASCENT RNDZ PAD							UPDATE (IF REQ'D)						
GETI LIFT-OFF	HRS	+	0	0			+	0	0				
	MIN	+	0	0	0		+	0	0	0			
	SEC	+	0				+	0					
GETI	HRS	+	0	0			+	0	0				
TPI	MIN	+	0	0	0		+	0	0	0			
N37	SEC	+	0				+	0					

COELLIPTIC RNDZ PAD							UPDATE (IF REQ'D)						
GETI LIFT-OFF	HRS	+	0	0			+	0	0				
	MIN	+	0	0	0		+	0	0	0			
	SEC	+	0				+	0					
GETI	HRS	+	0	0			+	0	0				
CSI	MIN	+	0	0	0		+	0	0	0			
N11	SEC	+	0				+	0					
GETI	HRS	+	0	0			+	0	0				
TPI	MIN	+	0	0	0		+	0	0	0			
N37	SEC	+	0				+	0					

UPDATE:
/NO GO FOR LIFT-OFF

LM LIFT-OFF

VHF RNG-RESET

LM INSERTION

P52(OPTION 3)
RECORD STAR NO.

SHAFT

TRUNNION

P00

MSFN UPLINK:
LM S.V.

P34(ACCEPT MNKY)(BYPASS MNVR)
V57-LOAD R2=1

BEFORE STEADY STATE

PRE-TPI: N49 > (+00200,+00120) REJECT/REPEAT
POST-TPI: N49 > (+00080,+00050) REJECT/REPEAT

AFTER STEADY STATE

ANYTIME: N49 > (+00030,+00020) REJECT/REPEAT

VERIFY LM TRACKER LT-ON

ALIGN GDC TO N20

PERFORM GDC REFSMMAT DETERMINATION PROCEDURE

V37E00E; V96E; V21 N1E,1214E,63E;
V25 N26E,13001E,3425E,30005E; V30E

SCS BURN MANEUVER

N/A SET STARS	C	S	M	B	/	O	PURPOSE
	S	P	S	G	&	N	PROP/GUID
R ALIGN N / A	+			N	/	A	WT N47
P ALIGN N / A		0	0	N	/	A	P TRIM N48
Y ALIGN N / A		0	0	N	/	A	Y TRIM
	+	0	0				HRS GETI
	+	0	0	0			MIN N33
	+	0					SEC
ULLAGE							ΔV _X N81
4 JET, 11 SEC							ΔV _Y
							ΔV _Z
	X	X	X				R ..
	X	X	X				P
	X	X	X				Y
ΔVC	+			N	/	A	H _A N44
				N	/	A	H _P

*IF LM BAILOUT REQ'D:
* COPY P76 DATA FROM LM

*33 : :
*84 . . .

*GO TO RESCUE BOOK PG 4

*IF CSM BAILOUT REQ'D:

*MSFN UPDATE:
* CSM BAILOUT P30 PAD

*P30

*P40; SET UP EMS

*SPS BURN CUE CARD

*CSM BAILOUT BURN

*GO TO RESCUE BOOK PG 4

P34 INPUT

37	LM GETI-TPI		
	:	:	:
55	INTEG OPT +00000	ELEVATION J +000.00	TRANSFER J +130.00

IMU FAILURE
RENDEZVOUS

-25

-17

-10

-8

-6

0

V
H
F
O
N
L
Y

V
H
F
A
N
D
S
X
T

P34 (ACCEPT MNKY)(NO SXT MARKS UNTIL TPI - 17)
V25 N7E,76E,20000E,0E
V21 N1E,301E,37777E
(V86E TO REJECT MARK)

MNVR TO SXT TRACK ATT (180,334,0)
LOAD N20 AND ATT SET TW'S TO(180,334,0)
MNVR BY NULLING ERROR NEEDLES

BEGIN SXT MARKS

* IF MARK REJECT BUTTON INADVERTENTLY PUSHED: *
* BEFORE PROCEEDING ON F 51 *
* V21 N1E,1336E,31264E *

VERIFY DSE TAPE MOTION(LBR/RCD/FWD/CMD RESET)

P34 FINAL COMP
COMPARE SOLUTIONS

P40
LOAD N18 VALUES IN N20 AND ATT SET TW'S
MNVR BY NULLING ERROR NEEDLES

SPS CHECKLIST

P00

TPI

LM +75.1,-0.5,+14.1
CSM -76.1,+0.5,-12.1
(180,279,0)

GROUND TPI FOR LM

						ΔV_X
						ΔV_Y
						ΔV_Z

P34 FINAL COMP

	INTEG OPT	ELEVATION §	TRANSFER §
55	+00000	.	+130.00
58	PERILUNE ALT	TPI ΔV	TPF ΔV
81	TPI ΔV -LV	.	.
84	LM TPI ΔV -LV	.	.
P76 84	LM TPI ΔV -LV	.	.

P76(P77)

P35(ACCEPT MNKY)

CALL N22; LOAD N22 VALUES IN N20 AND ATT SET TW'S
MNVR BY NULLING ERROR NEEDLES

V25 N7E,76E,20000E,0E

V21 N1E,301E,37777E

V
H
F
A
N
D
S
X
T

P35 FINAL COMP

P41(P40); LOAD N18 VALUES IN N20 AND ATT SET TW'S
MNVR BY NULLING ERROR NEEDLES

P00

MCC-1

P76(P77)

P34(ACCEPT MNKY)

V93

CALL N22; LOAD N22 VALUES IN N20 AND ATT SET TW'S
MNVR BY NULLING ERROR NEEDLES

V25 N7E,76E,20000E,0E

V21 N1E,301E, 37777E

V
H
F
A
N
D
S
X
T

P34 FINAL COMP

P41(P40); LOAD N18 VALUES IN N20 AND ATT SET TW'S
MNVR BY NULLING ERROR NEEDLES

P00

MCC-2

P35 FINAL COMP

	MCC1 ΔV-LV		
81	.	.	.
84	LM MCC1 ΔV-LV .	.	.
84	LM MCC1 ΔV-LV .	.	.

P76

P34 INPUT

	GETI-MCC2		
37	:	:	.
55	INTEG OPT +00000	ELEVATION } +000.00	TRANSFER } +040.00

P34 FINAL COMP

	INTEG OPT +00000	ELEVATION } .	TRANSFER } +040.00
55	PERILUNE ALT .	MCC2 ΔV .	TPF ΔV .
58	MCC2 ΔV-LV .	.	.
81	LM MCC2 ΔV-LV .	.	.
84	LM MCC2 ΔV-LV .	.	.
84	LM MCC2 ΔV-LV .	.	.

P76

-3

-12

-15

-18

-26

-30

P76(P77)

P79

LOAD N22 VALUES IN ATT SET TW'S
MNVR BY NULLING ERROR NEEDLES

ACQ MSFN HGA

PERFORM PRE-DOCK CHECKLIST

CENTER LM IN COAS
CYCLE BMAG MODE SWITCHES-RATE 2/ATT 1 RATE 2
FDAI SOURCE-GDC(VERIFY)

IF CSM ACTIVE:

AT R=1.25 NM; LOAD EMS WITH -(100+TPFΔV)
FOR DSKY DISPLAY OF VHF RANGE:
V25 N7E,75E,100E,1E; V87E; V16 N2E,3703E
SEC PRPLNT FUEL PRESS(4)-OPEN
EMS FUNC-ΔV
EMS MODE-NORMAL

TPF

LM 30.9 (TOTAL)
CSM 32.7 (TOTAL)
180,285,0

EMS MODE-STBY
EMS FUNC-OFF
EXT RNDZ LT-OFF

LM STATION KEEP

POO

CUE MSFN FOR LOGIC ARM
SECS LOGIC(BOTH)-ON(UP)
MSFN GO FOR PYRO ARM
SECS PYRO ARM(2)-ON(UP)

LM MNVR TO DOCKING ATTITUDE

TRANSLATE TO CAPTURE LATCH
PERFORM DOCKING CHECKLIST

DOCKING

PRE-DOCK CHECKLIST

FDAI SOURCE-GDC
LIMIT CYCLE-OFF(VERIFY)
TRANS CONTR PWR-ON(UP)
ROT CONTR PWR DIRECT(BOTH)-MNA/MNB
AUTO RCS SEL(16)-MNA/MNB
CB DOCK PROBE(2)-CLOSED
PROBE RETRACT(2)-OFF(VERIFY)

PROBE EXTND/REL - RETR
PROBE EXTND/REL TB (2) - GRAY (VERIFY)
(IF TB NOT GRAY, GO TO PG S/2-13,E)
CB SECS LOGIC (2) - CLOSED (VERIFY)
CB SECS ARM (2) - CLOSED
EXT LIGHTS RUN/EVA - ON (UP) (VERIFY)
COAS PWR - ON (UP) (VERIFY)

BRAKING GATES

R,NM	R,FPS	RETICLE ANG,DEG	R,FT
1.50	45	.08	9000
1.00	30	.13	6000
.50	20	.26	3000
.25	10	.54	1500
.08	5	1.60	500
.05		2.70	300
.03		4.00	200
.02		8.50	100

DOCKING CHECKLIST

AT CAPTURE

PROBE EXTND/REL TB (2) - BP (VERIFY)
(IF TB NOT BP, GO TO PG S/2-11, A)
REPORT CAPTURE TO LM
BMAG MODE (3) - RATE 2
ALLOW PROBE TO DAMP SC MOTION (10 SEC)
WHEN WITHIN ± 3° OF DOCKING ATTITUDE
PROBE RETRACT SEC - 1 (PRIM - 2 IF REQ'D)

AT DOCK LATCH

PROBE EXTND/REL TB (2) - GRAY

AT HARD DOCK

SECS PYRO ARM (2) - SAFE
SECS LOGIC (BOTH) - OFF
CB SECS ARM (2) - OPEN
CB DOCK PROBE (2) - OPEN
THC - LOCKED
RHC - LOCKED

EXT RUN/EVA LIGHT - OFF
EXT RNDZ LIGHT - OFF
COAS PWR - OFF
LIMIT CYCLE - ON
ATT DB - MAX

BMAG MODE (3) - ATT 1/RATE 2
AUTO RCS SEL ROLL(4)-OFF
THC PWR - OFF
RHC PWR DIR (2) - OFF

PROBE EXTND/REL - OFF
PROBE RETRACT (2) - OFF
VHF RANGING-OFF

SPS RESCUE BURN TABLE

ENGINE LIMITS	P OR Y RATES	ATT DEVIATION	MANUAL START ACTION	RESIDUALS
LOOSE	10°/SEC. COMPLETE	±10° COMPLETE	START IF ΔV TO GO >12 FPS	TRIM ALL AXES TO 0.2 FPS

SPS RESCUE
BURN TABLE

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BURN TABLE