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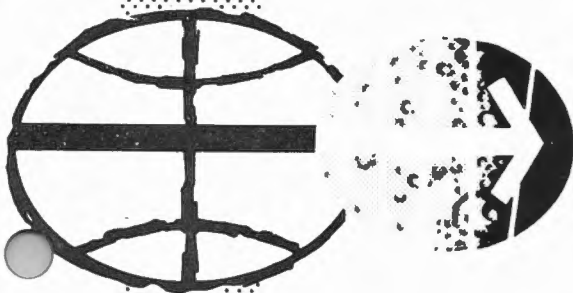
APOLLO 15
MISSION J-1

FINAL

**CSM
RENDEZVOUS
PROCEDURES**

PREPARED BY

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MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

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PROJECT APOLLO
CSM RENDEZVOUS PROCEDURES
MISSION J-1, APOLLO 15, CSM 112

30 June 1971

PREPARED FOR

CREW PROCEDURES DIVISION
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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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 CSM/LM Apollo 15 rendezvous.

The procedures developed in this document are for the first J mission which will be flown with the CSM 112 spacecraft. The prime Command Module Pilot is Major Alfred J. Worden and the backup Command Module Pilot is Mr. Vance D. Brand. Any trajectory dependent information contained in this document is based on the prime launch date of 26 July 1971 and a LM lunar lift-off GET of 171:37:24.

Six 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 Dennis C. Wammack, CSM Rendezvous Procedures Group, McDonnell-Douglas Astronautics Company, phone 483-6101.

2.0 CMP RENDEZVOUS PROCEDURES

The G&N procedures employed by the Command Module Pilot during the Apollo 15 nominal rendezvous are presented in this section. These procedures are divided into groups of congruous operations called Steps.

The rendezvous 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 information on how to perform each Step is presented in subsection 2.3.

2.1 RENDEZVOUS 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	169:46:00
LM LIFT-OFF	171:37:24
LM INSERTION	171:44:39
LM TPI	172:29:39
LM TPF	173:12:26
DOCKING	173:35:00

The Apollo 15 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 45 minutes after insertion and to apply the graduated braking burns approximately 130° of orbital travel after TPI. Two nominally zero DV midcourse correction burns are scheduled at 15 minute intervals after TPI to

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 becomes unable to apply them. The CSM will perform the rendezvous with a roll of 180°.

Although Apollo 15 will utilize the same rendezvous technique as used for Apollo 14, significant procedural changes have been made. The major changes affecting the CMP are listed below:

- A. Due to the additional 33 hours of lunar stay, the relative position of the sun and the landing site at lift-off has changed from Apollo 14. This requires the TPI burn time to be changed to occur at insertion +45 minutes rather than at the Apollo 14 time of insertion +38 minutes, to maintain the desired terminal phase lighting conditions.
- B. After TPF the CSM will not pitch 360° for the CDR to inspect the SPS engine bell, but will instead maneuver to allow the CDR to inspect the Scientific Instrument Module.
- C. The Apollo 15 CMC will incorporate the Minimum Keystroke (MINKEY) automatic sequencer software. MINKEY is designed to reduce the astronaut workload during the rendezvous by automatically sequencing operations that were once required to be routinely performed on the DSKY by the CMP. Some of the operations that are now automatically scheduled during the nominal rendezvous include:
 - a. Initiation of the appropriate CMC program
 - b. Initialization of the W-matrix with the appropriate diagonal values and at the appropriate time
 - c. Initiation of the maneuver to the appropriate attitude to track the LM
 - d. Initiation of VHF marking on the LM prior to each burn

If a NO-GO decision for the Direct Ascent Rendezvous is made prior to nominal lift-off time, the lift-off will be delayed 2.5 minutes and the four-impulse Coelliptic Rendezvous technique planned for missions prior to Apollo 14 will be used. If the LM lifts off on time but the insertion conditions preclude completion of the nominal two-impulse rendezvous, the LM will apply a bailout burn five minutes after insertion so that the coelliptic plan can be used. If the bailout burn is necessary but cannot be applied by the LM, then the CMP will perform a backup bailout burn at insertion +12 minutes.

2.2 PROCEDURES RATIONALE

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

<u>GET</u>	<u>STEP NO.</u>	<u>RATIONALE</u>
169:46	1	<u>Reconfigure DAP.</u> The DAP has been configured to maintain a narrow deadband for P24 landmark tracking. The DAP is reconfigured to a wide deadband at this time in order to conserve RCS fuel.
169:48	2	<u>Maneuver to COAS Calibration Attitude.</u> The maneuver to this attitude will center a star in the COAS at GET 170:06 to accomplish Step 6. This attitude will also allow HGA coverage and option 3 of P52.
169:54	3	<u>Acquire MSFN with HGA.</u> Ground communication is necessary in order to receive a data uplink and rendezvous information. The HGA is more efficient than the OMNI system, therefore its use is preferred.

<u>GET</u>	<u>STEP NO.</u>	<u>RATIONALE</u>
169:56	4	<u>Accept MSFN Uplink and Copy Update.</u> 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 +18 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 the ground 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 state vector at lift-off so that it will be available to the CMP in case the CMC's knowledge of the state vector is compromised and there is no communication between the CSM and ground. The CSM consumables pad will be updated if required.
170:01	5	<u>Realign IMU.</u> The IMU must be periodically fine-aligned in order to provide an accurate attitude reference for navigation computations and burn maneuvers. The last fine align occurred at 166:30:00.
170:06	6	<u>Calibrate COAS.</u> The COAS alignment must be calibrated in case COAS marking is required due to a sextant failure.
170:11	7	<u>Align GDC and Verify ORDEAL.</u> The GDC is aligned and ORDEAL is verified as a standard procedure after P52 completion.

<u>GET</u>	<u>STEP NO.</u>	<u>RATIONALE</u>
170:18	8	<u>Verify DSE Tape Motion.</u> Just prior to LOS the Data Storage Equipment operation should be checked to assure the acquisition of systems data while the CSM is behind the moon.
171:04	9	<u>Acquire MSFN with HGA.</u> Ground communication is necessary to downlink the DSE record and to establish communication with the LM over the MSFN S-band relay.
171:06	10	<u>Configure VHF and Rendezvous Lights.</u> The VHF system should be configured for ranging and voice during the rendezvous. It should be in this configuration prior to the VHF voice check scheduled before lift-off. The CSM exterior rendezvous lights should be activated so that the LM may take AOT marks 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.
171:12	11	<u>Reconfigure DAP.</u> A narrow deadband is loaded into the DAP to facilitate marking during rendezvous navigation and accurate line-of-sight rate monitoring after MCC-2. The CMC MODE switch is cycled from AUTO to FREE to AUTO in order to redefine the dead-band center and avoid possible thruster firing.

<u>GET</u>	<u>STEP NO.</u>	<u>RATIONALE</u>
171:14	12	<u>Maneuver to Post-Insertion Track Attitude.</u> The CSM maneuvers to this attitude in order to be prepared for LM tracking after insertion. HGA coverage is not available at this attitude; OMNI D is selected for ground communication.
171:20	13	<u>Align GDC and Verify ORDEAL.</u> The GDC is aligned to the IMU and ORDEAL alignment is verified prior to lift-off to provide an accurate backup attitude reference during rendezvous.
171:24	14	<u>Enable RR Monitor.</u> Prior to leaving the LEB, the CMP configures the switches which will enable verification of the RR lock-on after insertion.
171:29	15	<u>Load TPI GETI into CMC.</u> This value is loaded into N37 for later use in initializing the TPI pre-thrust program. It is loaded at this time in order to save time after insertion.
171:30	16	<u>Configure VHF and EMS for Ranging.</u> As the CSM approaches the landing site, the CMP should switch from the left to the right VHF antenna. The VHF RANGING RESET switch should be reset prior to insertion in order to obtain lock-on for ranging and the EMS switches should be configured for range display.
171:49	17	<u>Accept MSFN Uplink.</u> The CMP should be prepared to accept an uplink of the LM state vectors.
171:51	18	<u>Initiate P34 and Rendezvous Navigation.</u> The TPI pre-thrust program is entered at this time in order to accomplish the following: A. Initiate LM tracking

<u>GET</u>	<u>STEP NO.</u>	<u>RATIONALE</u>
		B. Initiate VHF marking on the LM C. Initiate the automatic rendezvous program sequence (MINKEY) D. Initialize the program for the upcoming recycle and final comp E. Display the time until TPI F. Display the number of sextant and VHF marks taken Sextant marks should be started as soon as possible after P34 is initialized and sunshafting has ended.
172:06	19	<u>Start Recycle Sequence.</u> Preliminary solutions for the TPI burn components are displayed for comparison with the LM solutions. Three minutes are allowed for the recycle operation. SXT marks will not be taken during the recycle. The CDR compares the rendezvous radar range and the VHF range to verify the accuracy of both systems in order that the CMC TPI solution may be compared with the LGC TPI solution.
172:16	20	<u>Verify DSE Tape Motion.</u> Just prior to LOS, the Data Storage Equipment Operation should be checked to assure the acquisition of systems data while the CSM is behind the moon.
172:20	21	<u>Compute TPI Solution and Terminate Navigation.</u> The TPI burn components are computed and supplied to the CDR to be compared with the LGC solution. The burn solution is also used in the CMC for a possible CSM active TPI burn. The final comp terminates rendezvous navigation until after TPI.

<u>GET</u>	<u>STEP NO.</u>	<u>RATIONALE</u>
172:22	22	<u>Backup LM TPI Burn.</u> In the event the LM can not apply the TPI burn, it must be applied by the CSM in order to establish an intercept trajectory so that the rendezvous may be completed.
172:31	23	<u>Update LM S.V. in the CMC.</u> The CMC's knowledge of the LM state vector should be updated to include the LM TPI burn in order to prevent possible excessive updates during the next navigation period.
172:33	24	<u>Initiate P35 and Rendezvous Navigation.</u> The MCC pre-thrust program is entered at this time in order to: A. Initiate LM tracking B. Initiate VHF marking on the LM C. Display the time since TPI D. Display the number of sextant and VHF marks taken
172:42	25	<u>Compute MCC-1 Solution and Terminate Navigation.</u> 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. Final comp initiation should be as close as possible to TPI +12 minutes since the MCC-1 GETI is computed to be at final comp initiation +3 minutes. The final comp terminates rendezvous navigation until after MCC-1.
172:43	26	<u>Backup LM MCC-1 Burn.</u> In the event the LM cannot apply the MCC-1 burn, it may be applied by the CSM to refine the intercept trajectory.

<u>GET</u>	<u>STEP NO.</u>	<u>RATIONALE</u>
172:45	27	<u>Update LM S.V. in the CMC.</u> 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 prevent possible excessive updates during the next navigation period.
172:48	28	<u>Initiate P35 and Rendezvous Navigation.</u> The MCC pre-thrust program is entered at this time in order to: A. Initiate LM tracking B. Initiate VHF marking on the LM C. Display the time since MCC-1 D. Display the number of sextant and VHF marks taken
172:57	29	<u>Compute MCC-2 Solution and Terminate Navigation.</u> 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. Final comp initiation should be as close to TPI+27 minutes as possible since the MCC-2 GETI is computed to be at final comp initiation +3 minutes. The final comp terminates rendezvous navigation.
172:58	30	<u>Backup LM MCC-2 Burn.</u> In the event the LM cannot apply the MCC-2 burn, it should be applied by the CSM to refine the intercept trajectory.
173:00	31	<u>Update LM S.V. in the CMC.</u> If the LM applies MCC-2, the CMC's knowledge of the LM state vector should

<u>GET</u>	<u>STEP NO.</u>	<u>RATIONALE</u>
		be updated to include the burn so that the CMC may compute and display accurate range and range rate information.
173:01	32	<u>Maneuver to COAS Track Attitude.</u> The CMP should allow P79 to maneuver the CSM to the COAS track attitude so that he may monitor LM line-of-sight rates and be prepared to perform braking if the LM becomes unable to do so.
173:03	33	<u>Acquire MSFN with HGA.</u> Ground communication is necessary to arm the pyros, for television transmission, and for the ground to monitor the docking.
173:04	34	<u>Perform Docking Preparation Activities.</u> These operations include configuring switches for docking and initiating LM photography.
173:18	35	<u>Maneuver to SIM Bay Inspection Attitude.</u> The maneuver is scheduled so that the CDR may observe the condition of the CSM SIM Bay. Ground communication is temporarily suspended while at this attitude.
173:26	36	<u>Maneuver to Docking Attitude.</u> The CSM must maneuver to an attitude favorable for docking. HGA coverage is reacquired.
173:27	37	<u>Arm Pyros.</u> 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.

<u>GET</u>	<u>STEP NO.</u>	<u>RATIONALE</u>
173:31	38	<u>Perform Docking Activities.</u> These operations are necessary in order to capture the LM latch and achieve hard docking. After docking is confirmed, the docking checklist is performed.
173:37	39	<u>Reconfigure DAP.</u> The DAP is reloaded to specify the docked LM-CSM configuration.
173:38	40	<u>Configure Switches for Post-Docking.</u> Spacecraft control was removed from the CMC during docking. Control should now be returned to that configuration.

2.3 DETAILED PROCEDURES

The detailed procedures for the LM active nominal rendezvous are contained in subsection 2.3.1. If the CSM is required to become active during the rendezvous, the contingency detailed procedures presented in subsection 2.3.2 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. 172:41: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. 172:29:39). The LTNG column indicates the CSM in daylight (blank) or darkness (black), and the MSFN column indicates the CSM has AOS (— — —) or LOS (blank).

The OPERATIONS column lists the Step and substep headings, which are underlined, and the sets 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 unknown a priori, "X"'s with the proper decimal place are shown in the column.

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 MSFN updates are defined. Additional MSFN 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 to facilitate the operations.

2.3.1 NOMINAL DETAILED PROCEDURES

The nominal detailed procedures begin 169 hours 46 minutes into the mission and continue through the post-docking switch configuration at 173 hours 38 minutes.

These procedures are presented in pages 14 through 42, with the first 4 pages containing assumed initial switch settings.

GET H:M:S	L T N G	M S F 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			1	
					MODE-STBY			1	
					CMC ATT-IMU			1	
					FDAI SCALE-5/1			1	
					SELECT-1/2			1	
					SOURCE-ATT SET			1	
					ATT SET-GDC			1	
					MANUAL ATTITUDE(3)-RATE CMD			1	
					LIMIT CYCLE-OFF			1	
					ATT DEADBAND-MAX			1	
					RATE-LOW			1	
					TRANS CONTR PWR-OFF			1	
					ROT CONTR PWR NORMAL 1-OFF			1	
					2-AC/DC			1	
					DIRECT(BOTH)-OFF			1	
					SC CONT-CMC			1	
					CMC MODE-AUTO			1	
					BMAG MODE(3)-RATE 2			1	
					SPS THRUST DIRECT-NORMAL			1	
					DV THRUST(2)-OFF			1	
					SCS TVC(2)-RATE CMD			1	
					SPS GIMBAL MOTORS(4)-OFF			1	
					DV CG-CSM			1	
					IMU CAGE-OFF			1	
					LV/SPS IND(2)-PC, GPI			1	
					TVC GMBL DRIVE(BOTH)-AUTO			1	
					DOCKING PROBE-OFF			2	
					DOCKING PROBE RETRACT(BOTH)-OFF(CTR)			2	

GET H:M:S	L T N G	M S F N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
					EXTERIOR LIGHTS RUN/EVA-OFF			2	
					RNDZ-OFF(CTR)			2	
					CAUTION/WARNING NORMAL-NORMAL			2	
					CSM-CSM			2	
					POWER-POWER			2	
					UP TLM(BOTH)-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-LEFT			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-NORM			3	
					S BAND ANTENNA-OMNI D			3	
					VHF AM A-OFF			3	
					B-DUPLEX			3	
					RCV ONLY-B DATA			3	
					VHF RANGING-OFF			3	
					S BAND SQUELCH-OFF			3	
					TAPE RECORDER-PCM/ANGL			3	
					-FWD			3	
					-OFF(CTR)			3	

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

GET H:M:S	L T N G	M S F N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
169:46:XX					G/N POWER(2)-ON(UP) RNDZ XPNDR-PWR			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 EXCEPT:			229	
					MAIN RELEASE(2)-OPEN			229	
					RECONFIGURE DAP V37E 00E				
					P00	BB BB			
					V48E	F 04 46	11101 X1111		R1-DAP CONFIGURATION R2-DAP CONFIGURATION
169:48:XX					V21E 11112E	F 04 46	11112 X1111		
					PRO	F 06 47	+35956. +36636.		R1-CSM WEIGHT (LBS) R2-LM WEIGHT (LBS)
					PRO	F 06 48	+000.60 +000.89		R1-GIMBAL PITCH TRIM(DEG) R2-GIMBAL YAW TRIM(DEG)
					PRO	BB BB			
					MANEUVER TO COAS CALIB ATTITUDE V49E				

GET H:M:S	L T N G	M S F N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
169:54:XX					V25E +18000E +22400E +1600E	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)
					PRO	F 06 22	+180.00 +224.00 +016.00		
					PRO	F 50 18	+180.00 +224.00 +016.00		R1-AUTO ATT MNVR; ROLL(DEG) R2-AUTO ATT MNVR; PITCH(DEG) R3-AUTO ATT MNVR; YAW(DEG)
					MONITOR MANEUVER	06 18	+180.00 +224.00 +016.00		
					ENTER	F 50 18	+180.00 +224.00 +016.00		
						BB BB			
					<u>ACQUIRE MSFN WITH HGA</u> V64E	F 06 51	-046.XX +164.XX		R1-HGA ANG; RHO(DEG) R2-HGA ANG; GAMMA(DEG)
					HIGH GAIN ANTENNA TRACK-MAN SET P&Y POSITIONS S BAND ANTENNA-HI GAIN HIGH GAIN ANTENNA TRACK-AUTO			2 2 3 2	RHO=-46, GAMMA=+164
					PRO	BB BB			
169:56:XX			04	P00	<u>ACCEPT MSFN UPLINK AND COPY UPDATE</u> UP TLM CM-ACCEPT			2 2	
					P27 VERIFY UPLINK ACTIVITY LT-ON				

GET H:M:S	L T N G	M S F N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
					MONITOR UPLINK	XX XX	XXXXX XXXXX XXXXX		LM S.V. (INS+18) CSM S.V. (L/O) RESET SURFACE FLAG
					COPY UPDATE				CONSUMABLES (IF REQ'D) CSM S.V. (L/O) ASCENT PADS CSM WEIGHT
				P00	VERIFY UPLINK ACTIVITY LT-OFF UP TLM CM-BLOCK	BB BB		2 2	CSM ENTERS MOON SHADOW
170:00:19									
170:01:XX			05	P00	<u>REALIGN IMU</u> V37E 52E				
				P52		F 04 06	00001 00003		R1-IMU ORIENTATION OPTION R2-REFSMAT
					PRO	F 50 25	00015		R1-CELESTIAL BODY ACQUISITION
					PRO	F 01 70	00001		R1-CELESTIAL BODY CODE (BEFORE MARK)
					OPTICS ZERO-OFF CHECK FIRST STAR CODE			122	
					PRO	06 92	+182.XX +20.XXX		R1-NEW OCDU ANG; SHAFT (DEG) R2-NEW OCDU ANG; TRUNNION (DEG)
					OPTICS MODE-MAN	F 51 BB		122	PLEASE MARK
					OHC-CENTER STAR IN SXT MARK BUTTON-DEPRESS			122 122	
					PRO	F 50 25	00016		R1-TERMINATE MARK SEQUENCE
						F 01 71	00001		R1-CELESTIAL BODY CODE (AFTER MARK)
					PRO	F 01 70	00044		R1-CELESTIAL BODY CODE (BEFORE MARK)

GET H:M:S	L T N G	M S F N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
					CHECK SECOND STAR CODE OPTICS MODE-CMC PRO	06 92	+000.XX +17.XXX	122	R1-NEW OCDU ANG; SHAFT(DEG) R2-NEW OCDU ANG; TRUNNION(DEG)
					OPTICS MODE-MAN	F 51 BB		122	PLEASE MARK
					OHC-CENTER STAR IN SXT MARK BUTTON-DEPRESS			122 122	
					PRO	F 50 25	00016		R1-TERMINATE MARK SEQUENCE
						F 01 71	00044		R1-CELESTIAL BODY CODE(AFTER MARK)
					PRO	F 06 05	+000.XX		R1-ANG ERROR DIFFERENCE(DEG)
					RECORD DATA PRO	F 06 93	+00.XXX +00.XXX +00.XXX		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	1	R1-FINE ALIGNMENT
					PRO	F 50 25	00015		R1-CELESTIAL BODY ACQUISITION
					ENTER	F 01 70	00001		R1-CELESTIAL BODY CODE (BEFORE MARK)
					V21E XXE	F 01 70	000XX		
					OPTICS MODE-CMC PRO	06 92	+XXX.XX +XX.XXX	122	R1-NEW OCDU ANG; SHAFT(DEG) R2-NEW OCDU ANG; TRUNNION(DEG)
					OPTICS ZERO-ZERO			122	

GET H:M:S	L T N G	M S F N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
170:06:XX			06	P52	<u>CALIBRATE COAS</u> V37E 52E PRO ENTER V21E 41E OPTICS ZERO-OFF PRO RHC 2-ARMED RHC 2-CENTER STAR IN COAS KEY VERB RECORD SHAFT AND TRUNNION RHC 2-LOCKED CMC MODE-AUTO OPTICS ZERO-ZERO 37E 00E P00	F 04 06 F 50 25 F 01 70 F 01 70 06 92 BB 92 BB BB	00001 00003 00015 000XX 00041 +000.XX +57.XXX +000.XX +57.XXX	122 1 122	R1-IMU ORIENTATION OPTION R2-REFSMAT R1-CELESTIAL BODY ACQUISITION R1-CELESTIAL BODY CODE (BEFORE MARK) R1-NEW OCDU ANG; SHAFT(DEG) R2-NEW OCDU ANG; TRUNNION(DEG) FREEZE DSKY DISPLAY KEY RELEASE LIGHT-ON KEY RELEASE LIGHT-OFF
170:11:XX			07		<u>ALIGN GDC AND VERIFY ORDEAL</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	

GET H:M:S	L T N G	M S F N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
					V83E	F 16 54	+XXX.XX +XXXX.X +XXX.XX		R1-RANGE(NM) R2-RANGE RATE(FPS) R3-THETA(DEG)
					MODE-HOLD/FAST ORDEAL SLEW-SLEW FDAI 2 TO APPROX THETA MODE-OPR/SLOW ORDEAL SLEW-SLEW FDAI 2 TO THETA PRO			13 13 13 13	
						BB BB			
170:18:XX			08	P00	VERIFY DSE TAPE MOTION PCM BIT RATE-LOW TAPE RECORDER-RECORD TAPE RECORDER-FWD UP TLM CMD-RESET			3 3 3 3	
170:18:13									LOSS OF SIGNAL
170:53:00									CSM LEAVES MOON SHADOW
171:02:XX					AUTO RCS SELECT(16)-MNA/MNB			8	
171:03:34			09	P00	ACQUIRE MSFN WITH HGA				ACQUISITION OF SIGNAL
171:06:XX			10	P00	CONFIGURE VHF AND RNDZ LIGHTS VHF AM B-DUPLEX(VERIFY) A-OFF(VERIFY) VHF RANGING-ON(UP) VHF ANT-LEFT(VERIFY) RNDZ XPNDR-PWR(VERIFY) EXTERIOR LIGHTS(2)-ON(UP)			3 3 3 3 100 2	
171:12:XX			11	P00	RECONFIGURE DAP CYCLE CMC MODE-FREE/AUTO V48E	F 04 06	11112 X1111	1	R1-DAP CONFIGURATION R2-DAP CONFIGURATION

GET H:M:S	L T N G	M S F N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
171:14:XX					V21E 11102E	F 04 46	11102 X1111		R1-CSM WEIGHT(LBS) R2-LM WEIGHT(LBS)
					PRO	F 06 47	+35956. +36636.		
					V24E +XXXXXE +5900E	F 06 47	+XXXXX. +05900.		
					PRO	F 06 48	+XXX.XX +XXX.XX		R1-GIMBAL PITCH TRIM(DEG) R2-GIMBAL YAW TRIM(DEG)
					PRO	BB BB			
					MANEUVER TO POST INSERTION TRACK ATTITUDE V49E	F 06 22	+180.00 +224.00 +016.00		R1-DESIRED ICDU ANG; ROLL(DEG) R2-DESIRED ICDU ANG; PITCH(DEG) R3-DESIRED ICDU ANG; YAW(DEG)
					V25E +18000E +4200E +E	F 06 22	+180.00 +042.00 +000.00		
					PRO	F 50 18	+180.00 +042.00 +000.00		
					PRO	06 18	+180.00 +042.00 +000.00		R1-AUTO ATT MNVR; ROLL(DEG) R2-AUTO ATT MNVR; PITCH(DEG) R3-AUTO ATT MNVR; YAW(DEG)
					MONITOR MANEUVER	F 50 18	+180.00 +042.00 +000.00		
					ENTER	BB BB			

GET H:M:S	L T N G	M S F N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
171:20:XX			13	POO	S BAND ANTENNA-OMNI D <u>ALIGN GDC AND VERIFY ORDEAL</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=NULL FDAI 1 ERROR NEEDLES ATT SET-GDC GDC ALIGN PB-PUSH UNTIL NEEDLES NULLED FDAI SELECT-1/2 V83E	F 16 54	+XXX.XX +XXXX.X +XXX.XX	3 1 1 1 1 1 1 1	SELECT OMNI D R1-RANGE(NM) R2-RANGE RATE(FPS) R3-THETA(DEG)
171:24:XX			14	POO	MODE-HOLD/FAST ORDEAL SLEW-SLEW FDAI 2 TO APPROX THETA MODE-OPR/SLOW ORDEAL SLEW-SLEW FDAI 2 TO THETA PRO	BB BB		13 13 13 13	
171:29:XX			15	POO	<u>ENABLE RR MONITOR</u> SYSTEMS TEST(LEFT)-XPNDR SYSTEMS TEST(RIGHT)-C <u>LOAD TPI GETI INTO CMC</u> V16N37E V25E +172E +29E +3900E	16 37 16 37	+00XXX. +000XX. +0XX.XX +00172. +00029. +039.00	101 101	R1-TPI GETI(HRS) R2-(MIN) R3-(SEC)

GET H:M:S	L T N G	M S F N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
171:30:XX			16	P00	<u>CONFIGURE VHF AND EMS FOR RANGING</u> VHF AM-T/R VHF ANT-RIGHT <u>CONFIGURE EMS FOR RANGING</u> EMS FUNCTION-DV SET/VHF RNG EMS MODE-BACKUP/VHF RNG VHF RNG-RESET			9 3	VERIFY VHF VOICE TRANSMISSION LM LIFT-OFF
171:37:24								1 1 9	LM INSERTION
171:44:39									
171:49:XX			17	P00	<u>ACCEPT MSFN UPLINK</u> UP TLM CM-ACCEPT			2 2	
				P27	VERIFY UPLINK ACTIVITY LT-CN MONITOR UPLINK	XX XX	XXXXX XXXXX XXXXX		LM S.V.
				P00	VERIFY UPLINK ACTIVITY LT-CFF UP TLM CM-BLOCK			2 2	
171:51:XX			18	P00	<u>INITIATE P34 AND RNDZ NAVIGATION</u> V37E 34E	BB BB			
				P20					
				P34		F 50 25	00017		R1-MINKEY SELECTION OPTION
				PRO		F 06 37	+00172. +00029. +039.00		R1-TPI GETI(HRS) R2- (MIN) R3- (SEC)
				PRO		F 06 55	+00000. +000.00 +130.00		R1-PRECISION OFFSETS R2-ELEVATION ANG(DEG) R3-TPI/TPF TRANSFER ANG(DEG)

GET H:M:S	L T N G	M S F N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
171:58:46					PRO	F 16 45	+XXB00 -37BXX -00001		R1-MARKS(VHF/OPTICS) R2-TFI(MIN/SEC) R3-NO FINAL COMP CODE
					SET DET IN MDC & LEB			1,122	CSM ENTERS MOON SHADOW
					<u>START SEXTANT MARKING</u> OPTICS ZERO-OFF OPTICS MODE-HAN OHC-CENTER LM IN SXT TAKE 7 SXT MARKS BY TPI-24 MIN			122 122 122	
TPI-24MIN			19	P34	<u>START RECYCLE SEQUENCE</u> OPTICS MODE-CMC			122	
					V32E	F 06 55	+00000. +208.34 +130.00		R1-PRECISION OFFSETS R2-ELEVATION ANG(DEG) R3-TPI/TPF TRANSFER ANG(DEG)
					RECORD DATA				
					PRO	F 06 58	+0008.1 +0073.3 +0033.5		R1-PERILUNE ALT(POST TPI)(NM) R2-DELTA V(TPI)(FPS) R3-DELTA V(TPF)(FPS)
					RECORD DATA				
					PRO	F 06 81	-0070.9 +0000.5 -0018.5		R1-DELTA VX (LV)(FPS) R2-DELTA VY (LV)(FPS) R3-DELTA VZ (LV)(FPS)
					RECORD DATA				
					PRO	F 16 45	+16B07 -21BXX -00001		R1-MARKS (VHF/OPTICS) R2-TFI(MIN/SEC) R3-NO FINAL COMP CODE
					SUPPLY VHF RANGE ON CDR MARK				

GET H:M:S	L T N G	M S F N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
					<u>START SEXTANT MARKING</u> OPTICS ZERO-OFF OPTICS MODE-MAN OHC-CENTER LM IN SXT TAKE 14 SXT MARKS BY TPI-10 MIN			122 122 122	IF NO SXT, V57-LOAD R2=1; CALL N78, LOAD R2=0; V58; V54; VHF ONLY UNTIL TPI-16, THEN VHF/COAS(6).
TPI-13:IN			20	P34	<u>VERIFY DSE TAPE MOTION</u> PCM BIT RATE-LOW TAPE RECORDER RECORD-RECORD TAPE RECORDER FWD-FWD UP TLM CMD-RESET			3 3 3 3	LOSS OF SIGNAL
172:16:20									
TPI-10MIN			21	P34	<u>COMPUTE TPI SOLUTION AND TERMINATE NAV</u> OPTICS MODE-CMC OPTICS ZERO-ZERO PRO RECORD DATA PRO RECORD DATA PRO RECORD DATA PRO	F 06 55 			

GET H:M:S	L T N G	M S F N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
TPI-08MIN			22	P34 P40	<u>BACKUP LM TPI BURN</u> PRO PRO MONITOR MANEUVER <u>ALIGN GDC TO IMU</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=NULL FDAI ERROR NEEDLES ATT SET-GDC GDC ALIGN PB-PUSH UNTIL NEEDLES NULLED FDAI SELECT-1/2 <u>RECORD P76 DATA</u> <u>CONFIGURE EMS</u> EMS MODE-STBY EMS FUNCTION-OFF EMS FUNCTION-DV SET/VHF RNG LOAD 62.3 INTO EMS EMS FUNCTION-DV	F 50 18 06 18 F 50 18	+180.XX +278.XX +002.XX +180.XX +278.XX +002.XX +180.XX +278.XX +002.XX	1 1 1 1 1 1 1 1 1 1 1 1 1 1	IF SXT OR VHF ONLY, OR VHF/COAS, V57-LOAD R2=1 R1-AUTO ATT MNVR; ROLL(DEG) R2-AUTO ATT MNVR; PITCH(DEG) R3-AUTO ATT MNVR; YAW(DEG) ATTITUDE INCLUDES SPS GIMBAL OFFSET AND TRIM OBTAIN TPI P76 FROM CDR TPI DV MINUS TAIL OFF

GET H:M:S	L T N G	M S F N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
					ATT DEADBAND-MIN			1	
					TRANS CONTR PWR-ON(UP)			1	
					MANUAL ATTITUDE(3)-RATE CMD(VERIFY)			1	
					MAIN BUS TIE(2)-ON(UP)			5	
					TVC SERVO POWER 1-AC1/MNA			7	
					2-AC2/MNB			7	
					ROT CONTR PWR NORMAL(BOTH)-AC			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				
					VERIFY MTVC				
					SC CONT-CMC			1	
					THC-CLOCKWISE				
					VERIFY NO MTVC				
					<u>SECONDARY TVC CHECK:</u>				
					SPS GIMBAL MOTORS PITCH 2-START/ON			1	
					YAW 2-START/ON			1	
					SET GPI TRIM				
					VERIFY MTVC				
					THC-NEUTRAL				
					VERIFY NO MTVC				
					VERIFY GPI RETURNS TO 0,0				
					ROT CONTR PWR NORMAL(BOTH)-AC/DC			1	
					ROT CONTR PWR DIRECT(BOTH)-MNA/MNB			1	
					BMAG MODE(3)-RATE 2			1	
				PRO		06 18	+180.XX +278.XX +002.XX		R1-AUTO ATT MNVR; ROLL(DEG) R2-AUTO ATT MNVR; PITCH(DEG) R3-AUTO ATT MNVR; YAW(DEG)
					MONITOR TRIM MANEUVER				

GET H:M:S	L T N G	M S F N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
					BMAG MODE(3)-ATT 1/RATE 2 ENTER	F 50 18	+180.XX +278.XX +002.XX	1	
					PRO	F 50 25	00204		R1-SPS GIMBAL TEST OPTION
					MONITOR GPI RESPONSE:	BB BB			(00,02,-02,00,02,-02,00, TRIM)
						06 40	-XXBXX +0073.4 +0000.0		R1-TFI(MIN/SEC) R2-VG (FPS) R3-DELTA V ACCUMULATED(FPS)
					FDAI SCALE-5/5			1	
					RATE-HIGH			1	
					VERIFY DET SET			1	
TPI-02MIN					THC-ARMED				
					RHC 2-ARMED(VERIFY)				
					PCM BIT RATE-HIGH			3	
TPI-35SEC					MONITOR DSKY BLANK	BB BB			
TPI-30SEC						06 40	-00B30 +0073.4 +0000.0		AVE G ON IF THE LM CANNOT APPLY THE TPI BURN, SEE SECTION 2.3.2 CASE A
					CHECK PIPA BIAS LESS THAN 2 FPS FOR 5 SEC				
TPI-05SEC						F 99 40	-00B05 +0073.4 +0000.0		ENGINE ON ENABLE REQUEST
172:29:39									LM TPI

GET H:M:S	L T N G	M S F N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
172:31:XX					CONFIRM LM BURN COMPLETE ATT DEADBAND-MAX SPS GIMBAL MOTORS(4)-OFF/SEQUENTIALLY TVC SERVO POWER(BOTH)-OFF MAIN BUS TIE(2)-OFF ENTER	F 16 85	+XXXX.X +XXXX.X +XXXX.X	1 1 7 5	R1-BODY VGX(FPS) R2-BCDY VGY(FPS) R3-BCDY VGZ(FPS)
					RATE-LOW EMS FUNCTION-GFF FDAI SCALE- 5/1 TRANS CONTR PWR-GFF ROT CONTR PWR DIRECT(BOTH)-OFF BMAG MODE(3)-RATE 2 PCM BIT RATE-LOW RHC 2-LOCKED THC-LOCKED			1 1 1 1 1 1 3	
					23 P40 <u>UPDATE LM S.V. IN THE CMC</u> PRO P76 PRO	F 06 33 F 06 84	+00172. +00029. +039.00 +0070.6 -0000.5 +0021.0		R1-GETI TPI(HRS) R1- (MIN) R3 (SEC) R1-LM DELTA VX(LV)(FPS) R2-LM DELTA VY(LV)(FPS) R3-LM DELTA VZ(LV)(FPS)
TPI+03MIN			24	P76	<u>INITIATE P35 AND RNDZ NAVIGATION</u> PRO				

GET H:M:S	L T N G	M S F N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
				P35	CONFIGURE EMS FOR RANGING <u>EMS FUNCTION-DV SET/VHF RNG</u> EMS MODE-BACKUP/VHF RNG VHF RNG-RESET <u>START SEXTANT MARKING</u> OPTICS ZERO-OFF OPTICS MODE-MAN OHC-CENTER LM IN SXT TAKE ONE SXT MARK PER MINUTE	F 16 45	+27B21 +03BXX -00001	1 1 9	R1-MARKS(VHF/OPTICS) R2-TFI(MIN/SEC) R3-NO FINAL COMP CODE
TPI+12MIN			25	P35	<u>COMPUTE MCC1 SOLUTION AND TERMINATE NAV</u> OPTICS MODE-CMC OPTICS ZERO-ZERO PRO RECORD DATA PRO	F 06 81	+XXXX.X +XXXX.X +XXXX.X	122 122 122	R1-DELTA VX(LV)(FPS) R2-DELTA VY(LV)(FPS) R3-DELTA VZ(LV)(FPS)
TPI+13MIN			26	P35	<u>BACKUP LM MCC1 BURN</u>	F 16 45	+09B09 -02BXX +XXX.XX		R1-MARKS(VHF/OPTICS) R2-TFI(MIN/SEC) R3-MGA(DEG)
				P41	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)

GET H:M:S	L T N G	M S F N	S T E P	P R O G	OPERATIONS	V-H DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
					ENTER	06 85	+XXXX.X +XXXX.X +XXXX.X		R1-BODY VGX(FPS) R2-BODY VGY(FPS) R3-BODY VGZ(FPS)
MCC-35SEC					MONITOR DSKY BLANK	BB BB			
MCC-30SEC						16 85	+XXXX.X +XXXX.X +XXXX.X		AVE G ON
172:44:39						F 16 85	+XXXX.X +XXXX.X +XXXX.X		IF THE LM CANNOT APPLY THE MCC1 BURN, SEE SECTION 2.3.2 CASE B.
					VERIFY LM BURN COMPLETE				LM MCC1
172:45:08									CSM LEAVES MOON SHADOW
172:45:XX			27	P41 P76	<u>UPDATE LM S.V. IN THE CMC</u> PRO	F 06 33	+00172. +00044. +039.00		R1-GETI MCC1(HRS) R2- (MIN) R3- (SEC)
					PRO	F 06 84	+XXXX.X +XXXX.X +XXXX.X		R1-LM DELTA VX(LV)(FPS) R1-LM DELTA VY(LV)(FPS) R3-LM DELTA VZ(LV)(FPS)
TPI+18MIN			28	P76	<u>INITIATE P35 AND RNDZ NAVIGATION</u>				IF CSM ACTIVE AND TPF DELTA V > 55 FPS, SEE SECTION 2.3.2 CASE C.

GET H:M:S	L T N G	M S F N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
									IF VHF/COAS, V93 BEFORE FIRST MARK
				P35	PRO	F 16 45	+09B09 +03BXX -00001		R1-MARKS(VHF/OPTICS) R2-TFI(MIN/SEC) R3-NO FINAL COMP CODE
					<u>START SEXTANT MARKING</u> OPTICS ZERO-OFF OPTICS MODE-MAN OHC-CENTER LM IN SXT TAKE ONE SXT MARK PER MINUTE			122 122 122	
TPI+27MIN			29	P35	<u>COMPUTE MCC2 SOLUTION AND TERMINATE NAV</u> OPTICS MODE-CMC OPTICS ZERO-ZERO PRO			122 122	
					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)
						F 16 45	+09B09 -02BXX +XXX.XX		R1-MARKS (VHF/OPTICS) R2-TFI(MIN/SEC) R3-MGA(DEG)
TPI+28MIN			30	P35	<u>BACKUP LM MCC2 BURN</u> PRO				
				P41		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)

GET H:M:S	L T N G	M S F N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
MCC-35SEC					MONITOR DSKY BLANK	BB BB			
MCC-30SEC						16 85	+XXXX.X +XXXX.X +XXXX.X		AVE G ON
172:59:39						F 16 85	+XXXX.X +XXXX.X +XXXX.X		IF LM CANNOT APPLY THE MCC2 BURN,SEE SECTION 2.3.2 CASE B.
173:00:XX			31	P41 P76	VERIFY LM BURN COMPLETE <u>UPDATE LM S.V. IN THE CMC</u> PRO	F 06 33	+00172. +00059. +039.00		LM MCC2 R1-GETI MCC2(HRS) R2- (MIN) R3- (SEC)
173:01:XX			32	P76 P79	<u>MANEUVER TO COAS TRACK ATTITUDE</u> PRO PRO	F 06 84 F 50 18	+XXXX.X +XXXX.X +XXXX.X +180.XX +289.XX +000.XX		R1-LM DELTA VX(LV)(FPS) R2-LM DELTA VY(LV)(FPS) R3-LM DELTA VZ(LV)(FPS) 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	M S F N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
173:01:48					MONITOR MANEUVER	06 18	+180.XX +289.XX +000.XX		ACQUISITION OF SIGNAL
173:03:XX			33	P79	<u>ACQUIRE MSFN WITH HGA</u> HIGH GAIN ANTENNA TRACK-MAN SET P&Y POSITIONS S BAND ANTENNA-HI GAIN HIGH GAIN ANTENNA TRACK-AUTO	F 16 54	+XXX.XX -XXXX.X +XXX.XX	2 2 3 2	R1-RANGE(NM) R2-RANGE RATE(FPS) R3-THETA(DEG) RHO= -.57; GAMMA= +45
173:04:XX			34	P79	<u>PERFORM DOCKING PREPARATION ACTIVITIES</u>				

GET H:M:S	L T N G	M S F N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
					<u>PERFORM PRE-DOCK CHECKLIST</u>				
					MANUAL ATTITUDE (3)-RATE CMD (VERIFY)			1	
					LIMIT CYCLE-OFF (VERIFY)			1	
					ATT DEADBAND-MIN			1	
					RATE-LOW(VERIFY)			1	
					TRANS CONTR PWR-ON (UP)			1	
					ROT CONTR PWR DIRECT (BOTH)-MNA/MNB			1	
					SC CONT-CMC (VERIFY)			1	
					CMC MODE -HOLD			1	
					AUTO RCS SELECT (16)-MNA/MNB(VERIFY)			8	
					CB DOCK PROBE(2)-CLOSED			8	
					DOCKING PROBE RETRACT(BOTH)-OFF(CTR) (VERIFY)			2 2	
					DOCKING PROBE-RETRACT			2	
					DOCKING PROBE EXTD/REL TB(2)-GRAY (VERIFY)			2	IF TB NOT GRAY, GO TO CSM SYSTEM'S CHECKLIST PAGE S/2-12, PARAGRAPH 17 E.
					CB SEQ EVENTS CONT SYS(4)-CLOSED			8	
					COAS POWER-CN(UP)(VERIFY)			15	
					EXTERIOR LIGHTS RUN/EVA-ON(UP)(VERIFY)			2	IF CSM ACTIVE BRAKING, SEE SECTION 2.3.2 CASE D
173:09:XX					<u>PHOTOGRAPH LM</u>				
					UTILITY POWER-ON(UP)(VERIFY)			15	
					TV-ON				
					DAC-ON				
					BEGIN PHOTOS WITH DAC AND TV				
173:12:26					<u>CONFIGURE SWITCHES FOR POST TPF</u>				
					EMS MODE-STBY			1	
					EMS FUNCTION-OFF			1	
					EXTERIOR LIGHTS RNDZ-OFF(CTR)			2	

GET H:M:S	L T N G	M S F N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
173:18:XX					<u>TERMINATE LM PHOTOS AND P79</u> PRO OOE P00 DAC-OFF TV-OFF CMC MODE-AUTO 35 P00 <u>MANEUVER TO SIM BAY INSPECTION ATTITUDE</u> V49E V25E +31200E +24800E +E PRO PRO MONITOR MANEUVER ENTER	F 37 BB BB BB F 06 22 F 06 22 F 50 18 06 18 F 50 18 BB BB	+180.XX +289.XX +000.XX +312.00 +248.00 +000.00 +312.00 +248.00 +000.00 +312.00 +248.00 +000.00	1	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	M S F N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
173:26:XX			36	P00	<u>MANEUVER TO DOCKING ATTITUDE</u> V49E V25E +18000E +28900E +E PRO PRO MONITOR MANEUVER ENTER REACQUIRE MSFN HCA	F 06 22 F 06 22 F 50 18 06 18 F 50 18 BB BB	+312.00 +248.00 +000.00 +180.00 +289.00 +000.00 +180.00 +289.00 +000.00 +180.00 +289.00 +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) RHC=-57; GAMMA=+45
173:27:XX			37	P00	<u>ARM PYROS</u> CUE MSFN FOR LOGIC ARM SEQ EVENTS CONT SYSTEM LOGIC(BOTH)- ON(UP) MSFN GO FOR PYRO ARM SEQ EVENTS CONT SYSTEM PYRO ARM(BOTH) ON(UP)			8 8	

GET H:M:S	L T N G	M S F N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
173:31:XX			38	P00	<u>PERFORM DOCKING ACTIVITIES</u> V37E 47E	F 16 83	+0000.0 +0000.0 +0000.0		R1-DELTA VX(FPS) R2-DELTA VY(FPS) R3-DELTA VZ(FPS)
				P47	<u>INITIATE LM PHOTOGRAPHY</u> DAC-ON TV-ON PHOTOGRAPH LM 90° PITCH MNVR				
					<u>TRANSLATE TO CAPTURE LATCH</u> THC-ARMED THC-MINIMUM THRUST FORWARD	F 16 83	+XXXX.X +XXXX.X +XXXX.X		
173:35:00					THC-LOCKED <u>PERFORM AT CAPTURE</u> DOCKING PROBE EXT/REL TB(2)-BP(VERIFY)			2	DOCKING IF TB NOT BP, GO TO CSM SYSTEMS CHECKLIST PAGE S/2-11, PARAGRAPH 17 A.
					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)			1 1	
					PERFORM AT DOCK LATCH DOCKING PROBE EXT/REL TB(2)-GREY (VERIFY)			2 2	WHEN WITHIN ±3° OF DOCKING ATTITUDE
					<u>PERFORM AT HARD DOCK</u> SEQ EVENT CONT SYS PYRO ARM(BOTH)-SAFE LOGIC(BOTH)-OFF CB SEQ EVENTS CONT SYS ARM(2)-OPEN PROBE(2)-OPEN			8 8 8 8	

GET H:M:S	L T N G	M S F N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
173:37:XX					THC-LOCKED				
					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	
					LIMIT CYCLE-ON(UP)			1	
					ATT DEADBAND-MAX			1	
					BMAG MODE(3)-ATT 1/RATE 2			1	
					SC CONT-SCS			1	
					AUTO RCS SELECT B/D ROLL(4)-OFF			8	
					TRANS CONTR PWR-OFF			1	
					ROT CONTR PWR DIRECT (BOTH)-OFF			1	
					<u>TERMINATE LM PHOTOGRAPHY AND P47</u>				
					DAC-OFF				
					TV-OFF				
				PRO		F 37 BB			
				OOE		BB BB			
				P00					
				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. +05900.		R1-CSM WEIGHT(LBS) R2-LM WEIGHT(LBS).
				PRO		F 06 48	±XXX.XX ±XXX.XX		R1-GIMBAL PITCH TRIM(DEG) R2-GIMBAL YAW TRIM(DEG)
				PRO		BB BB			

GET H:M:S	L T N G	M S F N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
173:38:XX			40	P00	<u>CONFIGURE SWITCHES FOR POST-DOCKING</u> CMC MODE-AUTO SC CONT-CMC BMAG MODE(3)-RATE 2 RNDZ XPNDR-OFF			1 1 1 100	

2.3.2 CONTINGENCY DETAILED PROCEDURES

The CSM is the passive vehicle during the nominal rendezvous. However, conditions could necessitate the CSM becoming the active vehicle during one or more events of the rendezvous. The contingency procedures contained in this section cover the following CSM active operations:

- A. CSM Active TPI Burn (PAGE 44)
- B. CSM Active MCC Burn (PAGE 46)
- C. CSM Active TPF With TPF Delta V > 55 fps (PAGE 47)
- D. CSM Active Braking (PAGE 55)

CASE A

GET H:M:S	L T N G	M S F N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
					***** CSM ACTIVE TPI BURN *****				
				P40	VERIFY NO LM BURN DV THRUST A(B)-NORMAL EMS MODE-NORMAL THC-APPLY ULLAGE			1 1	
TIG-11SEC TIG-05SEC						F 99 40	-00B05 +XXXX.X +XXXX.X		R1-TFI (MIN/SEC) R2-VG(FPS) R3-DELTA V ACCUMULATED(FPS)
				PRO		06 40	+00BXX +XXXX.X +XXXX.X		
TIG					THC-TERMINATE ULLAGE AT(TIG+1SEC) MONITOR CSM TPI BURN	F 16 40	+00BXX +XXXX.X +XXXX.X		
					DV THRUST(2)-OFF PRO			1	
						F 16 85	+XXXX.X +XXXX.X +XXXX.X		R1-BODY VGX(FPS) R2-BODY VGY(FPS) R3-BODY VGZ(FPS)
					THC-NULL RESIDUALS	F 16 85	+0000.0 +0000.0 +0000.0		
					SPS GIMBAL MOTORS(4)-OFF/SEQUENTIALLY TVC SERVO POWER(BOTH)-OFF MAIN BUS TIE(2)-OFF EMS FUNCTION-OFF EMS MODE-STBY TRANS CONTR PWR-OFF ROT CONTR PWR DIRECT(BOTH)-OFF BMAG MODE(3)-RATE 2 FDAI SCALE-5/1			1 7 5 1 1 1 1 1 1	

CASE A

GET H:M:S	L T N G	M S F N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
					RATE-LOW PCM BIT RATE-LOW RHC 2-LOCKED THC-LOCKED P40 <u>UPDATE LM S.V. IN THE CMC</u> PRO PRO ***** CONTINUE WITH STEP 24 OF NOMINAL RNDZ PROCEDURES *****	F 06 33 F 06 84	+00172. +00029. +039.00 +0000.0 +0000.0 +0000.0	1 3	R1-GETI TPI(HRS) R2- (MIN) R3- (SEC) 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	M S F N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
TIG					* * * * * CSM ACTIVE MCC BURN * * * * *				
				P41	<u>VERIFY NO LM BURN</u> THC-ARMED RHC 2-ARMED THC-NULL VG'S RHC 2-LOCKED THC-LOCKED	F 16 85 F 16 85	+XXXX.X +XXXX.X +XXXX.X +0000.0 +0000.0 +0000.0		R1-BODY VGX(FPS) R2-BODY VGY(FPS) R3-BODY VGZ(FPS)
				P41	<u>UPDATE LM S.V. IN THE CMC</u>				
				P76	PRO	F 06 33	+00XXX. +000XX. +0XX.XX		R1-GETI MCC(HRS) R2- (MIN) R3- (SEC)
					PRO	F 06 84	+0000.0 +0000.0 +0000.0		R1-LM DELTA VX(LV)(FPS) R2-LM DELTA VY(LV)(FPS) R3-LM DELTA VZ(LV)(FPS)
					* * * * * CONTINUE WITH STEP 28(32) OF NOMINAL RNDZ PROCEDURES * * * * *				

CASE C

GET H:M:S	L T N G	M F N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
TPI+18MIN				P76 P20 P34	***** CSM ACTIVE TPF WITH TPF DELTA V > 55 FPS ***** INITIATE P34 V37E 34E V93E PRO V25E +173E +6E +3900E PRO COMPUTE TRANSFER ANG=(TPF DELTA V)/2 V23E +XXXXXE PRO	F 50 25 F 06 37 F 06 37 F 06 55 F 06 55 F 16 45	00017 +00172. +00029. +039.00 +00173. +00006. +039.00 +00000. +000.00 +130.00 +00000. +000.00 +XXX.XX +XXB00 -XXBXX -00001		REINITIALIZE THE W-MATRIX R1-MINKEY SELECTION OPTION R1-GETI TPI(HRS) R2- (MIN) R3- (SEC) R1-GETI TPI(2)(HRS) R2- (MIN) R3- (SEC) R1-PRECISION OFFSETS R2-ELEVATION ANG(DEG) R3-TPI/TPF TRANSFER ANG(DEG) R1-MARKS(VHF/OPTICS) R2-TFI(MIN/SEC) R3-NO FINAL COMP CODE

CASE C

GET H:M:S	L T N G	M S F N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
TPI+20MIN				P34	<u>INITIATE SXT NAVIGATION</u> OPTICS ZERO-OFF OPTICS MODE-MAN OHC-CENTER LM IN SXT TAKE ONE SXT MARK PER MIN			122 122 122	
TPI+26MIN				P34	<u>TERMINATE MARKING</u> OPTICS MODE-CMC OPTICS ZERO-ZERO			122 122	
TPI+27MIN				P34	<u>COMPUTE P34 SOLUTION</u> PRO	F 06 55	+00000. +XXX.XX +XXX.XX		R1-PRECISION OFFSETS R2-ELEVATION ANG(DEG) R3-TPI/TPF TRANSFER ANG(DEG)
					RECORD DATA PRO	F 06 58	+XXXX.X +XXXX.X +XXXX.X		R1-PERILUNE ALT(POST-TPI)(NM) R2-DELTA V TPI(2)(FPS) R3-DELTA V TPF(FPS)
					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)
					RECORD DATA PRO	F 16 45	+XXBXX -XXBXX +XXX.XX		R1-MARKS(VHF/OPTICS) R2-TFI(MIN/SEC) R3-MGA(DEG)
					PRO	F 37 BB			

CASE C

GET H:M:S	L T N G	M F N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
TPI+30MIN				P34	<u>RECONFIGURE DAP</u> V48E	F 04 46	11102 X1111		R1-DAP CONFIGURATION R2-DAP CONFIGURATION
					V21E 11103E	F 04 46	11103 X1111		
					PRO	F 06 47	+XXXXX. +XXXXX.		R1-CSM WEIGHT(LBS) R2-LM WEIGHT(LBS)
					PRO	F 06 48	+XXX.XX +XXX.XX		R1-GIMBAL PITCH TRIM(DEG) R2-GIMBAL YAW TRIM(DEG)
					PRO	F 37 BB			
				P34	<u>INITIATE P40 THRUSTING PROGRAM</u> 40E	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)
				P40					
					PRO	06 18	+XXX.XX +XXX.XX +XXX.XX		
					MONITOR MANEUVER	F 50 18	+XXX.XX +XXX.XX +XXX.XX		
TPI+32MIN					<u>CONFIGURE EMS</u> EMS MODE-STBY EMS FUNCTION-OFF EMS FUNCTION-DV SET/VHF RNG LOAD(DV MINUS 11 FPS)IN EMS EMS FUNCTION-DV ATT DEADBAND-MIN TRANS CONTR PWR-ON(UP)			1 1 1 1 1 1 1	

CASE C

GET H:M:S	L T N G	M S F N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
					MANUAL ATTITUDE(3)-RATE CMD(VERIFY) MAIN BUS TIE(2)-ON(UP) TVC SERVO POWER 1-AC1/MNA 2-AC2/MNB ROT CONTR PWR NORMAL(BOTH)-AC BMAG MODE(3)-ATT 1/RATE 2 SC CONT-SCS RHC 2-ARMED			1 5 7 7 1 1 1	
					PRIMARY TVC CHECK: <u>SPS GIMBAL MOTORS</u> 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 1	
					SECONDARY TVC CHECK: <u>SPS GIMBAL MOTORS</u> 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 PRO			1 1 1 1 1	
						06 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)
					MONITOR TRIM MANEUVER	F 50 18	+XXX.XX +XXX.XX +XXX.XX		
					BMAG MODE(3)-ATT 1/RATE 2			1	

CASE C

GET H:M:S	L T N G	M S F N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
					ENTER				
					PRO	F 50 25	00204		R1-SPS GIMBAL DRIVE OPTION
					MONITOR GPI RESPONSE:	BB BB			(00,02,-02,00,02,-02,00,TRIM)
					FDAI SCALE-5/5 RATE-HIGH(VERIFY) VERIFY DET SET THC-ARMED RHC 2-ARMED(VERIFY) PCM BIT RATE-HIGH	06 40	+XXBXX +XXXX.X +0000.0	1 1 1	R1-TFI(MIN/SEC) R2-VG(FPS) R3-DELTA V ACCUMULATED(FPS)
TPI+35MIN					MONITOR DSKY BLANK	BB BB		3	
TIG-35SEC						06 40	-00B30 +XXXX.X +0000.0		AVE G ON
TIG-30SEC					DV THRUST A(B)-NORMAL EMS MODE-NORMAL THC-APPLY ULLAGE			1 1	
TIG-11SEC TIG-05SEC					PRO	F 99 40	-00B05 +XXXX.X +XXXX.X		
						06 40	-00BXX +XXXX.X +XXXX.X		
TIG					THC-TERMINATE ULLAGE AT(TIG +1SEC) MONITOR CSM TPI BURN	F 16 40	+00BXX +XXXX.X +XXXX.X		
					DV THRUST(2)-OFF			1	

CASE C

GET H:M:S	L T N G	M S F N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
TPI+38MIN					PRO	F 16 85	+XXXX.X +XXXX.X +XXXX.X		R1-BODY VGX(FPS) R2-BODY VGY(FPS) R3-BODY VGZ(FPS)
					THC-NULL RESIDUALS	F 16 85	+0000.0 +0000.0 +0000.0	1 1 1 7 5 1 1 1 1 1 3	
					RATE-LOW FDAI SCALE-5/1 SPS GIMBAL MOTORS(4)-OFF/SEQUENTIALLY TVC SERVO POWER(BOTH)-OFF MAIN BUS TIE(2)-OFF EMS FUNCTION-OFF EMS MODE-STBY ATT DEADBAND-MAX TRANS CONTR PWR-OFF ROT CONTR PWR DIRECT(BOTH)-OFF BMAG MODE(3)-RATE 2 PCM BIT RATE-LOW RHC 2-LOCKED THC-LOCKED				
				P40	MANEUVER TO COAS TRACK ATTITUDE				
				P79	V37E 79E	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)
					PRO	06 18	+XXX.XX +XXX.XX +XXX.XX		
					MONITOR MANEUVER	F 16 54	+XXX.XX -XXXX.X +XXX.XX		R1-RANGE(NM) R2-RANGE RATE(FPS) R3-THETA(DEG)

CASE C

GET H:M:S	L T N G	M S F N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
TPI+39MIN				P79	ACQUIRE MSFN WITH HGA HIGH GAIN ANTENNA TRACK-MAN SET P&Y POSITIONS S BAND ANTENNA-HI GAIN HIGH GAIN ANTENNA TRACK-AUTO			2 2 3 2	
TPI+40MIN				P79	RECONFIGURE DAP PRO	F 37 BB			
				P00	OOE	BB BB			
					V48E	F 04 46	11103 X1111		R1-DAP CONFIGURATION R2-DAP CONFIGURATION
					V21E 11102E	F 04 46	11102 X1111		
					PRO	F 06 47	+XXXXX. +XXXXX.		R1-CSM WEIGHT(LBS) R2-LM WEIGHT(LBS)
					PRO	F 06 48	±XXX.XX ±XXX.XX		R1-GIMBAL PITCH TRIM(DEG) R2-GIMBAL YAW TRIM(DEG)
					PRO	BB BB			
				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(UP) 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)-CLOSED DOCKING PROBE RETRACT(BOTH)-OFF(CTR) (VERIFY)			1 1 1 1 1 1 1 1 8 8 2	

CASE C

GET H:M:S	L T G	M S F N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
					DOCKING PROBE-RETRACT DOCKING PROBE EXTD/REL TB(2)-GRAY (VERIFY)			2 2	IF TB NOT GREY, GO TO CSM SYSTEMS CHECKLIST PAGE S/2-12, PARAGRAPH 17 E.
					CB SEQ EVENTS CONT SYS(4)-CLOSED(VERIFY) COAS POWER-ON(UP)(VERIFY) EXTERICR LIGHTS RUN/EVA-ON(UP)(VERIFY)			8 15 2	
					<u>PHOTOGRAPH LM</u> UTILITY POWER-ON(UP)(VERIFY) TV-ON DAC-ON BEGIN PHOTOS WITH DAC AND TV			15	IF CSM ACTIVE BRAKING, SEE SECTION 2.3.2 CASE D
					<u>CONFIGURE SWITCHES FOR POST TPF</u> EMS MODE-STBY EMS FUNCTION-OFF EXTERIOR LIGHTS RNDZ-OFF(CTR)			1 1 2	
					<u>TERMINATE LM PHOTO</u> DAC-OFF TV-OFF				TPF
					***** CONTINUE WITH STEP 35 OF NOMINAL RNDZ PROCEDURES *****				

CASE D

GET H:M:S	L T N G	M S F N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
					***** CSM ACTIVE BRAKING *****				
			PXX		INITIATE THRUST MONITOR PROGRAM				
					MONITOR EMS RANGE UNTIL 1.25NM				
			P47		V37E 47E	F 16 83	+0000.0 +0000.0 +0000.0		PERFORM WHEN RANGE = 1.25NM R1-DELTA VX(FPS) R2-DELTA VY(FPS) R3-DELTA VZ(FPS)
					SM RCS SEC PRPLNT FUEL PRESS(4)-OPEN			2	
					V83E	F 16 54	+001.XX -XXXX.X +XXX.XX		R1-RANGE(NM) R2-RANGE RATE(FPS) R3-THETA(DEG)
					THC-ARMED RHC 2-ARMED				
					MONITOR EMS RANGE UNTIL 1.11NM (APPROX)				
				N83E		F 16 83	+0000.0 +0000.0 +0000.0		KEY RELEASE LT-ON

CASE D

GET H:M:S	L T N G	M S F 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 FT/SEC AT 1.00NM KEY "KEY RELEASE"	F 16 54	+001.00 -0030.0 +XXX.XX		KEY RELEASE LT-OFF
					THC-NUL LINE-OF-SIGHT RATES MONITOR EMS RANGE UNTIL 0.65NM (APPROX) N83E	F 16 83	+XXXX.X +XXXX.X +XXXX.X		KEY RELEASE LT-ON
					MONITOR F 16 83, R1 THC-THRUST AFT TO REDUCE RDOT TO -20.0 FT/SEC AT 0.50NM KEY "KEY RELEASE"	F 16 54	+000.50 -0020.0 +XXX.XX		KEY RELEASE LT-OFF
					THC-NUL LINE-OF-SIGHT RATES MONITOR EMS RANGE UNTIL 0.35NM (APPROX) N83E	F 16 83	+XXXX.X +XXXX.X +XXXX.X		KEY RELEASE LT-ON
					MONITOR F 16 83, R1 THC-THRUST AFT TO REDUCE RDOT TO -10.0 FT/SEC AT 0.25NM				

CASE D

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

CASE D

GET H:M:S	L T N G	M S F N	S T E P	P R O G	OPERATIONS	V-N DISPLAY	REGISTER DISPLAYS	STA PANEL	COMMENTS
173:09:XX				P47	<u>MAINTAIN STATION KEEPING</u>				
				P47	<u>PHOTOGRAPH LM</u> UTILITY POWER-CN(UP)(VERIFY) TV-ON DAC-ON BEGIN PHOTOS WITH DAC AND TV			15	
173:12:26				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> V37E 00E				
				P00	DAC-OFF TV-OFF CMC MODE-AUTO ***** CONTINUE WITH STEP 35 OF NOMINAL RNDZ PROCEDURES *****	BB BB		1	

TPF

3.0 ACRONYMS AND ABBREVIATIONS

AC	Alternating Current
ACCEL	Acceleration
AGS	Abort Guidance System
ALT	Altitude
AM	Amplitude Modulation
AMPL	Amplifier
ANG	Angle
ANGL	Angle
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
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
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

4.0 REFERENCES

1. Apollo 15 Flight Plan for 26 July 1971 Launch (Change B); dated 14 June 1971.
2. Apollo 15 CSM Rescue Book (Change A); dated 22 June 1971.
3. Apollo 15 CSM G&C Checklist (Change A); dated 24 May 1971.
4. Apollo 14 CSM Rendezvous Procedures (Final), MSC-03887; dated 8 January 1971.
5. Apollo Operations Handbook - Command and Service Module - Volume 2, SM2A-03-BLOCK II-J - (2); dated 25 March 1971.
6. CSM/LM Spacecraft Operational Data Book, Volume III, SNA-8-D-027, Revision 3; dated 1 April 1971.
7. Spacecraft Operational Trajectory for Apollo 15 Launched 26 July 1971, Volume I; MSC Internal Note No. 71-FM-130; dated 16 April 1971.
8. Guidance System Operations Plan for Manned CM Earth Orbital and Lunar Missions Using Program COLOSSUS 3, Section 4, Revision 16; dated March 1971.
9. Moore, R. H., MSC Memorandum 71-FM64-26, "Apollo 15 Rendezvous Data for Flight Planning"; dated 1 April 1971.

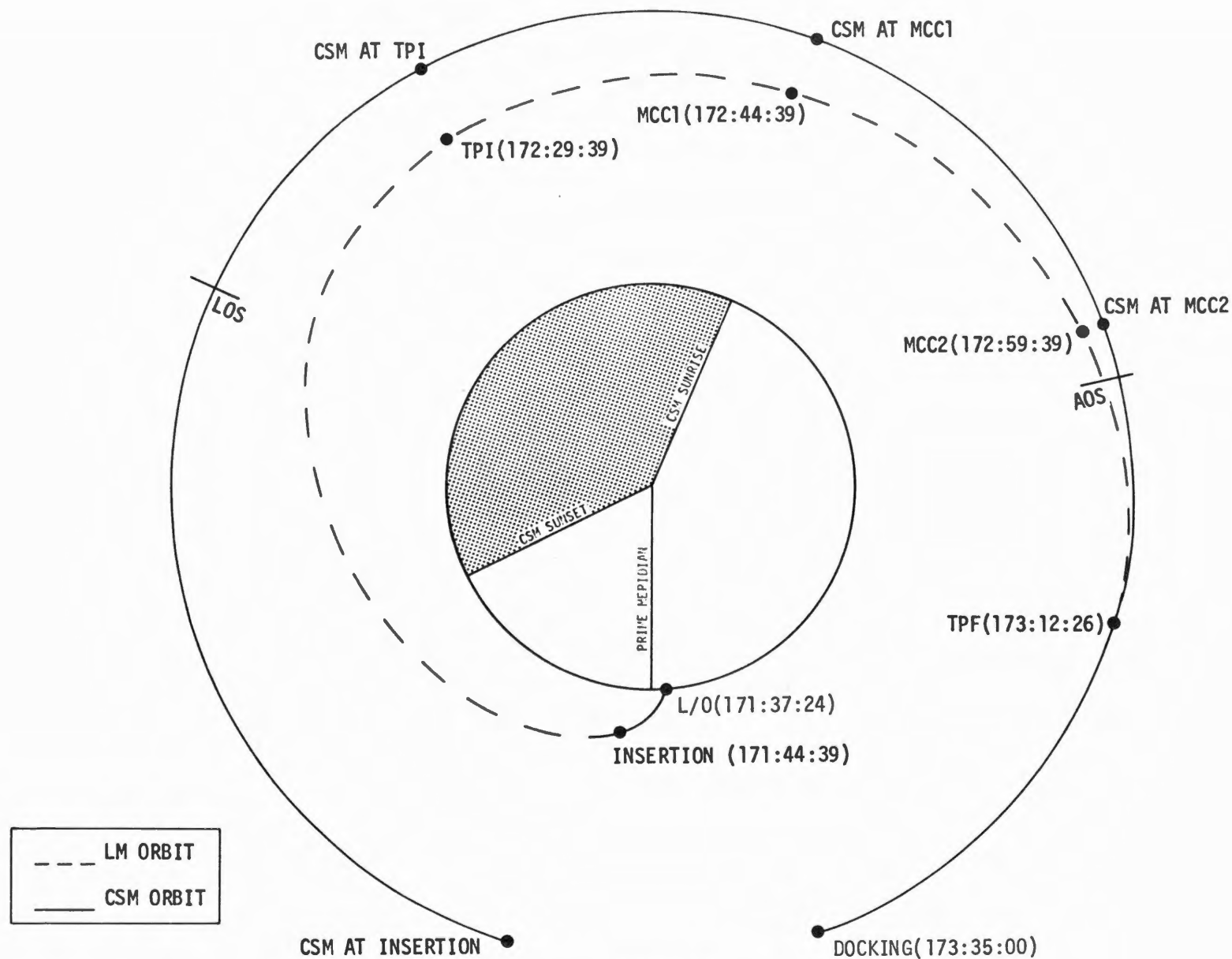
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APPENDIX A

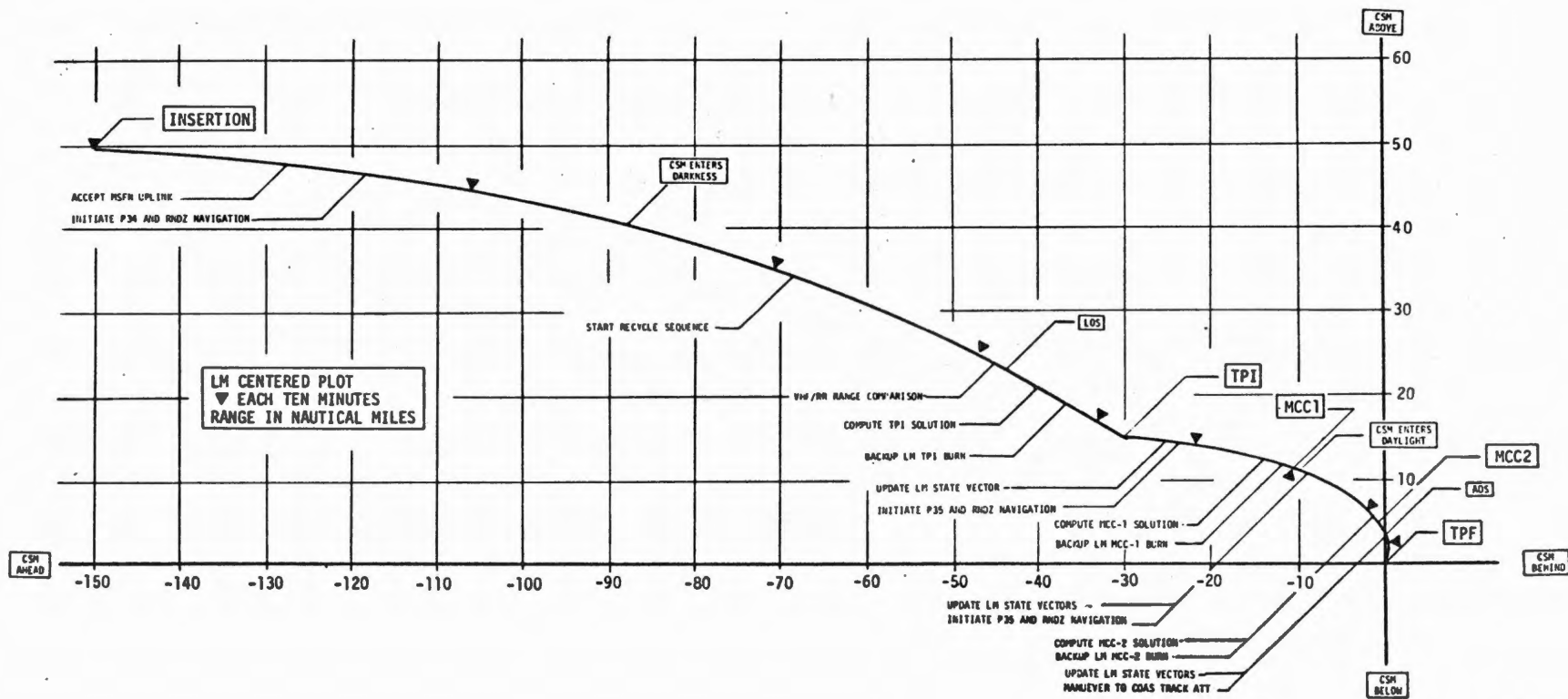
DIRECT ASCENT RENDEZVOUS TRAJECTORY MOTION PLOTS

An orbital motion and a relative motion plot for the nominal Apollo 15 rendezvous are contained in this appendix.

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.



APOLLO 15
DIRECT ASCENT RENDEZVOUS
ORBITAL MOTION PLOT



APOLLO 15
DIRECT ASCENT RENDEZVOUS
RELATIVE MOTION PLOT

APPENDIX A

-4-

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APPENDIX B

CMP RENDEZVOUS NAVIGATION SCHEDULES

Approximately two hours prior to lift-off, the ground uplinks to the CMC the predicted CSM state vector at lift-off and the predicted LM state vector at insertion +18 minutes. The CMP improves the CMC's knowledge of the LM state vector by allowing the incorporation of sextant and VHF mark data into the onboard computer.

Figure B-1 contains the nominal marking schedule and the schedules for VHF, sextant, and LM tracker light failures. Marking periods are indicated by diagonal lines in the column for the appropriate instrument. Marks are taken at one per minute except for the sextant marks after sunshifting when seven marks are taken in six minutes and after the recycle when fourteen marks are taken in eleven minutes. "AUTO" in the WRI column indicates an automatic W-matrix reinitialization by MINKEY and "V93" indicates a manual reinitialization by the CMP. A "V57" in the WRI column indicates that the CMP must initiate the MINKEY "failed sensor" W-matrix reinitialization option. The initial diagonal values of the W-matrix are 10,000 feet and 10 fps. Upon entering the first pre-thrust program final comp, the diagonal values are redefined by MINKEY to be 2,000 feet and 2 fps.



FIGURE B-1. CMP RENDEZVOUS MARKING SCHEDULES

APPENDIX C

CSM ATTITUDE REQUIREMENTS
FOR
THE APOLLO 15 RENDEZVOUS

The Apollo 15 CSM G&N rendezvous attitude requirements begin approximately two hours prior to LM lift-off and continue until docking.

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

Figures C-1, C-2, and C-3 present the CSM attitude history for REVS 47, 48, and 49, respectively.

GET (HRS:MIN:SEC)	EVENT	INERTIAL ATTITUDE		MANEUVER TIME (MIN:SEC)
		START (ROLL,PITCH,YAW)	STOP (ROLL,PITCH,YAW)	
169:48:XX	MNVR TO COAS CALIB ATT	(0,242,0)	(180,224,016)	06:00
169:56:XX	MSFN UPLINK	(180,224,016)		
170:01:XX	P52 (OPTION 3)	(180,224,016)		
170:06:XX	COAS CALIB	(180,224,016)		
171:14:XX	MNVR TO COMM/P20 TRACK ATT	(180,224,016)	(180,042,0)	06:00
171:49:XX	MSFN UPLINK (IF REQ'D)	(180,042,0)		
171:51:XX	TRIM TO PREFERRED AXIS TRACK ATT	(180,042,0)	(180,042,0)	00:00
171:51:XX	TRACK LM	(180,042,0)	(180,315,0)	29:00
172:21:XX	MNVR TO TPI BURN ATT	(180,315,0)	(180,278,2)	01:10
172:29:39	TPI BURN	(180,278,2)		
172:32:XX	MNVR TO PREFERRED AXIS TRACK ATT	(180,278,2)	(180,285,0)	00:10
172:32:XX	TRACK LM	(180,285,0)	(180,264,0)	11:20
172:44:39	MCC-1 BURN	(180,264,0)		
172:47:XX	MNVR TO PREFERRED AXIS TRACK ATT	(180,264,0)	(180,259,0)	00:10
172:47:XX	TRACK LM	(180,259,0)	(180,253,0)	11:20
172:59:39	MCC-2 BURN	(180,253,0)		
173:01:XX	MNVR TO COAS TRACK ATT	(180,253,0)	(180,288,0)	01:10
173:12:26	TPF	(180,289,0)		
173:18:XX	MNVR TO SIM BAY INSPECTION ATT	(180,289,0)	(312,248,0)	05:00
173:26:XX	MNVR TO DOCKING ATT	(312,248,0)	(180,289,0)	05:00
173:35:XX	DOCKING	(180,289,0)		

TABLE C-1. APOLLO 15 CSM MANEUVER REQUIREMENTS FOR DIRECT ASCENT RENDEZVOUS

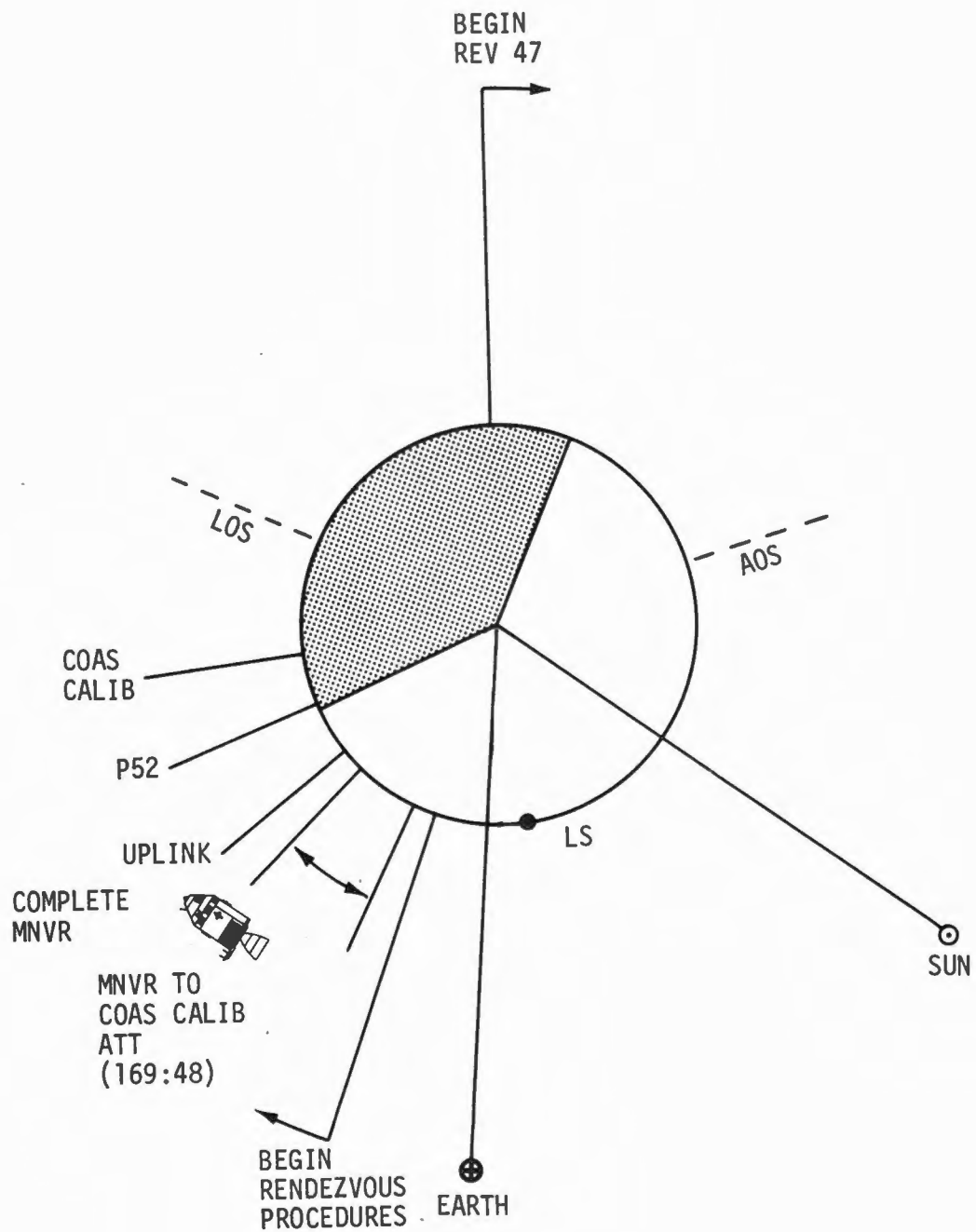


FIGURE C-1. CSM ATTITUDE HISTORY FOR REV 47.

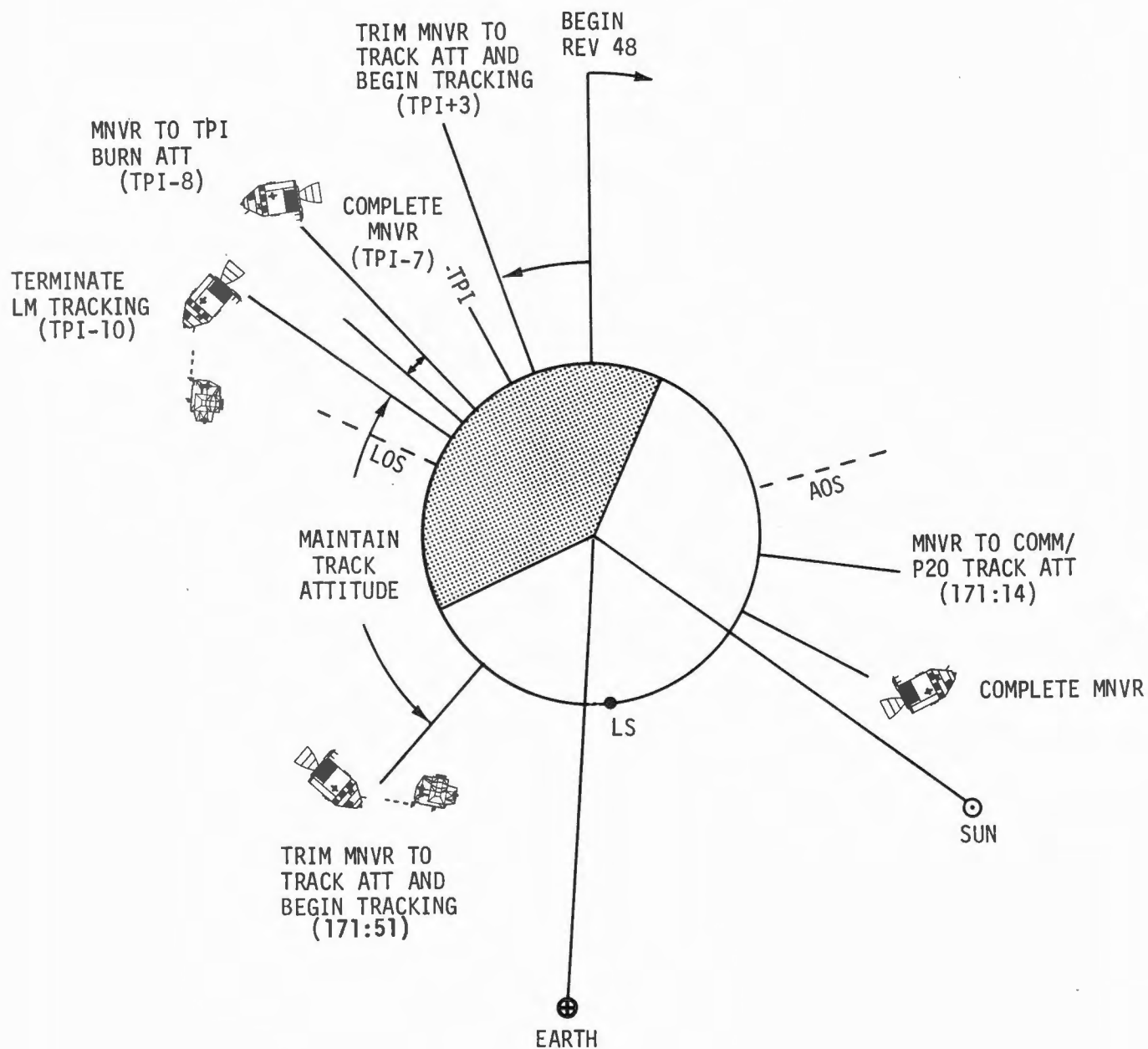


FIGURE C-2. CSM ATTITUDE HISTORY FOR REV 48.

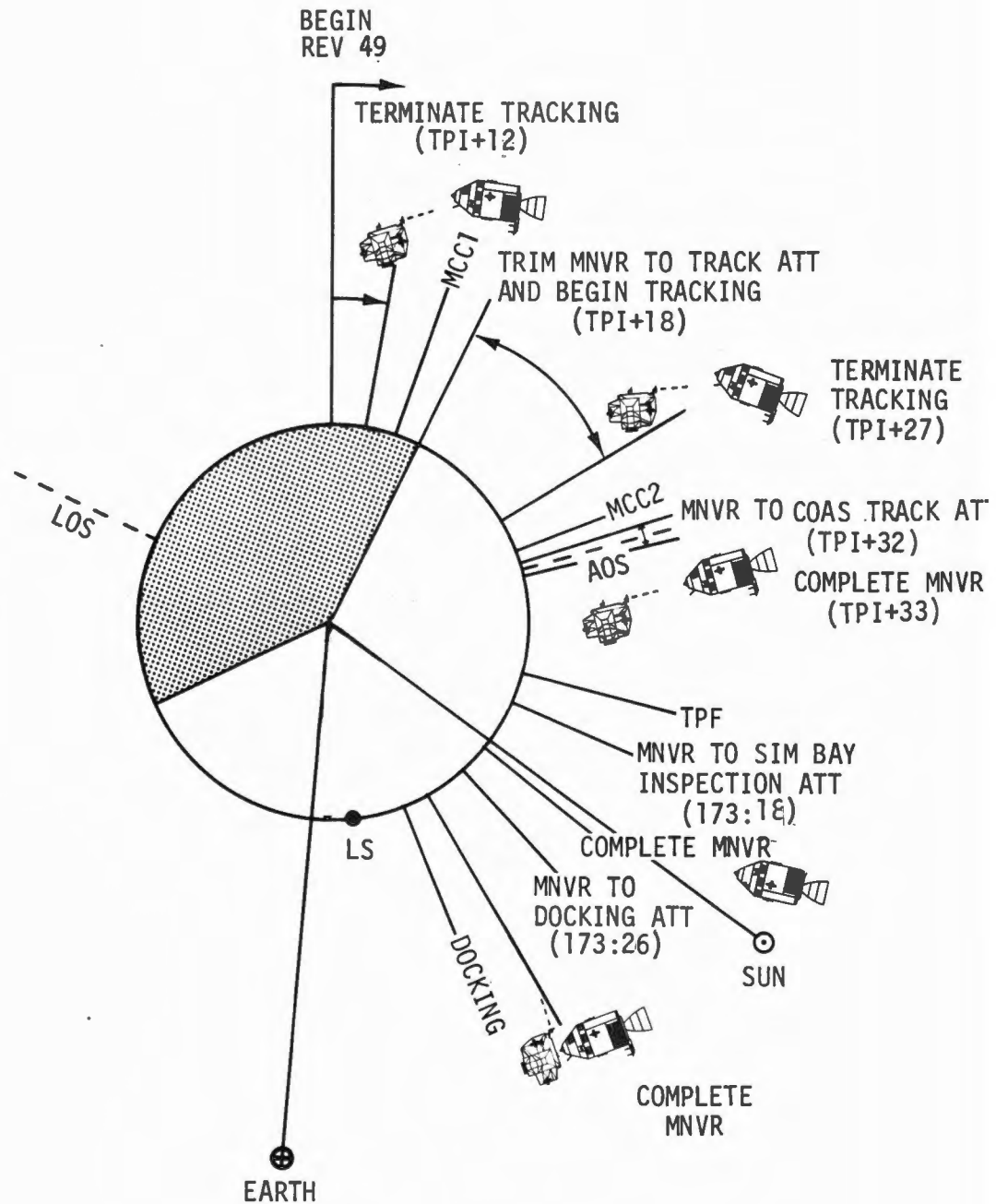


FIGURE C-3. CSM ATTITUDE HISTORY FOR REV 49.

APPENDIX C

-6-

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APPENDIX D

CMP INTERFACE REQUIREMENTS

FOR

THE APOLLO 15 RENDEZVOUS

During a rendezvous, data must constantly be transferred between MSFN, CSM and LM. This appendix documents the data concerning the CMP to be exchanged during the rendezvous.

TIME	MSFN	CMP	CDR/LMP
169:54	VERIFY	ACQUIPE MSFN WITH HGA	
169:56	UPLINK TO CMC: LM S.V. FOR INS+18 CSM S.V. FOR L/O RESET SURFACE FLAG	ACCEPT	
	UPDATE TO CMP: CONSUMABLES (IF REQ'D) CSM S.V. FOR L/O	COPY	
	UPDATE TO LM: LM CONSUMABLES DIRECT ASCENT PAD CSM WEIGHT COELLIPTIC RNDZ PAD	COPY AS REQUIRED COPY COPY COPY	COPY
170:06	COPY	REPORT P52 GYRO TORQUING ANGLES	
170:18	START DSE	VERIFY	
	ENABLE MSFN S-BAND RELAY	VERIFY	VERIFY
171:04	DSE DUMP	ACQ MSFN WITH HGA	
171:31	GO/NO-GO FOR L/O	ACKNOWLEDGE	ACKNOWLEDGE
		CHECK VHF COMM WITH LM	ACKNOWLEDGE
	DISABLE MSFN S-BAND RELAY	GO VHF COMM	GO VHF COMM

TIME	MSFN	CMP	CDR/LMP
171:49	UPLINK TO CMC LM S.V.	ACCEPT	
TPI-33 MIN		REQUEST LM TRACKER LT STATUS	VERIFY LM TRACKER LT ON
TPI-21 MIN		SUPPLY TPI SOLUTION AT CDR REQUEST	COMPARE TPI SOLUTIONS
		SUPPLY VHF RANGE AT CDR REQUEST	COMPARE VHF AND RR RANGES
172:16	START DSE	VERIFY	
TPI-6 MIN		SUPPLY TPI SOLUTION AT CDR REQUEST	COMPARE TPI SOLUTIONS
		REQUEST TPI P76 PAD FROM CDR	SUPPLY P76 PAD TO CMP
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	SUPPLY P76 PAD TO CMP

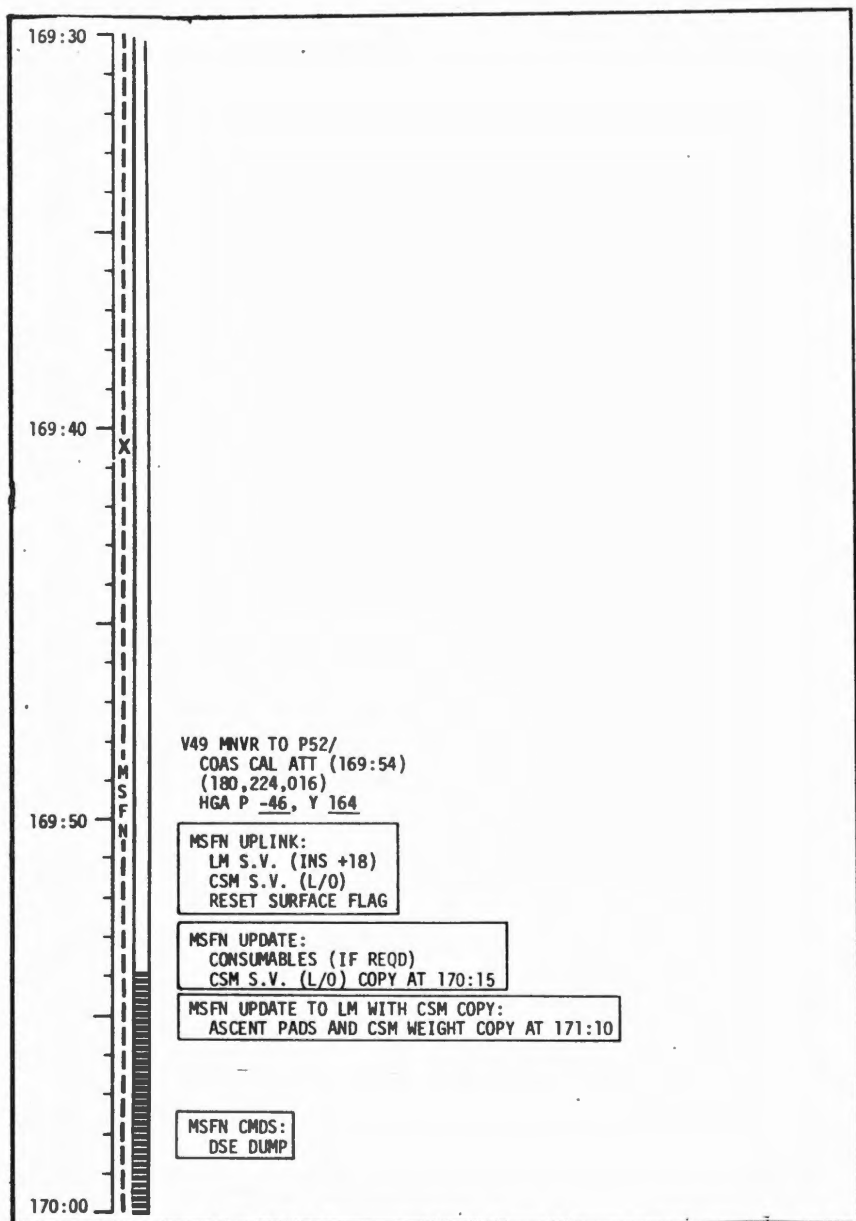
TIME	MSFN	CMP	CDR/LMP
MCC-1		ACKNOWLEDGE	VERIFY GOOD MCC-1 BURN TO CMP
TPI+28 MIN		SUPPLY MCC-2 SOLUTION AT CDR REQUEST	REQUEST MCC-2 SOLUTION
		REQUEST MCC-2 P76 PAD FROM CDR	SUPPLY P76 PAD TO CMP
MCC-2		ACKNOWLEDGE	VERIFY GOOD MCC-2 BURN TO CMP
173:03	DSE DUMP	ACQUIRE MSFN WITH HGA	
173:27	VERIFY SWITCH 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 E

FLIGHT DATA FILE

NOMINAL RENDEZVOUS PROCEDURES

The Apollo 15 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 15 FLIGHT PLAN.



170:00
(11112)
(X1111)

H₂ PURGE LINE HEATERS - ON
P52 (OPTION 3)
(LIFT-OFF ORIENT)
REPORT: GYRO TORQUING ANGLES

P52 (COAS CALIB)
USE STAR NO. 41

170:10

POO
GDC ALIGN
VERIFY ORDEAL

CONFIGURE CAMERAS: (DOCKING)

GAMMA RAY*
ALPHA PART*

CM2/DAC/18/CEX-BRKT,MIR (T8,1/250,=) 6 fps (40% MAG)

MAG (C) _____ MAG % _____
UTILITY PWR - ON

MSFN CMDS:
DSE RECORD

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

MSFN ENABLES MSFN S-BAND RELAY

170:20

CM/EL/80/CEX (f8,1/250,FOCUS) (10 FR)

MAG (Q) _____, FR # _____

CM4/TV-BRKT
(f44, PEAK) 11 MIN (ZOOM - 75MM)

H₂ AND O₂ FUEL CELL PURGE
WASTE WATER DUMP
URINE DUMP

P52 IMU REALIGN

N71: _____

N05: _____

N93: _____

X _____

Y _____

Z _____

GET _____

COAS CALIB - N92

SHAFT: _____

TRUN: _____

CSM S.V. (L/O) P27 UPDATE

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

170:30

170:30
(11112)
(X1111)

DON PGA WITHOUT HELMET AND GLOVES

UNSTOW JETTISON BAG (R13)
PACK JETTISON ITEMS (4 L10H CANISTERS FROM A9)
INSTALL CABIN FAN LUNAR DUST FILTER (PGA BAG)
INSTALL SPRINGS AND CLIPS ON A8, A6, A3, AND PNL 350
INSTALL TEMP STOWAGE BAGS ON LH AND RH SIDES OF LEB
REMOVE B5 AND B6 POUCHES
REMOVE COVERALLS, CWG AND INSTALL T-ADAPTERS
UNSTOW AND ASSEMBLE:
VACUUM CLEANER, PWR CABLE, HOSE AND BAG (SIDE A12, SIDE A8)
REMOVE DECONTAMINATION BAGS (A8, U1)
H₂ PURGE LINE HEATERS - OFF

170:40

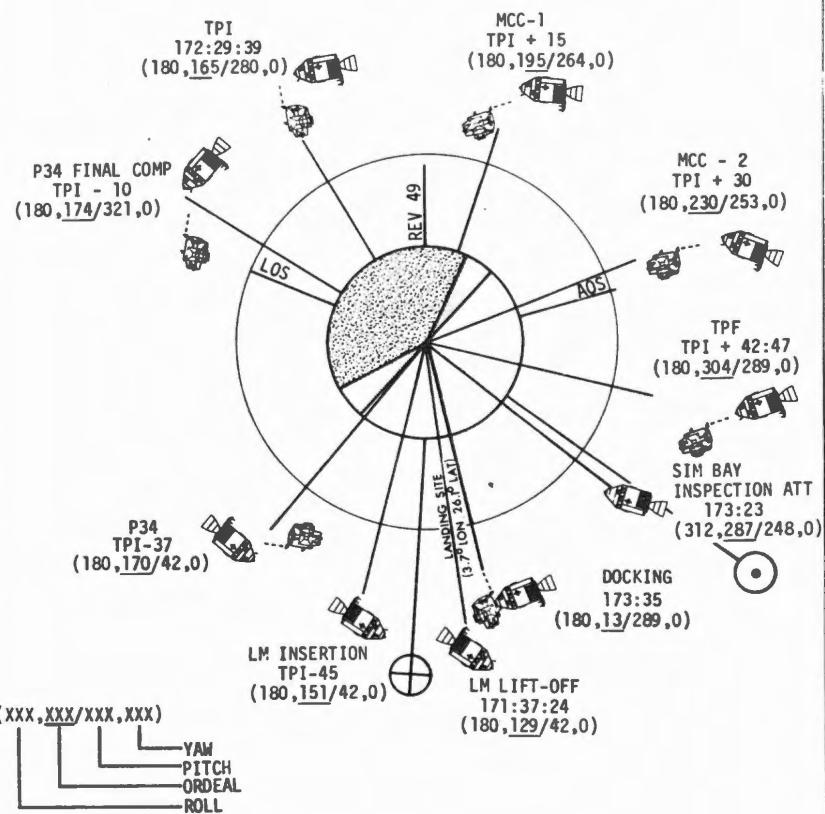
REV 48

GAMMA RAY*
ALPHA PART*

EAT PERIOD

170:50

171:00



171:00
(11112)
(X1111)

AUTO RCS SEL (16) - MNA/MNB

ACQ MSFN HGA P -46, Y 164

MSFN CMDS:
DSE DUMP

171:10

VHF AM B - DUPLEX (VERIFY)
VHF AM A - OFF (CTR) (VERIFY)
VHF RANGING - ON(UP)
VHF ANT - LEFT
RNDZ XPNDR - PWR
EXT LIGHTS RUN/EVA - ON (UP)
EXT LIGHTS RNDZ - RNDZ

GAMMA RAY*
ALPHA PART*

(11102)
(X1111)

CYCLE CMC MODE - FREE/AUTO
V48 (11102)
(X1111)
LOAD CSM AND LM WT
V49 MNVR TO P20 ATT (171:20)
(180,42,0) OMNI D

171:20

GDC ALIGN
VERIFY ORDEAL

SYSTEMS TEST - XPNDR/C

GAMMA RAY EXP - OFF
X-RAY - OFF
α RAY/X DR - α OFF
MASS SPECT EXP - OFF
MAP CAMERA ON - STBY (VERIFY)
MAP CAMERA IMAGE MTN - OFF (VERIFY)
PAN CAMERA PWR - BOOST

LOAD N37

171:30

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

COELLIPTIC RNDZ PAD						UPDATE (IF REQ'D)					
GETI	HRS	+	0	0		+	0	0			
LIFT-OFF	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				

171:30

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

+55

VHF VOICE CHECK

MSFN DISABLES MSFN S-BAND RELAY
GO VHF COMM

VHF ANT - RIGHT

LM LIFT-OFF

171:37:24

171:40

VHF RNG-RESET

LM INSERTION

171:44:39

154.62
-448.0

MSFN UPLINK:
LM S.V.

171:50

P34 (TRIM) (180,170/42,0)
VERIFY N37 AND N55

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

92.91
-349.9

172:00

P30 MANEUVER

N/A SET STARS	C	S	M	B	O	PURPOSE
	S	P	S	G	& N	PROP/GUID
	+			N	A	WT N47
R ALIGN N / A		0	0	N	A	P TRIM N48
P ALIGN N / A		0	0	N	A	Y TRIM
Y ALIGN N / A	+	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 REQD:
* COPY P76 DATA FROM LM

*33

*84

*GO TO RESCUE BOOK PG C

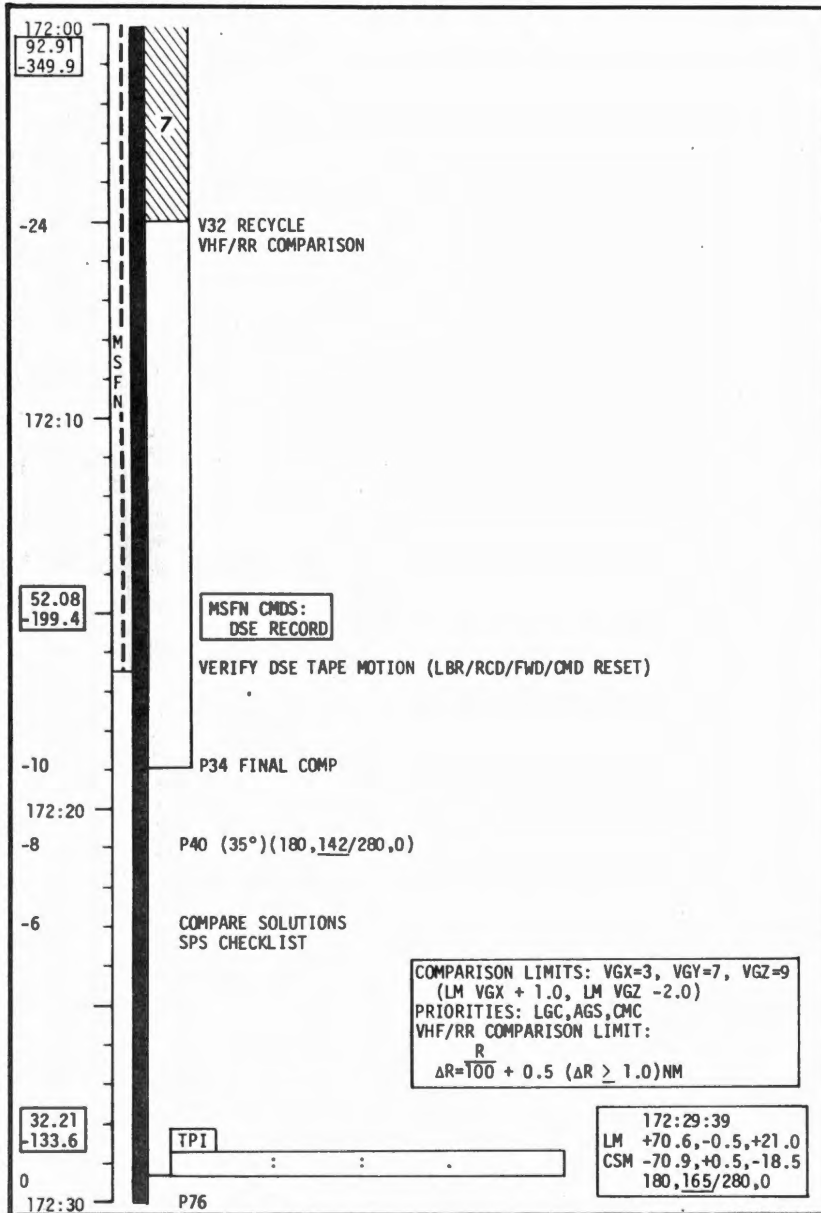
* IF CSM BAILOUT REQD:

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

P34 INPUT

37	LM GETI-TPI		
55	INTEG OPT +00000	ELEVATION \$ +000.00	TRANSFER \$ +130.00

* IF NO SXT,V57-LOAD R2=1;CALL N78,
* LOAD R2=0; V58; V54; VHF ONLY
* UNTIL TPI-16, THEN VHF/COAS(6).



* CONTINGENCY PROCEDURE *
* (P30-P40 BACKUP WITH LM SOLUTION) *
* P30-MIRROR IMAGE OF LM ΔV *
* P40 *

P34 RECYCLE			
55	INTEG OPT +00000	ELEVATION } .	TRANSFER } +130.00
58	PERILUNE ALT	TPI ΔV	TPF ΔV
81	TPI ΔV-LV	.	.
84	LM TPI ΔV-LV	.	.

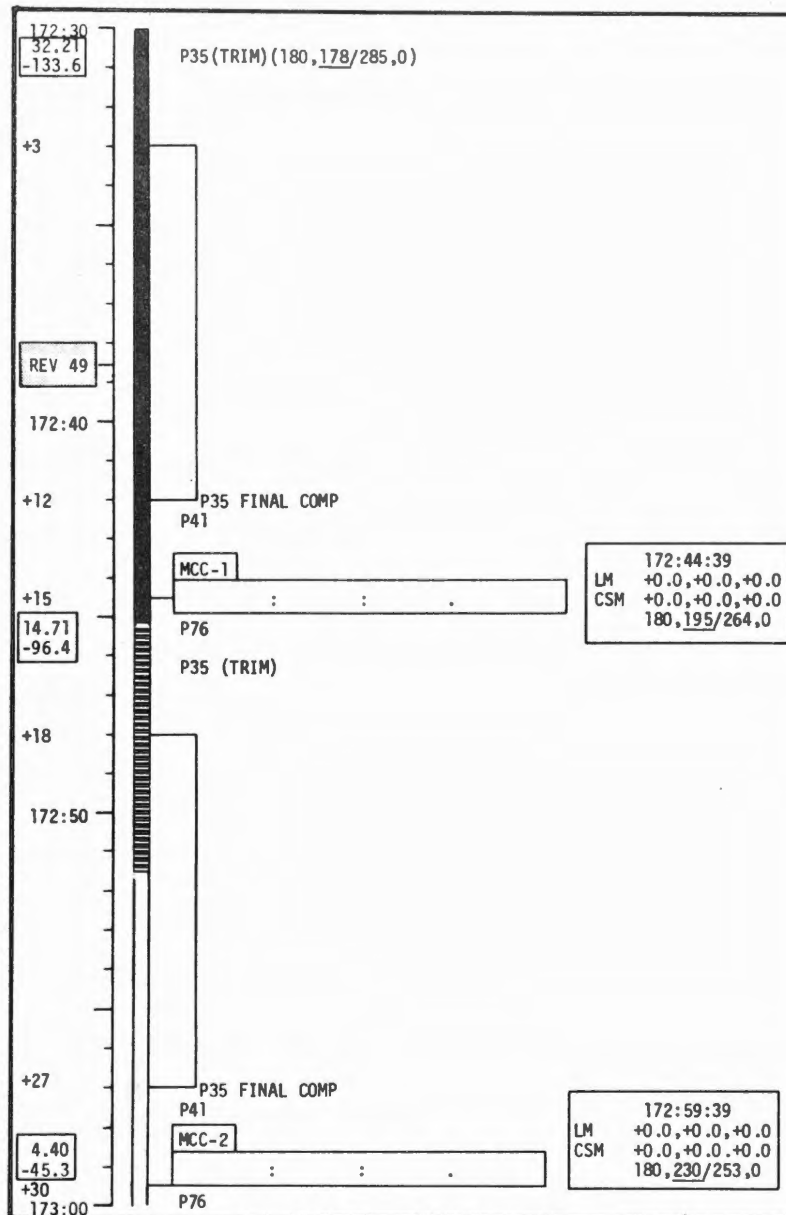
GROUND TPI FOR LM

								ΔV _X
								ΔV _Y
								ΔV _Z

P34 FINAL COMP			
55	INTEG OPT +00000	ELEVATION } .	TRANSFER } +130.00
58	PERILUNE ALT	TPI ΔV	TPF ΔV
81	TPI ΔV-LV	.	.
84	LM TPI ΔV-LV	.	.
84	LM TPI ΔV-LV	.	.

P76

* IF SXT OR VHF ONLY, OR *
* VHF/COAS, V57-LOAD R2=1.*



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

P76

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

 * IF VHF/COAS, V93 *
 * BEFORE FIRST MARK *

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

P76

173:00
4.40
-45.3

P79(35°)(180,271/289,0)

ACQ MSFN HGA P -57, Y 45

MSFN CMDS:
DSE DUMP

PERFORM PRE-DOCK CHECKLIST

IF CSM ACTIVE:

P47 AT R=1.25 NM

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 LIGHT RNDZ - OFF

LM STATIONKEEP

P00

DAC/TV - OFF

CMC MODE - AUTO

V49 MNVR TO SIM BAY INSPECTION ATTITUDE (173:23)
(312,248,0)

V49 MNVR TO DOCKING ATT (173:31)
(180,289,0) ACQ MSFN HGA P -57, Y 45

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

173:12:26
LM 31.7 (TOTAL)
CSM 33.6 (TOTAL)
180,304/289,0

PRE-DOCK CHECKLIST

MAN ATT (3) - RATE CMD (VERIFY)	CB DOCK PROBE (2) - CLOSED
LIMIT CYCLE - OFF (VERIFY)	PROBE RETRACT (2) - OFF (VERIFY)
ATT DB - MIN	PROBE EXT/REL - RETRACT
RATE - LOW (VERIFY)	PROBE EXT/REL TB (2) - GRAY (VERIFY)
TRANS CONTR PWR - ON (UP)	(IF TB NOT GRAY, GO TO PG S/2-12, E)
ROT CONTR PWR DIRECT (BOTH) - MNA/MNB	CB SECS LOGIC (2) - CLOSED (VERIFY)
SC CONT - CMC (VERIFY)	CB SECS ARM (2) - CLOSED
CMC MODE - HOLD	EXT LIGHTS RUN/EVA - ON (UP) (VERIFY)
AUTO RCS SEL (16) - MNA/MNB (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

173:30
(11102)
(X1111)

P47
DAC/TV - ON (ZOOM - 25MM)
LM PITCH DOWN 90°, YAW LEFT 120°

T TRANSLATE TO CAPTURE LATCH
V PERFORM DOCKING CHECKLIST

DOCKING

173:35:00

DAC/TV - OFF
POO

V48 (61101) RECORD MAG % _____
(11111) RECORD EL FR # _____

CMC MODE - AUTO
SC CONT - CMC
RNDZ XPNDR - OFF

173:40

173:50

174:00

DOCKING CHECKLIST

AT CAPTURE

PROBE EXTD/REL TB (2) - BP
(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 EXTD/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	LIMIT CYCLE - ON (UP)
CB DOCK PROBE (2) - OPEN	ATT DB - MAX
THC - LOCKED	SC CONT - SCS
RHC - LOCKED	BMAG MODE (3) - ATT 1/RATE 2
BMAG MODE (3) - RATE 2	AUTO RCS SEL B/D ROLL (4) - OFF
PROBE EXTD/REL - OFF	TRANS CONTR PWR - OFF
PROBE RETRACT (2) - OFF	ROT CONTR PWR DIRECT (BOTH) - OFF

APPENDIX F

FLIGHT DATA FILE

ABORT AND RESCUE RENDEZVOUS PROCEDURES

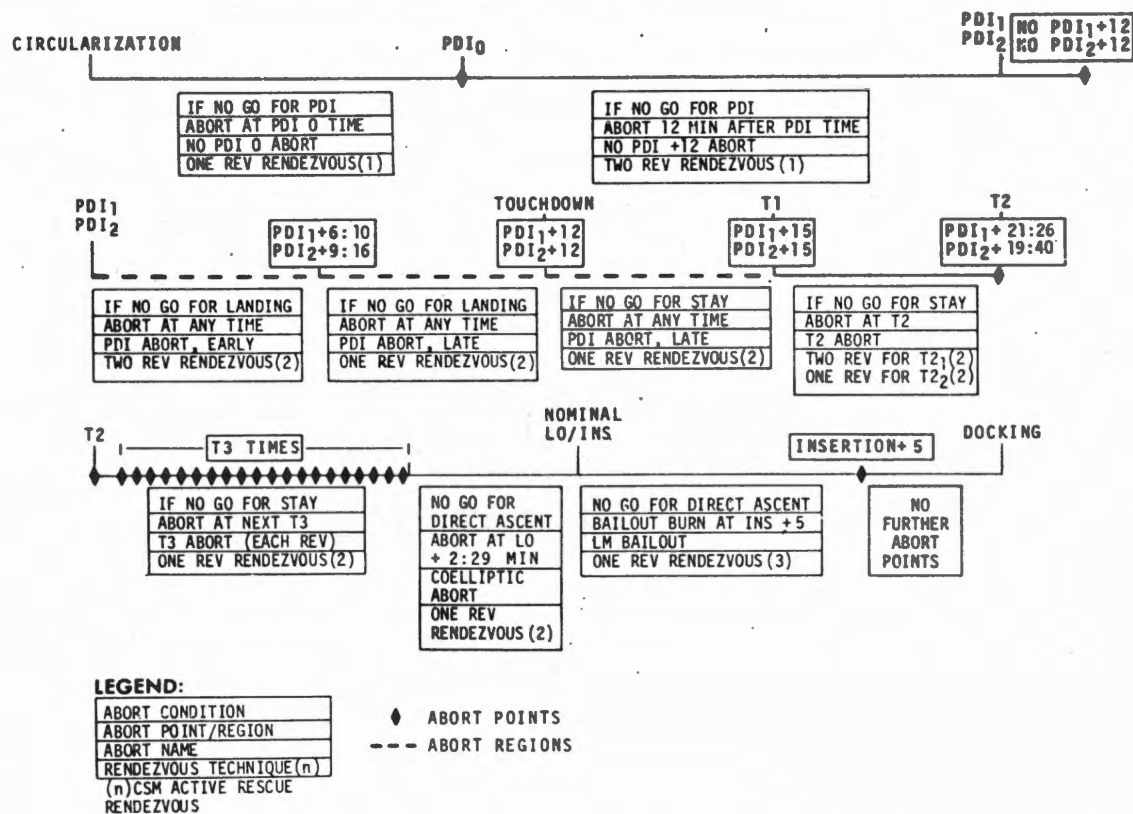
Two LM active rendezvous techniques are available in case of an abort. These are commonly referred to as the One Rev and Two Rev Rendezvous. Three other techniques are available but require one or more CSM SPS burns and will not be used except under extreme conditions. These are the Rescue Two, Dwell,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

CMP procedures for these five techniques are contained in the CSM RESCUE BOOK for inclusion in the Apollo 15 Flight Data File. This appendix presents the procedures as contained in the Apollo 15 CSM RESCUE BOOK.

CONTENTS

LM ABORT POINTS/CSM RESCUE CASES	3
ONE REV RENDEZVOUS	4
TWO REV RENDEZVOUS	8
RESCUE TWO RENDEZVOUS	14
CSM DWELL RENDEZVOUS	24
MANUAL INSERTION RENDEZVOUS	32
TPF ACTIVITIES	38
SPS PRE-BRAKING BURN PROCEDURES	40
IMU FAILURE RENDEZVOUS	42

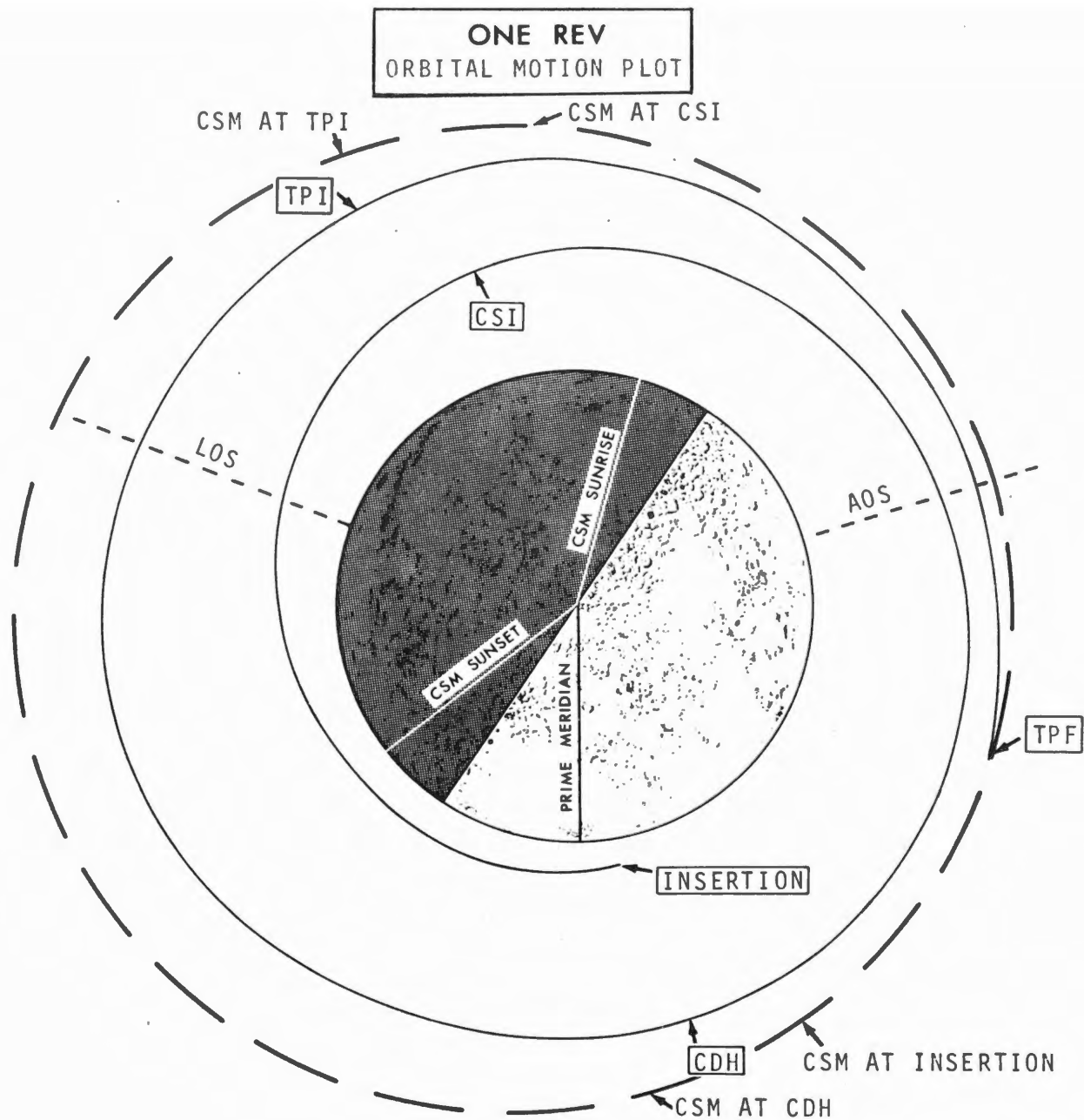
LM ABORT POINTS

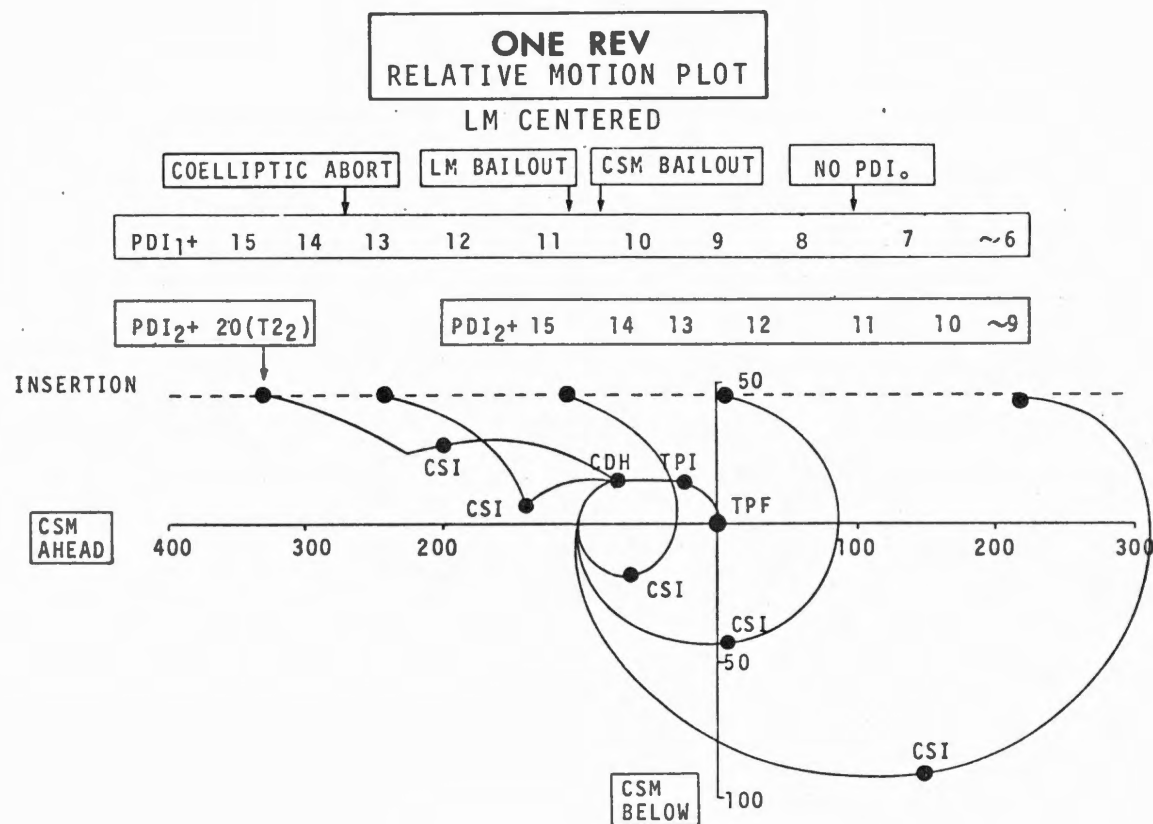


CSM RESCUE CASES

IF THE CSM BECOMES ACTIVE AFTER:

- | | |
|--|---|
| (1) AN ACCURATE LM ABORT INITIATION MANEUVER | COMPLETE THE ONE REV OR TWO REV RENDEZVOUS |
| A PARTIAL LM ABORT INITIATION MANEUVER | INITIATE THE RESCUE TWO RENDEZVOUS |
| (2) THE LM INSERTS INTO THE DESIRED ORBIT | COMPLETE THE EARLY, ONE REV, OR TWO REV RENDEZVOUS |
| THE LM INSERTS WITH AN UNDERSPEED OR OVERSPEED | INITIATE A CSM BAILOUT, MANUAL INSERTION, CSM DWELL, OR RESCUE TWO RNDZ AS DIRECTED |
| (3) AN ACCURATE LM BAILOUT MANEUVER | COMPLETE THE ONE REV RENDEZVOUS |
| A PARTIAL LM BAILOUT MANEUVER | PERFORM THE P30 CSM BAILOUT BURN AND COMPLETE THE ONE REV RENDEZVOUS |





ONE REV
BURN TIMES

NO PDI 0 ABORT
CSI AT A.I.M. +60 MIN
TPI AT 105:21:46.5

PDI 2, LATE ABORT
CSI AT INS +55 MIN
TPI AT 109:18:38.3

BACKUP COELLIPTIC
CSI AT INS +55 MIN
TPI AT 174:29:02.9

CSM BAILOUT
CSI AT INS +55 MIN
TPI AT 174:29:02.9

PDI 1, LATE ABORT
CSI AT INS +55 MIN
TPI AT 107:20:12.5

T2 ABORT, 2ND OPP
CSI AT INS +50 MIN
TPI AT 109:18:38.3

LM BAILOUT
CSI AT INS +55
TPI AT 174:29:02.9

ONE REV TIMELINE

POWER DOWN SIM(SEE SYSTEMS CHECKLIST, PAGE S/1-40)
PCO; 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

PLANE CHANGE

TO BYPASS GYRO TORQUE: ENTER ON F 50 25
TO GYRO TORQUE: CMC MODE-FREE
PRO ON F 50 25

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.	33	LM A.I.M.GETI	
P76	84	LM A.I.M.DV-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	LM Y DOT
	81	CSI DV-LV	+0000.0
		Y DOT	LM Y DOT
FINAL COMP	90	Y	LM Y DOT
	81	CSI DV-LV	+0000.0
		Y DOT	LM Y DOT
P76	84	LM CSI DV-LV	

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

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

P34m, OVERWRITE N55 R2.

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

IF ONLY ONE SENSOR OPERATIONAL:
 V57(00004, 00001)

-20

RECYCLE(COPY)

-12

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

P40m

0

TPI BURN

P76m; P35m

+12

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

+15

MCC1

P76m; P35m

+27

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

+30

MCC2

GO TO TPF ACTIVITIES(PAGE 38)

+42

TPF

TPI-ELEVATION OPTION

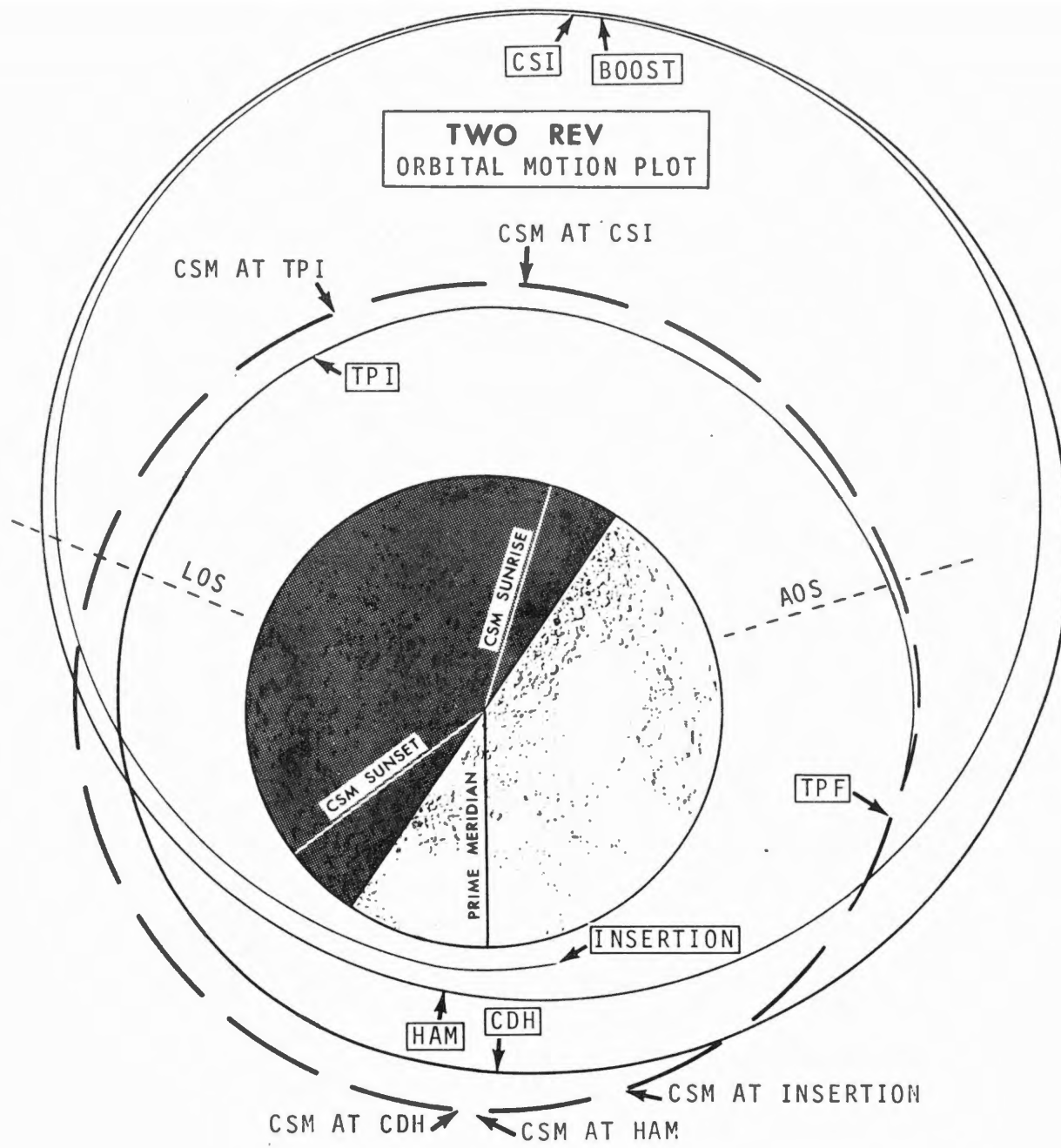
INPUT		TPI GETI		
		PROCEED ON DISPLAYED GETI		
RECYCLE	37	INTEG OPT	ELEVATION	TRANSFER
	55	+00000	+208.30	+130.00
	81	PERILUNE ALT	TPI ΔV	TPF ΔV
FINAL COMP	37	INTEG OPT	ELEVATION	TRANSFER
	55	+00000	.	+130.00
	81	PERILUNE ALT	TPI ΔV	TPF ΔV
P76	37	LM TPI GETI	.	.
	55	LM TPI ΔV-LV	.	.
	84	LM TPI ΔV-LV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

MCC COMPUTATION

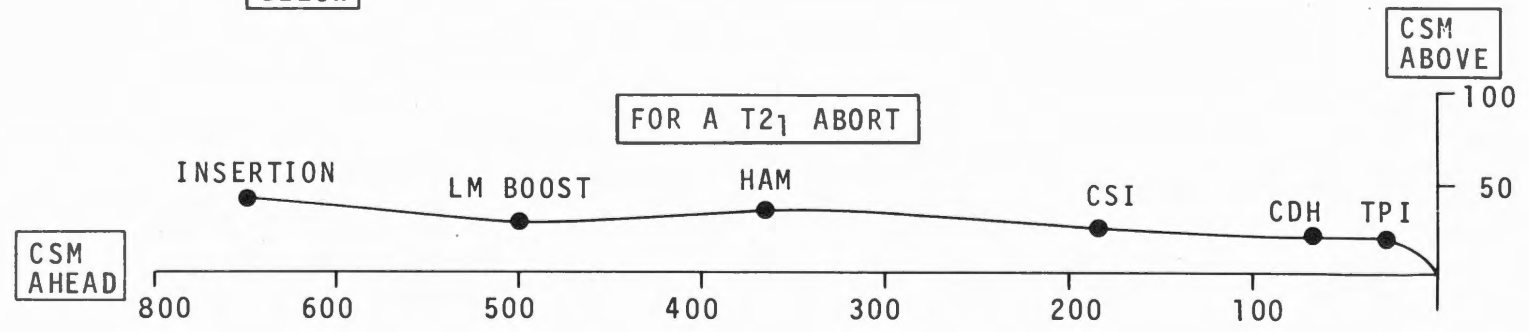
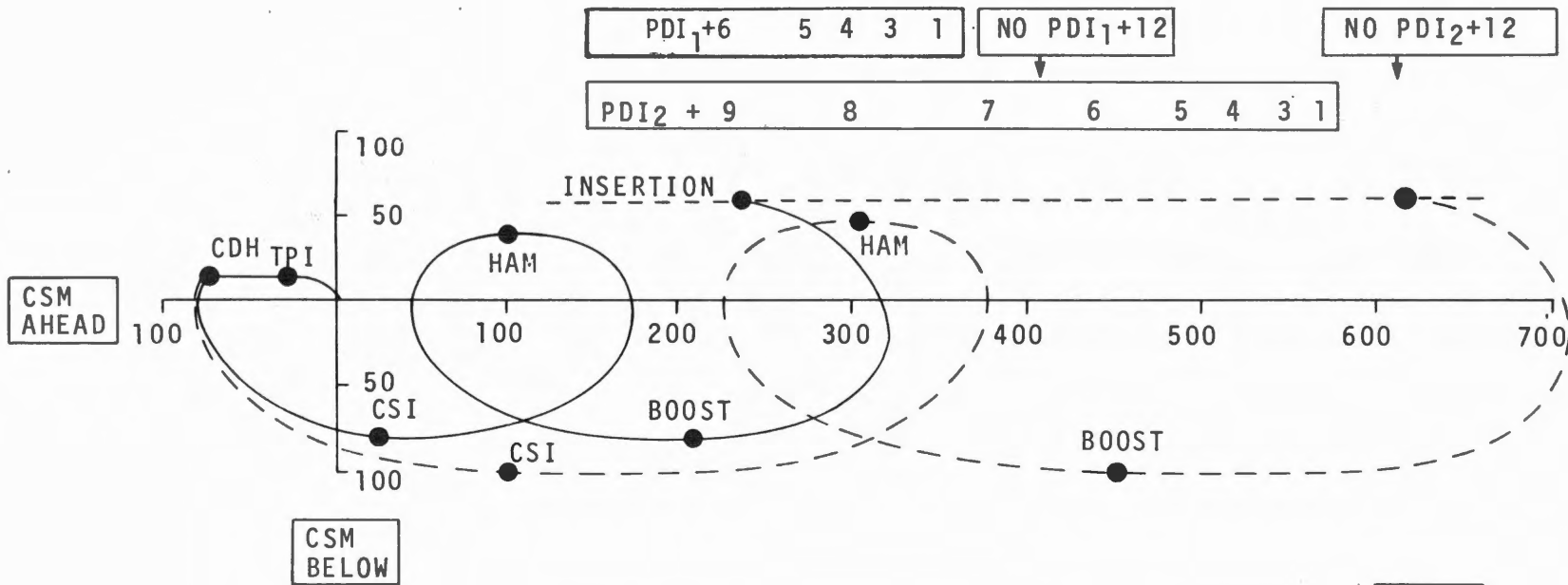
FIN COMP	81	MCC1 ΔV-LV	.	.
P76	84	LM MCC1 ΔV-LV	.	.

MCC COMPUTATION

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



TWO REV
RELATIVE MOTION PLOT
LM CENTERED



TWO REV BURN TIMES

NO PDI 1+12 ABORT

BOOST AT AIM +55 MIN HAM AT BOOST +60 MIN CSI AT HAM +60 MIN TPI AT 109:18:38.3
--

PDI 1, EARLY ABORT

BOOST AT INS +60 MIN HAM AT BOOST +60 MIN CSI AT HAM +60 MIN TPI AT 109:18:38.3
--

T2 ABORT, 1ST OPP

BOOST AT INS +50 MIN HAM AT BOOST +60 MIN CSI AT HAM +50 MIN TPI AT 109:18:38.3
--

NO PDI 2+12 ABORT

BOOST AT AIM +60 MIN HAM AT BOOST +60 MIN CSI AT HAM +60 MIN TPI AT 111:17:04.2
--

PDI 2, EARLY ABORT

BOOST AT INS +60 MIN HAM AT BOOST +60 MIN CSI AT HAM +60 MIN TPI AT 111:17:04.2
--

TWO REV TIMELINE

POWER DOWN SIM(SEE SYSTEMS CHECKLIST, PAGE S/1-40)
P00; V48(11102,X1111)

INSERTION OR A. I. M.
MSFN UPLINK: LM S.V.

OBTAIN LM BOOST GETI AND DV(COPY)

LM BOOST

P76; OBTAIN LM CSI, TPI AND HAM GETI'S(COPY)
P31 WITH LM GETI(SEE INPUT)

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

RECYCLE(COPY)

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

HAM

P76m

IF NO MARKS HAVE BEEN TAKEN:
V67(+10000,+00100,+00001)

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

HAM COMPUTATION				
INPUT	11	LM CSI GETI	:	:
	55	N	+00001	ELEVATION 2 +208.30
	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

(10000/10)W-MATRIX

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

(2000/2)W-MATRIX

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

P32m

SXT/VHF

RECYCLE(COPY)

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

CSI BURN

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

SXT/VHF

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

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

TO BYPASS GYRO TORQUE: ENTER ON F 50 25
TO GYRO TORQUE: CMC MODE-FREE
PRO ON F 50 25

CSI COMPUTATION

INPUT	11	LM CSI GETI		
		PROCEED ON DISPLAYED GETI *		
	55	N +00001	ELEVATION +208.30	180° OPT +130.00
	37	LM TPI GETI		
		PROCEED ON DISPLAYED GETI *		
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
P76	84	LM CSI ΔV-LV	.	.

PLANE CHANGE COMPUTATION

INPUT	33	LM PC GETI		
		PROCEED ON DISPLAYED GETI *		
	90	Y	Y DOT	LM Y DOT
	81	PC ΔV-LV	.	+0000.0
P76	84	LM PC ΔV-LV	.	+0000.0

CDH COMPUTATION

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

IF ONLY ONE SENSOR OPERATIONAL:
 V57(00004, 00001)

S
X
T
/
V
H
F
-20 RECYCLE(COPY)

-12 OBTAIN LM TPI GETI AND DV(COPY); FINAL
 COMP, OVERWRITE N37 WITH LM TPI GETI

P40m

0 TPI BURN

S
/
V
+12 P76m; P35m

+15 FINAL COMP(COPY);OBTAIN LM MCC1 DV(COPY); P41m

MCC1

S
/
V
+27 P76m; P35m

+30 FINAL COMP(COPY); OBTAIN LM MCC2 DV(COPY); P41m

MCC2

+42 GO TO TPF ACTIVITIES(PAGE 38)

TPF

TPI-ELEVATION OPTION

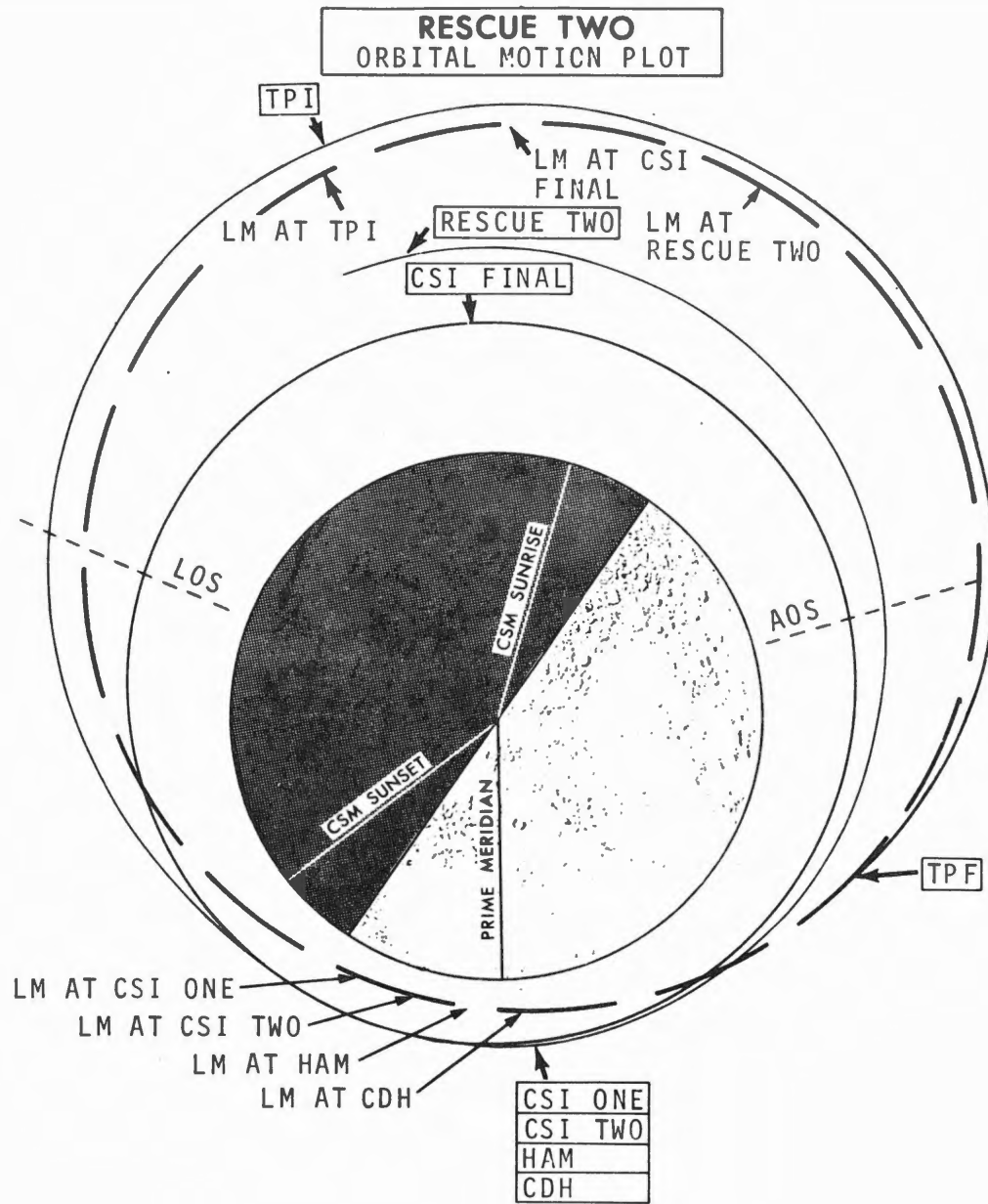
INPUT	37 55	TPI GETI PROCEED ON DISPLAYED GETI		
		INTEG OPT +00000	ELEVATION +208.30	TRANSFER +130.00
RECYCLE	37	TPI GETI PROCEED ON DISPLAYED GETI		
	58	PERILUNE ALT	TPI ΔV	TPF ΔV
	81	TPI ΔV-LV	.	.
FINAL COMP	37	LM TPI GETI		
	55	INTEG OPT +00000	ELEVATION .	TRANSFER +130.00
	58	PERILUNE ALT	TPI ΔV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

MCC COMPUTATION

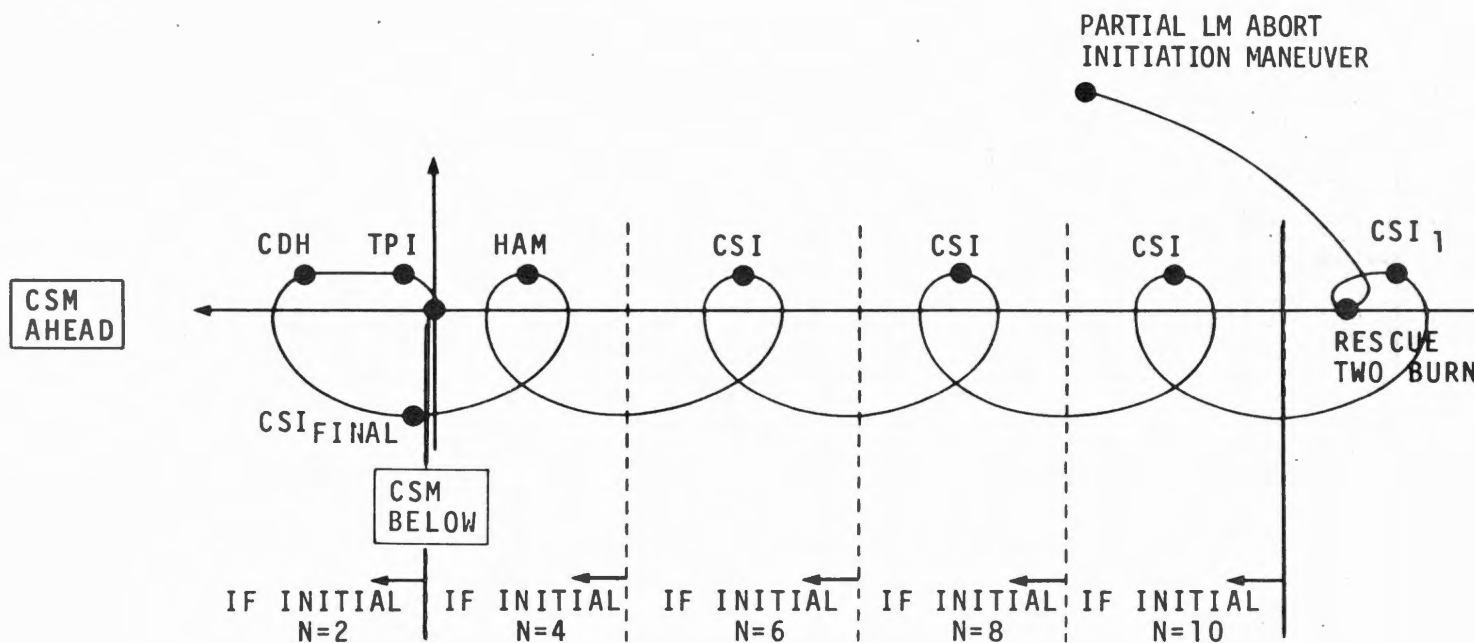
FIN COMP	81	MCC1 ΔV-LV	.	.	.
P76	84	LM MCC1 ΔV-LV	.	.	.

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 SYSTEM CHECKLIST,
PAGE S/1-40); P00; V48(11102,X111)

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

SET STARS	R	2	N	=			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
	+	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

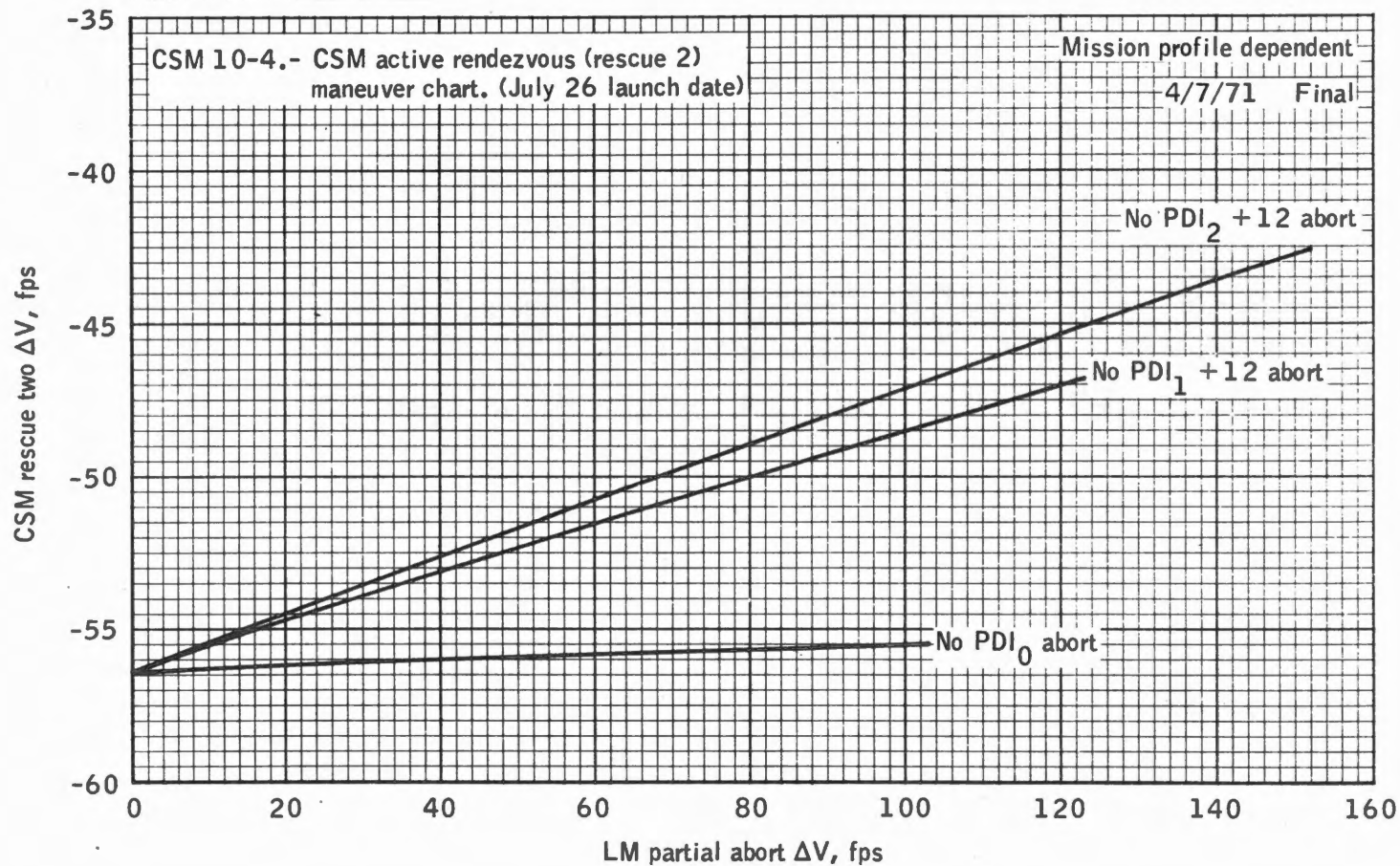
N11	CSI GETI	+		:	:	.
	N	+	0	0	0	
N55	ELEV 4	+	2	0	8.3	0
	180° OPT	+	1	3	0.0	0
N37	TPI GETI	+		:	:	.

-12

0

RESCUE TWO BURN INFORMATION

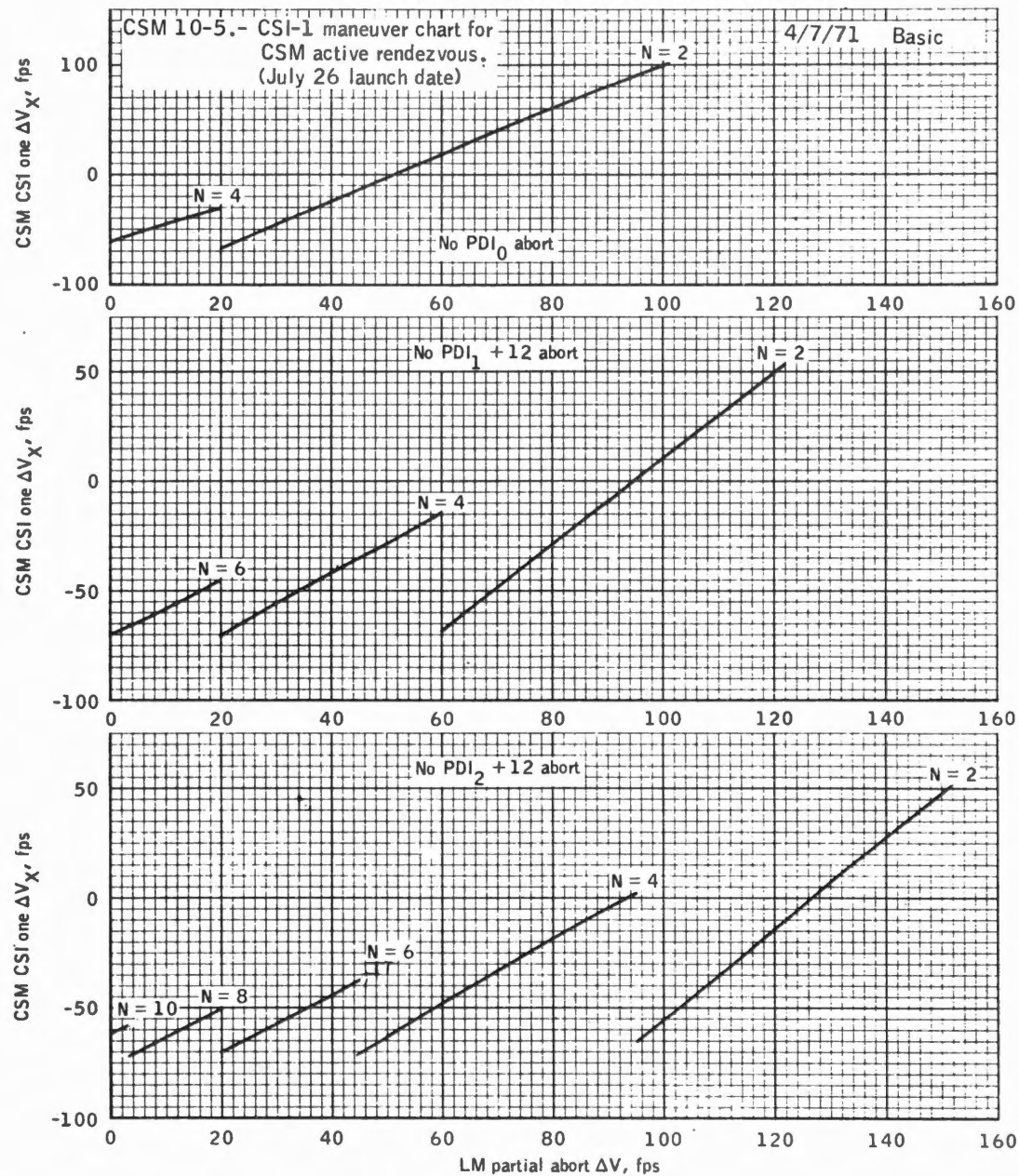
DuPont/OMAB/MPAD (for CSM Rescue)

Data source Spacecraft O.T.Data confirmed UFO

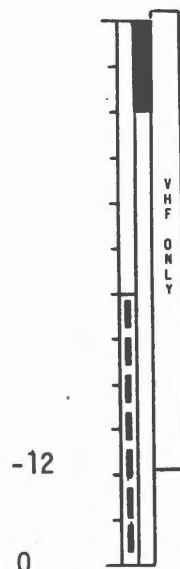
CSM active rendezvous (rescue 2) maneuver chart.

CSI ONE BURN INFORMATION

DuPont/OMAB/MPAD (for CSM Rescue)
 Data source SC O.T.
 Data confirmed U.S.S.



P32 (LOAD P32 INITIALIZATION PAD ON PAGE 16)



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

IF NO MARKS HAVE BEEN TAKEN:
V67(+10000,+00100,+00001)

IF INITIAL N>4, CONTINUE ON PAGE 20
IF INITIAL N=4, CONTINUE ON PAGE 21
IF INITIAL N=2, CONTINUE ON PAGE 22

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

GROUND
 $\Delta V X$

COMPARISON
LIMIT=±3 FPS

(A)

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

P52,OPT 3; P32

(10000/10)W-MATRIX

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

(2000/2)W-MATRIX

BEFORE STEADY STATE
N49>(+00080,+00050):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

IF NO MARKS HAVE BEEN TAKEN:
V67(+10000,+00100,+00001)

RECYCLE TO (A) UNTIL
N=4 WAS INPUT FOR THE
PREVIOUS CSI BURN,
THEN CONTINUE TO PAGE 21.

FOR N=8

CSI ☐ COMPUTATION				
INPUT	11	CSI GETI		
		PROCEED ON DISPLAYED GETI		
	55	N +00008	ELEVATION 9 +208.30	180° OPT +130.00
	37	TPI GETI		
		PROCEED ON DISPLAYED GETI		
FINAL COMP	90	Y	Y DOT	LM Y DOT
	81	CSI 3V-LV	+0000.0	+0000.0

FOR N=6

CSI ☐ COMPUTATION				
INPUT	11	CSI GETI		
		PROCEED ON DISPLAYED GETI		
	55	N +00006	ELEVATION 9 +208.30	180° OPT +130.00
	37	TPI GETI		
		PROCEED ON DISPLAYED GETI		
FINAL COMP	90	Y	Y DOT	LM Y DOT
		.	.	.
	81	CSI 3V-LV	+0000.0	+0000.0

FOR N=4

CSI ☐ COMPUTATION				
INPUT	11	CSI GETI		
		PROCEED ON DISPLAYED GETI		
	55	N +00004	ELEVATION 9 +208.30	180° OPT +130.00
	37	TPI GETI		
FINAL COMP		PROCEED ON DISPLAYED GETI		
	90	Y .	Y DOT .	LM Y DOT .
	81	CSI 3V-LV		
		.	+0000.0	+0000.0

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

V24	N1E
2367E	
0E	
22062E	

(10000/10)W-MATRIX

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

(2000/2)W-MATRIX

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

HAM COMPUTATION			
INPUT	11	CSI GETI	
		PROCEED ON DISPLAYED GETI	
	55	N +00001	ELEVATION 1 +208.30 100' OPT +130.00
	37	TPI GETI	
	33	HAM GETI	
		PROCEED ON DISPLAYED GETI	
RECYCLE	90	Y	Y DOT
	81	HAM $\Delta V-LV$	+0000.0
FINAL COMP	90	Y	Y DOT
	81	HAM $\Delta V-LV$	+0000.0

-20

-9

0

RECYCLE (COPY)

FINAL COMP, OVERWRITE DVY(COPY); P41m

HAM

P76m

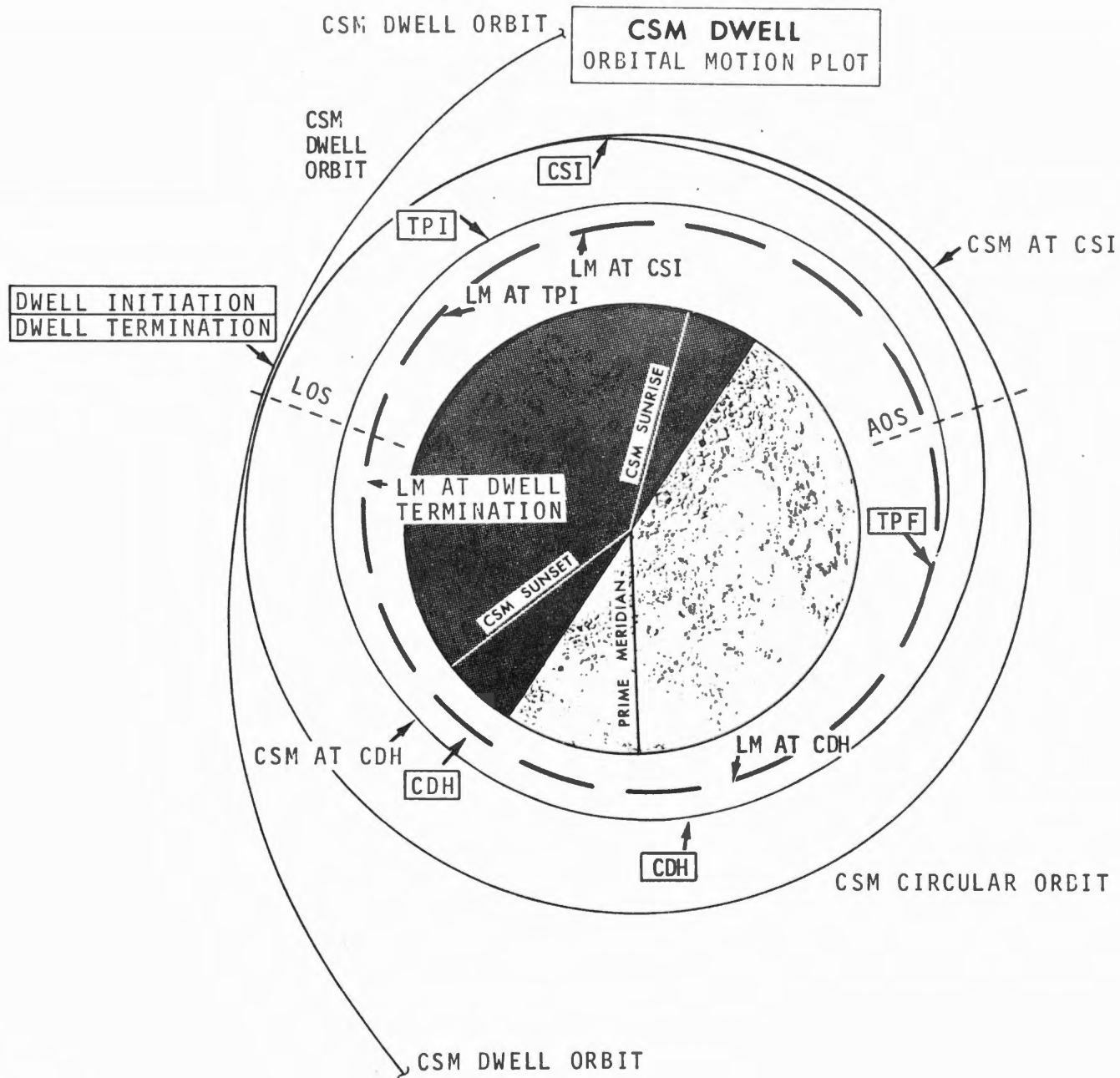
IF NO MARKS HAVE BEEN TAKEN: V67(+10000,+00100,+00001)

		P34m, OVERWRITE N55 R2
-20	S X T / V H F	RECYCLE (COPY)
-12		FINAL COMP (COPY); P40m
0		TPI BURN
	S /	P76m; P35m
+12		P35 FINAL COMP (COPY); P41m
+15		MCC1
	S /	P76m, P35m
+27		P35 FINAL COMP (COPY); P41m
+30		MCC2
		GO TO TPF ACTIVITIES (PAGE 38)
+42		TPF

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

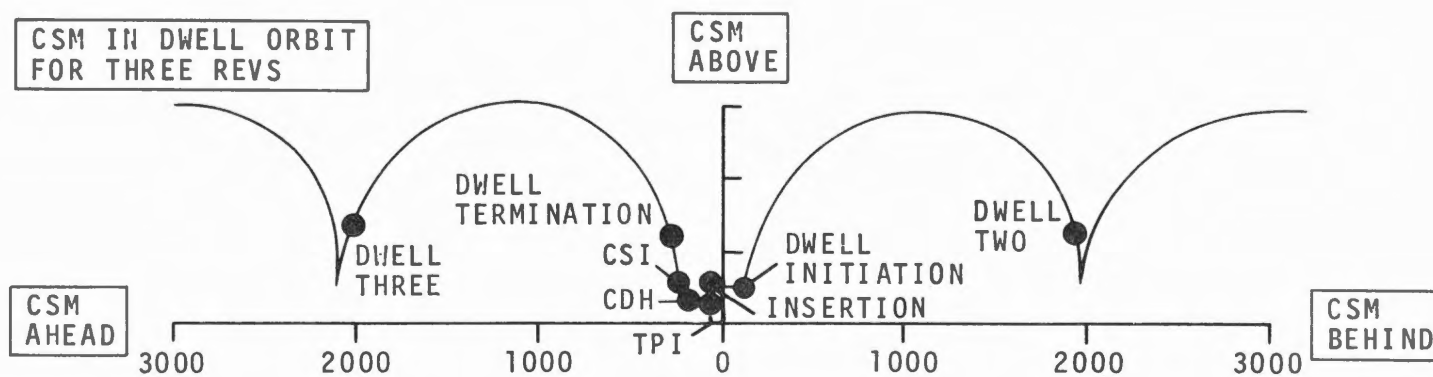
IF ONLY ONE SENSOR OPERATIONAL:
V57(00004, 00001)

TPI-ELEVATION OPTION			
INPUT	37	TPI GETI	
	55	PROCEED ON DISPLAYED GETI	
		INTEL OPT	ELEVATION
		+00000	+208.30
			+130.00
RECYCLE	37	TPI GETI	
	58	PROCEED ON DISPLAYED GETI	
	81		
		PERILUNE ALT	TPI LV
		.	.
		TPI LV-LV	
		.	.
FINAL COMP	37	TPI GETI	
	55	PROCEED ON DISPLAYED GETI	
	81		
		INTEL OPT	ELEVATION
		+00000	+130.00
		PERILUNE ALT	TPI LV
		.	.
		TPI LV-LV	
		.	.
MCC COMPUTATION			
FIN COMP	81	MCC1 SV-LV	
		.	.
MCC COMPUTATION			
FIN COMP	81	MCC2 SV-LV	
		.	.



CSM DWELL
RELATIVE MOTION PLOT

LM CENTERED



CSM DWELL TIMELINE

PAGE 26

DWELL INITIATION P30 PAD

SET STARS	D	W	E	L	L	I	PURPOSE
	S	P	S	G	E	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	+						ΔVT
ORBIT FOR	X	X	X				BT
REVS	X						ΔVC

P32 INITIALIZATION PAD

N11	CSI GETI	+		:	:	.
	N	+	0	0	0	1
N55	ELEV 4	+	2	0	8.3	0
	180° OPT	+	1	3	0	0
N37	TPI GETI	+		:	:	.

POWER DOWN SIM(SEE SYSTEMS CHECKLIST, PAGE S/1-40)

INSERTION

MSFN UPLINK: LM S.V.

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

P30; P40

DWELL INITIATION BURN

P00

APPENDIX F

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

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

P52, OPT 3
P00

P30; P41

DWELL TWO BURN
P00

P32 INITIALIZATION PAD

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

-9

0

THIS PAGE IS FOR A
THREE REV DWELL
ONLY.

IF DWELL TERMINATION
IS THE NEXT BURN,
GO TO PAGE 29.

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				X	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	+	: : .				

DWELL TERMINATION PAD

	D	W	E	L	L	T	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
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), ZERO DVY TO BYPASS P52m, P4Xm
P52m; P4Xm

PLANE CHANGE

P76m; P33m(COPY)

TO BYPASS GYRO TORQUE: ENTER ON F 50 25
TO GYRO TORQUE: CMC MODE-FREE
PRO ON F 50 25

RECYCLE(COPY)

FINAL COMP(COPY); P40m

CDH BURN

P76m

CSI COMPUTATION

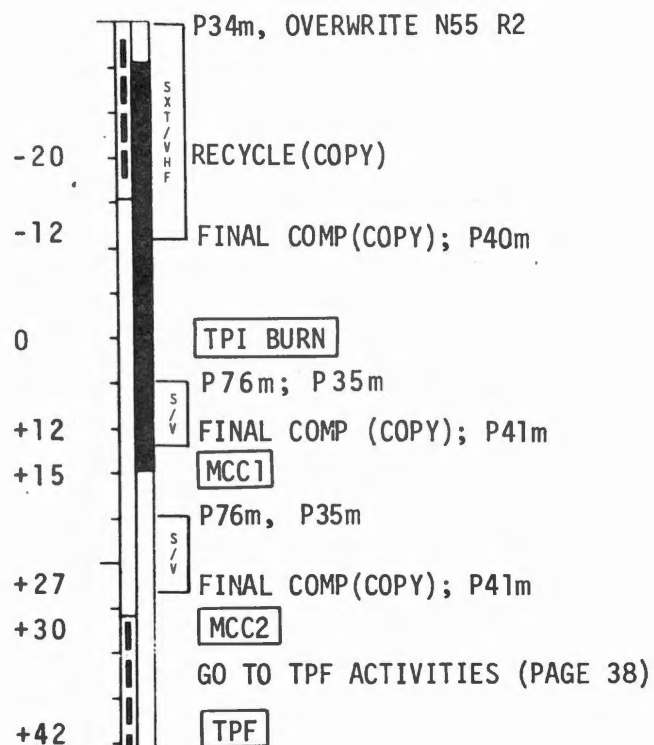
FINAL COMP	90 81	Y	Y DOT	LM Y DOT
		CSI ΔV-LV	.	+0000.0

PLANE CHANGE COMPUTATION

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

CDH COMPUTATION

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



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

IF ONLY ONE SENSOR OPERATIONAL:
V57(00004, 00001)

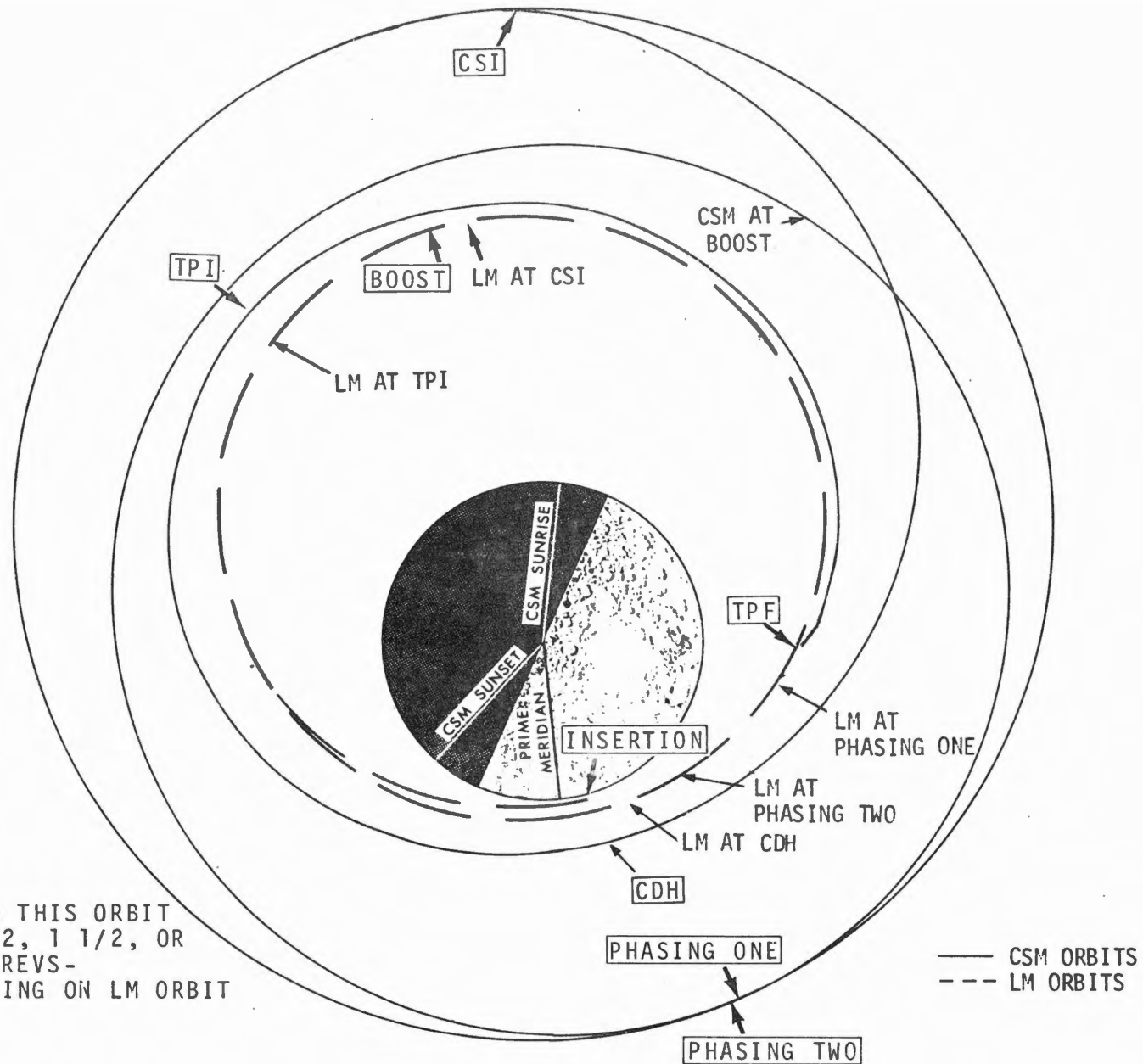
TPI ELEVATION OPTION			
INPUT	37	TPI GETI	
	55	PROCEED ON DISPLAYED GETI	
		INTEG OPT	ELEVATION
		+00000	+208.30 +130.00
RECYCLE	37	TPI GETI	
	58	PROCEED ON DISPLAYED GETI	
	59	PERILUNE ALT	TPI ΔV
		TPI ΔV-LVS	TPF ΔV
FINAL COMP	37	TPI GETI	
	58	PROCEED ON DISPLAYED GETI	
	81	PERILUNE ALT	TPI ΔV
		TPI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

MCC COMPUTATION			
FIN COMP	81	MCC1 ΔV-LV	

MCC COMPUTATION			
FIN COMP	81	MCC2 ΔV-LV	

MANUAL INSERTION
ORBITAL MOTION PLOT

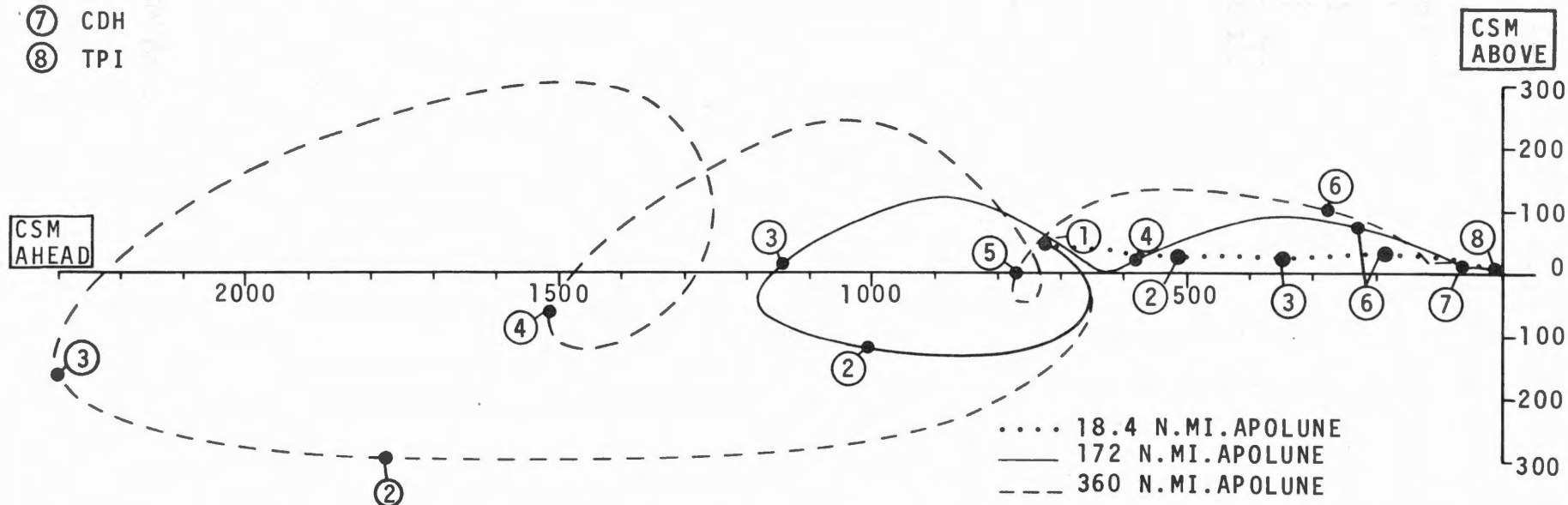
CSM IN THIS ORBIT
FOR 1/2, 1 1/2, OR
2 1/2 REVS-
DEPENDING ON LM ORBIT



MANUAL INSERTION RELATIVE MOTION PLOTS

LM CENTERED

- 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 SYSTEMS CHECKLIST, PAGE S/1-40)

INSERTION

MSFN UPLINK: LM S.V.
P52, OPT 3
P00

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

SET STARS	P	H	A	S	E	1	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
OTHER	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	+	: : .				

-110

-15

0

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 **A**

PHASING TWO P30 PAD

	P	H	A	S	E	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	+	:	:	:	:
	N	+	0	0	0	0 1
N55	ELEV 4	+	2	0	8	3 0
	180° OPT	+	1	3	0	0 0
N37	TPI GETI	+	:	:	:	:

PHASING THREE P30 PAD

	P	H	A	S	E	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 4	+	2	0	8	3 0
	180° OPT	+	1	3	0	0 0
N37	TPI GETI	+	:	:	:	:

-9

0

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

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

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

PAGE 36

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

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

APPENDIX F

-20

RECYCLE(COPY)

-12

FINAL COMP(COPY); P40m

0

CSI BURN

P76m; P36m(COPY)

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

-9

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

0

PLANE CHANGE

P76m; P33m(COPY)

TO BYPASS GYRO TORQUE: ENTER ON F 50 25
TO GYRO TORQUE: CHC MODE-FREE
PRO ON F 50 25

-20

RECYCLE(COPY)

-12

FINAL COMP(COPY); P40m

0

CDH BURN

P76m

		P34m, OVERWRITE N55 R2
-20	S T /	RECYCLE (COPY)
-12	V H F	FINAL COMP (COPY); P40m
0		TPI BURN
		P76m; P35m
+12	S /	FINAL COMP(COPY); P41m
+15	V	MCC1
		P76m; P35m
+27	S /	FINAL COMP(COPY); P41m
+30	V	MCC2
		GO TO TPF ACTIVITIES (PAGE 38)
+42		TPF

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

IF ONLY ONE SENSOR OPERATIONAL:
V57(00004, 00001)

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

MCC COMPUTATION			
FIN COMP	81	MCC1 ΔV-LV	
		.	.

MCC COMPUTATION			
FIN COMP	81	MCC2 ΔV-LV	
		.	.

TPF ACTIVITIES

PAGE 38

APPENDIX F

+30

(11102)
(X1111)

MCC2

P76m; P79m

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

P00

DAC/TV-OFF

+42

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)
CMC MODE-HOLD
AUTO RCS SEL(16)-MNA/MNB(VERIFY)
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/2-12,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

CMC MODE - AUTO
V49 MNVR TO SIM BAY INSPECTION ATTITUDE (312,248,0)

V49 MNVR TO DOCKING ATTITUDE (180,289,0)

DOCKING ATTITUDE
VERIFY HGA

BMAG MODE (3)-ATT 1/RATE 2
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 PITCH DOWN 90°, YAW LEFT 120°
TRANSLATE TO CAPTURE LATCH
PERFORM DOCKING CHECKLIST

DOCKING

P00
V48 (61111)
11111

CMC MODE-AUTO
SC CONT-CMC
BMAG MODE (3)-RATE 2
RNDZ XPNDR-OFF
GO TO 173:35 VOL II OF FLIGHT PLAN

DOCKING CHECKLIST

AT CAPTURE

PROBE EXT/REL TB(2)-BP (IF TB NOT BP,
GO TO PG S/2-11,A)
REPORT CAPTURE TO LM
SC CONT-CMC
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)

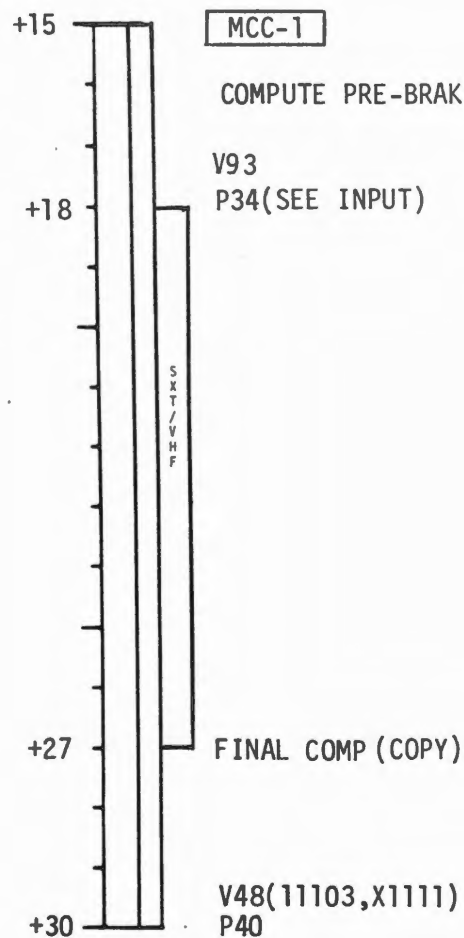
AT DOCK LATCH

PROBE EXT/REL TB(2)-GRAY

AFTER 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
PROBE EXT/REL - OFF
PROBE RETRACT (2) - OFF
EXT RUN/EVA LIGHT - OFF
EXT RNDZ LIGHT - OFF
COAS PWR - OFF
LIMIT CYCLE - ON
ATT DB - MAX
SC CONT - SCS
BMAG MODE (3) - ATT 1/RATE 2
AUTO RCS SEL B/D ROLL (4) - OFF
THC PWR - OFF
RHC PWR DIR (2) - OFF

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

$$\text{TRANSFER } \delta = \frac{\text{TPF } \Delta V}{2}$$

$$= \frac{.}{2}$$

TRANSFER δ = .

LOAD INTO N55 (R3)

PRE-BRAKING BURN COMPUTATION				
INPUT	37	COMPUTED P34 GETI.		
	55	INTEG OPT +00000	ELEVATION +0000.0	COMPUTED TRANSFER .
FINAL COMP	37	*PROCEED ON DISPLAYED GETI *		
	55	INTEG OPT +00000	ELEVATION .	TRANSFER .
	58	PERILUNE ALT	P34 ΔV	TPF ΔV
	81	P34 ΔV-LV	.	.

+30

P40

SPS CHECKLIST

+37

PRE-BRAKING BURN

P79

ACQ MSFN HGA

V48(11102,X1111)

PERFORM PRE-DOCK CHECKLIST

P47 AT R=1.25 NM

SEC PRPLNT FUEL PRESS(4)-OPEN

V83E
N83E KEY REL

UTIL PWR-ON (VERIFY)

DAC/TV-ON

LM PHOTOS WITH DAC/TV

TPF

EMS MODE-STBY

EMS FUNC-OFF

EXT RNDZ LT-OFF

GO TO 173:15 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)
 CMC MODE-HOLD
 AUTO RCS SEL(16)-MNA/MNB(VERIFY)
 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/2-12,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	$\dot{R}$,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

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/7-14)

MNVR TO TRACK/STAR FIELD ATT (180,340,0), OMNI D
 LOAD N20 AND ATT SET TW'S TO (180,340,0)
 MNVR BY NULLING ERROR NEEDLES

SYSTEMS TEST-XPNDR/C

LOAD N37

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

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					

+55

GO/NO GO FOR LIFT-OFF
VHF VOICE CHECK
MSFN DISABLES MSFN S-BAND RELAY
GO VHF COMM

VHF ANT-RIGHT

LM LIFT-OFF

0

VHF RNG-RESET

LM INSERTION

-45

154.62
-448.0

P52(OPTION 3)
RECORD STAR NO.

SHAFT

TRUNNION

P00
MSFN UPLINK:
LM S.V.

-37

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

-31

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
	+			N	/	A	WT N47
R ALIGN N / A		0	0	N	/	A	P TRIM N48
P ALIGN N / A		0	0	N	/	A	Y TRIM
Y ALIGN N / A	+	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 6

 *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 6

P34 INPUT

37	LM GETI-TPI	:	:
55	INTEG OPT +00000	ELEVATION $\downarrow$ +000.00	TRANSFER $\downarrow$ +130.00

-25

VHF ONLY

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

-17

VHF AND SXT

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)

-10

P34 FINAL COMP
 COMPARE SOLUTIONS

-8

P40(35°)(180,280,0)
 LOAD N18 VALUES IN N20 AND ATT SET TW'S
 MNVR BY NULLING ERROR NEEDLES

-6

SPS CHECKLIST

P00

TPI

LM +70.6,-0.5,+21.0
 CSM -70.9,+0.5,-18.5
 180,280,0

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)(5°)(180,285,0)
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)(180,259,0)

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

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

P76

P34 INPUT

37	GET1-MCC2	:	:	.
55	INTEG OPT +00000	ELEVATION § +000.00	TRANSFER § +040.00	

P34 FINAL COMP

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

P76

P76(P77)

P79(180,289,0)

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

ACQ MSFN HGA P -57, Y 45

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 CF VHF RANGE:
V25 N7E,75E,100E,1E; V87E; V16 N2E,3703E
SEC PRPLNT FUEL PRESS(4)-OPEN
EMS FUNC-ΔV
EMS MODE-NORMAL

TPF

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

LM STATIONKEEP

POO

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

LM PITCH DOWN 90°, YAW LEFT 120°

TRANSLATE TO CAPTURE LATCH
PERFORM DOCKING CHECKLIST

DOCKING

LM 31.7 (TOTAL)
CSM 33.6 (TOTAL)
180,289,0

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(VERIFY)
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/2-12, 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
(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

AFTER 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 B/D ROLL (4) - OFF
THC PWR - OFF
RHC PWR DIR (2) - OFF