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*FINAL
FLIGHT MISSION RULES

APOLLO 17
(AS-514/114/LM-12)

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FLIGHT CONTROL DIVISION

MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

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APOLLO 17

FINAL FLIGHT MISSION RULES

PREFACE

THIS DOCUMENT CONTAINS THE FINAL FLIGHT MISSION RULES FOR APOLLO 17 AS OF SEPTEMBER 1, 1972. ALL SUBSEQUENT REVISIONS TO THIS DOCUMENT WILL BE PRINTED ON DIFFERENT COLORED PAGES FOR EASY RECOGNITION.

IT IS REQUESTED THAT ANY ORGANIZATION HAVING COMMENTS, QUESTIONS, OR SUGGESTIONS CONCERNING THESE MISSION RULES CONTACT MR. JOHN H. TEMPLE, FLIGHT OPERATIONS AND RECOVERY BRANCH, BUILDING 30, ROOM 2058, PHONE 713-483-4126.

ANY REQUESTS FOR ADDITIONAL COPIES OR CHANGES TO THE DISTRIBUTION LIST IN APPENDIX B OF THIS DOCUMENT MUST BE MADE IN WRITING TO MR. HOWARD W. TINDALL, JR., DIRECTOR OF FLIGHT OPERATIONS, MANNED SPACECRAFT CENTER, HOUSTON, TEXAS.

THIS IS A CONTROL DOCUMENT AND ANY CHANGES ARE SUBJECT TO THE CHANGE CONTROL PROCEDURES DELINEATED IN APPENDIX C. THIS DOCUMENT IS NOT TO BE REPRODUCED WITHOUT THE WRITTEN APPROVAL OF THE CHIEF, FLIGHT CONTROL DIVISION, MANNED SPACECRAFT CENTER, HOUSTON, TEXAS.

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INTRODUCTION AND PURPOSE

MISSION RULES ARE PROCEDURAL STATEMENTS WHICH PROVIDE FLIGHT CONTROL PERSONNEL WITH GUIDELINES TO EXPEDITE THE DECISION-MAKING PROCESS. THE RULES ARE BASED ON AN ANALYSIS OF MISSION EQUIPMENT CONFIGURATION, SYSTEMS OPERATIONS AND CONSTRAINTS, FLIGHT CREW PROCEDURES, AND MISSION OBJECTIVES. THE DIRECTOR OF FLIGHT OPERATIONS, MANNED SPACECRAFT CENTER, HOUSTON, TEXAS, HAS THE OVERALL RESPONSIBILITY FOR THE PREPARATION, CONTENTS, AND CONTROL OF THE FLIGHT MISSION RULES.

MISSION RULES CAN BE CATEGORIZED AS "GENERAL" AND "SPECIFIC." GENERAL MISSION RULES CONTAIN THE BASIC PHILOSOPHIES USED IN THE DEVELOPMENT OF THE FLIGHT MISSION RULES. SPECIFIC MISSION RULES PROVIDE THE BASIC CRITERIA FROM WHICH REAL-TIME DECISIONS ARE MADE AND WILL BE FORMATTED AS FOLLOWS:

A. THE "CONDITION/MALFUNCTION" COLUMN DEFINES THE FAILURE.

B. THE "PHASE" COLUMN IDENTIFIES THE TIME INTERVAL IN WHICH THE CONDITION/MALFUNCTION OCCURS.

C. THE "RULING" COLUMN DEFINES FLIGHT CONTROLLER ACTION AND/OR PROCEDURES THAT MUST BE ACCOMPLISHED AS A RESULT OF THE CONDITION.

D. THE "CUES/NOTES/COMMENTS" COLUMN PROVIDES THE FLIGHT CONTROLLER WITH ADDITIONAL INFORMATION CONCERNING THE CONDITION/MALFUNCTION AND/OR THE RULING.

PART I
GEN GUIDELINES
OMSF GENERAL RULES

PART II
1 GENERAL RULES AND SOP'S

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~~19 EMU/EVA~~

20 COMMUNICATIONS/ INSTRUMENTATION

PART I
GEN GUIDELINES
OMSF GENERAL RULES

R	ITEM	
		OMSF GENERAL RULES
	I-1	MISSION RULES ARE EFFECTIVE DURING THE LAUNCH COUNTDOWN, FLIGHT, RECOVERY, AND DURING PRELAUNCH TESTS WHEN APPLICABLE. WHEN POST MISSION QUARANTINE IS IMPOSED, RULES WILL BE APPLICABLE UNTIL DELIVERY OF THE FLIGHT CREW, FLIGHT HARDWARE, AND LUNAR SAMPLES TO THE LUNAR RECEIVING LABORATORY.
	I-2	DURING THE CONDUCT OF THE MISSION, THE MISSION DIRECTOR WILL BE ADVISED OF ALL RECOMMENDATIONS THAT INVOLVE CHANGES TO PRIMARY OBJECTIVES, MISSION RULES, FLIGHT PLAN CONTENT, OR LAUNCH/FLIGHT SAFETY.
	I-3	WITHIN THEIR RESPECTIVE AREAS OF RESPONSIBILITY, THE SPACECRAFT COMMANDER, THE LAUNCH DIRECTOR, FLIGHT DIRECTOR, DOD MANAGER FOR MSF SUPPORT OPERATIONS, AND THE MISSION DIRECTOR MAY TAKE OR RECOMMEND ANY ACTION REQUIRED FOR OPTIMUM CONDUCT OF THE MISSION.
	I-4	THE SPACECRAFT COMMANDER, SPACECRAFT TEST CONDUCTOR, LAUNCH VEHICLE TEST CONDUCTOR, SPACE VEHICLE TEST SUPERVISOR, LAUNCH OPERATIONS MANAGER, LAUNCH DIRECTOR, FLIGHT DIRECTOR, DOD MANAGER FOR MSF SUPPORT OPERATIONS, OR THE MISSION DIRECTOR MAY REQUEST A HOLD FOR CONDITIONS WITHIN THEIR RESPECTIVE AREAS OF RESPONSIBILITY.
	I-5	DURING THE COUNTDOWN, THE LAUNCH VEHICLE AND SPACECRAFT PROGRAM MANAGERS AND RESPECTIVE CENTER OPERATIONS MANAGERS WILL PROVIDE TECHNICAL ADVICE AND SUPPORT DIRECTLY TO THE LAUNCH OPERATIONS MANAGER AND LAUNCH DIRECTOR. THE LATTER TWO WILL KEEP THE MISSION DIRECTOR FULLY INFORMED OF PROBLEMS AND PROPOSED SOLUTIONS. DURING THE FLIGHT PHASE OF OPERATIONS, SIMILAR SUPPORT AS REQUIRED WILL BE PROVIDED TO THE FLIGHT DIRECTOR AND THE MSC DIRECTOR OF FLIGHT OPERATIONS. THE MISSION DIRECTOR WILL BE KEPT FULLY INFORMED BY THESE INDIVIDUALS OF PROBLEMS AND PROPOSED SOLUTIONS DURING THE APPLICABLE PHASES OF THE MISSION.
	I-6	WHEN TIME PERMITS, THE FAILURE OF A MANDATORY OR HIGHLY DESIRABLE ITEM WILL BE REPORTED TO THE MISSION DIRECTOR BY THE LAUNCH DIRECTOR OR THE FLIGHT DIRECTOR. THE INITIAL REPORT WILL INCLUDE THE POSITION OR FACILITY THAT DETECTED THE MALFUNCTION. SUBSEQUENTLY, THE MISSION DIRECTOR WILL BE INFORMED OF ESTIMATED TIME TO REPAIR AND RECOMMENDED "PROCEED, HOLD, RECYCLE," OR "SCRUB" ACTION AS IT DEVELOPS.

R	ITEM	
	I-7	IF A MANDATORY ITEM FAILS DURING THE COUNTDOWN, IT WILL BE CORRECTED PRIOR TO LAUNCH, HOLDING OR RECYCLING THE COUNTDOWN AS NECESSARY. IF A MANDATORY ITEM CANNOT BE CORRECTED TO PERMIT LIFTOFF WITHIN THE LAUNCH WINDOW, THE MISSION DIRECTOR MAY PROCEED WITH THE LAUNCH AFTER APPROPRIATE COORDINATION WITH THE APPROPRIATE OPERATIONS AND PROGRAM MANAGERS. GENERALLY THE LOSS OF A MANDATORY ITEM WILL RESULT IN A SCRUB.
	I-8	AS THE DESIGNATED REPRESENTATIVE OF THE PROGRAM DIRECTOR, ONLY THE MISSION DIRECTOR MAY SCRUB THE MISSION. FURTHER, THE MISSION DIRECTOR RETAINS THE PRIMARY AUTHORITY TO DOWNGRADE A MANDATORY CATEGORY. THIS AUTHORITY WILL BE EXERCISED AS CIRCUMSTANCES DICTATE AND AFTER APPROPRIATE RECOMMENDATIONS FROM THE DIRECTOR OF FLIGHT OPERATIONS, PROGRAM MANAGERS, LAUNCH DIRECTOR, AND FLIGHT DIRECTOR.
	I-9	CONSIDERATION WILL BE GIVEN TO THE REPAIR OF ANY HIGHLY DESIRABLE ITEM, BUT IN NO CASE WILL THE LAUNCH BE SCRUBBED FOR ANY SINGLE HIGHLY DESIRABLE ITEM. IF TWO OR MORE HIGHLY DESIRABLE ITEMS FAIL AND/OR OTHER AGGRAVATING CIRCUMSTANCES OCCUR, THE MISSION DIRECTOR MAY SCRUB THE MISSION AFTER COORDINATION WITH THE APPROPRIATE OPERATIONS AND PROGRAM MANAGERS.
	I-10	WHENEVER POSSIBLE, THE LAUNCH SITE AND MCC WILL VERIFY TELEMETRY READOUT DISCREPANCIES OCCURRING PRIOR TO LIFTOFF. IF THE MCC LOSES A PARAMETER BUT THE LAUNCH SITE HAS A VALID READOUT, THE MCC WILL CONTINUE ON THE LAUNCH SITE READOUT. THIS IS TRUE EXCEPT FOR THOSE MANDATORY PARAMETERS (LISTED IN THE FLIGHT MISSION RULES) UPON WHICH MISSION RULES ACTION IS TAKEN. IN THIS CASE, A HOLD MAY BE CALLED TO EVALUATE THE PROBLEM.
	I-11	THE COUNTDOWN WILL CONTINUE, WHERE POSSIBLE, CONCURRENTLY WITH CORRECTION OF AN EXISTING PROBLEM.
	I-12	THE LAUNCH DIRECTOR WILL BE RESPONSIBLE FOR ALL ACTIONS IN THE EVENT OF LAUNCH SITE EMERGENCIES EXCEPT FOR RECOVERY OPERATIONS OF THE FLIGHT CREW AND SPACECRAFT RESULTING FROM A PAD ABORT.
	I-13	THE LAUNCH OPERATIONS MANAGER MAY SEND AN ABORT REQUEST FROM THE TIME THE LAUNCH ESCAPE SYSTEM IS ARMED UNTIL THE SPACE VEHICLE REACHES SUFFICIENT ALTITUDE TO CLEAR THE TOP OF THE UMBILICAL TOWER. THE CRITERIA FOR SENDING AN ABORT REQUEST WILL BE ESTABLISHED IN THE LAUNCH MISSION RULES.

R	ITEM	
	I-14	FROM LIFTOFF TO UMBILICAL TOWER CLEARANCE, THE LAUNCH OPERATIONS MANAGER AND FLIGHT DIRECTOR WILL HAVE CONCURRENT RESPONSIBILITY FOR SENDING AN ABORT REQUEST. THE CRITERIA FOR SENDING AN ABORT REQUEST DURING THIS PERIOD WILL BE ESTABLISHED IN THE LAUNCH AND FLIGHT MISSION RULES RESPECTIVELY.
	I-15	WHERE POSSIBLE, ALL MANUAL ABORT COMMAND/REQUESTS FROM THE GROUND DURING FLIGHT WILL BE BASED ON TWO INDEPENDENT INDICATIONS OF THE FAILURE. CREW ABORT ACTION WILL NORMALLY BE BASED UPON TWO CUES.
	I-16	THE LAUNCH OPERATIONS MANAGER WILL INFORM THE MCC WHEN THE SPACE VEHICLE REACHES SUFFICIENT ALTITUDE TO CLEAR THE TOP OF THE UMBILICAL TOWER BY STATING "CLEAR TOWER" OVER ONE OF THE LOOPS FOR KSC TO MCC.
	I-17	IN THE EVENT OF NON-CATASTROPHIC SPACE VEHICLE COLLISION WITH THE UMBILICAL TOWER OR OTHER CONTINGENCIES WHICH DO NOT REQUIRE IMMEDIATE ACTION, THE LAUNCH OPERATIONS MANAGER WILL CONTINUE TO EVALUATE THE EXTENT OF DAMAGE AND WILL PROVIDE INFORMATION TO THE FLIGHT DIRECTOR FOR ANY ACTION NECESSARY AFTER UMBILICAL TOWER CLEARANCE.
	I-18	COMPLETE GROUND CONTROL OF THE SPACE VEHICLE PASSES FROM THE LAUNCH DIRECTOR TO THE FLIGHT DIRECTOR WHEN THE SPACE VEHICLE REACHES SUFFICIENT ALTITUDE TO CLEAR THE TOP OF THE UMBILICAL TOWER.
	I-19	IN THE MCC, THE FLIGHT DIRECTOR, FLIGHT DYNAMICS OFFICER AND BOOSTER SYSTEMS ENGINEER WILL HAVE THE CAPABILITY TO SEND AN ABORT REQUEST. THE CRITERIA FOR SENDING AN ABORT REQUEST WILL BE ESTABLISHED IN THE FLIGHT RULES.
	I-20	THE SPACECRAFT COMMANDER MAY INITIATE SUCH INFLIGHT ACTION AS HE DEEMS ESSENTIAL FOR CREW SAFETY.
	I-21	FLIGHT CREW SAFETY SHALL TAKE PRECEDENCE OVER THE ACCOMPLISHMENT OF MISSION OBJECTIVES.
	I-22	IN THE EVENT OF COMMUNICATIONS LOSS BETWEEN THE MANNED SPACE FLIGHT NETWORK AND THE SPACECRAFT, THE SPACECRAFT COMMANDER WILL ASSUME RESPONSIBILITY FOR MISSION CONDUCT AS DESCRIBED WITHIN THE FLIGHT MISSION RULES.
	I-23	THE FLIGHT DIRECTOR, THROUGH THE RECOVERY COORDINATOR, WILL PROVIDE THE DOD MANAGER FOR MANNED SPACE FLIGHT SUPPORT OPERATIONS THE PREDICTED LOCATION AND TIME OF SPLASHDOWN.

R	ITEM	
	I-24	THE DOD MANAGER FOR MANNED SPACEFLIGHT SUPPORT OPERATIONS IS RESPONSIBLE FOR RECOVERY AND FOR COMMAND AND CONTROL OF DOD RECOVERY FORCES. RECOMMENDATIONS, GUIDELINES AND REQUIREMENTS - AS SET FORTH BY NASA - WILL BE CONSIDERED TO EFFECT SAFE AND EXPEDITIOUS RECOVERY OF THE FLIGHT CREW AND SPACECRAFT.
	I-25	IF THE LM DESCENT STAGE WITH A NUCLEAR POWER SOURCE ABOARD IS ABANDONED WHILE SUBJECT TO EARTH RETURN AND IF CREW SAFETY AND CONTROL SYSTEMS CONSIDERATIONS PERMIT, THE LM WILL BE TARGETED FOR AN OCEAN AREA REENTRY. THE PREDICTED IMPACT LOCATION WILL BE DETERMINED AND REPORTED TO THE APOLLO MISSION DIRECTOR.
	I-26	NO SPACE VEHICLE COMPONENT WILL BE DELIBERATELY TARGETED FOR A LUNAR IMPACT WITHOUT THE PRIOR APPROVAL OF THE APOLLO MISSION DIRECTOR.
		RULE NUMBERS I-27 THROUGH I-35 ARE RESERVED.

R	ITEM	
		DEFINITIONS
	I-36	PRIMARY OBJECTIVE - A STATEMENT OF THE PRIMARY PURPOSE OF THE FLIGHT. WHEN USED IN CENTER CONTROL DOCUMENTATION, THE PRIMARY OBJECTIVE(S) MAY NOT BE MODIFIED BUT MAY BE AMPLIFIED BY DETAILED OBJECTIVES.
	I-37	DETAILED OBJECTIVE - A SCIENTIFIC, ENGINEERING, MEDICAL, OR OPERATIONAL INVESTIGATION THAT PROVIDES IMPORTANT DATA AND EXPERIENCE FOR USE IN DEVELOPMENT OF HARDWARE AND/OR PROCEDURES FOR APPLICATION TO APOLLO MISSIONS. CSM ORBITAL PHOTOGRAPHIC TASKS, THOUGH REVIEWED BY THE MANNED SPACE FLIGHT EXPERIMENTS BOARD, ARE NOT ASSIGNED AS FORMAL EXPERIMENTS AND WILL BE PROCESSED AS A SINGLE DETAILED OBJECTIVE.
	I-38	CATEGORY - A CATEGORY IS A DEGREE OF IMPORTANCE ASSIGNED TO SPACE VEHICLE AND OPERATIONAL SUPPORT ELEMENTS. SPECIFIC CATEGORIES APPLICABLE TO MISSION RULES ARE MANDATORY AND HIGHLY DESIRABLE.
	I-39	MANDATORY (M) - A MANDATORY ITEM IS A SPACE VEHICLE ELEMENT OR OPERATIONAL SUPPORT ELEMENT THAT IS ESSENTIAL FOR ACCOMPLISHMENT OF THE MISSION, WHICH INCLUDES PRELAUNCH, FLIGHT, AND RECOVERY OPERATIONS THAT ENSURE CREW SAFETY AND EFFECTIVE OPERATIONAL CONTROL AS WELL AS THE ATTAINMENT OF THE PRIMARY OBJECTIVES.
	I-40	HIGHLY DESIRABLE (HD) - A HIGHLY DESIRABLE ITEM IS A SPACE VEHICLE ELEMENT OR OPERATIONAL SUPPORT ELEMENT THAT SUPPORTS AND ENHANCES THE ACCOMPLISHMENT OF THE MISSION AND IS ESSENTIAL FOR THE ACCOMPLISHMENT OF THE DETAILED OBJECTIVES.
	I-41	SPACE VEHICLE ELEMENT - A PART OF ANY LAUNCH VEHICLE OR SPACECRAFT SYSTEM.
	I-42	OPERATIONAL SUPPORT ELEMENT - A PART OF ANY SYSTEM OR ACTIVITY THAT IS INVOLVED IN THE COUNTDOWN, LAUNCH, FLIGHT, OR RECOVERY OPERATIONS OTHER THAN THOSE ELEMENTS WHICH ARE A PART OF THE SPACE VEHICLE ITSELF.
	I-43	REDLINE - A REDLINE VALUE IS A MAXIMUM AND/OR MINIMUM LIMIT OF A CRITICAL PARAMETER NECESSARY TO IDENTIFY VEHICLE, SYSTEM, AND COMPONENT PERFORMANCE AND OPERATION. REDLINE VALUES WILL BE ESTABLISHED SUCH THAT FURTHER DEGRADATIONS OF THE SYSTEM OR COMPONENT COULD LEAD TO A FAILURE TO ACCOMPLISH THE PRIMARY OBJECTIVES.
	I-44	REDLINE FUNCTION - A REDLINE FUNCTION IS A PARAMETER THAT HAS BEEN IDENTIFIED TO MONITOR THE FUNCTIONING OF A UNIT TO ENSURE THAT THE OPERATIONAL PERFORMANCE OF THE UNIT IS ACCEPTABLE TO MEET THE PRIMARY OBJECTIVES. REDLINE FUNCTIONS ARE MANDATORY.

R	ITEM	
	I-45	MEASUREMENT - A MEASUREMENT IS A SPECIFIC DATA CHANNEL OF INSTRUMENTATION MONITORING A SINGLE FUNCTION.
	I-46	INSTRUMENTATION - INSTRUMENTATION IS THE EQUIPMENT THAT ACQUIRES, TRANSMITS, AND MONITORS DATA FOR PERFORMANCE EVALUATION OF SPACE VEHICLE AND OPERATIONAL SUPPORT ITEMS.
	I-47	COUNTDOWN - THE PERIOD OF TIME COMMENCING WITH START OF THE OFFICIAL COUNTDOWN CLOCK. DURING THE INTERVAL OF TIME PRIOR TO THIS PERIOD, TASK ACCOMPLISHMENT IS NOT STRICTLY TIME-RELATED AND A HOLD IS A MEANINGLESS TERM. THE OFFICIAL COUNTDOWN CLOCK STARTS AT THE BEGINNING OF LAUNCH VEHICLE BATTERY INSTALLATION.
	I-48	PROCEED - CONTINUE IN ACCORDANCE WITH PRESCRIBED COUNTDOWN PROCEDURES.
	I-49	HOLD - INTERRUPTION OR DELAY OF THE COUNTDOWN FOR ANY REASON SUCH AS UNFAVORABLE WEATHER, REPAIR OF HARDWARE OR CORRECTION OF CONDITIONS UNSATISFACTORY FOR LAUNCH OR FLIGHT.
	I-50	HOLD-POINT - A PREDETERMINED POINT WHERE THE COUNTDOWN MAY BE CONVENIENTLY INTERRUPTED.
	I-51	SCRUB - THE LAUNCH IS TERMINATED TO BE RESCHEDULED.
	I-52	RECYCLE - THE COUNTDOWN IS STOPPED AND RETURNED TO A DESIGNATED POINT OR AS SPECIFIED IN THE LAUNCH MISSION RULES.
	I-53	TURNAROUND TIME - TURNAROUND TIME IS THE TOTAL TIME REQUIRED FROM A SCRUB TO THE NEXT SCHEDULED LIFTOFF TIME (T-0) INCLUDING RECYCLE AND COUNTDOWN.
	I-54	CUTOFF - THE AUTOMATIC OR MANUAL COMMAND TO STOP THE LAUNCH SEQUENCE AFTER INITIATION OF THE AUTOMATIC LAUNCH SEQUENCE.
	I-55	LIFTOFF - THE EVENT DETERMINED BY THE INSTRUMENTATION UNIT UMBILICAL DISCONNECT SIGNAL. IT IS THAT POINT IN TIME WHEN PLUS TIME COMMENCES.

R	ITEM	
	I-56	ABORT - MISSION TERMINATION BY UNSCHEDULED INTENTIONAL SEPARATION OF THE SPACECRAFT FROM THE LAUNCH VEHICLE PRIOR TO ORBITAL INSERTION.
	I-57	EARLY MISSION TERMINATION - UNSCHEDULED INTENTIONAL MISSION TERMINATION AT OR AFTER ORBITAL INSERTION.
	I-58	MISSION PERIOD TERMINATION (LUNAR LANDING MISSION) - MISSION PERIOD TERMINATION OCCURS UPON THE RELEASE OF THE FLIGHT CREW, FLIGHT HARDWARE, OR RELEASE OF THE LUNAR SAMPLES TO APPROVED PRINCIPLE INVESTIGATORS, WHICHEVER OCCURS LATER.

PART II
1 GENERAL RULES
AND SOP'S

R	ITEM	
		GENERAL
	1-1	THE FLIGHT MISSION RULES OUTLINE PREPLANNED DECISIONS DESIGNED TO MINIMIZE THE AMOUNT OF REAL-TIME RATIONALIZATION REQUIRED WHEN NON-NOMINAL SITUATIONS OCCUR DURING THE TERMINAL COUNTDOWN, THE FLIGHT PHASE, AND RECOVERY OPERATIONS.
	1-2	WHENEVER POSSIBLE, THE CREW AND GROUND WILL VERIFY ALL MALFUNCTIONS. WHENEVER THERE IS A CONFLICT BETWEEN SPACECRAFT AND GROUND TELEMETRY READOUTS, THE SPACECRAFT READOUTS ARE PRIME (ASSUMING THE SPACECRAFT HAS ADEQUATE INSTRUMENTATION AND THAT APPLICABLE SPACECRAFT COCKPIT READOUTS ARE OPERATIONAL).
	1-3	SPACECRAFT LAUNCH WILL NOT BE ATTEMPTED IF KNOWN SPACECRAFT SYSTEMS MALFUNCTIONS WILL LIMIT THE MISSION DURATION SUCH THAT ACCOMPLISHMENT OF THE PRIMARY DETAILED OBJECTIVES WILL BE COMPROMISED.
	1-4	WHEN A CONFLICT OF FLIGHT PLAN ACTIVITIES OCCURS, THE FLIGHT DIRECTOR WILL DETERMINE THE PRIORITY OF ACTIVITIES.
	1-5	IN SOME INSTANCES THE SPECIFIC MISSION RULES MAY DEVIATE FROM THE GENERAL GUIDELINES CONTAINED IN PART I OR FROM THESE GENERAL RULES. THE SPECIFIC MISSION RULE WILL APPLY IN ALL CASES, AND THE DEVIATIONS FROM THE GENERAL GUIDELINES WILL BE NOTED.
	1-6	THE FLIGHT DIRECTOR MAY, AFTER ANALYSIS OF THE FLIGHT, CHOOSE TO TAKE ANY NECESSARY ACTION REQUIRED FOR THE SUCCESSFUL COMPLETION OF THE MISSION.
	1-7	MISSION RULE LIMITS THAT ARE CONSIDERED TO BE INTERIM OR UNCONFIRMED NUMBERS WILL BE UNDERLINED IN THIS PUBLICATION AND IN ALL SUBSEQUENT REVISIONS UNTIL THE NUMBERS ARE CONFIRMED BY THE RESPONSIBLE NASA AGENCY.
	1-8	THE SYSTEMS LIMITS LISTED IN THESE RULES ARE THE ACTUAL VEHICLE LIMITS AS WELL AS THEY ARE KNOWN AND UNDERSTOOD AND ARE NOT BIASED TO COMPENSATE FOR TIME DELAYS OR INSTRUMENTATION ERRORS WITHIN THE SPACECRAFT AND MSFN DATA/DISPLAY SYSTEMS.
	1-9	UNLESS STATED OTHERWISE, MANDATORY AND HIGHLY DESIRABLE INSTRUMENTATION REQUIREMENTS ARE SATISFIED BY EITHER ONBOARD OR PCM CAPABILITY.

R	ITEM	
	1-10	MANDATORY SPACE VEHICLE INSTRUMENTATION FOR THE PURPOSES OF FLIGHT MISSION RULES MUST BE IN ACCORD WITH THE FOLLOWING CRITERIA (REFERENCE OMSF GENERAL RULE I-39): A. REQUIRED TO INSURE FLIGHT CREW SAFETY B. REQUIRED TO IMPLEMENT RULES RESULTING IN LAUNCH ABORTS C. REQUIRED TO IMPLEMENT RULES RESULTING IN EARLY MISSION TERMINATION D. REQUIRED TO MAKE DECISION TO CONTINUE TO THE NEXT MISSION PHASE USING THE ABOVE CRITERIA, THE MANDATORY INSTRUMENTATION LISTINGS IN THIS DOCUMENT WILL BE CROSS-REFERENCED TO THE APPROPRIATE MISSION RULE.
	1-11	THE CRITERION FOR CATEGORIZING INSTRUMENTATION AS HIGHLY DESIRABLE IN THE FLIGHT MISSION RULES IS ANY INSTRUMENTATION REQUIRED FOR NORMAL SYSTEMS MANAGEMENT OR REQUIRED FOR FLIGHT CONTROL DECISIONS NOT IN THE MANDATORY CATEGORY.
	1-12	RF COMMANDS WILL NOT BE TRANSMITTED TO THE SPACECRAFT OR LAUNCH VEHICLE DURING THE LAUNCH PHASE UNLESS SPECIFIC MISSION RULES ARE INVOKED WHICH REQUIRE COMMAND ACTIVITY.
	1-13	THE LAUNCH OPERATIONS MANAGER WILL INFORM THE FLIGHT DIRECTOR WHEN THE SPACE VEHICLE HAS CLEARED THE UMBILICAL TOWER BY STATING "CLEAR TOWER" OVER CHANNEL 111.
	1-14	THE COMMAND PILOT MAY INITIATE SUCH INFLIGHT ACTION AS HE DEEMS ESSENTIAL FOR CREW SAFETY.
	1-15	IN THE EVENT OF LOSS OF COMMUNICATIONS BETWEEN THE MSFN AND THE S/C, THE COMMAND PILOT WILL ASSUME RESPONSIBILITY OF MISSION DIRECTION WITHIN THE FRAMEWORK OF THE MISSION RULES.
		RULE NUMBERS 1-16 THROUGH 1-23 ARE RESERVED.

R	ITEM	
		DEFINITIONS
	1-24	ASAP - AS SOON AS PRACTICABLE (I.E., AS SOON AS POSSIBLE AND REASONABLE).
	1-25	PTP - A PREFERRED TARGET POINT IS A STRATEGICALLY LOCATED SET OF COORDINATES FOR WHICH THE SPACECRAFT SHOULD BE TARGETED IF IT BECOMES NECESSARY TO LAND ON THAT REVOLUTION.
	1-26	ATP - AN ALTERNATE TARGET POINT IS A STRATEGICALLY LOCATED SET OF COORDINATES CHOSEN TO PROVIDE A SPACECRAFT TARGET POINT MIDWAY BETWEEN PTP'S.
	1-27	NEXT BEST PTP - A PREFERRED TARGET POINT WHICH CAN BE REACHED BY THE SPACECRAFT WITHIN THE CONSTRAINTS IMPOSED BY THE SPACECRAFT PROBLEM CAUSING AN EARLY MISSION TERMINATION AND ALLOWING THE BEST POSSIBLE REENTRY AND LANDING AREA CONDITIONS. THE MISSION WILL NOT PROCEED TO THE NEXT PHASE UNLESS SPECIFICALLY NOTED.
	1-28	REENTER ASAP - REENTER AS SOON AS PRACTICABLE (I.E., AS SOON AS POSSIBLE AND REASONABLE).
	1-29	TERMINATE ASAP - REENTER WITH THE MINIMUM TRIP TIME TO AN UNSPECIFIED LANDING AREA.
	1-30	CRITICAL MANEUVERS: A. ANY BURN REQUIRED TO EFFECT CREW RECOVERY WHEN THERE IS NO ALTERNATIVE METHOD FOR OBTAINING THE NECESSARY ΔV OR B. ANY REQUIRED BURN WHERE THE USE OF A DEGRADED SPS IS PREFERABLE TO THE USE OF ANY AVAILABLE ALTERNATIVE METHOD: THE MANEUVERS TABULATED ON MR 3-86 HAVING SPS LIMITS OF "NONE" OR "LOOSE" ARE GENERALLY CATEGORIZED AS CRITICAL BURNS WITH THE DEGREE OF CRITICALITY INDICATED BY THE ENGINE LIMITS AND CREW ACTIONS SPECIFIED IN THAT TABLE.
	1-31	NON-CRITICAL BURN - A NON-CRITICAL BURN IS ANY OTHER BURN AND INCLUDES THOSE CHARACTERIZED BY "TIGHT" LIMITS IN MR 3-86. BECAUSE OF TRAJECTORY CONSIDERATIONS OR OTHER REASONS A NON-CRITICAL BURN MAY, ONCE INITIATED, CHANGE CLASSIFICATION. ALSO, A BURN CONSIDERED AS NON-CRITICAL MAY BE RECLASSIFIED IF, IN THE EXISTING MISSION SITUATION, THE FLIGHT DIRECTOR JUDGES ITS VALUE TO BE COMMENSURATE WITH ANY INCREASED RISK.
	1-32	EARLY STAGING - UNSCHEDULED SEPARATION OF THE S-IVB STAGE FROM THE S-II STAGE.

R	ITEM	
	1-33	CONTINGENCY ORBIT INSERTION (COI) - AN SPS PROPULSIVE MANEUVER WHICH WILL PROVIDE CSM INSERTION INTO A SAFE ORBIT ($H_p \geq 70$ NM) IN THE EVENT OF AN SLV FAILURE OCCURRING IMMEDIATELY PRIOR TO INSERTION, OR IN THE EVENT OF DEGRADED SLV PERFORMANCE.
	1-34	S-IVB DESTRUCT PACKAGE SAFING - THE EMERGENCY DESTRUCT PACKAGE IS SAFED BY THE RSO TRANSMITTING A COMMAND WHICH PERMANENTLY REMOVES POWER FROM THE RANGE SAFETY RECEIVERS.
	1-35	S-IVB SAFING - A PASSIVATION SEQUENCE IN WHICH S-IVB LOX, LH_2, AND HIGH PRESSURE SPHERES ARE DEPLETED.
	1-36	PRELAUNCH PHASE (PRELN) - THE TIME INTERVAL FROM THE COMPLETION OF THE FLIGHT READINESS REVIEW TO LIFTOFF.
	1-37	FLIGHT PHASE - THE INTERVAL FROM LIFTOFF THROUGH SPLASHDOWN. FOR MISSION RULE PURPOSES THE FLIGHT PHASE IS FURTHER SUBDIVIDED AS SHOWN BELOW:

A. LAUNCH PHASE - FROM LIFTOFF THROUGH INSERTION (TB1 THROUGH TB4)

B. EARTH ORBIT PHASE - FROM INSERTION THROUGH S-IVB CUTOFF FOR TRANSLUNAR INJECTION (TLI)

C. TD&E PHASE - FROM CSM/S-IVB SEPARATION THROUGH LM EJECTION FROM SLA

D. TRANSLUNAR COAST PHASE - FROM S-IVB CUTOFF FOR TLI THROUGH LOI 1 CUTOFF

E. DOCKED PHASE - THE TIME INTERVALS DURING WHICH THE LM AND CSM ARE DOCKED

F. LUNAR ORBIT PHASE - FROM LOI CUTOFF TO UNDOCKING AND FROM REDOCKING TO TEI CUTOFF

G. UNDOCKED PHASE - FROM UNDOCKING TO CSM CIRCULARIZATION

H. PRE-PDI PHASE - FROM CIRCULARIZATION TO PDI

I. POWERED DESCENT - THE TIME INTERVAL FROM THE INITIATION OF THE PDI MANEUVER TO TOUCHDOWN

1. PDI TO PDI + 6:10 - DURING THIS TIME PERIOD, THE LM CAN ABORT THE POWERED DESCENT AND GET INTO ORBIT USING THE DPS ONLY AND RETAIN THE DESCENT STAGE AFTER INSERTION.
2. PDI + 6:10 TO HIGH GATE - THIS PERIOD ENDS WHEN THE MANEUVER IS MADE TO VISUALLY AQUIRE THE LANDING STIE.
3. HIGH GATE TO TOUCHDOWN - LANDING SITE VISABILITY TO TOUCHDOWN.

J. LUNAR STAY PHASE - THE TIME INTERVAL FROM TOUCHDOWN UNTIL LIFTOFF

K. EVA - THE TIME INTERVAL FROM LM DEPRESSURIZATION (3.5 PSIA AND DECREASING) UNTIL LM REPRESSURIZATION (3.5 PSIA AND INCREASING)

L. ASCENT PHASE - THE TIME INTERVAL FROM LIFTOFF TO LM INSERTION INTO LUNAR ORBIT

M. RENDEZVOUS - THE TIME INTERVAL FROM INSERTION INTO LUNAR ORBIT AFTER ASCENT OR AFTER AN ABORTED DESCENT UNTIL CSM/LM DOCKING

N. TRANSEARTH COAST PHASE - FROM TEI CUTOFF TO CM/SM SEPARATION

O. ENTRY PHASE - FROM CM/SM SEPARATION TO SPLASHDOWN

R	ITEM	
	1-38	RECOVERY PHASE - THE TIME INTERVAL FROM SPLASHDOWN TO DELIVERY OF THE FLIGHT CREW AND SPACECRAFT TO DESIGNATED LAND BASED INSTALLATIONS.
	1-39	REENTRY DEFINITIONS: A. AUTOMATIC - REENTRY CONTROLLED BY CMC WHICH OUTPUTS BANK ANGLE COMMAND TO THE RCS. B. CLOSED LOOP - REENTRY CONTROLLED BY THE CREW MANUALLY FLYING BANK ANGLE MODULATION USING CMC ENTRY PROGRAM OUTPUTS. C. OPEN LOOP REENTRY - REENTRY CONTROLLED BY THE CREW USING SPACECRAFT DISPLAYS AND FLYING: 1. BANK ANGLE (RR 0-90) AND RETRB (RL 0-90). 2. CONSTANT BANK ANGLE - CREW ESTABLISHES AND MAINTAINS A CONSTANT BANK ANGLE. (CONSTANT BANK ANGLES GREATER THAN 90 DEGREES WILL NOT BE FLOWN EXCEPT WHEN SKIP-OUT RULE IS VIOLATED.) 3. ROLLING REENTRY - MAINTAIN CONSTANT 18 DEGREES PER SECOND ROLL RATE. 4. EMS RANGING - CONSTANT BANK ANGLE IS HELD TO 1G. THEN THE RANGE-TO-GO DISPLAY AND THE RANGE POTENTIAL LINES ARE COMPARED TO MODULATE THE BANK ANGLE. AT RETRB, THE PRESENT BANK ANGLE IS REVERSED. D. CONSTANT G ENTRY - CREW CONTROLS THE BANK ANGLE TO MAINTAIN A SPECIFIED G LEVEL. E. EMS REENTRY - CREW CONTROLS THE BANK ANGLE TO MAINTAIN A CONSTANT G UNTIL VELOCITY LESS THAN 25,500 FPS. THE EMS IS THEN USED TO CONTROL RANGE BY NULLING THE DIFFERENCE BETWEEN THE RANGE-TO-GO COUNTER AND THE RANGE POTENTIAL GUIDELINES. ALL MANEUVERS ARE OVERRIDDEN AS NECESSARY TO PREVENT AN ONSET OR OFFSET VIOLATION.
	1-40	OPERATIONAL FOOTPRINT - THE AREA THAT IS OPERATIONALLY ACCESSIBLE USING THE G&N, EMS, AND CONSTANT 4G ENTRY MODES AND ALLOWING FOR THEIR ASSOCIATED DISPERSIONS. THE G&N PORTION IS AN AREA ±70 NM TO EITHER SIDE OF THE GROUND TRACK AND EXTENDING FROM 915 NM FROM EI TO 2000 NM FROM EI. THE EMS AREA IS THE AREA FROM 61 NM UPRANGE TO 91 NM DOWNRANGE AND ±52 NM IN CROSSRANGE ABOUT THE CONSTANT 4G TARGET POINTS. THE CONSTANT 4G AREA IS THE AREA 110 NM UPRANGE TO 140 NM DOWNRANGE AND ±27 NM CROSSRANGE ABOUT THE CONSTANT 4G TARGET POINTS.
	1-41	ALTERNATE MISSION - ANY DEVIATION FROM THE NOMINAL MISSION TIMELINE WHERE FURTHER MISSION OBJECTIVES ARE CONSIDERED BEFORE THE END OF THE MISSION.
	1-42	CONTINUE MISSION - THE CONTINUE MISSION RULING FOR MALFUNCTIONS INDICATES THAT THE MISSION WILL BE CONTINUED IN ACCORDANCE WITH PRESENT PLANS UNLESS OVERRIDING FACTORS ARE PRESENT WHICH WOULD CAUSE SELECTION OF AN ALTERNATE CHOICE.
	1-43	EVASIVE MANEUVER - USE OF RESIDUAL S-IVB PROPELLANTS TO ACHIEVE THE FOLLOWING IN ORDER OF PRIORITY: 1. A REDUCTION IN THE PROBABILITY OF S-IVB AND SPACECRAFT RECONTACT 2. A REDUCTION IN THE PROBABILITY OF S-IVB EARTH IMPACT 3. AN INCREASE IN THE PROBABILITY OF S-IVB LUNAR IMPACT

R	ITEM

1-44 LUNAR ABORT MODES AFTER EARLY LOI SHUTOFF (REFERENCE RULE 5-61 FOR ABORT MANEUVER DEFINITION) DPS:

A. MODE I - 0 TO 613 FPS (IGN TO 1 + 31)
B. MODE II - 613 TO 1200 FPS (1 + 31 TO 2:54)
C. MODE III - 1200 TO 2980 (2 + 54 TO C/O)

1-45 SATURN L/V TIME BASES

TIME BASE	DEFINITION	NOMINAL INITIATE TIME
TB1	LIFTOFF TO S-IC INBOARD ENGINE CUTOFF	0:00
TB2	S-IC INBOARD ENGINE CUTOFF TO S-IC OUTBOARD ENGINE CUTOFF (S-IC/S-II STAGING)	2:17
TB3	S-IC OUTBOARD ENGINES CUTOFF TO S-II CUTOFF (S-II/S-IVB STAGING)	2:40
TB4	S-II CUTOFF TO S-IVB FIRST BURN CUTOFF	9:17
TB5	S-IVB FIRST BURN CUTOFF TO S-IVB RESTART PREPARATIONS (RESTART MINUS 9 MIN 38 SEC)	11:46
TB6	S-IVB RESTART MINUS 9 MIN 38 SEC TO S-IVB SECOND BURN CUTOFF	2:20:48
TB7	S-IVB SECOND CUTOFF TO START OF S-IVB EVASIVE MANEUVER BURN	2:36:22
TB8	START EVASIVE BURN TO END OF S-IVB/IC LIFETIME.	4:14:22 (BY GROUND CMD)

RULE NUMBERS 1-45 THROUGH 1-47 ARE RESERVED.

R	ITEM

CRITERIA FOR TARGET POINT SELECTION

1-48 THE CRITERIA LISTED BELOW WILL BE USED WHEN CHOOSING BETWEEN TWO OR MORE TARGET POINTS. THE CRITICALITY OF THE MISSION SITUATION WILL AFFECT THE APPLICATION OF THESE CRITERIA.

	PRIORITY
ACCEPTABLE LAND MASS CLEARANCE	1
ACCEPTABLE WEATHER CONDITIONS FOR RECOVERY OPERATIONS AND CM STRUCTURAL INTEGRITY	2
CAPABILITY OF RECOVERY FORCES	3
COMMUNICATION WITH THE SPACECRAFT FROM A GROUND STATION AT LEAST 40 MINUTES PRIOR TO DEORBIT BURN*	4
SUFFICIENT DAYLIGHT FOR RECOVERY OPERATIONS	5
A GROUND STATION FOR POST-DEORBIT BURN* TRACKING	6
VOICE CONTACT PRIOR TO AND DURING DEORBIT BURN*	7
POST-BLACKOUT TRACKING DATA AVAILABLE FOR REENTRY (ASSUMES PRE-BLACKOUT ACQUISITIONS)	8
GROUND STATIONS AVAILABLE TO OBTAIN ΔV_C READOUTS AND TO PASS CREW BACKUP GUIDANCE QUANTITIES	9

*OR FINAL MCC MANEUVER

1-49 LUNAR RETURN ENTRY RANGE PRIORITY - THE RELATIVE ENTRY RANGE AT A -6.5 DEG FLIGHTPATH ANGLE (400,000 FEET TO SPLASH) PRIORITY IS AS FOLLOWS:

A. 1070-1215 NM (NOMINAL)
B. 1455-1565 NM (USED TO AVOID WEATHER VIOLATIONS IN PRIORITY A.)
C. 1800-2500 NM (USED TO AVOID EXTREME WEATHER VIOLATIONS IN PRIORITES A AND B.)

RULE NUMBERS 1-50 THROUGH
1-55 ARE RESERVED.

R	ITEM	
		PRELAUNCH RULES
	1-56	MANDATORY - THE COGNIZANT FLIGHT CONTROLLER WILL REQUEST A HOLD OR A CUTOFF FROM THE FLIGHT DIRECTOR IN CASE OF A LOSS OR FAILURE OF A MANDATORY ITEM. PRIOR TO T-1 MIN, FAILURES OF MANDATORY ITEMS WILL BE CONFIRMED PRIOR TO REQUESTING A HOLD OR A CUTOFF. AFTER T-1 MIN, CUTOFF WILL BE REQUESTED FOR MANDATORY ITEMS WITHOUT VERIFICATION DUE TO THE LIMITED TIME REMAINING. AT T-20 SEC, ALL MANDATORY ITEMS WILL REVERT TO HIGHLY DESIRABLE UNLESS SPECIFICALLY DESIGNATED AS MANDATORY TO L/O. REFERENCE THE LAUNCH MISSION RULES DOCUMENT FOR SPECIFIC PROCEDURES.
	1-57	HIGHLY DESIRABLE - THE COGNIZANT FLIGHT CONTROLLER WILL NOTIFY THE FLIGHT DIRECTOR IN CASE OF A LOSS OR A FAILURE OF A HIGHLY DESIRABLE ITEM(S). A HOLD MAY BE CALLED BY THE FLIGHT DIRECTOR TO REPAIR THIS ITEM(S) WHEN IT IS CONVENIENT AND IF THE ESTIMATED TIME TO REPAIR OR REPLACE THE ITEMS(S) IS ACCEPTABLE. ALL HIGHLY DESIRABLE ITEMS REVERT TO DESIRABLE AFTER AUTO SEQUENCE START.
	1-58	DESIRABLE - FLIGHT CONTROLLERS WILL NOT CALL HOLDS FOR THE LOSS OF DESIRABLE ITEMS AS THEY ARE PLACED IN THIS CATEGORY BECAUSE THEY ARE ITEMS OF SUPPORT WHICH ARE OF MINOR IMPORTANCE TO FLIGHT OPERATIONS.
	1-59	MANUAL CUTOFF WILL NOT BE ATTEMPTED FROM T-11 SECONDS (ENGINE IGNITION) TO T-0.
		RULE NUMBERS 1-60 THROUGH 1-65 ARE RESERVED.

R	ITEM	
		LAUNCH ABORTS
	1-66	ABORT REQUEST COMMANDS ARE COMMANDS TRANSMITTED FROM THE MCC OR LCC WHICH ILLUMINATE THE ABORT REQUEST LIGHT ON THE COMMAND PILOT'S PANEL. THE "ABORT LIGHT" AND A VOICE REPORT "ABORT" OVER A/G ARE CONSIDERED TWO CUES FOR THE CREW TO TAKE THE NECESSARY ACTION TO ABORT THE MISSION. THE GROUND WILL USE TWO INDEPENDENT CUES PRIOR TO TRANSMITTING "ABORT REQUEST." ADDITIONAL CUES FOR THE CREW WILL COME FROM ONBOARD INDICATIONS.
	1-67	ABORT ACTION CAN BE INITIATED ONLY BY THE CREW OR THE EDS.
	1-68	WHENEVER POSSIBLE, ALL ABORTS AND EARLY MISSION TERMINATIONS WILL BE TIMED FOR A WATER LANDING.
	1-69	THE FLIGHT DIRECTOR WILL INITIATE THE ABORT REQUEST FOR SPACECRAFT SYSTEM MALFUNCTIONS.
	1-70	THE FLIGHT DYNAMICS OFFICER WILL INITIATE THE ABORT REQUEST COMMAND DURING THE FLIGHT PHASE IF THE SPACE VEHICLE EXCEEDS THE FLIGHT DYNAMICS ENVELOPE.
	1-71	THE BOOSTER SYSTEMS ENGINEER WILL INITIATE THE ABORT REQUEST COMMAND BASED UPON LAUNCH VEHICLE TIME-CRITICAL SYSTEMS MALFUNCTIONS THAT WOULD NOT ALLOW A SAFE INSERTION OR CONTINUATION TO A FLIGHT DYNAMICS LIMIT LINE.
	1-72	THE ONLY KSC POSITION THAT WILL HAVE ABORT REQUEST CAPABILITY IS THE LAUNCH OPERATIONS MANAGER. THE LAUNCH OPERATIONS MANAGER MAY SEND AN ABORT REQUEST FROM THE TIME THE LAUNCH ESCAPE SYSTEM IS ARMED UNTIL THE SPACE VEHICLE REACHES SUFFICIENT ALTITUDE TO CLEAR THE TOP OF THE UMBILICAL TOWER. PRIOR TO TRANSFER OF CONTROL TO THE FLIGHT DIRECTOR, THE LAUNCH OPERATIONS MANAGER WILL INITIATE THE ABORT REQUEST COMMAND FROM KSC BASED ON THE CRITERIA DEFINED IN THE LMRD. THESE INCLUDE: A. MAJOR STRUCTURAL FAILURE OR EXPLOSION B. NEGATIVE VERTICAL MOTION C. UNCONTROLLABLE VEHICLE TILTING D. CATASTROPHIC FIRES PRIOR TO LIFTOFF

R	ITEM	
	1-73	THE RSO CAN SHUT DOWN THE SLV BY TRANSMITTING THE MFCO COMMAND WHICH ALSO LIGHTS THE ABORT REQUEST LIGHT IN THE SPACECRAFT. THE MFCO WILL INITIATE AN AUTO-ABORT IF TRANSMITTED PRIOR TO EDS DISABLE. THE MFCO COMMAND INITIATES A 4.1-SEC TIMER ON THE GROUND (CAPE RSO CONSOLE ONLY), WHICH IN TURN ENABLES DESTRUCT CAPABILITY IF TRANSMITTED. THE BRSO INSERTS A TIME DELAY MANUALLY. THE RSO DESTRUCT COMMAND CAN THEN DESTROY THE SLV. THE RSO WILL ALWAYS SAFE THE S-IVB AFTER TRANSMITTING MFCO UPON VERIFICATION OF CUTOFF IF THE DESTRUCT COMMAND IS NOT TO BE TRANSMITTED.
	1-74	THE RSO WILL SAFE THE S-IVB DESTRUCT SYSTEM AFTER CONFIRMATION OF S-IVB C/O FROM THE FLIGHT DYNAMICS OFFICER. IF COMMUNICATIONS ARE LOST WITH THE FIDO, THE S-IVB DESTRUCT SYSTEM WILL BE SAFED, BASED ON THE RSO'S VERIFICATION OF S-IVB CUTOFF. ONCE SAFED, THE S-IVB DESTRUCT SYSTEM CANNOT BE REINITIATED. IF THE RSO INITIATES MFCO, THE RSO WILL INITIATE SAFING AFTER VERIFICATION OF S-IVB CUTOFF.
	1-75	EMERGENCY ENGINE SHUTDOWN METHODS:

INITIATOR	METHOD	STAGE	TIME FRAME
ASTRONAUT	CCW ON THC	S-IC, S-II, S-IVB	T+30 SEC TO S-IVB CUTOFF
ASTRONAUT	S-II/ S-IVB L/V STAGE SWITCH	S-II, S-IVB	T+2:43 TO S-IVB CUTOFF
RSO	RF CMD (MFCO)	S-IC, S-II, S-IVB	T-0 TO S-IVB CUTOFF
EDS	2 OF 3 VOTING LOGIC	S-IC	T+30 SEC TO EDS AUTO OFF AT T+2:00 MIN NOTE: EDS WILL INITIATE ABORT FROM T-0 TO T+30 SEC. HOWEVER, S-IC ENGINES WILL NOT BE SHUT DOWN.

	1-76	THE AUTOMATIC EDS (TWO ENGINE OUT AND OVERRATE AUTO-ABORT CAPABILITIES) WILL BE FLOWN CLOSED LOOP UNTIL T+02:00. DURING LAUNCH, MALFUNCTIONS AFFECTING EDS OPERATION WILL BE MANAGED AS FOLLOWS: THE EDS AUTO SWITCH WILL BE TURNED OFF WHENEVER ANY TWO CSM ENTRY BATTERIES ARE TIED TO THE SAME MAIN BUS OR FOR CONFIRMED LOSS OF ANY CSM ENTRY BATTERY.						

R	ITEM	
	1-77	ABORT MODES

MODE I	BOUNDARY OF APPLICATION
IA	LES ABORT ENABLE (APPROX T-45 MIN) TO GET 61 SEC (22.1K FT)
IB	GET 61 SEC TO 100K FEET ALTITUDE (GET APPROX 1:50)
IC	100K FEET ALTITUDE TO TOWER JETTISON (GET APPROX 3:15)

1-78 MODE II

BOUNDARY OF APPLICATION	PROCEDURES
TOWER JETTISON (GET APPROX 3:15) UNTIL FULL LIFT SPLASH POINT IS 3200 NM DOWNRANGE (GET APPROX 10:13)	A. MCC PROVIDES: 1. GET OF 300K 2. PITCH AT .05G 3. GET DROGUE B. ENTRY IS FULL LIFT

R	ITEM			
	1-79	MODE III	BOUNDARY OF APPLICATION	PROCEDURES
			BETWEEN FULL LIFT SPLASH POINT EQUAL TO 3200 NM AND INSERTION.	A. MCC PROVIDES: 1. GETI AS S-IVB CUTOFF PLUS 02:05 2. DELTA V FOR 3350 NM SPLASH POINT 3. BURN DURATION 4. GET OF 300K 5. PITCH AT .05G 6. GET DROGUE B. MANEUVER IS SCS AUTO. C. ENTRY IS ROLL LEFT 55 DEGREES.
			NOTE MODE III "NO BURN" WILL BE CALLED IF THE ROLL LEFT 55-DEG ENTRY RANGE IS LESS THAN 3350 NM.	
	1-80	MODE IV	BOUNDARY OF APPLICATION	PROCEDURES
			CONTINGENCY ORBIT INSERTION CAPABILITY TO INSERTION (BASED ON COI LINE ON GAMMA VS V PLOT FOR NEAR NOMINAL ALTITUDE).	A. MCC PROVIDES: 1. GETI AT S-IVB CUTOFF PLUS 02:05 2. DELTA V REQUIRED TO ACHIEVE PERIGEE GREATER THAN OR EQUAL TO 70 NM 3. BURN DURATION 4. PITCH AT GETI B. MANEUVER IS SCS AUTO
	1-81	MODE	BOUNDARY OF APPLICATION	PROCEDURES
		APOGEE KICK	PRE-APOGEE CUTOFF, OUTSIDE THE COI BOUNDARY, CORRECTABLE TO SAFE ORBITAL CONDITIONS BY A MANEUVER AT APOGEE.	A. MCC PROVIDES: 1. GETI FOR BURN AT APOGEE 2. DELTA V REQUIRED TO ACHIEVE PERIGEE GREATER THAN OR EQUAL TO 70 NM 3. BURN DURATION 4. PITCH ATTITUDE B. MANEUVER IS SCS AUTO
		RULE NUMBERS 1-82 THROUGH 1-86 ARE RESERVED.		

R	ITEM

CREW ABORT LIMITS

1-87 MAX Q REGION

	PROCEDURES
(00:50 TO 02:00) AOA GREATER THAN OR EQUAL TO 100 PCT AND ROLL, PITCH, OR YAW ERROR GREATER THAN OR EQUAL TO 5 DEGREES (NOT APPLICABLE TO ANY ENGINE OUT PRIOR TO 50 SEC)	ABORT MODE I (ACTION ONLY AFTER BOTH HAVE REACHED THRESHOLD)

1-88 RATES AND ATTITUDE

	PROCEDURES
A. PITCH AND YAW	
1. L/O TO 2 MIN - 4 DEG/SEC 2. 2 MIN TO S-IVB CUTOFF - 10 DEG/SEC 3. YAW DEVIATION GREATER THAN 20 DEG (S-II AND S-IVB BURN ONLY) (WITH ALL ENGINES OPERATING)	ABORT MODE I, MODE II, MODE III, OR MODE IV
B. ROLL	
L/O TO S-IVB CUTOFF - 20 DEG/SEC	ABORT MODE I, MODE II, MODE III, OR MODE IV

1-89 EDS AUTOMATIC ABORT LIMITS (UNTIL MANUAL DEACTIVATION OF TWO ENGINES OUT AUTO AND LV RATES AT 2:00 MIN)

	BOUNDARY OF APPLICATION
A. RATES	
PITCH AND YAW	4.0 ± 0.5 DEG/SEC
ROLL	20.0 ± 0.5 DEG/SEC
B. ANY TWO ENGINES OUT	
C. CM TO IU BREAKUP	

R	ITEM	
	1-90	S-IVB TANK PRESSURE LIMITS A. BULKHEAD ΔP (FIRST S-IVB C/O TO S/C L/V SEP) FUEL GREATER THAN OXID = 26 PSID OXID GREATER THAN FUEL = 36 PSID B. LOX TANK PRESS GREATER THAN OR EQUAL TO 50 PSIA (L/O TO S/C L/V SEP)
	1-91	ENGINE FAILURES — PROCEDURES LOSS OF THREE OR MORE S-II ENGINES PRIOR TO S-IVB TO COI CAPABILITY — ABORT MODE I OR MODE II

R	ITEM

GENERAL

2-1 PRELAUNCH

A. LAUNCH AZIMUTH LIMITATIONS RESTRICT LAUNCHES TO OCCUR BETWEEN 72 DEGREES AND 100 DEGREES.

B. THE FLIGHT DIRECTOR WILL EVALUATE WIND SIMULATIONS ALONG THE MODE I (TOWER) ABORT TRACK PRIOR TO THE START OF CRITICAL COUNTDOWN ACTIVITIES AND WILL ADVISE THE LAUNCH DIRECTOR OF ANY PREDICTED PERIODS OF LAND LANDING. IF THE FLIGHT DIRECTOR IS UNABLE TO PROVIDE THIS EVALUATION, A LAND LANDING WILL BE ASSUMED AND THE SPACECRAFT WIND CONSTRAINTS FOR LAND IP'S WILL BE APPLIED. THESE CONSTRAINTS REQUIRE THAT THE SPACECRAFT NOT BE LAUNCHED OR REMAIN IN A TOWER ABORT MODE IF A TOWER ABORT WOULD RESULT IN A LAND LANDING WITH A HORIZONTAL VELOCITY COMPONENT OF GREATER THAN 54 FEET PER SECOND AT IMPACT. IN ALL CASES, THE LAUNCH DIRECTOR WILL BE PRIME FOR CALLING HOLDS FOR LAND LANDING LAUNCH WIND VIOLATIONS.

C. THE LAUNCH WILL NOT BE ATTEMPTED IF THE MINIMUM GROUND INSTRUMENTATION CAPABILITY IS COMPROMISED. CONTINUOUS TRACKING COVERAGE IS REQUIRED FROM LIFTOFF THROUGH LIFTOFF PLUS 10 MIN. CONTINUOUS TM AND VOICE ARE REQUIRED FROM LIFTOFF THROUGH INSERTION.

2-2 LAUNCH

IT IS PREFERABLE TO GO INTO ORBIT RATHER THAN PERFORM A LAUNCH ABORT. THEREFORE, THE LAUNCH WILL BE CONTINUED AS LONG AS THE CREW CONDITION IS SATISFACTORY, NO S/C OR SLV PROBLEMS EXIST WHICH JEOPARDIZE CREW SAFETY, AND SUFFICIENT CONSUMABLES, COOLANT, AND ELECTRICAL ENERGY REMAIN FOR AT LEAST ONE REVOLUTION PLUS ENTRY.

R	ITEM
	2-3

EARTH ORBIT

A. ENTRY WILL BE MADE AT THE NEXT BEST PTP WHEN ONE MORE CSM FAILURE WILL RESULT IN AN ASAP ENTRY OR UNCONTROLLABLE CONDITIONS.

B. ADEQUATE CONSUMABLES WILL BE MAINTAINED FOR ENTRY IN THE NEXT PTP, MAKING ALLOWANCES FOR SETUP AND ENTRY.

C. THE DEORBIT CAPABILITIES REQUIRED FOR EARTH ORBIT ARE:

1. TWO METHODS OF DEORBIT ARE REQUIRED.

2. IF A SUBSEQUENT SINGLE FAILURE WOULD PRECLUDE DEORBIT BY EITHER METHOD REMAINING, THE CSM WILL DEORBIT.

3. SPS IS THE PRIME METHOD OF DEORBIT AND SUFFICIENT ΔV WILL BE RESERVED FOR THIS MANEUVER.

4. SM-RCS (4 QUAD) AND SM-CM/RCS HYBRID WILL BE CONSIDERED AS INDEPENDENT DEORBIT METHODS AS LONG AS INDIVIDUAL SM-RCS QUAD AND GNCS INTEGRITY IS MAINTAINED AND SUFFICIENT RCS PROPELLANT IS AVAILABLE.

5. THE LM PROPULSION SYSTEM (DPS OR RCS) MAY BE USED TO PLACE THE CSM IN AN ORBIT ($H_p \geq 80$ NM) FROM WHICH A SM-RCS OR SM-CM/RCS HYBRID DEORBIT CAN BE CONDUCTED.

6. UTILIZATION OF BACKUP DEORBIT METHODS WILL BE BASED ON THE FOLLOWING PRIORITIES:

(A) SM-RCS
(B) LM PROP PLUS SM-RCS
(C) SM-CM/RCS HYBRID
(D) LM PROP PLUS SM-CM/RCS HYBRID

RULE NUMBERS 2-4 THROUGH
2-10 ARE RESERVED.

R	ITEM	
	2-11	TRANSLUNAR INJECTION

A. THE TLI WILL BE GO IF THE S/C AND L/V SATISFY THE FOLLOWING CRITERIA:

1. THERE HAVE BEEN NO FAILURES IN THE LAUNCH VEHICLE WHICH RESULT IN A CATASTROPHIC HAZARD.

2. A "GO FOR TLI" RECOMMENDATION WILL BE GIVEN IF ENOUGH PROPELLANT IS AVAILABLE AND THE SLV HARDWARE STATUS IS DEEMED ADEQUATE FOR A REASONABLE PROBABILITY OF REACHING A 28,000 NM APOGEE. THE FINAL DECISION RESTS WITH THE FLIGHT DIRECTOR FOR DETERMINING A REASONABLE PROBABILITY.

3. THE CSM HAS TOTAL SYSTEMS CAPABILITY WITH REDUNDANCY. REDUNDANCY VERIFICATION IS SUBJECT TO THE NUMBER AND TYPE OF REDUNDANT COMPONENT CHECKS WHICH CAN BE PERFORMED IN EARTH ORBIT.

B. THE TLI MANEUVER WILL BE DELAYED UNTIL THE SECOND OPPORTUNITY FOR SUSPECTED FAILURE OF A CRITICAL SYSTEM (PRIME OR BACKUP - MANEUVER, LIFE SUPPORT, COOLING, POWER SEQUENTIAL, COMMUNICATIONS) WHICH REQUIRES TIME FOR EVALUATION.

C. TLI TARGETING WILL BE SUCH THAT A SAFE CIRCUMLUNAR RETURN TO EARTH CAN BE RE-ESTABLISHED WITHIN LM DPS CAPABILITY AS LATE AS PC + 2 HRS. THE CAPABILITY WILL EXIST TO ESTABLISH A SAFE CIRCUMLUNAR RETURN TO EARTH WITH THE SM-RCS UNTIL TLI + 5 HRS.

	2-12	TRANSPOSITION, DOCKING AND EJECTION (TD&E)

A. THE NORMAL MINIMUM CABIN PRESSURE REDLINE OF 4.0 PSIA FOR TUNNEL/LM PRESSURIZATION SEQUENCES MAY BE WAIVED DURING TD&E. THE CM WILL BE DEPRESSURIZED AS REQUIRED TO ACCOMPLISH HATCH REMOVAL FOR UMBILICAL HOOKUP OR DOCKING INTERFACE INSPECTION.

B. IF NORMAL LM EJECTION IS NOT SUCCESSFUL, NO ATTEMPT WILL BE MADE TO MAN THE LM AND "STAGE" TO RECOVER THE ASCENT STAGE.

R	ITEM

2-13 TRANSLUNAR COAST

A. NO MCC WILL BE PERFORMED IF LOI CAN BE TARGETED WITHIN OPERATIONAL CONSTRAINTS.

B. TRANSLUNAR COAST WILL BE TERMINATED IF ADEQUATE CONSUMABLES (CSM AND/OR LM) ARE NOT AVAILABLE FOR A CIRCUMLUNAR EARTH RETURN + 12 HRS AND A TLC DIRECT ABORT PROVIDES AN EARLIER LANDING TIME.

C. THE CREW WILL MAN THE LM FOR BACKUP COMMUNICATIONS (VOICE, TM, TRACK) IF CSM COMMUNICATIONS ARE LOST WITH THE MSFN. WITH LOSS OF CSM COMMUNICATIONS, A LUNAR ORBIT MISSION WILL BE FLOWN UTILIZING THE LM COMMUNICATIONS SYSTEMS.

D. MCC'S WILL BE DESIGNED TO MEET LOI TARGETING CONSTRAINTS WHILE RESERVING A CAPABILITY TO PERFORM A RETURN TO EARTH MANEUVER WITH DPS ENGINE AS LATE AS 2 HOURS AFTER PERILUNE ON THE CIRCUMLUNAR TRAJECTORY.

E. FOR A CSM SOLO MISSION, MCC'S WILL BE TARGETED SO A SAFE CIRCUMLUNAR RETURN TO EARTH CAN BE ESTABLISHED WITHIN RCS CAPABILITY.

F. SIM BAY EXPERIMENT OPERATION DURING TLC

1. ALL CREWMEN WILL BE IN THE CSM FOR SIM BAY DOOR JETTISON.
2. A NO-GO FOR LOI WILL NOT PRECLUDE SIM BAY DOOR JETTISON.

2-14 LUNAR ORBIT INSERTION

A. LOI WILL BE INHIBITED AND A LUNAR FLYBY PERFORMED IF THE CSM DOES NOT SATISFY ANY OF THE FOLLOWING CONDITIONS:

1. FULL CRITICAL SYSTEMS REDUNDANCY
2. ADEQUATE CONSUMABLES FOR MINIMUM LUNAR ORBIT OPERATIONS WITH CAPABILITY TO SUSTAIN A CRYO TANK LOSS AND RETURN TO EARTH WITH AN AVERAGE POWER LEVEL OF 40 AMPS
3. SPS PROPELLANT RESERVE CAPABILITY FOR TEI AND TRANSEARTH MCC'S
4. RCS PROPELLANT RESERVE TO ACCOMPLISH TEI CONTROL, TRANSEARTH MCC CONTROL, PTC, MINIMUM TRANSEARTH AND LUNAR ORBIT OPERATIONS

B. A DPS LOI MAY BE PERFORMED IF REQUIRED TO ACCOMPLISH A LUNAR ORBIT MISSION.

C. FOR A CSM SOLO MISSION, THE SIM BAY DOOR MUST BE JETTISONED (ALLOWING SIM BAY SCIENCE OPERATIONS) TO BE GO FOR LOI.

R	ITEM
	2-15

LUNAR ORBIT

A. FOR LOI DISPERSIONS, IF A STABLE ORBIT HAS NOT BEEN ACHIEVED, A DPS 30-MINUTE ABORT OR A DPS 2-HOUR ABORT WILL BE EXECUTED FOLLOWED BY A SUBSEQUENT DPS (OR APS) MANEUVER IF REQUIRED.

B. DESIGNED REDUNDANT CAPABILITY MUST BE MAINTAINED IN ALL CSM SYSTEMS CRITICAL FOR TEI AND LIFE SUPPORT.

C. SUFFICIENT CONSUMABLES MUST REMAIN TO COMPLETE THE NEXT MISSION PHASE WITH CAPABILITY TO SUSTAIN A CRYO TANK LOSS DURING THE PHASE AND RETURN TO EARTH WITH AN AVERAGE POWER LEVEL OF 40 AMPS.

D. THE CSM MUST MAINTAIN AN SPS FUEL RESERVE CAPABILITY FOR THE TEI MANEUVERS AND TRANSEARTH MCC'S.

E. THE CSM MUST MAINTAIN RCS PROPELLANT RESERVE TO ACCOMPLISH TEI CONTROL, TEC MCC CONTROL, PTC, AND MINIMAL TRANSEARTH OPERATIONS.

F. IF A LANDING MISSION IS NOT POSSIBLE, THE ALTERNATE MISSION WILL NOT BE SHORTENED SOLELY TO ALLOW DPS TEI CAPABILITY. IF THE DPS IS AVAILABLE AT THE TEI TIME, IT WILL BE USED FOR TEI.

G. LUNAR ORBIT SCIENCE OPERATIONS

1. NO EVA WILL BE PERFORMED FOR SYSTEMS TROUBLE SHOOTING ON AN INDIVIDUAL SIM BAY MALFUNCTION.

2. DURING LUNAR SOUNDERS OPERATIONS, IF EMI RESULTS IN DEGRADATION OR LOSS OF TM, THE LUNAR SOUNDER OPERATION MAY BE CONTINUED DEPENDING ON THE STATUS OF CSM SYSTEMS.

R	ITEM	
	2-16	DESCENT ORBIT INSERTION (DOI) DOI_1 WILL BE PERFORMED ONLY IF A LUNAR LANDING MISSION CAN BE ACCOMPLISHED, OTHERWISE AN LOI-2 MANEUVER WILL BE PERFORMED TO ATTAIN APPROXIMATELY A 60 NM CIRCULAR ORBIT.
	2-17	INTRAVEHICULAR TRANSFER ONE HARDSUIT IVT FROM THE CSM TO THE LM WILL BE ACCOMPLISHED IF A REASONABLE CHANCE EXISTS THAT CORRECTIVE ACTION CAN BE TAKEN FOR A LM/TUNNEL PRESSURIZATION.
	2-18	DOCKED LM OPERATIONS FOR AN IMPENDING HAZARDOUS SITUATION RESULTING FROM A DESCENT STAGE PROBLEM, THE STAGE WILL BE JETTISONED AND ASCENT STAGE OPERATIONS WILL CONTINUE AFTER THE VEHICLE HAS MOVED TO A SAFE DISTANCE.
		RULES NUMBERS 2-19 AND 2-20 ARE RESERVED.
	2-21	CSM/LM UNDOCKING AND SEPARATION A. A MANNED LM WILL NOT BE UNDOCKED FROM THE CSM WITHOUT INDEPENDENT MANEUVER CAPABILITY OF BOTH VEHICLES TO RENDEZVOUS. B. EVT CAPABILITY IS REQUIRED FOR MANNED UNDOCKING. C. VHF COMMUNICATIONS ARE MANDATORY FOR SEPARATION.
	2-22	CSM LUNAR ORBIT UNDOCKED A. UNDOCKING TO PDI 1. LOSS OF REDUNDANT CAPABILITY IN CRITICAL SYSTEMS WILL BE CAUSE TO TERMINATE THE LANDING MISSION. LM SYSTEMS MAY BE UTILIZED TO PROVIDE SYSTEMS REDUNDANCY FOR CONTINUATION OF AN ALTERNATE MISSION. 2. LOSS OF CSM RESCUE CAPABILITY WILL BE CAUSE FOR TERMINATING THE MISSION AND PERFORMING A LM ACTIVE RENDEZVOUS ASAP. B. PDI TO LANDING NO CSM FAILURES WILL BE CAUSE FOR ABORT DURING POWERED DESCENT EXCEPT THOSE CONFIRMED SPS FAILURES REQUIRING RETENTION OF LM PROPULSION CAPABILITY. C. LUNAR STAY FAILURE TO MAINTAIN REDUNDANT CAPABILITY IN SYSTEMS REQUIRED FOR TEI OR LIFE SUPPORT WILL BE CAUSE FOR TERMINATION OF LUNAR STAY.

R	ITEM	
	2-23	RESERVED
	2-24	LM PDI FOR PDI, THE LM MUST MEET THE LUNAR STAY WITH EVA CRITERIA, AND MUST HAVE THE CAPABILITY TO LAND, ASCEND, AND RENDEZVOUS WITHOUT VIOLATING ANY SPECIFIC MISSION RULES OR REDLINES.
	2-25	LM POWERED DESCENT IF A SYSTEMS FAILURE OCCURS AND A CHOICE IS AVAILABLE - A. PDI TO HIGH GATE REDUNDANT CAPABILITY OF CRITICAL LM SYSTEMS AND SYSTEMS NEEDED FOR AN EVA ARE REQUIRED TO HIGH GATE. EARLY IN POWERED DESCENT, IF AN ABORT IS REQUIRED, IT IS PREFERABLE TO ABORT WHEN DPS TO ORBIT CAPABILITY (AND THE SHORTER RENDEZVOUS) ARE AVAILABLE. B. HIGH GATE TO TOUCHDOWN BECAUSE OF LIMITED TIME FOR PROBLEM VERIFICATION AND SYSTEM RECONFIGURATION, IT IS PREFERABLE TO LAND THAN ABORT. IF THE INDICATED FAILURE WILL ALLOW A SAFE LANDING AND ASCENT INTO AN ACCEPTABLE ORBIT, A LANDING WILL BE ACCOMPLISHED.
	2-26	LM LUNAR STAY A. ONLY THOSE TIME-CRITICAL SYSTEMS FAILURES OR TRENDS THAT INDICATE IMPENDING LOSS OF THE CAPABILITY TO ASCEND AND ACHIEVE A SAFE ORBIT WILL BE CAUSE FOR AN IMMEDIATE ABORT (ANYTIME LIFTOFF) FROM THE LUNAR SURFACE. B. LOSS OF REDUNDANT CAPABILITY IN CRITICAL LM SYSTEMS IS CAUSE FOR ABORT AT THE NEXT BEST OPPORTUNITY.

R	ITEM
	2-27

LUNAR SURFACE EVA'S

A. FOR THE NOMINAL (TWO-MAN) EVA, TOTAL EMU LIFE SUPPORT SYSTEMS CAPABILITY AND CRITICAL INSTRUMENTATION FOR BOTH ASTRONAUTS ARE REQUIRED.

B. A ONE-MAN EVA MAY BE INITATED.

C. THE ACTIVATION OF THE OPS IN THE MAKEUP MODE WILL REQUIRE EXPEDITIOUS COMPLETION OF THE SPECIFIC ACTIVITY BEING PERFORMED, FOLLOWED BY IMMEDIATE RETURN TO THE LM. ACTIVATION OF THE OPS HIGH OR LOW PURGE MODE WILL REQUIRE IMMEDIATE RETURN TO THE LM.

D. THE OPERATIONAL EVA PLAN WILL BE CONSTRAINED TO A MAXIMUM DURATION OF 7 HOURS.

E. AN EVA TRAVERSE LIMIT WILL BE APPLIED ALLOWING ONE FAILURE (LRV OR PLSS) WITH THE CAPABILITY TO RETURN TO THE LM. THE MAXIMUM ACCEPTABLE CREW HEAT STORAGE IS 300 BTU'S.

F. ALL PLANNED EVA'S WILL INCLUDE A 30-MINUTE, POST-EVA RESERVE ON EMU CONSUMABLES.

1. TWO-MAN EVA

OPERATIONAL LRV

(A) EVA EXCURSIONS WILL BE LIMITED TO ALLOW PLSS WALKBACK ASSUMING NO PLSS FAILURES.

(B) EVA EXCURSIONS WILL BE LIMITED TO SUPPORT RIDEBACK WITH A FAILED PLSS, USING BSLSS AND THE OPS IN LOW PURGE FLOW. WITH NO BSLSS, A COMBINATION OF HI AND LO PURGE FLOW WILL BE USED FOR RETURN AND INGRESS WITH A PAD ADDED TO THE LO PURGE FLOW PHASE.

NO LRV AVAILABLE

(A) EVA EXCURSIONS WILL BE LIMITED TO A BSLSS WALKBACK CAPABILITY USING THE OPS IN LOW PURGE FLOW.

(B) WITH NO BSLSS, THE EVA EXCURSIONS WILL BE LIMITED, ALLOWING LM RETURN USING THE OPS IN HIGH PURGE FLOW.

2. ONE-MAN EVA

OPERATIONAL LRV

(A) EVA EXCURSIONS WILL BE LIMITED TO PLSS WALKBACK CAPABILITY ASSUMING NO PLSS FAILURES.

(B) EVA EXCURSIONS WILL BE LIMITED, ALLOWING DRIVEBACK AND INGRESS USING THE OPS IN A COMBINATION OF LO AND HI PURGE FLOW WITH A PAD ADDED TO THE LO PURGE FLOW PHASE.

NO LRV AVAILABLE

(A) EVA EXCURSIONS WILL BE LIMITED TO ALLOW WALKBACK TO THE LM, USING THE OPS IN HIGH PURGE FLOW.

G. COMMUNICATIONS

1. FOR THE NORMAL (TWO-MAN) EVA, MSFN UPLINK VOICE AND DOWNLINK VOICE FROM ONE CREWMAN (OR TV DOWNLINK) ARE THE MINIMUM COMMUNICATION REQUIREMENTS.

2. FOR NORMAL OPERATIONS, BOTH EVA CREWMEN WILL NOT REMAIN OUTSIDE OF MSFN COVERAGE FOR A PERIOD EXCEEDING 5 MINUTES. WITH LCRU/ANTENNA PROBLEMS PREVENTING COMM DURING A TRAVERSE, THE SURFACE OPERATIONS WILL CONTINUE IF MINIMUM COMM CAN BE RE-ESTABLISHED AT THE END OF EACH TRAVERSE.

3. WITH THE LOSS OF TOTAL LCRU COMM CAPABILITY, THE CREW WILL RETURN TO THE VICINITY OF THE LM AND RE-ESTABLISH COMM WITH THE MCC VIA LM RELAY.

4. WITH LOSS OF LM VHF COMMUNICATIONS THE CREW WILL EGRESS, ACTIVATE THE LCRU, AND CONTINUE NORMAL SURFACE OPERATIONS.

5. THE LCRU MAY BE HAND CARRIED TO EXTEND THE ALLOWABLE TRAVERSE DISTANCES FROM THE LM OR THE LRV (AS REQUIRED) TO MAINTAIN COMMUNICATIONS.

R	ITEM	
	2-27 CONT	H. A VACUUM TRANSFER WILL ONLY BE ATTEMPTED IN AN EMERGENCY. I. THE LM WILL NOT BE PRESSURIZED WITH A CREWMAN ON THE LUNAR SURFACE. J. BOTH PLSS'S AND BOTH OPS WILL BE RETAINED UNTIL TWO LIFE SUPPORT UNITS (TWO OPS, TWO PLSS, OR ONE PLSS PLUS ONE OPS) HAVE BEEN VERIFIED TO HAVE SUFFICIENT CONSUMABLES TO SUPPORT CEVA. K. FOR THE TWO-MAN EVA, THE CDR WILL ALWAYS EGRESS FIRST AND INGRESS LAST UNLESS THE CDR HAS INITIATED AN OPS PURGE. THIS WILL INSURE THAT THE CDR IS IN THE LEFT PILOT POSITION SHOULD ASCENT BE REQUIRED WITHOUT AN OPPORTUNITY TO DOFF THE EMU'S.
	2-28	ASCENT IN THE EVENT OF PROCEDURAL ERRORS OR SYSTEMS PROBLEMS WHICH RESULT IN LOSS OF SOME CAPABILITY USED FOR ASCENT OR FOR RENDEZVOUS AND WHICH CAN BE CORRECTED IN ONE REV, IT IS BETTER TO DELAY ASCENT FOR ONE REV AND CORRECT THE SITUATION THAN IT IS TO LIFT OFF ON TIME.
	2-29	RENDEZVOUS A. SELECTION OF THE ACTIVE VEHICLE FOR RENDEZVOUS AND DOCKING WILL BE DETERMINED BY THE FLIGHT DIRECTOR AND THE FLIGHT CREW BASED UPON CONSUMABLES AND SYSTEMS PERFORMANCE. THE TOTAL LM CAPABILITY WILL BE DEDICATED TO ACCOMPLISHING THE RENDEZVOUS. B. THE DIRECT RNDZ PROFILE WILL BE PERFORMED IF THE MANDATORY CSM AND LM SYSTEM CONSTRAINTS CAN BE MET AND ALL PLANE ERROR CAN BE CORRECTED WITH ASCENT YAW STEERING. FOR ANY OTHER CASE, THE COELLIPTIC RENDEZVOUS WILL BE EXECUTED.
	2-30	RETENTION OF THE LM ASC STAGE CONSIDERATION WILL BE GIVEN TO RETAINING THE LM ASC STAGE TO PROVIDE REDUNDANT CAPABILITY AFTER CSM SYSTEM FAILURES. IF THE ASC STAGE MUST BE RETAINED FOR TEI, THE ΔV RESERVED FOR WEATHER AVOIDANCE MAY BE TRADED OFF TO ACCOMPLISH A FASTER EARTH RETURN TIME.

R	ITEM	
	2-31	TRANSEARTH COAST

A. THE STEEP TARGET LINE WILL BE USED FOR ALL MCC'S EXCEPT WHEN BOTH THE VELOCITY AT ENTRY INTERFACE IS LESS THAN 31,000 FPS AND THE G&N IS "GO" - THEN THE SHALLOW TARGET LINE WILL BE USED.

B. MCC'S MAY BE USED FOR LANDING AREA CONTROL PRIOR TO ENTRY INTERFACE MINUS 24 HOURS FOR RECOVERY ACCESS VIOLATIONS, UNACCEPTABLE WEATHER, OR LAND MASSES IN ANY PART OF THE OPERATIONAL FOOTPRINT.

C. IF THE FLIGHTPATH ANGLE IS OUTSIDE THE ENTRY CORRIDOR, AN MCC WILL BE EXECUTED AS SOON AS PRACTICAL.

D. MCC'S WILL BE ACCOMPLISHED BY THE SPS IF NECESSARY TO MAINTAIN RCS REDLINES.

2-32 TRANSEARTH COAST EVA

A. THE TEC EVA WILL BE INITIATED ONLY FOR RETRIEVAL OF FILM FROM THE PAN CAMERA, MAPPING CAMERA, OR LUNAR SOUNDER.

B. THE CSM OXYGEN SUPPLY, AND CRITICAL INSTRUMENTATION MUST ALL BE GO FOR EVA.

C. ALL RCS THRUSTER FIRE IN THE VICINITY OF THE TRANSFER PATH MUST BE INHIBITED.

D. SPACECRAFT ATTITUDE AND ATTITUDE RATES MUST BE WITHIN LIMITS THAT ALLOW SAFE EVA OPERATIONS WITH SUFFICIENT SUNLIGHT THROUGHOUT THE PLANNED EVA PERIOD.

E. A VACUUM TRANSFER WILL ONLY BE ATTEMPTED IN AN EMERGENCY.

F. ALL SIM BAY POWER WILL BE DISABLED FOR THE EVA.

2-33 ALTERNATE MISSION

A. EARTH ORBIT

1. CSM ONLY - EO SCIENCE, SPS INCLINATION CHANGE. ORBIT FOR SCIENCE OPERATIONS WILL BE A TRADE-OFF TO PROVIDE MOST OPTIMUM SIM BAY PHOTOGRAPHY AND LUNAR SOUNDER CONDITIONS YET REMAIN WITHIN RCS DEORBIT CAPABILITY.
2. CSM/LM - EO SCIENCE, INCLINATION CHANGE, ESTABLISH ORBIT FOR OPTIMUM SIM BAY PHOTOGRAPHY AND LUNAR SOUNDER CONDITIONS.

B. LUNAR ORBIT

1. CSM ONLY - SIM BAY EXPERIMENTS. APPROXIMATELY 6-DAY STAY, LOI TARGETED FOR EASTERN NODAL LOCATION 60 NM CIRCULAR ORBIT.
2. CSM/LM (NO LANDING CAPABILITY) - SIM BAY EXPERIMENTS. APPROXIMATELY 6-DAY STAY, 60 NM CIRCULAR ORBIT.

C. IN ANY ALTERNATE MISSION WITHIN THE CONSTRAINTS OF PROPELLANT REMAINING AND OTHER OPERATIONAL CONSIDERATIONS SUCH AS CREW SAFETY AND SYSTEMS LIFETIME, THE COMBINED LM ASC/DES STAGES WILL BE DISPOSED OF IN THE FOLLOWING ORDER OF DESCENDING PRIORITY:

1. LUNAR IMPACT
2. OCEAN IMPACT
3. LUNAR ORBIT

3 MISSION RULE SUMMARY

R	ITEM

THIS SECTION IS A SUMMARY OF THE DATA PRIORTY GUIDELINES BY MISSION PHASE, SLV RULES BY MISSION PHASE, AND SYSTEMS GO/NO-GO CRITERIA ON CHARTS BY MISSION PHASE.

THE SUMMARY RULES PLUS THE CHART ARE REQUIRED TO ENCOMPASS EACH PHASE.

THE CAPABILITY LISTED IN THE CHARTS ARE THE REQUIREMENTS FOR INITIATION OR CONTINUATION OF A MISSION PHASE OR EVENT. MISSION EVENTS FROM UNDOCKING TO PDI IGNITION REQUIRE THAT THE VEHICLES MEET THE LUNAR STAY WITH EVA CRITERIA AND HAVE THE CAPABILITY TO LAND, ASCEND, AND RENDEZVOUS.

LAUNCH PHASE

3-1 THE LAUNCH WILL BE ABORTED FOR THE FOLLOWING REASONS:

A. SLV

S-IC ADJACENT ENGINES OUT (TIME DEPENDENT)
S-II GIMBAL ACTUATOR HARDOVER INBOARD PRIOR TO "S-IVB TO COI" CAPABILITY
VIOLATION OF AUTO/MANUAL EDS LIMITS
S-II ENGINE FAILURES (TIME DEPENDENT)
S-II LOSS OF CONTROL (TIME DEPENDENT)
FAILURE OF SECOND PLANE SEPARATION
S-IVB LOSS OF HYDRAULIC FLUID (PRIOR TO S-IVB IGNITION)
S-IVB LOSS OF THRUST (TIME DEPENDENT) (POSSIBLE COI CAPABILITY)
S-IVB COLD He SHUTOFF VALVE(S) FAILED OPEN
S-IVB LOX CRYO REPRESS VLV(S) FAILS OPEN (REF. RULE 6-5)

B. CSM

1. ENVIRONMENTAL
   LOSS OF CABIN AND SUIT PRESSURE
   LOSS OF CABIN PRESSURE AND SUIT CIRCULATION
   FIRE/SMOKE IN CM
   LOSS OF CABIN PRESSURE AND O_2 MANIFOLD LEAK

2. ELECTRICAL
   THE FOLLOWING POWER SOURCES ARE REQUIRED TO CONTINUE LAUNCH:
   (A) ONE F/C OR AUX BAT PLUS ONE ENTRY BAT, OR
   (B) THREE ENTRY BATS
   UNCONTROLLABLE SHORTED MAIN BUS
   LOSS OF BOTH AC BUSES DURING MODE I OR MODE II

3. PROPULSION
   SUSTAINED LEAK OR LOSS OF He MANIFOLD PRESSURE IN BOTH CM-RCS RINGS (MODE I ONLY)

C. VIOLATION OF TRAJECTORY LIMIT LINES

D. TEAM DISCRETION WILL BE USED FOR:

1. SUIT/CABIN CONTAMINATION
2. MEDICAL PROBLEMS

R	ITEM	
	3-2	THE S-IVB EARLY STAGING WILL BE USED AFTER "S-IVB TO COI" CABAPILITY FOR THE FOLLOWING: S-II GIMBAL ACTUATOR INBOARD HARDOVER S-II LOSS OF CONTROL S-II ENGINE FAILURES S-IVB COLD He SHUTOFF VALVE(S) FAILS OPEN (AFTER TWR JETT)
	3-3	SWITCHOVER TO CSM GUIDANCE WILL BE PERFORMED FOR: SATURN GUIDANCE REFERENCE FAILURE
		RULE NUMBERS 3-4 THROUGH 3-10 ARE RESERVED.

R	ITEM	
		EARTH ORBIT
	3-11	CSM SEPARATION FROM THE S-IVB (WITHOUT LM EXTRACTION) WILL BE PERFORMED EARLY FOR THE FOLLOWING SLV CONDITIONS (CONSIDERATION WILL BE GIVEN TO EXTRACTING THE LM LATER IF THE CONDITION CAN BE CORRECTED): A. S-IVB RANGE SAFETY PROPELLANT DISPERSAL SYSTEM ARMS INADVERTENTLY AFTER INSERTION AND PRIOR TO SAFING* B. S-IVB LOX TANK PRESS IS GREATER THAN 50 PSI* (REFERENCE RULES 6-5 AND 7-6) C. LOSS OF ATTITUDE CONTROL DURING TB5 (CREW DISCRETION) D. S-IVB COMMON BULKHEAD DELTA PRESSURE EXCEEDS LIMITS* E. START BOTTLE GREATER THAN 1800 PSIA* *PERFORM SPS MANEUVER TO A SAFE DISTANCE.
	3-12	CSM SEPARATION FROM THE S-IVB (WITH LM EXTRACTION) WILL BE PERFORMED FOR: A. S-IVB NO-GO FOR TLI B. CSM NO-GO FOR TLI BUT GO FOR EARTH ORBIT MISSION
	3-13	TLI WILL BE INHIBITED FOR: A. INSUFFICIENT PROPELLANT REMAINS FOR ACHIEVING A 28K NM APOGEE ELLIPSE B. S-IVB ENGINE MAIN LOX VALVE FAILS TO CLOSE AT CUTOFF C. LOSS OF ATTITUDE CONTROL D. CONFIRMED ACTUATOR HARDOVER E. LOSS OF ENGINE HYDRAULIC FLUID F. MISALIGNMENT RATE BETWEEN THE IU AND IMU IS OUTSIDE LIMITS G. UNACCEPTABLE DIFFERENCES BETWEEN CMC AND IU PLATFORM VELOCITY COMPONENTS OR TOTAL VELOCITY AT INSERTION H. UNACCEPTABLE DIFFERENCE BETWEEN MSFN AND IU ORBITAL DECISION PARAMETERS
	3-14	TLI WILL BE TERMINATED FOR: A. PITCH OR YAW BODY RATES GREATER THAN 10 DEG/SEC B. ROLL BODY RATE GREATER THAN 20 DEG/SEC C. PITCH OR YAW ATTITUDE DEVIATIONS FROM NOMINAL PROFILES IN EXCESS OF 45 DEG D. OVERBURN WHERE T_{GO} (CMC) EQUALS ZERO PLUS 1 SECOND

R	ITEM	
	3-15	TLI WILL BE PERFORMED WITH MANUAL BACKUP FOR: A. A SATURN GUIDANCE REFERENCE FAILURE - CSM TAKEOVER IN EARTH ORBIT OR DURING TLI B. SATURN ACCELEROMETER FAILURES - IU COMPUTER CONTROL WITH A MANUAL CUTOFF BASED ON TOTAL INERTIAL VELOCITY FROM THE CMC.
	3-16	CSM SEPARATION (WITH 24-SEC RCS ASAP) FROM THE S-IVB WILL BE DONE FOR LOSS OF S-IVB ATTITUDE CONTROL.
		RULE NUMBERS 3-17 THROUGH 3-20 ARE RESERVED.

R	ITEM	
		TD&E
	3-21	TD&E WILL NOT BE PERFORMED FOR: A. PILOT'S EVALUATION OF RATES AND ATTITUDES, AND SLA CONFIGURATION NOT ACCEPTABLE. B. THE SLV IS NO-GO FOR: 1. VIOLATION OF S-IVB BULKHEAD ΔP LIMITS 2. LOX TANK PRESSURE GREATER THAN 50 PSI
		RULE NUMBERS 3-22 THROUGH 3-29 ARE RESERVED.

R	ITEM	
		TRANSLUNAR COAST
	3-30	THE G&N WILL BE THE PRIMARY MODE OF EXECUTING TRANSLUNAR MCC.
	3-31	MIDCOURSE CORRECTION NOMINAL EXECUTION POINTS WILL BE AT THE FOLLOWING: A. TLI C/O + 9 HOURS B. TLI C/O + 28 HOURS C. LOI - 22 HOURS D. LOI - 5 HOURS

R	ITEM
	3-32

DURING THE LOI BURN, THE FLIGHT CREW WILL TAKE THE FOLLOWING ACTION:

LOI ABORT MODES

MODE	TIME	DELTA VM	TYPE ABORT
I	0 TO 0:32	0 TO 207	DPS 2-HR DIRECT ABORT
	0:32 TO 0:53	207 TO 348	DPS 30-MIN DIRECT ABORT
	0:53 TO 1:31	348 TO 613	DPS TO DEPLETION 30-MIN DIRECT ABORT FOLLOWED BY AN APS BURN 2 HOURS LATER
II	1:31 TO 2:03	613 TO 833	DPS + APS 2-IMPULSE CIRCUMLUNAR ABORT WITH APS BURN TO SUPPLEMENT DPS BURN TO DEPLETION DURING SECOND IMPULSE (APS BURN IS 2 HRS AFTER DPS BURN)
	2:03 TO 2:54	833 TO 1200	DPS 2-IMPULSE CIRCUMLUNAR ABORT
III	2:54 TO 6:35	1200 TO 2980	EXECUTE TEI (SPS OR DPS) AT NEXT OPPORTUNITY OR INITIATE ALTERNATE MISSION

(FOR APOLLO 17 APS IS REQUIRED TO SUPPLEMENT DPS FOR LOI BURN TIME FROM 4:30 TO 6:35)

A. ALL ABORT MANEUVERS ARE MCC TARGETED EXCEPT THE DPS 30-MIN ABORT WHICH IS TAKEN FROM THE CREW CHART.

B. CONTROL LIMITS APPLY AS FOLLOWS:

LOI DELTA T	LOI DELTA V	LIMITS
0 TO 0:53	0 TO 348	TIGHT
0:53 TO 3:40	348 TO 1543	LOOSE
3:40 TO 6:35	1543 TO 2980	TIGHT

NOTE

IF ANY BALL VALVE CLOSES PREMATURELY, SHUT DOWN GOOD BANK 10 SEC PRIOR TO CUTOFF FOR VERIFICATION OF THE FAILURE.

NOTE

REFERENCE RULE 3-86 FOR DEFINITION OF TIGHT AND LOOSE LIMITS.

RULE NUMBERS 3-33 THROUGH 3-37 ARE RESERVED.

R	ITEM	
		LUNAR ORBIT
	3-38	PRIOR TO UNDOCKING, CSM MANEUVERS WILL BE SCHEDULED WHEN REQUIRED TO CORRECT THE FOLLOWING SITUATIONS: A. MISS DISTANCE OVER THE LLS GREATER THAN 0.5 DEG OUT OF PLANE B. DEVIATION IN APPROACH AZIMUTH GREATER THAN ±10 DEG FROM THE NOMINAL C. CURRENT PERICYNTHION ALTITUDE LESS THAN 30,000 FT
	3-39	DOI_1 RESIDUALS A. TRIM G&N X AXIS TO WITHIN 1 FPS. 1. FOR OVERBURNS LESS THAN 2.2 FPS, TRIM TO -1 FPS WITH THE -X SM RCS THRUSTERS. 2. FOR OVERBURNS GREATER THAN 2.2 FPS BUT LESS THAN 10 FPS, PITCH 180 DEGREES AND TRIM TO 1 FPS USING +X SM RCS THRUSTERS. 3. RESIDUALS GREATER THAN 10 FPS WILL BE TRIMMED USING SPS. B. IF THE G&N HAS OBVIOUSLY MALFUNCTIONED, THE NEGATIVE RESIDUAL INDICATED BY THE EMS WILL BE TRIMMED.
	3-40	RESERVED

R	ITEM	
	3-41	AT AOS AFTER DOI_1 THE REQUIREMENT FOR THE BAILOUT MANEUVER WILL BE DETERMINED BY EVALUATION OF THE THREE TRAJECTORY MONITORING SOURCES. THESE SOURCES - G&N, EMS, AND MSFN - WILL BE EXAMINED WITH THE FOLLOWING CRITERIA: A. IF MSFN RADAR DATA IS VALID AND REASONABLE, A STAY VOTE FROM MSFN IS REQUIRED TO REMAIN IN THE LOW ORBIT. B. IF MSFN RADAR DATA IS INVALID OR UNAVAILABLE, THE FOLLOWING CRITERIA APPLY: 1. IF THE G&N AND EMS ARE AVAILABLE, BOTH SOURCES MUST INDICATE STAY TO REMAIN IN THE LOW ORBIT. 2. IF ONLY ONE OF THE ONBOARD SOURCES (G&N, EMS) IS AVAILABLE, BOTH THAT SYSTEM AND BURN TIME MUST INDICATE STAY TO REMAIN IN THE LOW ORBIT. NOTES 1. THE EMS VOTE IS NO STAY IF THE EMS INDICATES A 10-FPS OVERSPEED AFTER TRIMMING THE G&N. 2. THE MSFN VOTE IS NO STAY IF THE INCOMING RADAR DATA INDICATES A CLOSEST APPROACH ALTITUDE OF EQUAL TO OR LESS THAN 1.0 NM ABOVE THE ACTUAL LUNAR TERRAIN. THIS ALTITUDE CORRESPONDS TO A PERICYNTHION ALTITUDE OF 3.38 NM. THE CORRESPONDING DOPPLER RESIDUALS ARE APPROXIMATELY -106 CYCLES PER SEC. BUT THE ACTUAL NUMBER WILL BE DETERMINED REAL TIME. 3. BURN TIME IS NO STAY IF AN OVERBURN OF 1.8 SECONDS IS INDICATED.
	3-42	THE FOLLOWING CRITERION APPLY TO DOI_2: A. VOICE CONFIRMATION OF CIRC IS REQUIRED FOR EXECUTION. B. DOI_2 WILL BE SCHEDULED AT LEAST 2 MIN AFTER CIRC. C. LM RCS BURN TIME WILL BE $\leq$ 30 SEC. D. TARGETED PERILUNE AT PDI WILL BE NO LESS THAN 40K FT.
	3-43	THE FOLLOWING RNDZ/RESCUE OPTIONS WILL BE UTILIZED AS NECESSARY FOR FAILURES REQUIRING TERMINATION OF LUNAR LANDING: A. FOR FAILURES FROM SEPARATION TO CIRCULARIZATION, THE NOMINAL RNDZ IS A P34 PROFILE WITH DOCKING OCCURRING 2 HRS AFTER SEP. B. FOR FAILURES FROM CIRCULARIZATION TO PDI, EXECUTE THE NO PDI +12 ABORT SEQUENCE WITH DOCKING IN ABOUT 3-1/4 HR. C. ABORT DURING POWERED DESCENT WILL INSERT THE LM INTO ORBIT UTILIZING THE ONBOARD VARIABLE ABORT TARGETING. FOR ABORTS DURING THE FIRST 11 MIN, DOCKING SHOULD OCCUR WITHIN 3-1/4 HR. FOR ABORTS AFTER 11 MIN, DOCKING WILL OCCUR WITHIN 5-1/4 HR. D. FOR COMPLETE LM FAILURES PRIOR TO PDI, THE CSM WILL EXECUTE A 5-IMPULSE RESCUE WITH DOCKING IN ABOUT 7-1/4 HR FROM PDI. RULE NUMBERS 3-44 THROUGH 3-48 ARE RESERVED.

R	ITEM	
		POWERED DESCENT PHASE
	3-49	PDI IGNITION - THE FOLLOWING ACTION WILL BE TAKEN: A. AUTO ULLAGE GOOD -IF NO AUTO DPS IGN, FLIGHT CREW PERFORM MANUAL DPS IGNITION B. NO AUTO ULLAGE -FLIGHT CREW BACK UP THE ULLAGE MANEUVER -IF NO AUTO DPS IGN FLIGHT CREW WILL NO-GO PDI

R	ITEM
	3-50

LR DATA IS REQUIRED FOR LANDING

A. LOCK ON

1. LR DATA ACCEPTED AND CONVERGED CONTINUOUS TO P64 - CONTINUE MISSION IF LOSS OF LOCK OCCURS IN P64.

2. LR DATA ACCEPTED AND CONVERGED WITH SUBSEQUENT DROPOUT - CONTINUE INTO P64.
   (A) LANDING RADAR REGAINED IN P64
      (1) DATA ACCEPTED BY LGC - CONTINUE MISSION
      (2) DATA NOT ACCEPTED BY LGC - ATTEMPT MANUAL LANDING IF LR/PGNS ΔH < 1500 FT
   (B) LANDING RADAR NOT REGAINED IN P64 - ABORT

3. LATE LR LOCK-ON WITH DATA BEING INCORPORATED AND CONVERGING - CONTINUE INTO P64.
   (A) DATA ACCEPTED BY LGC - CONTINUE MISSION
   (B) DATA NOT ACCEPTED BY LGC - ATTEMPT MANUAL LANDING

B. MINIMUM ALTITUDE WITHOUT LR ALTITUDE INCORPORATION

1. PGNS ALTITUDE LESS THAN 22,000 FEET AND PGNS NAVIGATION ERRORS, CONFIRMED BY MSFN OR DOPPLER RESIDUALS, THAT CAUSE THE AGS-PGNS RADIAL VELOCITY DIFFERENCE
   (A) RADIAL N69 NOT INCORPORATED AND DIFFERENCE EXCEEDS -10 FPS - ABORT
   (B) RADIAL N69 INCORPORATED AND DIFFERENCE EXCEEDS -20 FPS - ABORT

2. PGNS ALTITUDE LESS THAN 18,000 FEET AND PGNS NAVIGATION ERRORS, CONFIRMED BY DOPPLER BUT NOT BY AGS, THAT CAUSE THE MSFN-PGNS RADIAL VELOCITY DIFFERENCE TO EXCEED -20 FPS - ABORT

3. PGNS ALTITUDE LESS THAN 10,000 FEET
   (A) RADIAL N69 NOT INCORPORATED - ABORT
   (B) LOSS OF WORKING PGNS (AS DEFINED BY RULE 5-91) - ABORT

4. PGNS ALTITUDE LESS THAN 6,000 FEET - ABORT

NOTE

FOR FAILURES IN THE PGNS/LR INTERFACES, INCORPORATION MAY BE SATISFIED BY A PGNS/LR COMPARISON RESULTING IN A ΔH < 1500 FT.

C. MINIMUM ALTITUDE WITHOUT LR VELOCITY INCORPORATION

1. PGNS ALTITUDE LESS THAN 10,000 FEET WITH LANDMARK TRACKING OBTAINED AND PGNS NAVIGATION ERRORS CONFIRMED BY AGS OR DOPPLER THAT CAUSE MSFN - PGNS DOWNRANGE OR CROSSRANGE VELOCITY DIFFERENCES
   (A) NAV N69 INCORPORATED AND $\Delta\dot{X}$ EXCEEDS +50 OR -35 FPS OR $\Delta\dot{Y}$ EXCEEDS +90 OR -70 FPS - ABORT
   (B) NAV N69 NOT INCORPORATED AND $\Delta\dot{X}$ EXCEEDS ±20 FPS OR $\Delta\dot{Y}$ EXCEEDS +45 OR -25 FPS - ABORT

2. PGNS ALTITUDE LESS THAN 10,000 FEET WITHOUT LANDMARK TRACKING OBTAINED AND PGNS NAVIGATION ERRORS CONFIRMED BY AGS OR DOPPLER THAT CAUSE MSFN - PGNS DOWNRANGE OR CROSSRANGE VELOCITY DIFFERENCES
   (A) NAV N69 INCORPORATED AND $\Delta\dot{X}$ EXCEEDS ±35 FPS OR $\Delta\dot{Y}$ EXCEEDS +70 OR -25 FPS - ABORT
   (B) NAV N69 NOT INCORPORATED AND $\Delta\dot{X}$ EXCEEDS ±15 FPS OR $\Delta\dot{Y}$ EXCEEDS +30 OR -10 FPS - ABORT.

R	ITEM	
	3-51	POWERED DESCENT WILL BE TERMINATED FOR THE FOLLOWING: A. PGNS NAVIGATION ERRORS, CONFIRMED BY MSFN OR DOPPLER RESIDUALS, THAT RESULT IN THE FOLLOWING AGS-PGNS VELOCITY DIFFERENCES: $\Delta\dot{X}$ (DOWNRANGE) GREATER THAN +90 OR -35 FPS $\Delta\dot{Y}$ (CROSSRANGE) GREATER THAN ±90 FPS $\Delta\dot{Z}$ (RADIAL) GREATER THAN +60 OR -35 FPS B. PGNS NAVIGATION ERRORS, CONFIRMED BY DOPPLER RESIDUAL BUT NOT BY AGS, THAT RESULT IN THE FOLLOWING MSFN-PGNS VELOCITY DIFFERENCES: $\Delta\dot{Y}$ (CROSSRANGE) GREATER THAN ±200 FPS $\Delta\dot{Z}$ (RADIAL) GREATER THAN +45 OR -35 FPS C. COMMANDED THRUST INCREASING PRIOR TO THROTTLE-DOWN OR P63 TGO = 80 SEC D. GTC GREATER THAN 57 PERCENT BY P63/64 PROGRAM SWITCH PLUS 15 SEC E. FAILURE TO ACHIEVE FTP (AUTO OR MANUAL) BY NOMINAL TIG PLUS 31 SEC. (ABORT AT GTC DIVERGENCE.) F. THE FOLLOWING PGNS ALARMS: 20105, 00214, 20430, 20607, 21103, 20607, 21103, 01107, 21204, 21302, 21501, 00402 (CONTINUING) G. VIOLATION OF THE TIME BIASED DPS ABORT BOUNDARY H. NO THROTTLE RECOVERY (AUTO OR MANUAL) WITHIN 40 SEC AFTER GTC EQUALS 57 PERCENT
	3-52	AN ABORT WILL NOT BE PERFORMED FOR PGNS FAILURE AFTER OBTAINING PITCHOVER IN THE APPROACH PHASE.
	3-53	THE DESCENT TARGET POINT WILL BE SHIFTED DOWNTRACK IF GTC INDICATES NO THROTTLEDOWN BY P63/64 PROGRAM SWITCH. THE MAXIMUM SHIFT IS AS FOLLOWS: A. 20,000 FT DOWNTRACK IF VALID LANDMARK SIGHTINGS WERE OBTAINED. B. 10,000 FT DOWNTRACK IF NO VALID LANDMARK SIGHTINGS WERE OBTAINED. C. NO DOWNTRACK SHIFT WILL BE ALLOWED IF THE APPROACH AZIMUTH IS BETWEEN 95 AND 100 DEGREES. NOTE ONE MINUTE OF RCS WILL BE USED TO ALLOW LANDING WITHIN THE ABOVE LIMITS.
	3-54	IN THE EVENT MSFN AND DOPPLER DATA ARE NOT AVAILABLE FOR CONFIRMATION OF PGNS/AGS ERRORS, POWERED DESCENT WILL BE TERMINATED FOR THE FOLLOWING AGS-PGNS VELOCITY DIFFERENCES: $\Delta\dot{X}$ > -35 FPS $\Delta\dot{Z}$ > +60 OR -35 FPS

R	ITEM	
	3-55	IN THE EVENT MSFN, DOPPLER, AND AGS NAV DATA ARE NOT AVAILABLE FOR MONITORING OF POWERED DESCENT, AN ABORT WILL BE PERFORMED IF LR DATA IS NOT INCORPORATED INTO THE PGNS BY PDI + 7 MIN.
		RULE NUMBERS 3-56 THROUGH 3-61 ARE RESERVED.

R	ITEM

LUNAR SURFACE EVA PHASE

3-62 INITIATION/TERMINATION/CURTAILMENT

A. AFTER START OF A DRIVING TRAVERSE, THE TIMELINE WILL BE OPTIMIZED TO REMAIN WITHIN THE LRV DRIVING CAPABILITY TO RETURN TO THE LM.

B. IF LRV MOBILITY IS DEGRADED, THE FOLLOWING WILL BE EVALUATED TO ACCOMPLISH MAXIMUM SCIENTIFIC RETURN:

1. TRAVERSE DISTANCE
2. TIME AT EACH STOP
3. DELETION OF STOPS

C. THE LRV WILL BE UTILIZED BECAUSE OF ITS SCIENCE AND EQUIPMENT PAYLOAD CAPABILITY AND ITS ABILITY TO REDUCE METABOLIC RATES IF ITS SPEED IS APPROXIMATELY THE AVERAGE WALKING SPEED.

D. FOR EVA TERMINATION OR OTHER INTERRUPTIONS DURING ALSEP DEPLOYMENT, THE FOLLOWING PREFERRED DEPLOYMENT INTERRUPTION POINTS WILL BE OBSERVED IF PERMITTED BY CREW SAFETY CONSIDERATION:

1. REMOVE ALSEP PACKAGES 1 AND 2. CLOSE SEQ BAY DOOR. EMPLACE ALSEP PACKAGES WITH HANDLES UP AND EXPERIMENTS IN AND FACING THE SUN WITHIN ± 15°.

2. TILT FUEL CASK. DOME NOT REMOVED.

3. TILT FUEL CASK, REMOVE DOME. DO NOT DEFUEL.

4. FUEL RTG. CARRY ALSEP TO DEPLOYMENT SITE. REMOVE ALL COMPONENTS FROM PACKAGE 2. CARRY PACKAGE 1 TO EMPLACEMENT SITE. DO NOT CONNECT RTG CABLE TO C/S UNLESS SUFFICIENT TIME IS AVAILABLE TO ERECT THE CS SUNSHIELD.

5. CONNECT HFE AND LEAM CABLES TO C/S. REMOVE LSP, LSG, AND LMS FROM SUBPACKAGE 1. ALIGN C/S AND RAISE SUNSHIELD. MOUNT ANTENNA MAST, GIMBAL, AND ANTENNA. LEVEL AND ALIGN ANTENNA. DEPRESS SHORTING PLUG ON WAY BACK TO LM.

6. THE HFE CAN BE INTERRUPTED AFTER COMPLETION OF THE FIRST PROBE HOLE.

7. DEPLOY ALSEP EXPERIMENTS AND COMPLETE TASKS. A HOLD POINT EXISTS AFTER EACH TASK IS COMPLETED. DEPRESS SHORTING PLUG SWITCH ON WAY BACK TO LM (SEE CONTINGENCY PROCEDURES FOR HOLD POINTS).

E. IN REPLANNING THE LRV TRAVERSES BETWEEN EVA'S, BATTERY THERMAL MANAGEMENT TECHNIQUES WILL BE SCHEDULED AS NECESSARY TO KEEP THE PREDICTED LRV BATTERY TEMPS BETWEEN 40° F AND 125° F ON EVA'S 1 AND 2, AND BETWEEN 40° F AND 140° F ON EVA 3.

R	ITEM	
	3-63	PRECEDENCE/SCHEDULING GUIDELINES

A. FOR ANY MALFUNCTION ON A SURFACE TASK, A MAXIMUM OF 10 MINUTES WILL BE SPENT ON THE CONTINGENCY PROCEDURE BEFORE THE TASK IS ABANDONED, WITH THE FOLLOWING EXCEPTIONS:

1. RTG FUELING - UP TO 20 MINUTES WILL BE ALLOWED IN EXERCISING RTG FUELING CONTINGENCY PROCEDURES.

2. ALSEP PACKAGE 1 TO PACKAGE 2 CABLE CONNECTIONS - UP TO 20 MINUTES WILL BE ALLOWED FOR MAKING THE CABLE CONNECTION.

3. ALSEP ANTENNA - UP TO 30 MINUTES WILL BE ALLOWED FOR ANTENNA ERECTION AND ALIGNMENT.

4. LRV ANOMALIES - UP TO 10 MINUTES WILL BE ALLOWED FOR ISOLATING MALFUNCTIONS. UP TO 30 MINUTES WILL BE ALLOWED TO RECOVER UTILIZATION OF THE VEHICLE.

5. ALSEP DEPLOYMENT MAY BE CONTINUED ON A LATER EVA IF ADDITIONAL TIME TO SPEND ON CONTINGENCY PROCEDURES IS REQUIRED TO ATTAIN AN OPERATIONAL ALSEP.

B. IF A TASK IS NOT ABANDONED AND IS LEFT INCOMPLETE AT THE END OF AN EVA, IT WILL BE SCHEDULED DURING A SUBSEQUENT EVA CONSISTENT WITH ITS RANK WITHIN THE PRIORITIES DEFINED.

C. ALSEP DEPLOYMENT WILL NOT BE STARTED IF IT IS KNOWN THAT LESS THAN 1 HR 30 MIN IS AVAILABLE FOR ALSEP IN EVA 1.

3-64. LRV SYSTEMS/NAVIGATION

A. THERE ARE NO MINIMUM LRV SYSTEMS REQUIREMENTS WHICH WOULD CAUSE ABANDONMENT OF THE LRV IF THE CREW EVALUATES THE FOLLOWING AS ACCEPTABLE:

1. MOBILITY AND CONTROL
2. TRAVERSE RATE IS AT LEAST APPROXIMATELY EQUAL TO WALKING RATE
3. REDUNDANT LIFE SUPPORT CAPABILITY FOR LM RETURN

B. WITH A NONOPERATIONAL LRV NAVIGATION SYSTEM, ONE OF THE FOLLOWING RETURN TRAVERSE CAPABILITIES IS REQUIRED TO INITIATE OR CONTINUE A TRAVERSE:

1. REASONABLE VISUAL ACCESS OF THE LM
2. REASONABLE VISUAL ACCESS OF THE OUTBOUND TRAVERSE PATH
3. SUN RELATIVE BEARING TO THE LM

C. CONTINGENCY POWER/THERMAL MANAGEMENT AND/OR TRAVERSE ADJUSTMENT MUST BE EXERCISED TO KEEP THE LRV BATTERY TEMPERATURE BELOW 125° F ON EVA'S 1 AND 2 AND 140° F ON EVA 3. EXCEEDING THIS LIMIT WILL RESULT IN AN UNPREDICTABLE DEGRADATION OF BATTERY PERFORMANCE AND NAVIGATION ELECTRONICS.

D. THE LRV WILL NOT BE ABANDONED BECAUSE OF EXCESSIVE BATTERY TEMPERATURE(S).

R	ITEM
	3-65

COMMUNICATIONS/TV

A. THE FOLLOWING COMM CAPABILITY IS REQUIRED TO START AND CONTINUE A TRAVERSE:

1. MSFN VOICE UPLINK TO ONE CREWMAN, AND VOICE DOWNLINK FROM ONE CREWMAN OR TV (FOR MONITORING CREW RESPONSE).

2. MONITOR STATUS OF EMU CRITICAL PARAMETERS (MSFN OR CREW).

3. LOSS OF COMM WILL BE ACCEPTABLE DURING LRV MOVING OPERATIONS IF MINIMUM COMM REQUIREMENTS CAN BE MET AT THE NEXT STOP. THE MAXIMUM ALLOWABLE CONTINUOUS LOSS OF COMM WOULD BE APPROXIMATELY 30 MIN.

B. IF LCRU PROBLEMS OCCUR, VOICE AND TM HAVE PRIORITY OVER TV.

NOTE

GCTA TV IS NOT AVAILABLE
IN THE HAND-CARRY MODE.

C. GCTA OPERATIONS

1. THE COLOR TV CAMERA WILL NOT BE POINTED SUCH THAT THE SUN WILL BE IN THE FIELD OF VIEW. THE CAMERA MAY BE POINTED NEAR THE SUN. HOWEVER, IF OBJECTIONABLE FLARE OCCURS, THE GROUND WILL REQUEST THE CAMERA BE MOVED OR WILL MOVE THE CAMERA VIA GROUND COMMANDS.

2. THE GROUND WILL MONITOR THE TV PICTURE AND RECOMMEND OR COMMAND CAMERA MOVEMENT TO PREVENT IRREVERSIBLE VIDICON TUBE BURNS FROM REFLECTIVE OBJECTS.

3. BETWEEN EVA'S, THE TV CAMERA WILL BE LOCATED IN THE SUN AND WILL BE OFF TO MAINTAIN THERMAL BALANCE.

4. WHEN A BRIGHT OBJECT WITH A CONSTRASTING DARK BACKGROUND IS IN THE FIELD OF VIEW, THE GROUND WILL RECOMMEND OR COMMAND AN ALC SWITCH SETTING TO GET THE BEST PICTURE. THE ALC-PEAK WILL GIVE THE BEST PICTURE OF THE BRIGHT OBJECT, AND THE ALC-AVERAGE WILL GIVE THE BEST PICTURE OF THE DARK BACKGROUND.

R	ITEM
	3-66

ALSEP

A. ALSEP SHORTING PLUG SWITCH WILL BE ACTIVATED ASAP AFTER CENTRAL STATION DEPLOYMENT.

B. IF THE GROUND IS UNABLE TO OBTAIN DOWNLINK, THE GROUND WILL REQUEST THE ASTRONAUT TO ROTATE THE RESET POWER SWITCH CW AND THEN CCW.

C. IF THE CREW MUST RETURN TO THE LM PRIOR TO COMPLETE ALSEP DEPLOYMENT, THE SHORTING PLUG SWITCH WILL BE ACTIVATED "ON" IF THE ANTENNA IS EMPLACED. IF THE ANTENNA IS NOT EMPLACED, THIS SWITCH WILL NOT BE ACTIVATED (PICK UP HERE ON EVA 2).

D. THE HFE WILL HAVE PRIORITY OVER DRILL CORE STEM. THE HFE BORE HOLES WILL BE ATTEMPTED FIRST. IF PROBLEMS ARE ENCOUNTERED, EFFORTS ON BORE HOLES WILL BE TERMINATED AFTER A TOTAL OF 20 MIN ACCUMULATED DRILL ON TIME.

E. IF A HARD OBJECT IS ENCOUNTERED WHICH REDUCES DRILL RATE TO LESS THAN 5 INCHES PER MINUTE ON EITHER HFE PROBE HOLE, THE FOLLOWING WILL BE ACCOMPLISHED:

1. IF THE SECOND STEM SECTION IS NOT ATTACHED, WITHDRAW AND START AT A DIFFERENT LOCATION FOR MAXIMUM OF TWO WITHDRAWALS.

2. IF SECOND STEM IS ATTACHED, CONTINUE UNTIL 10 MINUTES OF POWER "ON" TIME FOR THE DRILL STRING HAS ELAPSED.

F. IF UNABLE TO DRILL NORMAL HFE BORE HOLES, THE FOLLOWING SHOULD BE ACCOMPLISHED:

1. ATTEMPT TO INSERT PROBE INTO LUNAR SUBSURFACE USING HAND-AUGER, DOUBLE CORE TUBE HOLE, OR TRENCH METHODS, IN THAT ORDER.

2. IF BORE HOLE IS AT LEAST 24 INCHES DEEP, PLACE PROBE IN HOLE AS FAR AS IT WILL GO.

G. THE LSG WILL BE RECHECKED FOR LEVEL AND ALIGNMENT AND READINGS REPORTED BY THE ASTRONAUT AFTER EXPERIMENT UNCAGING. IF OUTSIDE ± 3° AZ, ± 3° LEVEL, THE LSG WILL BE RELEVELED AND REALIGNED.

H. THE LSP CHARGES WILL BE DEPLOYED WITHIN LINE-OF-SIGHT OF THE LSP TRANSMITTING ANTENNA AND IN AN AREA WHERE THE CHARGE WILL HAVE UNIFORM CONTACT WITH THE LUNAR SURFACE.

R	ITEM
	3-67

GEOPHYSICS EXPERIMENTS

A. IF THE TRAVERSE GRAVIMETER EXHIBITS A PHASE LOCK LOOP ALARM WHILE A READING IS TAKEN ON THE LRV, SUBSEQUENT READINGS WILL BE TAKEN ON THE SURFACE. IF THE PHASE LOCK LOOP ALARM OCCURS WHEN A READING IS TAKEN ON THE SURFACE, THE PHASE LOCK LOOP WILL BE BY-PASSED.

B. IF THE TGE MEASUREMENTS INDICATE DEVIATION OF PRECISION OVEN TEMPERATURES, READINGS WILL BE CONTINUED UNTIL THE TEMPERATURES ARE OFF SCALE. IF THE TGE INTERMEDIATE OVEN READING ON EVA 1 INDICATES A HOT ALARM PRIOR TO THE TRAVERSE, IT WILL BE LEFT IN THE LM SHADOW WITH THE RADIATOR EXPOSED.

C. IF THE VIBRATING STRING AMPLIFIER SIGNAL IS LOST THE TGE WILL BE ABANDONED (REFERENCE MSN RULE 31-109, 110).

D. SEP EXPERIMENT THERMAL CONTROL WILL BE ACCOMPLISHED BY OPENING OR CLOSING OF THE RADIATOR COVERS, BRUSHING DUST FROM THE RADIATOR SURFACES, AND TURNING THE DSEA TAPE CASSETTE OFF AT TRAVERSE STOPS GREATER THAN 30 MINUTES, OR BY TURNING THE POWER CONTROL TO STBY.

E. SEP RADIATOR SURFACES WILL BE DUSTED:

1. PRIOR TO EACH COOL-DOWN PERIOD.
2. AT EACH TRAVERSE STOP AT WHICH THE COVERS ARE OPEN.

F. IF THE NEUTRON FLUX MONITOR DOES NOT HAVE THE DRILL CORE HOLE AVAILABLE OR ENCOUNTERS DIFFICULTY IN PENETRATING THE CORE HOLE, ALTERNATE METHODS WILL BE USED TO IMPLACE THE MONITOR TO A MINIMUM DEPTH OF 18 INCHES.

RULE NUMBERS 3-68 THROUGH 3-79 ARE RESERVED.

R	ITEM

ASCENT

3-80 ASCENT

A. GUIDANCE SWITCHOVER TO AGS WILL BE PERFORMED FOR:

1. THE FOLLOWING PGNS ALARMS: 20105, 00214, 20430, 20607, 21103, 01107, 21204, 21302, AND 21501.

2. CONFIRMED PGNS NAVIGATION ERRORS (DURING ASCENT OR FOLLOWING DESCENT ABORT) THAT RESULT IN ANY OF THE FOLLOWING CONDITIONS:

   (A) AGS PREDICTED H_p AT INSERTION LESS THAN 40,000 FT
   (B) AGS PREDICTED H_a AT INSERTION GREATER THAN TARGET VALUE PLUS 40 NM
   (C) AGS PREDICTED INSERTION WEDGE ANGLES GREATER THAN 1.0 DEG (DESCENT ABORT CASE OR COELLIPTIC SEQ RNDZ) OR GREATER THAN 0.5 DEG (DIRECT RNDZ)

3. CONFIRMED PGNS NAVIGATION ERRORS THAT RESULT IN THE FOLLOWING MSFN PGNS VELOCITY DIFFERENCES:

   (A) DELTA V_X (DOWN RANGE) GREATER THAN ±24 FPS
   (B) DELTA V_Y (CROSS RANGE) GREATER THAN ±90 FPS (COELLIPTIC SEC RNDZ) OR GREATER THAN ±45 FPS (DIRECT RNDZ)
   (C) DELTA V_Z (RADIAL) GREATER THAN ±37 FPS

B. THE GROUND WILL NOT REQUEST SWITCHOVER AFTER AGS TGO LESS THAN 30 SECONDS.

C. DURING ASCENT, THE AGS WILL BE DECLARED NO-GO IF CONFIRMED AGS NAVIGATION ERRORS RESULT IN:

1. PGNS PREDICTED INSERTION H_p LESS THAN 30,000 FT
2. PGNS PREDICTED INSERTION H_a GREATER THAN TARGET VALUE PLUS 40 NM
3. PGNS PREDICTED INSERTION WEDGE ANGLE GREATER THAN 1.0 DEG (COELLIPTIC SEQ RNDZ) OR GREATER THAN 0.5 DEG (DIRECT RNDZ)

3-81 REQUIREMENTS TO COMMIT TO THE SHORT RNDZ

A. PRIOR TO L/O THE FOLLOWING IS REQUIRED:

1. ONE OPERATIONAL LM NAVIGATION SYSTEM
2. PREDICTED WEDGE ANGLE AT INSERTION EQUALS ZERO DEGREES.
3. NO VIOLATION OF THE NAVIGATION REQUIREMENTS (REFERENCE MATRIX PAGE 3-20)

B. AT INSERTION (PRE-TWEAK) THE FOLLOWING IS REQUIRED:

1. TWEAK ΔV LESS THAN 60 FPS
2. POST-TWEAK H_p GREATER THAN 5 NM
3. NO VIOLATION OF THE NAVIGATION REQUIREMENTS (REFERENCE MATRIX PAGE 3-20)

NOTE

WITH THE EXCEPTION OF LM COMPUTERS AND INERTIAL REFERENCES, NO ONBOARD NAVIGATION SYSTEMS ARE VERIFIED AFTER LIFT-OFF.

R	ITEM

REQUIRED G&N SYSTEMS NEEDED FOR DIRECT RNDZ

PRIMARY RNDZ NAVIGATION TECHNIQUE	SYSTEM REQUIREMENTS				
	COMPUTER	SENSOR/OPTICS	SENSOR/COMPUTER INTERFACE SUPPLYING	TRACKER LIGHT	PLATFORM
LGC/RR	LGC	RNDZ RADAR	RANGE, RANGE RATE, SHAFT AND TRUNION ANGLES		IMU
AGS/RR	AEA	RNDZ RADAR LM COAS	TAPEMETER: RANGE AND RANGE RATE	CSM	ASA
CMC/SXT	CMC	USEABLE SXT	SXT SHAFT AND TRUNNION ANGLES	LM	IMU

1. DIRECT RNDZ IS GO AS LONG AS ANY ONE OF THESE TECHNIQUES REMAINS AVAILABLE.
2. LOSS OF ALL THREE OF THESE TECHNIQUES WILL RESULT IN EXECUTION OF THE COELLIPTIC SEQUENCE RNDZ.

R	ITEM	
		TRANSEARTH COAST
	3-82	TRANSEARTH MCC NOMINAL EXECUTION POINTS WILL BE AT THE FOLLOWING: A. TEI + 17 HOURS B. EI - 22 HOURS C. EI - 3 HOURS
	3-83	TRANSEARTH MCC PHILOSOPHY: THE G&N IS THE PRIMARY MODE OF EXECUTION FOR ALL TEC MCC'S.
	3-84	CSM EVA ATTITUDE/RATES CONSTRAINTS: THE SUN LOOK ANGLES WILL BE MAINTAINED AT THETA 145 DEGREES, PHI 315 DEGREES ±5 DEGREES.

R	ITEM	

MANEUVERS

3-85 THE FOLLOWING GUIDELINES WILL APPLY TO LM MANEUVERS:

A. TRIMMING

1. DESCENT ABORTS/ASCENTS

(A) WITH COMM - TRIM CONTROLLING SYSTEM UNLESS GROUND ADVISES DIFFERENTLY.

(B) WITHOUT COMM - TRIM CONTROLLING SYSTEM UNLESS PGNS/AGS V_X DIFFERENCE IS GREATER THAN 10 FPS. IF SO, DETERMINE CORRECT SYSTEM USING RENDEZVOUS RADAR.

2. ALL RENDEZVOUS MANEUVERS WILL BE NULLED.

3. DOCKED DPS MANEUVERS WILL NOT BE TRIMMED.

B. ALTERNATE MISSION DOCKED DPS MANEUVERS WILL BE COMPLETED VIA AGS TAKEOVER FOR VIOLATION OF THE FOLLOWING LIMITS:

1. ATTITUDE RATES - 10 DEG/SEC
2. ATTITUDE ERRORS - 10 DEG
3. ATTITUDE EXCURSIONS - 10 DEG

C. ALTERNATE MISSION DOCKED DPS MANEUVERS WILL BE TERMINATED AFTER VIOLATION OF THESE OVERBURN CRITERIA:

1. DPS LOI - 10 SEC AND ΔV AGS GREATER THAN 10 FPS
2. DPS TEI - 10 SEC AND ΔV AGS GREATER THAN 2 FPS
3. DPS LOI ABORTS - 10 SEC AND ΔV AGS GREATER THAN 2 FPS

NOTE

A CMC ΔV OF 2 FPS (OVERSPEED) AND 10-SEC OVERBURN IS ALSO A VALID CUE FOR SHUTDOWN.

3-86 THE TABLE ON THE NEXT PAGE, INCLUDING NOTES AND REFERENCES, SUMMARIZES THE TAKEOVER, RESTART, SHUTDOWN, AND TRIMMING REQUIREMENTS, AND SPS ENGINE LIMITS FOR ALL SPS MANEUVERS.

RULE NUMBERS 3-87 THROUGH 3-89 ARE RESERVED.

R | ITEM

MANEUVER	ENGINE LIMITS		RATES/ERRORS FOR		MANUAL START ACTION	OVERBURN SHUTDOWN CRITERIA	EARLY C/O RESTART CRITERIA	RCS TRIM GUIDELINES
	INHIBIT	TERMINATE	TAKEOVER	ACTION				
MODE III	NONE	ERRATIC ENG	5/5	COMPLETE	START	g	Hp > 40	N/A
MODE IV	NONE	ERRATIC ENG	5/5	COMPLETE	START	g	Hp < 95 IF G&N GO ΔVTG > 60 OR C/O > 6 SEC EARLY	N/A
APOGEE KICK	NONE	ERRATIC ENG	5/5	COMPLETE	START	g	Hp < 95 IF G&N GO ΔVTG > 60 OR C/O > 6 SEC EARLY	N/A
TLC MCC	TIGHT[i]	TIGHT[i]	10/10	TERMINATE	DELAY	1 SEC	NO	X = 0.2[b]
LOI	TIGHT[h]				START[l]			NO
MODE I								
0 TO 0 + 53		TIGHT	10/10	COMPLETE			YES	
0 + 53 TO 1 + 31		LOOSE	10/10	COMPLETE			YES	
MODE II								
1 + 31 TO 2 + 54		LOOSE	10/10	COMPLETE			YES	
MODE III[c]								
2 + 54 TO 3 + 40		LOOSE	10/10	COMPLETE			YES	
3 + 40 TO C/O		TIGHT[h]	10/10	COMPLETE		10 SEC	VGO > 50 AND G&N GO	
DOI_1	TIGHT[i]	TIGHT[i]	10/10	TERMINATE	DELAY	BT	NO	j
CIRC	TIGHT[i]	TIGHT	10/10	TERMINATE	START	1 SEC	ΔV TO GO > 20	ALL = 0.2
RESCUE	LOOSE	LOOSE	10/10	COMPLETE	START	1 SEC	ΔV TO GO > 12	ALL = 0.2
LOPC	TIGHT[i]	TIGHT	10/10	TERMINATE	DELAY	1 SEC	NO	Y = 0.2
TEI (G&N)	NONE	NONE	10/10	COMPLETE	DELAY	2 SEC AND ΔV_C = -40[c]	C/O > 3 SEC EARLY AND ΔV_C > 50[c]	X AND Z = 0.2
TEI (SCS)	NONE	NONE	10/10	COMPLETE	START	2 SEC	ΔV_C > 50 OR C/O > 5 SEC EARLY	NO
TEC MCC								
CORRIDOR	LOOSE	LOOSE	10/10	COMPLETE	DELAY	1 SEC AND ΔV_C = 0	NO	X = 0.2
IP CONTROL[b]	TIGHT	TIGHT	10/10	TERMINATE	DELAY	1 SEC AND ΔV_C = 0	NO	X AND Z = 0.2
TLC ABORT	TIGHT	LOOSE	10/10	COMPLETE	START	10 SEC AND ΔV_C = -70	C/O > 10 SEC EARLY AND ΔV_C > 70	NO
EARTH DEOB	TIGHT[d]	LOOSE	10/10	COMPLETE	START	1 SEC AND ΔV_C = 0	ΔV TO GO > 30 AND C/O > 3 SEC EARLY[e]	ALL = 0.2

TIGHT LIMITS: Fuel Ox ΔP > 20 and low P_C; either prop tank press < 160 psi and low P_C; P_C < 80 or decays 10 psi and V_M vs BT low; inhibit burn for any leak in He or prop tank. (Certain burns may be allowed with He tank leak if blowdown ΔV exceeds remaining mission requirements)[f]; GN_2 A or B < 400 psi (for LOI only, GN_2 A and B < 400 psi).

LOOSE LIMITS: P_C < 70 psi and other cues; either prop tank < 115 psi and low P_C; erratic engine (popping, vibration, etc.)[f].

NOTES:
a. Reserved.
b. Trim all MCC (except MCC4) only if X ≤ 2 fps.
c. See Rule 5-131.
d. If SM RCS deorbit not available, use loose limits.
e. See Rule 5-27.
f. Some limits bay be downgraded if warranted by mission circumstance.
g. See Rule 5-3.
h. If indication of ball valve failure, start on good bank (with LM available). If thrusting, shut down good bank 10 sec prior to nominal cutoff to verify indication.
i. If indication of ball valve failure, start on suspect bank. For dual bank burns, if indication of ball valve failure while thrusting, shut down good bank to verify failure. If thrusting continues, reenable good bank.
j. See Rule 3-39.
k. Reserved.
l. Ignition may be delayed up to but no more than 120 sec.

SATURN LAUNCH VEHICLE GO/NO-GO CRITERIA

9/1/72

GO/NO-GO ITEM CONDITION		LAUNCH → EARTH PARKING ORBIT				
		ABORT/SEPARATION	S-II/S-IVB EARLY STAGE	GUIDANCE TAKEOVER	RESTART/TLI INHIBIT	RESTART/TLI TERMINATE
S-IC	LOSS OF THRUST ANY 2 ENG	PRIOR TO TB1 + 2:00 - AUTO ABORT				
	LOSS OF THRUST 2 ADJ ENG	BETWEEN TB1 +2:00 AND TB2 +0:08 SEC-MANUAL ABORT				
	Q BALL + 5° ATT ERROR ①	MANUAL ABORT				
	4°/SEC P AND Y, 20°/SEC R	AUTO ABORT TO 2 + 00				
	10°/SEC P AND Y, 20°/SEC R	MANUAL ABORT AFTER 2 + 00				TLI TERMINATE
IU	LOSS OF ATTITUDE CONTROL	ABORT (LAUNCH)	IF SMALL RATES UPSTAGE	ATTEMPT S/C CONTROL TB5 AND TB7 TO TB7 + 15 MIN	DURING TB6 TO TB6 + 9 MIN 20 SEC	TLI TERM DURING BURN CREW OPTION AFTER TB7 + 15
	INERTIAL ATTITUDE REFERENCE FAIL	← LAUNCH, EPO TLI →				
S-II	LOSS OF THRUST (2 ENG).					
	LOSS OF THRUST (3 OR MORE ENG) ABORT IF PRIOR TO S-IVB TO COI	ABORT	AFTER S-IVB TO COI			
	ACTUATOR HARDOVER INBOARD	PRIOR TO S-IVB TO COI - ABORT	AFTER S-IVB TO COI AND BEFORE S-II C/O MINUS 30 SEC			
	2ND PLANE SEPARATION FAIL	BEFORE TB3 + 1 MIN 45 SEC - ABORT				
	Y DEVIATION > 20°	ABORT				
S-IVB	LOSS OF THRUST	PRIOR TO EPO - SEPARATE				← →
	LOSS OF HYDRAULIC FLUID PRIOR TO START	INHIBIT START			INHIBIT TLI DURING TB5 AND TB6	
	COLD HE FAIL OPEN	ABORT PRIOR TO S-II IGN	AFTER S-II IGN			
	INSUFFICIENT PROPELLANT				INHIBIT RESTART	← →
	LOX VLV FAILS TO CLOSE AT 1ST C/O				INHIBIT RESTART	
	DESTRUCT SYSTEM ARMS INADVERTANTLY	SEP TO 7000 FT MINIMUM				
	FU/OX BULKHEAD ΔP EXCEEDS LIMITS	← -26 OR + 36 PSID (ANY TIME)	SEP TO 7000 FT MINIMUM →		← -26 OR + 36 PSID (ANY TIME) SEP TO 7000 FT MINIMUM →	
	START BOTTLE PRESS OUTSIDE RESTART LIMITS	SEP > 1800 PSIA			SEP > 1800 PSIA	
	LOX CHILLDOWN FAIL				FOR LOX LEAD > 20 SEC - INHIBIT	
	S-IVB ACTUATOR HARDOVER	NO START			ANYTIME PRIOR TO IGN	
	Y DEVIATION > 20°	ABORT				

① DISREGARD Q BALL FOR ENGINE OUT PRIOR TO 75 SEC.

LEGEND: ■ NO REQUIREMENT

REV

	EARTH ORBIT			TLC			CONT LO/DOI 1	UNDOCK AND SEP	CIRC/ DOI 2	POWERED DESCENT		LUNAR STAY		LUNAR ORBIT		TEC
	CONT BOOST	CONT EO	TLI	TD & E	CONT TLC	LOI				PDI	PDI TO T/D	PAST T_1	PAST T_3 & SUBS	POST RNDZ	LM JETT	CSM EVA
ECS																
CABIN INTEGRITY	⑦ CABIN INTEGRITY						CABIN INTEGRITY			②			CABIN INTEGRITY			
NO FIRE OR SMOKE IN CABIN	NO F OR S IN CAB						NO F OR S IN CAB			②			NO F OR S IN CAB			NO F OR S IN CAB
NO O_2 MANIFOLD LEAKS	⑦* NO O_2 MFLD LEAKS				NO O_2 MFLD LEAKS									NO O_2 MFLD LEAKS		NO O_2 MFLD LEAKS
MAIN O_2 REGULATORS	⑦* 1 OF 2	1 OF 2			1 OF 2			⑬						1 OF 2		BOTH ⑧
ECS COOLANT LOOPS		1 OF 2 ⑤	PRI ⑭		① PRIMARY ①		①	① PRIMARY ①	①				PRI ①	PRIMARY ①		PRIMARY
ECS RADIATORS		1 OF 2 ⑤	PRI ⑭		① PRIMARY ①		①	① PRIMARY ①	①				PRI ①	PRIMARY ①		
ECS GLYCOL EVAPS																
SUIT INTEGRITY	SI ⑦*							SI								SI
NO GLYCOL LEAK		NO GLY LEAK					NO GLY LEAK						NO GLY LEAK			NO GLY LEAK
NO EXCESS HUMIDITY		NO EXCESS HUMID					NO EXCESS HUMID			②			NO EXCESS HUMID			NO EXCESS HUMID
POTABLE & WASTE H_2O TK																
SURGE TK/REPRESS PACKAGE																SURGE TK & REPRESS PKG ⑧
SUIT COMPRESSORS	⑦* 1 OF 2 ⑫	1 OF 2			⑫	⑫	⑫ 1 OF 2		⑫	⑫ ②			⑫ 1 OF 2 ⑫		⑫	BOTH
SUIT CIRCUIT	⑦*	SUIT CIRCUIT					SUIT CIRCUIT			②			SUIT CIRCUIT			SUIT CIRCUIT
OVBD DUMPS		1 OF 3			1 OF 3									1 OF 3		
CRYO																
O_2 TANKS		1 OF 3	ALL ⑩		⑩	⑩	⑩ ALL ⑩		⑩	⑩			⑩ ALL ⑩		2 OF 3	ALL ③
H_2 TANKS		1 OF 3	ALL ⑩		⑩	⑩	⑩ ALL ⑩		⑩	⑩			⑩ ALL ⑩		1 OF 3	1 OF 3
EPS																
FUEL CELLS	1 OR	2 OF 3	2 OF 3				2 OF 3							2 OF 3	2 OF 3 ⑪	1 OF 3
AUX BATTERY	1 + 1 = 0															
ENTRY BATTERIES	1 + 1 = 3	2 OF 3	ALL ⑥		⑥	⑥	⑥ ALL ⑥		⑥	⑥			⑥ ALL ⑥			
MAIN BUSES	1 OF 2	BOTH					BOTH			②			BOTH			BOTH
BATTERY BUSES	1 OF 2	BOTH					BOTH			②			BOTH			
AC BUSES	1 OF 2 ⑨	BOTH					BOTH			②			BOTH			BOTH
BAT RELAY BUS		BAT RELAY BUS			BAT RELAY BUS								BAT RELAY BUS			
INVERTERS	1 OF 3 ⑨	2 OF 3					2 OF 3							2 OF 3		2 OF 3
AC ΦA (1 AND 2)		BOTH					BOTH			②			BOTH			
DOCKING																
DOCKING LATCHES						9 OF 12										
GN_2 BOTTLES																
SEQ																
SMJC		④ SMJC NOT ACT ④			④ SMJC NOT ACT ④											
SEQUENTIAL SYSTEMS		BOTH			BOTH											

LEGEND: ■ NO REQUIREMENTS

① BASED ON AMOUNT OF WATER AVAILABLE, CONSIDERATION WILL BE GIVEN TO CONTINUING THE MISSION ON SECONDARY LOOP

② IF POSSIBLE LM DESCENT STAGE WILL BE RETAINED FOR TEI IF CONDITION NOT MET

③ CONSIDERATION WILL BE GIVEN TO PERFORMING EVA IF TKS 1 & 2 OR 1 & 3 REMAIN AND QUANTITY IN 2 OR 3 IS LESS THAN 60%

④ NO REQUIREMENT IS SOURCE OF ACTIVATION CAN BE ISOLATED

⑤ MUST HAVE EITHER PRIMARY OR SECONDARY SYSTEM COMPOSED OF FUNCTIONING LOOP AND CORRESPONDING RADIATORS

⑥ CONSIDERATION WILL BE GIVEN TO CONTINUING WITH TWO REMAINING

⑦ MUST HAVE CABIN INTEGRITY OR SUIT LOOP CAPABLE OF SUPPORTING LIFE. ITEMS MARKED BY * ARE REQUIRED TO MAINTAIN SUIT LOOP

⑧ 1 OF 2 REQUIRED IF OPS AVAILABLE FOR USE BY LMP OR CDR

⑨ MODE I AND II REGIONS ONLY, 0 THEREAFTER

⑩ CONSIDERATION WILL BE GIVEN TO CONTINUING AFTER LOSS OF A TANK

⑪ BASED ON FAILURE MODE CONSIDERATION WILL BE GIVEN TO JETT LM WITH 1 REMAINING

⑫ 1 OF 2 SUIT COMPRESSORS OR VACUUM CLEANER

⑬ CONSIDERATION WILL BE GIVEN TO UNDOCKING IF MAIN REG FAILED CLOSED

⑭ TLI MAY BE PERFORMED WITH 1 OF 2 PRIMARY RADIATOR PANELS AND THE SECONDARY LOOP

CSM GNC GO CRITERIA

9/1/72

GO/NO-GO ITEM	EARTH ORBIT			TLC			LUNAR ORBIT (BEFORE UNDOCKING)			UNDOCK	CIRC/ DOI 2	POWERED DESCENT		LUNAR STAY		LUNAR ORBIT (P RNDZ)	POST DOCK	TEC
	CONT BOOST	CONT EO	TLI	TD&E	CONT TLC	LOI	CONT LOI	CONT LO	DOI 1			PDI	PDI TO TD	PAST T1	PAST T3 & SUBS	CONT L. O.	LM JETT	CSM EVA
GNCS/SCS																		
DEORBIT CAPABILITY		SPS+B/U METHOD																
AUTO ATTITUDE CONTROL		← 3 AXIS		(1)	3 AXIS →			← 2-AXIS →							2-AXIS	2-AXIS	2-AXIS	(3)
RATE DAMPING		← 3 AXIS		(1)	3 AXIS →			← 2-AXIS →							2-AXIS	2-AXIS	2-AXIS	(3)
DIRECT RCS		← 3 AXIS		(1)	3 AXIS →			← 3-AXIS →							3-AXIS	3-AXIS	3-AXIS	(3)
BMAGS P,Y		← 1 OF 2 →				1 OF 2	1 OF 2 OR DPS	← 1 OF 2 →							← 1 OF 2 →			
BMAGS R			1 OF 2			1 OF 2										1 OF 2		
FDAI		← 1 OF 2 →				1 OF 2										1 OF 2		
THC		← THC →						← 1 OF 2 →										
RHC		← 1 OF 2 →				1 OF 2		← THC →								1 OF 2		
EMS								← 1 OF 2 →										
CMC			CMC			CMC OR DPS	CMC OR DPS	← CMC →							(10) ← CMC →		CMC	
ISS			ISS			ISS		← ISS →							← ISS →		ISS	
OSS								← OSS OR VHF →										
OPTICS DAC						0-DAC OR DPS	0-DAC OR DPS	← 0-DAC →							← 0-DAC →			
NO SOLENOID DR GND																		
TVC SERVO LOOP		1 OF 2	(6)			(6) PLUS DPS	REFER TO MR 3-86	1 OF 2 AND DPS	← BOTH →						← BOTH →			
DSKY			1 OF 2			1 OF 2 OR DPS		1 OF 2 OR DPS	← 1 OF 2 →						(10) 1 OF 2 →		1 OF 2	
SPS																		(7)
FU/OX TANK (W/O LEAK)		← FU/OX →				FU/OX		← FU/OX TANK →						← FU/OX TNK →				
GN_2 TANK (W/O LEAK)		1 OF 2	1 OF 2 (9)			1 OF 2 AND DPS		1 OF 2 AND DPS	← BOTH →						← BOTH →			
BALL VALVE BANK		1 OF 2	1 OF 2			1 OF 2 AND DPS		1 OF 2 AND DPS	← BOTH →						← BOTH →			
FEEDLINE TEMP >40° F		← >40° →				>40°			← >40° →						← >40° →			
FU/OX ΔP < 20 PSI		← <20 →				←			← <20 →						← <20 →			
Pc > 70 PSI		>70				>70			← >70 →									
FLANGE TEMP <480°		<480				<480			← <480 →									
HE TANK (W/O LEAK)		(2)	HE TNK			HE TNK		HE TK OR DPS	← HE TNK →									
SM RCS																		
HE TANK (W/O LEAK)		3 OF 4	ALL			3 OF 4			← 3 OF 4 →						← 3 OF 4 →			
NO LEAK BELOW ISO VLV		3 OF 4	ALL			3 OF 4		3OF4	← ALL →						← 3 OF 4 →		4 OF 4	(7)
PKG TEMP > 55°		3 OF 4	3 OF 4			3 OF 4			← 3 OF 4 →						← 3 OF 4 →		3 OF 4	C + D
THRUSTERS		ALL ROT AXES +X TRANS	3 OF 4 P,Y 6 OF 8 R	(1)		3 OF 4 P,Y 6 OF 8 R		6OF8	← 3 OF 4 P,Y 7 OF 8 →	6 OF 8 R				3 OF 4 P,Y 6 OF 8 R	(1)		(5)	(4)
CM RCS																		
HE TANK (W/O LEAK)			(8)						(8)						(8)			
MANIFOLD (W/O LEAK)	1 OF 2 MODE 1		BOTH						BOTH						← BOTH →	← BOTH →		(7)
NOT ARMED																		

(1) REQUIRES 3 AXIS ATTITUDE CONTROL AND TRANSLATION 3 AXIS (ONE LATERAL AXIS MAY BE DEGRADED)

(2) MUST HAVE SUFFICIENT BLOWDOWN FOR DEORBIT

(3) AUTO OR MANUAL IN 3 AXIS

(4) REQUIRES C1 OR D1, C2 OR D2, C3, C4, D3, D4 THRUSTERS

(5) 3 AXIS ATT. CONTROL AND ± X TRANSLATION

(6) 3 OF 4 TOTAL REQUIRED, ROLL 90° IF NECESSARY TO KEEP REDUNDANCY IN YAW

NOTE

1 T_2 NO STAY CONDITIONS NONE

(7) CONSIDERATION WILL BE GIVEN TO PERFORMING THE EVA WITH A PROPELLANT LEAK

(8) NEITHER TANK REQUIRED IF SUFFICIENT BLOWDOWN EXISTS IN EACH RING FOR ENTRY. ARMING SYSTEM WITH SOURCE PRESS >1250 PSI WILL PROVIDE >60 LBS BLOWDOWN IN EACH RING

(9) SINGLE POINT FAILURES WHICH CAN ONLY BE CONFIRMED BY BURNING ENGINE

(10) CONSIDERATION WILL BE GIVEN TO COMPLETING THE LUNAR STAY PHASE

LEGEND: NO REQUIREMENT

DEFINITIONS

REV

SEQUENTIAL AND PYROTECHNIC

1. OPERATIONAL PYRO BATTERY

   PYRO BATTERY OCV >25 VDC AND STABLE OR THE PROJECTED VOLTAGE DEGRADATION TO 25 VDC PERMITS A MINIMUM LUNAR STAY TIME. IF THE OCV IS AT THE MONOXIDE PLATEAU LEVEL (≈ 30-31.5 VDC) BUT WAS NOT MONITORED AS IT FELL TO THAT LEVEL, THE BATTERY IS CONSIDERED LOST.

2. LM STAGES NON-RIGIDLY ATTACHED: THE GUILLOTINE FAILS TO SEVER THE INTERSTAGE UMBILICALS AND ALL OTHER INTERSTAGE ATTACH POINTS HAVE RELEASED

ELECTRICAL POWER

1. OPERATIONAL CDR OR LMP BUS

   A. BUS VOLTAGE GREATER THAN 26.5 VDC

   B. BUS CURRENT LESS THAN 90 AMPS.

2. OPERATIONAL EPS BATTERY

   A. NO CONFIRMED REVERSE CURRENT (PERFORMED WITH SUSPECT BATTERY AND ONE GOOD BATTERY IN PARALLEL)

   B. ABILITY TO MAINTAIN BUS VOLTAGE >26.5 VDC AT REQUIRED LOAD WHEN BATTERY ON ALONE

   C. ABILITY TO CONFIRM A MINIMUM OF NINETEEN ACCEPTABLE BATTERY CELLS (MUST HAVE AN OCV >36.7 VDC OR A STABLE OCV OF 35.1 VDC FOR 2 HOURS AND A LOAD CHECK VOLTAGE DEPRESSION EQUIVALENT TO ONE CELL FOR THE LOAD INVOLVED).

   D. ABILITY TO BE CONNECTED TO A FEEDER (NO MALFUNCTIONED ECA)

   E. TEMPERATURE LESS THAN 145° F [FOR AN OVERTEMP CONDITION THE BATTERY VOLTAGE WILL BE EQUAL TO (UNSTAGED) OR LESS THAN (STAGED) NORMAL WITH CURRENT LESS THAN NORMAL].

3. OPERATIONAL DC BUS FEEDER

   A. DESCENT--ABILITY TO USE AS A POWER PATH THE ELECTRICAL CONNECTIONS FROM THE OUTPUT TERMINALS OF THE DESCENT ECA'S TO THE DFR

   B. ASCENT--ABILITY TO USE AS A POWER PATH THE ELECTRICAL CONNECTIONS FROM THE OUTPUT TERMINALS OF THE ASCENT ECA'S TO THE BAT FEED TIE CIRCUIT BREAKERS

4. LOSS OF OVERCURRENT PROTECTION

   A. DEFINITE LOSS IF:

      1. BOTH CIRCUIT BREAKERS POWERING THE ECA'S FAIL OPEN (ALL DESCENT OR ALL ASCENT BATTERIES, DEPENDENT ON WHICH PAIR OF CIRCUIT BREAKERS FAILED).

      2. FAILURE OF AN ASCENT BATTERY NORMAL FEED CONTACTOR

      3. AN ASCENT BATTERY IS PLACED ON BACKUP FEED

      4. BOTH LMP AND CDR BUSES ARE FED SOLELY BY THE SAME FEEDER PAIR

   B. PROBABLE LOSS IF:

      1. UNABLE TO MEASURE A BATTERY CURRENT BOTH ONBOARD AND ON TELEMETRY.

      2. UNABLE TO TAKE THE BATTERY OFFLINE

5. OPERATIONAL INVERTER AND ASSOCIATED AC DISTRIBUTION

   A. AC BUS VOLTAGE GREATER THAN 110.5 AND LESS THAN 120 VAC

   B. AC BUS FREQUENCY GREATER THAN 390 AND LESS THAN 410 HZ.

   C. ABILITY TO SUPPLY POWER TO AN AC BUS

ENVIRONMENTAL CONTROL

1. CABIN INTEGRITY--LM PRESSURE VESSEL LEAKAGE SUCH THAT CABIN PRESSURE CAN BE MAINTAINED GREATER THAN OR EQUAL TO 4.6 PSIA WITH AN O_2 FLOW RATE OF LESS THAN 1.4 LBS/HR (ASSUMES TWO GOOD ASCENT TANKS). FOR DOCKED ACTIVITIES THE FLOW RATE WILL BE RELAXED TO 6 LBS/HR.

2. SUIT LOOP INTEGRITY--TOTAL PGA/SUIT LOOP DECAY LESS THAN 1.0 PSI/MIN (1.0 LBS/HR) DURING SUIT LOOP PRESSURE CHECK AND NO VISIBLE TEARS IN THE PGA.

3. OPERATIONAL COOLANT LOOP

   A. SUSTAINED GLYCOL TEMPERATURE LESS THAN 50° F EXCEPT DURING COOLANT LOOP STARTUP AND DRYOUT

   B. GLYCOL PUMP ΔP GREATER THAN 6 PSID (CIRCULATION) AND H_2O FEED CAPABILITY TO THE SUBLIMATOR(S)

4. GLYCOL COOLANT LEAK--OBSERVED FLUID IN CABIN CONFIRMED BY TASTE OR PRESENCE OF GLYCOL LOW INDICATION AND BY STATIC PRESSURE DROP

5. OPERATIONAL DESCENT O_2 TANKS--ABILITY TO TRANSFER O_2 FROM DESCENT TANKS

6. OPERATIONAL ASCENT O_2 TANKS

   A. ABILITY TO TRANSFER O_2 FROM AN ASCENT TANK

   B. IF UNSTAGED WITH MSFN COVERAGE AND A DESCENT O_2 TANK GREATER THAN 35 PERCENT, CONFIRMATION OF O_2 AVAILABILITY BY BALANCING ONE TANK AGAINST THE OTHER

   C. AVAILABILITY OF ONBOARD OR MSFN READOUTS IF STAGED OR IF DESCENT O_2 LESS THAN 35 PERCENT

7. OPERATIONAL H_2O TANK (DESCENT OR ASCENT)

   A. REMAINING TANK FEEDING AT NORMAL RATE IF ONE TANK MEASUREMENT LOST OR STATIC

   B. ABILITY TO SUPPLY H_2O TO W/B RESULTING IN MAINTAINING NORMAL GLYCOL AND SUIT LOOP TEMPERATURES (CREW AND MSFN) AND NORMAL H_2O ΔP (MSFN ONLY)

GO/NO-GO CRITERIA

REV

GO/NO-GO ITEM		UNDOCK TO PDI	POWERED DESCENT: PDI TO 6+10	POWERED DESCENT: 6+10 TO HI GATE	POWERED DESCENT: HI GATE TO TD	LUNAR STAY WITH EVA	LM ACTIVE RNDZ
SEQUENTIAL AND PYROTECHNIC							
1. OPERATIONAL PYRO BATTERIES	(2)	(7)	BOTH (4)		(4)	(1)	
2. ARM/DEARM (K1) CAPABILITY	ARM (2)		BOTH (4)				
	DEARM (5)		BOTH (4)			(46)	
3. STAGING RELAYS (K2-K6) HOT CLOSED	(5) (6)		BOTH (4)			(46)	
ELECTRICAL POWER							
1. CDR AND LMP BUS	(3) (11) (61)		BOTH (12)		(12)		1 OF 2
2. DC FEEDERS (13) (61)	DESCENT (16)		BOTH (12)			(14)	
	ASCENT		BOTH (12)			(15)	1 OF 2
3. OPERATIONAL BATTERIES	DESCENT		2 OF 5		2 OF 5 (14)		
	ASCENT (17)	(18) (61)	BOTH (19)	(19)	BOTH (18)		1 OF 2
4. OPERATIONAL AC SYSTEM (23)	INVERTERS (24)		1 OF 2				
	AC BUSES (25)		BUS A OR B				
ENVIRONMENTAL CONTROL							
1. SUIT/CABIN INTEGRITY	(41)	(61)	SUIT AND CABIN		SUIT	SUIT AND CABIN	
2. SUIT FANS	(42)		1 OF 2 (43)	(43)		1 OF 2	
3. O_2 DEMAND REGULATORS	(61) (44)		1 OF 2			1 OF 2	
4. H_2O SEPARATORS	(61)		1 OF 2			1 OF 2	
5. OPERATIONAL O_2 TANKS (61)	DESCENT		1 OF 2			1 OF 2	
	ASCENT (45)		1 OF 2			1 OF 2	
6. COOLANT LOOPS (61)	PRIMARY						(47)
	SECONDARY						(47)
7. H_2O FEEDPATHS			1 OF 2			1 OF 2	
8. OPERATIONAL H_2O TANKS (61)	DESCENT		1 OF 2			1 OF 2	
	ASCENT		1 OF 2			1 OF 2	(47)
9. NO FIRE, SMOKE, OR GLYCOL IN SUIT OR CABIN	(48)						

LEGEND: ■ NO REQUIREMENT

REV

SPECIFIC RULES

IF NO-GO AT UNDOCKING
DO NOT UNDOCK

IF NO-GO UNDOCKED
NO-GO FOR CIRC

IF NO-GO AT CIRC OR PRE-PDI
NO-GO FOR PDI

IF NO-GO DURING POWERED DESCENT
ABORT/ABORT STAGE

IF NO-GO FOR LUNAR STAY
L/O NEXT BEST OPPORTUNITY

IF NO-GO FOR LM ACTIVE RENDZ
CSM ACTIVE RENDZ

DOCK ASAP FOR ALL NO-GO CONDITIONS EXCEPT:

PYRO
UNABLE TO DEARM SYSTEM*
STAGING RELAYS (K2 TO K6) FAILED CLOSED

ELECTRICAL
LOSS OF 1 ASCENT BATTERY (UNSTAGED)
LOSS OF AC POWER

ENVIRONMENTAL
LOSS OF DEMAND REGULATORS
LOSS OF PRIMARY COOLANT LOOP**
LOSS OF H_2O TANKS**

*ALTERNATE MISSION WITHIN STAGED RNDZ CAPABILITY MAY BE PERFORMED
**RETURN TO VICINITY OF CSM

NOTE: T_1 NO STAY CONDITIONS NONE
T_2 NO STAY CONDITIONS NONE

REV

SEQUENTIAL AND PYROTECHNIC

LOSS OF A PYRO SYSTEM (MANUAL STAGING)

(1) A. NO DETECTABLE PYRO SYSTEM FAILURES WILL BE CAUSE FOR EVA TERMINATION.

B. WITH THE IMPENDING LOSS OF A PYRO SYSTEM(S) DUE TO A DEGRADING PYRO BATTERY OR BATTERIES, MANUAL STAGING USING BOTH SYSTEMS WILL BE PERFORMED PRIOR TO LOSS OF THE BATTERY OR BATTERIES.

C. IF ONLY A SINGLE PYRO SYSTEM REMAINS, MANUAL STAGING WILL BE DELAYED AS LONG AS POSSIBLE.

D. IF MANUAL STAGING ATTITUDE/DES GOX PRESSURE CONSTRAINTS CANNOT BE MET, MANUAL STAGING WILL NOT BE PERFORMED. THE DES GOX HIGH PRESSURE LINE WILL BE VENTED, IF NECESSARY, TO INSURE SAFE MANUAL STAGING.

(2) A. UNDOCKED STAGING WITH ONE PYRO SYSTEM WILL BE PERFORMED ONLY IF , ABSOLUTELY NECESSARY TO MAINTAIN CREW SAFETY.

B. CSM RESCUE MAY BE REQUIRED DUE TO RCS REDLINES IF STAGING CANNOT BE ACCOMPLISHED.

(3) LOSS OF A DC BUS RESULTS IN LOSS OF ONE PYRO SYSTEM.

(4) FOR LOSS OF A PYRO SYSTEM AFTER LOSS OF OPS-TO-ORBIT CAPABILITY DURING POWERED DESCENT IT IS BETTER TO LAND. MANUALLY STAGE AND LIFTOFF NEXT BEST OPPORTUNITY.

K1-K2 FAILED CLOSED

(5) A. A FUNCTIONALLY CONFIRMED FAILED CLOSED K1 OR K2 RELAY IS CONSIDERED UNSAFE FOR THE VIBRATION/SHOCK ENVIRONMENT ASSOCIATED WITH LUNAR TOUCHDOWN. FOR UNSTAGED ORBITAL OPERATION, PLACE ONE ASCENT BATTERY ON THE BUS POWERING THE ACTIVE GUIDANCE SYSTEM. STAGE AS REQUIRED IN ORBIT.

B. IF UNABLE TO VERIFY VIA ONBOARD INST OR TM THAT A PYRO SYS IS DEARMED (FAILED ARMED OR DEARMED INDICATION) THEN: (1) PRIOR TO SHE PRESS THE DEARMED STATUS WILL BE VERIFIED ONLY THE FIRST TIME IT IS DEARMED. (2) FOR SHE PRESS THE DEARMED STATUS WILL BE VERIFIED ONLY FOR AN ARMED INDICATION, (3) AFTER TO THE DEARMED STATUS WILL NOT BE VERIFIED.

K2-K6 FAILURE

(6) A. PRIOR TO PDI, A K2 TO K6 FAILURE WILL BE CONFIRMED. CONFIRMATION WILL RESULT IN A PARTIAL OR COMPLETE STAGING SEQUENCE. HOWEVER, A STAGED ALTERNATE MISSION MAY BE PERFORMED.

B. AFTER PDI, THE FAILURE CANNOT BE CONFIRMED. THE LOGIC POWER B CB MUST REMAIN CLOSED DURING MAIN DESCENT PROPULSION BURNS TO MAINTAIN REDUNDANT ENGINE "ON" CAPABILITY. PRIOR TO ANY MASTER ARM, HOWEVER, THE CB MUST BE OPENED AS ARMING THE SYSTEM MAY STAGE THE LM.

PYRO BATTERY REDLINE

(7) IF THE PYRO BATTERY READING JUST PRIOR TO PDI INDICATES A DECREASE FROM THE VOLTAGE LEVEL READ AT ACTIVATION, THEN PDI WILL BE DELAYED BY ONE REV TO DETERMINE IF THE BATTERY IS CONTINUING TO DEGRADE.

ALTERNATE MISSIONS

(8) A. FOR ORBITAL ALTERNATE MISSIONS, IF INCOMPLETE STAGING OCCURS, THE MISSION MAY BE CONTINUED IF THE ASCENT AND DESCENT STAGES ARE RIGIDLY ATTACHED. IF THE LM STAGES ARE NON-RIGIDLY ATTACHED, THE LM SHOULD GO TO DRIFTING FLIGHT AND A CSM RESCUE INITIATED. CEVA WILL BE REQUIRED IF UNABLE TO DOCK.

B. THERE IS NO REQUIREMENT TO MAINTAIN A LM STAGING CAPABILITY FOR ORBITAL ALTERNATE MISSIONS.

LANDING GEAR

(9) IF UNABLE TO DEPLOY ONE OR MORE LANDING GEAR, A LANDING WILL NOT BE ATTEMPTED. DESCENT ENGINE BURNS WILL BE CONTINUED SINCE CONTROL PROBLEMS ARE NOT EXPECTED TO EXIST AND DAMAGE TO THE LANDING GEAR FROM THE BURN WILL NOT AFFECT ALTERNATE MISSIONS.

(10) RESERVED

ELECTRICAL POWER

BUSES

(11) A. LOSS OF EITHER DC BUS DURING DESCENT ENGINE BURNS RESULTS IN THROTTLING TO 10D PERCENT. IF ON INV 2, LOSS OF THE LMP BUS CAUSES THE ENGINE TO SHUT DOWN UNLESS ENG START PB1 HAS BEEN PUSHED.

B. IF A DC BUS IS DETERMINED TO BE CRITICAL (LOSS OF THE BUS RESULTS IN A CATASTROPHIC SITUATION DUE TO OTHER SYSTEMS FAILURES), THE ASCENT BATTERIES WILL BE CONFIGURED SPLIT BUS ON BACKUP FEED PATHS (NORMAL FEED OFF) FOR ASCENT AND DESCENT IF TIME PERMITS.

FEEDERS

(12) DURING POWERED DESCENT WHEN TIME IS NOT AVAILABLE TO TROUBLESHOOT, A SHORT ON EITHER AN ASCENT OR DESCENT FEEDER WILL BE CONSIDERED LOSS OF A BUS AND THUS REQUIRE AN ABORT.

(13) A SHORTED ASCENT OR DESCENT DC FEEDER WILL ALWAYS BE REASON FOR ABORTING THE LANDING MISSION. ONE OPEN DESCENT FEEDER WILL NOT BE REASON FOR ABORTING THE LANDING MISSION.

GENERAL NOTES

REV

ELECTRICAL POWER (CONT)

(14) FOR AN OPEN DESCENT FEEDER OR FOR THE LOSS OF THREE DESCENT BATTERIES ON THE SAME BUS, THE CROSSTIE BAL LOAD CIRCUIT BREAKERS WILL BE CLOSED ON THE LUNAR SURFACE AND THE MISSION CONTINUED WITHIN THE CONSUMABLES BUDGET.

(15) FOR A SHORTED ASCENT FEEDER ON THE LUNAR SURFACE, THE ASCENT BATTERIES WILL NOT BE CONNECTED UNTIL THE NOMINAL TIME TO NEED PRECONDITIONING REQUIREMENTS.

(16) FOR A SHORTED DESCENT FEEDER, THE ASCENT BATTERIES WILL BE PLACED ON NORMAL FEED WITH THE SHORT ISOLATED VIA THE DEADFACE RELAY. OPERATIONALLY, THIS RESULTS IN THE LOSS OF ALL REMAINING DESCENT ELECTRICAL ENERGY FOR CONSUMABLE CONSIDERATIONS. THE DESCENT BATTERIES THAT STILL HAVE AN OPERABLE FEED PATH WILL BE USED ONLY IF NECESSARY TO MAINTAIN CREW SAFETY.

BATTERIES

(17) IF THE ASCENT BATTERY OCV AT HOUSEKEEPING IS 37.2 OR 37.0 VDC AND AT ACTIVATION IS 36.5 THROUGH 35.3 VDC, THEN STOP ACTIVATION PROCEDURES AND GO INTO A HOLD STATUS CONSERVING LM CONSUMABLES UNTIL THE ASCENT BATTERY STATUS CAN BE DETERMINED.

(18) ASCENT BATTERY CONFIRMED LOST (ORBIT OR SURFACE-UNSTAGED). WHEN REMAINING ASCENT BATTERY REQUIRED:

1. GOOD BATTERY NORMAL AND BACKUP FEED PATHS
2. BUS CROSSTIE (100A) CB CLOSED
3. DESCENT BATTERIES OFF AT 5 SECOND INTERVALS
4. DES ECA CB'S (2) OPEN
5. ABORT STAGE-PUSH

(19) ASCENT BATTERY CONFIRMED LOST BY REVERSE CURRENT DURING POWERED DESCENT (REVERSE CURRENT ONLY ACCEPTABLE LOSS OF BATTERY CRITERIA).

PDI TO HI GATE	HI GATE TO TOUCHDOWN
1. PANEL 11 DES ECA CB-OPEN IF STAGING REQUIRED:	1. PANEL 11 DES ECA CB-OPEN 2. BUS CROSSTIE (100A) CB-CLOSED
2. BUS CROSSTIE (100A) CB-CLOSED IF ABORT REQUIRED: 3. DESCENT BATS OFF AT 5 SEC INTERVALS 4. PANEL 16 DES ECA CB-OPEN 5. GOOD ASCENT BATTERY BACKUP FEED-ON 6. ABORT STAGE-PUSH	3. PANEL 16 DES ECA CB-OPEN 4. IF TIME PERMITS, GOOD ASCENT BAT BACKUP FEED-ON 5. IF TIME PERMITS, DESCENT BATS OFF AT 5 SEC INTERVALS 6. ABORT STAGE-PUSH

(20) BATTERY MANAGEMENT WILL BE PERFORMED ONLY DURING LUNAR STAY PERIODS. THE DESCENT BATTERY STATE OF CHARGE WILL BE KEPT AS EQUAL AS PRACTICAL.

(21) A BATTERY WILL NOT BE PUT ONLINE IF ITS OCV IS LESS THAN BUS VOLTAGE.

(22) THE ASCENT BATTERIES WILL BE PRECONDITIONED FOR:

A. ABORT STAGING WITH TWO ASCENT BATTERIES/SPLIT BUS OPERATION - BY REMOVING A MINIMUM OF 2.5 AMP HOURS FROM THE BATTERY ON THE LMP BUS (NORMALLY BATTERY 5) AND A MINIMUM OF 5 AMP HOURS FROM THE BATTERY ON THE CDR BUS (NORMALLY BATTERY 6) IMMEDIATELY PRIOR TO PDI. WITH THE LOSS OF A CELL, THE AFFECTED BAT WILL BE PRECONDITIONED BY REMOVING A TOTAL OF 10 AMP HOURS.

B. LUNAR L/O OR STAGING DURING COASTING FLIGHT WITH TWO ASCENT BATTERIES/SPLIT BUS OPERATION - BY REMOVING A MINIMUM OF 2.5 AMP HOURS FROM EACH ASCENT BATTERY IMMEDIATELY PRIOR TO DISCONNECTING THE LAST DESCENT BATTERY FROM EACH BUS.

C. LUNAR L/O OR STAGING DURING COASTING FLIGHT WITH ONE ASCENT BATTERY/TWO BUS OPERATION--BY REMOVING A MINIMUM OF 5 AMP HOURS FROM THE REMAINING ASCENT BATTERY IMMEDIATELY PRIOR TO DISCONNECTING THE LAST DESCENT BATTERY FROM THE BUSES.

AC POWER

(23) IF ON INV 2 OR AC BUS A IS LOST, PUSH ENGINE START PB1 FOR ALL DPS BURNS.

(24) THE INVERTERS WILL BE SWITCHED FOR A VOLTAGE LESS THAN OR EQUAL TO 112 VAC OR A FREQUENCY GREATER THAN OR EQUAL TO 402 OR LESS THAN OR EQUAL TO 398 Hz TO TURN OFF THE INVERTER CAUTION LIGHT.

(25) AC BUS A IS REQUIRED IF THE RR IS REQUIRED.

GENERAL

(26) ELECTRICAL POWER WILL NEVER BE INTENTIONALLY APPLIED TO A SHORT TO HELP DETERMINE ITS LOCATION UNLESS THE FEEDER FAULT LIGHT HAS FAILED. A GOOD BUS WILL NEVER BE CROSSTIED INTO A SHORT OR POSSIBLE SHORT.

(27) THE BAL LOAD CROSSTIES (30 A) WILL BE OPEN FOR MAIN PROPULSION BURNS, STAGING, AND WHENEVER AGS IS IN THE OPERATE MODE WITH BOTH "AEA" CIRCUIT BREAKERS CLOSED. BOTH BUS CROSS TIES (100 A) WILL NOMINALLY NEVER BE CLOSED EXCEPT DURING DESCENT BATTERY LOW TAP TO HIGH TAP SWITCHOVER.

REV

28 THE MISSION WILL BE CONTINUED AFTER LIFTOFF WITH THE LOSS OF OVERCURRENT PROTECTION. IF THIS PROTECTION IS LOST PRIOR TO LIFTOFF, A HOLD WILL BE CALLED.

A. IF OVERCURRENT PROTECTION IS LOST ON AN INDIVIDUAL DESCENT BATTERY, THE BATTERY WILL BE LEFT ON LINE EXCEPT FOR EVA IF POSSIBLE.

B. TO MONITOR CURRENT AND OBTAIN A CONSUMABLES TREND IF ALL DESCENT OVERCURRENT PROTECTION IS LOST, BOTH ASCENT BATTERIES WILL BE PARALLELED WITH THE DESCENT BATTERIES PERIODICALLY DURING ACTIVATION. DURING LUNAR SURFACE OPERATIONS WITH THE COMPUTERS OFF, THE ASCENT BATTERIES WILL BE TURNED ON ALONE FOR PERIODIC CURRENT MONITORING. FOR AN EVA, THE CDR AND LMP BUSES WILL BE SPLIT (THE CROSSTIE CIRCUIT BREAKERS ON PANEL 16 OPENED).

C. IF ONE OR BOTH ASCENT BATTERY NORMAL FEED CONTACTORS FAIL OPEN, THE SPACECRAFT WILL BE CONFIGURED WHEN ASCENT STAGE ONLY OPERATIONS ARE REQUIRED, USING THE BACKUP FEEDS ON BOTH ASCENT BATTERIES WITH THE CROSSTIES LEFT OPEN.

29 ANY REQUIREMENT FOR A NEXT BEST OPPORTUNITY LIFTOFF WILL BE CAUSE FOR TERMINATION OF AN EVA. ADDITIONALLY A CREWMAN WILL BE REQUIRED TO RETURN FROM AN EVA TO CORRECT A DESCENT BATTERY MALFUNCTION REQUIRING THE BATTERY TO BE TAKEN OFFLINE.

30 WHEN AGS IS IN THE OPERATE MODE MOMENTARILY CLOSE THE AEA C/B ON THE CDR BUS WHEN POWERING UP INV 2.

1 FOR ANY MISSION PLANNING CASE (NOMINAL, ALTERNATE, CONTINGENCY, EMERGENCY, ETC.) THE DESCENT BATS WILL BE CONSIDERED TO HAVE A MAXIMUM OF 415 AH AND THE DES COOLING VLV WILL NOT BE USED UNLESS THE DES BATS MUST BE RUN BEYOND 415 AH. IF, AND ONLY IF, THE DES BATS MUST BE RUN BEYOND 415 AH, THE VLV WILL BE CLOSED BASED ON DES BAT CAPABILITIES DETERMINED BY THE MISSION SIM ATP WITHOUT COOLING AND A MAXIMUM INTERNAL BATTERY TEMP OF 130° F.

2-40 RESERVED

ENVIRONMENTAL

SUIT/CABIN INTEGRITY

41 CREW WILL GO TO EGRESS MODE IF INSUFFICIENT O_2 IS AVAILABLE TO MAINTAIN CABIN PRESSURE. A MISSION PHASE WILL NOT INITIATED IF THIS CONDITION CAN BE ANTICIPATED.

SUIT FAN

42 RETAIN PLSS'S, IF POSSIBLE WHEN BOTH SUIT FANS ARE LOST, AND DO NOT DEPRESS CABIN OR STAGE WHILE UNDOCKED.

43 FOR LOSS OF BOTH SUIT FANS PLACE DEMAND REG B TO "DIRECT O_2" IMMEDIATELY OR REMOVE HELMETS. (HELMETS MUST BE REMOVED FOR STAGING.)

O_2 REGULATORS

44 DO NOT DEPRESS CABIN WITH LOSS OF BOTH QMD REGS.

O_2 TANKS

45 IF EITHER ASCENT O_2 TANK IS LESS THAN OR EQUAL TO 90 PERCENT, IT WILL BE REPLENISHED FROM THE DESCENT O2 WHEN THE DESCENT TANK QUANTITY IS GREATER THAN OR EQUAL TO 35 PERCENT AND AS CLOSE TO STAGING AS POSSIBLE.

46 DESCENT OXYGEN TANK 2 WILL BE VENTED, IF NECESSARY, TO PROVIDE AN ACCEPTABLE LANDING ATTITUDE FOR AN INADVERTENT STAGING. IF INADVERTENT STAGING IS UNACCEPTABLE, LIFTOFF AT NEXT BEST OPPORTUNITY.

COOLANT LOOPS

47 CREW MAY ELECT TO REMOVE PGA'S FOR COOLING FOR LOSS OF BOTH COOLANT LOOPS OR LOSS OF BOTH ASCENT WATER TANKS.

CONTAMINATION

48 FOR CONTAMINATION IN THE CABIN OR SUIT LOOP (GLYCOL, FIRE, SMOKE, ETC.) THE CREW MAY ELECT TO DECONPRESS THE CABIN OR PURGE THE SUIT LOOP.

GENERAL

49 OXYGEN PURGE SYSTEM AND PLSS CONSUMABLES WILL BE RESERVED FOR POSSIBLE CEVA AND WILL NOT BE CONSIDERED FOR LM GO/NO-GO'S OR REDLINES.

50 ANY REQUIREMENT FOR A NEXT BEST OPPORTUNITY LIFTOFF WILL BE CAUSE FOR TERMINATION OF EVA. ADDITIONALLY, A CREWMAN WILL BE REQUIRED TO RETURN FROM AN EVA TO CORRECT A FAILED OPEN DEMAND REGULATOR.

51-60 RESERVED

MISCELLANEOUS

61 WHERE ADVANTAGEOUS, THE DESCENT STAGE WILL BE RETAINED ALAP.

LM CONTROL MISSION RULES

9/1/72

DEFINITIONS

REV

GUIDANCE AND CONTROL

1. 3-AXIS ATTITUDE CONTROL--THE ABILITY TO CHANGE THE EXISTING VEHICLE ATTITUDE PLUS AND MINUS ABOUT EACH AXIS. TO HAVE THIS CAPABILITY, THE LM REQUIRES AN OPERATIONAL MANUAL OR AUTOMATIC CONTROL SYSTEM.
2. REDUNDANT 3-AXIS ATTITUDE CONTROL--TWO AUTONOMOUS 3-AXIS ATTITUDE CONTROL SYSTEMS INDEPENDENT OF SECONDARY COILS, I.E., NO SINGLE FAILURE WILL CAUSE LOSS OF BOTH AUTONOMOUS SYSTEMS.
3. GUIDANCE STEERING--ABILITY TO CALCULATE AND STEER THE LM ALONG THE DESIRED THRUST VECTOR DURING A POWERED MANEUVER. THIS CAPABILITY REQUIRES AN OPERATIONAL PGNS OR AGS INCLUDING A 3-AXIS ATTITUDE CONTROL SYSTEM.
4. OPERATIONAL PGNS--A PGNS WITHOUT AN LGC, ISS, DSKY OR CES FAILURE(S) PREVENTING PGNS 3-AXIS ATTITUDE CONTROL.
5. OPERATIONAL AGS--AN AGS WITHOUT AN AEA, ASA, DEDA OR CES FAILURE(S) PREVENTING AGS 3-AXIS ATTITUDE CONTROL.
6. 3-AXIS TRANSLATION--ONE TTCA AND AN OPERATIONAL PGNS OR MANUAL (AGS MODE) TRANSLATION CAPABILITY.

DPS PROPULSION

1. OPERATIONAL DPS

   PRIOR TO PDI IGNITION

   A. FUEL AND/OR OXID ENGINE INLET PRESSURE GREATER THAN 30 PSIA.

   B. FUEL AND OXID BULK TEMPERATURES GREATER THAN 50° F AND LESS THAN 90° F.

   C. Δ TEMP BETWEEN FUEL AND OXID LESS THAN 10° F.

   D. Δ PRESSURE (FUEL HIGH) LESS THAN 50 PSID.

   E. PROPELLANT AND SUPERCRITICAL HELIUM ADEQUATE TO COMPLETE MISSION.

   AFTER PDI IGNITION

   A. FUEL AND/OR OXID ENGINE INLET PRESSURES GREATER THAN 150 PSIA (ULLAGE PRESSURES GREATER THAN 160 PSIA).

   B. THROAT AREA INCREASE LESS THAN 52 PERCENT.

   C. ADEQUATE PROPELLANT AND SUPERCRITICAL HELIUM TO COMPLETE MISSION.

2. DPS INSERTION CAPABILITY--THE ABILITY TO OBTAIN A SAFE INSERTION USING ONLY THE DPS.

APS PROPULSION

OPERATIONAL APS

1. PREPRESSURIZATION

   A. Δ PRESSURE BETWEEN APS FUEL AND OXID ENGINE INLET PRESSURES LESS THAN 90 PSID.

   B. Δ TEMP BETWEEN APS FUEL AND OXID LESS THAN 10° F.

   C. APS FUEL AND/OR OXID TEMP GREATER THAN 50° F AND LESS THAN 90° F.

   D. APS FUEL OR OXID INLET PRESSURE GREATER THAN 62 PSIA AND LESS THAN 220 PSIA.

   E. REDUNDANT PRESSURIZATION PATHS AND NO HELIUM TANK/LINE LEAKS.

2. POST-PRESSURIZATION

   A. Δ PRESSURE BETWEEN FUEL AND OXID INLET PRESSURES LESS THAN OR EQUAL TO 15 PSID.

   B. FUEL AND/OR OXID INLET PRESSURES GREATER THAN 105 PSIA. (ULLAGE PRESSURE GREATER THAN 110 PSIA).

   C. ADEQUATE PROPELLANT AND SOURCE PRESSURE TO COMPLETE MISSION.

REACTION CONTROL

OPERATIONAL RCS

A. AN RCS CONTAINING 8 OPERATIONAL THRUSTERS SUPPLIED BY ITS OWN PRESSURIZATION AND PROPELLANT FEED SYSTEM INDEPENDENT OF ASCENT FEED AND CROSSFEED.

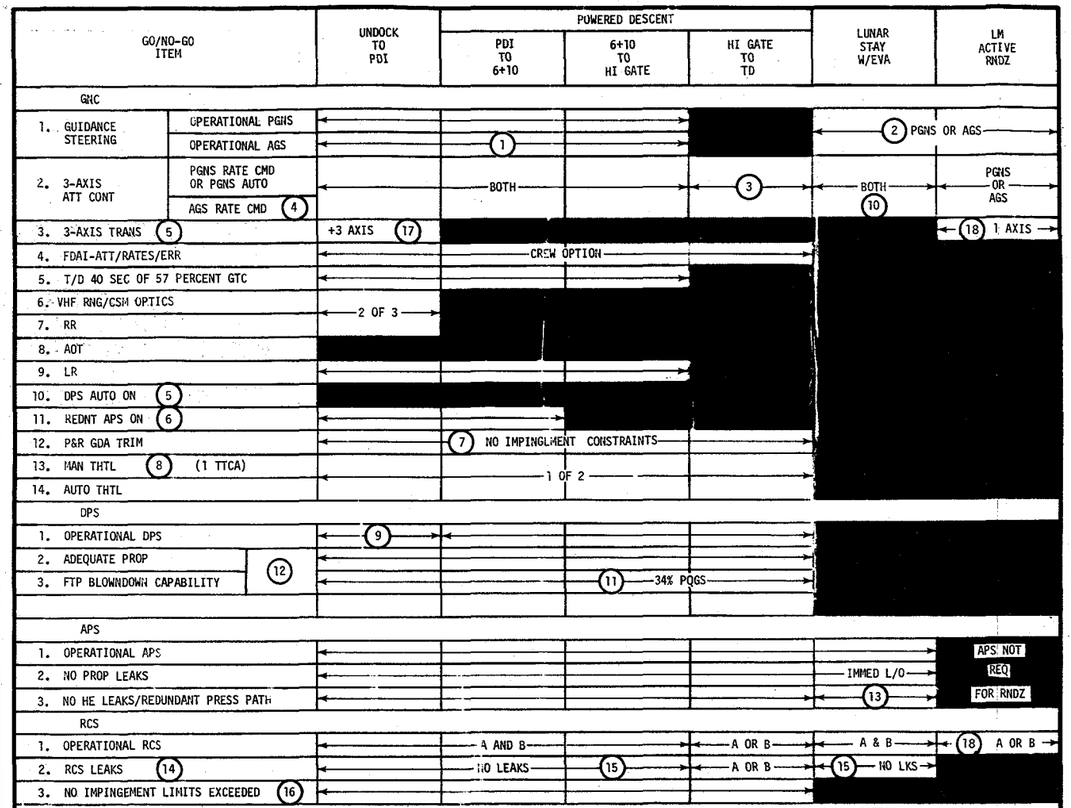
B. FUEL AND/OR OXID MANIFOLD PRESSURES GREATER THAN OR EQUAL TO 100 PSIA.

C. FUEL TEMP GREATER THAN OR EQUAL TO 40° F AND LESS THAN OR EQUAL TO 100° F.

D. QUAD TEMPS GREATER THAN 119° F.

GO/NO-GO CRITERIA

REV



GENERAL NOTES

1. LOSS OF AGS GUIDANCE STEERING IS ACCEPTABLE PROVIDED RDNT 3-AXIS ATT CONT EXISTS
2. LOSS OF PGNS OR AGS GUIDANCE STEERING IS ACCEPTABLE PROVIDED RDNT 3-AXIS CONT EXISTS
3. FOR SINGLE CONTROL MODE, LANDING IS CREW OPTION
4. AGS RATE CMD MAY CONSIST OF 2 AXIS RATE CMD AND ONE DIRECT, I.E. ONE RATE GYRO FAILED
5. NO AUTO ULLAGE PLUS NO AUTO START--PDI NO GO
6. MANUAL IS MANDATORY PLUS EITHER PGNS AUTO OR AGS AUTO
7. GDA WILL BE COMMANDED OFF--ABORT STAGE IF IMPINGEMENT LIMITS VIOLATED
8. WORK-AROUND PROCEDURE EXISTS FOR MAXIMUM THRUST
9. INHIBIT DPS BURNS
10. ASCEND NEXT BEST OPPORTUNITY
11. ABORT STAGE PRIOR TO INLET PRESSURES REACHING 150 PSIA
12. ABORT, THEN ABORT STAGE AT DPS DEPLETION IF:
    A. LOW LEVEL CONFIRMS INSUFFICIENT PROPELLANT TO LAND
    B. Δ BETWEEN FUEL AND OXIDIZER QUANTITY IS GREATER THAN 10 PERCENT
    C. PQGS READING 2 PERCENT AND NO VALID TIME ESTIMATE FROM LOW LEVEL
    D. DPS PROPELLANT MARGIN PREDICTED LESS THAN MINUS 0.2 PERCENT AFTER ENTRY INTO P64 (CONFIRMED BY OTHER CUES)
13. APS HELIUM SOURCE LEAK AFTER PRESSURIZATION REQUIRES IMMEDIATE LIFTOFF
14. IF MANIFOLD PRESSURE LESS THAN 100 PSIA, AND LEAK UPSTREAM OF MAIN SOV, CROSSFEED FROM GOOD SYSTEM
15. CONTINUE MISSION ONLY IF RCS BLOWDOWN CAPABILITY EXISTS TO MEET CONSUMABLE REDLINES
16. ABORT STAGE AS SOON AS POSSIBLE
17. CONTINUE MISSION AFTER CIRC
18. LOSS OF SOME TRANSLATIONAL CAPABILITY REQUIRES HYBRID LM/CSM MANEUVERS DURING DOCKING PHASE

NOTE

1 T_1 NO STAY CONDITIONS:
- APS PROP LEAK
- RCS PROP LEAK (BOTH SYS)

2 T_2 NO STAY CONDITIONS:
- APS PROP LEAK
- RCS LEAK (BOTH SYS)

SPECIFIC RULES

IF NO-GO AT UNDOCKING
DO NOT UNDOCK

IF NO-GO UNDOCKED
NO GO FOR CIRC/DOCK

IF NO-GO AT CIRC OR PRE-PDI
NO GO FOR PDI/DOCK

IF NO-GO DURING POWERED DESCENT
ABORT
ABORT STAGE AT LOSS OF DPS CAPABILITY

IF NO-GO LUNAR STAY
L/O NEXT BEST OPPORTUNITY

IF NO-GO RENDEZVOUS
CSM ACTIVE RENDEZVOUS

MANAGEMENT RULES

REV

GUIDANCE AND CONTROL

1. IMU
   A. IRIG BIAS UPDATES WILL BE ACCOMPLISHED WHEN GYRO DRIFT IS GREATER THAN THE TWO SIGMA DRIFT MEASUREMENT ACCURACY AND UPON CONTROL/GUIDANCE CONCURRENCE. NO UPDATES WILL BE MADE FOR GYRO DRIFTS LESS THAN 0.075 DEG/HR (5 MERU).
   B. THE PGNS WILL BE CONSIDERED NO GO WITH A GYRO DRIFT GREATER THAN OR EQUAL TO ±1.5 DEG/HR (100 MERU). THE MAXIMUM ALLOWABLE VALUE WITHIN THE LGC IS ±1.93 DEG/HR (128 MERU).
   C. PIPA BIAS UPDATES WILL BE ACCOMPLISHED AS FOLLOWS:
      1. NO BIAS UPDATES WILL BE ACCOMPLISHED PRIOR TO 30 MINUTES OF IMU OPERATION.
      2. THE INITIAL BIAS UPDATE WILL NOT BE PERFORMED IF THE Δ BIAS IS LESS THAN ±0.03 CM/SEC/SEC. SUBSEQUENT UPDATES WILL ONLY BE PERFORMED IF THE Δ BIAS IS GREATER THAN ±0.1 CM/SEC/SEC.
   D. IF LOSS OF IMU COOLING OCCURS, TURN-ON/OPERATION TIMES WILL BE DETERMINED BY REAL-TIME FLIGHT PLANNING REQUIREMENTS.
2. RENDEZVOUS RADAR

   THE RR ANTENNA WILL BE POSITIONED AFTER LUNAR T/D TO PRECLUDE REPOSITIONING DUE TO ANTENNA HEATING ON THE LUNAR SURFACE.
3. LANDING RADAR
   A. THE LR SHOULD NOT NORMALLY BE OPERATED AT AN ANTENNA TEMP LESS THAN +50° F; HOWEVER, THE LUNAR LANDING MISSION WILL BE ATTEMPTED IF THE ANTENNA TEMP IS ABOVE THE CRITICAL LIMIT OF -15° F (HARDWARE DAMAGE).
   B. LR ACTIVATION WILL BE DELAYED SO THAT THE PREDICTED LR TEMP WILL BE NO GREATER THAN 145° F AT HI-GATE.
4. AGS
   A. THE AGS IS DECLARED NO GO DURING A GYRO AND ACCELEROMETER CALIBRATION IF THE GYRO DRIFT CHANGE IS GREATER THAN 2.00 DEG/HR AND IF THE ACCELEROMETER BIAS CHANGE IS GREATER THAN 0.039 FT/SEC/SEC FROM THE VALUE AT THE START OF THE CALIBRATION.
   B. IF LOSS OF ASA COOLING OCCURS, TURN ON/OPERATION TIMES WILL BE DETERMINED BY REAL-TIME FLIGHT PLANNING REQUIREMENTS.
5. CES

   LOSS OF INVERTER ONE/AC BUS A REQUIRES A MANUAL ENGINE ON SIGNAL TO MAINTAIN DPS ENGINE ELECTRICAL "ON" REDUNDANCY.

DPS PROPULSION

1. FROM A SAFETY STANDPOINT, SUPERCRITICAL HELIUM BURST DISC RUPTURE DURING MANNED OPERATION IS AN ALLOWABLE EVENT.
2. IF POWERED DESCENT IS ABORTED DURING DPS INSERTION CAPABILITY OR IF A DOCKED DPS CONTINGENCY IS REQUIRED AND PQGS LESS THAN 86 PERCENT, THE DES HELIUM REG 1 AND REG 2 VALVES SHOULD BE CLOSED 10 SECONDS PRIOR TO ENGINE CUTOFF TO PREVENT POSSIBLE FUEL/HELIUM HEAT EXCHANGER FREEZING.
3. THE DPS PRESSURIZATION SYSTEM MAY BE OPENED TO A START TANK LEAK. IF DONE, THE PRIMARY HELIUM REG SOV SHOULD BE CLOSED AFTER EACH BURN AND REOPENED PRIOR TO ANY SUBSEQUENT BURN.
4. THE START TANK SQUIBS WILL NOT BE BLOWN IF A LEAK EXISTS IN THE TANK PRIOR TO PRESSURIZATION UNLESS THE FUEL OR OXIDIZER ENGINE INLET PRESSURES ARE LESS THAN 30 PSIA.
5. 91 SEC AFTER LOW LEVEL THE CREW WILL EVALUATE WHETHER TO LAND OR ABORT. (BINGO CALL WHEN 5 SEC AT FTP OR 20 SEC AT 27.5% REMAINING)

APS PROPULSION

1. ASCENT FEED WILL NOT BE UTILIZED IF AN APS HELIUM/PROPELLANT LEAK OR VALID APS LO-LEVEL EXISTS DURING ANY PHASE OF THE MISSION.
2. OPTIMIZATION OF APS HELIUM (ISOLATION OF LEAKING SOURCE, BLOW DOWN, ETC.) SHOULD BE ACCOMPLISHED IF POSSIBLE FOR HELIUM LEAKS.
3. ONE HELIUM BOTTLE IS CONSIDERED SUFFICIENT TO SUPPLY APS ΔV FOR NON-LANDING ALTERNATE MISSIONS.
4. WITH AN APS PROPELLANT VALVE MISMATCH INDICATION DURING A BURN, FUTURE APS BURNS ARE POSSIBLE ONLY IF THE MISMATCH IS NOT PRESENT FOLLOWING THE BURN.

REACTION CONTROL

1. ASCENT FEED WILL NOT BE UTILIZED IF AN RCS PROPELLANT LEAK EXISTS DOWNSTREAM OF THE MAIN SOV'S.

GO/NO-GO CRITERIA/SPECIFIC RULES

REV

LUNAR SURFACE EVA

1. EMU PRESSURE INTEGRITY

   A. ABLE TO PASS EMU PRESSURE INTEGRITY CHECK (HIGH O_2 FLOW FLAG CLEARS AFTER INITIAL PRESSURIZATION).

   B. PROPER PRESSURE REGULATION [LOST IF REGULATED PRESSURE LESS THAN 3.75 PSID (TM) AND DECREASING ON LUNAR SURFACE].

2. OPERATIONAL PRIMARY OXYGEN SUBSYSTEM (POS)

   A. SOURCE PRESSURE GREATER THAN 220 PSIA OR 5 PERCENT (INDICATOR).

   B. ABLE TO SUPPLY OXYGEN TO OXYGEN VENTILATION LOOP.

   C. PROPER PLSS PRESSURE REGULATION [NOT LESS THAN 3.75 PSID (TM) AND DECREASING OR GREATER THAN 4.05 PSID (TM) AND INCREASING].

3. OPERATIONAL PLSS POWER SUPPLY

   A. PLSS BATTERY VOLTAGE GREATER THAN OR EQUAL TO 16.0 VDC AND STABLE

   B. PLSS BATTERY CURRENT DRAIN GREATER THAN 2.0 AMPS

4. PLSS & BSLSS THERMAL CONTROL CAPABILITY

   LIQUID COOLED GARMENT/LIQUID TRANSPORT LOOP CIRCULATION.

5. PLSS THERMAL CONTROL CAPABILITY

   A. LCG H_2O INLET TEMPERATURE AND SUBLIMATOR O_2 OUTLET TEMPERATURE LESS THAN 50° F AND LCG H_2O ΔT GREATER THAN 5° F WITH DIVERTER VALVE IN MAX POSITION.

   B. FEEDWATER RESERVOIR INTEGRITY AND THE ABILITY TO SUPPLY H_2O TO SUBLIMATOR.

6. VENTILATION CAPABILITY--OPERATIONAL FAN (BAT CURRENT GREATER THAN 2.0 AMPS)

7. CONTAMINATION CONTROL CAPABILITY

   A. VENTILATION CAPABILITY

   B. PLSS CO_2 PARTIAL PRESSURE LESS THAN 15.0 MM OF HG

   C. INSUFFICIENT CONTAMINATION (LIOH AND BY-PRODUCTS) IN THE VENTILATION LOOP TO RESULT IN CREWMAN DISCOMFORT

8. OPERATIONAL OXYGEN PURGE SYSTEM (OPS)

   A. 15 MINUTES HI PURGE CAPABILITY AT THE END OF A PLANNED EVA.

      OPS RESIDUALS ARE:

      1. GREATER THAN 240 PSIA AT HIGH PURGE
      2. GREATER THAN 90 PSIA AT LOW PURGE
      3. GREATER THAN 100 PSIA AT MAKEUP

   B. OPS O_2 REGULATED PRESSURE GREATER THAN 3.4 AND LESS THAN 4.0 PSID, OR OPS O_2 REGULATED PRESSURE DOES NOT GO FROM 4.0 TO 5.0 PSID IN LESS THAN 1 SEC. THE OPS WILL BE CONSIDERED UNACCEPTABLE FOR MAKEUP MODE OPERATIONS IF THE OPS O_2 REGULATED PRESSURE EXCEEDS 4.0 PSID.

   C. PURGE VALVE (REDUNDANT LOCKING PIN NOT REQUIRED)

REV

LUNAR SURFACE EVA (CONTINUED)

9. OPERATIONAL PGA

   MUST PASS EMU INTEGRITY CHECK AND HAVE ALL CONNECTORS LOCKED AND ALL RESTRAINTS CABLES EXCEPT GLOVE OR NECK CABLES INTACT. NOTE ONLY A SINGLE LOCKING MECHANISM IS REQUIRED FOR EACH CONNECTOR.

10. TERMINATE EVA--THE CREW WILL BE ALLOWED SUFFICIENT TIME TO CLOSE OUT THE ACTIVITY IN WHICH THEY ARE ENGAGED (5 TO 10 MINUTES) AND WILL THEN RETURN TO THE LM AND EXPEDITIOUSLY COMPLETE CLOSEOUT ACTIVITIES AS REQUIRED.

11. TERMINATE EVA IMMEDIATELY--THE CREW WILL CEASE THEIR SURFACE ACTIVITIES AND IMMEDIATELY RETURN TO THE LM, INGRESS, AND REPRESSURIZE.

12. CRITICAL INSTRUMENTATION

MEAS DESCRIPTION	PAM FM/FM	ONBOARD	
PGA PRESS GAGE		CUFF GAGE	1 OF 3 M
PGA PRESS	GT8168P/GT8268P		
LOW PGA PRESS TONE		TONE	
LOW VENT FLOW TONE		TONE	1 OF 2 M
PLSS BAT CURRENT	GT8140C/GT8240C		

CMP EVA

1. CMP EMU PRESSURE INTEGRITY

   A. ABLE TO MEET MAX 0.8 PSID/MIN DECAY CRITERIA DURING EMU PRESSURE INTEGRITY CHECK.

   B. CMP EMU REGULATED PRESSURE NOT LESS THAN 3.70 PSID (CREWMAN) AND DECREASING OR GREATER THAN 4.0 PSID (CREWMAN) AND INCREASING DURING CMP EVA.

2. ADEQUATE O_2 FLOW FROM SCU

   CMP EMU O_2 FLOW INTO SUIT GREATER THAN 6.0 LBS/HR (60 TO 65 PSI UMBILICAL PRESS)

3. TERMINATE CMP EVA--THE CREWMAN WILL CEASE PLANNED EVA ACTIVITIES, TRANSFER TO THE CM, INGRESS AND REPRESSURIZE.

4. CRITICAL INSTRUMENTATION

PGA PRESS GAGE LOW PRESS WARNING SWITCH	CUFF GAGE ONBOARD (CMP ONLY)	1 OF 2 M
LOW FLOW WARNING SWITCH CM PRESS GAGE	ONBOARD (CMP ONLY) ONBOARD	1 OF 2 M

REV

LUNAR SURFACE EVA

GO/NO-GO ITEM	IF NO-GO		NOTES
	TERMINATE EVA IMMEDIATELY	TERMINATE EVA	
PROPER VENTILATION	X		①
PLSS POWER	X		②
CONTAMINATION CONTROL	X		①
EMU PRESS INTEGRITY			③
A. PRESS <3.4 PSID	X		
B. 3.4 <PRESS <3.5 PSID		X	
THERMAL CONTROL		X	②
PRIMARY O_2 SUPPLY		X	③④
CRITICAL INSTRUMENTATION		X	
OPERATIONAL OPS		X	
OPERATIONAL PGA		X	

NOTES:
① ACTIVATE OPS: OPEN PGA PURGE VLV -- LOW FLOW.
② ACTIVATE BSLSS AND/OR OPS PURGE AS REQUIRED.
③ ACTIVATE OPS
④ IF EMU REG PRESS GREATER THAN 4.05 PSID, CLOSE POS SHUTOFF VLV AFTER ACTUATING OPS.

CMP EVA

GO/NO-GO ITEM	IF NO-GO	
	TERMINATE EVA ACTIVATE OPS AS REQUIRED	TERMINATE EVA
EMU PRESSURE INTEGRITY	X	
ADEQUATE O_2 FLOW (FROM SCU)	X	
CRITICAL INSTRUMENTATION		X

REV

LUNAR SURFACE EVA

1. THE BSLSS WILL BE CARRIED ON ALL TWO-MAN EVA TRAVERSES.

   IF ITS USE IS REQUIRED, THE TETHER WILL BE ATTACHED FOR ALL OPERATIONS EXCEPT GETTING ON AND OFF THE LRV AND INGRESSING LM. FOR THESE ACTIONS, THE BSLSS WILL BE DISCONNECTED FROM THE CREWMAN WITH THE FAILED PLSS.

2. INTERMITTENT OPS PURGING FOR DECONTAMINATION OR ADDITIONAL COOLING REQUIRES THE PRIMARY O_2 SHUTOFF VALVE BE TURNED OFF FOLLOWING OPS ACTIVATION, BUT PRIOR TO PURGING. THE PURGE VALVE SHOULD BE CLOSED PRIOR TO REOPENING THE PRIMARY O_2 SHUTOFF VALVE AND DEACTIVATION OF THE OPS.

3. CREWMAN MAY ATTEMPT A WET SUBLIMATOR RESTART IF BREAKTHROUGH OCCURS.

4. VACUUM TRANSFERS WILL BE USED ONLY IN SUPPORT OF:

   A. CONTINGENCY INTRAVEHICULAR TRANSFERS OR CONTINGENCY EXTRAVEHICULAR ACTIVITIES

   B. A LM CABIN REPRESS FAILURE

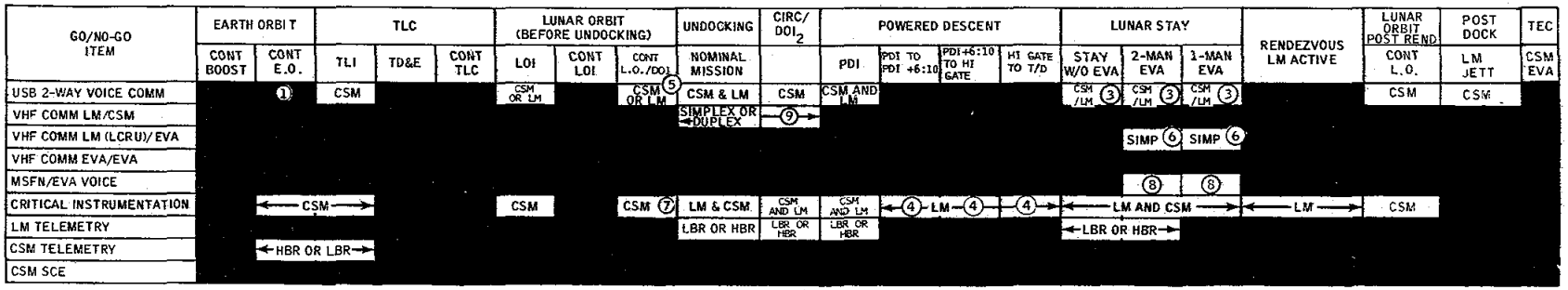
5. AN EMU/LM ECS HYBRID LIFE SUPPORT AND COMM CONFIGURATION IS ACCEPTABLE IF WITHIN SYSTEMS CAPABILITIES AND IF REQUIRED TO PRECLUDE TIMELINE IMPACT.

6. BOTH PLSS'S AND OPS'S WILL BE RETAINED UNTIL TWO LIFE SUPPORT UNITS (2 OPS, 2 PLSS, OR 1 PLSS + 1 OPS) HAVE BEEN VERIFIED TO HAVE SUFFICIENT CONSUMABLES TO SUPPORT CONTINGENCY EXTRAVEHICULAR ACTIVITIES.

7. THE LM WILL NOT BE PRESSURIZED WITH A CREWMAN ON THE LUNAR SURFACE.

8. FOR THE 2 MAN EVA, THE CDR WILL ALWAYS EGRESS FIRST AND INGRESS LAST UNLESS THE CDR HAS INITIATED AN OPS PURGE. THIS WILL ENSURE THAT THE CDR IS IN THE LEFT PILOT POSITION SHOULD ASCENT BE REQUIRED WITHOUT AN OPPORTUNITY TO DOFF THE EMU'S.

COMMUNICATIONS/INSTRUMENTATION GO CRITERIA
9/1/72



(1) VHF IS ACCEPTABLE
(2) RESERVED
(3) LM RELAY TO CSM IS ACCEPTABLE
(4) ADQUATE DATA TO MAKE FINAL GO/NO-GO TO CONTINUE POWERED DESCENT (TM OR ONBOARD DISPLAY)
(5) CSM AND LM COMM IS REQUIRED FOR DOI
(6) IF LM PROBLEM IS DEFINED, CONTINUE EVA PREP AND ACTIVATE LCRU ASAP
(7) CSM AND LM CRITICAL INST REQUIRED FOR DOI
(8) VOICE UPLINK TO EITHER CREWMAN, VOICE DOWNLINK FROM ONE CREWMAN OR TV
(9) VOICE CONFIRMATION OF CIRC MNVR IS MANDATORY FOR DOI 2

LEGEND: NO REQUIREMENT

SPECIFIC MISSION RULES

REV

PANORAMIC CAMERA

CONDITION/MALFUNCTION		TLC	LUNAR ORBIT
1. SIM TEMP SL1211T ≤ 45° OR ≥ 105° F (1) (2)		TURN 64K BIT DATA SYSTEM ON AND APPLY POWER TO THE CAMERA	
2. FORWARD LENS TEMP (SL1040T)	NONOPERATE ≤ 45° F	LEAVE HEATERS ENABLED	
	NONOPERATE ≥ 120° F (14)	DISABLE HEATERS. GO TO COLD SOAK	
	OPERATE ≤ 75° F		LEAVE HEATERS ENABLED
	OPERATE ≥ 105° F		TERMINATE PHOTO PASS (3)
3. CAPPING SHUTTER FAILS OPEN OR CLOSED			CONTINUE OPERATION (4)
4. TEST CYCLE FAILS		OPER CAMERA FOR 1 MIN	
5. STEREO MODE FAILS			OPER CAMERA IN MONO MODE
6. TB REMAINS GREY AT TURN-ON			CYCLE OPER/STBY SWITCH TO STBY FOR 30 SEC THEN BACK TO OPERATE. REMAIN IN OPERATE FOR GROUND ANALYSIS
7. TB - BP DURING OPERATE (5)		CYCLE OPER/STBY SWITCH TO STBY FOR 30 SEC THEN BACK TO OPERATE. IF TB RETURNS TO TB - BP, GO TO STBY AND WAIT FOR GROUND ANALYSIS	
8. FORWARD MOTION COMPENSATION FAILS			CONTINUE OPERATION
9. LOSS OF DOWNLINK DATA		CONTINUE OPERATION	

MAPPING CAMERA

CONDITION/MALFUNCTION		TLC	LUNAR ORBIT
1. SIM TEMP SL1217T ≤ 40° F OR ≥ 105° F (2)		TURN 64K BIT DATA SYSTEM ON AND APPLY POWER TO THE CAMERA	
2. FORWARD LENS TEMP (SL1060T)	NONOPERATE ≤ 40° F	REMAIN IN STBY	
	NONOPERATE ≥ 100° F	TURN CAMERA OFF	
	OPERATE ≥ 90° F		TERMINATE PHOTO PASS
3. TB - BP (6)		CONFIGURE FOR STBY MODE AND WAIT FOR GROUND ANALYSIS	
4. FORWARD MOTION COMPENSATION FAILS		CONTINUE OPERATION	
5. DEPLOYMENT MECHANISM FAILS (7)	RETRACTED		CONTINUE OPERATION (8)
	EXTENDED	INHIBIT SM RCS JETS A_2, A_4, B_1, B_4 (13)	
6. LOSS OF DOWNLINK DATA		CONTINUE OPERATION	

LASER ALTIMETER

CONDITION/MALFUNCTION		TLC	LUNAR ORBIT
1. SIM TEMP SL1217T ≤ -30° F OR ≥ 150° F (2)		SCHEDULE SIM BAY HOT/COLD SOAK AS REQUIRED	
2. CAVITY TEMP SL1094T	< - 10° F		LEAVE LASER ALTIMETER POWERED
	>131° F AND INTERMITTENT RANGE READOUT OR >160° F		POWER DOWN LASER
3. LOSS OF AUTO MODE			LIMIT OPER TO NOMINAL CAMERA MODE SEQUENCES
4. LOSS OF VALID RANGE DATA IN CAMERA MODE			LIMIT OPER TO NOMINAL AUTO MODE SEQUENCES
5. PFN VOLTAGE >2900V			POWER DOWN LASER
6. LOSS OF DOWNLINK DATA			LIMIT OPER TO NOMINAL CAMERA MODE SEQUENCES

MC/LA DOOR

CONDITION/MALFUNCTION		TLC	LUNAR ORBIT
1. FAILS (10)	CLOSED		OPERATE CAMERA TO OBTAIN BASELINE ENGINEERING DATA AND THEN POWER DOWN (9)
	OPEN		MINIMIZE AND DELAY AS LONG AS POSSIBLE ANY URINE DUMPS, H_2O DUMPS, FUEL CELL PURGES AND UNDESIRABLE THRUSTER ACTIVATIONS

GN_2

CONDITION/MALFUNCTION		TLC	LUNAR ORBIT
1. EXCESSIVE GN_2 USAGE	MECHANICAL FAILURE		SCHEDULE PC OPERATION TO EXHAUST FILM PRIOR TO GN_2 DEPLETION (11)
	ELECTRICAL FAILURE		RESTRICT PC OPERATION TO HIGHEST PRIORITY TARGETS WITHIN GN_2 REMAINING
2. GN_2 DEPLETED			OPER MAPPING CAMERA AND ATTEMPT OPER OF PAN CAMERA (12)

NOTES

REV

(1) AFTER FILM ADVANCE AVERAGE EITHER 1201T, 1204T, OR 1206T WITH 1211T. ΔT 5° F

(2) THIS RULE ONLY APPLICABLE PRE SIM DOOR JETT

(3) SEE OPTICS MGMT RULE 11

(4) INSUFFICIENT DATA TO DISTINGUISH BETWEEN A FAILED CAPPING SHUTTER AND A FAILED T/M POINT

(5) A NO-GO INDICATION WILL BE RECEIVED IF ANY OF THE FOLLOWING CONDITIONS ARE SENSED:

A. STEREO MALFUNCTION
B. FILM PATH FAILURE
C. CAPPING SHUTTER NOT ACTIVATED
D. LENS ROTATION SIGNAL LOST
E. OUT OF FILM SIGNAL

(6) A NO-GO INDICATION WILL BE RECEIVED IF ANY ONE OF THE FOLLOWING PARAMETERS IS IN THE IMPROPER STATE:

A. MC FRONT LENS TEMP
B. STELLAR CAMERA FRONT ELEMENT TEMP
C. SUPPLY CASSETTE TEMP

(7) REFERENCE MALFUNCTION PROCEDURE X.X.

(8) THIS RULE ALSO APPLICABLE TO THE TEC PHASE

(9) CONSIDERATION WILL BE GIVEN TO OPENING THE DOOR DURING THE TEC EVA

(10) REFERENCE MALFUNCTION PROCEDURE X.X.

(11) CUE:

FOR MECHANICAL FAILURE, SL1031X READS "ON" CONTINUOUSLY EVEN WHEN PC IS IN STBY. GN_2 WILL BE SUPPLIED TO THE AIR BARS CONTINUOUSLY AT A MAX FLOW RATE OF 1.55 LB/HR. GN_2 WOULD BE DEPLETED IN 6.09 HOURS. FOR ELECTRICAL FAILURE, SL1031X READS "ON" CONTINUOUSLY BUT ONLY DURING PC OPERATION.

(12) CUE:

SL1031X READS "OFF" CONTINUOUSLY DURING PC OPERATION. PC FILM MAY JAM IF GN_2 IS NOT SUPPLIED TO AIR BARS

(13) B4 WILL BE ENABLED FOR TRANSLATION MANEUVERS, FOR RESCUE CAPABILITY DURING LM DESCENT AND LM ASCENT AND FROM 8 HOURS BEFORE MCC-7 TO ENTRY INTERFACE TO PROVIDE COUPLED ATTITUDE CONTROL WHEN FORWARD FIRING RCS THRUSTERS ARE REQUIRED.

(14) PRIOR TO SIM DOOR JET, THE UPPER NONOPERATING LIMIT IS 100° F.

REV

GENERAL

1. PRIOR TO SIM DOOR JETTISON THE SIM EXPERIMENTS AND SCIENTIFIC DATA SYSTEM (SDS) WILL BE POWERED AS REQUIRED TO SUPPORT THE FOLLOWING FUNCTIONS:

   A. THERMAL MONITORING AND THERMAL MANAGEMENT OF THE SIM BAY.

   B. PERIODIC ADVANCEMENT OF THE PANORAMIC AND MAPPING CAMERA FILM.

2. RESCHEDULING OF EXPERIMENT OPERATION IF REQUIRED DUE TO EXCESSIVE CONSUMABLES USAGE (RCS, PWR, ETC.) OR ANOMALOUS EXPERIMENT OPERATION WILL BE ACCOMPLISHED WITHIN THE GUIDELINES OF THE EXPERIMENT PRIORITIES.

3. LUNAR ORBIT SIM BAY EXPERIMENTS ARE LISTED BELOW IN THEIR ORDER OF PRIORITY.

   A. LUNAR SOUNDER

   B. SM ORBITAL PHOTOGRAPHIC TASKS

   C. IR SCANNING RADIOMETER (ISR)

   D. FAR UV SPECTROMETER (UVS)

4. IF CORONA IS DETECTED IN AN EXPERIMENT AND IS DEGRADING ONLY THAT EXPERIMENT, THAT EXPERIMENT'S OPERATION WILL NOT BE TERMINATED FOR THE MISSION BUT MAY BE RESCHEDULED TO MAXIMIZE THE SCIENTIFIC RETURN.

5. ALL EXPERIMENT COVERS WILL NORMALLY BE CLOSED FOR THE FOLLOWING CONDITIONS AFTER SIM DOOR JETTISON:

   A. ACTIVATION OF SM RCS JETTS A2, A4, B1, or B4

   B. SPS BURNS

   C. WATER AND URINE DUMPS*

   D. FUEL CELL PURGES*

   E. VIOLATION OF THE SUN-AVOIDANCE CONSTRAINTS

   F. CSM EVAPORATOR OR LM SUBLIMATOR OPERATION*

   *N/A TO UVS COVER AFTER 2 DAYS IN-CIRCULAR LUNAR ORBIT.

6. SM RCS THRUSTERS A2, A4, B1, AND B4 WILL BE DISABLED DURING ALL EXPERIMENT OPERATIONS.

7. WATER AND URINE DUMPS WILL BE INHIBITED FROM 3 HOURS BEFORE UNTIL IMMEDIATELY AFTER PC AND MC OPERATIONS.

8. A FAILURE OF ANY EXPERIMENT COVER OR EXTENSION MECHANISM WILL NOT PRECLUDE AN EVA FOR FILM RETRIEVAL.

9. THERE ARE THREE ACCEPTABLE CUES ON ANTENNA POSITION. THESE ARE THE APPROPRIATE TALKBACK INDICATOR, VISUAL VERIFICATION FROM AN UNDOCKED LM, AND THE ANTENNA SAFE SIGNAL ON TELEMETRY. ANY ANTENNA THAT CANNOT BE VERIFIED AS RETRACTED BY ONE OF THESE MEANS WILL BE ASSUMED TO BE EXTENDED BEYOND THE SPS BURN LIMIT.

10. SIM BAY HARDWARE REDLINES WILL NOT BE VIOLATED IN THE PURSUIT OF SCIENCE DATA UNLESS THE DATA BEING COLLECTED IS JUDGED TO BE MORE IMPORTANT THAN ALL SUBSEQUENT DATA.

11. A "NO-GO" FOR LOI WILL NOT PRECLUDE SIM BAY DOOR JETTISON.

12. AN ATTITUDE DEADBAND OF 0.5 DEGREES WILL BE USED DURING THE FOLLOWING OPERATIONS:

   A. ALL CAMERA OPERATIONS

   B. MANDATORY LASER ALTIMETER OPERATION

   C. HF AND VHF ACTIVE SOUNDING MODES

   D. UVS INERTIAL ATTITUDE HOLD TARGETS

   A DEADBAND OF 3.0 DEGREES MAXIMUM WILL BE USED FOR ALL OTHER EXPERIMENT OPERATION.

REV

OPTICS MANAGEMENT

1. THE FILM IN THE PANORAMIC AND MAPPING CAMERAS (PC AND MC) WILL BE CYCLED AT INTERVALS OF 24 ± 6 HOURS. THE CAMERAS AND SDS SYSTEM WILL BE ACTIVATED TO MONITOR THESE FUNCTIONS.

2. DURING ALL SPS POWERED FLIGHT PHASES, THE PC WILL BE PLACED IN THE "BOOST" MODE AND THE MC IN THE "STANDBY" MODE WITH IMAGE MTN "OFF".

3. THE PC LENS STOW POSITION WILL BE VERIFIED PRIOR TO SIM DOOR JETTISON AND PRIOR TO INITIATING THERMAL PRECONDITIONING OF THE PC. ADDITIONAL STOW VERIFICATION WILL BE SCHEDULED AS REQUIRED.

4. A PC PHOTO SEQUENCE WILL NOT EXCEED 30 MINUTES.

5. THE PC HEATERS WILL BE ENABLED PRIOR TO THE FIRST CAMERA OPERATION TO ALLOW FOR THERMAL STABILIZATION. THE PC HEATERS WILL REMAIN ENABLED BETWEEN PHOTO PASSES.

6. THE MC WILL BE PLACED IN "STANDBY" PRIOR TO THE FIRST CAMERA OPERATION TO ALLOW FOR THERMAL STABILIZATION. THE MC WILL REMAIN IN STBY BETWEEN PHOTO PASSES.

7. IN THE EVENT OF EXCESSIVE GN_2 USAGE, THE OPERATION OF ONE CAMERA WILL NOT BE TERMINATED TO SAVE GN2 FOR THE OTHER CAMERA.

8. TOTAL FAILURE OF THE GN_2 SYSTEM WILL NOT PRECLUDE ATTEMPTS TO OPERATE THE MC AND PC.

9. THE IMAGE MOTION RATE ON THE MC WILL BE ADJUSTED TO MINIMUM ERROR FOR THE ORBIT OF OPERATION.

10. THE PC PHOTO SEQUENCES LISTED BELOW AND ALL PC PHOTOGRAPHY WITHIN ±10° OF THE SUBSOLAR POINT WILL BE TERMINATED FOR A PC FWD LENS TEMP GREATER THAN 112° F. ALL OTHER PC PHOTO SEQUENCES WILL BE TERMINATED FOR A PC FWD LENS TEMP GREATER THAN 105° F.

REV NO.	START DEG LONG.	STOP DEG LONG.
TBD	TBD	TBD

11. LA OPERATION WILL NOT BE ATTEMPTED WITH THE MC/LA DOOR CLOSED.

12. IF EXCESSIVE TRAVEL TIMES ARE DETECTED DURING MC/LA POSITIONING, SUBSEQUENT CYCLES FOR CONTAMINATION PROTECTION WILL BE DELETED.

13. IF THE LASER ALTIMETER LIFETIME IS JUDGED TO BE SHORTER THAN THE REMAINING MISSION REQUIREMENT, THE LA OPERATING PROFILE WILL BE REDUCED TO INSURE COVERAGE OF PRIORITY OBJECTIVES.

SPECIFIC MISSION RULES

REV

FAR ULTRAVIOLET SPECTROMETER

CONDITION/MALFUNCTION		TLC	LUNAR ORBIT/TEC
1. SIM TEMP SL12XX (1)	<TBD° F	APPLY POWER TO SPECTROMETER	
	>TBD° F	GO TO COLD SOAK ATTITUDE	
2. SPECTROMETER TEMPS SL1101T OR SL1102T	<- 35° F	LEAVE SPECTROMETER POWERED	
	>180° F	POWER DOWN SPECTROMETER (2)	
3. CORONA IN THE UVS		TURN OFF SPECTROMETER	ENHANCE OPERATING ENVIRONMENT
4. SUN APPROACHING FIELD-OF-VIEW			CLOSE SPECTROMETER COVER
5. COVER FAILS	CLOSED		OPERATE TO OBTAIN ENGINEERING DATA
	OPEN		MINIMIZE DUMPS, PURGES, AND JET FIRINGS

INFRARED SCANNING RADIOMETER

CONDITION/MALFUNCTION		TLC	LUNAR ORBIT/TEC
1. SIM TEMP SLXXXXT (1)	<TBD° F	APPLY POWER TO RADIOMETER	
	>TBD° F	GO TO COLD SOAK ATTITUDE	
2. PRIMARY MIRROR TEMP SL1129T	<15° F	LEAVE RADIOMETER POWERED	
	>122° F	POWER DOWN RADIOMETER (3)	
3. SUN APPROACHING FIELD-OF-VIEW			CLOSE RADIOMETER COVER
4. COVER FAILS	CLOSED		OPERATE TO OBTAIN ENGINEERING DATA
	OPEN		MINIMIZE DUMPS, PURGES, AND JET FIRINGS

LUNAR SOUNDER

CONDITION/MALFUNCTION		TLC	LUNAR ORBIT/TEC
1. SIM TEMP SL1206 (1)	<TBD° F	APPLY STBY PWR TO CSAR AND OPTICAL RECORDER	
	>TBD° F	GO TO COLD SOAK ATTITUDE	
2. FILM CASSETTE TEMP SL1275T	<TBD° F	ENABLE OPTICAL RECORDER HTRS	
	>TBD° F	GO TO COLD SOAK ATTITUDE	REMOVE PWR FROM OPTICAL RECORDER HTRS (4)
3. CSAR INTERNAL TEMP SL1256T	<TBD° F	APPLY STBY PWR TO CSAR	
	>TBD° F	GO TO COLD SOAK ATTITUDE	REMOVE PWR FROM CSAR
4. FILM MOTION FAILURE			TERMINATE ACTIVE SOUNDER OPERATIONS (5)
5. LOSS OF PRF-1 AND PRF-2			TERMINATE SOUNDER OPERATION IN THE HF MODE
6. LOSS OF PRF-3			TERMINATE SOUNDER OPERATION IN THE VHF MODE
7. CLOCK FAILURE			TERMINATE ACTIVE SOUNDER OPERATION (5)
8. LOSS OF OSC FREQ LOCK			TERMINATE ACTIVE SOUNDER OPERATION (5)
9. LOSS OF VIDEO			TERMINATE ACTIVE SOUNDER OPERATION (5)
10. HF RF PWR OUTPUT <TBD			TERMINATE SOUNDER OPERATION IN HF MODE
11. VHF RF PWR OUTPUT <TBD			TERMINATE SOUNDER OPERATION IN VHF MODE
12. EMI INTO LS ISOLATED TO	HGA		RESCHEDULE VHF OPERATIONS
	HBR TM		PERFORM FLIGHT PLAN ON LBR

HF ANTENNAS

CONDITION/MALFUNCTION	TLC	LUNAR ORBIT/TEC
1. FAILURE TO FULLY EXTEND	OPERATE IN DEGRADED MODE	
2. FAILURE TO RETRACT SAFE DISTANCE	JETTISON PRIOR TO NEXT SPS BURN	

REV

NOTES

(1) THIS RULE ONLY APPLIES TO PRE SIM DOOR JETTISON PHASE

(2) THE SPECTROMETER WILL BE POWERED DOWN IF THE TEMPS GET ABOVE 125° F AND VALID DATA IS NOT BEING COLLECTED.

(3) THE RADIOMETER WILL BE POWERED DOWN IF THE TEMPS GET ABOVE 100° F AND VALID DATA IS NOT BEING COLLECTED.

(4) IF TEMP CONTINUES TO INCREASE, COLD SOAK WILL BE REQUIRED.

(5) OPERATING MODE WILL BE LIMITED TO RECEIVE-ONLY MODE.

REV

GENERAL

1. PRIOR TO SIM DOOR JETTISON THE SIM EXPERIMENTS AND SCIENTIFIC DATA SYSTEM (SDS) WILL BE POWERED AS REQUIRED TO SUPPORT THE FOLLOWING FUNCTIONS:
   A. THERMAL MONITORING AND THERMAL MANAGEMENT OF THE SIM BAY.
   B. PERIODIC ADVANCEMENT OF THE PANORAMIC AND MAPPING CAMERA FILM.
2. RESCHEDULING OF EXPERIMENT OPERATION IF REQUIRED DUE TO EXCESSIVE CONSUMABLES USAGE (RCS, PWR, ETC.) OR ANOMALOUS EXPERIMENT OPERATION WILL BE ACCOMPLISHED WITHIN THE GUIDELINES OF THE EXPERIMENT PRIORITIES.
3. LUNAR ORBIT SIM BAY EXPERIMENTS ARE LISTED BELOW IN THEIR ORDER OF PRIORITY.
   A. LUNAR SOUNDER
   B. SM ORBITAL PHOTOGRAPHIC TASKS
   C. IR SCANNING RADIOMETER (ISR)
   D. FAR UV SPECTROMETER (UVS)
4. IF CORONA IS DETECTED IN AN EXPERIMENT AND IS DEGRADING ONLY THAT EXPERIMENT, THAT EXPERIMENT'S OPERATION WILL NOT BE TERMINATED FOR THE MISSION BUT MAY BE RESCHEDULED TO MAXIMIZE THE SCIENTIFIC RETURN.
5. ALL EXPERIMENT COVERS WILL NORMALLY BE CLOSED FOR THE FOLLOWING CONDITIONS AFTER SIM DOOR JETTISON:
   A. ACTIVATION OF SM RCS JETS A2, A4, B1, OR B4
   B. SPS BURNS
   C. WATER AND URINE DUMPS*
   D. FUEL CELL PURGES*
   E. VIOLATION OF THE SUN-AVOIDANCE CONSTRAINTS
   F. CSM EVAPORATOR OR LM SUBLIMATOR OPERATION*
   *N/A TO UVS COVER AFTER 2 DAYS IN CIRCULAR LUNAR ORBIT.
6. SM RCS THRUSTERS A2, A4, B1, AND B4 WILL BE DISABLED DURING ALL EXPERIMENT OPERATIONS.
7. WATER AND URINE DUMPS WILL BE INHIBITED FROM 3 HOURS BEFORE UNTIL IMMEDIATELY AFTER PC AND MC OPERATIONS.
8. A FAILURE OF ANY EXPERIMENT COVER OR EXTENSION MECHANISM WILL NOT PRECLUDE AN EVA FOR FILM RETRIEVAL.
9. THERE ARE THREE ACCEPTABLE CUES ON ANTENNA POSITION. THESE ARE THE APPROPRIATE TALKBACK INDICATOR, VISUAL VERIFICATION FROM AN UNDOCKED LM, AND THE ANTENNA SAFE SIGNAL ON TELEMETRY. ANY ANTENNA THAT CANNOT BE VERIFIED AS RETRACTED BY ONE OF THESE MEANS WILL BE ASSUMED TO BE EXTENDED BEYOND THE SPS BURN LIMIT.
10. SIM BAY HARDWARE REDLINES WILL NOT BE VIOLATED IN THE PURSUIT OF SCIENCE DATA UNLESS THE DATA BEING COLLECTED IS JUDGED TO BE MORE IMPORTANT THAN ALL SUBSEQUENT DATA.
11. A "NO-GO" FOR LOI WILL NOT PRECLUDE SIM BAY DOOR JETTISON.
12. AN ATTITUDE DEADBAND OF 0.5° WILL BE USED DURING THE FOLLOWING OPERATIONS:
    A. ALL CAMERA OPERATIONS
    B. MANDATORY LASER ALTIMETER OPERATION
    C. HF AND VHF ACTIVE SOUNDING MODES
    D. UVS INERTIAL ATTITUDE HOLD TARGETS

    A DEADBAND OF 3.0 DEGREES MAXIMUM WILL BE USED FOR ALL OTHER EXPERIMENT OPERATION.

REV

FAR UV SPECTROMETER MANAGEMENT

1. UNTIL THE COMPLETION OF TWO DAYS IN CIRCULAR ORBIT, THE EXPERIMENT COVER WILL BE CLOSED FOR DUMPS AND PURGES. DUMPS AND PURGES WILL NOT BE SCHEDULED WITHIN 15 MINUTES OF THE START OF A DATA TAKE.
2. THE EXPERIMENT COVER WILL BE CLOSED FOR THE ACTIVATION OF RCS JETS A2, A4, B1 AND B4 OR WHENEVER THE SUN ENTERS THE SPECTROMETER FOV.

INFARED SCANNING RADIOMETER

1. THE EXPERIMENT COVER WILL REMAIN CLOSED FOR TBD MINUTES FOLLOWING A DUMP OR PURGE.
2. THE ISR SCAN DRIVE MOTOR WILL BE POWERED FOR SIM DOOR JETT.

LUNAR SOUNDER

1. A MINIMUM OF 2 MINUTES OF HBR/HF MODE DATA WILL BE COLLECTED BEFORE AND AFTER THE 2 REV HF ACTIVE MODE.
2. SIM BAY JET CONFIGURATION WILL BE INITIATED A MINIMUM OF 30 MINUTES PRIOR TO OPTICAL RECORDER OPERATION.
3. THE SOUNDER RDR AND OPTICAL RCDR WILL BE THERMALLY PRECONDITIONED PRIOR TO DATA COLLECTION.
4. ALL OTHER SIM BAY EXPERIMENTS AND THE SDS WILL BE POWERED DOWN DURING SOUNDER OPERATIONS.
5. THE HGA WILL BE POWERED DOWN DURING THE HF AND RECEIVE ONLY MODES.
6. THE LS TRANSMITTERS WILL NOT BE OPERATED WITHIN 100 FEET OF AN UNSTAGED L/M.
7. FAILURE OF THE HF ANTENNAS TO FULLY EXTEND WILL NOT PRECLUDE SOUNDER OPERATION IN THE HF AND LISTEN MODES.
8. THE OPTICAL RECORDER FILM WILL NOT BE TRANSPORTED WITH LESS THAN 10 FEET OF FILM REMAINING.
9. A CSM CONFIGURATION WILL BE ESTABLISHED FOR THE EMI TEST AND LS OPERATION. NO CONFIGURATION CHANGES WILL BE MADE TO RESOLVE EMI EXCEPT FOR POSSIBLE DOWNGRADING OF THE TELECOMMUNICATIONS SYSTEMS.

R	ITEM

CONSUMABLES

3-90 SPS (APOLLO 16 DATA)

A. THE SPS REDLINE WILL GUARANTEE SUFFICIENT PROPELLANT TO ACHIEVE A NOMINAL LUNAR ORBIT, LANDING, LM RESCUE AND A SAFE RETURN TO EARTH. VIOLATION OF THE SPS REDLINE WILL REQUIRE MNVR TRADE-OFFS AS SHOWN IN FMR 5-34. THE SPS REDLINE INCLUDES:

LOI	24184	LBS	2807	FPS	
DOI	1522	LBS	206	FPS	
CIRC	370	LBS	100	FPS	
LOPC 1	576	LBS	159	FPS	
RESCUE	1108	LBS	300	FPS	
TEI	9542	LBS	3212	FPS	(NOMINAL RETURN, 67 HRS)
TEC MCC	415	LBS	160	FPS	(3 SIGMA SCS C/O ON TEI)
UNUSABLE	400	LBS	0	FPS	

B. THE MINIMUM SPS REQUIREMENTS FOR A LUNAR ORBIT MISSION ARE BASED ON A MINIMUM SOLO MISSION. THE SEQUENCE OF MANEUVERS WOULD BE LOI 1 (60 X 170), LOI 2 (60 X 60), TEI AND TEMC'S. THE FOLLOWING NUMBERS REPRESENT MINIMUMS WITHOUT RESPECT TO TRAJECTORIES OR OTHER VARIABLES AND SHOULD BE USED AS BASELINE DATA ONLY.

LOI 1	11267	LBS	2775	FPS
LOI 2	539	LBS	150	FPS
TEI	8108	LBS	2650	FPS
TEMC'S	1318	LBS	500	FPS
UNUSABLE	400	LBS	0	FPS

3-91 SM RCS (APOLLO 16 DATA)

A. THE SM RCS REDLINE INCLUDES:

1. NOMINAL USAGE FROM LAUNCH THRU TD&E (75 LBS)
2. POST TD&E TO MCC-2. INCLUDES ALLOWANCE FOR ONE PTC, MANEUVER, TRIM & DAMPING FOR MCC-2. (26 LBS)
3. MCC-2 TO MCC-4. INCLUDES ALLOWANCE FOR TWO PTC'S, MANEUVER, TRIM AND DAMPING FOR MCC-4. (25 LBS)
4. MCC-4 THRU LM UNDOCKING NOMINAL USAGE (174 LBS)
5. CSM SOLO ATTITUDE HOLD FROM POST UNDOCKING THRU LM LIFT-OFF. INCLUDES ULLAGES AND TRIMS FOR CIRC AND PC-1. NO ALLOWANCE FOR SOLO EXPERIMENTS OR PHOTOGRAPHY THAT REQUIRES ADDITIONAL PROPELLANT (117 LBS)
6. NOMINAL BUDGETED USAGE FROM LM LIFT-OFF TO DOCKING. ALSO INCLUDED ARE FOUR 10 SECOND 4 JET ULLAGES, 1 FPS TRIMS AND CSM ACTIVE BRAKING, LM JETTISION AND SEPARATION (349 LBS)
7. TWO REVS ATTITUDE HOLD PLUS TEI. INCLUDES ALLOWANCE FOR ONE P52, ULLAGE AND DAMPING (30 LBS)
8. SEVEN FPS MCC (1 SIGMA G&N TEI CUTOFF) (22 LBS)
9. PTC ALLOWANCE (20 LBS)
10. NOMINAL USAGE FROM MCC 7 TO CM/SM SEP (39 LBS)

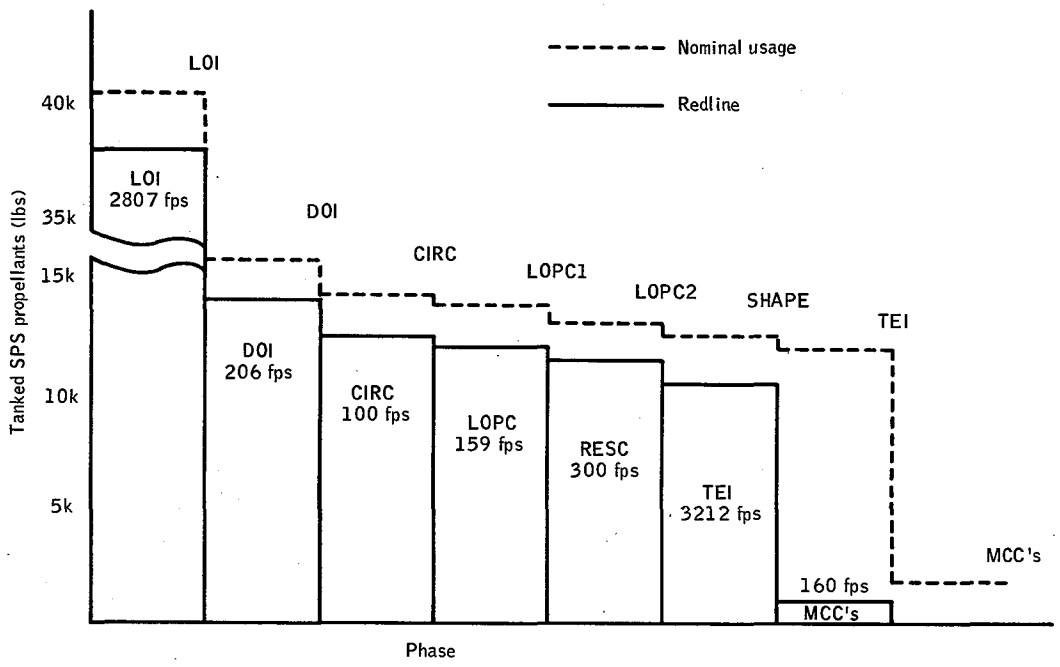
B. THE LUNAR ORBIT REDLINE REPRESENTS THE MINIMUM SMRCS PROPELLANT REQUIRED TO LEAVE LUNAR ORBIT AND PROVIDE A NOMINAL TRANSEARTH RETURN. VIOLATION OF THE LUNAR ORBIT REDLINE WILL RESULT IN TERMINATION OF LUNAR ORBIT ACTIVITIES. THE LO REDLINE INCLUDES:

110 LBS	2 REVS LO, TEI ULLAGE AND DAMPING, NOMINAL TEC BUDGET.
64 LBS	20 FPS MCC (3 SIGMA G&N TEI CUTOFF)
174 LBS	TOTAL

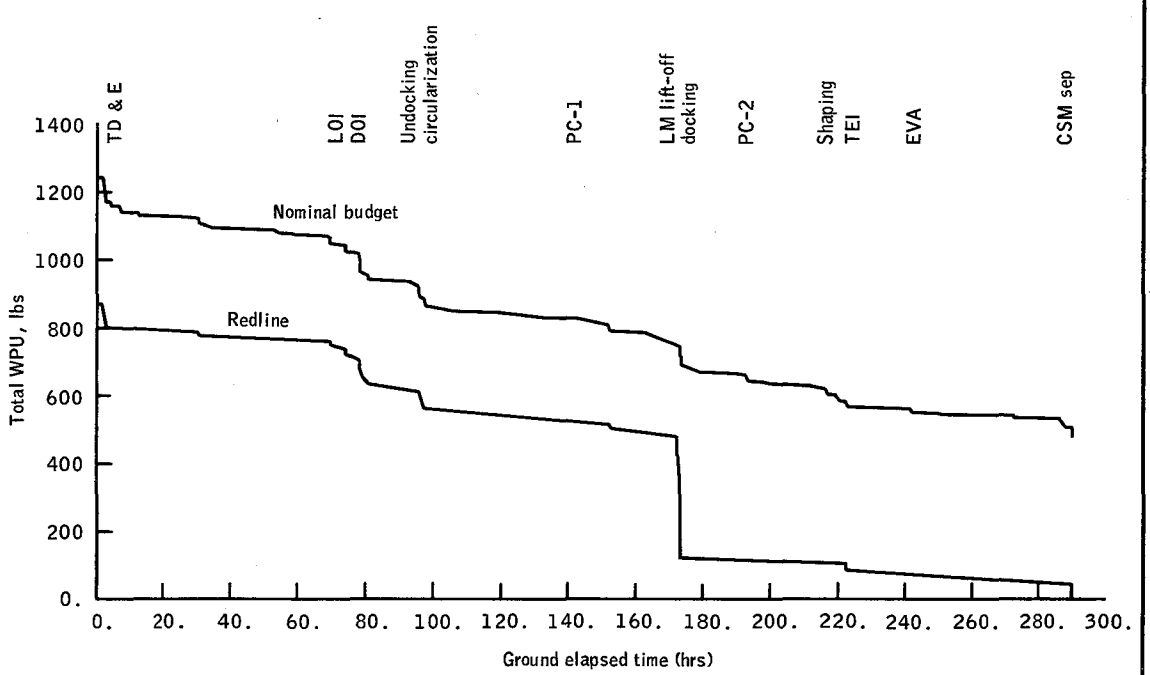
RULE NUMBERS 3-92 THROUGH 3-100 ARE RESERVED.

R	ITEM

Apollo 16 SPS propellant budget



Apollo 16 SM RCS propellant budget



	MISSION	REV	DATE	SECTION	GROUP	PAGE	
	APOLLO 17	FNL	9/1/72	MISSION RULE SUMMARY	CONSUMABLES	3-34	Tape 12.2

R	ITEM
	3-101

CSM BATTERY ENERGY AND CRYOGENIC O_2 AND H_2 (APOLLO 16 DATA)

THE FOLLOWING MINIMUM USABLE ENERGY/QUANTITIES MUST BE AVAILABLE TO INITIATE THE SPECIFIC PHASES.

		LAUNCH	LOI	UNDOCK	LOPC		SHAPE MNVR
					1	2	
BAT AMP-HOURS REMAINING	3 BAT	90.8 ①	80.8	72.7	68.4	64.6	58.2
	2 BAT	56.1	47.1	43.4	42.2	41.0	38.1
O_2 TOTAL LBS	3 TANKS	782	631	584	477	398	352
H_2 TOTAL LBS	3 TANKS	64.9	50.3	45.7	33.4	24.5	18.9

① ENERGY REQUIREMENT TO PERFORM NOMINAL MISSION WITHOUT CHARGER. REDLINE DOES NOT ALLOW PRE-LOI GIMBAL DRIVE CHECK OR BACKUP SPS BURN PREPS AND REQUIRES POWER DOWN OF ECS RADIATOR HEATERS OVERLOAD SENSING.

NOTES

(A) PRELAUNCH BATTERY REDLINES ARE BASED ON FAILURE OF THE BATTERY CHARGER BEFORE ACCOMPLISHING ANY CHARGING.

(B) THE TWO BATTERY REDLINES REFLECT THE ENERGY REQUIRED IN THE TWO LOWEST BATTERIES TO PROVIDE CAPABILITY FOR A SAFE RETURN FROM ANY POINT IN THE MISSION. THE REDLINES ARE BASED ON LOSS OF THE HIGHEST BATTERY SUBSEQUENT TO LOSS OF THE BATTERY CHARGER WITH A TWO-BATTERY ENTRY (WITH G&N) AND 12 HOURS OF POSTLANDING TIME.

(C) IF RESCUE IS REQUIRED, THE THREE-BATTERY ENERGY REQUIREMENTS WILL BE RECOVERED BY POWERING DOWN TO A TWO-BATTERY G&N ENTRY.

(D) AUX BAT ENERGY IS NOT INCLUDED IN BAT REDLINES.

(E) CONSIDERATION WILL BE GIVEN TO PERFORMING SPS BURNS WITHOUT BATTERY SUPPLEMENT IF REDLINE NOT MET.

(F) CRYOGENIC REDLINES ARE BASED ON CAPABILITY TO PERFORM NOMINAL MISSION WITH CAPABILITY TO RETURN TO EARTH AT A 40 AMP AVERAGE POWER LEVEL AFTER LOSS OF ANY CRYO TANK AT THE WORST CASE TIME FOR FAILURE.

(G) THREE-TANK CRYOGENIC REDLINE IS BASED ON THE TOTAL QUANTITY REQUIRED TO PERFORM NOMINAL LENGTH MISSION.

RULE NUMBERS 3-102 THROUGH 3-110 ARE RESERVED.

EVA (TYPICAL)

REV

I. EPS AND ECS MINIMUM CONSUMABLE REQUIREMENTS

A. FROM UNDOCKING TO TOUCHDOWN, THE MINIMUM REQUIREMENTS ARE BASED ON THE TIME TO COMPLETE A LANDING, A 24.5-HR STAY WITH ONE EVA, ASCENT, AND A 2.0-HR RENDEZVOUS THROUGH CREW TRANSFER, A 2-HR ORBITAL CONTINGENCY, AND REDUNDANT ASCENT EPS SOURCES FOR THE RENDEZVOUS.

THE TIME TO COMPLETE A LANDING AND THE 24.5-HR LUNAR STAY MAY BE SUPPORTED BY ANY COMBINATION OF DESCENT AND ASCENT CONSUMABLES. IN ADDITION, EACH ASCENT BATTERY, ONE H_2O TANK AND ONE ASCENT O_2 TANK (THE LM CABIN IS CONSIDERED A REDUNDANT O_2 SOURCE) MUST CONTAIN THE CONSUMABLES REQUIRED FOR LIFTOFF AND A 2.0-HR RENDEZVOUS THROUGH CREW TRANSFER. THE 2-HR ORBITAL CONTINGENCY, INSOFAR AS ASCENT O_2 AND ELECTRICAL POWER ARE CONCERNED, IS CONSIDERED TO BE SATISFIED BY THE REDUNDANCY REQUIREMENT. SHOULD TWO ASCENT H_2O TANKS BE AVAILABLE, THE REQUIREMENT FOR LIFTOFF THROUGH CREW TRANSFER CAPABILITY IN EACH TANK WILL SATISFY THE 2-HR ORBITAL CONTINGENCY. IF ONLY ONE TANK IS AVAILABLE, IT MUST ALSO INCLUDE THE 2-HR CONTINGENCY.

B. FOR THE REMAINDER OF THE LUNAR STAY, THE MINIMUM DESCENT STAGE REQUIREMENTS ARE BASED ON THOSE CONSUMABLES REQUIRED FOR THE SCHEDULED ACTIVITIES DURING EACH DEFINED PHASE, AN ASCENT PREPARATION, AND A 2-HR SURFACE RESERVE. THE LAST 4 HOURS OF THIS REQUIREMENT FOR EPS MUST BE SPLIT-BUS OPERATION. ASCENT STAGE MINIMUM REQUIREMENTS ARE AS STATED ABOVE.

C. FOR THE RENDEZVOUS, THE MINIMUM REQUIREMENTS ARE THOSE CONSUMABLES NECESSARY TO SUPPORT A LM-ACTIVE RENDEZVOUS THROUGH CREW TRANSFER. SHOULD THESE MINIMUM REQUIREMENTS BE VIOLATED, THE LM WILL BE POWERED DOWN WHILE THE CSM BECOMES THE ACTIVE VEHICLE. HOWEVER, THE LM WILL BE POWERED UP TO PERFORM BRAKING WITH SUFFICIENT CONSUMABLES BEING RETAINED FOR THIS PURPOSE.

D. TWO POUNDS OF OXYGEN CONTAINED IN THE LM CABIN AT 5.3 PSIA WILL BE CONSIDERED AVAILABLE IN CALCULATING MINIMUM O_2 REQUIREMENTS. THE CABIN CAN BE CONSIDERED, WHEN DISCUSSING FUNCTIONAL PRESSURE VESSEL REQUIREMENTS, AS A BACKUP TO THE ASCENT O_2 TANKS.

II. EMU CONSUMABLE REQUIREMENTS

A. GO/NO-GO'S

1. NOMINAL AND ALTERNATE EVA'S

AMP-HRS, O_2, LIOH AND H_2O QUANTITIES REQUIRED TO COMPLETE EVA PREP, EVA, PLUS THE VALUES REQUIRED FOR 30 MINUTES OF POST EVA RESERVE.

2. CEVA

BOTH PLSS'S AND OPS WILL BE RETAINED UNTIL TWO LIFE SUPPORT UNITS (2 OPS, 2 PLSS'S OR 1 PLSS AND 1 OPS) HAVE BEEN VERIFIED TO HAVE SUFFICIENT CONSUMABLES TO SUPPORT CEVA (MINIMUM OF 15 MIN LIFETIME; OPS IN HI FLOW)

REV

B. REDLINES

NOMINAL AND ALTERNATE EVA'S--PLSS AMP-HOURS, O_2, LIOH, AND H_2O REQUIRED FOR 30 MINUTES OF POST EVA RESERVE.

C. EXCURSION CONSTRAINTS

EVA EXCURSION LIMITATIONS ARE A FUNCTION OF TRAVERSE MODES (RIDING OR WALKING), NUMBER OF EVA CREWMAN, EVA EQUIPMENTS AVAILABLE, AND PLSS CONSUMABLES REMAINING.

1. FOR A TWO-MAN RIDING TRAVERSE THE FOLLOWING WILL APPLY:

(A) EVA EXCURSIONS WILL BE LIMITED TO ALLOW WALKBACK FROM A FAILED LRV ASSUMING NO PLSS FAILURES.

(B) EVA EXCURSIONS WILL BE LIMITED TO ALLOW RIDEBACK WITH A FAILED PLSS, USING BSLSS AND OPS IN LOW PURGE FLOW.

(C) EVA EXCURSIONS WITHOUT THE BSLSS (OR IF THE BSLSS IS BEING USED) WILL BE LIMITED ALLOWING WALKBACK TO THE LRV ($\leq$ 100 METERS) AND RIDING ON LRV USING OPS LOW PURGE FLOW AND ALLOWING 13 MIN AT HIGH PURGE FLOW FOR INGRESS. AN ARBITRARY 10 MIN PAD WILL BE IMPOSED FOR THE LOW PURGE FLOW PHASE.

2. FOR A TWO-MAN WALKING TRAVERSE THE FOLLOWING WILL APPLY:

(A) EVA EXCURSIONS WILL BE LIMITED TO A BSLSS WALKBACK CAPABILITY USING THE OPS IN LOW PURGE FLOW.

(B) WITH NO BSLSS, THE EVA EXCURSIONS WILL BE LIMITED, ALLOWING LM RETURN USING THE OPS IN HIGH PURGE FLOW.

3. FOR A ONE-MAN RIDING TRAVERSE THE FOLLOWING WILL APPLY:

(A) EVA EXCURSIONS WILL BE LIMITED TO WALKBACK FROM A FAILED LRV ASSUMING NO PLSS FAILURES.

(B) EVA EXCURSIONS WILL BE LIMITED TO ALLOW WALKBACK TO LRV ($\leq$ 100 METERS) AND RIDING ON THE LRV USING OPS LOW PURGE FLOW AND ALLOWING 13 MIN AT HI PURGE FLOW FOR INGRESS. AN ARBITRARY 10 MIN PAD WILL BE IMPOSED FOR THE LO PURGE FLOW PHASE.

4. FOR A ONE-MAN WALKING TRAVERSE THE FOLLOWING WILL APPLY:

EVA EXCURSIONS WILL BE LIMITED TO ALLOW WALKBACK TO THE LM, UTILIZING THE OPS IN HIGH PURGE FLOW.

5. ALL EMERGENCY RETURNS ARE CONSTRAINED BY THE 300 BTU MAXIMUM CREWMAN HEAT STORAGE AND THE 13 MINUTES REQUIRED FOR TERMINATION AND INGRESS. ALL RIDING AND WALKING RATES ARE UNCORRECTED MAP RATES.

REV

(A) RIDING TRAVERSES

(1) THE LRV/BSLSS/OPS (L) RETURN TRAVERSE CAPABILITY REPRESENTS AN OPS LOW PURGE FLOW RATE OF 4.0 LBS/HR, TIME REQUIRED FOR WALKBACK TO THE LRV AT 4.0 KM/HR, 5 MINUTES FOR BSLSS ACTIVATION, AND THE TIME REQUIRED FOR LRV RETURN TRAVERSE AT 7.3 KM/HR.

(2) THE LRV/OPS (L/H) RETURN TRAVERSE CAPABILITY REPRESENTS AN OPS LO PURGE FLOW RATE OF 4.0 LBS/HR FOR WALKBACK TO THE LRV ($\leq$ 100 METERS) AT 4.0 KM/HR, AND THE LRV RETURN TRAVERSE AT 7.3 KM/HR, AND AN OPS HI PURGE FLOW RATE OF 7.8 LBS/HR FOR INGRESS. AN ARBITRARY 10 MIN PAD WILL BE IMPOSED DURING THE LOW PURGE FLOW PHASE.

(3) THE WALKBACK RETURN TRAVERSE CAPABILITY REPRESENTS A PARTICULAR CONSUMABLE CONSIDERING A WALKBACK RETURN RATE OF 3.6 KM/HR FOR DISTANCES <3.6 KM AND 2.7 KM/HR FOR DISTANCES >3.6 KM. THE BSLSS RIDEBACK RETURN TRAVERSE CAPABILITY REPRESENTS 5 MIN FOR BSLSS ACTIVATION AND AN LRV RATE OF 7.3 KM/HR.

(B) WALKING TRAVERSES

(1) THE WALKING/BSLSS/OPS (L) RETURN TRAVERSE CAPABILITY REPRESENTS AN OPS LOW PURGE FLOW RATE OF 4.0 LB/HR, 5 MIN FOR BSLSS ACTIVATION, AND THE TIME REQUIRED FOR THE WALKING RETURN TRAVERSE.

(2) THE WALKING/OPS (H) RETURN TRAVERSE CAPABILITY REPRESENTS AN OPS HIGH PURGE FLOW RATE OF 7.8 LBS/HR FOR THE TIME REQUIRED FOR THE WALKING RETURN TRAVERSE.

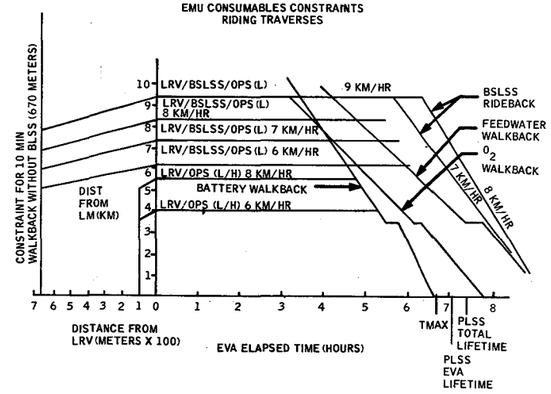
(3) THE WALKBACK RETURN TRAVERSE CAPABILITY REPRESENTS THE PARTICULAR CONSUMABLE USED AT A CONTINGENCY RATE AT THE 3.6 KM/HR RETURN WALKING RATE.

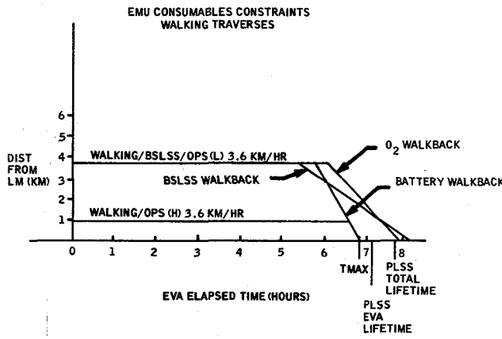
6. THE PREMISSION ESTIMATES USED IN DEFINING THE OPERATIONAL ENVELOPE, BSLSS RIDEBACK AND NORMAL RIDEBACK LIMITS, WILL BE UPDATED AS NECESSARY DURING THE TRAVERSE BASED ON A REAL-TIME ASSESSMENT OF MOBILITY AND CONSUMABLES.

7. PLSS TOTAL LIFETIME - THE MAXIMUM PLSS LIFETIME AVAILABLE AS AFFORDED BY THE MOST CONSTRAINING CONSUMABLE. IT IS DETERMINED BY DIVIDING THE CONSUMABLE QUANTITY MINUS RESIDUAL BY THE PREDICTED CONSUMABLE USE RATE.

PLSS EVA LIFETIME - THE MAXIMUM POSSIBLE EVA TIME AS AFFORDED BY THE MOST CONSTRAINING PLSS CONSUMABLE. IT IS DETERMINED BY SUBTRACTING 30 MINUTES (POST-EVA RESERVE) FROM THE TOTAL PLSS LIFETIME.

TMAX - THE EVA TIME AT WHICH THE CREWMAN MUST BE AT THE LM AS LIMITED BY THE MOST CONSTRAINING PLSS CONSUMABLE. FOR A RIDING TRAVERSE, IT IS DETERMINED BY SUBTRACTING 10 MINUTES (LRV EQUIPMENT ASSEMBLY TIME) AND 13 MINUTES (LM INGRESS TIME) FROM THE PLSS EVA LIFETIME. FOR A WALKING TRAVERSE, IT IS DETERMINED BY SUBTRACTING 13 MINUTES (LM INGRESS TIME) AND 5 MINUTES (BSLSS HOOKUP TIME) FROM THE PLSS EVA LIFETIME.





LM CONSUMABLE REQUIREMENTS/ MANAGEMENT CONTROL

REV

9/1/72

I. RCS CONSUMABLE REQUIREMENTS

A. GO/NO-GO'S

THE GO/NO-GO FOR EACH MISSION PHASE IS DEFINED AT THE QUANTITY REQUIRED FOR COMPLETION OF THE NOMINAL MISSION TO DOCKING PLUS OPS RESERVE. ALL GO/NO-GO'S ARE THE AVERAGE OF SYSTEM A AND B.

B. REDLINES (AN "X" INDICATES THAT PROPELLANT IS REQUIRED FOR THE FUNCTION LISTED)

REDLINES	DOCKING	LONGEST ABORT RNDZ (DPS)	STAGING	BRAKING	ASCENT	LONGEST LOS FOR CSM RESCUE	TWEAK	1 REV CSM RNDZ	OPS RESERVE
UNDOCKING TO CIR	X								X
CIRC TO PDI	X	X	X	X					X
PDI TO T/D	X			X	X	X			X
LUNAR STAY	X			X	X	X			X
ASC TO TWEAK	X				X		X	X	X
TWEAK TO TPF	X							X	X
TPF TO DOCKING									X

ALL REDLINES REQUIRE A PERCENT READING ON EACH INDIVIDUAL SYSTEMS GAGE (OR AN EQUIVALENT OF PROPELLANT IF THE GAGE HAS FAILED) EQUAL TO OR GREATER THAN THE REDLINE VALUE.

C. OPS RESERVE

1. AFTER COMMITTING TO A RENDEZVOUS BUT PRIOR TO TPF, THE OPS RESERVE IS THAT QUANTITY OF RCS PROPELLANT REQUIRED FOR ONE REV OF LOS TRACKING OF THE CSM (LM STAGED) OR 2.5 PERCENT.

2. AFTER TPF, THE OPS RESERVE IS THAT QUANTITY OF RCS PROPELLANT REQUIRED FOR A CSM ACTIVE DOCKING OR 1.0 PERCENT.

II. PROPULSION PROPELLANT GAGING

A. DPS

1. PRIME METHOD--PQGS TM AND ONBOARD (1.3 PERCENT).

2. BACKUP METHOD--GROUND MASS CALCULATION (3 PERCENT)

B. APS

1. PRIME METHOD--APS QUANTITY FROM LGC MASS CALCULATION (3 PERCENT)

2. BACKUP METHOD-- FLOW RATE TIMES ELAPSED TIME (5 PERCENT)

C. RCS

1. PRIME METHOD--GROUND RCS PROGRAM (6 PERCENT)

2. BACKUP METHOD--PQMD (ONBOARD READOUT 13 PERCENT, GROUND READOUT 10 PERCENT)

III. CONSUMABLES MANAGEMENT

A. RCS

THE RCS SYSTEM SHOULD BE CROSSFED WHEN NECESSARY TO INSURE NEITHER SYSTEM EXCEEDS ITS RCS CONSUMABLE REDLINE.

4 GROUND INSTRUMENTATION REQUIREMENTS

R	ITEM

GENERAL

4-1 GENERAL

A. THE FOLLOWING PRELAUNCH REQUIREMENTS DEFINE THE MCC/MSFN REQUIREMENTS WHICH MUST BE MET BEFORE A "GO" IS GIVEN FOR LAUNCH. ALL RANGE SAFETY OFFICER REQUIREMENTS ARE CONTAINED IN SECTION 5.

B. WHEN A SPECIFIC HARDWARE ITEM OR OPERATIONAL CAPABILITY IS DEFINED AS A MANDATORY ITEM, THE HARDWARE AND/OR SOFTWARE INTERFACE REQUIRED TO PROVIDE THE MANDATORY FUNCTIONS OF THAT HARDWARE ITEM OR OPERATIONAL CAPABILITY ARE TO ASSUME A MANDATORY STATUS ALSO.

C. WHERE REDUNDANCY EXISTS FOR MANDATORY ITEMS, A BACKUP CAPABILITY IS CONSIDERED HIGHLY DESIRABLE.

NOTE

THE VARIOUS EQUIPMENT LISTINGS IN THIS SECTION ARE TO BE UTILIZED AS A GUIDE ONLY. IT IS MANDATORY, PRIOR TO COMMITTING THE MISSION TO LAUNCH, TO BE ABLE TO:

A. RECEIVE AND DISPLAY TELEMETRY AND TRACKING DATA
B. MAINTAIN VOICE COMMUNICATIONS WITH THE CREW

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
				MCC	
	4-2	TELEMETRY			
		A. CONSOLE DISPLAY (D/TV, EVENTS, ANALOGS)	PRELAUNCH	MANDATORY	A. FOR DISPLAY OF MANDATORY S/V PARAMETERS
		B. PCM GROUND STATIONS (4)	PRELAUNCH	2 OF 4 MANDATORY, 2 HIGHLY DESIRABLE	B. FOR DISPLAY OF MANDATORY S/V EVENTS AND ANALOGS
		C. RECORDING AND PLAYBACK 1. ALDS 2. MSFN	PRELAUNCH	DESIRABLE	
	4-3	COMMAND			
		A. MOCR TOGGLE SWITCHES (BOTH A AND B) 1. BSE ABORT REQUEST 2. FIDO ABORT REQUEST 3. FD ABORT REQUEST	PRELAUNCH	HIGHLY DESIRABLE	A. FOR LAUNCH PHASE ABORT REQUEST
		B. COMMAND PANELS: INCO, GUIDO, BSE, CCATS	PRELAUNCH	HIGHLY DESIRABLE	
		C. MOCR CONSOLE/SITE SELECT CAPABILITY 1. RTC CONSOLE (CCATS) 2. CCATS CMD CONSOLE MED	PRELAUNCH	HIGHLY DESIRABLE	
		D. FC/M&O SWITCHING CAPABILITY 1. CCATS 2. CCATS CMD MED	PRELAUNCH	HIGHLY DESIRABLE	
		E. ABORT/CCATS TEST SWITCHING CAPABILITY 1. FD CONSOLE 2. CCATS CMD MED	PRELAUNCH	HIGHLY DESIRABLE	

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	4-4	TRAJECTORY			
		A. TRAJECTORY DATA PROCESSING			A. THE TRAJECTORY DATA SOURCES ARE UTILIZED AS FOLLOWS:
		1. AVAILABILITY OF ONE INDEPENDENT TRACKING SOURCE (IPR, USB) FROM LIFTOFF TO T+10 MINUTES	PRELAUNCH	1 MANDATORY	1. (A) INDEPENDENT VERIFICATION OF L/V NAVIGATION (B) PROTECTION AGAINST VIOLATION OF LAUNCH ENVELOPE
		2. IU AND CMC TM VECTORS FROM LIFTOFF TO INSERTION	PRELAUNCH	BOTH MANDATORY	A. 2. REQUIRED FOR ORBIT GO/NO-GO
		B. RTCC - DATA SELECT CAPABILITY	PRELAUNCH	MANDATORY	B. TO SELECT BEST AVAILABLE DATA SOURCE
	4-5	COMMUNICATIONS			
		A. MOCR:			A. FOR MISSION CONTROL
		AFD CONF LOOP FD LOOP	PRELAUNCH	1 OF 2 MANDATORY	
		MOCR DYN MOCR SYS 1 & 2 A/G 1 LOOP A/G 2 LOOP	PRELAUNCH	ALL HIGHLY DESIRABLE	
		B. MCC/LAUNCH COMPLEX: 121 CLTC 111 CVTS 212 MSTC	PRELAUNCH	1 OF 3 MANDATORY	B. FOR TERMINAL COUNT COORDINATION OF MCC-PAD ACTIVITIES
		C. MCC/RSO: FD LINE TO RSO RSO PRIVATE LINE CAPE 111 RSO LOOP	PRELAUNCH	1 OF 3 MANDATORY	C. FOR TRAJECTORY VERIFICATION AND BOOSTER SAFING
		D. MCC/REMOTED SITES: ONE A/G PATH	PRELAUNCH	MANDATORY	D. USED FOR COMMUNICATION WITH CREW
	4-6	COMPUTER			
		A. MOC (IBM 360/75)	PRELAUNCH	MANDATORY	TO PROCESS MANDATORY S/V PARAMETERS AND TRAJECTORY DATA
		B. DSC (IBM 360/75)	PRELAUNCH	HIGHLY DESIRABLE	AN SSC (IBM 360/75) IS AVAILABLE AS BACKUP TO THE MOC OR DSC.
		C. CCATS (UNIVAC 494)-ONLINE CCATS (UNIVAC 494)-STANDBY	PRELAUNCH	1 MANDATORY AND 1 HIGHLY DESIRABLE	TO THROUGH PROCESS MANDATORY S/V PARAMETERS TO MOC
	4-7	TIMING			
		MITE (2)	PRELAUNCH	1 MANDATORY	MCC TIMING STANDARD TO SUPPORT MANDATORY RTCC/CCATS COMPUTERS

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	4-8	MCC POWER			
		A. BUS A1	PRELAUNCH	MANDATORY	A. UNINTERRUPTABLE POWER FOR D/TV
		B. BUS A2	PRELAUNCH	HIGHLY DESIRABLE	B. POWERS ADEG NO VSM ON A2.
		C. BUS B1	PRELAUNCH	HIGHLY DESIRABLE	C. 20 SECONDS INTERRUPTABLE POWER FOR THE FOLLOWING HIGHLY DESIRABLE ITEMS: - ONE-HALF MOCR CONSOLE POWER - FLT DYN SSR CONSOLES AND PLOTBOARDS - RTCC CONSOLES (EXCEPT COMP SUP) - PDSDD - TTY
		D. BUS B2	PRELAUNCH	MANDATORY	D. 20 SECONDS INTERRUPTABLE POWER FOR ONE-HALF OF THE MOCR CONSOLE POWER, ALL SSR CONSOLE POWER, AND ALL MOC DDD'S
	4-9	DISPLAY			
		A. MOCR D/TV CHANNELS POSITION — NO. OF CHANNELS RETRO 1 FIDO 1 GUIDO 1 EECOM 1 GNC 1 RTCC 1 BOOSTER 1	PRELAUNCH	7 OF 40 MANDATORY	A. FOR DISPLAY OF MANDATORY S/V PARAMETERS IF DISPLAY SWITCHING CAPABILITY IS ALSO LOST: 1. FIDO WILL REQUIRE 2 CHANNELS AND GAMMA VS V AND GAMMA (EI) VS V (EI) ON PLOTBOARDS 2. BSE WILL REQUIRE 3 CHANNELS
		B. TRAJECTORY DISPLAY			
		1. FDO LAUNCH DIGITALS	PRELAUNCH	MANDATORY ON D/TV	B. 1. FOR CONTINGENCY ORBIT INSERTION MANEUVER DATA AND T_{FF} LIMITS
		2. GAMMA VS V	PRELAUNCH	MANDATORY ON 1 OF 4: (A) 10 X 20 SCRIBER PLOTTER (B) D/TV (C) RTCC PLOTBOARD (D) SSR PLOTBOARD	2. FROM SELECTED TRACKING DATA SOURCE
		3. RFO LAUNCH DIGITALS	PRELAUNCH	MANDATORY ON D/TV	3. MONITOR FOR MODES III AND IB MANEUVER DATA
		4. GAMMA(EI) VS V(EI)	PRELAUNCH	MANDATORY ON 1 OF 2: (A) D/TV (B) SSR PLOTBOARD	4. MONITOR FOR G-LIMIT VIOLATION
		5. PHI VS LAMBDA	PRELAUNCH	HIGHLY DESIRABLE ON 1 OF 2: (A) RTCC PLOTBOARD (B) SSR PLOTBOARD	5. MONITOR FOR CROSS-RANGE LIMITS
		6. T_{FF} VS R_{IP}	PRELAUNCH	HIGHLY DESIRABLE ON 1 OF 2: (A) D/TV (B) SRR PLOTBOARD	6. MONITOR FOR ABORT MODES II, III, AND IB.
		7. H VS D	PRELAUNCH	HIGHLY DESIRABLE ON 10 X 20 SCRIBER PLOTTER	
		8. GAMMA(I) VS V(I) (CMC DYNAMIC STATUS)	PRELAUNCH	HIGHLY DESIRABLE ON 10 X 10 SCRIBER PLOTTER	8. MONITOR FOR L/V AND S/C NAVIGATION PERFORMANCE (GUIDANCE SYSTEM ANALYSIS - COMPARES CMC WITH TRACKING).
		9. WEDGE ANGLE MONITOR	PRELAUNCH	HIGHLY DESIRABLE ON D/TV	9. MONITOR FOR L/V AND S/C NAVIGATION PERFORMANCE

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	4-9 (CONT)	10. GUIDO ANALOG CHART RECORDERS ONE AND TWO	PRELAUNCH	HIGHLY DESIRABLE ON TV	
		11. INSERTION/INJECTION DIGITALS	PRELAUNCH	MANDATORY ON D/TV	11. FOR G&N GO/NO-GO
		C. ADEG CHANNELS 90-93	PRELAUNCH	HIGHLY DESIRABLE	C. FOR DSC DISPLAYS
		D. VSM	PRELAUNCH	MANDATORY	D. FOR D/TV. IF MANDATORY CHANNELS CAN BE DISPLAYED, THE VSM IS HD FOR LAUNCH PROVIDED THE ETO IS LESS THAN 1 HOUR
		E. AUX VSM	PRELAUNCH	HIGHLY DESIRABLE	
		F. EIDOPHORS (3)	PRELAUNCH	2 HIGHLY DESIRABLE	
		NOTE: INDIVIDUAL FLIGHT CONTROLLERS WILL BE RESPONSIBLE FOR REPORTING LOSS OF DISPLAY CAPABILITY OF MANDATORY PARAMETERS TO THE FLIGHT DIRECTOR.			

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
				GSFC/KSC/MSFN	
	4-10	GSFC			
		A. GSFC UNIVAC-494 (2) COMMUNICATIONS PROCESSOR	PRELAUNCH	1 MANDATORY	A. ONE UNIVAC-494 CAN PERFORM ALL NECESSARY FUNCTIONS, THE SECOND ONE IS BACKUP.
		B. WBD (50.0 KBPS) LINES (2) BETWEEN MCC AND GSFC	PRELAUNCH	1 MANDATORY	B. EITHER LINE CAN BE SWITCHED TO EITHER UNIVAC-494.
		C. TTY CIRCUITS BETWEEN MCC AND GSFC			C. VFTG PROVIDES TWO REDUNDANT 16 CIRCUIT TTY CHANNELS.
		1. OUTGOING	PRELAUNCH	1 OF 32 CIRCUITS HIGHLY DESIRABLE	1. FOR ACQ MSG, LS CMD
		2. INCOMING (JJ)	PRELAUNCH	1 OF 32 CIRCUITS MANDATORY	2. FOR RECEPTION OF LOWSPEED RADAR DATA.
	4-11	KSC			
		TELEMETRY:			
		A. VHF TM FROM THE FOLLOWING FOR S-II, S-IVB, AND IU:			A. THESE ANTENNAS CAN BE SWITCHED TO MILA OR CIF FACILITIES
		1. CIF ANTENNA 2. MILA VHF ANTENNA	PRELAUNCH	1 HIGHLY DESIRABLE	
		B. USB TM FROM THE FOLLOWING:			B. USB IS THE CSM'S ONLY SOURCE OF DATA.
		1. MILA USB 2. CIF USB	PRELAUNCH	1 MANDATORY	
		COMMAND:			
		THIS CAPABILITY IS DEFINED UNDER GSFC/ KSC/MSFN COMMAND RULE 4-12 FOR LAUNCH COVERAGE.			
		TRACKING:			
		THAT CAPABILITY REQUIRED TO SATISFY RULE 4-4 (TRAJECTORY) IS MANDATORY.			
		VOICE COMMUNICATIONS:			
		THIS KSC CAPABILITY IS DEFINED UNDER MCC RULE 4-5 (COMMUNICATIONS).			

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	4-12	LAUNCH COVERAGE KSC/MSFN SITES (SITES NOT LISTED DUE TO VARIABLE LAUNCH AZIMUTH) MUST PROVIDE THE FOLLOWING CAPABILITIES FROM LIFTOFF THROUGH S-IVB CUTOFF. REFER TO DECISION MATRIX (RULE 4-17) TO DETERMINE CAPABILITY			
		A. CMD			
		CCS	PRELAUNCH	HIGHLY DESIRABLE	
		B. TELEMETRY			
		S-IC (VHF)	PRELAUNCH	HIGHLY DESIRABLE	S-IC DATA IS ONLY HIGHLY DESIRABLE SINCE THE MCC IS NOT PRIME FOR REQUESTING AN ABORT FOR S-IC MALFUNCTIONS.
		S-II (VHF)	PRELAUNCH	HIGHLY DESIRABLE FROM LIFTOFF TO S-II CUTOFF (APPROX 9:17 SEC)	FOR ABORT CUES FROM MCC
		S-IVB VHF (CP-1)	PRELAUNCH	HIGHLY DESIRABLE	
		IU CCS (DP-1B) IU VHF (DP-1)	PRELAUNCH	1 OF 2 MANDATORY	FOR ABORT CUES FROM MCC
		CSM (USB)	PRELAUNCH	MANDATORY FROM LIFTOFF THROUGH S-IVB CUTOFF	FOR ABORT CUES FROM MCC
		C. TRACKING THAT CAPABILITY REQUIRED TO SATISFY RULE 4-4 (TRAJECTORY) IS MANDATORY			
		D. A/G COMMUNICATIONS			
		1. MILA VHF USB	PRELAUNCH	1 OF 2 MANDATORY	
		2. MSFN VHF USB	PRELAUNCH	1 OF 2 MANDATORY	

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	4-13	GENERAL ORBITAL COVERAGE IT IS REQUIRED THE MSFN HAVE THE CAPABILITY OF PROVIDING THE MCC THE MINIMUM MISSION CONTROL SUPPORT LISTED BELOW OF TWO MSFN USB SITES PER REVOLUTION THROUGH REVOLUTION 3.			
		A. CMD			
		CCS	PRELAUNCH	HIGHLY DESIRABLE	
		CSM USB	PRELAUNCH	HIGHLY DESIRABLE	
		B. TELEMETRY			
		S-IVB VHF (CP-1)	PRELAUNCH	HIGHLY DESIRABLE	
		IU CCS (DP-1B) IU VHF (DP-1)	PRELAUNCH	1 OF 2 MANDATORY	DOWNLINKS REQUIRED TO RECOVER S-IVB DATA.
		CSM USB	PRELAUNCH	MANDATORY	
		C. TRACK			
		C-BAND	PRELAUNCH	HIGHLY DESIRABLE	
		USB	PRELAUNCH	MANDATORY	
		D. A/G COMMUNICATIONS			
		VHF USB	PRELAUNCH	1 OF 2 MANDATORY	USB MANDATORY AT LEAST ONE STATION PRIOR TO TLI TO CONFIRM ONBOARD CSM USB A/G CAPABILITY.
	4-14	POST S/C SEPARATION IT IS MANDATORY THAT 1 SITE PROVIDE THE FOLLOWING CAPABILITIES:			
		A. TLM - CCS	PRELAUNCH	MANDATORY	A. TO PROVIDE TM FOR DETERMINING S-IVB STATUS BEYOND VHF RANGE.
		B. CMD - CCS	PRELAUNCH	MANDATORY	B. TO PROVIDE CORRECTIVE COMMAND CAPABILITY FOR S-IVB BULKHEAD DELTA PROBLEMS. C. BOTH OF THE ABOVE ARE REQUIRED TO INSURE CREW SAFETY AND LM EXTRACTION.

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	4-15	HSK, GDS, MAD IT IS MANDATORY 2 OF 3 OF THESE SITES PROVIDE THE FOLLOWING CAPABILITIES:			
		A. TM USB	PRELAUNCH	MANDATORY	A. TO COVER TRANSLUNAR COAST AND LPO
		B. TRACK USB	PRELAUNCH	MANDATORY	
		C. VOICE USB	PRELAUNCH	MANDATORY	
		D. CMD USB	PRELAUNCH	HIGHLY DESIRABLE	
	4-16	RIOMETER NETWORK SITES	PRELAUNCH		
		GWM.IMA		HIGHLY DESIRABLE	

R	ITEM	
	4-17	INTRODUCTION TO SITE FAILURE DECISION MATRIX

FOR PRELAUNCH FAILURES OF LAUNCH PHASE SITE CAPABILITY, THE FOLLOWING DECISION MATRIX APPLIES THE LAUNCH PHASE GROUND INSTRUMENTATION REQUIREMENTS TO THE RESULTING DEGRADED COVERAGE.

THIS MATRIX POINTS OUT THE LOSS OF CONTINUOUS COVERAGE BETWEEN LIFTOFF AND INSERTION PLUS 60 SECONDS FOR VARIOUS SITE FAILURES. IF SITE FAILURES OCCUR PRIOR TO LAUNCH, THE MATRIX WILL BE USED TO DETERMINE WHETHER MANDATORY CONTINUOUS COVERAGE HAS BEEN LOST.

(NOMINAL INSERTION IS 11:55)

TO USE THE MATRIX:

A. LOOK FOR AN X UNDER THE COLUMN FOR SITE WHERE THE FAILURE OCCURRED.

B. GO ACROSS TO THE COLUMN FOR THE CAPABILITY THAT WAS LOST AND READ THE DECISION.

C. THE COVERAGE THAT WAS LOST IS IN THE COLUMN LABELED "APPROXIMATE MANDATORY COVERAGE LOST."

D. MORE THAN ONE X IN A ROW SPECIFIES A FAILURE OF THE SAME CAPABILITY AT MORE THAN ONE SITE.

R | ITEM

	SITES FAILED				APPROXIMATE MANDATORY COVERAGE LOST FOR NO-GO ITEMS FOR ALL LAUNCH AZIMUTHS	CAPABILITY LOST			
	ALDS TM	MIL/ CAPE	BDA	VAN		TM	CMD	TRACK	A/G
	00:00 TO 08:49	00:00 TO 08:49	04:10 TO 12:40	09:10 TO 16:05		USB OR CCS AND VHF	USB AND CCS	BOTH S AND C BAND	USB AND VHF
SINGLE SITE FAILURE	X				NONE SEE NOTE 1	GO	N/A	N/A	N/A
		X			00:00 TO 04:10 SEE NOTE 2	GO	GO	NO-GO	NO-GO
			X		08:49 TO 09:10 SEE NOTE 3	GO	GO	GO	GO
				X	NONE	GO	GO	GO	GO
MULTIPLE SITE FAILURES	X	X			00:00 TO 04:10	NO-GO	GO	NO-GO	NO-GO
		X	X		00:00 TO 09:10 SEE NOTE 2	GO	GO	NO-GO	NO-GO
		X		X	00:00 TO 04:10 SEE NOTE 2	GO	GO	NO-GO	NO-GO
			X	X	08:49 TO 16:05	NO-GO	GO	NO-GO	NO-GO
	X		X		08:49 TO 09:10 SEE NOTE 3	GO	GO	GO	GO
	X			X	NONE	GO	GO	GO	GO
	X	X	X		00:00 TO 09:10	NO-GO	GO	NO-GO	NO-GO

NOTES: 1. LOSS OF ALDS RESULTS IN LOSS OF S-IC TM. HOWEVER, IT IS NOT MANDATORY FOR LAUNCH.

2. GO ON TM BECAUSE OF ALDS DATA UNTIL 08:49.

3. LOSS OF COVERAGE IS NOT SEVERE ENOUGH FOR A NO-GO CONDITION.

5 TRAJECTORY AND GUIDANCE

R	ITEM	

LAUNCH/TRANSEARTH

5-1 THE LAUNCH PHASE WILL BE TERMINATED FOR ANY OF THE FOLLOWING CONDITIONS:

A. VIOLATION OF THE VEHICLE BREAKUP LINE
B. $T_{FF} \leq$ 1:40 AND DECREASING AFTER TOWER JETTISON
C. VIOLATION OF ENTRY "G" LIMIT
D. V_S INCREASING
E. OVERSPEED CONDITIONS AT INSERTION
F. VIOLATION OF EXIT HEATING LINE
G. IF H $\leq$ 75 NM AND DECREASING BEFORE ACHIEVING MODE IV CAPABILITY

5-2 THE LES WILL NOT BE JETTISONED UNTIL MODE II CAPABILITY IS ESTABLISHED BY $T_{FF} \geq$ 1:20 AND INCREASING.

5-3 MODE II, III, IV, AND APOGEE KICK

A. THE GROUND IS PRIME FOR ABORT MODE DETERMINATION AND MODE III MANEUVER COMPUTATION. THE CREW USING THE G&N, WILL BE PRIME FOR MODE IV, APOGEE KICK MANEUVERS, AND DETERMINATION OF S-IVB OVERSPEED CONDITIONS.

B. MODE III MANEUVERS WILL BE INTERRUPTED WHEN T_{FF} = 1:00 AND DECREASING.

C. MODE IV MANEUVERS AND APOGEE KICK MANEUVERS WILL BE INTERRUPTED WHEN T_{FF} = 1:40 AND DECREASING.

D. MODE IV MANEUVERS WILL BE INTERRUPTED IF THE CURRENT ALTITUDE IS 70 NM, DECREASING, AND Hp < 300K FT.

E. IF ENTERING, UTILIZE LIFT TO AVOID LAND. UNAVOIDABLE LAND LANDING USE RL 90 DEG.

F. IF NO SLA SEP OR IF SPS FAILS:

1. Hp < 40 - EXECUTE CM/SM SEP BY T_{FF} = 1:40.

2. 40 < Hp < 70 - GROUND WILL DECIDE TO USE CM RCS ASAP OR AT APOGEE TO REDUCE Hp TO 40 NM

5-4 MODE III ABORTS

A. PREDICTED T_{FF} AFTER SPS C/O <1:00.

1. FULL LIFT IP ON WATER - DO NOT UBURN.
2. G&N GO AND FULL LIFT IP ON LAND - BURN TO T_{FF} = 1:00, RL 90 DEG.
3. G&N NO-GO AND FULL LIFT IP ON LAND - BURN A REDUCED ΔV TO MAINTAIN T_{FF} AFTER C/O AND RL 90 DEG.

B. IF ΔTB $\leq$ 2 SEC, DO NOT BURN.

C. IF IGNITION OCCURS AFTER GETI + 10 SEC, BURN UNTIL G&N ΔR = 0, RL 55 DEG. (IF UNABLE TO BURN ΔR = 0, RL 90 DEG.)

R	ITEM	
	5-5	THE S/C CMC WILL BE NO-GO FOR ABORT MANEUVER DETERMINATION AND MONITORING FOR ANY OF THE FOLLOWING: A. CMC PROGRAM ALARMS: SINGLE OCCURRENCE - 00214, 00777, 01107, 01407, 04777, 07777, 10777, 13777, 14777, 00205 CONTINUOUS OCCURRENCE - 20430, 20607, 20610, 21204, 21206, 21210, 21302, 21501, 21502, 21521, 31104, 31201, 31202, 31203, 31211 B. RTCC AND CMC T_{FF} DIFFERENCE OF > 40 SEC. C. CONFIRMED ERROR IN S/C PLATFORM VELOCITY COMPONENTS OF > 50 FPS IN X OR 100 FPS IN Z. D. CMC TRAJECTORY SOURCE INDICATES "GO" OR "NO-GO" INCONSISTENT WITH BEST TRAJECTORY SOURCE(S) INDICATION.
	5-6	THE ORBIT IS "GO" IF Hp $\geq$ 70 NM.
	5-7	ELIMINATION OF CM RCS PROPELLANTS DURING MODE I ABORTS A. THE CREW WILL BE ADVISED TO BURN OFF THE CM RCS PROPELLANTS IN THE EVENT OF A MODE I ABORT IF THE PREDICTED LANDING POINT IS ON LAND. B. FOR LOSS OF COMM WITH MCC AND MODE I ABORT BETWEEN 61 SEC GET AND 120 SEC GET THE CM RCS PROPELLANT WILL BE BURNED OFF.
		RULES 5-8 THROUGH 5-19 ARE RESERVED.

R	ITEM	
		EARTH ORBIT AND TLI
	5-20	EARTH ORBITAL ALTITUDE CONSTRAINTS: A. REAL-TIME MISSION PLANNING PERIGEE - 85 NM MINIMUM. MAXIMUM Hp IS DETERMINED BY SM RCS AVAILABLE FOR HYBRID DEORBIT. B. CONTINGENCY PERIGEE - 70 NM MINIMUM (VIOLATIONS WILL BE CORRECTED ASAP) IF Hp < 70 NM AND MANEUVER TO RAISE Hp IS NOT POSSIBLE: 1. 40 < Hp < 70 - EXECUTE SPS RETROGRADE ASAP UNTIL Hp < 40. IF NO SPS, LSE SM-RCS. 2. Hp < 40 - CM/SM SEP - RETRO WILL RECOMMEND ENTRY PROFILE.
	5-21	RESERVED
	5-22	S/C L/O TIME (GRR) WILL BE UPDATED WITH SRC L/U TIME IF THE TWO ARE DIFFERENT BY 10 SEC.
	5-23	TIME BETWEEN EPO RETROFIRE GETI AND 400K MUST BE >9 MIN. IF NOT, RETARGET FOR NEXT PTP.
	5-24	RESERVED
	5-25	PLANNED G&N AND SCS RETROFIRE MANEUVERS WILL BE UPDATED IF: A. THE COMPUTED RETROFIRE POSITION CHANGES BY >0.5° LONGITUDE PRIOR TO GETI - 30 MIN. B. THE COMPUTED RETROFIRE POSITION CHANGES >2° LONGITUDE AFTER GETI - 30 MIN.
	5-26	RESERVED

R	ITEM	
	5-27	IF SPS FAILS AFTER EPO RETROFIRE IGNITION OR NO SLA SEP:

A. Hp > 70 NM - RETARGET FOR NEXT BEST PTP USING RCS.

B. 40 < Hp < 70 - PITCH UP TO LOCAL HORIZONTAL ATTITUDE AND BURN SM RCS USING FOLLOWING PRIORITIES:

1. BURN Hp TO PAD VALUE

2. BURN MAXIMUM SM RCS ΔV AVAILABLE

3. BURN CM RCS TO Hp = 40 NM IF SM RCS ΔV NOT SUFFICIENT TO OBTAIN Hp = 40 NM. IF Hp $\leq$ 40 NM, TERMINATE ALL THRUSTING AT T_{FF} = 7 MIN.

C. Hp < 40 NM - REMAIN IN RETRO ATTITUDE AND BURN SM RCS USING THE FOLLOWING PRIORITY:

1. BURN ΔV RESIDUALS.

2. BURN MAXIMUM SM ΔV AVAILABLE.

NOTE

THE S-IVB LOX DUMP CAPABILITY MAY BE USED TO SHAPE THE ORBIT FOR RETROFIRE MANEUVER OR TO REDUCE THE S-IVB WEIGHT TO OBTAIN MORE SM RCS ΔV.

5-28 THE G&N IS NO-GO FOR ENTRY IF:

A. THE CMC VALUE OF DOWNRANGE ERROR (RP- RT) AT .2G DIFFERS > ±100 NM FROM GROUND VALUE. CREW B. V AND VTY.

B. V AND GAMMA AT 400K ARE OUTSIDE THE CORRIDOR. GROUND WILL PROVIDE ENTRY PROFILE.

5-29 BOOSTER NAVIGATION AND TARGET UPDATES FOR TLI:

A. AN IU NAVIGATION UPDATE WILL BE PERFORMED (AND TIME TAGGED TO INSURE INCORPORATION OVER A MSFN STATION PRIOR TO TB6 INITIATION) FOR THE FOLLOWING SITUATIONS:

1. WHERE AN IU ACCELEROMETER FAIL OCCURRED PRIOR TO EARTH ORBIT INSERTION.

2. FOR A FIRST OR SECOND TLI OPPORTUNITY WHERE MSFN VERSUS IU DIFFERENCE VIOLATES ANY OF THE FOLLOWING:

AT GET = 56 MIN: DOWNRANGE POSITION $\geq$ 33,101 FT
SEMI-MAJOR $\geq$ 1.1 NM
CROSSRANGE VELOCITY (MAXIMUM) $\geq$ 9 FPS

AT GET = 1 HR 45 MIN: DOWNRANGE POSITION $\geq$ 56,894 FT
SEMI-MAJOR AXIS $\geq$ 1.21 NM
CROSSRANGE VELOCITY (MAXIMUM) $\geq$ 9 FPS

B. THERE WILL BE NO IU TARGET UPDATES FOR EITHER TLI OPPORTUNITY.

R	ITEM	
	5-30	RESERVED
	5-31	RESERVED
	5-32	THE MAXIMUM ALLOWABLE MISALIGNMENT RATES BETWEEN THE IU AND IMU ARE 0.6 DEG/HR (IU) AND 1.5 DEG/HR (IMU).
	5-33	RESERVED
	5-34	TLI UNDERBURNS

A. FOR APOGEE ALTITUDES ABOVE 100K NM, A LUNAR LANDING MISSION IS AVAILABLE. THE TRADEOFFS THAT WILL BE MADE TO ACHIEVE THIS MISSION ARE, IN ORDER OF PRIORITY: (ITEMS ARE ADDITIVE)

1. PROVIDE ADDITIONAL ΔV FOR MCC BY FOREGOINT ANY NOMINAL CONSTRAINTS ON TEC RETURN INCLINATION.
2. EXECUTE MCC 1 AT TLI + 3 HRS
3. PROVIDE ADDITIONAL ΔV FOR MCC 1 BY:
   - (A) UTILIZE THE LM YAW STEERING BUDGET DURING ASCENT
   - (B) GIVE UP LOPC 2
   - (C) ADD 24 HRS TO TEC
   - (D) REOPTIMIZE THE DESCENT APPROACH AZ
4. EXECUTE MCC 1 AT TLI + 1 HR
5. PROVIDE ADDITIONAL ΔV FOR MCC 1 BY:
   - (A) REOPTIMIZE TLC (INCREASE DESCENT SEA)
   - (B) SCHEDULE TEI SHORTLY AFTER RNDZ
   - (C) ADD 24 HRS TO TEC (MAINTAIN MISSION DURATION <300 HRS)
   - (D) SHORTEN THE PLANNED LUNAR STAY TIME TO ELIMINATE LOPC 1.

NOTE

THE ADDITIONAL CAPABILITY ACHIEVED BY EACH ITEM IS HIGHLY MISSION DEPENDENT.

B. FOR APOGEE ALTITUDES BETWEEN 100K NM AND 28,000 NM, A LUNAR ORBIT ALTERNATE MISSION IS AVAILABLE. THE NOMINAL PLAN FOR THIS MISSION IS:

1. EXECUTE MCC 1 ASAP (BETWEEN TLI + 1 AND TLI + 3 HRS)
2. EXECUTE A DPS LOI
3. EXECUTE ALL REMAINING MANEUVERS (CIRC, LOPC, TEI) WITH THE SPS

C. FOR APOGEE ALTITUDES BELOW 28,000 NM, AN EARTH ORBIT ALTERNATE MISSION WILL BE PERFORMED.

R	ITEM	
	5-35	DIFFERENCE IN CMC AND IU PLATFORM VELOCITY COMPONENTS OR TOTAL VELOCITY AT INSERTION: A. VIOLATION OF ANY OF THE FOLLOWING MEANS TLI IS NO-GO: $\Delta\dot{X} > \pm 38$ FPS $\Delta\dot{Y} > \pm 73$ FPS $\Delta\dot{Z} > \pm 87$ FPS $\Delta V_T > \pm 34$ FPS B. VIOLATION OF ANY OF THE FOLLOWING MEANS TLI IS TEMPORARILY NO-GO: $\pm 7.5 < \Delta\dot{X} < \pm 38$ FPS $\pm 41 < \Delta\dot{Y} < \pm 73$ FPS $\pm 28 < \Delta\dot{Z} < \pm 87$ FPS $\pm 14 < \Delta V_T < \pm 34$ FPS NOTE TLI IS NO-GO UNTIL PARTS C AND 5-36 ARE DETERMINED (ORBITAL PARAMETER DECISIONS). C. VIOLATION OF ANY OF THE FOLLOWING ORBITAL DECISION PARAMETERS AT GET = 1 HR 45 MIN MEANS TLI IS NO-GO. PARAMETERS ARE IU VERSUS MSFN. SEMI-MAJOR AXIS > ±3.28 NM CROSSRANGE VELOCITY IS > ±32 FPS
	5-36	DIFFERENCE IN MSFN AND IU DOWNRANGE POSITION $\Delta RV > \pm 105{,}100$ FT AT GET = 56 MIN MEANS TLI IS NO-GO.
	5-37	WITH AN S-IVB GUID REF FAIL OR AN S-IVB ACCELEROMETER FAIL DURING LAUNCH PHASE, VIOLATION OF ANY OF THE FOLLOWING ORBITAL DECISION PARAMETERS MEANS TLI IS NO-GO. PARAMETERS ARE CMC VERSUS MSFN. A. DIFFERENCE IN DOWNRANGE POSITION > ±535,900 FEET AT GET = 56 MIN B. DIFFERENCE IN SEMIMAJOR AXIS > ±11.6 NM AT GET = 1 HR 45 MIN C. DIFFERENCE IN CROSSRANGE VELOCITY > ±78.7 FPS AT GET = 1 HR 45 MIN
		RULES 5-38 THROUGH 5-45 ARE RESERVED.

R	ITEM

MANEUVERS/COAST

5-46 THE CMC OR LGC WILL BE TEMPORARILY NO-GO FOR MANEUVER CONTROL FOR ANY OF THE FOLLOWING:

A. COMPUTER PROGRAM ALARMS:

SINGLE OCCURRENCE - 00205, 00214, 00777, 01107, 01407, 03777, 04777, 07777, 10/77, 13777, 14777

CONTINUOUS OCCURRENCE - 20430, 20607, 20610, 21204, 21206, 21210, 21302, 21501, 21502, 21521, 31104, 31201, 31202, 31203, 31211

B. CMC/IMU ALIGNMENT DISCREPANCY (FOR MANEUVER EXECUTION, MONITORING, AND ORBIT DETERMINATION):

1. SEXTANT STAR CHECK - AUTO OPTICS POSITIONING DOES NOT PLACE SELECTED STAR IN FIELD OF VISION OF SXT.
2. HORIZON CHECK ERROR >4 DEG FOR RETROFIRE FROM EPO.

C. LGC/IMU ALIGNMENT DISCREPANCY INDICATE BY >2 DEG FROM PREDICTED CQAS COORDINATES.

D. DIFFERENCE BETWEEN CMC/LGC GROUND NAV CHECK AFTER A NAV UPDATE FROM GROUND IS:

1. LATITUDE > 0.02°
2. LONGITUDE > 0.02°
3. H > 0.2 NM

5-47 SPACECRAFT TIMING MUST BE MAINTAINED WITHIN THE FOLLOWING LIMITS:

	CMC (SEC)	LGC (SEC)	AGS (SEC)
A. RETROFIRE	2	---	---
B. ENTRY	2	---	---
C. TLI	2	---	---
D. MCC'S	2	---	---
E. LOI/DOI/CIRC/LOPC	2	2	---
F. TEI	2	2	---
G. DESCENT	0.5	0.3	0.3
H. ASCENT	0.5	0.3	0.3
I. RENDEZVOUS	0.5	0.5	0.5
J. SXT TRACKING	0.5	---	---

RULES 5-48 THROUGH 5-55 ARE RESERVED.

R	ITEM	
	5-56	RESERVED
	5-57	TRANSLUNAR MCC EXECUTION CRITERIA A. MCC'S 2 AND 4 ARE PREFERRED EXECUTION POINTS. THE FIRST MIDCOURSE WILL BE DELAYED UNTIL MCC2 IF THE COST IS NOT PROHIBATIVE. B. MIDCOURSE CORRECTIONS WILL BE COMPUTED TO UTILIZE THE PREFERRED PROPULSION SYSTEM. THIS MAY INCLUDE NON-FREE RETURN MANEUVERS OFF OF A NOMINAL FREE RETURN TRAJECTORY.
	5-58	RESERVED
	5-59	LOI SHALL BE TARGETED WITHIN THESE CONSTRAINTS: A. THE PERICYNTHION OF THE APPROACH HYPERBOLA WILL BE MAINTAINED WITHIN ±10 NM OF Hp TARGET. B. THE ALTITUDE OF THE NODE (BETWEEN THE APPROACH HYPERBOLA AND THE DESIRED LPO) WILL BE MAINTAINED BETWEEN -10 AND +15 NM OF Hp TARGET.
	5-60	A "GO" FOR LOI REQUIRES THE FOLLOWING: A. COMMITMENT TO AT LEAST 4 HRS IN LPO (PROVIDES ONE REV OF TRACK AFTER LOI FOR CALCULATION OF TEI). B. ADEQUATE FUEL REMAINING FOR SUBSEQUENT LUNAR ORBIT OPERATIONS (MINIMUM IS TEI AND TEC MCC'S)

R	ITEM
	5-61

PREMATURE LOI SHUTDOWN FOR SPS PROBLEMS (LOI ABORT MODES)

A. SHUTDOWN IN MODE I REGION -

EXECUTE A DPS 2-HR DIRECT ABORT FOR:
LOI BURN TIME FROM 0 TO 0:32
LOI ΔV_M FROM 0 TO 207

EXECUTE A DPS 30-MIN DIRECT ABORT FOR:
LOI BURN TIME FROM 0:32 TO 0:53
LOI ΔV_M FROM 207 TO 3 + 48

EXECUTE A DPS TO DEPLETION 30-MIN DIRECT ABORT FOLLOWED BY A SUPPLEMENTARY APS BURN 2 HRS LATER:
LOI BURN TIME FROM 0:53 TO 1:31
LOI ΔV_M FROM 348 TO 613

B. SHUTDOWN IN MODE II REGION -

EXECUTE A DPS + APS 2-IMPULSE CIRCUMLUNAR ABORT WITH APS BURN TO SUPPLEMENT DPS BURN TO DEPLETION DURING SECOND IMPULSE (APS BURN IS TWO HOURS AFTER DPS BURN) FOR:
LOI BURN TIME FROM 1:31 TO 2:03
LOI ΔV_M FROM 613 TO 833

EXECUTE A DPS 2-IMPULSE CIRCUMLUNAR ORBIT:
LOI BURN TIME FROM 2:03 TO 2:54
LOI ΔV_M FROM 833 TO 1200

C. SHUTDOWN IN MODE III REGION -

EXECUTE TEI (SPS OR DPS) AT NEXT OPPORTUNITY OR INITIATE AN ALTERNATE MISSION:
LOI BURN TIME FROM 2:54 TO 6:35
LOI ΔV_M FROM 1200 TO 2980
(FOR APOLLO 17 APS IS REQUIRED TO SUPPLEMENT DPS FOR LOI BURN TIME FROM 4:30 TO 6:35)

NOTES

1. ALL ABORT MANEUVERS ARE MCC-H TARGETED EXCEPT FOR THE DPS 30-MIN ABORT WHICH IS TAKEN FROM THE CREW CHART

2. CONTROL LIMITS APPLY AS FOLLOWS:

LOI BURN TIME	LOI DELTA VM	LIMITS
0 TO 0:53	0 TO 348	TIGHT
0:53 TO 3:40	348 TO 1543	LOOSE
3:40 TO 6:35	1543 TO 2980	TIGHT

RULES 5-62 THROUGH 5-75 ARE RESERVED.

R	ITEM	
		LUNAR ORBIT
	5-76	THE DOI_1 MANEUVER WILL BE TARGETED TO OPTIMIZE THE GROUND TRACK FOR LUNAR LANDING. NOTE THE TARGETED Hp IN REV 12 IS 80K FT.
	5-77	A "GO" FOR DOI REQUIRES COMMITMENT TO AT LEAST 4 HRS IN LUNAR ORBIT. NOTE THIS PROVIDES ONE FULL REV OF TRACK AFTER DOI FOR CALCULATION OF TEI
	5-78	AFTER AOS FOLLOWING DOI_1, EXECUTION OF THE BAILOUT ABORT MANEUVER WILL BE RECOMMENDED IF INCOMING MSFN RADAR DATA INDICATES A CLOSEST APPROACH ALTITUDE OF EQUAL TO OR LESS THAN 1.0 NM ABOVE THE LUNAR TERRAIN. NOTES 1. THE PERICYNTHION ALTITUDE WHICH CORRESPONDS TO 1.0 NM CLOSEST APPROACH IS 3.38 NM. 2. THE VALUE OF DOPPLER RESIDUALS AT AOS WHICH CORRESPONDS TO THIS PERICYNTHION IS APPROXIMATELY -106 CYCLES PER SEC BUT THE ACTUAL VALUE WILL BE DETERMINED IN REAL TIME.
	5-79	PRIOR TO UNDOCKING, CSM MANEUVERS WILL BE SCHEDULED ASAP TO CORRECT THE FOLLOWING SITUATIONS: A. MISS DISTANCE OVER THE LLS GREATER THAN 0.5 DEG OUT OF PLANE B. DEVIATION IN APPROACH AZIMUTH GREATER THAN ±10 DEG FROM THE NOMINAL C. CURRENT PERICYNTHION ALTITUDE LESS THAN 30,000 FT

R	ITEM	
	5-80	RESERVED
	5-81	RESERVED
	5-82	THE FOLLOWING CRITERION APPLY TO DOI_2: A. VOICE CONFIRMATION OF CIRC IS REQUIRED FOR EXECUTION. B. DOI_2 WILL BE SCHEDULED AT LEAST 2 MIN AFTER CIRC. C. LM RCS BURN TIME WILL BE $\leq$ 30 SEC. D. TARGETED PERILUNE AT PDI WILL BE NO LESS THAN 40K FT.
	5-83	AN UPDATE TO THE LLS WILL BE PROVIDED THE CREW DURING PDI TO CORRECT ANY DOWNRANGE ERRORS THAT HAVE ACCUMULATED IN THE LGC ESTIMATE OF POSITION PROVIDING THIS UPDATE IS NO LESS THAN 1000 FT NOR MORE THAN 35,000 FT.
	5-84	THE CIRCULARIZATION MANEUVER WILL BE TARGETED TO ACHIEVE A CIRCULAR ORBIT AT RENDEZVOUS AND AN ORBITAL PERIOD THAT MAINTAINS THE CSM SOLO TIMELINE.

R	ITEM	
	5-85	A. THE LLS LANDMARK SIGHTINGS WILL BE CONSIDERED ACCEPTABLE IF THE PREMISSION LLS POSITION IS CHANGED BY LESS THAN: $\phi \leq$ 7,900 FT (CROSSTRACK LIMIT MAY BE UPDATED IN FLIGHT BASED ON QUALITY OF TRACKING DATA.) $\lambda \leq$ 3,800 FT R $\leq$ 4,350 FT B. POWERED DESCENT WILL NOT BE SLIPPED TO ACHIEVE AN ACCEPTABLE SET OF LANDMARK SIGHTINGS.
	5-86	ALLOWABLE MISALIGNMENT AT PDI IS 0.6 DEG ABOUT THE Y AXIS. IF THE SECOND P52 ALIGNMENT DETECTS DRIFT RATES INDICATIVE OF GREATER MISALIGNMENT, PDI WILL BE SLIPPED ONE REV IF NEW COMPENSATION CANNOT BE IMMEDIATELY APPLIED.
		RULES 5-87 THROUGH 5-89 ARE RESERVED.

R	ITEM	
		RULES 5-85 THROUGH 5-89 ARE RESERVED.
	5-90	LR DATA IS REQUIRED FOR LANDING.

A. LOCK-ON

1. LR DATA ACCEPTED AND CONVERGED CONTINUOUS TO P64 - CONTINUE MISSION IF LOSS OF LOCK OCCURS IN P64.

2. LR DATA ACCEPTED AND CONVERGED WITH SUBSEQUENT DROPOUT - CONTINUE TO P64.

   (A) LANDING RADAR REGAINED IN P64.
   (1) DATA ACCEPTED BY LGC - CONTINUE MISSION
   (2) DATA NOT ACCEPTED BY LGC - ATTEMPT MANUAL LANDING IF LR/PGNS ΔH <1500 FT

   (B) LANDING RADAR NOT REGAINED AT P64 - ABORT

3. LATE LR LOCK-ON WITH DATA BEING INCORPORATED AND CONVERGING - CONTINUE TO P64

   (A) DATA ACCEPTED BY LGC - CONTINUE MISSION
   (B) DATA NOT ACCEPTED BY LGC - ATTEMPT MANUAL LANDING

B. MINIMUM ALTITUDE WITHOUT LR ALTITUDE INCORPORATION

1. PGNS ALTITUDE LESS THAN 22,000 FEET AND PGNS NAVIGATION ERRORS, CONFIRMED BY MSFN OR DOPPLER RESIDUALS, THAT CAUSE AN AGS-PGNS RADIAL VELOCITY DIFFERENCE
   (A) RADIAL N69 NOT INCORPORATED AND DIFFERENCE EXCEEDS 10 FPS - ABORT
   (B) RADIAL N69 INCORPORATED AND DIFFERENCE EXCEEDS 20 FPS - ABORT

2. PGNS ALTITUDE LESS THAN 18,000 FEET AND PGNS NAVIGATION ERRORS, CONFIRMED BY DOPPLER BUT NOT BY AGS, CAUSE THE MSFN-PGNS RADIAL VELOCITY DIFFERENCE TO EXCEED -20 FPS - ABORT

3. PGNS ALTITUDE LESS THAN 10,000 FT

   (A) RADIAL N69 NOT INCORPORATED - ABORT
   (B) LOSS OF WORKING PGNS (AS DEFINED BY RULE 5-91) - ABORT

4. PGNS ALTITUDE LESS THAN 6000 FT - ABORT

NOTE

FOR FAILURES IN THE PGNS/LR INTERFACES, INCORPORATION MAY BE SATISFIED BY A PGNS/LR COMPARISON RESULTING IN ΔH < 1500 FT.

C. MINIMUM ALTITUDE WITHOUT LR VELOCITY INCORPORATION

1. PGNS ALTITUDE LESS THAN 10,000 FEET WITH LANDMARK TRACKING OBTAINED AND PGNS NAVIGATION ERRORS CONFIRMED BY AGS OR DOPPLER THAT CAUSE MSFN - PGNS DOWNRANGE OR CROSSRANGE VELOCITY DIFFERENCES
   (A) NAV N69 INCORPORATED AND $\Delta\dot{X}$ EXCEEDS +50 OR -35 FPS OR $\Delta\dot{Y}$ EXCEEDS +90 OR -70 FPS - ABORT
   (B) NAV N69 NOT INCORPORATED AND $\Delta\dot{X}$ EXCEEDS ±20 FPS OR $\Delta\dot{Y}$ EXCEEDS +45 OR -25 FPS - ABORT

2. PGNS ALTITUDE LESS THAN 10,000 FEET WITHOUT LANDMARK TRACKING OBTAINED AND PGNS NAVIGATION ERRORS CONFIRMED BY AGS OR DOPPLER THAT CAUSE MSFN - PGNS DOWNRANGE OR CROSSRANGE VELOCITY DIFFERENCES
   (A) NAV N69 INCORPORATED AND $\Delta\dot{X}$ EXCEEDS ±35 FPS OR $\Delta\dot{Y}$ EXCEEDS +70 OR -25 FPS - ABORT
   (B) NAV N69 NOT INCORPORATED AND $\Delta\dot{X}$ EXCEEDS ±15 FPS OR $\Delta\dot{Y}$ EXCEEDS +30 OR -10 FPS - ABORT.

R	ITEM	
	5-91	POWERED DESCENT WILL BE TERMINATED FOR THE FOLLOWING: A. PGNS NAVIGATION ERRORS, CONFIRMED BY MSFN OR DOPPLER RESIDUALS, THAT RESULT IN THE FOLLOWING AGS-PGNS DIFFERENCES: $\Delta\dot{X}$ (DOWNRANGE) > +90 OR -35 FPS $\Delta\dot{Y}$ (CROSSRANGE) > ±90 FPS $\Delta\dot{Z}$ (RADIAL) > +60 OR -35 FPS B. PGNS NAVIGATION ERRORS, CONFIRMED BY DOPPLER RESIDUAL BUT NOT BY AGS, THAT RESULT IN THE FOLLOWING MSFN-PGNS VELOCITY DIFFERENCES: $\Delta\dot{Y}$ (CROSSRANGE) > ±200 FPS $\Delta\dot{Z}$ (RADIAL) > +45 OR -35 FPS C. COMMANDED THRUST INCREASING PRIOR TO THROTTLEDOWN OR P63 T_{GO} = 80 SECONDS D. GTC GREATER THAN 57 PERCENT BY P63/P64 PROGRAM SWITCH PLUS 15 SECONDS E. FAILURE TO ACHIEVE FTP (AUTO OR MANUAL) BY NOMINAL T_{IG} + 31 SECONDS (ABORT AT GTC DIVERGENCE) F. THE FOLLOWING PGNS ALARMS: 20105, 00214, 20430, 20607, 21103, 01107, 21204, 21302, 21501, 00402 (CONTINUING) G. CONSIDERATION WILL BE GIVEN TO ABORTING FOR VIOLATION OF THE TIME BAISED DPS ABORT BOUNDARY.
	5-92	THE DESCENT TARGET POINT WILL BE SHIFTED DOWNTRACK IF GTC INDICATES NO THROTTLEDOWN BY P63/64 PROGRAM SWITCH - THE MAXIMUM SHIFT IS AS FOLLOWS: A. 20,000 FT DOWNTRACK IF VALID LANDMARK SIGHTINGS WERE OBTAINED. B. 10,000 FT DOWNTRACK IF NO VALID LAND C. NO DOWNTRACK SHIFT WILL BE ALLOWED IF THE APPROACH AZIMUTH IS BETWEEN 95 AND 100 DEG NOTE ONE MINUTE OF RCS WILL BE USED TO ALLOW LANDING WITHIN THE ABOVE LIMITS.
	5-93	AN ABORT WILL NOT BE REQUESTED FOR A PGNS FAILURE AFTER PITCHOVER IN THE APPROACH PHASE.
	5-94	IN THE EVENT MSFN AND DOPPLER DATA ARE NOT AVAILABLE FOR CONFIRMATION OF PGNS/AGS ERRORS, POWERED DESCENT WILL BE TERMINATED FOR THE FOLLOWING AGS-PGNS VELOCITY DIFFERENCES: $\Delta\dot{X}$ > -35 FPS $\Delta\dot{Z}$ > +60 FPS OR -35 FPS

R	ITEM	
	5-95	IN THE EVENT MSFN, DOPPLER, AND AGS NAV DATA ARE NOT AVAILABLE FOR MONITORING OF POWERED DESCENT, AN ABORT WILL BE PERFORMED IF LR DATA IS NOT INCORPORATED INTO THE PGNS BY 7 MIN.

RULES 5-96 THROUGH 5-100 ARE RESERVED.

R	ITEM	
		ASCENT
	5-101	LM LIFTOFF WILL BE DELAYED ONE REVOLUTION RATHER THAN ACCEPTING A SLIP IN NOMINAL LIFTOFF TIME GREATER THAN A. 10 SECONDS FOR THE DIRECT RNDZ TECHNIQUE B. 90 SECONDS FOR THE COELLIPTIC SEQUENCE RNDZ
	5-102	FOLLOWING A DESCENT ABORT, GUIDANCE SWITCHOVER TO AGS WILL BE PERFORMED FOR A. THE FOLLOWING PGNS ALARMS: 20105, 00214, 20430, 20607, 21103, 01107, 21204, 21302, AND 21501 B. PGNS NAVIGATION ERRORS THAT RESULT IN: 1. AGS PREDICTED INSERTION Hp < 40,000 FEET. 2. AGS PREDICTED INSERTION Ha GREATER THAN TARGET VALUE PLUS 40 NAUTICAL MILES. 3. AGS PREDICTED INSERTION WEDGE ANGLE GREATER THAN 1.0 DEGREE.
	5-103	DURING ASCENT, GUIDANCE SWITCHOVER TO AGS WILL BE PERFORMED FOR A. THE FOLLOWING PGNS ALARMS: 20105, 00214, 20430, 20607, 21103, 01107, 21204, 21302, AND 21501 B. PGNS NAVIGATION ERRORS, CONFIRMED BY AGS RESIDUALS, THAT RESULT IN THE FOLLOWING MSFN-PGNS VELOCITY DIFFERENCES: $\Delta\dot{X}$ (DOWNRANGE) > ±24 FPS $\Delta\dot{Y}$ (CROSSRANGE) > ±90 FPS (COELLIPTIC SEQUENCE RENDEZVOUS), > ±45 FPS (DIRECT RENDEZVOUS) $\Delta\dot{Z}$ (RADIAL) > ±37 FPS C. PGNS NAVIGATION ERRORS THAT RESULT IN 1. AGS PREDICTED INSERTION Hp < 40,000 FEET. 2. AGS PREDICTED INSERTION Ha GREATER THAN TARGET VALUE PLUS 40 NAUTICAL MILES. 3. AGS PREDICTED INSERTION WEDGE ANGLES GREATER THAN 1.0 DEGREE (COELLIPTIC SEQUENCE RENDEZVOUS), GREATER THAN 0.5 DEG (DIRECT RENDEZVOUS) D. IF MSFN NOT VALID DURING ASCENT THE FOLLOWING DOPPLER RESIDUALS WILL BE USED TO CONFIRM SWITCHOVER: 1.(A). AGS-PGNS $\Delta\dot{Y}$ (CROSSRANGE) > ±45 FPS AND DOPPLER-PGNS RESIDUAL > ±8.0 FPS FOR THE DIRECT RNDZ (B). AGS-PGNS $\Delta\dot{Y}$ (CROSSRANGE) > ±90 FPS AND DOPPLER-PGNS RESIDUAL > ±16.0 FPS FOR THE COELLIPTIC RNDZ 2. AGS-PGNS $\Delta\dot{Z}$ (RADIAL) > ±37 FPS AND DOPPLER-PGNS RESIDUAL > ±32.0 FPS

R	ITEM	
	5-104	DURING ASCENT, THE AGS WILL BE DECLARED NO-GO FOR CONFIRMED AGS NAVIGATION ERRORS THAT RESULT IN A. PGNS PREDICTED INSERTION Hp < 30,000 FT. B. PGNS PREDICTED INSERTION Ha GREATER THAN TARGET VALUE PLUS 40 NM C. PGNS PREDICTED INSERTION WEDGE ANGLE GREATER THAN 1.0 DEGREE (COELLIPTIC SEQUENCE RENDEZVOUS), GREATER THAN 0.5 DEG (DIRECT RENDEZVOUS)
	5-105	THE GROUND WILL NOT REQUEST SWITCHOVER AFTER AGS T_{GO} < 30 SEC.
		RULE NUMBERS 5-106 THROUGH 5-110 ARE RESERVED

R	ITEM

RENDEZVOUS

5-111 THE PGNS IS PRIME FOR EITHER THE DIRECT RNDZ (TPI ONLY) OR THE COELLIPTIC SEQUENCE (CSI,CDH, AND TPI) MANEUVER COMPUTATION/EXECUTION WITH THE AGS AS BACKUP UTILIZING THE ACCEPTED SOLUTION. THE AVAILABLE SOLUTIONS FOR THESE MANEUVER(S) ARE, (IN ORDER OF PRIORITY) PGNS, AGS, CMC, AND CHARTS.

A. THE FOLLOWING VOTING LOGIC WILL BE OBSERVED FOR ALL MANEUVERS:

1. IF VHF AND RR AGREE - VOTE 2 OUT OF 3 SOURCES AND EXECUTE THE PRIORITY SOLUTION
2. IF VHF AND RR DISAGREE - MSFN WILL BE UTILIZED TO ISOLATE THE FAILED SYSTEM

B. AGREEMENT BETWEEN SOURCES IS DEFINED AS

1. DIRECT RNDZ - TIP

(A) 3 FPS IN ΔV_X
(B) 7 FPS IN ΔV_Y
(C) 9 FPS IN ΔV_Z

NOTE

LM BIASES OF 1 FPS IN ΔV_X AND -2 FPS IN ΔV_Z WILL BE APPLIED TO THE LM SOLUTION FOR COMPARISON WITH THE CSM SOLUTION

2. COELLIPTIC SEQUENCE RNDZ - ALL MANEUVERS

(A) 3 FPS IN ΔV_X
(B) 7 FPS IN ΔV_Y
(C) 9 FPS IN ΔV_Z

C. THE CMC SOLUTION FOR THE PLANE CHANGE MANEUVER WILL ALWAYS BE EXECUTED IF GREATER THAN 5 FPS.

5-112 LIFTOFF WILL BE COMPUTED TO SATISFY THE FOLLOWING CONSTRAINTS:

A. DIRECT RNDZ

1. THE ΔH AT TPI WILL BE 15 NM.
2. THE $\Delta\theta$ AT TPI WILL BE +1.69 DEG.
3. THE WEDGE ANGLE AT INSERTION WILL BE ZERO DEGREES.
4. TPI WILL OCCUR 45 MIN AFTER INSERTION.

B. COELLIPTIC SEQUENCE RNDZ

1. THE ΔH AT TPI WILL BE 15 NM.
2. THE NOMINAL ELEVATION ANGLE (26.6 DEG) WILL OCCUR 16 MIN PRIOR TO SUNRISE.
3. THE CDH MANEUVER WILL BE APPROXIMATELY ZERO ΔV.

R	ITEM	
	5-113	COELLIPTIC SEQUENCE RNDZ EXECUTION SHALL, WHERE POSSIBLE, OBSERVE THE FOLLOWING CONSTRAINTS: A. THE ACTUAL ΔH MAY BE SLIPPED ± 5 NM FROM 15 NM B. TPI MAY OCCUR NO EARLIER THAN 31 MIN PRIOR TO SUNRISE C. THE ΔT BETWEEN CDH AND TPI MUST BE GREATER THAN 30 MIN
	5-114	THE "BAILOUT" MANEUVER TO TRANSFER FROM THE DIRECT RNDZ TECHNIQUE TO THE COELLIPTIC SEQUENCE RNDZ WILL BE EXECUTED IF: A. THE ΔV_G OF THE TWEAK MANEUVER BECOMES GREATER THAN 60 FPS B. EXECUTION OF THE TWEAK WOULD RESULT IN A LM PERILUNE OF LESS THAN 5 NM C. LOSS OF ANY SYSTEM DURING ASCENT RESULTING IN VIOLATION OF THE RNDZ NAVIGATION MATRIX
	5-115	A. ONE PRIMARY RNDZ NAVIGATION TECHNIQUE IS REQUIRED TO COMMIT TO THE DIRECT RNDZ. THE PRIMARY RNDZ NAVIGATION TECHNIQUES ARE: 1. LGC AND RNDZ RADAR 2. AEA AND RNDZ RADAR 3. CMC, SEXTANT, AND LM LIGHT B. THE SECONDARY RNDZ NAVIGATION TECHNIQUES, WHICH MAY YIELD ACCEPTABLE MANEUVER SOLUTIONS BUT ARE NOT CONSIDERED ADEQUATE AS A SINGLE MANEUVER COMPUTATION SOURCE FOR COMMITTING TO DIRECT RNDZ ARE: 1. AEA, VHF EMS, LM COAS, AND CSM LIGHT 2. AEA, VHF CMC, LM COAS, AND CSM LIGHT 3. CMC, VHF CMC, SEXTANT, AND REFLECTED SUNLIGHT 4. CMC, VHF CMC, CSM COAS, AND LM LIGHT 5. CMC, VHF CMC, CSM COAS, AND REFLECTED SUNLIGHT
		RULES 5-116 THROUGH 5-120 ARE RESERVED.

R	ITEM	
		TRANSEARTH ENTRY
	5-121	TRANSEARTH MCC WILL BE TARGETED TO ACHIEVE ENTRY CONDITIONS AS FOLLOWS: A. IF V_{EI} > 31000 FPS OR G&N NO-GO, USE STEEP TARGET LINE. B. IF V_{EI} < 31000 FPS AND G&N GO, USE SHALLOW TARGET LINE.
	5-122	TRANSEARTH MCC PHILOSOPHY A. TEC MCC WILL NOT USE LANDING POINT CONTROL UNLESS THE LANDING POINT IS UNACCEPTABLE. B. IF GAMMA EI IS OUTSIDE THE ENTRY CORRIDOR. 1. PRIOR TO GET OF NOMINAL MCC 5 - EXECUTE MCC ASAP IF PREDICTED ΔV AT MCC 5 IS > 20 FPS 2. AFTER MCC 5 - EXECUTE MCC ASAP C. MCC GREATER THAN MINIMUM IMPULSE CAPABILITY WILL USE THE SPS IF PRACTICAL.
	5-123	TEC MCC FOR LANDING AREA CONTROL A. PRIOR TO EI MINUS 24 HRS - WILL BE EXECUTED FOR RECOVERY ACCESS VIOLATIONS, UNACCEPTABLE WEATHER AT IP, OR IF THERE IS ANY LAND MASS IN THE G&N EMS, OR CONSTANT G LANDING AREAS OR IF A SIGNIFICANT LAND MASS IS IN ANY OTHER PORTION OF THE OPERATIONAL FOOTPRINT. B. AFTER EI MINUS 24 HRS - WILL NOT BE EXECUTED.
	5-124	RESERVED
	5-125	BACKUP ENTRY IS CONSTRAINED AS FOLLOWS: A. THE CONSTANT G ENTRY MUST FALL BETWEEN 3 AND 5 G'S. B. EMS RANGING WILL NOT BE ATTEMPTED UNTIL V IS LESS THAN 25500 FPS.
	5-126	WEATHER AVOIDANCE WITH AERODYNAMIC LIFT WILL NOT BE ATTEMPTED UNLESS THE G&N IS OPERATIONAL, OR EMS-INDICATED VELOCITY IS LESS THAN 25500 FPS.
	5-127	PREDICTED ENTRY CORRIDOR VIOLATION AFTER THE LAST MCC OPPORTUNITY A. UNDERSHOOT LINE EXCEED - GROUND ADVISE CREW TO FLY FULL LIFT UNTIL PEAK G IS PASSED, THEN FLY G&N. B. OVERSHOOT LINE EXCEED - GROUND ADVISE CREW TO FLY NEGATIVE LIFT TO 2 G'S FOLLOWED BY 4-G CONSTANT ENTRY.

R	ITEM	
	5-128	RESERVED
	5-129	RESERVED
	5-130	THE G&N IS NO-GO DURING ENTRY IF A. P65 VALUE OF VL DIFFERS FROM THE GROUND COMPUTED LIMITS B. P65 VALUE OF DL DIFFERS FROM THE GROUND COMPUTED LIMITS C. CAUSES TRAJECTORY TO VIOLATE THE OFFSET LIMITS (SKIP) ON EMS SCROLL D. CAUSES TRAJECTORY TO VIOLATE THE ONSET LIMITS (G) ON EMS SCROLL E. THE G&N TRIM ATTITUDES AT CM/SM SEP DIFFER FROM THE HORIZON MONITOR ATTITUDE BY GREATER THAN 5 DEG F. THE G&N TRIM ATTITUDES AT .05 G DIFFER FROM THE GROUND VALUES BY GREATER THAN 5 DEG G. THE CMC FAILS TO SEQUENCE FROM P63 TO P64 AT RET .05 G ±5 SEC

R	ITEM

5-131 TEI ABORTS AND RESIDUAL TRIMMING PHILOSOPHY

A. IN GENERAL, ONCE THE SPS HAS BEEN IGNITED, THE MANEUVER WILL BE COMPLETED WITH THE SPS ENGINE. THIS IMPLIES THAT THERE WILL BE NO MANUAL SHUTDOWNS AND AS MANY RESTARTS AS NECESSARY TO COMPLETE THE TEI MANEUVER. QUANTITIES FOR THE ΔV RULES LISTED BELOW FOR PREMATURE SHUTDOWNS ARE GUIDELINES FOR USE OF RCS PROPELLANT.

1. NO SPS IGNITION - DO NOT ATTEMPT A MANUAL RESTART. SLIP 1 REV AND DO MALFUNCTION PROCEDURES.

2. AFTER SPS IGNITION, THERE WILL BE NO MANUAL SPS SHUTDOWN.

3. FOR PREMATURE SHUTDOWN:

   (A) TEI ΔV REMAINING GREATER THAN THE RCS ΔV CAPABILITY MINUS 20 FPS - RESTART SPS AND COMPLETE THE TARGETED BURN. NO TRIM.

   (B) TEI ΔV REMAINING LESS THAN THE RCS ΔV CAPABILITY MINUS 20 FPS, BUT GREATER THAN 5 FPS - RCS +X OR SPS MAY BE USED TO COMPLETE THE TARGETED BURN BASED UPON CREW JUDGEMENT. NO TRIM.

   (C) RESIDUAL LESS THAN 5 FPS - TRIM X AND Z.

NOTE

THIS RULE ALSO APPLIES FOR A DPS TEI WITH NO OPERATIONAL SPS FOR BACKUP.

B. PREMATURE DPS TEI SHUTDOWN WITH AN OPERATIONAL SPS AS BACKUP

1. NO DPS IGNITION - SLIP 1 REV AND DO MALFUNCTION PROCEDURES AND RETARGET USING DPS OR SPS.

2. FOR A PREMATURE SHUTDOWN IN THE MODE III REGION (ACHIEVED TEI ΔV < 1700 FPS/PRE-ABORT PERIOD LESS THAN 15 HR) - TARGET THE SPS FOR THE NEXT TEI.

3. FOR A PREMATURE SHUTDOWN IN THE MODE I REGION (ACHIEVED TEI ΔV > 1700 FPS) - TARGET THE SPS AT TEI +2 HR.

RULES 5-132 THROUGH 5-139
ARE RESERVED.

R	ITEM	

RANGE SAFETY RULES AND AGREEMENTS

GENERAL

5-140 RANGE SAFETY POLICIES AND CRITERIA ARE SPECIFIED IN AFETR MANUAL (AFETRM) 127-1 DATED 1 JANUARY 1969. THE FOLLOWING MISSION RULES CONCERNING SPECIFIC AFETR/NASA INTERFACE SUPPLEMENT AFETRM 127-1.

5-141 THE RSO WILL ACCOMPLISH THE PAD EMERGENCY RANGE CUTOFF PROCEDURE IF THE SPACE VEHICLE WILL NOT LIFT OFF AFTER IGNITION AND NASA IS UNABLE TO ACCOMPLISH CUTOFF. THE RSO WILL SEND "ARM/MFCO" ONLY IN RESPONSE TO A CODED VERBAL REQUEST FROM THE NASA LAUNCH VEHICLE TEST CONDUCTOR (CLTC). THE CLTC WILL CALL THE RSO ON THE CLTC-RSO DIRECT LINE TO TRANSMIT THIS REQUEST. THE RSO WILL NOT EXECUTE THIS PROCEDURE IF HE HAS A LIFTOFF INDICATION.

5-142 THE FLIGHT DIRECTOR (FD) WILL INITIATE ABORT IN RESPONSE TO A CODED VERBAL REQUEST FROM THE RSO. THIS PROCEDURE WILL BE EXECUTED IF RANGE SAFETY FLIGHT TERMINATION CRITERIA HAVE BEEN VIOLATED AND RSO EFFORTS TO TERMINATE THRUST HAVE FAILED. THE REQUEST FROM RSO TO FD WILL BE TRANSMITTED ON THE FLIGHT DIRECTOR LOOP WITH THE FIDO-RSO PRIVATE LINE AS BACKUP.

5-143 THE RSO WILL SEND "ARM/MFCO" IN RESPONSE TO A CODED VERBAL REQUEST FROM THE FLIGHT DIRECTOR (FD) OR THE FLIGHT DYNAMICS OFFICER (FIDO). THIS PROCEDURE WILL BE EXECUTED IF ABORT LIMITS HAVE BEEN EXCEEDED AND ABORT ACTION HAS BEEN UNSUCCESSFUL. THE REQUEST FROM FD/FIDO TO THE RSO WILL BE TRANSMITTED ON THE RSO LOOP (CAPE 111) WITH THE FIDO-RSO PRIVATE LINE AS BACKUP.

5-144 THE FD WILL INFORM THE RSO WHEN THE S-IC NO. 3 OR NO. 4 ENGINE HAS SHUT DOWN BY STATING "RSO, NO. 3 OUT" OR "NO. 4 OUT" ON THE RSO LOOP (CAPE 111) AND/OR ACTIVATE THE ENGINE OUT LIGHT ON THE RSO CONSOLE. THE NO. 3 ENGINE OUT LIGHT CIRCUIT FOR FD TO RSO IS HIGHLY DESIRABLE.

5-145 IF RANGE SAFETY DESTRUCT LINES ARE VIOLATED, THE RSO WILL SEND "ARM/MFCO" AND NOTIFY THE FD/FIDO. NO SPS THRUSTING WILL BE INITIATED FOLLOWING SUCH RANGE SAFETY ACTION EXCEPT TO PROVIDE CREW SAFETY AS DETERMINED BY THE FD.

5-146 IF AN ESTABLISHED IMPACT PREDICTION (IP) POINT IS ON THE CAPE KENNEDY LAND AREA, "DESTRUCT/PD" WILL BE TRANSMITTED.

5-147 IF AN ATTEMPT TO TERMINATE THRUST BY "ARM/MFCO" IS UNSUCCESSFUL WHILE THE IP IS ON THE CAPE KENNEDY LAND AREA, "DESTRUCT/PD" WILL BE SENT.

R	ITEM	
	5-148	WHEN THE IP HAS MOVED OFF THE CAPE, FLIGHT TERMINATION ACTION WILL BE LIMITED TO "ARM/MFCO" OR CREW INITIATED ABORT. THE "DESTRUCT/PD" FUNCTION WILL BE SENT ONLY AFTER FD/FIDO CONFIRMATION OF SATISFACTORY SPACECRAFT SEPARATION, AND ONLY IF FUEL DISPERSION IS NECESSARY.
	5-149	IF AN IP POINT IS ESTABLISHED AND "DESTRUCT/PD" IS DEEMED UNNECESSARY, THE RSO WILL NOTIFY FD/FIDO, "SAFE WILL BE SENT UPON FD/FIDO'S REQUEST, 'RSO SEND SAFE'".
	5-150	FD/FIDO WILL DECLARE TO THE RSO WHEN THERE IS NO POSSIBILITY OF INSERTING THE SPACECRAFT INTO AN ORBIT, AND THE RSO WILL NOT ALLOW THE AFRICAN GATE TO BE OVERFLOWN.
	5-151	AN ETR RANGE SAFETY OFFICER (BRSO) IS REQUIRED AT BERMUDA TO MONITOR PRESENT POSITION AND IMPACT PREDICTION CHARTS, TO OBSERVE TELEMETRY DISPLAYS, AND TO TRANSMIT THE RANGE SAFETY FUNCTIONS WHEN COMMANDED TO DO SO BY THE RSO. FOR FLIGHT AZIMUTHS LESS THAN 090 DEGREES, THE BRSO WILL ASSUME PRIMARY RANGE SAFETY RESPONSIBILITY IN THE EVENT OF LOSS OF COMMUNICATIONS BETWEEN THE BRSO AND THE RSO.
	5-152	SAFING BY THE RSO WILL BE TRANSMITTED AFTER GATE PENETRATION AND FIRST S-IVB CUTOFF WHEN THE FD/FIDO REQUESTS, "RSO SEND SAFE." WHEN SAFING IS CONFIRMED, THE RSO WILL STATE "SAFING CONFIRMED." IN THE EVENT OF LOSS OF COMM WITH FD/FIDO, THE RSO WILL SEND SAFE ONLY IF HE CAN CONFIRM S-IVB CUTOFF.
	5-153	IF SAFING CANNOT BE CONFIRMED BY THE RSO, ANOTHER SAFING ATTEMPT WILL BE MADE BY THE RSO ON THE FIRST ORBITAL PASS OVER THE CAPE. COORDINATION WILL BE EFFECTED WITH THE SUPERINTENDENT OF RANGE OPERATIONS (SRO) AND FIDO TO ENSURE COMMAND COVERAGE AND TELEMETRY DISPLAY AVAILABILITY. AT THE AGREED TIME, FIDO WILL STATE, "RSO SEND SAFE." UPON CONFIRMATION, THE RSO WILL STATE, "SAFING CONFIRMED".
	5-154	THE FD/FIDO WILL INFORM THE RSO IMMEDIATELY UPON DETERMINATION OF A SPACECRAFT SEPARATION. THIS NOTIFICATION WILL BE TRANSMITTED ON THE RSO LOOP (CAPE 111) WITH THE FIDO-RSO PRIVATE LINE AS BACKUP.

R	ITEM	
		TRACKING SOURCES
	5-155	AT LEAST TWO (2) VEHICLE POSITION DATA SOURCES ARE MANDATORY TO L/O FOR EACH PHASE OF POWERED FLIGHT PRIOR TO THE AFRICAN GATE TO ENABLE THE RANGE SAFETY OFFICER TO DETERMINE IF THE VEHICLE IS NORMAL OR VIOLATES ESTABLISHED INFLIGHT SAFETY CRITERIA.
	5-156	DATA FROM TWO (2) OF THE FOLLOWING THREE (3) RADARS ARE MANDATORY TO L/O (OTHER HIGHLY DESIRABLE): BERMUDA FPS-16, BERMUDA FPQ-6, AND GRAND TURK TPQ-18.
	5-157	PRESENT POSITION AND IP PLCTS AT BERMUDA (BDA) USING INPUTS FROM EITHER THE BDA FPS-16 OR BDA FPQ-6 RADAR ARE HIGHLY DESIRABLE FOR LAUNCH.

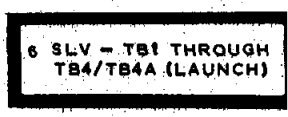
R	ITEM	
		AIRBORNE SYSTEMS
	5-158	TWO (2) OPERATIONAL RANGE SAFETY COMMAND RECEIVERS ON EACH LAUNCH VEHICLE STAGE (S-IC, S-II, AND S-IVB) ARE MANDATORY TO L/O. THE RANGE SAFETY SUPERVISOR (CRSS) AT THE LAUNCH CONTROL CENTER WILL DETERMINE IF THE RECEIVERS ARE OPERATING PROPERLY.
	5-159	IU C-BAND BEACON NO. 1 OR NO. 2 IS HIGHLY DESIRABLE FOR LAUNCH.

R	ITEM	
		COMMAND/CONTROL
	5-160	NASA BERMUDA DRS COMMAND/CONTROL CAPABILITY IS MANDATORY TO L/O FOR FLIGHT AZIMUTHS LESS THAN 90 DEGREES.
	5-161	A 4-SECOND TIME DELAY BETWEEN "ARM/MFCC" AND "DESTRUCT/PD" WILL BE PROVIDED BY TIMERS IN THE RSO CONSOLE IN THE RCC.

R	ITEM	
		COMMUNICATIONS
	5-162	ONE (1) OF TWO (2) PRIVATE, INDEPENDENT, GEOGRAPHICALLY DIVERSIFIED COMMUNICATIONS LINKS BETWEEN THE RSO AND BRSO IS MANDATORY AND THE OTHER IS HIGHLY DESIRABLE.
	5-163	ONE (1) OF THE FOLLOWING THREE (3) COMMUNICATIONS LINKS IS MANDATORY BETWEEN THE RSO AND FD/FIDO AND THE OTHERS ARE HIGHLY DESIRABLE. A. RSO LOOP (CAPE 111) B. RSO PRIVATE LINE C. FLIGHT DIRECTOR LOOP
	5-164	A COMMUNICATIONS LINK BETWEEN THE RSO AND THE RANGE SAFETY SUPERVISOR (CRSS) AT THE LAUNCH CONTROL CENTER IS MANDATORY FOR T-40 MINUTE DESTRUCT CHECKS.
	5-165	A DIRECT LINE COMMUNICATIONS LINK BETWEEN THE RSO AND THE LAUNCH VEHICLE TEST CONDUCTOR (CLTC) IS HIGHLY DESIRABLE.

R	ITEM	
		TELEMETRY
	5-166	IU TELEMETRY DATA (ONBOARD GUIDANCE PARAMETERS) TO THE RTCS ARE HIGHLY DESIRABLE UNTIL S-IVB CUTOFF FOR IP COMPUTATION AND RSO DISPLAY.
	5-167	TELEMETRY REQUIREMENTS TO BE DISPLAYED FOR THE RSO AND THE BRSO ARE HIGHLY DESIRABLE.

R	ITEM	
		RANGE SAFETY WEATHER RESTRICTIONS
	5-168	WIND RESTRICTIONS AN ANNUAL PROFILE WIND RESTRICTION OF 1.25 SIGMA (11 PERCENT) WILL BE IN EFFECT FOR LAUNCH.
	5-169	CEILING AND VISIBILITY RESTRICTIONS NO CEILING OR VISIBILITY RESTRICTIONS WILL BE IMPOSED PROVIDING CNV FPS-16 AND MILA TPQ-18 RADARS AND BEACON NO. 1 ARE OPERATIONAL.


6 SLV – TB1 THROUGH
TB4/TB4A (LAUNCH)

R	ITEM

SUMMARY OF LAUNCH PHASE RULES

6-1 S-IC LOSS OF THRUST
6-2 LOSS OF ATTITUDE CONTROL
6-3 INERTIAL PLATFORM FAILURE - ACCELEROMETER
6-4 SLV INERTIAL PLATFORM FAILURE
6-5 S-IVB CRYO REPRESS VALVES FAIL OPEN
6-6 EXCESSIVE ATTITUDE ERROR IN PITCH OR YAW DURING S-II BURN
6-7 S-II LOSS OF THRUST
6-8 S-II GIMBAL SYSTEM FAILURE
6-9 S-II SECOND PLANE SEPARATION FAILS
6-10 S-IVB LOSS OF HYDRAULIC FLUID
6-11 S-IVB LOSS OF THRUST
6-12 S-IVB COLD HELIUM SHUTOFF VALVE(S) FAIL OPEN

THE FOLLOWING MISSION RULES ALSO APPLY TO THIS SECTION:
NONE

R	ITEM

A. BSE GENERALIZED SWITCH SELECTOR COMMAND CAPABILITY EXISTS:

1. WHEN CREW ENABLES IU COMMAND SYSTEM (EXCEPT AS NOTED BELOW IN ITEM D)
2. AFTER TB7 + 20 MIN
3. AFTER SPACECRAFT SEPARATION

B. BSE MANEUVER UPDATE AND INHIBIT CAPABILITY EXISTS FOR TB7 MANEUVERS ONLY.

C. BSE HAS NAVIGATION UPDATE CAPABILITY (FMR 6-3) AND TARGET UPDATE CAPABILITY (NO REQUIREMENT).

D. BSE HAS NO COMMAND CAPABILITY DURING POWERED BURN PHASES.

E. A SAFE DISTANCE BETWEEN THE SPACECRAFT AND S-IVB/IU IS DEFINED AS 7000 FT.

F. BSE WILL RECOMMEND NO S-IVB RESTART FOR ANY CONFIRMED CONDITION/MALFUNCTION IN THE LAUNCH VEHICLE WHICH RESULTS IN:

1. A CATASTROPHIC HAZARD
2. ACHIEVEMENT OF AN S-IVB ENGINE MAINSTAGE BURN WITH EXPECTED CUTOFF OR SHUTDOWN CONDITIONS DEFINITELY PRECLUDING AN ACCEPTABLE LUNAR MISSION. IN APPLYING THIS CRITERIA TO SPECIFIC MISSION RULES, A GO/NO GO RECOMMENDATION WILL BE REQUIRED IF INSUFFICIENT S-IVB CONSUMABLES OR PROPULSION PERFORMANCE IS AVAILABLE TO ASSURE ANY FINITE PROBABILITY OF ACHIEVING A CUTOFF ORBIT WITH 28K NM APOGEE ALTITUDE (FMR 7-1).

G. IN THE EVENT OF NO S-IVB IGNITION AT RESTART OR AN EARLY S-IVB SECOND BURN CUTOFF, THE SPACECRAFT SHOULD REMAIN ATTACHED TO THE S-IVB/IU AND MONITOR LH_2 AND LOX ULLAGE PRESSURES UNTIL THE STAGE STATUS CAN BE ASSESSED BY GROUND. IF EMERGENCY SEPARATION IS REQUIRED IMMEDIATELY AFTER S-IVB CUTOFF, THE SPACECRAFT SHOULD IMMEDIATELY GO TO A SAFE DISTANCE (7000 FT) FROM THE S-IVB/IU.

H. ABORT OR SPACECRAFT SEPARATION DURING LAUNCH PHASE WILL BE RECOMMENDED FOR THE FOLLOWING:

6-1 S-IC LOSS OF THRUST
6-5 S-IVB LOX CRYO REPRESS VALVE(S) FAIL OPEN
6-6 EXCESSIVE ATTITUDE ERRORS IN PITCH OR YAW DURING S-II BURN
**6-7 S-II LOSS OF THRUST
**6-8 S-II ANY SINGLE ACTUATOR HARDOVER INBOARD
6-9 S-II SECOND PLANE SEPARATION FAILS TO OCCUR AT TB3 + 31 SEC
6-10 S-IVB LOSS OF ENGINE HYDRAULIC FLUID PRIOR TO FIRST S-IVB BURN
6-11 S-IVB STAGE LOSS OF THRUST
6-12 S-IVB COLD HELIUM SHUTOFF VALVE(S) FAILS OPEN

I. SPACECRAFT GUIDANCE TAKEOVER WILL BE RECOMMENDED FOR THE FOLLOWING:

6-4 LAUNCH VEHICLE INERTIAL PLATFORM FAILURE-ATTITUDE REFERENCE
7-8 LOSS OF ATTITUDE CONTROL DURING TB5, TB7

J. S-II/S-IVB EARLY STAGING WILL BE RECOMMENDED FOR THE FOLLOWING:

6-5 S-IVB LOX CRYO REPRESS VALVE(S) FAIL OPEN
**6-6 EXCESSIVE ATTITUDE ERROR IN PITCH OR YAW DURING S-II BURN
**6-7 S-II LOSS OF THRUST
**6-8 S-II ANY SINGLE ACTUATOR HARDOVER INBOARD
**6-12 S-IVB COLD HELIUM SHUTOFF VALV(S) FAILS OPEN

** TIME DEPENDENT

R	ITEM

K. TLI INHIBIT PRIOR TO RESTART OR SPACECRAFT SEPARATION WILL BE RECOMMENDED FOR THE FOLLOWING:

7-1 INSUFFICIENT PROPELLANTS REMAIN FOR ACHIEVEMENT OF ACCEPTABLE ALTERNATE MISSIONS.
7-5 FAILURE OF RANGE SAFETY SYSTEM AFTER INSERTION
7-8 LOSS OF ATTITUDE CONTROL
7-22 S-IVB CONFIRMED LOSS OF HYDRAULIC FLUID
8-6 S-IVB ACTUATOR CONFIRMED HARDOVER PRIOR TO IGNITION
8-8 LOSS OF ATTITUDE CONTROL DURING S-IVB SECOND BURN

L. SPACECRAFT SEPARATION OR TLI INHIBIT WILL BE RECOMMENDED UNLESS COMMAND ACTION IS SUCCESSFUL FOR THE FOLLOWING:

7-4 J-2 ENGINE MAIN OXIDIZER VALVE FAILS TO CLOSE AT FIRST S-IVB CUTOFF
*7-6 S-IVB COLD HELIUM SHUTOFF VALVES FAIL TO CLOSE
7-12 J-2 ENGINE MAIN FUEL VALVE OR MAIN OXIDIZER VALVE LEAKAGE
*7-14 S-IVB STAGE COMMON BULKHEAD DELTA PRESSURE REACHES OR EXCEEDS +36 OR -26 PSID
7-20 J-2 ENGINE START BOTTLE PRESSURE OUTSIDE RESTART LIMITS

*EMERGENCY SEPARATION REQUIRED

M. BSE WILL INHIBIT TB6 IN THE EVENT A TLI NO-GO DECISION IS MADE IN TB5.

N. THERE MUST BE AT LEAST AN 80 MIN COAST PERIOD BETWEEN S-IVB FIRST AND SECOND BURNS.

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	6-1	S-IC STAGE LOSS OF THRUST	LAUNCH		CUES
		A. ANY SINGLE ENGINE PRIOR TO TB3		A. CONTINUE MISSION BSE INFORM FLIGHT AND FIDO.	A&B. 1. THRUST OK SWITCHES - OFF (K33-115 THROUGH K47-115) 2. THRUST CHAMBER PRESSURE (D8-101 THROUGH D8-105) 3. LONGITUDINAL ACCELERATION (A2-603) 4. FINAL THRUST OK CUTOFF - ON (K52-115 THROUGH K56-115)
		B. ANY TWO OR MORE ENGINES PRIOR TO DEACTIVATION OF ENGINE AUTO ABORT		B. ABORT BSE INFORM FLIGHT AND TRANSMIT ABORT REQUEST.	
		C. LOSS OF TWO ADJACENT CONTROL ENGINES AFTER DEACTIVATION OF AUTO ABORT AND BEFORE TB2 + 8 SEC		C. ABORT BSE INFORM FLIGHT AND TRANSMIT ABORT REQUEST WHEN ALL ENGINES CUT OFF	NOTES A&B. 1. CREW MAY DEACTIVATE AUTOMATIC ABORT AFTER TB1 120 SEC.
		D. LOSS OF TWO ADJACENT CONTROL ENGINES AFTER TB2 + 8 SEC		D. CONTINUE MISSION BSE INFORM FLIGHT AND FIDO.	C. 1. FOR LOSS OF TWO ADJACENT CONTROL ENGINES BEFORE CECO (TB2 + 0), ALL ENGINES WILL CUT OFF AT CECO, FOR LOSS OF TWO ADJACENT CONTROL ENGINES AFTER CECO. ALL ENGINES WILL CUT OFF IMMEDIATELY.
		E. LOSS OF THRUST - ENGINE 3 OR 4 (THIS RULE APPLIES ONLY FOR THE UNIQUE CASE OF ENGINE 3 OR 4 THRUST LOSS BETWEEN 0 TO 45 SEC)	LAUNCH	E. CONTINUE MISSION BSE INFORM FLIGHT AND FIDO. FLIGHT INFORM RSO.	D. 1. ALL ENGINES WILL SHUT DOWN IMMEDIATELY. S-IC/S-II STAGING IS ENABLED AT TB2 + 16.9 SEC.
		1. VOICE COMM WITH RSO		1.(A) FLIGHT CONFIRM ENGINE 3 OR 4 OUT VIA RSO LOOP. (B) FLIGHT CONFIRM NO OTHER KNOWN ANOMALIES BY LIGHT ACTIVATION AND VOICE REPORT.	CUES E. 1. THRUST CHAMBER PRESSURE (D8-103 AND D8-104) 2. ENGINE 3 OR ENGINE 4 THRUST OK SWITCHES OFF (K39-115 THROUGH K44-115) 3. ENGINE 3 OR 4 FNL THRUST OK CUTOFF (K54-115 THROUGH K55-115)
		2. NO VOICE COMM WITH RSO		2. FLIGHT CONFIRM ENGINE 3 OR 4 OUT AND NO OTHER KNOWN ANOMALIES BY LIGHT ACTIVATION.	NOTES E. 1. RSO PL OR FD LOOP BACKUP TO RSO LOOP. 2. CONFIRMATION OF NO OTHER KNOWN ANOMALIES WILL BE BASED ON: (A) ENGINE CHAMBER PRESSURE NOT DECREASING, AND (B) THRUST OK SWITCHES - ON

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	6-2	LOSS OF ATTITUDE CONTROL			CUES
		A. PRIOR TO DEACTIVATION OF EDS AUTO ABORT	LAUNCH	A. ABORT BSE TRANSMIT ABORT REQUEST	A.1. ANGULAR RATES - PITCH (R4-602) OR YAW (R5-602) GREATER THAN 2 DEG/SEC AND NOT DECREASING. ROLL (R6-602) GREATER THAN 5 DEG/SEC AND NOT DECREASING. 2. ANGULAR RATES - PITCH (R13-602) OR YAW (R8-602) GREATER THAN 2 DEG/SEC AND NOT DECREASING. ROLL (R12-602) GREATER THAN 5 DEG/SEC AND NOT DECREASING (SEE NOTE A.2) 3. LOSS OF ATTITUDE CONTROL ALERT (SEE NOTE A.2.) NOTES A.1. THESE CUES ARE VALID IF RATE CHANNEL SWITCHOVER HAS NOT OCCURRED.
		B. BETWEEN DEACTIVATION OF EDS AUTO ABORT AND TB5 INITIATE	LAUNCH	B. ABORT BSE TRANSMIT ABORT REQUEST	CUES B.1. ANGULAR RATES - PITCH (R4-602), YAW (R5-602), GREATER THAN OR EQUAL TO 10 DEG/SEC, ROLL (R34-602) GREATER THAN OR EQUAL TO 20 DEG/SEC. 2. ANGULAR RATES - PITCH (R13-602), YAW (R8-602), GREATER THAN OR EQUAL TO 10 DEG/SEC. 3. EDS OVERRATE - PITCH OR YAW (K84-602), ROLL (K83-602). NOTES B.1. R13-602 AND R8-602 ARE VALID IF RATE CHANNEL SWITCHOVER HAS NOT OCCURRED. 2. LOSS OF ATTITUDE CONTROL ALERT WILL BE GIVEN FOR THE FOLLOWING CONDITIONS: (A) LVDC/LVDA COMPUTATIONAL FAILURE. (B) ATTITUDE ERROR SIGNALS: TB1 + 120 SEC THRU S-II BURN - PITCH, YAW, ROLL, 5 DEG. S-IVB BURN - PITCH AND YAW, 5 DEG; ROLL, 3.5 DEG. (C) FAILURE TO INITIATE PROPER GUIDANCE SEQUENCE (D) S-IVB ENGINE ACTUATOR HARDOVER GREATER THAN ±5 DEG (S-II BURN ONLY) (E) FAILURE OF S-IVB ENGINE HYDRAULICS (S-IVB BURN ONLY) 3. ROLL ATTITUDE ERRORS >3.5 DEG. DURING S-IVB BURN MAY BE A RESULT OF LOSS OF BOTH APS MODULES. THE CREW SHOULD ATTEMPT TO CONTROL ROLL WITH RCS.

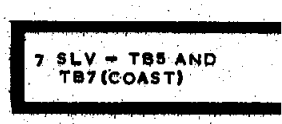
R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	6-3	INERTIAL PLATFORM FAILURE - ACCELEROMETER (ONE OR MORE AXIS)	LAUNCH COAST RESTART	CONTINUE MISSION BSE INFORM FLIGHT, FIDO, AND GUIDO CAPCOM ADVISE CREW	CUES 1. GUIDANCE STATUS WORD (MODE CODE 24) (H60-603) BITS D26 AND D25 FOR Z ACCEL SET TO "ONE" BITS D24 AND D23 FOR X ACCEL SET TO "ONE" BITS D22 AND D21 FOR Y ACCEL SET TO "ONE" 2. ACCELEROMETER PICKOFFS (X, Y, OR Z) INDICATE IN EXCESS OF 3 DEG AND NOT DECREASING (H10-603, H11-603, H12-603) NOTES 1. NO EFFECT ON VEHICLE TRAJECTORY DURING S-IC STAGE BURN. 2. LVDC SWITCHES TO A BACKUP MODE AND UTILIZES A PRECOMPUTED F/M PROFILE FOR FAILED AXIS DURING THE S-IC, S-II, AND S-IVB BURNS. THE IU STATE VECTOR THEREAFTER MAY NOT REFLECT THE ACTUAL FLIGHT TRAJECTORY. 3. A NAVIGATION UPDATE WILL BE REQUIRED UNLESS REAL-TIME ANALYSIS INDICATES A NAVIGATION UPDATE IS NOT REQUIRED (SEE FMR 5-29). 4. CREW WILL INITIATE MANUAL CUTOFF FOR AN OVERSPEED CONDITION. 5. THE SECOND BURN PRECOMPUTED F/M PROFILE FOR THE FAILED AXIS ASSUMES NOMINAL PROPULSION PERFORMANCE AND NOMINAL MASS HISTORY.
	6-4	LAUNCH VEHICLE INERTIAL PLATFORM FAILURE - ATTITUDE REFERENCE	ALL	CONTINUE MISSION BSE INFORM FLIGHT AND RECOMMEND SPACECRAFT GUIDANCE TAKEOVER	CUES 1. GUIDANCE REFERENCE FAILURE (D04 OR D06) GUID MODE WORD 2 (MODE WORD 26) BIT 8 SET TO ONE (H60-603) 2. GUIDANCE STATUS WORD (MODE CODE 24) (H60-603) BITS D20 AND D19 FOR Z GIMBAL SET TO "ONE" BITS D18 AND D17 FOR X GIMBAL SET TO "ONE" BITS D16 AND D15 FOR Y GIMBAL SET TO "ONE" 3. LADDER OUTPUTS CONSTANT FOR FAILED AXES (H54-603, H55-603, H56-603) 4. ATTITUDE ERROR CONSTANT FOR FAILED AXES (H69-602, H70-602, H71-602) NOTES IN THE EVENT OF THIS FAILURE PRIOR TO TB6, THE CREW WILL HAVE TO INITIATE TB6, AND TLI C/O WILL BE ISSUED BY CMC.

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	6-5	S-IVB LOX CRYO REPRESS VALVE(S) FAILS OPEN	LAUNCH		CUES
		A. PRIOR TO S-II CUTOFF		A. CONTINUE MISSION/EARLY STAGE/ ABORT	A.1. LOX TANK ULLAGE PRESSURE AT RELIEF (41-44 PSIA) AND RELIEVING (D179-406, D180-406)
		1. DURING S-IC BURN		1. CONTINUE MISSION/ EARLY STAGE/ABORT	2. COLD HELIUM REGULATOR DISCHARGE PRESSURE REMAINS LESS THAN 50 PSIA (D105-403).
				BSE INFORM FLIGHT AND RECOMMEND CREW HOLD TOWER. AT TB3 + 35 SECONDS, BSE RECOMMEND EARLY STAGE.	3. COLD HELIUM BOTTLE PRESSURE DECAYING (D261-403, D263-403).
				IF S-IVB DOES NOT START, BSE TRANSMIT ABORT REQUEST	4. BURNER LOX REPRESS COIL TEMPERATURE BELOW -100° F (C378-403).
				IF S-IVB STARTS, BSE RECOMMEND CREW JETTISON TOWER AND CONTINUE MISSION.	
		2. DURING S-II BURN		2. CONTINUE MISSION/ EARLY STAGE	
				BSE INFORM FLIGHT AND RECOMMEND EARLY STAGE 3 MINUTES FROM MALFUNCTION.	
				IF THE LOX TANK ULLAGE PRESSURE IS AT 50 PSIA OR OFF-SCALE HIGH, BSE INFORM FLIGHT AND TRANSMIT ABORT REQUEST.	
		B. IN TB5	EARTH ORBIT	B. CONTINUE MISSION/EMERGENCY SPACECRAFT SEPARATION	B.1. COLD HELIUM REGULATOR DISCHARGE PRESSURE REMAINS LESS THAN 50 PSIA (D105-403).
				BSE INFORM FLIGHT AND	2. LOX TANK ULLAGE PRESSURE INCREASING (D179-406, D180-406).
				1. CYCLE AND CLOSE LOX CRYO REPRESS VALVE	3. BURNER LOX REPRESS COIL TEMPERATURE BELOW -100° F (C378-403).
				IF 1 IS UNSUCCESSFUL,	4. COLD HELIUM BOTTLE PRESSURE DECAYING (D261-403, D263-403).
				2. VENT LOX TANK	NOTES
				3. OPEN LH2 CRYO REPRESS VLV	1. ACTION REQUIRED TO AVOID EXCEEDING LOX TANK OVER-PRESSURE OR BULKHEAD POSITIVE DELTA PRESSURE LIMITS (FMR 7-14).
				4. TERMINATE LOX VENT ASAP AFTER 8 MIN	2. SEE FMR 7-18 FOR RESTART CRITERIA FOR OFF-NOMINAL COLD HELIUM PRESSURE.
				5. CLOSE LH2 CRYO REPRESS VALVE ASAP AFTER 40 MIN	3. IF THE LOX NPV VALVE FAILS TO OPEN, THE LOX VENT VALVE CAN BE OPENED AS BACKUP.
				IF THE LOX TANK ULLAGE PRESSURE IS AT 50 PSIA OR OFF-SCALE HIGH, BSE INFORM FLIGHT AND TRANSMIT ABORT REQUEST AND REQUEST EMERGENCY SEPARATION.	4. IF THE LH2 CRYO REPRESS VALVE IS OPENED, THE IU STATE VECTOR WILL BE IN ERROR SINCE THE IU USES A STORED PROGRAM. A NAV UPDATE MAY BE REQUIRED.
					5. THIS FAILURE WILL REQUIRE EVALUATION OF RESIDUALS TO DETERMINE ADEQUACY FOR TLI VELOCITY CUTOFF AND LUNAR IMPACT OPERATIONS.

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	6-6	EXCESSIVE ATTITUDE ERROR IN PITCH OR YAW DURING S-II BURN	LAUNCH	ABORT/EARLY STAGE	CUES
		A. PRIOR TO S-IVB TO COI CAPABILITY		A. ABORT BSE INFORM FLIGHT AND TRANSMIT ABORT REQUEST	1. GUIDANCE CHI MINUS THETA GIMBAL ANGLE (H60-603) GREATER THAN 85 DEG PITCH, 45 DEG YAW AND DIVERGING. 2. ACTUATORS NOT RESPONDING (G8-201 THRU 204, G9-201 THRU 204, G30-201 THRU 204, G31-201 THRU 204).
		B. BETWEEN S-IVB TO COI AND S-II CUTOFF		B. EARLY STAGE BSE INFORM FLIGHT AND FIDO AND RECOMMEND EARLY STAGING	3. VERIFIED TRAJECTORY DEVIATION. NOTE THIS RULE DOES NOT APPLY FOR OTHER IDENTIFIED LAUNCH VEHICLE MALFUNCTIONS. SEE FMR 6-2, 6-3, 6-4, 6-7.
	6-7	S-II LOSS OF THRUST	LAUNCH		CUES
		A. ANY SINGLE ENGINE FAILURE TO ATTAIN THRUST OR LOSS OF THRUST PRIOR TO NOMINAL S-II CUTOFF		A. CONTINUE MISSION BSE INFORM FLIGHT AND FIDO.	A.1. THRUST OK SWITCHES-OFF (K231-201 THRU 205, K232-201 THRU 205). 2. THRUST CHAMBER PRESSURE- ZERO (D13-201 THRU 205). 3. LONGITUDINAL ACCELERATION (A2-603).
		B. ANY TWO ENGINES FAILURE TO ATTAIN THRUST OR LOSS OF THRUST		B. CONTINUE MISSION CREW WILL ABORT ON ONBOARD LIMITS.	B.1. THRUST OK SWITCHES OFF (K231-201 THRU 205, K232-201 THRU 205) 2. THRUST CHAMBER PRESSURE ZERO (D13-201 THRU 205) 3. LONGITUDINAL ACCELERATION (A2-603)
		C. THREE OR MORE ENGINES OUT 1. PRIOR TO S-IVB TO COI CAPABILITY 2. AFTER S-IVB TO COI CAPABILITY BUT PRIOR TO LOW LEVEL SENSE ARM 3. AFTER LOW LEVEL SENSE ARM (A) 3 CONTROL ENGINES OUT (B) ALL ENGINES OUT		C. ABORT/EARLY STAGE/ CONTINUE MISSION 1. ABORT BSE INFORM FLIGHT AND TRANSMIT ABORT REQUEST. 2. EARLY STAGE BSE INFORM FLIGHT AND RECOMMEND EARLY STAGING 3. EARLY STAGE/ CONTINUE MISSION (A) EARLY STAGE BSE INFORM FLIGHT AND RECOMMEND EARLY STAGE (B) CONTINUE MISSION BSE INFORM FLIGHT	C.1. THRUST OK SWITCHES OFF (K231-201 THRU 205, K232-201 THRU 205) 2. THRUST CHAMBER PRESSURE ZERO (D13-201 THRU 205) 3. LONGITUDINAL ACCELERATION (A2-603) C. NOTE AFTER PROGRAMED S-II CENTER ENGINE CUTOFF, ENGINES OUT REFERS ONLY TO CONTROL ENGINES.

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	6-8	S-II STAGE ANY SINGLE ACTUATOR HARDOVER INBOARD A. PRIOR TO S-IVB TO COI CAPABILITY B. BETWEEN S-IVB TO COI CAPABILITY AND 30 SEC PRIOR TO S-II CUTOFF C. AFTER S-II CUTOFF MINUS 30 SEC	LAUNCH	ABORT/EARLY STAGE/CONTINUE MISSION A. ABORT BSE INFORM FLIGHT AND TRANSMIT ABORT REQUEST B. EARLY STAGE BSE INFORM FLIGHT AND RECOMMEND EARLY STAGING C. CONTINUE MISSION BSE INFORM FLIGHT	CUES 1. YAW ACTUATOR POSITION EXCEEDS +6 DEG (G8-201 THRU 204, G30-201 THRU 204) 2. PITCH ACTUATOR POSITION EXCEEDS +6 DEG (G9-201 THRU 204, G31-201 THRU 204) 3. ADJACENT CONTROL ENGINE ACTUATOR IN SAME PLANE MOVES 4-1/2 DEG INBOARD (SAME MEASUREMENTS AS CUES 1 AND 2) NOTES THE CREW SHOULD ABORT OR EARLY STAGE AS SOON AS POSSIBLE AFTER MALFUNCTION OCCURS TO PRECLUDE EXCESSIVE THERMAL PROBLEM IN AFT INTERSTAGE.
	6-9	S-II SECOND PLANE SEPARATION FAILS TO OCCUR AT TB3 + 31.7 SEC	LAUNCH	ABORT BSE INFORM FLIGHT AND TRANSMIT ABORT REQUEST. CREW ABORT PRIOR TO TB3 + 1 MIN 45 SEC.	CUES 1. SECOND PLANE SEPARATION INDICATION SHOWS NO SEPARATION (M86-206, M87-206) 2. GUIDANCE MODE WORD 1 MODE CODE 25 BIT D15 REMAINS ZERO (H60-603). 3. IGNITION BUS VOLTAGE REMAINS AT APPROXIMATELY 28 VOLTS (M125-207). 4. RECIRCULATION BUS VOLTAGE REMAINS AT APPROXIMATELY 56 VOLTS (M111-207). NOTES THE CREW SHOULD ABORT AS SOON AS POSSIBLE AFTER MALFUNCTION OCCURS TO PRECLUDE EXCESSIVE THERMAL PROBLEMS IN AFT INTERSTAGE.
	6-10	S-IVB LOSS OF HYDRAULIC FLUID PRIOR TO FIRST S-IVB BURN	LAUNCH	ABORT BSE INFORM FLIGHT AND FIDO AND RECOMMEND NO S-IVB START. BSE TRANSMIT ABORT REQUEST AT S-II CUTOFF.	CUES 1. HYDRAULIC RESERVOIR OIL LEVEL APPROX ZERO PERCENT (L7-403). 2. HYDRAULIC SYSTEM PRESSURE LESS THAN 1700 PSIA (D41-403). 3. HYDRAULIC RESERVOIR PRESSURE APPROX ZERO PSIA (D42-403). NOTES 1. IF L7-403 IS FUNCTIONING PROPERLY, IT IS REQUIRED FOR IMPLEMENTATION OF THIS RULE. 2. SPACECRAFT SHOULD HAVE COI CAPIBILITY AT S-II CUTOFF 3. AT S-II CUTOFF, THE CREW SHOULD INHIBIT THE S-IVB START WITH THE TRANSLATION HANDCONTROLLER.

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	6-11	S-IVB STAGE LOSS OF THRUST			CUES 1. THRUST CHAMBER PRESSURE - ZERO (D1-401). 2. THRUST OK SWITCHES - OFF (K14-401, K157-401). 3. LONGITUDINAL ACCELERATION - ZERO (A2-603). 4. TB5 IS INITIATED. GUID MODE WORD 1 (MODE CODE 25); BIT D2 SET TO ONE (H60-603). 5. TB7 IS INITIATED. GUID MODE WORD 2 (MODE CODE 26); BIT D20 SET TO ONE (H60-603). NOTES 1. SEPARATION WILL BE REQUIRED FOR VIOLATION OF FMR 7-6 OR FMR 7-14. 2. FOR A FAILURE OF THE S-IVB TO RESTART, THE ONBOARD PROGRAM WILL RECYCLE TO TB5 THROUGH TB6C FOR A SECOND RESTART OPPORTUNITY.
		A. FAILS TO ATTAIN THRUST OR PREMATURE SHUTDOWN PRIOR TO OBTAINING PARKING ORBIT	LAUNCH	A. ABORT BSE TRANSMIT ABORT REQUEST.	
		B. SHUTDOWN PRIOR TO ACHIEVING MINIMUM REQUIRED APOGEE ALTITUDE AND ENTRY INTO TB7 FOR REASONS OTHER THAN A PROPELLANT DEPLETION	TLI	B. CONTINUE MISSION BSE INFORM FLIGHT AND COMMAND TO EARTH ORBITAL CONFIGURATION THE SPACECRAFT SHOULD REMAIN ATTACHED TO THE S-IVB/IU AND MONITOR LH2 AND LOX TANK ULLAGE PRESSURES. IF SEPARATION IS REQUIRED, THE SPACECRAFT SHOULD IMMEDIATELY GO TO A SAFE DISTANCE (7000 FT) FROM THE S-IVB/IU.	
	6-12	S-IVB COLD HELIUM SHUTOFF VALVES FAIL OPEN	LAUNCH		CUES 1. COLD HELIUM REG DISCHARGE PRESSURE REMAINS GREATER THAN 200 PSIA (D105-403) 2. LOX ULLAGE PRESSURE AT RELIEF SETTING (41-44 PSIA) AND RELIEVING (D179-406, D180-406) 3. COLD HELIUM BOTTLE PRESSURE DECAYING (D261-403, D263-403).
		A. PRIOR TO S-II ENGINE START.		A. ABORT BSE INFORM FLIGHT AND TRANSMIT ABORT REQUEST	
		B. BETWEEN S-II ENGINE START AND 30 SEC PRIOR TO S-II CUTOFF		B. EARLY STAGE BSE INFORM FLIGHT AND RECOMMEND EARLY STAGING IMMEDIATELY. IF PRIOR TO TOWER JETTISON, THE CREW SHOULD HOLD THE TOWER UNTIL AFTER S-IVB START	
		C. AFTER S-II CUTOFF MINUS 30 SEC		C. CONTINUE MISSION BSE INFORM FLIGHT	


7 SLV - TB5 AND
TB7 (COAST)

R	ITEM

SUMMARY OF COAST PHASE RULES

7-1 INSUFFICIENT PROPELLANT
7-2 LOSS OF ONE APS MODULE
7-3 MAIN FUEL VALVE FAILS TO CLOSE
7-4 MAIN OXIDIZER VALVE FAILS TO CLOSE
7-5 RANGE SAFETY SYSTEM NOT SAFED AFTER INSERTION
7-6 COLD HELIUM SHUTOFF VALVE FAILS OPEN
7-7 AUXILIARY HYDRAULIC PUMP FAILS
7-8 LOSS OF ATTITUDE CONTROL
7-9 CONTINUOUS VENT REGULATOR FAILS TO OPEN
7-10 APS ULLAGE ENGINE FAILS ON
7-11 RESERVED
7-12 J2 ENGINE MAIN FUEL VALVE OR MAIN OXIDIZER VALVE LEAKAGE IN TB5
7-13 IU ENVIRONMENTAL CONTROL SYSTEM FAILS
7-14 COMMON BULKHEAD ΔP
7-15 LOSS OF S-IVB STAGE PNEUMATICS
7-16 RESERVED
7-17 LH_2 TANK VENT FAILURE OR LEAK
7-18 LOW COLD HELIUM SUPPLY
7-19 LOX TANK ULLAGE PRESSURE IS LESS THAN 31 PSIA
7-20 J-2 ENGINE START BOTTLE PRESSURE OUTSIDE RESTART LIMITS
7-21 PU VALVE FAILURE
7-22 S-IVB CONFIRMED LOSS OF HYDRAULIC FLUID
7-23 RESERVED
7-24 RESERVED
7-25 LOX NON-PROPULSIVE VENT FAILS TO OPEN
7-26 LH_2 LATCHING VENT VALVE FAILS TO OPEN
7-27 GH_2 START BOTTLE DUMP FAILS TO OCCUR
7-28 COLD HELIUM DUMP FAILS TO OCCUR
7-29 RESERVED
7-30 RESERVED

THE FOLLOWING MISSION RULES ALSO APPLY TO THIS SECTION:

6-3 INERTIAL PLATFORM FAILURE - ACCELEROMETER
6-4 LAUNCH VEHICLE INERTIAL PLATFORM FAILURE - ATTITUDE REFERENCE
6-5 SIV B LOX CRYO REPRESS VALVE FAILS OPEN.

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	7-1	PRIOR TO S-IVB RESTART, PROPELLANT QUANTITIES PRECLUDE ACHIEVEMENT OF AN ACCEPTABLE LUNAR MISSION AND:	EARTH ORBIT	NO S-IVB RESTART/CONTINUE MISSION	CUES 1. PROPELLANT REMAINING AS ASCERTAINED DURING R/T EVALUATIONS.
		A. NO FAILURES HAVE BEEN IDENTIFIED WHICH RESULTED IN AN EXCESSIVE PROPELLANT IMBALANCE, AND INSUFFICIENT PROPELLANT REMAINS FOR ACHIEVEMENT OF AN ACCEPTABLE ALT MISSION		A. NO S-IVB RESTART BSE INFORM FLT OF PREDICTED CAPABILITY	NOTES 1. FAILURES REQUIRING EVALUATION OF PROPELLANT REMAINING ARE DEFINED BY FMR'S 6-5, 6-7, 6-12, 7-3, 7-4, 7-6, 7-9, 7-12, 7-17, 7-18, 7-19, 7-21, 7-24, 7-30, 8-4.
		B. FAILURES HAVE BEEN IDENTIFIED WHICH RESULTED IN AN EXCESSIVE IMBALANCE OF PROPELLANTS		B. CONTINUE MISSION/NO S-IVB RESTART	2. FAILURES WHICH RESULT IN A LOX DUMP REQUIREMENT ARE: (A) LOX CRYO REPRESS VALVES FAIL OPEN (FMR 6-5). OTBV FAILS OPEN DURING S-IVB FIRST BURN (FMR 7-30) (B) COLD HELIUM SHUTOFF VALVES FAIL OPEN (FMR 7-6) (C) LOW LOX TANK ULLAGE PRESS (FMR 7-18, 7-19) (D) J-2 ENGINE MAIN FUEL VLV FAILS TO CLOSE (FMR 7-3). DO NOT DUMP LOX IF MFV IS OPEN. (E) MRCV FAILS TO 4.5 POSITION (FMR 7-24) (F) LOX BLEED VLV FAILS OPEN (FMR 7-21) (G) OTBV FAILS OPEN (FMR 7-30)
		1. LOX DUMP WOULD SIGNIFICANTLY IMPROVE THE PROBABILITY OF A MINIMUM LUNAR LANDING OR A MINIMUM LO MISSION.		1. CONTINUE MISSION BSE INFORM FLT AND CMD LOX DUMP TO MAXIMIZE ACCEPTABLE LUNAR MISSION CAPABILITY. IF C199-401 IS EXPECTED TO BE COLDER THAN 3200 R, OR C200-401 IS EXPECTED TO BE COLDER THAN 160° R AT ENGINE START, BSE CMD (A) MAINSTAGE ENABLE NO 2 ON (B) BURN MODE A ON	3. IMPLEMENTATION OF A LOX DUMP MAY REQUIRE A STATE VECTOR UPDATE. 4. FAILURE MUST BE IDENTIFIED PRIOR TO CYI LOS. 5. CORRECTIVE ACTION MUST BE TAKEN ON ITEMS 2(A), 2(B), 2 (C), 2(D), 2(E), 2(F), 2(G), AS NOTED BY THE REFERENCED FMR.
		2. LOX DUMP WOULD NOT SIGNIFICANTLY IMPROVE THE PROBABILITY OF A MINIMUM LO MISSION.		2. NO S-IVB RESTART BSE INFORM FLIGHT OF PREDICTED CAPABILITY.	

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	7-2	LOSS OF ONE APS MODULE			CUES
		A. TB5 TO TB6+9 MIN 20 SEC	EARTH ORBIT TLC	A. CONTINUE MISSION 1. BSE INFORM FLIGHT AND COMMAND - S-IVB BURN MODE ON 2. CREW WILL STABILIZE THE VEHICLE WITH CSM RCS	1. MANIFOLD PRESSURE MOD. 1 BELOW 100 PSIA (D70-414), (D71-414) 2. MANIFOLD PRESSURE MOD. 2 BELOW 100 PSIA (D72-415), (D73-415)
		B. TB7 TO TB7+15 MIN		B. CONTINUE MISSION 1. BSE INFORM FLIGHT AND COMMAND - FCC POWER OFF 2. CREW WILL STABILIZE VEHICLE WITH CSM RCS	
		C. TB7+15 MIN TO LM EJECTION		C. CONTINUE MISSION 1. BSE INFORM FLIGHT AND COMMAND - FCC POWER OFF 2. CREW DISCRETION FOR DOCKING	
		D. LM EJECTION TO YAW MANEUVER COMPLETE		D. CONTINUE MISSION 1. BSE INFORM FLIGHT AND COMMAND - FCC POWER OFF 2. SPACECRAFT WILL DO EVASIVE MANEUVER 3. DO NOT INITIATE TB8 4. BSE PERFORM NON-PROPULSIVE S-IVB SAFING BY GROUND COMMAND	
		E. AFTER YAW ATTITUDE MANEUVER COMPLETE		E. CONTINUE MISSION BSE INFORM FLIGHT AND 1. CMD TB8 ASAP CONSISTENT WITH MISSION CONSTRAINTS 2. AFTER EVASIVE BURN, CMD ULLAGE MOTOR ON OR CMD SHORT LOX DUMPS WITH BURN MODE ON AND ATT ERROR LIMITS OF ±15.3°, TO MANEUVER VEHICLE TO THE ALTERNATE LOX DUMP ATT 3. ACCOMPLISH LOX DUMP WITH BURN MODE ON 4. AFTER COMPLETION OF LOX DUMP, INITIATE SOLAR HEATING AVOIDANCE MANUEVER IF RULING E.2. IS UNSUCCESSFUL: 5. CMD ATT ERROR LIMITS OF ±3.5° 6. PERFORM LOX DUMP SIMULTANEOUSLY WITH THE MANUEVER TO ALT LOX DUMP ATT WITH BURN MODE ON 7. PERFORM RULING E.4. ABOVE	NOTES 1. LIMITS IN FMR 7-8 CONDITION/MALFUNCTION DO NOT APPLY TO THE FAILURE IN 7-2 CONDITION/MALFUNCTION E. 2. CVS PROP VENTING SHOULD BE INHIBITED TO PRECLUDE UNDESIRABLE TORQUE ON THE STAGE DURING ULLAGE MOTOR MANUEVERING.

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	7-3	J-2 ENGINE MAIN FUEL VALVE (MFV) FAILS TO CLOSE AT:			CUES 1. MAIN FUEL VALVE POSITION (G4-401). 2. MAIN FUEL VALVE OPEN (K118-401). 3. FUEL FLOWMETER FLOWRATE (F2-401).
		A. FIRST S-IVB CUTOFF	EARTH ORBIT	A. CONTINUE MISSION BSE INFORM FLIGHT AND COMMAND (ASAP) 1. PREVALVES AND RECIRC SHUTOFF VALVES CLOSED (SEE NOTE 1) 2. ATTEMPT TO CYCLE AND CLOSE MFV IF SUCCESSFUL, BSE COMMAND 3. PREVALVE AND RECIRC SHUTOFF VALVES OPEN IF UNSUCCESSFUL AND MFV CONFIRMED FULLY OPEN, BSE COMMAND 4. MAINSTAGE ENABLE NO. 2 - ON 5. BURN MODE A - ON	NOTES 1. IF THE MFV IS OPEN, THE LH2 PUMP INLET PRESSURE WILL GO TO ZERO AFTER COMMAND ACTION (A.1). 2. THIS FAILURE WILL REQUIRE EVALUATION OF LH2 RESIDUALS TO DETERMINE ADEQUACY FOR TLI VELOCITY CUTOFF (REF FMR 7-1). 3. A FAILURE FOLLOWING SECOND BURN CUTOFF WILL REQUIRE A RE-EVALUATION OF LUNAR IMPACT VELOCITY DESIRED. 4. IMPLEMENTATION OF PART A4 AND 5 WILL RESULT IN AN EXTENDED FUEL LEAD JUST PRIOR TO TLI IGN, AND THERE WILL BE NO LOX AND LH2 RECIRCULATION. ENGINE M/S WILL OCCUR 7 SECONDS EARLY. 5. IF THE MFV DOES NOT CLOSE, FMR 8-4 SHOULD NOT BE IMPLEMENTED SINCE IT WILL RESULT IN A SIMULTANEOUS LOX AND LH2 DUMP. 6. FUEL DUMP WILL INITIATE 3.2 SEC. EARLIER THAN NOMINAL LOX DUMP TIME. 7. THIS FAILURE WILL REQUIRE REAL-TIME ASSESSMENT BY THE LUNAR IMPACT TEAM.
		B. SECOND S-IVB CUTOFF	TLC	B. CONTINUE MISSION BSE INFORM FLIGHT AND 1. ATTEMPT TO CLOSE MFV. IF UNSUCCESSFUL, BSE CMD ASAP IN TB 8. 2. ENGINE PUMP PURGE OFF. 3. EDS CUTOFF NO 2 ENABLE PROCEED WITH LH2 DUMP AT NOMINAL LOX DUMP TIME (SEE NOTE 6) BSE TERMINATE LH2 DUMP AFTER 200 SECONDS BY COMMANDING 4. PREVALUES AND RECIRC VALVES CLOSED	

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	7-4	J-2 ENGINE MAIN OXIDIZER VALVE (MOV) FAILS TO CLOSE AT:			CUES 1. MAIN OXIDIZER VALVE POSITION (G3-401) INDICATES NOT FULL CLOSED. 2. MAIN OXIDIZER VALVE OPEN-ON (K120-401). 3. LOX FLOWMETER FLOWRATE F1-401 INDICATING FLOW. 4. LOX INJECTOR PRESSURE (D0005-401)
		A. FIRST S-IVB CUTOFF	EARTH ORBIT	A. CONTINUE MISSION/ NO S-IVB RESTART BSE INFORM FLIGHT AND COMMAND (ASAP) 1. PREVALVES AND RECIRC SHUTOFF VALVES CLOSED 2. ATTEMPT TO CLOSE MOV IF A.2 IS SUCCESSFUL, BSE INFORM FLIGHT AND COMMAND 3. PREVALVES AND RECIRC SHUTOFF VALVES OPEN IF A.2 IS UNSUCCESSFUL, BSE INFORM FLIGHT AND RECOMMEND NO S-IVB RESTART	NOTES 1. IF THE MOV IS OPEN, THE LOX PUMP INLET PRESSURE WILL GO TO ZERO AFTER COMMAND (A.1). 2. THIS FAILURE WILL REQUIRE EVALUATION OF RESIDUALS TO DETERMINE ADEQUACY FOR TLI VELOCITY CUTOFF AND LUNAR IMPACT OPERATIONS. 3. LOX DUMP WILL BE INITIATED 3.2 SEC EARLY. 4. THIS FAILURE WILL REQUIRE REAL-TIME ASSESSMENT BY LUNAR IMPACT TEAM.
		B. SECOND S-IVB CUTOFF	TLC	B. CONTINUE MISSION BSE INFORM FLIGHT AND: 1. ATTEMPT TO CLOSE MOV IF UNSUCCESSFUL, BSE CMD ASAP IN TB 8 2. ENGINE PUMP PURGE OFF BSE TERMINATE LOX DUMP 120 SEC AFTER GAS INGESTION OBSERVED BY COMMANDING: (SEE NOTE 3) 3. PREVALVES AND RECIRC VALVES CLOSED	
		C. AT END OF LOX DUMP		C. CONTINUE MISSION BSE INFORM FLIGHT AND TERMINATE LOX DUMP 120 SEC AFTER GAS INGESTION OBSERVED BY COMMANDING: 1. PREVALVES AND RECIRC VALVES CLOSED 2. ATTEMPT TO CLOSE MOV IF C.2. IS SUCCESSFUL 3. CLOSE PREVALVES AND RECIRC VALVES	

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	7-5	RANGE SAFETY SYSTEM NOT SAFED AFTER INSERTION	EARTH ORBIT		CUES
		A. PROPELLANT DISPERSION SYSTEM NOT ARMED		A. CONTINUE MISSION BSE INFORM FLIGHT AND RECOMMEND RSO SEND SAFE COMMAND	1. FIRING UNIT 1 RS EBW GREATER THAN OR EQUAL TO 1.6 VOLTS (M30-411). 2. FIRING UNIT 2 RS EBW GREATER THAN OR EQUAL TO 1.6 VOLTS (M31-411). 3. RANGE SAFETY RECEIVER NO. 1 ENABLE (N57-411) BETWEEN 2.4 AND 4.5 VOLTS. 4. RANGE SAFETY RECEIVER NO. 2 ENABLE (N62-411) BETWEEN 2.4 AND 4.5 VOLTS. 5. RSO DISPLAY AND COMMAND SYSTEM STATUS.
		B. PROPELLANT DISPERSION SYSTEM ARMED AND RSO HAS NOT SENT MFCO		B. EMERGENCY SPACECRAFT SEPARATION BSE INFORM FLIGHT AND RECOMMEND EMERGENCY SPACECRAFT SEPARATION. WHEN SPACECRAFT HAS REACHED A SAFE DISTANCE (7,000 FT) RECOMMEND RSO SEND SAFE COMMAND.	NOTES 1. RSO SHOULD NOT ATTEMPT TO SAFE THE RANGE SAFETY RECEIVERS UNTIL IT IS CONFIRMED THAT THE PROPELLANT DISPERSION SYSTEM IS NOT ARMED (CONDITION A ONLY). 2. EITHER CUE 1 OR CUE 2 IS SUFFICIENT FOR IMPLEMENTING RULE B. 3. CUES 3 AND 4 ARE VALID ONLY WHEN THE VEHICLE IS RECEIVING 450 MHZ RADIATION.
	7-6	S-IVB STAGE COLD HELIUM SHUTOFF VALVES FAIL OPEN IN			CUES
		A. TB5	EARTH ORBIT	A. CONTINUE MISSION/ EMERGENCY SPACECRAFT SEPARATION BSE INFORM FLIGHT AND 1. VENT LOX TANK 2. ATTEMPT TO CLOSE THE STAGE COLD HELIUM VALVES IF 2 IS SUCCESSFUL 3. TERMINATE LOX VENT IF 2 IS UNSUCCESSFUL 4. OPEN LH2 CRYO REPRESS VLV. 5. TERMINATE LOX VENT ASAP AFTER 8 MIN. 6. LH2 CRYO REPRESS VLV CLOSE ASAP AFTER 40 MIN. IF LOX ULLAGE PRESSURE AT 50 PSIA OR SATURATED, BSE INFORM FLIGHT AND TRANSMIT ABORT REQUEST AND RECOMMEND EMERGENCY S/C SEPARATION.	1. COLD HELIUM REGULATOR DISCHARGE PRESSURE GREATER THAN 200 PSIA (D0105-403). 2. LOX TANK ULLAGE PRESSURES (D0179-406, D0180-406). 3. COLD HELIUM BOTTLE PRESSURE DECAYING (D261-403, D0263-403). NOTES 1. ACTION REQUIRED TO AVOID EXCEEDING LOX TK OVER PRESS OR BULKHEAD POSITIVE DELTA PRESS LIMITS (FMR 7-14) 2. SEE FMR 7-18 FOR RESTART CRITERIA FOR OFF-NOMINAL COLD HELIUM PRESSURE. 3. IF LOX NPV VALVE FAILS TO OPEN, THE LOX VENT VALVE CAN BE OPENED AS BACKUP. 4. THIS FAILURE WILL REQUIRE EVALUATION OF RESIDUALS TO DETERMINE ADEQUACY FOR TLI VELOCITY CUTOFF AND LUNAR IMPACT OPERATIONS (FMR 7-1)
		B. TB7	TLC	B. CONTINUE MISSION AFTER TB7 + 2 MIN 30 SEC BSE INFORM FLIGHT AND 1. VENT LOX TANK FOR 12 MIN 30 SEC VENTING SHOULD BE TERMINATED PRIOR TO S/C SEPARATION	

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	7-7	S-IVB AUXILIARY HYDRAULIC PUMP FAILS			CUES
		A. TO TURN OFF AS SEQUENCED	EARTH ORBIT	A. CONTINUE MISSION BSE INFORM FLIGHT AND ATTEMPT TO TURN OFF AUXILIARY HYDRAULIC PUMP AS SOON AS POSSIBLE	A.1. SYSTEM PRESSURE (D41-403). 2. RESERVOIR LEVEL (L7-403). 3. AFT BATTERY NO. 2 CURRENT (M22-404). 4. HYDRAULIC RESERVOIR OIL PRESSURE (D42-403). NOTES A. FAILURE TO TURN OFF HYDRAULIC PUMP DEPLETES AFT NO. 2 BATTERY IN APPROXIMATELY 90 MIN AND OVERHEATS HYDRAULIC SYSTEM IN APPROXIMATELY 70 MIN.
		B. TO TURN ON 1. AS SEQUENCED AND THE RESERVIOR OIL TEMP IS BELOW OR PREDICTED TO BE BELOW 35° F BEFORE NEXT STATION AOS		B. CONTINUE MISSION BSE INFORM FLIGHT AND 1. ATTEMPT TO TURN AUXILIARY HYDRAULIC PUMP ON	CUES B.1. SYSTEM PRESSURE (D41-403). 2. RESERVOIR OIL LEVEL (L7-403). 3. AFT BAT NO. 2 CURRENT (M22-404). 4. RESERVOIR PRESSURE (D42-403).
		2. AT TB6 + 3 MIN 39 SEC	TLI	BSE INFORM FLIGHT AND 2. COMMAND AUXILIARY HYDRAULIC PUMP OFF	5. HYDRAULIC PUMP INLET OIL TEMP (C50-401). 6. RESERVOIR OIL TEMP (C51-403).
		C. TO TURN ON FOR LOX DUMP (J-2 ENGINE NOT CENTERED IN PITCH PLANE PRIOR TO LOX DUMP)	TLC	C. CONTINUE MISSION	C.1. ACTUATOR POSITION (G1-403) 2. SYSTEM PRESSURE (D41-403) 3. CHI MINUS THETA GREATER THAN 10 DEGREES (H60-603)
		1. ENGINE GIMBAL ANGLE LESS THAN ±3 DEGREES		1. CONTINUE MISSION BSE INFORM FLIGHT	NOTES
		2. ENGINE GIMBAL ANGLE GREATER THAN ±3 DEGREES		2. CONTINUE MISSION BSE INFORM FLIGHT AND INHIBIT LOX DUMP	1. A PITCH ACTUATOR DEFLECTION IN EXCESS OF ±3 DEGREES IS ONLY EXPECTED FOR THE FOLLOWING CONDITIONS: (A) ERRONEOUS COMMAND SIGNAL (B) ACTUATOR FAILURE
		3. ATTITUDE ERROR GREATER THAN 10 DEGREES DURING DUMP		3. CONTINUE MISSION BSE INFORM FLIGHT AND TERMINATE LOX DUMP	2. SINCE TWO APS ENGINES ARE AVAILABLE FOR ATTITUDE CONTROL IN THE YAW PLANE, ATTITUDE CONTROL IN THIS PLANE WILL BE MAINTAINED FOR AN ACTUATOR IN A HARDOVER CONDITION. 3. IF APS PROPELLANT IS INSUFFICIENT AND EITHER CONDITION C.2. OR C.3. PRECLUES LOX DUMP, CONSIDERATION WILL BE GIVEN TO CONDUCTING A CYCLE LOX DUMP TO ATTAIN THE REQUIRED ΔV FOR LUNAR IMPACT BASED ON REAL-TIME DECISION OF LUNAR IMPACT TEAM. 4. ANY TIME THE HYDRAULIC OIL TEMP (C51-403) DROPS BELOW 35° F, THE AUX HYDRAULIC PUMP SHOULD BE CYCLED.

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	7-8	LOSS OF ATTITUDE CONTROL DURING			CUES
		A. TB5	EARTH ORBIT/TLC	A. SPACECRAFT GUIDANCE TAKEOVER/SPACECRAFT SEPARATION BSE INFORM FLIGHT AND RECOMMEND SPACECRAFT GUIDANCE TAKEOVER. IF UNSUCCESSFUL, BSE RECOMMEND SPACECRAFT SEPARATION	A.1. ANGULAR RATES - PITCH (R4-602) OR YAW (R5-602) GREATER THAN 0.3 DEG/SEC AND NOT DECREASING, OR ROLL (R6-602, R12-602), GREATER THAN 0.5 DEG/SEC AND NOT DECREASING 2. ANGULAR RATE - PITCH (R13-602) OR YAW (R8-602) GREATER THAN 0.3 DEG/SEC AND NOT DECREASING, OR ROLL (R12-602) GREATER THAN 0.5 DEG/SEC AND NOT DECREASING (SEE NOTE 3) 3. LOSS OF ATTITUDE CONTROL ALERT (SEE NOTE 2)
		B. TB6 TO TB6 + 9 MIN 20 SEC	TLI	B. TLI INHIBIT BSE INFORM FLIGHT AND RECOMMEND TLI INHIBIT	B.1. SAME AS A.1. ABOVE 2. SAME AS A.2. ABOVE 3. LOSS OF ATTITUDE CONTROL ALERT (SEE NOTES 2 AND 4)
		C. TB7	TLC	C. CREW DISCRETION BSE INFORM FLIGHT AND FIDO 1. DO NOT START EVASIVE MANEUVER 2. DO NOT INITIATE TB8 3. BSE PERFORM NON-PROPULSIVE S-IVB SAFING BY GROUND COMMAND.	C.1. SAME AS A.1 ABOVE 2. SAME AS A.2. ABOVE 3. LOSS OF ATTITUDE CONTROL ALERT (SEE NOTES 2 AND 4)
		D. TB8	TLC	D. CONTINUE MISSION BSE INFORM FLIGHT AND FIDO AND TERMINATE 1. LOX DUMP 2. ULLAGE ENGINE BURNS 3. LH2 CVS	D.1. SAME AS A.1. ABOVE 2. SAME AS A.2. ABOVE 3. LOSS OF ATTITUDE CONTROL ALERT (SEE NOTES 2 AND 4) NOTES 1. IMMEDIATELY AFTER S-IVB CUTOFF, S/C RETURN OF CONTROL TO SATURN, OR DURING PROGRAMED MANEUVERS THE ABOVE RATE LIMITS ARE NOT APPLICABLE. 2. LOSS OF ATTITUDE CONTROL ALERT WILL BE GIVEN FOR THE FOLLOWING CONDITIONS: (A) LVDC/LVDA COMPUTATIONAL FAILURE (B) ABNORMAL ATTITUDE ERROR SIGNALS (C) FAILURE TO INITIATE PROPER GUIDANCE SEQUENCE 3. THESE CUES ARE VALID IF RATE CHANNEL SWITCHOVER HAS NOT OCCURRED. 4. LOSS OF ATTITUDE CONTROL ALERT IS SUFFICIENT FOR IMPLEMENTING THIS RULE EXCEPT FOR PARTS B AND D.

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	7-9	CONTINUOUS VENT SYSTEM (CVS) REGULATOR FAILS TO OPEN IN TB5 (TB5 + 59 SEC)	EARTH ORBIT/ TLI	CONTINUE MISSION BSE INFORM FLIGHT AND 1. ATTEMPT TO OPEN CVS RELIEF OVERRIDE SHUTOFF VALVE IF UNSUCCESSFUL, BSE 2. VENT THE LH2 TANK PRIOR TO TB6 + 8 MIN 40 SEC TO A VALUE BELOW THE PRESSURE REQUIRED FOR S-IVB RESTART. IF THE LH2 BLOWDOWN IS COMPLETED WITHIN 30 MINUTES PRIOR TO TB6 INITIATE, COMMAND 3. ULLAGE ENGINES AFTER 90 SEC OF ULLAGE, SEND 4. ULLAGE ENGINES OFF ULLAGING SHOULD BE COMPLETED PRIOR TO THE AMBIENT REPRESSURIZATION.	CUES 1. CVS NOZZLE PRESSURE (D181-409, D182-409). 2. CVS REGULATOR CLOSED (K154-411). 3. LH2 ULLAGE PRESSURE (D177-408, D178-408). NOTES 1. IF THE CVS REGULATOR FAILS TO OPEN, THE LH2 SATURATION TEMPERATURE WILL INCREASE ABOVE NOMINAL RESTART LIMITS. 2. COMMAND ACTION WILL REQUIRE EVALUATION OF LH2 RESIDUALS TO DETERMINE ADEQUACY FOR TLI VELOCITY CUTOFF. 3. IF THE CVS REGULATOR IS CLOSED DURING ORBIT, THE IU STATE VECTOR WILL BE IN ERROR SINCE THE IU USES A STORED PROGRAM FOR THIS THRUST. A NAVIGATION UPDATE MAY BE REQUIRED (REF FMR 7-11).
			EARTH ORBIT	IF EITHER ACTION 1 OR 2 IS UNSUCCESSFUL, BSE INFORM FLIGHT	
	7-10	APS ULLAGE ENGINE(S) THRUST FAILS TO TERMINATE AT SEQUENCED TIMES	EARTH ORBIT/ TLI/TLC	CONTINUE MISSION BSE INFORM FLIGHT AND ATTEMPT TO TERMINATE ULLAGE ENGINE THRUST. IF UNSUCCESSFUL, BSE INFORM FLIGHT OF IMPENDING LOSS OF ATTITUDE CONTROL CAPABILITY	CUES 1. ULLAGE ENGINE THRUST CHAMBER PRESSURE (D220-414, D221-415). 2. APS HELIUM SPHERE PRESSURE DECREASING (D35-414, D36-415, D250-414, D251-415).

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	7-11	IU STATE VECTOR IS IN ERROR WHEN COMPARED TO MSFN STATE VECTOR (I.E., SOME COMPONENT OF IU PLATFORM AND/OR COMPUTER HAS FAILED OR EXHIBITS A LARGE ERROR)	LAUNCH	CONTINUE MISSION BSE XMIT IU NAV UPDATE BASED ON GUIDO RECOMMENDATION PER FMR 5-29	CUES IF IU AND MSFN ΔA, ΔRV, AND $\Delta \dot{W}$ MAX DIFFER BY THE FOLLOWING AMOUNTS: 1. AT T + 56 MIN (A) ΔA = 1.1 NM (B) ΔRV = 33,101 FT (C) $\Delta \dot{W}$ MAX = 9.0 FPS WHEN ΔW = 2307 FT 2. AT T + 1 HOUR 45 MIN (A) ΔA = 1.21 NM (B) ΔRV = 56,894 FT (C) $\Delta \dot{W}$ MAX = 9.0 FPS WHEN ΔW = 3857 FT NOTES 1. ANY HARDWARE FAILURE OR MALFUNCTION, SUCH AS CVS FAILURE, OR ACCELEROMETER FAILURE MAY BE CAUSE TO PERFORM A NAVIGATION UPDATE. 2. THERE ARE TWO TIMES DURING EPO THAT THESE VECTOR COMPARISONS ARE MADE. THESE TIMES CORRESPOND TO A VECTOR TIME TAGGED AT TL + 56 MIN AND A VECTOR TIME TAGGED AT TL + 1 HR 45 MIN. THE VECTOR COMPARISONS WILL BE MADE ON THE FOLLOWING PARAMETERS: (A) ΔA - BASICALLY, THE DELTA SEMIMAJOR AXIS OF EPO (B) ΔRV - THE LOCAL DELTA DOWNRANGE COMPONENT (C) $\Delta \dot{W}$ MAX - THE LOCAL CROSSRANGE VELOCITY. THIS IS A FUNCTION OF W AND CHANGES AS W CHANGES.

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	7-12	J-2 ENGINE MAIN FUEL VALVE OR MAIN OXIDIZER VALVE LEAKAGE IN TB5	EARTH ORBIT	CONTINUE ACTION BSE INFORM FLIGHT AND COMMAND 1. PREVALVES CLOSED 2. MEASURE PROPELLANT FLOW ON RECIRC FLOWMETERS	CUES 1. THRUST CHAMBER TEMP (C199-401) DECREASING 2. FUEL INJECTION TEMP (C200-401) COLDER THAN 160° R 3. MAIN FUEL VALVE POSITION (G4-401) APPROXIMATELY 0 DEG. 4. MAIN OXIDIZER VALVE POSITION (G3-401) APPROXIMATELY 0 DEG. 5. LH2 RECIRC FLOW (F5-404) 6. LOX RECIRC FLOW (F4-404)
		A. FOR ANY PROP LEAK FOR WHICH THE PREDICTED PROP REMAINING AT SECOND START IS LESS THAN REQUIRED TO ASSURE 50 PERCENT PROBABILITY OF A MINIMUM LUNAR LANDING CAPABILITY.		A. CONTINUE MISSION BSE INFORM FLIGHT AND CMD 1. RECIRC VALVES CLOSED REASSESS REQUIREMENTS FOR A LUNAR LANDING MISSION. DETERMINE THE TIME AT WHICH REINITIATING THE LEAK WILL NOT VIOLATE THESE REQUIREMENTS. AT THE EARLIEST OPPORTUNITY FOLLOWING THIS TIME, BSE CMD: (NOTE3). 2. RECIRC VALVES OPEN IF C199-401 IS EXPECTED TO BE COLDER THAN 320° R AND C200-401 IS EXPECTED TO BE COLDER THAN 160° R PRIOR TO ENGINE START, BSE CMD: (NOTE 4) 3. MAINSTAGE ENABLE NO. 2 ON 4. BURN MODE A ON	NOTES 1. THIS FAILURE WILL REQUIRE EVALUATION OF TRAJECTORY UPDATE AND CONSUMABLES (REF FMR 7-1). 2. IF THE LOX LEAK IS GREATER THAN 31 GPM WITH PREVALVES CLOSED, REFER FMR 7-4. 3. IF CMD A.2. IS NOT SENT, RECIRCULATION CHILLDOWN WILL NOT BE ACCOMPLISHED DUE TO RECIRCULATION VALVES CLOSED CONDITION. (REFER TO FMR 8-3 AND 8-4) 4. IMPLEMENTATION OF CMDS 3 AND 4 UNDER RULING A OR B WILL RESULT IN A 1 SECOND FUEL LEAD PRIOR TO TLI IGN AND ENGINE M/S APPROXIMATELY 7 SECONDS EARLY. 5. A LOX DUMP SHOULD NOT BE ATTEMPTED WITH A LEAKING MFV DUE TO THE HAZARDS OF SIMULTANEOUS DUMPING. 6. THE LH2 DUMP MUST BE COMPLETED PRIOR TO THE TIME OF THE NOMINAL TANK VENTING SEQUENCE. 7. THIS FAILURE WILL REQUIRE REAL-TIME ASSESSMENT BY THE LUNAR IMPACT TEAM.
		B. FOR ANY LEAK FOR WHICH THE PREDICTED PROPELLANT REMAINING AT SECOND START IS MORE THAN REQUIRED TO ASSURE 50 PERCENT PROBABILITY OF A LUNAR LANDING CAPABILITY.	EARTH ORBIT	B. CONTINUE MISSION BSE INFORM FLIGHT AND CMD 1. PREVALVES OPEN REASSES REQUIREMENTS FOR A LUNAR LANDING MISSION. IF LEAKAGE WILL RESULT IN LESS THAN 50 PERCENT PROBABILITY OF A LUNAR LANDING CAPABILITY, BSE: 2. CLOSE PREVALVES AND REVERT TO RULING A ABOVE; IF C199-401 IS EXPECTED TO BE COLDER THAN 320° R, OR C200-401 IS EXPECTED TO BE COLDER THAN 160° R AT ENGINE START, BSE CMD: (NOTE 4). 3. MAINSTAGE ENABLE NO. 2 ON 4. BURN MODE A ON	

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	7-12 (CONT)	C. MOV LEAKING IN TB7	TLC	C. CONTINUE MISSION BSE INFORM FLIGHT AND COMMAND IN TB8. 1. ENGINE PUMP PURGE OFF BSE REINITIATE LOX DUMP AFTER SEQUENCED DUMP BY COMMANDING: 2. MAIN LOX VALVE OPEN BSE TERMINATE DUMP AND SECURE SYSTEM 120 SEC AFTER GAS INGESTION OBSERVED BY COMMANDING: 3. MAIN LOX VALVE CLOSED 4. PREVALVES AND RECIRC CLOSED	
		D. MFV LEAKING IN TB7		D. CONTINUE MISSION BSE INFORM FLIGHT AND CMD ASAP IN TB 8: 1. ENGINE PUMP PURGE OFF 2. EDS CUTOFF NO. 2 ENABLE BSE INITIATE LH2 DUMP AFTER NOMINAL LOX DUMP TERMINATION TIME BY COMMANDING: (SEE NOTE 6) 3. EDS CUTOFF NO. 2 DISABLE 4. MAIN FUEL VALVE OPEN AFTER 200 SEC., BSE TERMINATE LH2 DUMP BY COMMANDING: 5. MAIN FUEL VALVE CLOSED 6. PREVALVES AND RECIRC VALVES CLOSED.	

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	7-13	IU ECS WATER VALVE FAILS TO CYCLE OPEN OR CLOSE			
		A. WATER VALVE CLOSED AND COOLANT INLET CONTROL TEMPERATURE IS 64° F OR HIGHER, AND THE INERTIAL GIMBAL TEMPERATURE IS 117° F OR HIGHER, OR THE LVDA MEMORY TEMP NO. 1 OR NO. 2 IS 147° F OR HIGHER, OR THE LVDC MEMORY TEMP IS 115° F OR HIGHER, OR THE LVDC LOGIC TEMP IS 142° F OR HIGHER, OR COOLANT MANIFOLD PUMP INLET PRESS IS 17.5 PSIA OR HIGHER.	EARTH ORBIT TLI TO APS BURN NO. 1	A. CONTINUE MISSION BSE INFORM FLIGHT AND SEND 1. ECS LOGIC INHIBIT COMMAND 2. WATER VALVE OPEN	CUES 1. WATER VALVE CLOSED/OPEN (G5-601, G6-601) 2. COOLANT TEMP (C15-601) 3. ST-124 INERTIAL GIMBAL TEMP (C34-603) 4. SUBLIMATOR INLET TEMP (C11-601) 5. LVDC MEMORY TEMP (C54-603) 6. LVDA TEMP NO. 1 (C55-603) 7. LVDA TEMP NO. 2 (C46-603) 8. LVDC LOGIC TEMP (C53-603) 9. COOLANT MANIFOLD INLET PRESS (D24-601)
		B. WATER VLV CLOSED AND COOLANT INLET CONTROL TEMP IS 64° F OR HIGHER, AND THE INERTIAL GIMBAL TEMP IS 149° F OR HIGHER, OR THE LVDA TEMP NO. 1 OR NO. 2 IS 147° F OR HIGHER, OR THE LVDC MEMORY TEMP IS 115° F OR HIGHER, OR THE LVDC LOGIC TEMP IS 142° F OR HIGHER, OR COOLANT MANIFOLD PUMP INLET PRESS IS 17.5 PSIA OR HIGHER.	APS BURN NO. 1 TO EOM	B. CONTINUE MISSION BSE INFORM FLT AND SEND: 1. WATER VLV OPEN 2. WATER VLV CLOSED WHEN THE TEMP WHICH WAS IN VIOLATION DECREASES 27° F OR IF VLV OPENED AS A RESULT OF PRESS VIOLATION, VLV WILL BE CLOSED WHEN PRESS DECREASES TO A NOMINAL LEVEL AND ANY ONE CRITICAL TEMP DECREASES 27° F.	NOTE 1. RULING"B" IS IN EFFECT ONLY IF ECS LOGIC HAS BEEN INHIBITED WITH THE WATER VLV IN THE CLOSED POSITION TO COMPENSATE FOR SUBLIMATOR VENTING FROM 15 MINUTES BEFORE APS BURN NO. 1 TO EOM.
		C. WATER VLV OPEN AND COOLANT INLET CONTROL TEMP IS 55° F OR LESS, AND THE INERTIAL GIMBAL TEMP IS 102° F OR LESS, OR THE LVDA TEMP NO. 1 OR NO. 2 IS 50° F OR LESS, OR THE LVDC MEMORY OR LOGIC TEMPS ARE 50° F OR LESS.	EARTH ORBIT TLI TLC	C. CONTINUE MISSION BSE INFORM FLT AND SEND: 1. ECS LOGIC INHIBIT CMD 2. WATER VLV CLOSED	

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	7-14	S-IVB STAGE COMMON BULKHEAD DELTA PRESSURE REACHES OR EXCEEDS: A. MINUS 20 PSID OR PLUS 30 PSID B. MINUS 26 PSID OR PLUS 36 PSID	EARTH ORBIT TLC	A. CONTINUE MISSION BSE INFORM FLIGHT AND COMMAND LH2 AND/OR LOX VENT VALVES OPEN OR CLOSED TO PRECLUDE REACHING SEPARATION LIMITS B. EMERGENCY SPACECRAFT SEPARATION BSE TRANSMIT ABORT REQUEST AND REQUEST EMERGENCY S/C SEPARATION.	CUES 1. LH2 TANK ULLAGE PRESSURE (K177-408, D178-408). 2. LOX TANK ULLAGE PRESSURE (D180-406, D179-406) 3. LH2 PUMP INLET PRESSURE (D2-403). 4. LOX PUMP INLET PRESSURE (D3-403). NOTES 1. MINUS DELTA PRESSURE IS DEFINED AS A FUEL TANK ULLAGE PRESSURE GREATER THAN THE LOX TANK ULLAGE PRESSURE. 2. PLUS DELTA PRESSURE IS DEFINED AS A LOX TANK ULLAGE PRESSURE GREATER THAN THE FUEL TANK ULLAGE PRESSURE. 3. THE MINIMUM RECOMMENDED DISTANCE BETWEEN THE S-IVB AND THE SPACECRAFT IS 7,000 FT. 4. THE BULKHEAD WILL STRUCTURALLY FAIL AT THE ULTIMATE LIMITS OF -32.5 PSID OR +42.0 PSID.

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	7-15	S-IVB STAGE PNEUMATIC SUPPLY PRESSURE DECAY EXCESSIVE IN:		A. CONTINUE MISSION BSE INFORM FLIGHT AND	CUES 1. ENGINE PUMP PURGE PRESSURE (D50-403)
		A. TB5	EARTH ORBIT	1. ATTEMPT TO TERMINATE PUMP PURGE AND/OR CLOSE AMBIENT HELIUM SUPPLY SHUTOFF VALVE. 2. RE-OPEN AMBIENT HELIUM SUPPLY SHUTOFF VALVE WHEN PNEUMATICS REQUIRED	2. AMBIENT HELIUM PNEUMATIC SPHERE PRESSURE (D236-403, D256-403). 3. LOX REPRESS SUPPLY PRESSURE (D88-403, D254-403). NOTE AN EXCESSIVE PNEUMATIC SUPPLY PRESSURE DECAY IS ONE WHICH WILL RESULT IN DEPLETION OF STAGE PNEUMATICS PRIOR TO COMPLETION OF TB8 FUNCTIONS.
		B. TB7	TLC	B. CONTINUE MISSION BSE INFORM FLIGHT AND 1. OPEN PREVALVES AND CHILLDOWN SHUTOFF VALVES IF EXCESSIVE PRESSURE DECAY CONTINUES, BSE 2. CLOSE AMBIENT HELIUM SUPPLY SHUTOFF VALVES 3. REOPEN AMBIENT HELIUM SUPPLY SHUTOFF VALVES WHEN PNEUMATICS REQUIRED.	
	7-16	CONTROL SIGNAL PROCESSOR NULL SHIFT IN TB7 OR TB8	TLC	CONTINUE MISSION BSE INFORM FLIGHT AND COMMAND LADDER LIMITS TO 12.0 DEG	CUES: 1. PRIME RATE GYRO MINUS REFERENCE RATE GYRO GREATER THAN 0.3 DEG/SEC (PITCH, R4-602, R13-602; YAW, R5-602, R8-602; ROLL, R6-602, R12-602) 2. GUIDANCE CHI MINUS THETA GIMBAL ANGLE (H60-603) GREATER THAN 10 DEG AND NOT CONVERGING. 3. LADDER ERRORS GREATER THAN 1.6 DEG(H54-603, H55-603, H56-603) EXCEPT DURING PROGRAMED MANEUVER. NOTES 1. IF BOTH RATE GYRO MEASUREMENTS ARE VALID, CUE 1 MUST BE USED. 2. FOR AS-511 ONLY, IF A NULL SHIFT OCCURS PRIOR TO TB6 + 9 SECONDS, A DCS CMD TO OPEN THE LADDER LIMITS TO 12 DEGREES MUST BE SENT AFTER TB6 + 9 SECONDS TO PREVENT THE LVDC FROM SWITCHING BACK TO THE LOWER LIMITS DURING TB7 AND TB8.

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	7-17	LH2 TANK ULLAGE PRESSURE LESS THAN 17 PSIA IN TB5	EARTH ORBIT/ TLI	CONTINUE MISSION BSE INFORM FLIGHT AND COMMAND 1. LH2 TANK VENT VALVES BOOST CLOSE ON AND OFF AND/OR CVS REGULATOR CLOSED (ORIFICE OPEN) (NOTE 1). IF THE CONDITION CANNOT BE CORRECTED AND SUFFICIENT AMBIENT REPRESS HELIUM IS AVAILABLE, BSE 2. INHIBIT O2/H2 BURNER	CUES 1. LH2 ULLAGE PRESSURE (D177-408, D178-408). 2. LH2 PUMP INLET PRESSURE (D2-403). 3. LH2 VENT CLOSED DISCRETES (K1-410, K210-410). NOTES 1. IF THE ULLAGE PRESSURE RISES ABOVE 21 PSIA AFTER THE REGULATOR HAS BEEN CLOSED, THE REGULATOR SHOULD BE CYCLED TO MAINTAIN A 17 TO 21 PSIA ULLAGE PRESSURE IN LH2 TANK. 2. IF LH2 TANK ULLAGE PRESSURE IS EXPECTED TO BE LESS THAN 19.5 PSIA AT TB6 INITIATE, RESULTING PROPELLANT LOSSES SHOULD BE INCLUDED IN THE EVALUATION OF CAPABILITY TO ACHIEVE ACCEPTABLE ALTERNATE MISSION PER FMR 7-1.

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	7-18	LOW COLD HELIUM SUPPLY PRESSURE			CUE
		A. PRIOR TO BURNER START	EARTH ORBIT	A. CONTINUE MISSION BSE INFORM FLIGHT AND COMMAND FROM LAST STATION PRIOR TO TB6 BURNER LOX SHUTDOWN VALVE CLOSE ON	COLD HELIUM SPHERE PRESSURE (D261-403, D263-403). NOTE 1. AN EXCESSIVE COLD HELIUM SUPPLY PRESSURE DECAY IS ONE WHICH WILL RESULT IN A COLD HELIUM BOTTLE PRESSURE OF LESS THAN 1000 PSIA AT TB6 INITIATE OR LESS THAN 450 PSIA AT COMPLETION OF CRYOGENIC REPRESSURIZATION.
		B. DURING BURNER OPERATION		B. CONTINUE MISSION BSE INFORM FLIGHT AND CMD LH2 AND LOX REPRESS VALVE CLOSED.	2. THIS FAILURE WILL REQUIRE EVALUATION OF RESIDUALS TO DETERMINE ADEQUACY FOR TLI VELOCITY CUTOFF AND LUNAR IMPACT OPERATIONS (FMR 7-1).
	7-19	A. LOX TANK ULLAGE PRESSURE LESS THAN 31 PSIA DURING ORBITAL COAST OR EXPECTED TO BE LESS THAN 31 PSIA BY TB6 INITIATE	EARTH ORBIT	CONTINUE MISSION BSE INFORM FLIGHT AND COMMAND 1. LOX TANK VENT VALVE BOOST CLOSE IF LOX TANK ULLAGE PRESSURE IS NOT MORE THAN 9 PSI BELOW THE REQUIRED ULLAGE PRESSURE, BSE COMMAND 2. LOX TANK REPRESS CONTROL VALVE OPEN ON UNTIL TANK PRESSURE GREATER THAN REQUIRED, THEN OFF 3. DELETED IF LOX TANK ULLAGE PRESSURE IS GREATER THAN 9 PSI BELOW THE REQUIRED ULLAGE PRESSURE, OR IF THE REQUIRED ULLAGE PRESSURE IS GREATER THAN THE FLIGHT CONTROL PRESSURE SWITCH SETTING, BSE COMMAND 4. BURNER LOX SHUTDOWN VALVE CLOSE 5. AS CLOSE AS POSSIBLE TO TB6 + 7 MIN 30 SEC, LOX AMBIENT REPRESS ON	CUES 1. LOX ULLAGE PRESSURE (D179-406, D180-406) 2. LOX PUMP INLET PRESSURE (D3-403)

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	7-20	J-2 ENGINE START BOTTLE PRESSURE OUTSIDE RE-START LIMITS	EARTH ORBIT		CUES START BOTTLE PRESSURE (D17-401, D241-401)
		A. ABOVE 1450 PSIA DURING ORBITAL COAST FOR FIRST OPPORTUNITY RESTART OR ABOVE 1500 PSIA FOR SECOND OPPORTUNITY RESTART		A. CONTINUE MISSION BSE INFORM FLIGHT AND SENT 1. START BOTTLE VENT OPEN FOR 3 SEC 2. REPEAT COMMAND AS NECESSARY TO INSURE A PRESSURE OF LESS THAN 1450 PSIA FOR FIRST OPPORTUNITY RESTART OR 1500 PSIA FOR SECOND OPPORTUNITY RESTART	NOTES 1. EXCESSIVE START BOTTLE DECAY DURING ORBITAL COAST IS DEFINED AS A PRESSURE DECAY WHICH WILL RESULT IN A START BOTTLE PRESSURE BELOW 800 PSIA AT SECOND BURN ENGINE START COMMAND (TB6 + 9 MIN 30 SEC). 2. A START BOTTLE PRESSURE OF 300 PSIA MAXIMUM IS ALLOWABLE AT START BOTTLE RECHARGE COMMAND.
		B. ABOVE 1800 PSIA PRIOR TO RESTART		B. EMERGENCY SPACECRAFT SEPARATION BSE TRANSMIT ABORT REQUEST AND RECOMMEND EMERGENCY SPACECRAFT SEPARATION	
		C. BELOW 800 PSIA (SEE NOTE)		C. CONTINUE MISSION BSE INFORM FLIGHT AND COMMAND ASAP 1. START TANK RECHARGE ARM ON 2. START TANK VENT OPEN UNTIL TANK PRESSURE LESS THAN 300 PSIA, THEN CLOSE	
	7-21	LOX BLEED VLV FAILS OPEN DURING S-IVB FIRST BURN	LAUNCH	CONTINUE MISSION BSE INFORM FLT ASAP AFTER CUTOFF, BSE: 1. CYCLE LOX BLEED VLV; IF 1. IS UNSUCCESSFUL, BETWEEN TB6 + 7 MIN 30 SEC AND TB6 + 9 MIN 30 SEC, BSE: 2. CLOSE MRCV (5.0 POSITION)	CUES: 1. OXIDIZER BLEED VLV CLOSED OFF (K126-401) DURING S-IVB FIRST BURN. 2. REDUCED ENGINE PERFORMANCE (REFER TO REAL-TIME PERFORMANCE RESULTS) NOTES: 1. THIS FAILURE WILL RESULT IN PROPELLANT IMBALANCE AND WILL REQUIRE EVALUATION OF RESIDUALS TO DETERMINE ADEQUACY FOR TLI VELOCITY CUTOFF (REF FMR 7-1)
	7-22	S-IVB CONFIRMED LOSS OF HYDRAULIC FLUID	EARTH ORBIT/ TLI	NO S-IVB RESTART (TB5)/TLI INHIBIT (TB6) BSE INFORM FLIGHT AND RECOMMEND NO S-IVB RESTART	CUES 1. HYDRAULIC RESERVOIR OIL LEVEL APPROX ZERO PERCENT (L7-403). 2. HYDRAULIC SYSTEM PRESSURE LESS THAN 1700 PSIA (D41-403). 3. HYDRAULIC RESERVOIR PRESSURE APPROXIMATELY ZERO PSIA (D42-403). NOTES IF L7-403 IS FUNCTIONING PROPERLY, IT IS REQUIRED FOR IMPLEMENTATION OF THIS RULE.

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	7-23	LOSS OF ECS COOLANT CIRCULATION	EO TLI TLC	CONTINUE MISSION BSE INFORM FLT AND SEND: COOLANT PUMP NO. 1 ON AND PRESSURE SWITCH DEACTIVATE	CUES: 1. FLOW RATE IU EXIT COOLANT (F9-602) APPROXIMATELY 1.5 GPM. 2. FLOW RATE S-IVB INLET COOLANT (F10-601) APPROXIMATELY 1.5 GPM. 3. COOLANT MANIFOLD INLET PRESS. (D17-601) APPROXIMATELY 16 PSIA. 4. COOLANT PUMP NO. 2 POWER ON (K161-601) +28 VDC 5. COOLANT PUMP INLET PRESS (D24-601) APPROXIMATELY 16 PSIA.
	7-24	MIXTURE RATIO CONTROL VLV (MRCV) FAILS OPEN (4.5 POSITION) DURING S-IVB FIRST BURN	LAUNCH	CONTINUE MISSION BSE INFORM FLT ASAP AFTER FIRST ENGINE CUTOFF, BSE: CYCLE MRCV	CUES: 1. MIXTURE RATIO CONTROL VLV POSITION (G17-401) DOES NOT INDICATE 5.0 POSITION. 2. MRCV OPEN ON (K219-404) (4.5 POSITION). 3. FAILURE VERIFIED BY ENGINE PERFORMANCE (REFER TO REAL-TIME ENGINE PERFORMANCE RESULTS). NOTES: THIS FAILURE WILL RESULT IN PROPELLANT IMBALANCE AND WILL REQUIRE EVALUATION OF RESIDUALS TO DETERMINE ADEQUACY FOR TLI VELOCITY CUTOFF (REF FMR 7-1)

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	7-25	S-IVB STAGE LOX NON-PROPULSIVE VENT (NPV) FAILS			CUES 1. LOX NPV NOZZLE PRESSURES (D243-404, D244-404). 2. LOX TANK ULLAGE PRESSURE (D180-406, D179-406). 3. LOX NPV OPEN DISCRETES (K198-424, K199-424).
		A. TO OPEN AT TB7 + 0.7 SEC	TLC	A. CONTINUE MISSION BSE INFORM FLIGHT AND VENT THE LOX TANK TO 18-20 PSIA PRIOR TO TB7 + 15 MIN.	
		B. TO LATCH OPEN AT TB8 + 28 MIN 10 SEC	TLC	B. CONTINUE MISSION BSE INFORM FLIGHT AND 1. ATTEMPT TO LATCH OPEN THE LOX VENT IF UNSUCCESSFUL, BSE COMMAND AT TB8 +26 MIN 15 SEC 2. LH2 LATCHING VENT VALVE CLOSED	
	7-26	LH2 LATCHING VENT VALVE FAILS TO LATCH OPEN AS PROGRAMED	TLC		CUES 1. LH2 NPV NOZZLE PRESSURE (D183-409, D184-409). 2. LH2 ULLAGE PRESSURE (D177-408, D178-408). 3. LH2 LATCHING VENT VALVE DISCRETES (K210-410, K211-410). 4. LH2 PUMP INLET PRESSURE (D2-403)
		A. IN TB7		A. CONTINUE MISSION BSE INFORM FLIGHT AND 1. ATTEMPT TO OPEN THE LH2 LATCHING VENT VALVE IF UNSUCCESSFUL, BSE COMMAND 2. LH2 LATCHING VENT VALVE CLOSED 3. LH2 VENT VALVE OPEN AT TB7 + 15 MIN OR TB7 + 1 HR 15 MIN COMMAND 4. LH2 VENT VALVE CLOSE	
		B. IN TB8		B. CONTINUE MISSION BSE INFORM FLIGHT AND 1. ATTEMPT TO LATCH OPEN THE LH2 LATCHING VENT VALVE IF UNSUCCESSFUL, BSE COMMAND (ASAP) 2. LOX NPV UNLATCHED AND CLOSED	

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	7-27	ENGINE START BOTTLE DUMP FAILS TO INITIATE	TLC	CONTINUE MISSION BSE INFORM FLIGHT AND ATTEMPT TO OPEN THE START BOTTLE VENT VALVE FOR A MINIMUM OF 40 SECONDS	CUES GH2 START BOTTLE PRESSURE (D17-401, D241-401). NOTES THE MAXIMUM SAFE PRESSURE LIMIT TO PRECLUDE REACHING BOTTLE PROOF PRESSURE PRIOR TO LUNAR IMPACT IS 615 PSIA.
	7-28	S-IVB STAGE COLD HELIUM DUMP FAILS TO INITIATE	TLC	CONTINUE MISSION BSE INFORM FLIGHT AND 1. ATTEMPT TO INITIATE THE COLD HELIUM DUMP THROUGH LH2 COIL ON O2/H2 BURNER FOR A MINIMUM OF 45 MINUTES IF UNSUCCESSFUL, BSE INFORM FLIGHT AND, AFTER LOX NPV OPEN IN TB8, COMMAND 2. LOX PRESSURIZATION SHUTOFF VALVES OPEN FOR A MINIMUM OF 30 MINUTES	CUE COLD HELIUM BOTTLE PRESSURE (D261-403, D263-403). NOTE THE MAXIMUM SAFE PRESSURE LIMIT TO PRECLUDE REACHING BOTTLE PROOF PRESSURE PRIOR TO LUNAR IMPACT IS 100 PSIA.
	7-29	ENG HELIUM CONTROL VLV LEAKING AFTER FIRST ENGINE CUTOFF	EO	CONTINUE MISSION BSE INFORM FLT AND: 1. CYCLE ENG HELIUM CONTROL VLV (NOTE 1) IF EITHER BLEED VALVE IS CLOSED, REFER TO FMR 8-3 OR 8-4	CUES: 1. ENG REG OUTLET PRESS (D018-401) 60 PSIA OR GREATER 2. ENG CONTROL HELIUM PRESS (D019-401, D242-401) DECREASING 3. FUEL TK HELIUM REPRESS SPHERE PRESS (D20-403, D249-403) 4. BLEED VLVS CLOSED (K126-401, K127-401) NOTES: 1. RULING 1 MAY BE REPEATED AT DISCRETION OF BSE IN AN EFFORT TO TERMINATE LEAKAGE. 2. RULINGS 1 THROUGH 4 MUST BE TAKEN PRIOR TO LOS AFTER FIRST ENGINE CUTOFF. 3. MOV MUST BE CLOSED PRIOR TO RESTART AS MOV OPEN VIOLATES FMR 7-4.

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	7-30	OXIDIZER TURBINE BYPASS VLV (OTBY) FAILS OPEN DURING S-IVB FIRST BURN	LAUNCH	CONTINUE MISSION BSE INFORM FLT AS SOON AS POSSIBLE AFTER FIRST BURN CUT-OFF, BSE: 1. CLOSE PREVALVES AND RECIRC VALVES 2. DRAIN AND PURGE LOX SYS 3. DRAIN LH2 SYSTEM AND PURGE (SEE NOTE 3) 4. CYCLE OTBV 5. RETURN SYSTEM TO NORMAL IF CYCLE OF OTBV IS UNSUCCESS-FUL, BETWEEN TB6 + 7 MIN 30 SEC AND TB6 + 9 MIN 30 SEC, BSE: 6. CLOSE MRCV (5.0 POSITION)	CUES: 1. OTBV POSITION (G8-401) INDICATES OPEN DURING S-IVB FIRST BURN. 2. OTBV CLOSED OFF (K125-401) DURING S-IVB FIRST BURN. 3. REDUCED ENG PERFORMANCE (REFER TO R/T ENGINE PERFORMANCE RESULTS). NOTES: 1. THIS FAILURE WILL RESULT IN PROPELLANT IMBALANCE AND WILL REQUIRE EVALUATION OF RESIDUALS TO DETERMINE ADEQUACY FOR TLI VEL. CUTOFF (REF FMR 7-1) 2. THIS RULE MUST BE IMPLEMENTED AS SOON AS POSSIBLE AFTER C/O. 3. THE ENGINE PUMP PURGE MUST BE OFF PRIOR TO CYCLING THE OTBV TO PREVENT BACKFLOW OF GASES TO THE GG WHEN OTBV CYCLED.
	7-31	LOW APS HELIUM SUPPLY SUPPLY PRESSURE	EARTH ORBIT/ TLI	CONTINUE MISSION IF APS HELIUM BOTTLE PRESSURE IS EXPECTED TO BE BELOW 350 PSIA PRIOR TO THE NEXT GROUND STATION, BSE INFORM FLIGHT AND RECHARGE APS HELIUM BOTTLE AS REQUIRED TO MAINTAIN ATTITUDE CONTROL.	CUES: 1. HELIUM SUPPLY PRESSURE MODULE 1 (D0035-414; D0250-414); MODULE 2 (D00036-415; D0251-415).


8 SLV – TB6
(RESTART)

R	ITEM

SUMMARY OF RESTART PHASE RULES

8-1 RESERVED
8-2 O_2/H_2 BURNER LH_2 VALVE FAILS
8-3 LH_2 CHILLDOWN SYSTEMS FAILS
8-4 LOX CHILLDOWN SYSTEM FAILS
8-5 RESERVED
8-6 S-IVB ACTUATOR HARDOVER
8-7 CONTINUOUS VENT REGULATOR FAILS TO CLOSE
8-8 LOSS OF ATTITUDE CONTROL DURING SECOND BURN

THE FOLLOWING MISSION RULES ALSO APPLY TO THIS SECTION:

6-3 INERTIAL PLATFORM FAILURE - ACCELEROMETER
6-4 LAUNCH VEHICLE INERTIAL PLATFORM FAILURE ATTITUDE REFERENCE
6-11 S-IVB STAGE LOSS OF THRUST
7-2 LOSS OF ONE APS MODULE
7-7 S-IVB AUXILIARY HYDRAULIC PUMP FAILS
7-8 LOSS OF ATTITUDE CONTROL DURING TB6 TO TB6 + 9 MIN 10 SEC (CREW IMPLEMENTATION)
7-9 CONTINUOUS VENT REGULATOR FAILS TO OPEN
7-13 IU ECS WATER VALVE FAILS TO CYCLE OPEN AND CLOSED
7-14 S-IVB STAGE COMMON BULKHEAD DELTA PRESSURE REACHES OR EXCEEDS -20 PSID OR +36 PSID (CREW IMPLEMENTATION) OR +30 PSID, -26 PSID
7-17 LH_2 TANK VENT FAILURE OR LEAK DURING ORBITAL COAST
7-18 LOW COLD HELIUM SUPPLY PRESSURE
7-19 LOX TANK ULLAGE PRESSURE LOW (CREW IMPLEMENTATION)
7-20 J-2 ENGINE START BOTTLE PRESSURE OUTSIDE RESTART LIMITS
7-22 S-IVB LOSS OF ENGINE HYDRAULIC FLUID

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	8-1	RESERVED			
	8-2	S-IVB STAGE O2/H2 BURNER FUEL PROPELLANT VALVE FAILS CLOSED A. PRIOR TO TB6 + 341 SEC	TLI	A. CONTINUE MISSION BSE INFORM FLIGHT AND COMMAND 1. BURNER SHUTDOWN 2. CONTINUOUS VENT SYSTEM ORIFICE OPEN 3. LH2 REPRESSURIZATION CONTROL VALVE CLOSE 4. LOX REPRESSURIZATION CONTROL VALVE CLOSE	CUES A AND B 1. BURNER CHAMBER DOME TEMPERATURE (C2034-403, C382-403). 2. BURNER PROPELLANT VALVE POSITIONS (K180-404, K192-403, K181-404) 3. AMBIENT REPRESSURIZATION MODE SELECT (K195-404). NOTE THE O2/H2 BURNER VOTING CIRCUIT WILL NOT DETECT FAILURE OF THE BURNER TO IGNITE OR BURNER FLAME-OUT IN THE EVENT THE FUEL PROPELLANT VALVE FAILS CLOSED.
		B. AFTER TB6 + 341 SEC		B. CONTINUE MISSION BSE INFORM FLIGHT AND COMMAND 1. BURNER SHUTDOWN 2. APSULLAGE ENGINES ON 3. LH2 REPRESSURIZATION CONTROL VALVE CLOSE 4. LOX REPRESSURIZATION CONTROL VALVE CLOSE	
	8-3	LH2 CHILLDOWN SYSTEM FAILS DURING RESTART PREPARATIONS	TLI	CONTINUE MISSION BSE INFORM FLIGHT AND 1. ATTEMPT TO CORRECT SITUATION SPECIFIED IN NOTE A, B, D IF UNSUCCESSFUL, BSE INFORM FLIGHT	CUES 1. LH2 PUMP INLET TEMP (C3-403). 2. LH2 RECIRC FLOW (F5-404). 3. LH2 PREVALVE DISCRETES (K111-404, K112-404). 4. LH2 BLEED VALVE CLOSE (K127-401). 5. LH2 RECIRC VALVE CLOSE (K136-409). 6. LH2 ULLAGE PRESS TO LH2 PUMP INLET PRESS ΔP (D177-408; D178-408; D2-403). NOTE LH2 CHILLDOWN WILL NOT BE SATISFACTORY IF A. PREVALVE IS OPEN B. RECIRCULATION VALVE IS CLOSED C. BLEED VALVE IS CLOSED D. CHILLDOWN PUMP IS NOT ON

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	8-4	S-IVB STAGE LOX CHILLDOWN SYSTEM FAILS DURING RESTART PREPARATIONS	TLI	CONTINUE MISSION/TLI INHIBIT BSE INFORM FLIGHT AND 1. ATTEMPT TO CORRECT SITUATION SPECIFIED IN NOTES 1.A, 1.B, 1.D IF 1 IS UNSUCCESSFUL, BSE INFORM FLIGHT AND BETWEEN TB6 + 4 MIN 10 SEC AND TB6 + 7 MIN 37.8 SEC COMMAND 2. ALTERNATE SEQUENCE 6D IF LOX LEAD EXCEEDS 20 SEC, BSE INFORM FLIGHT AND 3. RECOMMEND TLI INHIBIT	CUES FOR CHILLDOWN FAILURE 1. LOX CHILLDOWN FLOW RATE (F4-424). 2. LOX ULLAGE PRESSURE TO LOX DUMP INLET PRESSURE ΔP (D179-406,D180-406,D003-403). 3. LOX PUMP INLET TEMP NOT DECREASING (C4-403). 4. LOX PREVALVE DISCRETES (K109-403, K110-403). 5. LOX BLEED VALVE CLOSED (K126-401). 6. LOX RECIRCULATION VALVE CLOSED (K139-424). CUES FOR MOV FAILURE 1. MOV POSITION INDICATES NOT FULL CLOSED (G3-401). 2. MOV OPEN DISCRETE ON (K120-401). 3. LOX FLOWMETER (F1-401) INDICATES FLOW. 4. LOX INJECTOR PRESSURE (D005-401). NOTES 1. LOX CHILLDOWN WILL NOT BE SATISFACTORY IF (A) PREVALVE IS OPEN (B) RECIRCULATION VALVE IS CLOSED (C) BLEED VALVE IS CLOSED (D) CHILLDOWN PUMP IS NOT ON 2. ALTERNATE SEQ 6D COMMAND WILL ENABLE AN ONBOARD PROGRAMED 8 SEC LOX LEAD BEGINNING AT TB6 + 7 MIN 37.8 SEC. 3. THIS FAILURE WILL REQUIRE EVALUATION OF RESIDUALS TO DETERMINE ADEQUACY FOR TLI VELOCITY CUTOFF AND LUNAR IMPACT OPERATIONS.
	8-5	RESERVED			

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	8-6	S-IVB ACTUATOR CONFIRMED HARDOVER PRIOR TO TLI IGN AND AUXILIARY HYDRAULIC PUMP IS OPERATING	TLI	CONTINUE MISSION/TLI INHIBIT/CUTOFF A. CONTINUE MISSION IF TIME PERMITS, SET UP FOR THE CREW TO ATTEMPT TO GIMBAL THE ENGINE WITH THE ROTATIONAL HAND CONTROLLER IF THERE IS NOT TIME, OR IF UNSUCCESSFUL, B. TLI INHIBIT/CUTOFF BSE INFORM FLIGHT AND RECOMMEND TLI INHIBIT/ CUTOFF AND IMPLEMENT THE ABOVE PROCEDURE	CUE ACTUATOR POSITIONS ±5 DEG OR GREATER (G1-400, G1-403, G2-400, G2-403). NOTE BOTH INDIVIDUAL PITCH/YAW ACTUATOR POSITION INDICATORS MUST CONFIRM MALFUNCTION PRIOR TO IMPLEMENTATION OF THE RULE.
	8-7	S-IVB STAGE CONTINUOUS VENT MODULE A. REGULATOR FAILS TO CLOSE DURING RESTART SEQUENCE	TLI	A. CONTINUE MISSION BSE INFORM FLIGHT AND 1. ATTEMPT TO CLOSE THE CVS REGULATOR IF 1 IS UNSUCCESSFUL, BSE INFORM FLIGHT AND COMMAND 2. O2/H2 BURNER SHUTDOWN	CUES A.1. CVS NOZZLE PRESSURE REMAINS GREATER THAN 3 PSIA (D181-409 THROUGH D182-409). 2. CVS REGULATOR CLOSED (K154-411). 3. LH2 TANK ULLAGE PRESSURE (D177-408, D178-408).
		B. REGULATOR FAILS TO CLOSE OR ORIFICE SHUTOFF VALVE FAILS TO CLOSE AT TB7 + 2 MIN 30.9 SEC (SEE NOTE)		B. CONTINUE MISSION BSE INFORM FLIGHT AND 1. ATTEMPT TO CLOSE THE CVS REGULATOR OR THE CVS ORIFICE SHUTOFF VALVE IF 1 IS UNSUCCESSFUL, BSE COMMAND AT TB7 + 15 MIN AND TB7 + 1 HR 15 MIN 2. LH2 LATCHING VENT VALVE OPEN AND LATCH	B.1. LH2 TANK CONTINUOUS VENT ORIFICE SHUTOFF VALVE CLOSED (K0155-411). 2. CVS NOZZLE PRESSURE DOES NOT DECREASE TO 0 PSIA AT TB7 + 2 MIN 30.9 SEC (D0181-409, D0182-409). NOTE THIS FAILURE WILL REQUIRE RE-EVALUATION OF ΔV REQUIRED FOR LUNAR IMPACT.

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	8-8	LOSS OF ATTITUDE CONTROL DURING S-IVB SECOND BURN	TLI	CONTINUE MISSION BSE INFORM FLIGHT AND FIDO CREW WILL TAKE ACTION ON LIMITS (NOTE 1)	CUES 1. ANGULAR RATES - PITCH (R4-602), YAW (R5-602), OR ROLL (R6-602) GREATER THAN 5 DEG/SEC AND NOT DECREASING. 2. ANGULAR RATES - PITCH (R13-602), YAW (R8-602), OR ROLL (R12-602) GREATER THAN 5 DEG/SEC AND NOT DECREASING (SEE NOTE 3). 3. LOSS OF ATTITUDE CONTROL ALERT (SEE NOTE 2). NOTES 1. TLI BURN WILL BE TERMINATED FOR (A) PITCH OR YAW BODY RATES GREATER THAN ±10 DEG/SEC (B) ROLL BODY RATE GREATER THAN ±20 DEG/SEC (C) PITCH OR YAW ATTITUDE DEVIATION FROM NOMINAL PROFILES GREATER THAN 45 DEG 2. LOSS OF ATTITUDE CONTROL ALERT WILL BE GIVEN FOR THE FOLLOWING CONDITIONS: (A) LVDC/LVDA COMPUTATIONAL FAILURE. (B) ATTITUDE ERROR SIGNALS-ROLL GREATER THAN ±3.5 DEG, PITCH AND YAW GREATER THAN ±5 DEG. (C) FAILURE TO INITIATE PROPER GUIDANCE SEQUENCE. (D) FAILURE OF S-IVB ENGINE HYDRAULICS. 3. THE CUES ARE VALID IF RATE CHANNEL SWITCHOVER HAS NOT OCCURRED. 4. ROLL ATTITUDE ERRORS >3.5 DEG. MAY BE A RESULT OF LOSS OF BOTH APS MODULES. THE CREW SHOULD ATTEMPT ROLL CONTROL WITH RCS.

9 SLV-T88 (SAFING AND LUNAR IMPACT)

R	ITEM

SUMMARY OF SAFING AND SLINGSHOT RULES

9-1 STAGE PNEUMATIC DUMP FAILS
9-2 LOX DUMP FAILS
9-3 ENGINE CONTROL BOTTLE DUMP FAILS
9-4 RESERVED
9-5 RESERVED

THE FOLLOWING REFERENCED FLIGHT MISSION RULES ARE ALSO APPLICABLE DURING TIME BASE EIGHT (TB8):

7-3 J-2 ENGINE MAIN FUEL VALVE (MFV) FAILS TO CLOSE AT FIRST S-IVB CUTOFF, SECOND S-IVB CUTOFF
7-4 J-2 ENGINE MAIN OXIDIZER VALVE FAILS TO CLOSE AT FIRST S-IVB CUTOFF, SECOND BURN CUTOFF
7-8 LOSS OF ATTITUDE CONTROL DURING TB5 AND TB7 TO SPACECRAFT SEPARATION, TB6 TO TB6 + 9 min 20 SEC AFTER SPACECRAFT SEPARATION, AFTER TB8 INITIATE
7-13 IU ECS VALVE FAILS TO CYCLE OPEN AND CLOSED
7-14 S-IVB STAGE COMMON BULKHEAD DELTA PRESSURE REACHES OR EXCEEDS -20 PSID OR +30 PSID, -26 PSID OR +36 PSID
7-25 S-IVB STAGE LOX NON-PROPULSIVE VENT (NPV) FAILS TO OPEN AT TB7 + 0.7 SEC, TO LATCH OPEN AT TB8 +17 MIN 3 SEC
7-26 LH_2 LATCHING VENT VALVE FAILS TO LATCH OPEN AS PROGRAMED
7-28 S-IVB STAGE COLD HELIUM DUMP FAILS TO INITIATE

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	9-1	S-IVB STAGE PNEUMATIC DUMP FAILS TO INITIATE	TLC	CONTINUE MISSION BSE INFORM FLIGHT AND ATTEMPT TO OPEN THE ENGINE PUMP PURGE CONTROL VALVE	CUES 1. ENGINE PUMP PURGE PRESSURE (D50-403). 2. AMBIENT HELIUM SUPPLY PRESSURE (D236-403, D256-403). NOTES THE STAGE PNEUMATIC BOTTLE WILL BE SAFE AT LIFTOFF AND WILL NOT REACH PROOF PRESSURE PRIOR TO LUNAR IMPACT.
	9-2	S-IVB LOX DUMP FAILS TO INITIATE	TLC	CONTINUE MISSION BSE INFORM FLIGHT AND ATTEMPT TO INITIATE THE THE REQUIRED LOX DUMP	CUES 1. MAIN OXIDIZER VALVE POSITION (G3-401). 2. MAIN OXIDIZER VALVE OPEN DISCRETE (K120-401). 3. LOX PUMP INLET TEMPERATURE (C4-403). 4. LOX FLOW RATE (F1-401). 5. LOX PREVALVE OPEN DISCRETE (K109-403). 6. LOX PREVALVE CLOSE DISCRETE (K110-403). NOTES 1. LOX DUMP WILL FAIL TO INITIATE IF (A) THE MOV REMAINS CLOSED (B) THE LOX PREVALVE REMAINS CLOSED 2. IF A LOX DUMP IS UNSUCCESSFUL, A RE-EVALUATION OF THE LUNAR IMPACT ΔV WILL BE REQUIRED.
	9-3	ENGINE CONTROL BOTTLE DUMP FAILS TO INITIATE	TLC	CONTINUE MISSION BSE INFORM FLIGHT AND ATTEMPT TO OPEN THE ENGINE HELIUM CONTROL VALVE	CUES 1. ENGINE CONTROL REG PRESS (D18-401). 2. ENGINE CONTROL HELIUM SPHERE PRESSURE (D19-401, D242-401). NOTES THE MAXIMUM SAFE PRESSURE LIMIT TO PRECLUDE REACHING BOTTLE PROOF PRESSURE PRIOR TO LUNAR IMPACT IS 2300 PSIA.
		RULES 9-4 AND 9-5 ARE RESERVED.			

R | ITEM

PRELAUNCH INSTRUMENTATION

STAGE COMMUNICATIONS SYSTEM AND FLIGHT CONTROL MEASUREMENT CATEGORIZATION

MEASUREMENT DESCRIPTION	MEAS NUMBER	ONBOARD	TRANSDUCERS	CATEGORY	EFFEC-TIVITY	MISSION RULE REF
STAGE COMMUNICATIONS SYSTEM						
S-II STAGE						
LINK BP1				HD		
MUX BP1A0				HD		
MUX BP1B0				HD		
MUX CP1A0				HD		
S-IVB STAGE						
LINK CP1				HD		
MUX DP1B0 (VIA IU)				M		
MUX CP1B0				HD		
INSTRUMENT UNIT						
LINK DP1				HD		
LINK DP1B				M		
MUX CP1A0 (VIA S-IVB)				HD		
MUX DP1A0				HD		
EMERGENCY DETECTION SYSTEM (EDS)				M		
COMMAND COMMUNICATIONS SYSTEM (CCS) UPLINK				M		
FLIGHT CONTROL MEASUREMENTS						
S-IVB STAGE						
PRESS, FUEL PUMP INLET	D2-403					7-14
PRESS, FUEL TANK ULLAGE EDS 1	D177-408	METER*	COMMON	2 OF 3		7-14
PRESS, FUEL TANK ULLAGE EDS 2	D178-408	METER*	COMMON	M		7-14/19
PRESS, OXID PUMP INLET	D3-403					
PRESS, OXID TANK ULLAGE EDS 1	D179-406	METER*	COMMON	2 OF 3		7-14/19,8-5
PRESS, OXID TANK ULLAGE EDS 2	D180-406	METER*	COMMON	M		7-14/19,8-5
INSTRUMENT UNIT						
GUIDANCE COMPUTER OPERATION	H60-603			M		6-1/4/7/9, 7-8/11,8-1/8
COMPUTER RESET PULSE NO. 1-GUIDANCE DECODER	J71-603			1 OF 2		REQUIRED TO COMPLETE MULTIPLE WORD GROUND COMMANDS
COMPUTER RESET PULSE NO. 2-GUIDANCE DECODER	J72-603			M		

*ONBOARD DISPLAY MANDATORY

10 CSM ENVIRONMENTAL CONTROL SYSTEM

R	ITEM	
		GENERAL
	10-1	LAUNCH LAUNCH WILL BE CONTINUED AS LONG AS THE SUIT CIRCUIT AND O_2 SUPPLY WILL SUPPORT FLIGHT CREW DEMANDS FOR AT LEAST ONE REV AND ENTRY INTO 2-1. THERE ARE NO COOLANT FAILURES FOR WHICH LAUNCH/INSERTION PHASE WILL BE TERMINATED. TLC & TEC WATER EVAPORATION WILL BE LIMITED TO COMPONENT TESTING. POWERED DESCENT THERE ARE NO CSM ENVIRONMENTAL CONTROL SYSTEMS FAILURES FOR WHICH POWERED DESCENT WILL BE TERMINATED. ALL PHASES A. BACKUP SYSTEMS AND BACKUP COMPONENTS WILL NORMALLY BE USED FOR THE MOST RAPID PRACTICAL RETURN TO EARTH, NOT FOR MISSION CONTINUATION. B. LM SYSTEMS WILL BE USED AS REQUIRED FOR CSM SYSTEMS BACKUP. IF CSM SYSTEMS REQUIRE LM BACKUP, THE DESCENT STAGE WILL BE RETAINED WHERE POSSIBLE. C. TO CONTINUE, WATER QUANTITY PREDICTIONS MUST REFLECT ADEQUATE QUANTITIES TO MEET NORMAL MISSION REQUIREMENTS.

R	ITEM
	10-2

DEFINITIONS

LOSS OF CABIN INTEGRITY:

CM PRESSURE VESSEL LEAKAGE SUCH THAT CABIN PRESSURE CANNOT BE MAINTAINED GREATER THAN OR EQUAL TO 4.5 PSIA BY CABIN PRESSURE REGULATORS (1.2 LB/HR TOTAL).

LOSS OF SUIT/SUIT CIRCUIT INTEGRITY:

- PGA CHECK WITH LEAKAGE GREATER THAN 0.5 PSI/MIN DURING PGA CHECK.
- TOTAL LOOP CHECK WHICH RESULTS IN ECS O_2 FLOW > 0.9 LB/HR AFTER SUIT TEST PRESSURE STABILIZATION DURING SUIT CIRCUIT INTEGRITY CHECK.

LOSS OF SUIT CIRCUIT:

INABILITY OF THE SUIT CIRCUIT TO MAINTAIN ADEQUATE CREW COMFORT AND/OR CO_2 REMOVAL WITHOUT USING DIRECT O_2.

LOSS OF O_2 MANIFOLD:

AN O_2 MANIFOLD OR REGULATOR FAILURE WITH WHICH THE SUIT CIRCUIT O_2 DEMANDS CANNOT BE SUPPLIED FOR ENTRY.

LOSS OF PRIMARY LOOP COOLING:

LOSS OF ALL FLOW, A LEAK WHICH CANNOT BE ISOLATED, OR COMBINED FAILURES SUCH THAT RADIATORS AND EVAPORATOR PROVIDE NO COOLING.

LOSS OF SECONDARY LOOP COOLING:

LOSS OF ALL FLOW, A LEAK WHICH CANNOT BE ISOLATED, OR COMBINED FAILURES SUCH THAT RADIATORS AND EVAPORATOR PROVIDE NO COOLING.

LOSS OF COLLANT LOOP RADIATORS:

RADIATOR LEAK, BLOCKAGE OF ALL FLOW THROUGH RADIATORS, OR RADIATOR DEGRADATION SUCH THAT TOTAL LONG-TERM USAGE OF WATER IS MORE THAN IS BEING PRODUCED.

LOSS OF ALL COOLING:

LOSS OF PRIMARY AND SECONDARY LOOP COOLING.

LOSS OF SURGE TANK AND/OR REPRESS PACK:

SURGE TANK,REPRESS PACK, OR ASSOCIATED ISOLATABLE PLUMBING FAILURES WHICH REQUIRE ISOLATION OF THE SURGE TANK AND/OR REPRESS PACK.

RULE NUMBERS 10-3 THROUGH 10-9 ARE RESERVED.

R	ITEM

SYSTEMS MANAGEMENT

10-10 O_2 SYSTEM

A. SUIT FLOW RELIEF VALVE WILL REMAIN CLOSED FOR DURATION OF FLIGHT.

B. NORMAL CM REPRESSURIZATION WILL UTILIZE THE REPRESS PACK.

C. THE REPRESS PACK VALVE WILL BE IN OFF POSITION FOR ALL PHASES EXCEPT LAUNCH, CSM EVA, ENTRY, AND TUNNEL/LM PRESSURIZATION AND RECHARGE.

D. THE SUIT CIRCUIT MUST BE PURGED OF ACCUMULATED H_2 ONCE EVERY 6 HOURS FOR 1 MINUTE WHEN ALL CREWMEN ARE SUITED AND THE SUIT CIRCUIT IS ISOLATED.

E. THE SURGE TANK AND REPRESS PACK WILL NORMALLY BE RECHARGED SIMULTANEOUSLY.

F. CM CABIN PRESSURE WILL NOT BE ALLOWED TO DROP BELOW 4.0 PSIA DURING NORMAL LM PRESSURIZATION EXCEPT DURING TD&E.

G. THE CM ECS WILL NORMALLY SUPPLY ALL O_2 FOR CONSUMPTION AND LEAKAGE DURING IVT PHASES.

H. THE FLIGHT CREW WILL DON SUITS FOR THE FOLLOWING:

1. INABILITY TO MAINTAIN CABIN PRESSURE ABOVE 4.5 PSIA
2. TD&E
3. GLYCOL LEAKS IN COMMAND MODULE
4. FIRE, SMOKE, AND/OR CONTAMINATION IN CABIN
5. LM JETT
6. CSM EVA

I. THE FLIGHT CREW WILL DOFF SUITS (TIME AND CONDITIONS PERMITTING) FOR THE FOLLOWING:

1. LOSS OF SUIT CIRCUIT.
2. CONFIRMED LEAK OF GLYCOL IN SUIT CIRCUIT

COOLANT MANAGEMENT

A. FOR SIMULTANEOUS PRIMARY AND SECONDARY LOOP OPERATION, EITHER THE PRIMARY OR SECONDARY LOOP RADIATOR WILL NORMALLY BE ISOLATED.

B. GLYCOL RESERVOIR WILL BE ON LINE AND RADIATORS WILL BE BYPASSED FOR LAUNCH.

C. INDICATED GLYCOL ACCUMULATOR QUANTITY WILL BE MAINTAINED BETWEEN 30 AND 70 PERCENT.

D. SECONDARY COOLANT WILL BE OFF FOR LAUNCH.

E. ADDITIONAL POWER LOADS WILL BE ADDED AS REQUIRED IN AN ATTEMPT TO MAINTAIN PRIMARY RADIATOR OUTLET TEMPERATURE GREATER THAN -20 DEG.

R	ITEM	
	10-10 (CONT)	WATER SYSTEM

A. WASTE WATER WILL BE MANUALLY DUMPED OVERBOARD AS REQUIRED TO MAINTAIN INDICATED QUANTITY LESS THAN 85-90 PERCENT. WASTE WATER WILL NORMALLY BE DUMPED TO 15 PERCENT. HOWEVER, IF WASTE WATER QUANTITY INSTRUMENTATION (CF0009) IS LOST, WASTE WATER WILL BE DUMPED UNTIL POTABLE WATER QUANTITY (CF0010) BEGINS TO DECREASE.

B. WATER DUMPS WILL BE MANAGED SO THAT:

1. AT LOI, THE WASTE TANK WILL CONTAIN GREATER THAN 75 PERCENT
2. AT CM-SM SEPARATION, THE POTABLE TANK WILL BE FULL AND THE WASTE TANK WILL BE 90 PERCENT FULL

C. WATER DUMPS AND FUEL CELL PURGES WILL NORMALLY BE SCHEDULED TO OCCUR:

1. IMMEDIATELY AFTER THE SEXTANT STAR CHECK IN MANEUVER PREPARATION - OR CISLUNAR NAVIGATION - OR NO LATER THAN 1 HOUR BEFORE AN OPTICAL SIGHTING
2. BEHIND THE MOON, WITH THE COMPLETION OF THE DUMP OR PURGE BEFORE AOS

D. IN ORDER TO REDUCE TRAJECTORY CALCULATION PERTUBATIONS, WATER DUMPS AND FUEL CELL PURGES WILL NOT BE SCHEDULED:

1. TEN HOURS BEFORE MCC-4 UNTIL AFTER LOI
2. DURING MSFN TRACKING PERIODS
3. TEN HOURS BEFORE MCC-7 UNTIL ENTRY

E. WATER DUMPS, FUEL CELL PURGES, AND URINE DUMPS WILL BE INHIBITED:

1. THREE HOURS BEFORE AND UNTIL IMMEDIATELY AFTER PAN CAMERA AND MAPPING CAMERA OPERATIONS
2. FIFTEEN MIN BEFORE AND UNTIL IMMEDIATELY AFTER FAR UV SPECTROMETER OPERATION (ONLY EFFECTIVE FOR FIRST TWO DAYS AFTER CIRCUMLUNAR ORBIT).
3. BEFORE AND UNTIL IMMEDIATELY AFTER IR OPERATION.

SYSTEM BACKUP

LM SYSTEMS WILL BE USED AS REQUIRED FOR CSM SYSTEMS BACKUP. DESCENT AND/OR ASCENT STAGE WILL BE RETAINED IF POSSIBLE.

RULE NUMBERS 10-11 THROUGH 10-19 ARE RESERVED.

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
				SPECIFIC	
	10-20	CABIN PRESSURE CANNOT BE RELIEVED	LAUNCH	CONTINUE MISSION	NORMAL RELIEF STARTS AT 50 SECONDS
	10-21	CABIN PRESSURE DECREASING AND/OR LESS THAN 4.5 PSIA AND:			CREW OPTION TO USE LM ENVIRONMENT FOR EARTH RETURN IN LIEU OF SUITED RETURN.
		A. SUIT PRESSURE GREATER THAN 3.5 PSIA	LAUNCH	A.1. CONTINUE MISSION	
			PRE-PDI	2. ENTER NEXT BEST PTP NO-GO FOR PDI. RETAIN DESCENT STAGE FOR TEI IF POSSIBLE	
			POWERED DET	3. CONTINUE MISSION NO-GO FOR LUNAR STAY	
			ALL	4. ENTER NEXT BEST PTP IF CABIN PRESS NOT RESTORED GREATER THAN 4.5 PSIA.	
		B. SUIT PRESSURE LESS THAN 3.5 PSI	LAUNCH	B.1. ABORT ASAP	
			ALL	2. ENTER ASAP	
		C. LOSS OF SUIT CIRCULATION	LAUNCH	C.1. ABORT ASAP OPEN DIRECT O2 45 DEG FROM LAUNCH SETTING.	C.1. CORRESPONDS TO 12.6 LB/HR (APPROX 3 CFM/CREWMAN)
			ALL	2. ENTER ASAP	

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	10-22	LOSS OF SUIT CIRCUIT, CABIN STABLE AND GREATER THAN 4.5 PSIA			LM SYSTEMS (IF AVAILABLE) WILL BE USED FOR CO2 AND H2O REMOVAL.
			LAUNCH	A. CONTINUE MISSION OPEN DIRECT O2 VALVE 45 DEG FROM LAUNCH SETTING	A. CORRESPONDS TO 12.6 LB/HR (APPROX 3 CFM/CREWMAN)
			PRE-PDI	B. ENTER NEXT BEST PTP NO-GO FOR PDI. RETAIN LM DESCENT STAGE FOR TEI IF POSSIBLE	
			POWERED DESCENT	C. CONTINUE MISSION NO-GO FOR LUNAR STAY	
			ALL	D. ENTER NEXT BEST PTP 1. DOFF SUITS 2. OPEN WASTE OVERBOARD DRAIN VALVE TO OBTAIN CABIN BLEED FLOW 3. DON FACE MASKS AFTER 1 HR 4. IF VACUUM CLEANER FUNCTIONAL AND TIME PERMITS, USE LiOH CANISTER ASSEMBLY SHOWN IN CONTINGENCY CHECKLIST C/2-26(5).	D.2. WASTE OVERBOARD BLEED = 1.0 LB O2/HR 3. TIME REQUIRED FOR CM CO2 PARTIAL PRESSURE TO INCREASE TO 7.6 mm HG: 1 CREWMAN - 4 HR 3 CREWMAN - 80 MIN
	10-23	LOSS OF SURGE TANK OR REPRESS PACK	TEC	A. NO-GO FOR CSM EVA UNLESS OPS AVAILABLE FOR USE BY CDR AND LMP	FOR LEAK IN SURGE TANK, ISOLATE SURGE TANK AND PLACE REPRESS PKG VALVE TO FILL.
			ALL	B. CONTINUE MISSION	
	10-24	LOSS OF SURGE TANK AND REPRESS PACK	LAUNCH	A. CONTINUE MISSION	
			ALL	B. CONTINUE MISSION PLAN TO RESTORE ENTRY O2 BY STORING OPS IN CM AT FINAL LM EGRESS.	B. OPS O2 QTY - 4 LB/OPS (TWO OPS AVAILABLE)
			TEC	C. CONTINUE MISSION DOFF SUITS FOR ENTRY. NO-GO FOR CSM EVA	

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	10-25	FIRE OR SMOKE IN COMMAND MODULE	LAUNCH	A. ABORT 1. DECOMPRESS CABIN 2. TROUBLESHOOT ELECTRICAL SYSTEM PER FLIGHT CREW CHECKLIST BOOST FIRE PROCEDURES.	
			PRE-PDI	B. ENTER NEXT BEST PTP NO-GO FOR PDI. RETAIN LM DESCENT STAGE FOR TEI	
			POWERED	C. CONTINUE MISSION NO-GO FOR LUNAR STAY	
			TEC	D. NO-GO FOR CSM EVA	
			ALL	E.1. TROUBLESHOOT/COMBAT FIRE PER FLIGHT CREW CHECKLIST EMERGENCY PROCEDURES. 2. ASSESS DAMAGE AND REMOVE POWER FROM AFFECTED SYSTEMS 3. ENTER NEXT BEST PTP RETAIN LM, IF POSSIBLE.	
	10-26	CONTAMINATION IN CABIN	ALL	CREW MAY ELECT TO DECOMPRESS	IF UNABLE TO CLEAR CONTAMINATION, MISSION MAY BE TERMINATED EARLY.
	10-27	LOSS OF SUIT INTEGRITY	LAUNCH	A. CONTINUE MISSION	
			ALL	B. CONTINUE MISSION NO-GO FOR UNDOCK	
			TEC	C. NO-GO FOR CSM EVA	

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	10-28	LOSS OF 02 MANIFOLD			LM 02 (IF AVAILABLE) MAY BE USED TO SUPPLEMENT CSM SUPPLY.
		A. 02 MANIFOLD LEAKS GREATER THAN 4 LB/HR AND CABIN PRESSURE GREATER THAN 4.5 PSIA	LAUNCH	A.1. CONTINUE MISSION	
			UNDOCKED PRE-PDI POWERED DESCENT/ LUNAR STAY	2. CONTINUE MISSION	
			ALL	3. ENTER NEXT BEST PTP	A.3. APPROXIMATELY 5 HOURS ARE REQUIRED TO DEPLETE CABIN 02 FROM 4.8 TO 3.5 PSIA, WITH 0.456 LB/HR USAGE RATE (CREW + CABIN LEAK + TANK PRESS BLEED).
				(A) VERIFY SURGE TANK AND REPRESS PACK ISOLATED UNTIL ENTRY	
				(B) RETRIEVE OPS FROM LM, IF DOCKED	A.3.(B) CREW OPTION TO USE LM ENVIRONMENT FOR EARTH RETURN IN LIEU OF MANUAL CABIN PRESSURE REGULATION.
				(C) NO-GO FRO CSM EVA	
		B. 02 MANIFOLD LEAKS GREATER THAN 4 LB/HR AND CABIN PRESSURE LESS THAN 4.5 PSIA	LAUNCH	B.1. ABORT ASAP	
			ALL	2. ENTER ASAP	
				USE OPS IN SUITED MODE FOR ENTRY IF PRACTICAL	
	10-29	LOSS OF ONE MAIN REGULATOR			
		A. FAILED CLOSED	TEC/EO	A.1. NO-GO FOR CSM EVA UNLESS OPS AVAILABLE FOR USE BY CDR AND LMP	
			UNDOCK	2. CONSIDERATION WILL BE GIVEN TO UNDOCKING	
			ALL	3. CONTINUE MISSION	
		B. FAILED OPEN	ALL	B. CONTINUE MISSION	
	10-30	BOTH MAIN REGULATORS FAILED CLOSED	LAUNCH	A. CONTINUE MISSION	LM SYSTEMS (IF AVAILABLE) MAY BE USED IN LIEU OF CSM SYSTEMS.
			LO	B. NO-GO FOR UNDOCKING	
			UNDOCKED/ PRE-PDI POWERED DESCENT/ LUNAR STAY	C. CONTINUE MISSION	
			ALL	D. ENTER NEXT BEST PTP	D. SUIT LOOP PRESSURE WILL DROP FROM 3.75 PSIA TO 2.5 PSIA IN APPROXIMATELY 9 MINUTES.
				NO-GO FOR CSM EVA	

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	10-31	LOSS OF ONE SUIT COMPRESSOR	ALL TEC	A. CONTINUE MISSION B. NO-GO FOR CSM EVA	
	10-32	LOSS OF TWO SUIT COMPRESSORS	LAUNCH EO LO ALL	A. CONTINUE MISSION OPEN DIRECT O2 45 DEG FROM LAUNCH SETTING B. CONTINUE MISSION NO-GO FOR TLI C. NO-GO FOR UNDOCKING D. CONTINUE MISSION NO-GO FOR CSM EVA	VACUUM CLEANER MAY BE CONNECTED TO SUIT LOOP BUT WILL NOT PROVIDE SUIT INTEGRITY. CONSIDERATION WILL BE GIVEN TO RETAINING LM.
		RULE NUMBERS 10-33 THROUGH 10-39 ARE RESERVED.			

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	10-40	PRIMARY COOLANT LOOP MALFUNCTIONS			
		A. LOSS OF EVAPORATOR	LAUNCH	A.1. CONTINUE MISSION	
			ALL	2. CONTINUE MISSION ACTIVATE SECONDARY COOLANT LOOP WITH RADIATORS IN BYPASS AS REQUIRED TO MAINTAIN PRIMARY EVAPORATOR OUT TEMP LESS THAN 90° F OR AS REQUIRED FOR CREW COMFORT.	A.2.(A) MAINTAIN PRI RAD OUT TEMP GREATER THAN -20° F. (B) WATER MANAGEMENT MAY DICTATE ACTIVATION AND DEACTIVATION OF SECONDARY LOOP TO MAINTAIN PRIMARY RAD OUT TEMP BETWEEN 45° AND 90° F.
		B. LOSS OF EITHER RADIATOR PANEL	LAUNCH	B.1. CONTINUE MISSION	B.1. ALTERNATE MISSION MAY BE PERFORMED
			ALL	2. BASED ON WATER AVAILABLE FOR EVAPORATIVE COOLING THE MISSION WILL BE CONTINUED USING SECONDARY RADIATORS SUPPLEMENTED BY PRIMARY LOOP EVAPORATOR.	
		C. TOTAL LOSS OF LOOP	LAUNCH	C.1. CONTINUE MISSION ACTIVATE SECONDARY LOOP	
			EO	2. CONTINUE MISSION NO-GO FOR TLI. ACTIVATE SECONDARY LOOP	C.2. ALTERNATE MISSION MAY BE PERFORMED.
			POWERED DESCENT/ LUNAR STAY	3. CONTINUE MISSION ACTIVATE SECONDARY LOOP.	
			TEC	4. NO-GO FOR CSM EVA	
			ALL	5. BASED ON AMOUNT OF WATER AVAILABLE, CONSIDERATION WILL BE GIVEN TO CONTINUING MISSION ON SECONDARY LOOP.	
		D. LOSS OF BOTH PRIMARY RADIATOR PANELS	LAUNCH	D.1. CONTINUE MISSION ACTIVATE SECONDARY LOOP	
			EO	2. CONTINUE MISSION NO GO FOR TLI, ACTIVATE SECONDARY LOOP	
			ALL	3. BASED ON AMOUNT OF WATER AVAILABLE CONSIDERATION WILL BE GIVEN TO CONTINUING MISSION ON SECONDARY LOOP.	
	10-41	SECONDARY LOOP MALFUNCTIONS			
		A. LOSS OF EVAPORATOR	ALL	A. CONTINUE MISSION	
		B. LOSS OF RADIATORS	EO	B. CONTINUE MISSION	B. LOOP IS STILL OPERATIONAL IN EVAPORATIVE MODE.
		C. TOTAL LOSS OF LOOP	ALL	C. CONTINUE MISSION	
	10-42	LOSS OF PRIMARY AND SECONDARY EVAPORATORS	ALL	CONTINUE MISSION	

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	10-43	LOSS OF ALL COOLING, PRIMARY AND SECONDARY			LM SYSTEMS (IF AVAILABLE) WILL BE USED TO SUPPLEMENT CSM OPERATIONS.
			LAUNCH	A. CONTINUE MISSION	
			EO	B. ENTER NEXT BEST ATP OR PTP MAXIMUM ORBIT TIME: 4 HOURS EMERGENCY POWER DOWN FOLLOWED BY 1.5 HOURS OF POWER UP FOR ENTRY.	B. LOSS OF TWO FUEL CELLS, POWER DOWN.
			POWERED DESCENT	C. CONTINUE MISSION	
			ALL	D. ENTER ASAP	
	10-44	CONFIRMED LEAK OF GYLCOL COOLANT			LM ENVIRONMENT (IF AVAILABLE) MAY BE USED FOR EARTH RETURN IN LIEU OF CSM.
		A. IN COMMAND MODULE	LAUNCH	A.1. CONTINUE MISSION	
			EO	2. ENTER NEXT BEST PTP DON SUITS. PURGE SUIT LOOP WITH DIRECT 02.	
			POWERED DESCENT	3. CONTINUE MISSION NO-GO FOR LUNAR STAY	
			TEC	4. NO-GO FOR CSM EVA	
			ALL	5. ENTER NEXT BEST PTP	
		B. IN SUIT CIRCUIT	LAUNCH	B.1. CONTINUE MISSION	
			EO	2. ENTER NEXT BEST PTP DOFF SUITS AND USE FACE MASKS IF REQUIRED.	
			POWERED DESCENT	3. CONTINUE MISSION NO-GO FOR LUNAR STAY	
			TEC	4. NO-GO FOR CSM EVA	
			ALL	5. ENTER NEXT BEST PTP	
		RULE NUMBERS 10-45 THROUGH 10-49 ARE RESERVED.			

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	10-50	LOSS OF ALL OVERBOARD DUMP CAPABILITY	EO TLC	A.1. ENTER NEXT BEST PTP NO-GO FOR TLI NO-GO FOR LOI	1. BLEED O2 FROM WATER TANK THROUGH WASTE MANAGEMENT OVERBOARD DRAIN VALVE INTO CABIN. 2. IF POTABLE AND WASTE TANKS (OR WASTE TANKS ALONE) BECOME FULL, FORCED WATER BOILING WILL BE NECESSARY TO ALLOW FUEL CELL AND/OR CYCLIC ACCUMULATOR OPERATION. 3. CSM FLUID STORAGE BAGS AND LM URINE STORAGE CAPABILITY (IF AVAILABLE) WILL BE USED.
			ALL	B. CONTINUE MISSION	
	10-51	UNCONTROLLABLE HIGH HUMIDITY	LAUNCH	A. CONTINUE MISSION	LM SYSTEMS MAY BE USED FOR HUMIDITY CONTROL.
			PRE-PDI	B. ENTER NEXT BEST PTP NO-GO FOR PDI. RETAIN LM DESCENT STAGE FOR TEI	
			POWERED DESCENT	C. CONTINUE MISSION NO-GO FOR LUNAR STAY	
			TEC	D. NO-GO FOR CSM EVA	
			ALL	E. ENTER NEXT BEST PTP	
	10-52	WASTE WATER TANK LEAK OR LOSS OF WASTE WATER STORAGE CAPABILITY	ALL	CONTINUE MISSION	1. LM SYSTEMS (IF AVAILABLE) MAY BE USED TO SUPPLEMENT CSM. 2. WHEN POTABLE WATER TANK BECOMES FULL, SURPLUS FUEL CELL WATER WILL BE ELIMINATED BY: (A) TEMPORARY STORAGE IN CSM FLUID BAGS OR DUMPING POTABLE WATER DIRECTLY OVERBOARD USING URINE TRANSFER/WATER GUN HOSES TO ENHANCE TRACKING PERIODS (B) RELIEVING THROUGH OVERBOARD PRESSURE RELIEF VALVES. 3. LOSS OF SUIT LOOP MAY RESULT.
	10-53	CONFIRMED LEAK IN POTABLE WATER TANK OR UNABLE TO TRANSFER FUEL CELL WATER TO POTABLE TANK	LAUNCH	A. CONTINUE MISSION	LM SYSTEMS (IF AVAILABLE) MAY BE USED TO SUPPLEMENT CSM.
			ALL	B. CONTINUE MISSION	WATER STORAGE BAG(S) WILL BE USED AS BACKUP WATER TANK.
		RULE NUMBERS 10-54 THROUGH 10-59 ARE RESERVED			

R | ITEM

INSTRUMENTATION REQUIREMENTS

10-60

MEAS DESCRIPTION	PCM	ONBOARD	TRANSDUCER	CATEGORY	MSN RULE REFERENCE
CABIN PRESS	CF0001P	METER	COMMON	1 OF	10-20
SUIT PRESS	CF0012P	METER	COMMON	3 M	
TANK BLADDER PRESS	CF0120P	-----	------		
SURGE TANK PRESS	CF0006P	METER	COMMON	1 OF	10-28
OXYGEN REPRESS PRESS	-------	METER	------	2 M	
PRIM ACCUM QTY	CF0019Q	METER	COMMON	1 OF	10-40,
PRIM PUMP OUT PRESS	CF0016P	METER	COMMON	2 M	10-44
POTABLE H2O QTY	CF0010Q	METER	COMMON	HD	10-53,
WASTE H2O QTY	CF0009Q	METER	COMMON	HD	10-52
SEC STEAM PRESS	CF0073P	METER	COMMON	HD	10-41
SEC EVAP OUT TEMP	CF0071T	METER	COMMON	HD	
SEC ACCUM QTY	CF0072Q	METER	COMMON	HD	
SEC PUMP OUT PRESS	CF0070P	METER	COMMON	HD	
PRIM EVAP OUT TEMP	CF0018T	METER	COMMON	HD	
PRIM STEAM PRESS	CF0034	METER	COMMON	HD	
ECS O2 FLOW	CF0035R	METER	COMMON	HD	
O2 MANIFOLD PRESS	CF0036P	-----	------	HD	
SUIT COMP PRESS	CF0015P	METER	COMMON	HD	
PRIM RAD OUT TEMP	CF0020T	METER	COMMON	HD	
PRIM EVAP INLET TEMP	CF0181T	-----	------	HD	
STEAM DUCT TEMP	CF0017T	-----	------	HD	
SEC RAD OUT TEMP	SF0263T	METER	------	HD	

11 CSM CRYOGENICS

R	ITEM	
		GENERAL
	11-1	LAUNCH THERE ARE NO CRYO FAILURES FOR WHICH THE LAUNCH/INSERTION PHASE WILL BE TERMINATED. FOR COMPLETE LOSS OF THE SYSTEM RESULTING IN THREE FUEL CELL FAILURES, ENTRY WILL BE PLANNED INTO PTP 3-1. THREE ENTRY BATTERIES AND THE AUX BAT ARE CAPABLE OF SUPPORTING THE LAUNCH AS LONG AS THREE REVS POWERED DOWN TO 50 AMPS AND ENTRY.
	11-2	ALL PHASES THE CRYOGENICS SYSTEM IS REQUIRED UNTIL CM/SM SEP SO THAT THE ENTRY AND LANDING PHASES WILL BE ENTERED INTO WITH FULL CONSUMABLES POTENTIAL, THAT IS, FULLY CHARGED ENTRY BATTERIES AND ENTRY O_2 TANKS. IF THIS CAPABILITY IS POTENTIALLY JEOPARDIZED BY CRYO SYSTEMS DEPLETION OR MALFUNCTION, MISSION TERMINATION PROCEDURES WILL BE ENACTED IN WHATEVER TIMEFRAME IS APPROPRIATE OR AVAILABLE. ANY ENTRY BATTERY OR ENTRY O_2 USAGE AFTER LOSS OF RECHARGE CAPABILITY FROM THE CRYO SYSTEM WILL REDUCE SUPPLY AVAILABLE FOR ENTRY, LANDING, AND POSTLANDING.
	11-3	POWERED DESCENT THERE ARE NO CRYO SYSTEM FAILURES FOR WHICH POWERED DESCENT WILL BE TERMINATED.
	11-4	LOSS OF CRYOGENIC TANK IS DEFINED AS: A. PRESSURE CANNOT BE MAINTAINED ABOVE 150 PSIA FOR O_2 AND 100 PSIA FOR H_2. B. A LEAK WHICH, COMBINED WITH A 40-AMP LOAD FLOW FROM THE TANK, WILL DEPLETE THE TANK BEFORE CM/SM SEP. C. LOSS OF ALL HEATERS IN AN O_2 TANK, LOSS OF 2 HEATERS AND ONE FAN IN H_2 TANKS 1 AND 2, OR LOSS OF BOTH FANS IN H_2 TANK 3.
	11-5	THE LUNAR MISSION WILL BE CONTINUED IF THE H_2 AND O_2 TANKS MEET REDLINE CRITERIA AND THE LOWEST TWO TANKS ARE CAPABLE OF SUPPORTING AN EARTH RETURN FROM ANY POINT WITH AT LEAST AN AVERAGE POWER LEVEL OF 40 AMPS.
	11-6	EARTH ORBIT MISSION WILL BE CONTINUED AS LONG AS ENOUGH TOTAL CRYO (O_2, H_2) IS AVAILABLE TO PERFORM AN ENTRY INTO THE NEXT DAILY GO/NO-GO AREA.
		RULE NUMBERS 11-7 THROUGH 11-9 ARE RESERVED.

R	ITEM	

SYSTEMS MANAGEMENT

11-10 CRYO MANAGEMENT

A. NORMALLY, TANK PRESSURES WILL BE MAINTAINED BY USE OF TANK HEATERS IN "AUTO" MODE WITH THE EXCEPTION OF H_2 TANK 3, WHICH WILL UTILIZE FANS.

B. MANUAL PRESSURE CONTROL WILL NORMALLY BE USED AS REQUIRED TO MAINTAIN:

1. TANK PRESSURES GREATER THAN 750 PSIA O_2 AND 200 PSIA FOR H_2.

2. SUFFICIENT QUANTITY IN THE LOWEST TWO TANKS IN EACH SYSTEM TO SUPPORT AN EARTH RETURN FROM ANY POINT WITH AT LEAST AN AVERAGE POWER LEVEL OF 40 AMPS AND AS REQUIRED TO MEET MISSION OBJECTIVES.

C. ONE FUEL CELL MAY BE PURGED OR THE SPACECRAFT ELECTRICAL LOADS MAY BE INCREASED TO PRECLUDE CRYO TANK VENTING.

D. H_2 TANKS 1 AND 2 FANS WILL NOT BE OPERATED IN THE AUTO MODE. H_2 TANK 3 FANS MAY BE OPERATED IN THE AUTO MODE.

E. O_2 TANK 3 ISOLATION VALVE WILL NORMALLY REMAIN OPEN, BUT IT WILL BE CLOSED IF LOSS OF TANKS 1 OR 2 AFFECTS TANK 3 PRESSURE IN ORDER TO PRESERVE O_2 FOR THE ECS.

11-11 CRYO GAGING

A. ONBOARD CRYOGENIC QUANTITY GAGING IS PRIME. ACCURACY IS ±2.65 PERCENT (±8.48 LB O_2, ±0.72 LB H_2) PER TANK. INSTANTANEOUS O_2 QUANTITY ACCURACIES MAY BE DEGRADED FROM THESE NUMBERS DUE TO LACK OF TANK FANS.

B. MCC CALCULATED QUANTITY USING PRESSURE VERSUS TEMPERATURE IS BACKUP.

RULE NUMBERS 11-12 THROUGH 11-19 ARE RESERVED.

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
				SPECIFIC MISSION RULES	
	11-20	LOSS OF ONE O2 TANK	LAUNCH	A. CONTINUE MISSION	LM, PLSS, AND OPS O2 WILL BE USED AS REQUIRED TO SUPPLEMENT CSM O2.
			ALL	B. CONSIDERATION WILL BE GIVEN TO CONTINUING THE MISSION AFTER LOSS OF A TANK	
			POST DOCK	C. JETTISON LM	
			TEC	D. CONSIDERATION WILL BE GIVEN TO PERFORMING CSM EVA IF TANKS 1 AND 2 OR 1 AND 3 REMAIN AND QUANTITY IN 2 OR 3 IS LESS THAN 60 PERCENT	
	11-21	LOSS OF TWO O2 TANKS AND/OR TWO H2 TANKS	LAUNCH	A. CONTINUE MISSION	
			EO	B. CONTINUE MISSION NO-GO FOR TLI	
			POWERED DESCENT	C. CONTINUE MISSION NO-GO FOR LUNAR STAY	
			ALL	D. ENTER NEXT BEST PTP RETAIN LM IF POSSIBLE	
	11-22	LOSS OF ONE H2 TANK	LAUNCH	A. CONTINUE MISSION	
			ALL	B. CONSIDERATION WILL BE GIVEN TO CONTINUING THE MISSION AFTER LOSS OF A TANK	
			POST DOCK	C. ENTER NEXT BEST PTP JETTISON LM	
	11-23	LOSS OF THREE O2 TANKS AND/OR THREE H2 TANKS	LAUNCH	A. CONTINUE MISSION ISOLATE SURGE TANK BEFORE 800 PSIA	AUX BATTERY WILL POWER SMJC'S.
			TLC	B. ENTER NEXT BEST PTP NO-GO FOR LOI	
			POWERED DESCENT	C. CONTINUE MISSION NO-GO FOR LUNAR STAY	
			ALL	D. ENTER NEXT BEST PTP RETAIN LM IF POSSIBLE	
		RULE NUMBERS 11-24 THROUGH 11-49 ARE RESERVED.			

R | ITEM

INSTRUMENTATION REQUIREMENTS

11-50

MEAS DESCRIPTION	PCM	ONBOARD	TRANSDUCERS	CATEGORY	MSN RULE REFERENCE
O2 TANK 1 QTY	SC0032Q	METER	COMMON	1 OF 3	11-20,21,22
O2 TANK 2 QTY	SC0033Q	METER	COMMON	MANDATORY	
O2 TANK 3 QTY	SC0051Q	METER	COMMON		
O2 TANK 1 TEMP	SC0041T	-----	------	HIGHLY	11-20,21,22
O2 TANK 2 TEMP	SC0042T	-----	------	DESIRABLE	
O2 TANK 3 TEMP	SC0055T	-----	------		
H2 TANK 1 QTY	SC0030Q	METER	COMMON	1 OF 3	11-21,22
H2 TANK 2 QTY	SC0031Q	METER	COMMON	MANDATORY	
H2 TANK 3 QTY	SC0050Q	METER	COMMON		
H2 TANK 1 TEMP	SC0043T	-----	------	HIGHLY	11-21,22
H2 TANK 2 TEMP	SC0044T	-----	------	DESIRABLE	
H2 TANK 3 TEMP	SC0054T	-----	------		
O2 TANK 1 PRESS	SC0037P	METER	COMMON	1 OF 3	11-20,21,22
O2 TANK 2 PRESS	SC0038P	METER	COMMON	MANDATORY	11-20,21,22
O2 TANK 3 PRESS	SC0053P	METER	COMMON		
H2 TANK 1 PRESS	SC0039P	METER	COMMON	1 OF 3	11-21,22
H2 TANK 2 PRESS	SC0040P	METER	COMMON	MANDATORY	11-21,22
H2 TANK 3 PRESS	SC0052P	METER	COMMON		
O2 TANK 2 AND 3 MAN. PRESS	SC0069P	C&W	COMMON	HD	
O2 TANK 1 HTR TEMP	SC0070T	METER	COMMON	HD	11-23
O2 TANK 2 HTR TEMP	SC0071T	METER	COMMON	HD	11-23
O2 TANK 3 HTR TEMP	SC0072T	METER	COMMON	HD	11-23

NOTE: PRESSURE OR QUANTITY MEASUREMENT REQUIRED IN EACH CRYO TANK.

12 CSM ELECTRICAL POWER SYSTEM

R	ITEM	
		GENERAL
	12-1	LAUNCH A. LAUNCH WILL BE CONTINUED AS LONG AS SUFFICIENT ENERGY IS AVAILABLE TO PERFORM AN ENTRY INTO AT LEAST PTP 2-1. THERE MUST BE AT LEAST ONE MAIN BUS AND ONE AC BUS (THROUGH MODE I AND II REGIONS) OPERATIONAL TO CONTINUE. B. THE LAUNCH PHASE WILL NOT BE TERMINATED AS LONG AS THREE ENTRY BATTERIES REMAIN TO SUPPLY MAIN BUS LOADS OR ONE ENTRY BATTERY AND ONE SM POWER SOURCE REMAIN.
	12-2	POWERED DESCENT THERE ARE NO EPS FAILURES FOR WHICH POWERED DESCENT WILL BE TERMINATED.
	12-3	ALL PHASES THE MISSION WILL BE CONTINUED AS LONG AS THE REQUIRED NUMBER OF FUEL CELLS ARE AVAILABLE AND ARE CAPABLE OF SUPPORTING MISSION REQUIREMENTS OF 75 TO 90 AMPS (WITHOUT BATTERY SUPPLEMENT EXCEPT DURING SPS ΔV'S) AND THREE GOOD ENTRY BATTERIES REMAIN.
	12-4	BATTERY IS CONSIDERED FAILED IF: A. LAUNCH - A BATTERY BUS VOLTAGE IS 0.5 VOLTS LESS THAN THE CORRESPONDING MAIN BUS. B. ORBIT - AN ENTRY BATTERY OUTPUT IS LESS THAN 3 AMPS WHEN CONNECTED TO A MAIN BUS DURING SPS MANEUVERS (NOMINAL TOTAL BATTERY CURRENT FOR SPS MANEUVERS IS 20 $\pm$ 2 AMPS). C. SUSTAINED BATTERY CHARGER OUTPUT TO AN ENTRY BATTERY IS GREATER THAN 2.0 AMPS AND ALL LOADS REMOVED. D. THE AUX BATTERY CANNOT SUPPORT REQUIRED MAIN BUS LOADS.
	12-5	AN AC BUS IS CONSIDERED FAILED IF ANY TWO PHASES CANNOT BE MAINTAINED GREATER THAN 95 VOLTS.
	12-6	AN INVERTER IS CONSIDERED FAILED IF: A. OUTPUT VOLTAGE ON ANY PHASE IS GREATER THAN 130 VAC. B. OUTPUT VOLTAGE ON ANY TWO PHASES IS LESS THAN 95 VAC. C. INVERTER TEMP >190° F MAY BE USED PERIODICALLY BASED ON TEMP.

R	ITEM	
	12-7	FUEL CELL IS CONSIDERED FAILED FOR MISSION PLANNING IF: A. FUEL CELL CANNOT SUPPLY SUFFICIENT POWER TO MEET ITS OWN PARASITIC LOADS (5 AMPS PLUS INLINE HEATER POWER AS REQUIRED). B. FUEL CELL H_2 LOOP IS CONTAMINATED WITH KOH. C. REGULATED H_2 PRESSURE IS LESS THAN 36.7 PSIA (CORRESPONDS TO N_2 PRESSURE SHIFT DOWN TO 28.2 PSIA FOR CRITICAL OPERATION - LOWER N_2 PRESSURE CAN BE MANAGED BY TURNING OFF H_2O TANK PRESSURE). D. EITHER THE H_2 OR GLYCOL PUMP HAS FAILED.
	12-8	TLI MINIMUM PURGE CAPABILITY IS BOTH OXYGEN AND HYDROGEN ON ONE FUEL CELL AND AT LEAST OXYGEN ON ONE OTHER FUEL CELL.
		RULE NUMBERS 12-9 THROUGH 12-19 ARE RESERVED.

R	ITEM	

SYSTEMS MANAGEMENT

12-20 BUS MANAGEMENT

A. MAIN BUSES WILL NORMALLY BE KEPT ISOLATED. BUT WHEN REQUIRED, ONE AND ONLY ONE FUEL CELL WILL BE TIED TO BOTH MAIN BUSES.

B. INVERTERS WILL BE CONFIGURED SUCH THAT MAIN BUS A WILL SUPPLY AC BUS 1 AND MAIN BUS B WILL SUPPLY AC BUS 2.

C. MAIN BUS VOLTAGE WILL BE MAINTAINED GREATER THAN 26.5 VDC AND LESS THAN 31 VDC. ONE FUEL CELL MAY BE OPEN CIRCUITED FOR OPTIMUM VOLTAGE AND POWER MANAGEMENT.

D. THE BATTERY CHARGER WILL BE USED TO CHECK OUT A SUSPECTED SHORTED BUS (EXCEPT MAIN BUSES) AFTER ALL EQUIPMENT AND POWER SOURCES HAVE BEEN REMOVED FROM BUS.

E. MINIMUM MAIN BUS VOLTAGE WILL BE MAINTAINED TO BE COMPATIBLE WITH ONLINE OPERATION EQUIPMENT:

1.	SPS	24.5
2.	PGNS	25.0
3.	AUTO SM-RCS	22.0
4.	AUTO CM-RCS	21.0
5.	DIRECT SM-RCS	21.0
6.	DIRECT CM-RCS	17.0
7.	INVERTERS	19.0

12-21 BATTERY MANAGEMENT

A. BATTERIES A AND B WILL BE USED TO SUPPLEMENT MAIN BUS LOADS FROM T-75 SECONDS TO INSERTION.

B. BATTERIES A AND B WILL BE USED TO SUPPLEMENT MAIN BUS LOADS FOR SPS MANEUVERS. BATTERY C WILL BE ROTATED TO MAINTAIN BATTERY BALANCE IN THE EVENT THE BATTERY CHARGER FAILS.

C. BATTERY CHARGING WILL BE TERMINATED FOR ONE OF THE FOLLOWING, WHICHEVER OCCURS FIRST:

1. INTEGRATED AMP-HOURS INTO BATTERY BY CHARGER EQUALS INTEGRATED AMP-HOURS OUT OF BATTERY BY LOADS

2. WHEN BATTERY CHARGER CURRENT DECREASES TO 0.62 AMPS (CORRESPONDS TO 39.8 VDC AT THE BATTERY BUS)

D. THREE BATTERIES WILL BE TIED TO THE MAIN BUSES FOR DEORBIT MANEUVER AND ENTRY.

E. BATTERIES ARE CONSIDERED TO HAVE 40 AMP-HR CAPABILITY INFLIGHT AND 45 AMP-HR CAPABILITY FOR POSTLANDING.

F. A SINGLE BATTERY THAT CANNOT BE RECHARGED WILL NOT BE USED EXCEPT DURING DEORBIT, ENTRY, AND POSTLANDING.

G. BATTERY VENT VALVE WILL REMAIN CLOSED UNLESS MANIFOLD PRESSURE IS GREATER THAN 6 PSIA. VENTING OPERATION WILL BE ALLOWED TO TROUBLESHOOT A SUSPECTED FROZEN DUMP. VENTING WILL BE CONSTRAINED TO HAVE A MINIMUM EFFECT ON SIM DATA.

H. THE AUX BATTERY WILL NOT BE USED FOR NORMAL MISSION OPERATIONS.

R	ITEM
	12-22

FUEL CELL MANAGEMENT

A. FUEL CELL WILL BE "SHUT DOWN" FOR THE FOLLOWING:

1. SUSTAINED CURRENT OUTPUT LESS THAN 5 AMPS
2. FUEL CELL H_2 LOOP IS CONTAMINATED WITH KOH
3. REACTANT LEAKAGE JEOPARDIZING MISSION DURATION

B. FUEL CELL MAY BE "OPEN CIRCUITED" FOR THE FOLLOWING:

1. SKIN TEMP GREATER THAN 475° F.
2. TCE TEMP GREATER THAN 225° F.
3. FAILURE OF H_2 PUMP OR GLYCOL PUMP
4. VOLTAGE MANAGEMENT
5. FUEL CELL CANNOT BE PURGED AND TIME TO GO IS GREATER THAN PREDICTED FUEL CELL LIFETIME
6. CRYO LEAK ISOLATION

C. FUEL CELL O_2 AND H_2 PURGES WILL NORMALLY BE PERFORMED AT 24 AND 48 HOUR INTERVALS, RESPECTIVELY. HOWEVER, THE INTERVALS WILL BE FLEXIBLE TO COINCIDE WITH WATER DUMPS (REF. MR 10-10, WATER SYSTEM, "C" AND "D").

D. ADDITIONAL PURGES WILL BE INITIATED AS OPERATIONAL CONDITIONS DICTATE.

E. FUEL CELLS WILL NOT BE PURGED FOR CONFIRMED HIGH PH INDICATION.

F. EACH H_2 PURGE WILL NORMALLY BE PRECEDED BY 20 MINUTES OF H_2 VENT HEATER OPERATION FOLLOWED BY 10 MINUTES OF HEATER OPERATION AFTER PURGE COMPLETION.

G. FUEL CELL INLINE HEATERS WILL NORMALLY OPERATE IN "AUTO" CONTINUOUSLY.

H. REACTANT VALVES MUST REMAIN OPEN AT ALL TIMES WITH THE FOLLOWING EXCEPTIONS:

1. IF THE FUEL CELL IS DECLARED FAILED, OR
2. FOR CRYO LEAK ISOLATION. THE FUEL CELL MUST BE "OPEN CIRCUITED" PRIOR TO REACTANT VALVE CLOSURE. THE REACTANT VALVES MUST BE REOPENED PRIOR TO AUTO INLINE HEATER ACTIVATION TO PRECLUDE FUEL CELL FAILURE.

I. ADDITIONAL POWER LOADS WILL BE ADDED AS REQUIRED TO MAINTAIN FC RAD OUT TEMP GREATER THAN -40°. IF CRYO BUDGET JEOPARDIZED OR RAD OUT TEMPS NOT MAINTAINED GREATER THAN -40°, FC RAD WILL BE PLACED IN EMERGENCY BYPASS.

J. ONE FUEL CELL MAY BE PURGED TO PRECLUDE VENTING OF CRYO TANKS OR FOR CRYO PRESSURE MANAGEMENT.

K. IF IT BECOMES OPERATIONALLY NECESSARY TO SHUT DOWN OR OPEN-CIRCUIT A FUEL CELL, THEN FUEL CELL 2 WILL BE SELECTED.

L. LOSS OF EITHER PUMP IN A FUEL CELL WILL BE CONSIDERED LOSS OF BOTH PUMPS, AND EXTENSIVE H_2 PURGES WILL NORMALLY NOT BE PERFORMED FOR THE PURPOSE OF COOLING AND/OR WATER REMOVAL.

R	ITEM	
	12-23	INVERTER MANAGEMENT INVERTERS MAY BE REMOVED FROM LINE FOR ANY OF THE FOLLOWING REASONS: A. INVERTER TEMP GREATER THAN 190° F B. SPACECRAFT LOAD MANAGEMENT C. ANY PHASE VOLTAGE OUTSIDE 115 ± 5 VAC RULE NUMBERS 12-24 THROUGH 12-29 ARE RESERVED

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
				SPECIFIC MISSION RULES	
	12-30	LOSS OF ONE FUEL CELL (OUTPUT LESS THAN 5 AMPS)	LAUNCH	A. CONTINUE MISSION IF LOSS IS FC 3, OPEN CIRCUIT AND CONFIGURE FC 2 TO MAIN BUS B ONLY.	BAT C WILL USED TO SUPPLEMENT MAIN BUSES LOADS DURING SPS BURNS TO BACK UP ANY SUBSEQUENT FUEL CELL FAILURES. BAT C MAY BE TIED TO EITHER OR BOTH BUSES.
			ALL	B. CONTINUE MISSION 1. OPEN CIRCUIT FUEL CELL. 2. IF LOSS IS FC 3 CONFIGURE FC 2 TO MAIN BUS B ONLY. 3. IF FUEL CELL CANNOT BE RESTORED, PERFORM SHUTDOWN.	
	12-31	LOSS OF TWO FUEL CELLS (OUTPUT LESS THAN 5 AMPS EACH)	LAUNCH	A. CONTINUE MISSION AFTER 2:00 GET PERFORM 1. EDS AUTO/OFF TO OFF 2. TIE BAT C TO BOTH MAIN BUSES	LM SYSTEMS MAY BE USED TO SUPPLEMENT CSM POWER. A.2. AUX BATTERY MAY BE USED IN LIEU OF BAT C.
			POWERED DESCENT	B. CONTINUE MISSION NO-GO FOR LUNAR STAY	
			POST DOCK	C. NO-GO FOR LUNAR STAY RETAIN LM IF POSSIBLE	
			TEC	D. GO FOR CSM EVA	
			ALL	E. ENTER NEXT BEST PTP 1. CONNECT REMAINING FUEL CELL TO BOTH MAIN BUSES. 2. PERFORM POWERDOWN TO MAINTAIN MAIN BUS VOLTS GREATER THAN 24.5 VDC.	E. ONE ENTRY BAT OR AUX MAY BE USED TO SUPPLEMENT REMAINING FC FOR G&N ALIGNMENT PRIOR TO DEORBIT. E.2 REF CREW EMERGENCY POWERDOWN PROCEDURE.

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	12-32	LOSS OF THREE FUEL CELLS (OUTPUT LESS THAN 10 AMPS EACH)			LM SYSTEMS (IF AVAILABLE) MAY BE USED TO SUPPLEMENT FUEL CELL POWER.
			LAUNCH	A. CONTINUE MISSION	
				1. TIE AUX BAT TO MAIN A	A.1 4.75 HOURS LEFT IN ORBIT BEFORE DEORBIT MANEUVER. TIE AUX BAT TO BOTH MAIN BUSES AFTER INSERTION.
				2. AFTER 2:00 EDS AUTO/OFF TO OFF. TIE BAT C TO BOTH MAIN BUSES	
				3. POWER DOWN TO 50 AMPS AND ENTER NEXT BEST PTP WITHIN 5 HRS IF FUEL CELLS CANNOT BE RESTORED	
			POWERED DESCENT	B. CONTINUE MISSION NO-GO FOR LUNAR STAY	
			ALL	C. ENTER NEXT BEST PTP	
	12-33	LOSS OF ALL SM POWER PLUS ONE ENTRY BATTERY CURRENT LESS THAN 50 PERCENT OF LOAD ON EITHER REMAINING BATTERY			USE LM SYSTEMS IF AVAILABLE. RESERVE ENTRY BATTERIES FOR ENTRY.
			LAUNCH	A. ABORT	A. ASSUMES ALL THREE FUEL CELL CURRENTS LESS THAN OR EQUAL TO 5 AMPS AND BATTERY C TIED TO BOTH MAINS.
			EO	B. ENTER NEXT BEST ATP OR PTP PERFORM EMERGENCY POWER DOWN	B. 2.4 HOURS LEFT IN ORBIT BEFORE SPS IGNITION.
			POWERED DESCENT	C. CONTINUE MISSION NO-GO FOR LUNAR STAY	
			ALL	D. ENTER NEXT BEST PTP PERFORM EMERGENCY POWER DOWN	
	12-34	DEGRADED FUEL CELLS (UNABLE TO SUPPORT NORMAL DRIFTING FLIGHT LOADS - SCS AND G&N POWERED DOWN - AND MAINTAIN MN BUS VOLTAGE GREATER THAN 26.5 VDC)	LAUNCH	A. CONTINUE MISSION	
			POWERED DESCENT	B. CONTINUE MISSION NO-GO FOR LUNAR STAY	
			ALL	C. ENTER NEXT BEST PTP	
		RULE NUMBERS 12-35 THROUGH 12-39 ARE RESERVED.			

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	12-40	LOSS OF ONE ENTRY BATTERY (OUTPUT LESS THAN 3 AMPS WHEN TIED TO MAIN BUS)	LAUNCH	A. CONTINUE MISSION 1. EDS AUTO/OFF TO OFF. 2. IF LOSS OF BAT A, TIE BAT C TO MAIN A. 3. IF LOSS OF BAT B, TIE BAT C TO MAIN B.	
			ALL	B. BASED ON FAILURE MODE, CONSIDERATION WILL BE GIVEN TO CONTINUING NOMINAL MISSION.	B. IF LOST DURING SPS MANEUVER, CONTINUE ON REMAINING BATTERY.
	12-41	LOSS OF TWO ENTRY BATTERIES (OUTPUT LESS THAN 3 AMPS EACH WHEN CONNECTED TO MAIN BUS)	LAUNCH	A. CONTINUE MISSION AS LONG AS ONE SM POWER SOURCE REMAINS 1. EDS AUTO/OFF TO OFF 2. ENTER NEXT BEST PTP	
			PRE-PDI	B. ENTER NEXT BEST PTP NO-GO FOR PDI	
			POWERED DESCENT	C. CONTINUE MISSION NO-GO FOR LUNAR STAY	
			ALL	D. ENTER NEXT BEST PTP USE ONE BATTERY ENTRY PROCEDURE.	D. IF LOSS DURING SPS MANEUVER, ATTEMPT TO TIE BAT C TO BOTH MAINS.
	12-42	LOSS OF BATTERY CHARGER	EO	A. CONTINUE MISSION ROTATE BATTERY C FOR BURNS TO MAINTAIN BALANCED BATTERIES	
			TLC	B. NO-GO FOR LOI IF SUM OF TWO LOWEST ENTRY BATTERIES LESS THAN 45.7 AMP-HRS.	
			LO	C. NO-GO FOR UNDOCK IF SUM OF TWO LOWEST ENTRY BATTERIES LESS THAN 41.1 AMP-HRS.	
	12-43	LOSS OF AUX BAT	ALL	CONTINUE MISSION	

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	12-44	LOSS OF AUX BAT GROUND TO RESISTOR NETWORK	ALL	CONTINUE MISSION	LOSS OF GROUND WILL RESULT IN LOSS OF THE FOLLOWING PCM MEASUREMENTS: SC2140R FC2 H2 FLOW ST0832K ALPHA CT RATE CHAN 3 (SAME AS LOGIC B IN MR 14-31)
		RULE NUMBERS 12-45 THROUGH 12-49 ARE RESERVED.			

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	12-50	MAIN BUS TIE MOTOR SWITCH FAILURES			
		A. ONE MOTOR SWITCH FAILS OPEN	LAUNCH	A.1. CONTINUE MISSION (A) IF MOTOR SW A/C, TIE BAT C TO MAIN BUS A. (B) IF MOTOR SW B/C, TIE BAT C TO MAIN BUS B. 2. CONTINUE MISSION CLOSE ALTERNATE MOTOR SW AND USE MAIN BUS TIE CB'S AS MOTOR SWITCHES.	A.2. BATTERIES MUST BE CHARGED THROUGH OPEN MOTOR SW. LEAVE BAT RLY CB CLOSED FOR CHARGING.
		B. ONE OR BOTH MOTOR SW FAILED CLOSED		B. CONTINUE MISSION 1. IF MOTOR SW A/C, BAT A WILL BE TIED TO MAIN BUS A VIA THE B/C MOTOR SW. 2. IF MOTOR SW B/C, BAT B WILL BE TIED TO MAIN BUS B VIA THE A/C MOTOR SW.	B. IF BOTH MOTOR SWITCHES FAIL CLOSED, BATTERIES CANNOT BE CHARGED. B.1 AND 2, REF CSM SCP A-11.

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	12-51	A. MAIN BUS A SHORTED GREATER THAN 25 AMPS	LAUNCH	A.1. CONTINUE MISSION (A) EDS AUTO/OFF - OFF (B) FC 2 TO MAIN B ONLY (C) BAT C TO MAIN B (D) INVERTER 3 TO AC 1, MAIN B (E) POWER DOWN MAIN A (F) TVC GIMBAL DRIVE (P, Y) - 2 (G) GIMBAL MOTOR CB'S CONTROL (YAW 2, PITCH 2) BAT B - OPEN AFTER GIMBAL MOTOR TURN ON	
			PRE-PDI	A.2. ENTER NEXT BEST PTP NO-GO FOR PDI. RETAIN LM DESCENT STAGE FOR TEI.	
			POWERED DESCENT	A.3. CONTINUE MISSION NO-GO FOR LUNAR STAY	
			ALL	A.4. ENTER NEXT BEST PTP POWER DOWN MAIN A.	
		B. MAIN BUS B SHORTED GREATER THAN 25 AMPS	LAUNCH	B.1. CONTINUE MISSION (A) EDS AUTO/OFF - OFF (B) BAT C TO MAIN A (C) INVERTER 3 TO AC 2, MAIN A (D) POWER DOWN MAIN B	
			PRE-PDI	B.2. ENTER NEXT BEST PTP NO-GO FOR PDI. RETAIN LM DESCENT STAGE FOR TEI.	
			POWERED DESCENT	B.3. CONTINUE MISSION NO-GO FOR LUNAR STAY	
			ALL	B.4. ENTER NEXT BEST PTP POWER DOWN MAIN B	
		C. MAIN BUS SHORTED GREATER THAN 25 AMPS AND FUEL CELL(S) CANNOT BE DISCONNECTED FROM SHORTED BUS	LAUNCH	C.1. ABORT	C.1. FAILURE OF MOTOR SWITCH TO DISCONNECT FROM SHORTED BUS INDICATED BY FC SHORTED BUS T/B GRAY.
			PRE-PDI	C.2. ENTER NEXT BEST PTP IF MAIN BUS NOT RESTORED. NO-GO FOR PDI. RETAIN LM DESCENT STAGE FOR TEI.	
			POWERED DESCENT	C.3. CONTINUE MISSION NO-GO FOR LUNAR STAY	
			ALL	C.4. ENTER NEXT BEST PTP	C.4. IF FUEL CELL FEED CIRCUITRY SHORTED, CLOSE FC REACTANT VALVES.

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	12-52	BATTERY BUS SHORTED			
		A. SHORT	LAUNCH	A.1. CONTINUE MISSION (A) PLACE EDS AUTO/OFF TO OFF (B) TIE BAT C TO ASSOCIATED MAIN BUS	A.1. GREATER THAN 18 AMPS WILL CAUSE BATTERY BUS VOLTAGE TO BE LESS THAN OR EQUAL TO MAIN BUS VOLTAGE.
			PRE-PDI	2. ENTER NEXT BEST PTP NO-GO FOR PDI. RETAIN LM DESCENT STAGE FOR TEI	
			POWERED DESCENT	3. CONTINUE MISSION NO-GO FOR LUNAR STAY	
			ALL	4. ENTER NEXT BEST PTP IF BUS NOT RESTORED	A.4. REMOVE POWER FROM BUS, IF SHORTED LESS THAN OR EQUAL TO 10 AMPS. POWER BUS JUST PRIOR TO ENTRY TO MAINTAIN SECS REDUNDANCY.
		B. SHORT LESS THAN 5 AMPS	ALL	B. CONTINUE MISSION REMOVE POWER FROM BUS EXCEPT FOR MANEUVERS AND ENTRY	
	12-53	BATTERY RELAY BUS SHORTED			
		A. SHORT GREATER THAN 2.0 AMPS	LAUNCH	A.1. CONTINUE MISSION	
			POWERED DESCENT	2. CONTINUE MISSION NO-GO FOR LUNAR STAY	
			ALL	3. ENTER NEXT BEST PTP OPEN BATTERY BUS TO BATTERY RELAY BUS CB'S	
		B. SHORT LESS THAN 2.0 AMPS	ALL	B. CONTINUE MISSION	B. CHARGE BAT B CONTINUOUSLY WITH BAT B POWER ENTRY AND POSTLANDING CB OPEN. CONSIDER BATTERY CHARGER LOST FOR MISSION PLANNING.

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	12-54	A. LOSS OF BAT RELAY BUS OR ONE BATTERY BUS, (UNABLE TO POWER BUS)	LAUNCH	A.1. CONTINUE MISSION	
			PRE-PDI	2. ENTER NEXT BEST PTP NO-GO FOR PDI. RETAIN LM DESCENT STAGE FOR TEI	
			POWERED DESCENT	3. CONTINUE MISSION NO-GO FOR LUNAR STAY	
			ALL	4. ENTER NEXT BEST PTP	
		B. LOSS OF ONE MAIN BUS (UNABLE TO POWER BUS)	LAUNCH	B.1. CONTINUE MISSION	
			PRE-PDI	2. ENTER NEXT BEST PTP NO-GO FOR PDI. REMAIN LM DESCENT STAGE FOR TEI	
			POWERED DESCENT	3. CONTINUE MISSION NO-GO FOR LUNAR STAY	
			TEC	4. NO-GO FOR CSM EVA	
			ALL	5. ENTER NEXT BEST PTP RETAIN LM, IF POSSIBLE	
		RULE NUMBERS 12-55 THROUGH 12-59 ARE RESERVED.			
	12-60	LOSS OF TWO INVERTERS	LAUNCH	A. CONTINUE MISSION	PLACE REMAINING INVERTER ON BOTH AC BUSES.
			PRE-PDI	B. ENTER NEXT BEST PTP NO-GO FOR PDI. RETAIN LM DESCENT STAGE FOR TEI	
			POWERED DESCENT	C. CONTINUE MISSION NO-GO FOR LUNAR STAY	
			TEC	D. NO-GO FOR CSM EVA	
			ALL	E. ENTER NEXT BEST PTP RETAIN LM	
	12-61	LOSS OF ONE AC BUS (TWO PHASES CANNOT BE MAINTAINED GREATER THAN 95 VAC)	LAUNCH	A. CONTINUE MISSION	
			PRE-PDI	B. ENTER NEXT BEST PTP NO-GO FOR PDI. RETAIN LM DESCENT STAGE FOR TEI, IF POSSIBLE	
			POWERED DESCENT	C. CONTINUE MISSION NO-GO FOR LUNAR STAY	
			ALL	D. ENTER NEXT BEST PTP RETAIN LM	

MISSION RULES

SECTION 12 - CSM ELECTRICAL POWER SYSTEM - CONTINUED

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	12-62	LOSS OF BOTH AC BUSES	LAUNCH	A. ABORT MODE I OR MODE II	
				1. OPEN DIRECT O2 FOR SUIT VENTILATION	
				2. IF AFTER MODE II, ENTER PTP 2-1	A.2. INITIATE CONTINUOUS FC H2 PURGE FOR COOLING.
			POWERED DESCENT	B. CONTINUE MISSION	
			ALL	C. ENTER NEXT BEST PTP OR ATP RETAIN LM. IF SUITED, REMOVE HELMET AND GLOVES. IF TIME PERMITS, REMOVE SUITS. IF CABIN DEPRESSURIZED, USE DIRECT O2 UNTIL CABIN IS REPRESSURIZED	C. FOR CSM ONLY, ENTER WITHIN 1-1/2 HOURS. INITIATE CONTINUOUS FC H2 PURGE FOR COOLING.
		RULE NUMBERS 12-63 THROUGH 12-69 ARE RESERVED.			

R | ITEM

12-70

INSTRUMENTATION REQUIREMENTS

MEAS DESCRIPTION	PCM	ONBOARD	TRANSDUCERS	CATEGORY	MSN RULE REFERENCE
AC BUS 1 PHASE A VAC	CC0200V	METER	SEPARATE	HIGHLY DESIRABLE	
AC BUS 1 PHASE B VAC	-------	METER	--------	HIGHLY DESIRABLE	12-5,6,61
AC BUS 1 PHASE C VAC	-------	METER	--------	HIGHLY DESIRABLE	
		COMMON METER			
AC BUS 2 PHASE A VAC	CC0203V	METER	SEPARATE	HIGHLY DESIRABLE	
AC BUS 2 PHASE B VAC	-------	METER	--------	HIGHLY DESIRABLE	12-5,6,61
AC BUS 2 PHASE C VAC	-------	METER	--------	HIGHLY DESIRABLE	
MAIN BUS A VDC	CC0206V	METER	SEPARATE	1 OF 2	12-20C,32,52
MAIN BUS B VDC	CC0207V	METER	SEPARATE	MANDATORY	12-22
BAT BUS A VDC	CC0210V	METER	SEPARATE	HIGHLY DESIRABLE	
BAT BUS B VDC	CC0211V	METER	SEPARATE	HIGHLY DESIRABLE	
BAT RELAY BUS VDC	CC0232V	METER	SEPARATE	HIGHLY DESIRABLE	
BAT A CURRENT	CC0222C	METER	COMMON		
BAT B CURRENT	CC0223C	METER	COMMON	2 OF 3 MANDATORY	12-4,33,40,41
BAT C CURRENT	CC0224C	METER	COMMON		
FC 1 CURRENT	SC2113C	METER	COMMON		
FC 1 O2 FLO	SC2142R	METER	COMMON	1 OF 3 MANDATORY	12-7,31,32,33,
FC 1 H2 FLO	SC2139R	METER	COMMON		22A
FC 2 CURRENT*	SC2114C	METER	COMMON		
FC 2 O2 FLO	SC2143R	METER	COMMON	1 OF 3 MANDATORY	12-7,31,32,33,
FC 2 H2 FLO	SC2140R	METER	COMMON		22A
FC 3 CURRENT	SC2115C	METER	COMMON		
FC 3 O2 FLO	SC2144R	METER	COMMON	1 OF 3 MANDATORY	12-7,31,32,33,
FC 3 H2 FLO	SC2141R	METER	COMMON		22A
BAT CHARGER CURRENT	CC0215C	METER	COMMON	HIGHLY DESIRABLE	
FC 1 SKIN TEMP	SC2084T	METER	COMMON	HIGHLY DESIRABLE	
FC 2 SKIN TEMP	SC2085T	METER	COMMON	HIGHLY DESIRABLE	12-22B
FC 3 SKIN TEMP	SC2086T	METER	COMMON	HIGHLY DESIRABLE	
FC 1 COND TEMP	SC2081T	METER	COMMON	HIGHLY DESIRABLE	
FC 2 COND TEMP	SC2082T	METER	COMMON	HIGHLY DESIRABLE	12-22B
FC 3 COND TEMP	SC2083T	METER	COMMON	HIGHLY DESIRABLE	
FC 1 RAD OUT TEMP	SC2087T	METER	COMMON	HIGHLY DESIRABLE	
FC 2 RAD OUT TEMP	SC2088T	METER	COMMON	HIGHLY DESIRABLE	12-22I
FC 3 RAD OUT TEMP	SC2089T	METER	COMMON	HIGHLY DESIRABLE	
BAT MANIFOLD PRESS	-------	METER	------	HIGHLY DESIRABLE	
INV 1 TEMP	CC0175T	MCWS	COMMON	HIGHLY DESIRABLE	
INV 2 TEMP	CC0176T	MCWS	COMMON	HIGHLY DESIRABLE	
INV 3 TEMP	CC0177T	MCWS	COMMON	HIGHLY DESIRABLE	
FC 1 PH	SC2160X	TALKBACK	COMMON	HIGHLY DESIRABLE	
FC 2 PH	SC2161X	TALKBACK	COMMON	HIGHLY DESIRABLE	12-22E
FC 3 PH	SC2162X	TALKBACK	COMMON	HIGHLY DESIRABLE	
AUX BAT (SM BAT)	SC0230V	--------	------	HIGHLY DESIRABLE	

NOTE: USE BAT C IN LIEU OF BATTERY WITH LOST INST.

* COMMON SHUNT FOR FC 2 AND AUX BAT CURRENT.

13 DOCKING AND UMBILICAL

R	ITEM	
		GENERAL
	13-1	THREE GOOD DOCKING RING LATCHES 120 DEG APART ARE REQUIRED FOR AN IVT.
	13-2	DOCKED SPS OR DPS BURNS REQUIRE AT LEAST NINE GOOD DOCKING RING LATCHES.
	13-3	MANNED UNDOCKING OPERATIONS WILL BE TERMINATED FOR ANY FAILURE OF A DOCKING RING LATCH TO RELEASE. NO ATTEMPT WILL BE MADE TO DISASSEMBLE A DOCKING RING LATCH.
	13-4	WITH FAILURE OF THE CSM FORWARD HATCH PRIMARY LOCK/UNLOCK MECHANISM, THE NOMINAL MISSION WILL BE PERFORMED USING THE SECONDARY LOCK/UNLOCK MECHANISM.
	13-5	LOSS OF VISUAL DOCKING AIDS (COAS AND TARGETS) WILL NOT INHIBIT DOCKING AND UNDOCKING.
	13-6	IF THE DOCKING PROBE FAILS TO INDICATE EXTENSION OR IF BOTH TALKBACK INDICATORS* ARE BARBER POLE, TD&E WILL BE ATTEMPTED. *NOTE: THE ONLY DOCKING PROBE INSTRUMENTATION CONSISTS OF TWO TALKBACK INDICATORS IN THE CSM
		RULE NUMBERS 13-7 THROUGH 13-10 ARE RESERVED.

R	ITEM	
		MANAGEMENT
	13-11	FOR MISFIRE OF A DOCKING RETRACT SQUIB, THE REMAINING SQUIB IN THE SAME SYSTEM WILL BE USED TO ATTEMPT COMPLETION OF DOCKING. TWO NITROGEN BOTTLES REMAINING ARE NORMALLY REQUIRED TO ALLOW UNDOCKING. HOWEVER, BASED ON THE FAILURE MODE, CONSIDERATION WILL BE GIVEN TO UNDOCKING WITH NO NITROGEN BOTTLE REMAINING.
	13-12	THE CM FORWARD AND LM UPPER HATCH NORMALLY WILL BE INSTALLED FOR ANY TYPE OF MANEUVER OR DOCKING.
	13-13	DURING OPERATIONS WHEN CM/LM DOCKED STATUS IS MAINTAINED BY PROBE PRELOAD ONLY (DOCKING LATCHES COCKED) CM/LM THRUSTER ACTIVITY ABOUT CM/LM X-AXIS IS LIMITED AS FOLLOWS:

TUNNEL PRESSURE, PSIA	COMBINED CM/LM ACTIVE THRUSTERS
GREATER THAN 1.5 PSIA	INHIBIT ALL CSM ROLL AND LM YAW CONTROL
BETWEEN 0 AND 1.5 PSIA	NO MORE THAN 2 ROLL JETTS
0 PSIA	NO MORE THAN 4 ROLL JETTS

	13-14	LOW PROBE TEMPERATURE WILL NOT INHIBIT DOCKING ATTEMPTS.					
		RULE NUMBERS 13-15 THROUGH 13-19 ARE RESERVED.					

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
				SPECIFIC MISSION RULES	
	13-20	FAILURE TO ACHIEVE OR MAINTAIN POWER TO X-LUNAR BUS LOADS FROM CSM	DOCKED	CONTINUE MISSION A. OPEN CB (11) LTG: ANUN/DOCK/COMPNT EPS: DES ECA OPEN CB (26) LTG: FLOOD EPS: DES ECA B. ALTERNATE USE OF BATTERIES 1,2,3, AND 4 UNTIL ACTIVATION	1. ANUN/DOCK/COMPNT CB MUST BE OPENED BEFORE 9 HRS AFTER CSM SEPARATION BECAUSE OF THERMAL CONSTRAINTS OF THE LIGHTING CONTROL ASSEMBLY (LCA). 2. NOMINAL MISSION MAY BE PERFORMED BECAUSE LCA, ECA, AND BATTERY THERMAL CONSTRAINTS WILL NOT BE VIOLATED. 3. OVERCURRENT PROTECTION IS LOST UNTIL A DES ECA CB IS CLOSED.
	13-21	FAILURE TO ACHIEVE S-IVB/LM SEPARATION OR FAILURE TO MATE LM UMBILICALS (P23 AND P24)	TD&E	PERFORM CSM/LM FINAL SEP	S-IVB/LM SEP CANNOT BE ACHIEVED WITHOUT MATING AT LEAST ONE UMBILICAL. POWER CAN BE SWITCHED AND MAINTAINED WITH EITHER PLUG.
	13-22	FAILURE TO ACHIEVE CSM/LM FINAL SEPARATION	DOCKED	MUST PERFORM NORMAL UNDOCKING A. RETRIEVE PROBE AND DROGUE AND INSTALL B. AFTER UNDOCKING, DEPRESS CSM AND JETTISON PROBE OVERBOARD	
	13-23	FAILURE TO INDICATE DOCKING PROBE EXTEND OR BOTH TALKBACK INDICATORS ARE BARBER POLE	TD&E UNDOCKED	A. CONTINUE MISSION ATTEMPT TD&E B. CONTINUE MISSION ATTEMPT DOCKING	DOCKING RING TUNNEL STRUCTURE DAMAGE MAY OCCUR TO THE EXTENT THAT TUNNEL PRESSURE CAN NOT BE MAINTAINED.
	13-24	CANNOT REMOVE CSM FORWARD HATCH	TD&E DOCKED	A. PERFORM CSM/LM FINAL SEP B. PERFORM CSM/LM FINAL SEP IF LM MANNED, PERFORM EVT TO CSM.	

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	13-25	CANNOT REMOVE DOCKING PROBE, LM DROGUE, AND/OR LM UPPER HATCH.	DOCKED	CONTINUE MISSION PERFORM EVT IF LM MANNED	SPS AND SM RCS MANEUVERS MAY BE PERFORMED.
	13-26	FAILURE TO RELEASE CAPTURE LATCHES	DOCKED	REDOCK	
	13-27	PRIMARY FORWARD HATCH LOCK/UNLOCK MECHANISM INOPERATIVE	ALL	CONTINUE MISSION	
	13-28	FAILURE TO LOCK CSM FORWARD HATCH	TD&E DOCKED	CONTINUE MISSION ENTER IN SUITS	REF SCP A15 I.A: ASSUMES HATCH CAN BE SEALED AND SECURED WITH CABIN PRESSURE.
	13-29	FAILURE TO REINSTALL PROBE AND/OR DROGUE OR FAILURE TO CLOSE LM UPPER HATCH	DOCKED	NO UNDOCKING	
	13-30	LOSS OF PRIMARY AND SECONDARY DOCKING SYSTEM	ALL	CONTINUE MISSION	

R	ITEM	
		GENERAL
	14-1	LAUNCH THERE ARE NO SEQUENTIAL MALFUNCTIONS FOR WHICH LAUNCH WILL BE TERMINATED.
	14-2	IF AN ENTRY BATTERY IS LOST, THE EDS WILL BE FLOWN OPEN LOOP.
	14-3	ALL MISSION PHASES (EXCEPT LUNAR ORBIT) TO CONTINUE THE MISSION, BOTH PYRO BUSES AND BOTH LOGIC BUSES ARE REQUIRED.
	14-4	POWERED DESCENT THERE ARE NO CSM SEQUENTIAL SYSTEM FAILURES FOR WHICH POWERED DESCENT WILL BE TERMINATED.
	14-5	SEQUENTIAL LOGIC BUS IS CONSIDERED FAILED IF: A. VOLTAGE IS LESS THAN 22 VDC AND UNABLE TO ACTIVATE RCS ENABLE AND/OR SLA SEP RELAYS (CD0170X AND/OR CD0123X SYSTEM A, CD0171X AND/OR CD0124X SYSTEM B). B. LOGIC BUS SHORTED GREATER THAN 10 AMPS.
	14-6	PYRO BUS IS CONSIDERED FAILED IF: A. SHORTED GREATER THAN 10 AMPS B. FAILURE TO PERFORM ANY SEQUENTIAL FUNCTION WITH SUSPECTED FAILED PYRO SYSTEM
		RULE NUMBERS 14-7 THROUGH 14-9 ARE RESERVED.

R	ITEM	
		MANAGEMENT
	14-10	ARMING OF THE SEQUENTIAL SYSTEM WILL BE PERFORMED WHILE IN CONTACT WITH A GROUND TELEMETRY SITE. THE FLIGHT CREW WILL ARM THE LOGIC BUSES AND STAND BY FOR A GO FROM THE GROUND TO PROCEED WITH ARMING THE PYRO BUSES.
		RULE NUMBERS 14-11 THROUGH 14-19 ARE RESERVED.

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
				SPECIFIC MISSION RULES	
	14-20	SEQUENTIAL LOGIC BUS A OR B LESS THAN OR EQUAL TO 22 VDC AND UNABLE TO ACTIVATE RCS ENABLE AND/OR SLA SEP RELAYS	LAUNCH	A. CONTINUE MISSION ENTER 3-1 IF BUS NOT RESTORED	CD0170X AND/OR CD0123X SYSTEM A, CD0171X AND/OR CD0124X SYSTEM B
			EO TLC	B. TERMINATE OPERATIONS ENTER NEXT BEST PTP IF BUS NOT RESTORED	
			LUNAR ORBIT/ LUNAR STAY	C. CONTINUE MISSION	
	14-21	PYRO BUS A OR B LESS THAN OR EQUAL TO 35 VDC			
		A. SHORTED GREATER THAN 10 AMPS	LAUNCH	A.1. CONTINUE MISSION	
			EO TLC	2. TERMINATE OPERATIONS ENTER NEXT BEST PTP	A.2. USE BATTERY TIE FOR PYRO POWER TO AFFECTED BUS.
			LUNAR ORBIT/ LUNAR STAY	3. CONTINUE MISSION	
		B. SHORTED LESS THAN 10 AMPS	ALL	B. CONTINUE MISSION	B. USE BATTERY TIE FOR PYRO POWER TO AFFECTED BUS.
		C. PYRO BUS TM READS 0 VDC AND PYRO BAT ONBOARD GREATER THAN 35 VDC	LAUNCH	C.1. CONTINUE MISSION	
			ALL	2. ATTEMPT FUNCTION USING SUSPECTED FAILED BUS ONLY: (A) IF FUNCTION NORMAL, CONTINUE MISSION (B) IF FUNCTION DOES NOT WORK NORMALLY, ENTER NEXT BEST PTP	C.2. ASSUME PYRO BAT VERIFIED GREATER THAN 35 VDC PRIOR TO ARMING. IF ENTRY BAT USED IN LIEU OF PYRO BAT, VOLTAGE SHOULD BE APPROXIMATELY EQUAL TO BAT BUS VOLTAGE.
	14-22	TELEMETRY INDICATES AN EDS VOTE INPUT 1, 2, OR 3	LAUNCH	CONTINUE MISSION A. IF ANY ENTRY BATTERY LESS THAN 22 VDC, EDS AUTO/OFF SWITCH TO OFF B. ALL ENTRY BATTERIES GREATER THAN 22 VDC: CHECK CORRESPONDING EDS CB'S 1, 2, OR 3 CLOSED	PARAMETERS ARE CD0132X, CD0133X, AND CD0134X RESPECTIVELY. A. BAT C VOLTAGE CAN ONLY BE MONITORED ONBOARD.

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	14-23	LET JETTISON MOTOR DOES NOT FIRE	LAUNCH	CONTINUE MISSION ATTEMPT JETTISON PER CREW CHECKLIST EMERGENCY PROCEDURE	
	14-24	SMJC ACTIVATES PREMATURELY	EO TLC	CONTINUE MISSION IF SOURCE OF ACTIVATION CAN BE DETERMINED AND ISOLATED. ENTER NEXT BEST PTP IF SOURCE OF ACTIVATION CAN NOT BE ISOLATED	
			ALL	CONTINUE MISSION	
	14-25	ACTIVATED CM RCS PRESS LOGIC RELAYS	ALL	CONTINUE MISSION A. PRIOR TO CM RCS PRESS: DO NOT ARM RESPECTIVE PYRO BUS (FOR BOTH INDICATIONS PERFORM SLA SEP WITH SECS ARM CB'S OPEN.) B. AT CM RCS PRESS: ARM RESPECTIVE PYRO BUS	CD0173X AND/OR CD0174X
	14-26	ACTIVATED SLA DEPLOY LOGIC RELAYS	ALL	CONTINUE MISSION A. PRIOR TO SLA SEP: DO NOT ARM RESPECTIVE PYRO BUS B. FOR SLA SEP: ARM RESPECTIVE PYRO BUS FIRST	CD0123X AND/OR CD0124X
	14-27	UNABLE TO PERFORM SLA SEPARATION	TLC	ENTER NEXT BEST PTP	
	14-28	ACTIVATED APEX JETTISON LOGIC RELAYS	LUNAR ORBIT/ LUNAR STAY	A. CONTINUE MISSION DO NOT ARM PYRO BUSES UNTIL MALFUNCTION HAS BEEN ISOLATED	DETECTED AT SECS POWER UP (CD0230X AND CD023X)
			ALL	B. ENTER NEXT BEST PTP DO NOT ARM PYRO BUSES UNTIL MALFUNCTION HAS BEEN ISOLATED	

MISSION RULES

SECTION 14 - CSM SEQUENTIAL - CONTINUED

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	14-29	ACTIVATED DROGUE CHUTE DEPLOY LOGIC RELAY	LUNAR ORBIT/ LUNAR STAY	A. CONTINUE MISSION DO NOT ARM PYRO BUSES UNTIL MALFUNCTION HAS BEEN ISOLATED	MAY BE DETECTED AT ANY TIME (CE0001X AND/OR CE0002X)
			ALL	B. ENTER NEXT BEST PTP DO NOT ARM PYRO BUSES UNTIL MALFUNCTION HAS BEEN ISOLATED	
	14-30	ACTIVATED PILOT CHUTE DEPLOY LOGIC RELAY	LUNAR ORBIT/ LUNAR STAY	A. CONTINUE MISSION DO NOT ARM PYRO BUSES UNTIL MALFUNCTION HAS BEEN ISOLATED	DETECTED AT SECS POWER UP PRIOR TO ENTRY (CE0003X AND/OR CE0004X) WITH EDS BAT A(B) CB CLOSED.
			ALL	B. ENTER NEXT BEST PTP DO NOT ARM PYRO BUSES UNTIL MALFUNCTION HAS BEEN ISOLATED	
	14-31	LOST GROUND TO RESISTOR NETWORK FOR LOGIC OR PYRO BUS VOLTS MEASUREMENTS	LAUNCH EO TD&E	CONTINUE MISSION ARM BOTH SYSTEMS	ARMING AFFECTED SYSTEM WILL RESULT IN LOSS OF FOLLOWING PCM MEASUREMENTS: LOGIC A SC2142R FC 1 02 FLOW SP0930P FU SM/ENG INTERFACE P SL1206T SIM THERMAL LOC 6 TEMP LOGIC B SC2140R FC 2 H2 FLOW ST0832K ALPHA CT RATE CHAN 3 SC0230V AUX BAT VOLTS PYRO A SC2143R FC 2 02 FLOW CT0018V SCE 10 VDC PYRO B SC2139R FC 1 H2 FLOW ST0831K ALPHA CT RATE CHAN 2
			ALL	CONTINUE MISSION DO NOT ARM AFFECTED SYSTEM UNTIL SEQUENTIAL GO/NO-GO PRIOR TO ENTRY UNLESS OTHER SYSTEM FAILS	
		RULE NUMBERS 14-32 THROUGH 14-49 ARE RESERVED.			

R	ITEM
	14-50

INSTRUMENTATION REQUIREMENTS

MEAS DESCRIPTION	PCM	ONBOARD	TRANSDUCERS	CATEGORY	MSN RULE REFERENCE
PYRO BUS A VOLTS	CD0005V	--------	-----	1 OF 2 M	14-21
PYRO BUS B VOLTS	CD0006V	--------	-----		14-21
SEQ LOGIC BUS A VOLTS	CD0200V	--------	-----	HD	14-20
SEQ LOGIC BUS B VOLTS	CD0201V	--------	-----	HD	14-20
APEX JET A	CD0230X	--------	-----	HD	14-29
APEX JET B	CD0231X	--------	-----	HD	14-29
DROGUE DEPLOY A	CE0001X	--------	-----	HD	14-30
DROGUE DEPLOY B	CE0002X	--------	-----	HD	14-30
PILOT CHUTE DEPLOY A	CE0003X	--------	-----	HD	14-31
PILOT CHUTE DEPLOY B	CE0004X	--------	-----	HD	14-31
SLA SEP RELAY A	CD0123X	--------	-----	HD	14-26
RCS/SCS ACTIVATE A	CD0170X	--------	-----	HD	-----
SLA SEP RELAY B	CD0124X	--------	-----	HD	14-26
RCS/SCS ACTIVATE B	CD0171X	--------	-----	HD	-----
CM RCS PRESS SIG A	CD0173X	--------	-----	HD	14-25
CM RCS PRESS SIG B	CD0174X	--------	-----	HD	14-25
CM-SM SEP RELAY A	CD0023X	--------	-----	HD	-----
CM-SM SEP RELAY B	CD0024X	--------	-----	HD	-----
CREW ABORT A	CD0130X	--------	-----	HD	-----
CREW ABORT B	CD0131X	--------	-----	HD	-----
EDS ABORT VOTE 1	CD0132X	--------	-----	HD	14-22
EDS ABORT VOTE 2	CD0133X	--------	-----	HD	14-22
EDS ABORT VOTE 3	CD0134X	--------	-----	HD	14-22
EDS ABORT A	CD0135X	--------	-----	HD	-----
EDS ABORT B	CD0136X	--------	-----	HD	-----
MAIN CHUTE DISC A	CE0321X	--------	-----	HD	-----
MAIN CHUTE DISC B	CE0322X	--------	-----	HD	-----
EDS ABORT REQ A	BS0080X	--------	-----	HD	-----
EDS ABORT REQ B	BS0081X	--------	-----	HD	-----
DOCKING PROBE TEMP	CS0220T	--------	-----	HD	
CSM-LM LOCK RING SEP RELAY A	CD1154X	--------	-----	HD	13-22
CSM-LM LOCK RING SEP RELAY B	CD1155X	--------	-----	HD	13-22
LM CURRENT	CC2962C	METER	COMMON	HD	-----

15 CSM GUIDANCE
AND CONTROL

R	ITEM

GENERAL

15-1 LAUNCH

THERE ARE NO FAILURES OF THE CSM GUIDANCE AND CONTROL SYSTEM WHICH ARE CAUSE FOR ABORT.

15-2 EARTH ORBIT PHASE

A. IN ORDER TO CONTINUE THE MISSION PAST THE NEXT BEST PTP, THE GUIDANCE AND CONTROL SYSTEMS MUST PROVIDE SPS CRITICAL BURN CAPABILITY AND ONE BACKUP DEORBIT METHOD (SM OR HYBRID). THE FOLLOWING MINIMUM CAPABILITIES MUST BE AVAILABLE:

1. ATTITUDE CONTROL: DIRECT RCS, AUTO ATTITUDE CONTROL AND RATE DAMPING IN EACH AXIS.

2. TVC (CRITICAL BURNS): ONE TVC SERVO LOOP IN EACH AXIS AND ONE TVC CONTROL MODE (ACCEL CMD EXCLUDED).

3. BACKUP DEORBIT: AS LONG AS ENOUGH PROPELLANT IS AVAILABLE FOR AN SM DEORBIT, THE G&C SYSTEMS MUST PROVIDE THAT CAPABILITY. IF SM DEORBIT IS NOT POSSIBLE DUE TO LACK OF PROPELLANT OR A SYSTEMS FAILURE, THE G&C SYSTEMS MUST PROVIDE CAPABILITY FOR A HYBRID DEORBIT.

   (A) SM DEORBIT REQUIREMENTS:

      (1) TRANSLATION CAPABILITY
      (2) ONE OPERATIONAL FDAI
      (3) RATE DAMPING IN ALL THREE AXES, DAP OR SCS

   (B) HYBRID DEORBIT REQUIREMENTS:

      (1) ALL SM DEORBIT REQUIREMENTS (RATE DAMPING MUST BE SCS)
      (2) OPERATIONAL IMU, CMC, AND MAIN DSKY
      (3) TWO OPERATIONAL RHC'S

B. IN ORDER TO PERFORM A NON-CRITICAL BURN AFTER THE STORAGE TANKS ARE EMPTY, THE G&C SYSTEMS MUST PROVIDE THE CAPABILITY TO EXECUTE AN ULLAGE MANEUVER BY EITHER CMC AUTO (RCS DAP), SCS AUTO, OR DIRECT ULLAGE.

C. IN ORDER TO COMMIT TO THE TRANSLUNAR COAST PHASE, THE GUIDANCE AND CONTROL SYSTEMS MUST PROVIDE REDUNDANT SPS BURN CAPABILITY. THE FOLLOWING MINIMUM CAPABILITIES MUST ALSO BE AVAILABLE TO GO FOR TLI:

1. ATTITUDE CONTROL: DIRECT RCS, AUTO ATT CONTROL AND RATE DAMPING IN EACH AXIS.

2. TVC: 3 OF 4 SERVO LOOPS AND TWO TVC CONTROL MODES (ACCEL. CMD EXCLUDED).

3. G&N: CMC, IMU, AND ONE DSKY FULLY OPERATIONAL AND OPTICS OR COAS CAPABLE OF ALIGNING PLATFORM. P40 ATTITUDE ERROR DISPLAY REQUIRED.

4. DISPLAYS: ONE OPERATIONAL FDAI.

5. ATTITUDE REFERENCE: REDUNDANT ATTITUDE SOURCES ARE REQUIRED FOR HIGH-SPEED ENTRY

R	ITEM	
	15-3	TRANSLUNAR COAST IN ORDER TO CONTINUE THE MISSION PAST THE NEXT BEST PTP, THE GUIDANCE AND CONTROL SYSTEMS MUST PROVIDE THE FOLLOWING MINIMUM CAPABILITIES: A. ATTITUDE CONTROL: DIRECT RCS, AUTO ATT CONTROL AND RATE DAMPING IN EACH AXIS. B. RCS TRANSLATION: X-AXIS VIA AUTO COILS OR DIRECT ULLAGE PUSHBUTTON.
	15-4	LOI IN ORDER TO COMMIT TO LOI, THE FOLLOWING MINIMUM CAPABILITIES MUST BE AVAILABLE: A. ATTITUDE CONTROL: DIRECT RCS, AUTO ATT CONTROL AND RATE DAMPING IN EACH AXIS B. TVC: BOTH SERVO LOOPS IN INERTIAL YAW, ONE IN PITCH (IF DPS IS AVAILABLE FOR ABORTS AND FOR TEI), AND TWO SCS TVC CONTROL MODES (ACCEL CMD EXCLUDED). C. DELETED D. SPS: NON-CRITICAL BURN CAPABILITY IS REQUIRED.
	15-5	LUNAR ORBIT A. LUNAR ORBIT WILL BE TERMINATED EARLY IF EITHER REDUNDANT ATTITUDE CONTROL OR NON-CRITICAL SPS CAPABILITY IS LOST. REDUNDANT SPS CONTROL IS REQUIRED IF LM DPS IS NOT AVAILABLE FOR TEI. B. IN ORDER TO PERFORM A NON-CRITICAL BURN, THE G&C SYSTEMS MUST BE ABLE TO PROVIDE AN ULLAGE MANEUVER BY EITHER CMC AUTO (RCS DAP), SCS AUTO, OR DIRECT ULLAGE.
	15-6	UNDOCKED THE UNDOCKED PHASE WILL BE DELETED OR TERMINATED IF THE G&C SYSTEMS CANNOT PROVIDE REDOCKING OR LM RESCUE CAPABILITY. THE G&C SYSTEMS MUST PROVIDE DIRECT RCS AND TRANSLATION CAPABILITY IN EACH AXIS, AND RATE DAMPING IN TWO AXES FOR LINE-OF-SIGHT CONTROL. IN ADDITION, THE FOLLOWING MINIMUM CAPABILITIES FOR LM RESCUE MUST BE AVAILABLE: A. OPERATIONAL OPTICS, OR VHF SUBSYSTEM AND COAS B. ONE DSKY C. TRANSLATION CAPABILITY IN EACH AXIS D. RATE DAMPING IN TWO AXES E. OPERATIONAL IMU AND CMC F. ONE OPERATIONAL RHC G. ONE OPERATIONAL FDAI H. DIRECT RCS IN ALL THREE AXES I. NON-CRITICAL SPS BURN CAPABILITY

R	ITEM	
	15-7	ASCENT, DESCENT THERE ARE NO GUIDANCE AND CONTROL SYSTEM FAILURES THAT AFFECT THE ASCENT OR DESCENT PHASES.
	15-8	LUNAR STAY PHASE LUNAR STAY WILL BE TERMINATED EARLY IF REDUNDANT SPS CONTROL CAPABILITY IS LOST. IN ADDITION, THE FOLLOWING MINIMUM CONTROL CAPABILITIES MUST BE AVAILABLE FOR THE ACCOMPLISHMENT OF TEI: A. ATTITUDE CONTROL: DIRECT RCS IN THREE AXES AND RATE DAMPING IN TWO AXES B. TVC: BOTH SERVO LOOPS AND TWO TVC CONTROL MODES (ACCEL CMD EXCLUDED) C. G&N: THE G&N MUST BE FULLY OPERATIONAL WITH THE EXCEPTION OF OPTICS AND EITHER DSKY
	15-9	CSM EVA CSM EVA WILL BE NO-GO/TERMINATED FOR LOSS OF THREE-AXIS ATTITUDE CONTROL (REF MR 17-5)

R	ITEM

SYSTEMS MANAGEMENT

15-10 ATTITUDE CONTROL

CSM IN ACTIVE RCS CONTROL - LM WILL NOT BE IN ACTIVE ATTITUDE HOLD. LM IN ACTIVE RCS CONTROL - CSM WILL NOT BE IN ACTIVE ATTITUDE HOLD. FOR DOCKING ACTIVITIES AFTER OPENING THE APS INTERCONNECT (BOTH VEHICLES IN ACTIVE RCS CONTROL), THE CSM MUST BE IN A TIGHTER DEADBAND THAN THE LM.

15-11 PIPA BIAS WILL BE UPDATED WHEN ACTUAL BIAS DIFFERS FROM THE VALUE IN CMC ERASABLE BY ±0.003 FT/SEC^2. THE FAILURE LIMIT ON THE CSM ACCELEROMETER IS ±0.164 FT/SEC^2. THE FIRST GYRO BIAS DRIFT WILL BE UPDATED IF THE DRIFT IS ±1 MERU (0.015 DEG/HR). THEREAFTER, ±3 MERU (±0.045 DEG/HR) WILL BE THE UPDATE CRITERIA. THE FAILURE LIMIT ON THE CSM GYRO IS ±100 MERU (±1.5 DEG/HR).

15-12 ΔV COUNTER DRIFT

A. FOR SPS BURNS, THE ΔV COUNTER SHOULD BE APPROPRIATELY BIASED FOR DRIFTS OF GREATER THAN 0.015 FT/SEC^2.

B. FOR RCS BURNS, THE ΔV COUNTER WILL BE BIASED FOR DRIFTS GREATER THAN OR EQUAL TO 0.01 FT/SEC^2. SHOULD THE DRIFT BE GREATER THAN 0.1 FT/SEC^2, THE EMS WILL BE CONSIDERED FAILED.

15-13 DAP INITIALIZATION

A. GIMBAL TRIMS: WILL BE UPDATED FOR EVERY SPS MANEUVER BASED ON FINAL TRIM POSITIONS OF THE PREVIOUS MANEUVER AS MONITORED ON TELEMETRY, IF THE PREVIOUS MANEUVER WAS SCS CONTROLLED. IF THE PREVIOUS MANEUVER WAS G&N CONTROLLED, THE CMC STORED VALUES WILL BE USED. TRIMS WILL BE REINITIALIZED FROM THE GROUND AFTER EACH VEHICLE CONFIGURATION CHANGE AND AFTER EACH WEIGHT UPDATE. TRIMS MUST BE UPDATED WHEN GROUND COMPUTED VALUES DIFFER FROM CMC STORED VALUES BY 0.5 DEGREE.

B. CSM, LM WEIGHT: SHOULD BE UPDATED WHEN GROUND COMPUTED VALUES DIFFER FROM CMC STORED VALUES BY 1.0 PERCENT. WEIGHTS MUST BE UPDATED WHEN GROUND VALUES DIFFER FROM CMC VALUES BY 10.0 PERCENT.

15-14 SPS THRUST CONSTRAINTS

A. ET DECAY WILL BE UPDATED WHEN ACTUAL VALUE DIFFERS FROM LOADED BY ±0.05 SECONDS.

B. EFIMP16 WILL BE UPDATED WHEN ACTUAL VALUE DIFFERS FROM LOADED BY 400 LB THRUST.

RULE NUMBERS 15-15 THROUGH 15-19 ARE RESERVED.

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
				SPECIFIC MISSION RULES	
	15-20	LOSS OF EITHER BMAG 1 OR 2 IN EITHER PITCH OR YAW CHANNEL	ALL	CONTINUE MISSION	1. REF MALF PROC: G&C-1, 3, 4, AND 8 SEC-1, 3, 3A, AND 6 2. NO SCS AUTO TVC 3. IF IN YAW CHANNEL, AFTER .05G RSI IS UNABLE IF REMAINING GYRO IS SELECTED FOR RATE. RSI MUST BE REALIGNED, IN ADDITION TO THE ABOVE, FOR YAW FAILURE AFTER .05G.
	15-21	LOSS OF BOTH BMAG 1 AND 2 IN EITHER PITCH OR YAW CHANNEL	LAUNCH	A. CONTINUE MISSION	A. MTVC ACCEL CMD IS ONLY MODE III OR MODE IV SPS CONTROL MODE.
			TLC	B. NO-GO FOR LOI	
			LO	C. NO-GO FOR UNDOCKING ENTER NEXT BEST PTP IF LM DPS NOT AVAILABLE FOR TEI	C. PLAN DPS TEI
			DESCENT	D. CONTINUE MISSION	
			CSM EVA	E. CONTINUE MISSION	
			ALL OTHERS	F. TERMINATE PHASE AND ENTER NEXT BEST PTP	F. IN EARTH ORBIT, LOSS OF PITCH CHANNEL RESULTS IN ALL THREE DEORBIT METHODS BEING SUBJECTED TO SINGLE FAILURES IN THE G&N SYSTEM. THE YAW LOSS PRECLUDES HYBRID DEORBIT AND SUBJECTS BOTH REMAINING DEORBIT METHODS TO SINGLE FAILURES IN THE G&N SYSTEM
			ENTRY	G. CONTINUE MISSION	G. RSI AND SCS FDAI ROLL UNUSABLE WITH YAW CHANNEL FAILURES.
	15-22	LOSS OF ROLL BMAG			
		A. NUMBER ONE	ALL	A. CONTINUE MISSION	A.1. MANUAL ROLL ATTITUDE CONTROL REQUIRED IN ALL SCS MODES. 2. FOR ENTRY, NO SCS FDAI ROLL. RSI VALID.
		B. NUMBER TWO	ALL	B. CONTINUE MISSION	B.1. USE OF ATT 1/RATE 2 AND LIM CYCLE MAY PROVIDE RATE DAMPED ATTITUDE HOLD WHEN RCS DAP IS NOT USED. GYRO PACKAGE 2 MUST BE POWERED DOWN TO EFFECT ATTITUDE HOLD IF FAILURE IS HARDOVER. 2. SELECTION OF RATE 1 WILL PROVIDE BOTH RSI AND SCS FDAI ROLL FOR ENTRY. RSI MUST BE REALIGNED FOR ROLL FAILURE AFTER .05G.

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	15-23	LOSS OF BOTH ROLL BMAG'S	LAUNCH	A. CONTINUE MISSION	
			EO	B.1. NO-GO FOR TLI	
				2. ENTER NEXT BEST PTP IF SM DEORBIT NOT AVAILABLE	
			TLC	C. NO-GO FOR LOI	C. NO SCS FDAI ROLL OR RSI AVAILABLE FOR ENTRY.
			POST RNDZ	D. ENTER NEXT BEST PTP	
			ALL OTHERS	E. CONTINUE MISSION	
	15-24	LOSS OF EITHER TVC SERVO LOOP IN EITHER PITCH OR YAW AXIS			MAINTAIN 20 LBS/QUAD/AXIS FOR HARDOVER RECOVERY FOR UNDOCKED AND TBD LBS/QUAD/AXIS FOR HARDOVER RECOVERY FOR DOCKED SPS MANEUVERS.
			LAUNCH/EO	A. CONTINUE MISSION	
				SELECT 1 OR 2 ON TVC GIMBAL DRIVE SWITCH IN APPROPRIATE AXIS	
			TLC	B. GO FOR LOI IF REDUNDANCY CAN BE MAINTAINED IN INERTIAL YAW AXIS	
			LO	C. NO-GO FOR UNDOCKING	C. IN LUNAR ORBIT, PLAN DPS TEI.
				ENTER NEXT BEST PTP IF LM DPS NOT AVAILABLE FOR TEI	
			DESCENT	D. CONTINUE MISSION	
			ALL OTHERS	E. TERMINATE PHASE AND	
				ENTER NEXT BEST PTP	
	15-25	LOSS OF BOTH TVC SERVO LOOPS	LAUNCH	A. CONTINUE MISSION	A.1. REF MALF PROC G&C-1, G&N-4, SCS-A1
					2. NO MODE III OR IV CAPABILITY. LIMITED LANDING POINT CONTROL IN MODE III OR IV WITH SM-RCS.
			EO	B. ENTER NEXT BEST PTP	
				RCS DEORBIT	
			TLC	C. NO-GO FOR LOI	
			DESCENT	D. CONTINUE MISSION	
			ALL OTHERS	E. TERMINATE PHASE AND	E. IN LUNAR ORBIT, DO DPS TEI.
				ENTER NEXT BEST PTP	
	15-26	LOSS OF PROPORTIONAL CONTROL FROM:			
		A. EITHER RHC	ALL	A. CONTINUE MISSION	
				USE REMAINING RHC	
		B. BOTH RHC'S	ALL	B. CONTINUE MISSION	B. NO MTVC RATE OR MTVC ACCEL CMD CAPABILITY
				USE DIRECT RCS OR ACCEL CMD FOR MANUAL MANEUVERS	

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	15-27	LOSS OF DIRECT RCS CONTROL FROM:			REF MALF PROC SCS 5
		A. EITHER RHC, ANY OR ALL AXES	ALL	A. CONTINUE MISSION	
		B. BOTH RHC'S, SAME AXIS	LAUNCH	B.1. CONTINUE MISSION	
			DESCENT	2. CONTINUE MISSION	
			CSM EVA	3. CONTINUE MISSION	
			ALL OTHERS	4. TERMINATE PHASE AND ENTER NEXT BEST PTP	B.5. FAILURE VIOLATES DIRECT RCS REQUIREMENT.
		C. BOTH RHC'S, TWO AXES	LUNAR STAY	C.1. TERMINATE PHASE AND ENTER NEXT BEST PTP	
			CSM/EVA	2. CONTINUE MISSION	
	15-28	COMPLETE LOSS OF AUTO ATTITUDE CONTROL IN PITCH AND YAW CHANNELS			REF MALF PROC SCS 1 SUSPECTED FAILURE WOULD BE AUTO INHIBIT CIRCUITRY.
		A. CONTROL IS REGAINED BY OPENING EMS CB'S	ALL	A. CONTINUE MISSION AFTER SM JETTISON EMS MAY BE REENABLED WITHOUT LOSS OF AUTO RCS	
		B. CONTROL IS REGAINED BY PLACING S/C CONTROL SWITCH TO CMC.	ALL	B. CONTINUE MISSION	B. NO SCS ATTITUDE CONTROL
		C. CONTROL IS NOT REGAINED	DESCENT	C.1. CONTINUE MISSION	
			CSM/EVA	2. CONTINUE MISSION	
			ALL OTHERS	3. TERMINATE PHASE AND ENTER NEXT BEST PTP USE DIRECT ULLAGE AND DIRECT RCS.	C.3. FAILURE VIOLATES RATE DAMPING REQUIREMENTS.
	15-29	LOSS OF FLIGHT DIRECTOR ATTITUDE INDICATORS			REF MALF PROC G&C-1,2,3,4,5, AND 6
		A. ONE	ALL	A. CONTINUE MISSION	
		B. BOTH	LAUNCH	B. 1. CONTINUE MISSION	
			TLC	2. NO-GO FOR LOI	
			DESCENT	3. CONTINUE MISSION	
			LUNAR STAY	4. CONTINUE MISSION	
			CSM EVA	5. CONTINUE MISSION	B.5. IN LUNAR ORBIT, DO DPS TEI.
			ALL OTHERS	6. TERMINATE PHASE AND ENTER NEXT BEST PTP	

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	15-30	LOSS OF AC1 PHASE A			1. LOSS OF AC1 PHASE A RESULTS IN THE LOSS OF: (A) REDUNDANT SERVO LOOP POWER. BOTH SERVO LOOPS MUST BE POWERED BY THE SAME BUS. (B) PROPORTIONAL ATTITUDE CONTROL FROM BOTH RHC'S. ALL PROPORTIONAL CONTROL FROM RHC NO. 1. (C) FDAI NO. 1 (D) GYRO ASSEMBLY NO. 1 (E) SCS TOTAL ATTITUDE ERROR (F) SCS TOTAL ATTITUDE (G) SCS AUTO TVC CAPABILITY (H) SCS MINIMUM IMPULSE CAPABILITY (I) SCS ATTITUDE CONTROL RATE DAMPING (J) GPI P AND Y DRIVE NO. 1 2. IN EARTH ORBIT, LOSS OF AC1 PRECLUDES HYBRID DEORBIT AND SUBJECTS BOTH REMAINING DEORBIT METHODS TO A SINGLE FAILURE (AC2 PHASE A)
			LAUNCH	A. CONTINUE MISSION	
			TLC	B. NO-GO FOR LOI	
			DESCENT	C. CONTINUE MISSION	
			CSM EVA	D. CONTINUE MISSION	
			ALL OTHERS	E. TERMINATE PHASE AND ENTER NEXT BEST PTP	E. IN LUNAR ORBIT DO DPS TEI.

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	15-31	LOSS OF AC2 PHASE A			1. LOSS OF AC2 PHASE A RESULTS IN THE LOSS OF: (A) REDUNDANT SERVO LOOP POWER (B) ALL PROPORTIONAL CONTROL (C) FDAI NO. 2 (D) GYRO ASSEMBLY NO. 2 (E) SCS PITCH AND YAW TOTAL ATTITUDE (F) ALL SCS TVC CAPABILITY (AUTO, RATE AND ACCEL CMD) (G) RSI (H) GPI P AND Y DRIVE NO. 2 2. IN EARTH ORBIT, LOSS OF AC2 RESULTS IN ALL THREE DEORBIT METHODS BEING SUBJECTED TO A SINGLE FAILURE (AC1 PHASE A).
			LAUNCH	A. CONTINUE MISSION	
			TLC	B. NO-GO FOR LOI	
			DESCENT	C. CONTINUE MISSION	
			CSM EVA	D. CONTINUE MISSION	
			ALL OTHERS	E. TERMINATE PHASE AND ENTER NEXT BEST PTP	E. IN LUNAR ORBIT, DO DPS TEI.
	15-32	LOSS OF ORBIT RATE DISPLAY (ORDEAL) EARTH AND LUNAR	ALL	CONTINUE MISSION	REF MALF PROC G&C-4 AND 5
	15-33	LOSS OF ENTRY MONITOR SYSTEM	ALL	CONTINUE MISSION	REF MALF PROC EMS-1
	15-34	GROUND AT EITHER SPS SOL DRIVER OUTPUT AND UNABLE TO REMOVE	ALL	CONTINUE MISSION OPEN SPS PILOT VALVE CB'S	REF MALF PROC G&C-1

MISSION RULES

SECTION 15 - GUIDANCE AND CONTROL - CONTINUED

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	15-35	LOSS OF TRANSLATION HAND CONTROLLER	LAUNCH	A. CONTINUE MISSION	
			EARTH ORBIT	B. ENTER NEXT BEST PTP	B. VIOLATES BOTH SM AND HYBRID DEORBIT MINIMUM REQUIREMENTS.
			TLC	C. CONTINUE MISSION	
			LO	D. NO-GO FOR UNDOCKING	D. VIOLATES LM RESCUE MINIMUM REQUIREMENTS.
			UNDOCKED	E. DOCK	
			ALL OTHERS	F. CONTINUE MISSION	
	15-36	COMPLETE LOSS OF RHC			
		A. ONE RHC	ALL	A. CONTINUE MISSION	
		B. BOTH RHC'S	LAUNCH	B.1. CONTINUE MISSION	
			TLC	2. NO-GO FOR LOI	
			DESCENT	3. CONTINUE MISSION	
			LUNAR STAY	4. CONTINUE MISSION	
			CSM EVA	5. CONTINUE MISSION	
			ALL OTHERS	6. ENTER NEXT BEST PTP	
		RULE NUMBERS 15-37 THROUGH 15-49 ARE RESERVED.			

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	15-50	LOSS OF COMMAND MODULE COMPUTER			REF MALF PROC G&N-5
			LAUNCH	A. CONTINUE MISSION	
			EO	B. CONTINUE ALTERNATE EO MISSION IF BOTH SPS AND SM DEORBIT CAPABILITY AVAILABLE	B. VIOLATES HYBRID DEORBIT MINIMUM REQUIREMENTS
			TLC	C. CONTINUE MISSION IF LM DPS AVAILABLE	
			LO	D. NO-GO FOR UNDOCKING ENTER NEXT BEST PTP IF LM DPS NOT AVAILABLE FOR TEI	D. IN LUNAR ORBIT, PLANS DPS TEI
			UNDOCKED	E. DOCK	E. VIOLATES LM RESCUE MINIMUM REQUIREMENTS
			DESCENT	F. CONTINUE MISSION	
			POST DOCK	G. RETAIN LM ASCENT STG	G. USE LM FOR COMM B/U
			CSM EVA	H. CONTINUE MISSION	
			ENTRY	I. PERFORM BACKUP ENTRY	
			ALL OTHERS	J. TERMINATE PHASE AND ENTER NEXT BEST PTP	J. CONSIDERATION WILL BE GIVEN TO COMPLETING THE LUNAR STAY PHASE
	15-51	LOSS OF DSKY			REF MALF PROC G&N-5
		A. EITHER MDC OR LEB DSKY	ALL	A. CONTINUE MISSION	
		B. BOTH MDC AND LEB DSKY	LAUNCH	B.1. CONTINUE MISSION	
			EO	B.2. CONTINUE ALTERNATE EO MISSION IF BOTH SPS AND SM DEORBIT CAPABILITY AVAILABLE	B.2. VIOLATES HYBRID DEORBIT MINIMUM REQUIREMENTS
			TLC	3. CONTINUE MISSION IF LM DPS AVAILABLE	
			LO	4. NO-GO FOR UNDOCKING ENTER NEXT BEST PTP IF LM DPS NOT AVAILABLE FOR TEI	4. PLAN DPS TEI
			UNDOCKED	5. DOCK	5. VIOLATES LM RESCUE MINIMUM REQUIREMENTS
			DESCENT	6. CONTINUE MISSION	
			POST DOCK	7. RETAIN LM ASCENT STG	7. USE LM FOR COMM B/U
			ENTRY	8. PERFORM BACKUP ENTRY	
			ALL OTHERS	9. TERMINATE PHASE AND ENTER NEXT BEST PTP	9. CONSIDERATION WILL BE GIVEN TO COMPLETING THE LUNAR STAY PHASE

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	15-52	LOSS OF INERTIAL SUBSYSTEM			REF MALF PROC G&N-6
			LAUNCH	A. CONTINUE MISSION	
			EO	B. CONTINUE ALTERNATE EO MISSION IF BOTH SPS AND SM DEORBIT CAPABILITY AVAILABLE	B. VIOLATES HYBRID DEORBIT MINIMUM REQUIREMENTS
			TLC	C. NO-GO FOR LOI	
			LO	D. ENTER NEXT BEST PTP	D. IN LUNAR ORBIT, DO DPS TEI
			UNDOCKED	E. DOCK	E. VIOLATES LM RESCUE REQUIREMENTS
			DESCENT	F. CONTINUE MISSION	
			POST DOCK	G. RETAIN LM ASCENT STG	G. USE LM G&N TO MONITOR BURNS
			CSM EVA	H. CONTINUE MISSION	
			ENTRY	I. PERFORM BACKUP ENTRY	
			ALL OTHERS	J. TERMINATE PHASE AND ENTER NEXT BEST PTP	J. VIOLATES LM RESCUE MINIMUM REQUIREMENTS
	15-53	LOSS OF OPTICS SUBSYSTEM	ALL	CONTINUE MISSION USE BACKUP ALIGNMENT PROCEDURE (COAS)	REF MALF PROC G&N-5
	15-54	LOSS OF OPTICS SUBSYSTEM COUPLING DATA UNIT DIGITAL-TO-ANALOG CONVERTER			REF MALF PROC G&C-1 CONSTITUTES LOSS OF TVC DAP
			LAUNCH	A. CONTINUE MISSION	
			EO	B. CONTINUE MISSION	
			TLC	C. CONTINUE MISSION	
			LO	D. NO-GO FOR UNDOCKING ENTER NEXT BEST PTP IF LM DPS NOT AVAILABLE FOR TEI	D. IN LUNAR ORBIT, PLAN DPS TEI.
			UNDOCKED	E. DOCK	
			DESCENT	F. CONTINUE MISSION	
			CSM EVA	G. CONTINUE MISSION	
			ALL OTHERS	H. TERMINATE PHASE AND ENTER NEXT BEST PTP	
		RULE NUMBERS 15-55 THROUGH 15-59 ARE RESERVED.			

R | ITEM

INSTRUMENTATION REQUIREMENTS

15-60

MEAS DESCRIPTION	PCM	ONBOARD	TRANSDUCERS	CATEGORY	MSN RULE REFERENCE
CMC DIGITAL DATA	CG0001V	-	-	MANDATORY	15-50
SPS SOL DRIVER 1	CH3604X	EMS-SPS-ON	SEPARATE	HIGHLY DESIRABLE	15-34
SPS SOL DRIVER 2	CH3605X	EMS-SPS-ON	SEPARATE	HIGHLY DESIRABLE	15-34
PITCH GIMBAL POS 1 & 2	CH3517H	GPI	COMMON	1 OF 2 MANDATORY ONBOARD/HD-PCM	15-24,25
YAW GIMBAL POS 1 & 2	CH3518H	GPI	COMMON	1 OF 2 MANDATORY ONBOARD/HD-PCM	15-24,25
TM BIAS 2.5 VDC	CG1110V	-	-	HIGHLY DESIRABLE	15-52,53,54
PIPA TEMP	CG2300T	-	-	HIGHLY DESIRABLE	15-52
IMU HTR +28 VDC	CH1513X	-	-	HIGHLY DESIRABLE	15-52
CMC OPERATE +28 VDC	CG1523X	-	-	HIGHLY DESIRABLE	15-50
OPTX OPERATE +28 VAC	CG1533X	-	-	HIGHLY DESIRABLE	15-54
IG 1X RSVR OUT SIN	CG2112V	FDAI	COMMON	HIGHLY DESIRABLE	15-52
IG 1X RSVR OUT COS	CG2113V	FDAI	COMMON	HIGHLY DESIRABLE	15-52
MG 1X RSVR OUT SIN	CG2142V	FDAI	COMMON	HIGHLY DESIRABLE	15-52
MG 1X RSVR OUT COS	CG2143V	FDAI	COMMON	HIGHLY DESIRABLE	15-52
OG 1X RSVR OUT SIN	CG2172V	FDAI	COMMON	HIGHLY DESIRABLE	15-52
OG 1X RSVR OUT COS	CG2173V	FDAI	COMMON	HIGHLY DESIRABLE	15-52
SHAFT CDU DAC OUT	CG3721V	-	-	HIGHLY DESIRABLE	15-54
TRUNNION CDU DAC OUT	CG3722V	-	-	HIGHLY DESIRABLE	15-54
CMC WARNING	CG5040X	C&W	COMMON	HIGHLY DESIRABLE	15-50
PITCH ATT ERROR	CH3500H	FDAI	COMMON	HIGHLY DESIRABLE	15-20,21,22,23
YAW ATT ERROR	CH3501H	FDAI	COMMON	HIGHLY DESIRABLE	15-20,21,22,23
ROLL ATT ERROR	CH3502H	FDAI	COMMON	HIGHLY DESIRABLE	15-20,21,22,23
SCS PITCH BODY RATE	CH3503R	FDAI	COMMON	HIGHLY DESIRABLE	15-20,21,22,23
SCS YAW BODY RATE	CH3504R	FDAI	COMMON	HIGHLY DESIRABLE	15-20,21,22,23
SCS ROLL BODY RATE	CH3505R	FDAI	COMMON	HIGHLY DESIRABLE	15-20,21,22,23
SCS TVC PITCH AUTO CMD	CH3582V	-	-	HIGHLY DESIRABLE	15-24,25
SCS TVC YAW AUTO CMD	CH3583V	-	-	HIGHLY DESIRABLE	15-24,25
MTVC PITCH CMD	CH3585H	-	-	HIGHLY DESIRABLE	15-24,25
MTVC YAW CMD	CH3586H	-	-	HIGHLY DESIRABLE	15-24,25
FDAI ERROR 5, RATE 5	CH3592X	-	-	HIGHLY DESIRABLE	15-20,21,22,23
FDAI ERROR 50/15, RATE 50/10	CH3593X	-	-	HIGHLY DESIRABLE	15-20,21,22,23
PITCH DIFF CLUTCH CUR	CH3666C	-	-	HIGHLY DESIRABLE	15-24,25
YAW DIFF CLUTCH CUR	CH3667C	-	-	HIGHLY DESIRABLE	15-24,25

16 CSM SERVICE PROPULSION SYSTEM

R	ITEM	
		GENERAL
	16-1	A. CATEGORIES OF FAILURES FAILURES AFFECTING THE SPS FALL INTO ONE OF THREE CATEGORIES: 1. FAILURES WHICH CAUSE THE SPS TO BE UNSAFE: THESE FAILURES RESULT IN MISSION TERMINATION ASAP. 2. FAILURES WHICH CAUSE THE SPS TO BE INOPERABLE OR HAZARDOUS TO OPERATE: THESE FAILURES RESULT IN ALTERATION OF THE MISSION TO MINIMIZE USAGE OF THE SPS. 3. FAILURES SUCH THAT CONTINUED OPERATION WILL RESULT IN SUBSEQUENT DEGRADATION: THESE FAILURES ALLOW PERFORMANCE OF CRITICAL BURNS ONLY. B. ULLAGE REQUIREMENTS SUBSEQUENT TO THE DEPLETION OF STORAGE TANK PROPELLANTS, AN ULLAGE MANEUVER WILL NORMALLY BE PERFORMED PRIOR TO ANY BURN. HOWEVER, INABILITY TO PERFORM AN ULLAGE WILL NOT PRECLUDE A CRITICAL BURN. C. PREMATURE TERMINATION OF BURNS CRITICAL BURNS WILL NOT BE TERMINATED BECAUSE OF ANOMALIES. NON-CRITICAL BURNS WILL BE TERMINATED UNDER VARIOUS CONDITIONS AS SPECIFIED IN RULE 3-86 AND THE SPECIFIC RULES OF THIS SECTION. NOTE A CRITICAL BURN IS DEFINED AS AN SPS BURN THAT IS REQUIRED FOR THE SAFE RETURN OF THE CREW.
	16-2	LAUNCH PHASE THERE ARE NO SPS FAILURES WHICH REQUIRE A LAUNCH ABORT.
	16-3	RESERVED

R	ITEM	
	16-4	EARTH ORBIT PHASE A. CRITICAL BURNS IN THIS PHASE ARE MODE IV, APOGEE KICK AND DEORBIT. IF THE SPS IS INCAPABLE OF PERFORMING CRITICAL BURNS, THE MISSION WILL BE TERMINATED BY ENTRY INTO THE NEXT BEST PTP USING SM-RCS OR HYBRID TECHNIQUES. B. IF THE SPS IS INCAPABLE OF PERFORMING NON-CRITICAL BURNS, TLI WILL BE INHIBITED AND A SUITABLE EARTH ORBIT ALTERNATE MISSION WILL BE IMPLEMENTED. THE SPS MAY BE USED FOR DEORBIT ONLY. C. IN ORDER TO PROVIDE THE TOTAL CAPABILITY TO DEORBIT FROM ANY POINT IN THIS PHASE, THE LM DPS AND LM RCS MAY BE USED FOR ORBIT SHAPING.
	16-5	TRANSLUNAR COAST PHASE A. CRITICAL BURNS IN THIS PHASE ARE TIME-CRITICAL ABORTS, BURNS TO ASSURE FREE RETURN, OR BURNS TO AVOID LUNAR OR LAND IMPACT. B. CERTAIN ABORT BURNS, BURNS TO ASSURE FREE RETURN OR BURNS TO AVOID LUNAR OR LAND IMPACT MAY USE THE LM DPS AND LM RCS.
	16-6	LUNAR ORBIT PHASE A. TEI IS THE ONLY CRITICAL BURN IN THIS PHASE. B. LM DPS MAY BE USED FOR TEI IF THE CAPABILITY EXISTS. C. TERMINATE PHASE FOR LOSS OF SPS REDUNDANCY WHEN DPS IS NOT AVAILABLE FOR TEI.
	16-7	DESCENT PHASE THE LM POWERED DESCENT WILL BE ABORTED FOR SPS PROPELLANT LEAKS.
	16-8	UNDOCKED AND LUNAR STAY PHASES A. THE LUNAR ORBIT PLANE CHANGE IS A CRITICAL BURN IF OUTSIDE TOTAL LM CAPABILITY. B. THESE PHASES WILL BE TERMINATED FOR CONFIRMED LOSS OF SPS REDUNDANCY. C. LUNAR STAY WILL BE ABORTED AT T1 FOR SPS PROPELLANT LEAKS.

R	ITEM	
	16-9	ASCENT PHASE LM RESCUE BURNS MAY BE REQUIRED, AND THEY ARE CRITICAL.
	16-10	TRANSEARTH COAST PHASE A. CRITICAL BURNS IN THIS PHASE ARE MIDCOURSE CORRECTIONS TO ATTAIN THE PROPER ENTRY CORRIDOR WHICH ARE OUTSIDE SM-SCS CAPABILITY. B. CONSIDERATION WILL BE GIVEN TO PERFORMING THE CSM EVA FOR SPS PROPELLANT LEAKS. SUIT AND CABIN CONTAMINATION BY PROPELLANTS IS THE BASIC PROBLEM AND WILL BE EVALUATED IN REAL TIME.
	16-11	CONSIDERATION WILL BE GIVEN TO RETAINING THE LM ASCENT STAGE TO GAIN ADDITIONAL ΔV FOR CERTAIN SPS FAILURES.

R	ITEM	

SYSTEMS MANAGEMENT

16-12 PROPELLANT GAGING

A. FOR BURNS LESS THAN 25 SECONDS DURATION:

1. PRIME METHOD: IMU ΔV OBTAINED
2. BACKUP METHOD: FLOW RATE X BURN TIME

B. FOR BURNS GREATER THAN 25 SECONDS DURATION:

1. PRIME METHOD: IMU ΔV OBTAINED
2. BACKUP METHOD: ONBOARD GAGING SYSTEM

16-13 THE PU VALVE WILL BE USED TO MAINTAIN THE UNBALANCE READING:

A. PRIOR TO CROSSOVER: WITHIN ±50 LBS OF THE STABLE VALUE OCCURRING APPROXIMATELY 25 SEC AFTER LOI IGNITION.

B. AFTER CROSSOVER: WITH ±100 LBS OF ZERO UNBALANCE.

16-14 DUAL BANK VS SINGLE BANK OPERATION

THE SPS WILL ALWAYS BE STARTED USING A SINGLE BANK. HOWEVER, THE OTHER BANK WILL BE OPENED 2 TO 5 SECONDS AFTER IGNITION FOR BURNS PLANNED TO BE LONGER THAN 10 SECONDS.

16-15 PROPELLANT MANAGEMENT

DELETED

R	ITEM	
	16-16	PROPELLANT FEEDLINE TEMPERATURE MANAGEMENT SPS LINE HEATERS WILL BE MANUALLY CYCLED TO MAINTAIN FEEDLINE TEMPERATURES BETWEEN 45° F AND 75° F AND ENGINE VALVE TEMPERATURE ABOVE 45° F.

RULE NUMBERS 16-17 THROUGH 16-19 ARE RESERVED.

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
				SPECIFIC MISSION RULES	
	16-20	SUSTAINED PRESSURE DECAY IN EITHER THE FUEL OR OXIDIZER TANK (COULD BE HELIUM OR FUEL OR OXIDIZER)			MALF PROC SPS 1B REF MR 3-86 MANEUVER TABLE MANUAL PRESSURIZATION OF THE TANKS SHOULD BE CONSIDERED PRIOR TO ANY REQUIRED SPS BURN.
			LAUNCH	CONTINUE MISSION	NOTE:
				PLAN RCS DEORBIT AT NEXT BEST PTP	SUSTAINED PRESSURE DECAY IS DEFINED AS A DECREASE OF AT LEAST 4 PSI, NOT ATTRIBUTABLE TO HELIUM ABSORPTION AND/OR THERMAL EFFECTS.
				IF LAND IMPACT IS IMMINENT AFTER ABORTING, REPRESS MANUALLY AND PERFORM BURN TO AVOID LAND.	
			EO	ENTER NEXT BEST PTP	
				RCS DEORBIT	
			TLC	NO-GO FOR LOI-	
				INHIBIT NON-CRITICAL SPS BURNS	
			LO	ENTER NEXT BEST PTP	
				USE DPS IF CAPABILITY EXISTS	
			UNDOCKED	DOCK ASAP	DO NOT STAGE LM
			DESCENT	ABORT	
			LUNAR STAY	RETURN TO CSM ASAP	
			TEC	CONTINUE MISSION	
				INHIBIT NON-CRITICAL BURNS	
			CSM EVA	CONTINUE MISSION	CONSIDERATION WILL BE GIVEN TO CONTINUING BASED ON AMOUNT OF CONTAMINANTS
		A. DURING NON-CRITICAL BURN (PRESS LESS THAN OR EQUAL TO 160 PSIA)	ALL	A. TERMINATE BURN	
		B. DURING CRITICAL BURN	ALL	B. CONTINUE BURN	
	16-21	LOSS OF ONE GN2 TANK PRESSURE (LESS THAN 400 PSI)			MALF PROC SPS 9 TRANSDUCER INDICATION CANNOT BE VERIFIED WITHOUT ENGINE OPERATION.
			EO	A. CONTINUE MISSION	
			ALL OTHERS	B.1. VERIFY OPERATION OF SUS-ON SUSPECT BANK 2. IF LOSS CONFIRMED BY ENGINE OPERATION, REF MR 16-22.	

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	16-22	LOSS OF ONE BANK OF BALL VALVES			MALF PROC SPS-9
			LAUNCH/ EO	A. CONTINUE MISSION	
			TLC	B. CONTINUE MISSION IF DPS AVAILABLE	
			LO	C. NO-GO FOR UNDOCKING ENTER NEXT BEST PTP IF LM DPS NOT AVAILABLE FOR TEI	C. PLAN DPS TEI
			UNDOCKED/ DESCENT	D. N/A	
			LUNAR STAY	E. ENTER NEXT BEST PTP	
	16-23	LOSS OF BOTH GN2 TANK PRESSURE (LESS THAN 400 PSIA)			MALF PROC SPS 9 TRANSDUCER INDICATION CANNOT BE VERIFIED WITHOUT ENGINE OPERATION.
			LAUNCH	A. CONTINUE MISSION	
			EO	B. ENTER NEXT BEST PTP RCS DEORBIT	
			TLC	C. NO-GO FOR LOI	
			LO	D. ENTER NEXT BEST PTP	D. DO DPS TEI.
			UNDOCKED	E. DOCK ASAP	E. DO NOT STAGE LM
			DESCENT	F. CONTINUE MISSION	
			LUNAR STAY	G. RETURN TO CSM AND PERFORM TEI ASAP	
			TEC	H. CONTINUE MISSION	
	16-24	FUEL FEEDLINE AND/OR OXIDIZER FEEDLINE TEMP LESS THAN 40° F AND UNABLE TO INCREASE.			MALF PROC SPS 11 LIMITATION FOR CRITICAL BURNS IS 25° F.
			LAUNCH	A. CONTINUE MISSION	
			EO	B. ENTER NEXT BEST PTP RCS DEORBIT	
			TLC	C. NO-GO FOR LOI/DOI	
			LO	D. ENTER NEXT BEST PTP	D. DO DPS TEI.
			UNDOCKED	E. DOCK ASAP	
			DESCENT	F. CONTINUE MISSION	F. DO NOT STAGE LM
			LUNAR STAY	G. RETURN TO CSM ASAP	
			TEC	H. CONTINUE MISSION	

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	16-25	ENGINE FLANGE TEMP GOES HIGHER THAN 480° F DURING AN SPS BURN	LAUNCH	NOT APPLICABLE	
			EO	ENTER NEXT BEST PTP	
				RCS DEORBIT	
			TLC	NO-GO FOR LOI/DOI/PDI	
			LO	ENTER NEXT BEST PTP	
				USE DPS IF AVAILABLE	
		A. DURING NON-CRITICAL BURN	ALL	A. TERMINATE BURN	
				INHIBIT FURTHER NON-CRITICAL BURNS	
		B. DURING CRITICAL BURN	ALL	B. CONTINUE BURN	
				INHIBIT FURTHER NON-CRITICAL BURNS	
	16-26	THRUST CHAMBER PRESSURE LESS THAN 70 PSI CONFIRMED BY OTHER INSTRUMENTATION			MALF PROC SPS 6 CONFIRMING INSTRUMENTATION INCLUDES ONBOARD PC METER, CREW, DEGRADED THRUST, FU AND OX INTERFACE PRESSURES, F/O VALVE POSITIONS, FU AND OX TANK PRESSURES.
			LAUNCH	A. NOT APPLICABLE	
			EO	B. ENTER NEXT BEST PTP	
				RCS DEORBIT	
			TLC	C. NO-GO FOR LOI/DOI/PDI	
			LO	D. ENTER NEXT BEST PTP	D. DO DPS TEI.
			UNDOCKED	E. DOCK	
			ALL OTHERS	F. CONTINUE MISSION	F. DO DPS TEI IF AVAILABLE.
		A. DURING NON-CRITICAL BURN		--TERMINATE BURN	
				INHIBIT FURTHER NON-CRITICAL BURNS	
		B. DURING CRITICAL BURN		--CONTINUE BURN	
				INHIBIT FURTHER NON-CRITICAL BURNS	

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	16-27	RESERVED			
	16-28	ΔP BETWEEN FUEL AND OX TANK PRESSURES GREATER THAN 20 PSI AND UNABLE TO DECREASE			MALF PROC SPS 1C
			LAUNCH	A. CONTINUE MISSION	
			EO	B. ENTER NEXT BEST PTP RCS DEORBIT	
			TLC	C. NO-GO FOR LOI	
			LO	D. ENTER NEXT BEST PTP	D. DO DPS TEI.
			UNDOCKED	E. DOCK ASAP	
			ALL OTHERS	F. CONTINUE MISSION	
		A. DURING NON-CRITICAL BURN		--TERMINATE BURN INHIBIT FURTHER NON-CRITICAL BURNS	
		B. DURING CRITICAL BURN		--CONTINUE BURN INHIBIT FURTHER NON-CRITICAL BURNS	

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	16-29	LEAK OR COMPLETE LOSS OF HELIUM SUPPLY PRESSURE OR BOTH HELIUM VALVES FAIL CLOSED			BLOWDOWN ΔV REMAINING IS A FUNCTION OF ULLAGE VOLUME AT TIME OF FAILURE. MALF PROC SPS 7 AND 8
			LAUNCH	A. CONTINUE MISSION	
			EO	B. NO-GO FOR TLI CONTINUE MISSION IN EO IF SUFFICIENT ULLAGE BLOW-DOWN ΔV CAPABILITY EXISTS	
			TLC	C. NO-GO FOR LOI	
			LO	D. NO-GO FOR UNDOCKING ENTER NEXT BEST PTP IF LM DPS NOT AVAILABLE FOR TEI	D. PLAN DPS TEI
			UNDOCKED	E. DOCK ASAP	
			ALL OTHERS	F. CONTINUE MISSION INHIBIT NON-CRITICAL BURNS	
		RULE NUMBERS 16-30 THROUGH 16-49 ARE RESERVED.			

R | ITEM

INSTRUMENTATION REQUIREMENTS

16-50

MEAS DESCRIPTION	PCM	ONBOARD	TRANSDUCERS	CATEGORY	MSN RULE REFERENCE
OX TK PRESS	SP0003P	METER/C&W	COMMON	1 OF 2 M O/B	16-20,28
OX TK PRESS	SP0033P	METER/C&W	COMMON		16-20,28
OX SM/ENG INTERFACE P	SP0931P	-	-	HD	16-20,29
FU TK PRESS	SP0006P	METER/C&W	COMMON	1 OF 2 M O/B	16-20,28
FU TK PRESS	SP0066P	METER/C&W	COMMON		16-20,28
FU SM/ENG INTERFACE P	SP0930P	-	-	HD	16-20,28
SPS VLV ACT PRESS-PRI	SP0600P	METER	COMMON	M O/B OR PCM	16-21,22
SPS VLV ACT PRESS-SEC	SP0601P	METER	COMMON	M O/B OR PCM	16-21,22
SPS FU FEEDLINE TEMP	SP0048T	METER	COMMON	HD	16-24
SPS OX FEEDLINE TEMP	SP0049T	SYS TEST	COMMON	HD	
ENG CHAMBER PRESS	SP0661P	METER	COMMON	M O/B	16-26
He TK PRESS	SP0001P	METER	SEPARATE	1 OF 2 M	16-29
FU/OX VLV 1 POS	SP0022H	DISPLAY	SEPARATE	1 OF 2 M	16-21,26
FU/OX VLV 2 POS	SP0023H	DISPLAY	SEPARATE	1 OF 2 M	16-21,26
FU/OX VLV 3 POS	SP0024H	DISPLAY	SEPARATE	1 OF 2 M	16-21,26
FU/OX VLV 4 POS	SP0025H	DISPLAY	SEPARATE	1 OF 2 M	16-21,26
OX TK 1 QTY - TOTAL AUX	SP0655Q	DISPLAY	COMMON	HD	16-10,11,13
OX TK 2 QTY	SP0656Q	DISPLAY	COMMON	HD	16-10,11,13
FU TK 1 QTY - TOTAL AUX	SP0657Q	DISPLAY	COMMON	HD	16-10,11,13
FU TK 2 QTY	SP0658Q	DISPLAY	COMMON	HD	16-10,11,13
ENG INJ FLANGE TEMP	SP0062T	-	-	HD	16-25

17 CSM SM–RCS

R	ITEM

GENERAL

17-1 LAUNCH

THE LOSS OF ONE QUAD IS NOT CAUSE FOR ABORT AND THERE ARE NO SINGLE FAILURES NOR ANY REASONABLE REALISTIC COMBINATION OF FAILURES WHICH LEAD ONLY TO LOSS OF MULTIPLE QUADS. THERE ARE, THEREFORE, NO SM-RCS FAILURES WHICH ARE CONSIDERED CAUSE FOR ABORT.

17-2 EARTH ORBIT PHASE

A. LOSS OF ONE QUAD, IN ITSELF, IS NOT NECESSARILY CAUSE FOR EARLY TERMINATION OF THE MISSION. THE GUIDELINE IS THAT AS LONG AS THE SPACECRAFT ATTITUDE CAN BE CONTROLLED AND THE SPS CAN BE BURNED THE MISSION NEED NOT BE TERMINATED EARLY. HOWEVER, LOSS OF ONE QUAD WILL REQUIRE TLI BE INHIBITED AND MAY LEAD TO EARLY MISSION TERMINATION SINCE THE CAPABILITY TO PERFORM SM OR HYBRID DEORBIT WILL BE AFFECTED.

B. LOSS OF TWO OR MORE QUADS IS CAUSE FOR ENTRY INTO THE NEXT BEST PTP.

1. LOSS OF TWO ADJACENT QUADS WILL DESTROY THE CAPABILITY TO PERFORM ULLAGE MANEUVERS AND WILL REQUIRE DELETION OF NON-CRITICAL SPS MANEUVERS. LOSS OF TWO ADJACENT QUADS PRECLUDES SM OR HYBRID DEORBIT.
2. LOSS OF TWO OPPOSITE QUADS WILL DESTROY THE CAPABILITY TO PERFORM PRECISE THREE-AXIS ATTITUDE CONTROL AND PRECLUDES SM OR HYBRID DEORBIT.

17-3 TRANSLUNAR COAST

LOSS OF ONE QUAD IS NOT CAUSE FOR TLC TERMINATION OR LOI INHIBIT. TD&E WILL CONTINUE AS LONG AS THE SM RCS CAN PROVIDE THREE-AXIS ATTITUDE CONTROL AND THREE-AXIS TRANSLATION CONTROL.

17-4 LUNAR ORBIT

LOSS OF ONE QUAD IS NOT, IN ITSELF, CAUSE FOR EARLY TERMINATION OF LUNAR ORBIT OR LUNAR STAY PHASES. UNDOCKING WILL BE NO-GO BECAUSE LOSS OF ONE QUAD PRECLUDES CSM ACTIVE DOCKING. LOSS OF TWO QUADS IS CAUSE FOR TERMINATING LUNAR ORBIT OR LUNAR STAY PHASES, AND IS ALSO CAUSE FOR PERFORMING TEI WITH THE LM DPS OR RETAINING THE LM ASCENT STAGE THROUGH TEI FOR ATTITUDE CONTROL.

17-5 CSM EVA

THE CSM EVA WILL BE NO-GO OR, IF IN PROGRESS, WILL BE TERMINATED FOR THE FOLLOWING FAILURES:

A. DELETED
B. LOSS OF ANY ONE OF THRUSTERS C2 AND D2, C3, C4, C1 AND D1, D3, D4 IF LM RCS CANNOT BE USED FOR ATTITUDE CONTROL.

RULE NUMBERS 17-6 THROUGH 17-14 ARE RESERVED

R	ITEM	

SYSTEMS MANAGEMENT

17-15 PROPELLANT GAGING

A. PRIME METHOD: RTCC EQUATION (5 PERCENT)
B. BACKUP METHOD: HELIUM PRESSURE/TEMPERATURE (11 PERCENT) (ONBOARD)

17-16 QUAD PROPELLANT BALANCE

PROP ISOLATION VALVES WILL NOT BE USED FOR QUAD PROPELLANT BALANCE. PROPELLANT BALANCE WILL BE ACCOMPLISHED BY SELECTING TWO-JET +X AND -X TRANSLATIONS WITH EITHER THE PITCH OR YAW QUAD AND BY CHOOSING SUITABLE JETS FOR ATTITUDE CONTROL. PROPELLANT DIFFERENCES BETWEEN QUADS WILL BE MAINTAINED WITHIN ±50 POUNDS.

17-17 SECONDARY PROPELLANT FUEL PRESSURE VALVE

THE RCS SECONDARY FUEL PRESSURIZATION VALVE WILL BE OPENED WHEN THE FUEL MANIFOLD PRESSURE REACHES 150 PSIA OR RTCC SHOWS 115 LBS WILL BE EXCEEDED DURING A TRANSLATION MANEUVER.

RULE NUMBERS 17-18 THROUGH 17-19 ARE RESERVED.

RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
			SPECIFIC MISSION RULES	
17-20	SUSTAINED LEAK IN HELIUM TANK			MALF PROC RCS 2 QUAD WILL REMAIN USABLE UNTIL He MANIFOLD PRESSURE REACHES 75 PSI.
	A. ONE OR MORE QUADS	LAUNCH	A. CONTINUE MISSION	
	B. ONE QUAD (ALL OTHER QUADS NORMAL)	EO	B.1. NO-GO FOR TLI	
		ALL OTHERS	2. CONTINUE MISSION	
	C. MORE THAN ONE QUAD	EO	C.1. CONTINUE MISSION ENTER PRIOR TO LOSS OF HYBRID DEORBIT CAPABILITY	
		TLC	2.(A) NO-GO FOR LOI (B) CONTINUE MISSION IF SUFFICIENT BLOWDOWN CAPABILITY EXISTS	
		DESCENT	3. CONTINUE MISSION	
		ALL OTHERS	4. TERMINATE PHASE AND ENTER NEXT BEST PTP	C.4.(A) IN LUNAR ORBIT, DO DPS TEI. (B) RETAIN LM ASCENT STAGE THROUGH TEI DEPENDING UPON LM RCS PROPELLANT REMAINING.
17-21	SUSTAINED LEAK BELOW He ISOLATION VALVE (COULD BE HELIUM OR FUEL OR OXIDIZER)			MALF PROC RCS 1C QUAD WILL REMAIN USABLE UNTIL He MANIFOLD PRESSURE REACHES 75 PSI.
	A. ONE OR MORE QUADS	LAUNCH	A. CONTINUE MISSION	
	B. ONE QUAD (ALL OTHER QUADS NORMAL)	EO	B.1. NO-GO FOR TLI	
		TLC	2.(A) CONTINUE MISSION	
		LO	3. NO-GO FOR DOI OR UNDOCKING	B.3. RETAIN LM ASCENT STAGE FOR TEI DEPENDING ON LM APS/RCS PROPELLANT REMAINING.
		UNDOCKED	4. DOCK ASAP	
		DESCENT	5. CONTINUE MISSION	
		LUNAR STAY	6. CONTINUE MISSION	
		CSM EVA	7. CONTINUE MISSION	B.7. CONSIDERATION WILL BE GIVEN TO CONTINUING THE MISSION BASED ON AMOUNT OF CONTAMINANTS
	C. MORE THAN ONE QUAD	DESCENT	C.1. CONTINUE MISSION	
		ALL OTHER	2. TERMINATE PHASE AND ENTER NEXT BEST PTP	C.2. IN LUNAR ORBIT DO DPS TEI.

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	17-22	PACKAGE TEMP LESS THAN 55° F AND UNABLE TO INCREASE	LAUNCH	NOT APPLICABLE	MALF PROC RCS 1A
		A. ONE QUAD (ALL OTHER QUADS NORMAL)	ALL	A. CONTINUE MISSION	
		B. MORE THAN ONE QUAD	TLC	B.1. CONTINUE MISSION NO-GO LOI	
			DESCENT	2. CONTINUE MISSION	
			ALL OTHER	3. TERMINATE PHASE AND ENTER NEXT BEST PTP	B.3.(A) IN LUNAR ORBIT DO DPS TEI. (B) RETAIN LM ASCENT STAGE FOR TEI DEPENDING UPON LM APS/RCS PROPELLANT.
	17-23	LOSS OF INDIVIDUAL THRUSTERS OR THRUSTER COMBINATIONS AS A RESULT OF CLOGGING, FREEZING, BURNOUT, OR CONTROL SYSTEM MALFUNCTION	LAUNCH	NOT APPLICABLE	CONTROL SYSTEM MALFUNCTION WILL CAUSE LOSS OF AUTO COILS OF THRUSTER ALTHOUGH DIRECT COILS ARE STILL AVAILABLE.
		A. LOSS OF ANY ROLL THRUSTER	ALL	A. CONTINUE MISSION	
		B. LOSS OF FOLLOWING THRUSTER COMBINATIONS: TWO PITCH OR TWO YAW	EO	B.1. CONTINUE ALTERNATE EO MISSION IF BOTH SPS AND SM RCS DEORBIT CAPABILITY AND ALL AXIS ATTITUDE CONTROL AVAILABLE	
		ONE PITCH AND ONE YAW		2. NO-GO FOR LOI	
		PITCH AND TWO ROLL IN SAME DIRECTION	TLC	PLAN TEI FOR NEXT OPPORTUNITY	
		ONE YAW AND TWO ROLL IN SAME DIRECTION	TLC/ UNDOCKED	3. DOCK ASAP	
		THREE ROLL IN SAME DIRECTION	DESCENT	4. CONTINUE MISSION	B.4. RETAIN LM ASCENT STAGE FOR TEI IF LOSS OF ALL THRUSTERS IN ONE DIRECTION IN SAME AXIS.
			LUNAR STAY	5. ENTER NEXT BEST PTP	
		C. LOSS OF +X THRUSTERS ON ADJACENT QUADS	EO	C.1. ENTER NEXT BEST PTP	C. REF SPS RULE 16-27, LACK OF ULLAGE CAPABILITY
			ALL	2. INHIBIT NON-CRITICAL SPS BURNS	
		D. LOSS OF ANY ONE OF C2 AND D2, C3, C4, C1 AND D1, D3, D4	CSM EVA	D. NO-GO/TERMINATE	D. USE LM RCS FOR ATTITUDE CONTROL IF AVAILABLE.
		RULE 17-24 THROUGH 17-49 ARE RESERVED.			

R | ITEM

INSTRUMENTATION REQUIREMENTS

17-50 MEAS DESCRIPTION	PCM	ONBOARD	TRANSDUCERS	CATEGORY	MSN RULE REFERENCE
SM He TK A PRESS	SR5001P	METER	COMMON	1 M	17-20,21
QTY SM-RCS PROP SYS A	SR5025Q	METER	COMMON	O/B OR PCM	17-20,21
SM He TK B PRESS	SR5002P	METER	COMMON		17-20,21
QTY SM-RCS PROP SYS B	SR5026Q	METER	COMMON	1 M O/B OR PCM	17-20,21
SM He TK C PRESS	SR5003P	METER	COMMON		17-20,21
QTY SM-RCS PROP SYS C	SR5027Q	METER	COMMON	1 M O/B OR PCM	17-20,21
SM He TK D PRESS	SR5004P	METER	COMMON		17-20,21
QTY SM-RCS PROP SYS D	SR5028Q	METER	COMMON	1 M O/B OR PCM	17-20,21
SM ENG PKG A TEMP	SR5065T	METER/C&W	COMMON	HD	17-22
SM ENG PKG B TEMP	SR5066T	METER/C&W	COMMON	HD	17-22
SM ENG PKG C TEMP	SR5067T	METER/C&W	COMMON	HD	17-22
SM ENG PKG D TEMP	SR5068T	METER/C&W	COMMON	HD	17-22
SM He TK A TEMP	SR5013T	METER	COMMON	HD	17-20,21
SM He TK B TEMP	SR5014T	METER	COMMON	HD	17-20,21
SM He TK C TEMP	SR5015T	METER	COMMON	HD	17-20,21
SM He TK D TEMP	SR5016T	METER	COMMON	HD	17-20,21
SM He MAN A PRESS	SR5729P	---	--	HD	17-20,21
SM He MAN B PRESS	SR5776P	---	--	HD	17-20,21
SM He MAN C PRESS	SR5817P	---	--	HD	17-20,21
SM He MAN D PRESS	SR5830P	---	--	HD	17-20,21
SM FU MAN A PRESS	SR5737P	METER/C&W	COMMON	HD	17-12,21
SM FU MAN B PRESS	SR5784P	METER/C&W	COMMON	HD	17-12,21
SM FU MAN C PRESS	SR5822P	METER/C&W	COMMON	HD	17-12,21
SM FU MAN D PRESS	SR5823P	METER/C&W	COMMON	HD	17-12,21
SM OX MAN A PRESS	SR5733P	---	--	HD	17-21
SM OX MAN B PRESS	SR5780P	---	--	HD	17-21
SM OX MAN C PRESS	SR5820P	---	--	HD	17-21
SM OX MAN D PRESS	SR5821P	---	--	HD	17-21

R	ITEM	

GENERAL

18-1 LAUNCH

A. A SUSTAINED LEAK IN OR THE LOSS OF HELIUM SUPPLY PRESSURE OR HELIUM MANIFOLD PRESSURE IN ONE CM RCS RING IS NOT CAUSE FOR ABORT SINCE THE REMAINING RING IS CAPABLE OF ABORT OR ENTRY ATTITUDE CONTROL. THIS FAILURE WILL REQUIRE ENTRY INTO NEXT REST PTP SINCE SYSTEMS ARE NO LONGER REDUNDANT.

B. A SUSTAINED LEAK IN OR THE LOSS OF HELIUM MANIFOLD PRESSURE IN BOTH CM RCS RINGS PRIOR TO TOWER JETTISON IS JUSTIFICATION FOR A MODE I ABORT. THE HELIUM SUPPLY PRESSURE IS NOT REQUIRED FOR MODE I IF THE SYSTEM CAN BE PRESSURIZED TO NOMINAL PRESSURES, WHICH WOULD PROVIDE SUFFICIENT BLOWDOWN IN EACH RING. AFTER TOWER JETTISON, IT IS NOT CAUSE FOR ABORT SINCE THE ABILITY TO PERFORM A SAFE ENTRY INTO THE ATLANTIC AT THE END OF THE FIRST REV STILL EXISTS BY USING THE CONTINGENCY SM RCS SPINUP PRIOR TO CM/SM SEP. THIS METHOD OF ENTRY IS CONSIDERED OPERATIONALLY PREFERABLE TO PERFORMING AN ABORT AND PRESENTS LESS POTENTIAL HAZARD TO CREW RECOVERY. FURTHERMORE, CM RCS CONTROL IS REQUIRED FOR ABORTS IN THE MODE II AND MODE III REGIONS, AND TO ABORT THE LAUNCH IN THESE REGIONS FOR LOSS OF CM RCS CAPABILITY WOULD PUT THE SPACECRAFT AND CREW INTO AN UNSAFE ENVIRONMENT.

18-2 LUNAR ORBIT, LUNAR STAY PHASES

A. LUNAR ORBIT ACTIVITIES WILL BE TERMINATED FOR LOSS OR IMPENDING LOSS OF ONE CM RCS SYSTEM.
B. THESE PHASES WILL BE CONTINUED IF THE CM RCS IS ARMED.
C. LOSS OF ONE SYSTEM IS CAUSE FOR ENTRY INTO THE NEXT BEST PTP.

18-3 LM DESCENT PHASE

THERE ARE NO CM RCS FAILURES THAT ARE CAUSE FOR TERMINATING THE DESCENT PHASE.

18-4 ALL OTHER PHASES

A. SUSTAINED LEAK IN OR LOSS OF HELIUM MANIFOLD PRESSURE (COULD BE EITHER FUEL OR OXIDIZER) IN ONE CM RCS RING DELETES THE REDUNDANCY OF THE ENTRY ATTITUDE CONTROL SYSTEM AND REDUCES THE ΔV AVAILABLE FOR HYBRID DEORBIT. LOSS OF HELIUM SUPPLY PRESSURE OR HELIUM MANIFOLD PRESSURE IN BOTH CM RCS RINGS DELETES ALL ENTRY ATTITUDE CONTROL CAPABILITY REQUIRING CONTINGENCY SM RCS SPINUP PRIOR TO CM/SM SEP. THE LOSS OF ONE OR BOTH CM RCS RINGS IS CAUSE FOR TERMINATING THE PHASE AND MISSION BY ENTRY INTO THE NEXT BEST PTP.

B. DELETED

C. DELETED

R	ITEM	
	18-5	ALL PHASES SUSTAINED DECREASE IN (OR LOSS OF) HELIUM TANK PRESSURES IN EITHER RING REQUIRES THAT THE CM RCS BE PRESSURIZED ASAP. 1250 PSI HELIUM TANK PRESSURE IS REQUIRED TO PROVIDE A FULLY PRESSURIZED SYSTEM.

RULE NUMBERS 18-6 THROUGH 18-9 ARE RESERVED.

R	ITEM	
		SYSTEMS MANAGEMENT
	18-10	THRUSTER TEMP CONTROL CM RCS THRUSTERS MAY BE HEATED PRIOR TO ENTRY FOR 20 MINUTES OR UNTIL THE LOWEST INDICATED TEMPERATURE IS 28° F, WHICHEVER COMES FIRST. IF THRUSTER(S) HEATER FUNCTION FAILS, CM RCS IS STILL CONSIDERED OPERATIONAL PENDING RESULTS OF CM RCS CHECKOUT PRIOR TO ENTRY. MALF PROC RCS 5.
	18-11	HELIUM INTERCONNECT AS A LAST RESORT, IF THE HELIUM IN ONE RING IS DEPLETED DUE TO A LEAK AND THE PROPELLANT IS DEPLETED IN THE OTHER RING, THE SYSTEMS MAY BE INTERCONNECTED IF THE REMAINING PROPELLANT IS REQUIRED FOR CONTROL. ONCE INTERCONNECTED, THE RINGS CANNOT BE ISOLATED. MALF PROC RCS 4.
		RULE NUMBERS 18-12 THROUGH 18-19 ARE RESERVED.

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
				SPECIFIC MISSION RULES	
	18-20	SUSTAINED LEAK IN OR COMPLETE LOSS OF HELIUM SUPPLY PRESSURE			
		ONE OR BOTH RINGS	ALL	CONTINUE MISSION IN SUFFICIENT BLOWDOWN IS AVAILABLE IN EACH RING FOR ENTRY	
	18-21	SUSTAINED LEAK IN OR COMPLETE LOSS OF HELIUM MANIFOLD PRESSURE (COULD BE EITHER FUEL OR OXIDIZER)			
		A. ONE RING	LAUNCH	A.1. CONTINUE MISSION AND ENTER NEXT BEST PTP	
			DESCENT	2. CONTINUE MISSION	
			EVA	3. CONTINUE MISSION	A.3. CONSIDERATION WILL BE GIVEN TO CONTINUING BASED ON AMOUNT OF CONTAMINANTS.
			ALL OTHERS	4. TERMINATE PHASE AND ENTER NEXT BEST PTP	
		B. BOTH RINGS	LAUNCH	B.1. CONTINUE MISSION AND ENTER NEXT BEST PTP UNLESS PRIOR TO TOWER JETTISON. IF PRIOR TO TOWER JETTISON, ABORT.	
			DESCENT	2. CONTINUE MISSION	
			EVA	3. CONTINUE MISSION	B.3. CONSIDERATION WILL BE GIVEN TO CONTINUING BASED ON AMOUNT OF CONTAMINANTS.
			ALL OTHER	4. TERMINATE PHASE AND ENTER NEXT BEST PTP	B.4. CM SPIN-UP REQUIRED PRIOR TO ENTRY.

MISSION RULES

SECTION 18 - CSM CM-RCS - CONTINUED

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	18-22	CM RCS IS ARMED FOR ANY REASON	ALL	CONTINUE MISSION	
		RULE NUMBERS 18-23 THROUGH 18-49 ARE RESERVED.			

R	ITEM
	18-50

INSTRUMENTATION REQUIREMENTS

MEAS DESCRIPTION	PCM	ONBOARD	TRANSDUCERS	CATEGORY	MSN RULE REFERENCE
CM He TK A PRESS	CR0001P	METER	COMMON	M O/B OR PCM	18-20
CM He TK B PRESS	CR0002P	METER	COMMON	M O/B OR PCM	18-20
CM TK A TEMP	CR0003P	METER	COMMON	HD	18-20
CM TK B TEMP	CR0004P	METER	COMMON	HD	18-20
CM He MNFLD A PRESS	CR0035P	C&W METER	SEPARATE	1 OF 2 M	18-21
CM He MNFLD B PRESS	CR0036P	C&W METER	SEPARATE	1 OF 2 M	18-21

THIS SECTION HAS BEEN DELETED. REFERENCE EVA MISSION RULES IN SECTION 3 OF THIS DOCUMENT.

THIS SECTION HAS BEEN DELETED. REFERENCE EVA MISSION RULES IN SECTION 3 OF THIS DOCUMENT.

R	ITEM

GENERAL

20-1 A. BASELINE REQUIREMENTS (ALL PHASES EXCEPT LAUNCH)

1. TWO-WAY VOICE COMM BETWEEN SPACECRAFT
2. TWO-WAY VOICE COMM BETWEEN CSM OR LM AND MSFN DURING ALL DOCKED ACTIVITIES AND BETWEEN CSM, LM/LCRU AND MSFN DURING UNDOCKED ACTIVITIES

B. LAUNCH

THERE ARE NO COMMUNICATIONS FAILURES FOR WHICH THE LAUNCH/INSERTION PHASE WILL BE TERMINATED.

C. LUNAR STAY ADDITIONAL REQUIREMENTS

1. FOR TWO-MAN EVA: VOICE COMM BETWEEN MSFN AND ONE EVA CREWMAN
2. FOR ONE-MAN EVA: VOICE COMM BETWEEN MSFN AND LM/LCRU AND EVA CREWMAN

NOTE

MSFN-TO-EVA-ONLY VOICE IS ACCEPTABLE IF TV IS AVAILABLE TO MONITOR CREW.

D. THE LM WILL BE RETAINED FOR TEC COMM IN EVENT OF LOSS OF ALL COMM BETWEEN THE CSM AND THE GROUND.

E. FAILURE OF VOICE OR TM TO THE MSFN, OR FAILURE OF TWO-WAY VOICE COMMUNICATIONS TO THE CMP, OR BOTH, WILL NOT PRECLUDE THE NOMINAL CMP EVA.

20-2 VHF EVA COMMUNICATIONS PRIORITIES ARE:

A. TWO-MAN EVA

1. PRIME: EVA-1 AR/EVA-2 AR (RELAY MODE ALLOWS DUPLEX VOICE BETWEEN EVA'S PLUS THE TRANSMISSION OF VOICE AND DATA FROM BOTH EVA'S TO LM/LCRU PLUS THE RECEPTION OF VOICE VIA LM/LCRU BY BOTH EVA'S

2. BACKUP: EVA-1 AR/EVA-2B OR EVA-1A/EVA-2B OR EVA-1B/EVA-2A (EITHER MODE COMBINATION ALLOWS DUPLEX VOICE BETWEEN EVA'S PLUS THE TRANSMISSION OF VOICE FROM BOTH THE EVA'S TO THE LM/LCRU PLUS THE TRANSMISSION OF DATA FROM ONE EVA TO THE LM/LCRU AND THE RECEIVING OF LM/LCRU VOICE BY ONE EVA)

B. ONE-MAN EVA

1. PRIME: EVA-1A OR EVA-2A (ALLOWS DUPLEX VOICE BETWEEN EVA AND THE LM/LCRU PLUS THE TRANSMISSION OF DATA FROM EVA TO LM/LCRU)

2. BACKUP: EVA-1B OR EVA-2B (ALLOWS DUPLEX VOICE BETWEEN EVA AND LM)

NOTE

NO VOICE CAPABILITY VIA LCRU IN THIS MODE.

RULES 20-3 THROUGH 20-6 ARE RESERVED.

R	ITEM	

MANAGEMENT

20-7 VOICE CONFIGURATION

A. LM/CSM/MSFN

1. VHF DUPLEX B AND USB WILL BE TRANSMITTED/RECEIVED SIMULTANEOUSLY FOR LAUNCH THROUGH CY1, REV 1. VHF SIMPLEX A AND USB WILL BE TRANSMITTED/RECEIVED SIMULTANEOUSLY FOR EARTH ORBIT AFTER CY1, REV 1 LOS.

2. VHF A SIMPLEX 296.8 MHZ IS PRIME VOICE COMM BETWEEN VEHICLES EXCEPT DURING RANGING WHEN DUPLEX B (CSM) AND DUPLEX A (LM) WILL BE USED.

3. VHF B SIMPLEX 259.7 MHZ IS BACKUP TO VHF A SIMPLEX 296.8 MHZ

4. USB IS PRIME VOICE COMM BETWEEN MSFN AND CSM, LM, OR LCRU.

5. USB/VHF RELAY IS VOICE COMM BACKUP TO USB BETWEEN MSFN AND MALFUNCTIONED S/C.

6. NORMAL VOICE COMM WILL USE SIMULTANEOUS MSFN UPLINK TO BOTH VEHICLES. HOWEVER, IF REQUIREMENT SHOULD EXIST, SIMULTANEOUS INDEPENDENT MSFN/CSM, MSFN/LM, AND MSFN/LCRU COMM MODES WILL BE INITIATED.

7. THE PRIME CSM/LM COMMUNICATIONS MODE DURING THE LUNAR ORBIT PHASE IS VHF. THE PRIME VHF MODE IS VHF A SIMPLEX UNLESS THIS MODE IS PRECLUDED BY THE USE OF VHF RANGING. DURING LUNAR STAY PHASE, THE PRIME CSM/LM/LCRU MODE IS MSFN RELAY.

8. THE CSM AND LM WILL TRANSMIT SIMULTANEOUSLY ON VHF AND USB DURING ALL LM POWERED UP PHASES IN LUNAR ORBIT.

9. IN THE EVENT OF A COMPLETE LOSS OF CSM S-BAND COMMUNICATIONS WITH MSFN, THE LM WILL BE CONFIGURED FOR LM TWO-WAY RELAY AND RETAINED FOR TEI AND TEC.

B. LM/EVA/MSFN

LM/LCRU TWO-WAY RELAY WITH TWO-MAN EVA IS THE PRIME MODE PLANNED FOR EVA OPERATION.

20-8 CSM VHF/USB MANAGEMENT

A. FOR CREW REST PERIODS, CSM S-BAND ANTENNAS WILL BE SELECTED BY GROUND COMMANDS.

B. NORMAL CONTROL OF THE S-BAND MODES WILL BE BY GROUND COMMAND. CSM COMMUNICATIONS SWITCH POSITION WILL REFLECT OUT-OF-SITE CONTACT CONFIGURATION.

R	ITEM	
	20-9	LM STEERABLE ANTENNA MANAGEMENT A. LM UPLINK MODES 2 AND 3 AND ALL PRN UPLINKS WILL BE AVOIDED IF POSSIBLE WHEN THE STEERABLE ANTENNA IS OPERATING IN THE AUTO TRACK MODE. B. THE STEERABLE ANTENNA TEMP SHOULD BE MAINTAINED BETWEEN -65° F AND 150° F. THE STEERABLE ANTENNA MAY BE OPERATED TO 195° F DURING CRITICAL MISSION PHASES.
	20-10	GCTA MANAGEMENT A. THE COLOR TV CAMERA WILL NOT BE POINTED SUCH THAT THE SUN WILL BE IN THE FIELD OF VIEW. THE CAMERA MAY BE POINTED NEAR THE SUN. HOWEVER, IF OBJECTIONABLE FLARE OCCURS, THE GROUND WILL REQUEST THE CAMERA TO BE MOVED OR WILL MOVE THE CAMERA VIA GROUND COMMANDS. B. THE GROUND WILL MONITOR THE TV PICTURE AND RECOMMEND CAMERA MOVEMENT (OR MOVE THE CAMERA VIA COMMANDS) TO PREVENT IRREVERSIBLE VIDICON TUBE BURNS FROM REFLECTIVE OBJECTS. C. BETWEEN EVA'S THE TV CAMERA WILL BE LOCATED IN THE SUN AND OFF TO MAINTAIN THERMAL BALANCE. D. RESERVED E. WHEN A BRIGHT OBJECT, WITH A CONTRASTING DARK BACKGROUND IS IN THE FIELD OF VIEW, THE GROUND WILL RECOMMEND OR COMMAND AN ALC SWITCH SETTING TO GET THE BEST PICTURE. THE ALC-PEAK WILL GIVE THE BEST PICTURE OF THE BRIGHT OBJECT, AND THE ALC-AVERAGE WILL GIVE THE BEST PICTURE OF THE DARK BACKGROUND. F. THE GROUND WILL NEVER INITIATE GCTA COMMANDS THAT WOULD CAUSE MORE THAN TWO DRIVE MOTORS TO OPERATE SIMULTANEOUSLY. G. THE GCTA WILL BE POSITIONED VIA GROUND COMMAND AS NECESSARY TO PROVIDE THERMAL MANAGEMENT. H. THE TV CAMERA AND THE TV CONTROL UNIT WILL BE DUSTED AT EACH STOP.
	20-11	LCRU MANAGEMENT A. THE THERMAL BLANKETS ON THE LCRU WILL BE POSITIONED AS REQUIRED TO MAINTAIN THERMAL MANAGEMENT. B. NOMINAL MODE OF OPERATION FOR MOVING IS PM1/WB1. NOMINAL MODE OF OPERATION FOR FIXED BASE IS FM/TV. BACKUP MODE OF OPERATION FOR MOVING IS PM1/NB. THE CONTINGENCY MODE FOR MOVING IS PM2/NB. THE TV REMOTE MODE WILL BE UTILIZED TO OBTAIN THE CLEAREST TV PICTURE (THIS MODE ALLOWS THE GROUND TO COMMAND OFF THE VOICE DOWNLINK AND WILL BE USED FOR LM ASCENT TV COVERAGE). C. THE THERMAL BLANKETS ON THE LCRU SHOULD BE OPENED 100 PERCENT FOR EITHER HANDCARRY MODE. THE CREW SHOULD RETAIN THE THERMAL BLANKET FOR POSSIBLE FUTURE USE. D. THE LCRU BATTERY WILL BE CHANGED WHEN THE VOLTAGE IS 27.5 V IF STOPPED OR, IF MOVING, AT THE NEXT STOP. E. THE LCRU WILL BE DUSTED AT EACH STOP.

R	ITEM
	20-12

SDS MANAGEMENT

A. THE CSM PCM WILL BE OPERATED IN HBR DURING ALL SCIENTIFIC OPERATIONS, EXCEPT FOR PORTIONS OF LUNAR SOUNDER OPERATIONS.

B. THE CONTROL OF THE DSE WILL BE VIA GROUND COMMAND WHENEVER POSSIBLE. HOWEVER, THE CREW MAY BE REQUESTED TO OPERATE THE DSE AT CERTAIN TIMES DURING AWAKE PERIODS TO ASSIST IN OBTAINING THE MAXIMUM AMOUNT OF SCIENTIFIC DATA.

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
				SPECIFIC	
	20-13	LOSS OF TWO-WAY VHF VOICE COMM BETWEEN CSM AND LM	DOCKED	CONTINUE MISSION	REF LM MAL PROC COMM 3 - LOSS OF VHF VOICE COMM WITH CSM
				NO-GO FOR SEP MNVR	
			UNDOCKED	DOCK ASAP	REF CSM MAL PROCEDURE COMM 5 - LOSS OF VHF COMM WITH LM
				NO-GO FOR CSM CIRC AND DOI_2	NOTE: MSFN RELAY MAY BE UTILIZED.
			PRE-PDI	CONTINUE MISSION	
			POWERED DESCENT	CONTINUE MISSION	
			LUNAR STAY	CONTINUE MISSION	
	20-14	LOSS OF TWO-WAY VOICE COMM WITH MSFN			REF CSM MAL PROCEDURES 7 AND 8 - LOSS OF CSM VOICE COMM
		A. CSM ONLY	LAUNCH	A.1. CONTINUE MISSION	
			EARTH ORBIT	2. ENTER NEXT BLOCK DATA POINT	
			TLC	3. CONTINUE MISSION	A.3 ENTER LM EARLY TO USE LM S-BAND FOR VOICE COMM WITH MSFN. LM COMM WILL BE USED FOR VOICE, AND CSM TM USED FOR SIM BAY SCIENCE OPERATIONS.
			DDI	4. CONTINUE MISSION	
				NO-GO FOR SEP MANEUVER	
			UNDOCKED/ POWERED DESCENT	5. CONTINUE MISSION	
			LUNAR STAY	6. CONTINUE MISSION	A.6 UTILIZE VHF OF VHF RELAY FROM LM. IF UNABLE, TERMINATE LUNAR STAY AND PERFORM A DOCKED TEI.
					NOTE: RETAIN LM FOR COMM DURING TEC.
		B. LM ONLY	DOCKED	B.1. CONTINUE MISSION	REF LM MAL PROC COMM 4 - LOSS OF S-BAND VOICE COMM
				NO-GO FOR SEP MANEUVER	
			UNDOCKED PRE-PDI	2. RETURN TO VICINITY OF CSM	
				NO-GO FOR PDI	
			POWERED DESCENT	3. PDI TO TOUCHDOWN - CONTINUE MISSION	
			LUNAR STAY	4. LM LIFTOFF NEXT ASCENT OPPORTUNITY	B.4 COMM VIA LCRU IS ACCEPTABLE.

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	20-15	LOSS OF TWO CSM AUDIO CENTERS	EPO	CONTINUE MISSION	
				NO-GO FOR TLI	
			TLC	CONTINUE MISSION	
			DOCKED	CONTINUE MISSION	
				NO-GO FOR DOI OR UNDOCKING	
			UNDOCKED	NO-GO FOR CIRC	
			PRE-PDI/ DESCENT/ LUNAR STAY	CONTINUE MISSION	
			POST DOCK	RETAIN ASCENT STAGE	
	20-16	FAILURE OF LM VHF RELAY. NO TWO-WAY VOICE WITH EITHER CREWMAN.	LUNAR STAY	CONTINUE MISSION PROCEED WITH EVA AND ACTIVATE THE LCRU ASAP	
	20-17	LOSS OF VOICE FROM EVA-2 TO EVA-1	DUAL EVA	CONTINUE MISSION EVA-2 GO TO POSITION "B"	EVA-1 (CDR) HAS EVC-1, EVA-2 (LMP) HAS EVC-2. IF ON LCRU: 1. EVA 2 CANNOT COMMUNICATE WITH MSFN. 2. NO TM FROM EVA-2. 3. EVA 2 MUST PROCEDURALLY TIME-SHARE ALL VOICE TRANSMISSIONS WITH MSFN. 4. MODES WILL BE SWITCHED EVERY 45 MIN TO MONITOR PLSS DATA ON BOTH CREWMEN.
	20-18	LOSS OF VOICE FROM EVA-1 TO EVA-2	DUAL EVA	CONTINUE MISSION A. EVA-2 GO TO POSITION "A" B. EVA-1 GO TO POSITION "B"	IF ON LCRU: B.1. EVA-1 CANNOT COMMUNICATE WITH MSFN AND NO TM. 2. EVA-1 MUST PROCEDURALLY TIME-SHARE ALL VOICE TRANSMISSIONS WITH MSFN. 3. MODES WILL BE SWITCHED EVERY 45 MINUTES TO MONITOR PLSS DATA ON BOTH CREWMEN.

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	20-19	LOSS OF DUPLEX VOICE BETWEEN EVA-1 AND EVA-2	DUAL EVA	CONTINUE EVA A. BOTH CREWMEN WILL GO TO POSITION"A" B. IF STILL NO COMM, SELECT POSITION "B" C. IF STILL NO COMM, CONTINUE EVA IF ONE CREWMAN CAN RECEIVE MSFN VOICE. IF NOT ABLE TO RECEIVE MSFN VOICE, RETURN TO VHF RANGE OF LM.	A.1. SIMPLEX CONFIGURATION WILL REQUIRE PTT OPERATION VICE VOX. 2. DATA WILL ONLY BE TRANSMITTED WHEN THE TRANSMITTER IS KEYED. B. EVCS MODE-B WILL NOT COMMUNICATE WITH LCRU.
	20-20	LOSS OF TWO-WAY VOICE BETWEEN MSFN AND EVA A. LCRU B. LM	DUAL EVA	VOICE UPLINK WITH TV AVAILABLE FOR MSFN MONITORING OF CREW RESPONSES IS ACCEPTABLE A. CONTINUE EVA 1. EVA-2 GO TO POSITION "A" EVA-1 GO TO POSITION "B" 2. IF SUCCESSFUL, CONTINUE EVA. 3. IF UNSUCCESSFUL, RETURN TO VHF RANGE OF LM. B. CONTINUE EVA 1. IF LCRU AVAILABLE, ACTIVATE ASAP AND CONTINUE EVA. 2. IF LCRU NOT AVAILABLE, EVA 2 RETURN TO LM AND RECONFIGURE COMM. THEN CONTINUE EVA WITHIN VHF RANGE OF LM.	A.1. EVCS MODE-B WILL NOT COMMUNICATE WITH LCRU.
	20-21	LOSS OF TWO-WAY VOICE BETWEEN MSFN AND EVA A. LCRU B. LM	ALT EVA (ONE-MAN)	VOICE UPLINK WITH TV AVAILABLE FOR MSFN MONITORING OF CREW RESPONSES IS ACCEPTABLE A.1. ATTEMPT TO RECONFIGURE EVCS. 2. IF SUCCESSFUL, CONTINUE EVA. 3. IF NOT SUCCESSFUL, RETURN TO VHF RANGE OF LM AND CONTINUE EVA. B.1. IF LCRU AVAILABLE, ACTIVATE ASAP AND CONTINUE EVA 2. IF LCRU NOT AVAILABLE, RETURN TO LM AND RECONFIGURE COMM. THEN CONTINUE EVA WITHIN VHF RANGE OF LM	

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	20-22	LOSS OF LCRU	EVA	CONTINUE EVA RETURN TO WITHIN VHF RANGE OF LM	
	20-23	LOSS OF LCRU HGA	EVA	CONTINUE EVA USE LGA	BY SWITCHING ANTENNA CONNECTIONS ON LCRU, TV AVAILABLE TO 210 FT SITE.
	20-24	LOSS OF LCRU LGA	EVA	CONTINUE EVA IF LOST DURING MOVING MODE, CONTINUE TO NEXT STOP AND REGAIN COMM VIA HGA.	HGA CANNOT BE USED FOR MOVING COMM.
	20-25	LOSS OF LCRU BATTERY	EVA	CONTINUE EVA A. PRIOR TO TRAVERSE-INSTALL BATTERY ASSIGNED TO NEXT EVA. B. DURING TRAVERSE-SWITCH TO LRV POWER UNTIL NEXT STOP, THEN INSTALL BATTERY FROM PREVIOUS EVA.	A. THE LAST EVA TRAVERSE WILL BE PLANNED BASED ON LRV POWER AVAILABLE. B. LCRU BATTERY FROM PREVIOUS EVA WILL BE CARRIED ON THE LRV.
	20-26	LOSS OF LCRU MOVING COMM MODE	EVA	CONTINUE EVA WHEN NEXT STOP IS REACHED, SWITCH ANTENNA CONNECTIONS AND USE FM/TV OR TV REMOTE MODE.	MOVING MODES: PRI - PM1/WB B/U - PM1/NB CONT - PM2/NB
	20-27	LOSS OF PM1 TRANSMITTER OR RECEIVER	EVA	CONTINUE EVA A. MOVING COMM-SWITCH LGA TO HGA CONNECTION PORT. B. STOPPED COMM- 1. 210 FT SITE AVAILABLE, RETAIN SWITCHED CONFIGURATION 2. 210 FT SITE NOT AVAILABLE, RETURN TO NORMAL CONFIGURATION.	B.1. TV AVAILABLE TO 210 FT SITE ON LGA B.2. TV AVAILABLE VIA HGA
	20-28	LOSS OF TRANSMITTER 2	EVA	CONTINUE EVA SWITCH TO PM1 TRANSMITTER TO REGAIN VOICE AND TM	TV AND COMMAND CAPABILITY IS LOST.

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	20-29	LOSS OF RECEIVER 2	EVA	CONTINUE EVA LOSS OF COMMAND AND UP VOICE A. DURING GEOLOGICAL STOP, REMAIN IN FM/TV OR TV REMOTE B. DURING WALKING PART OF THE STOP, SELECT PM1/WB	A. CREW CAN MANUALLY POSITION CAMERA. B. TV AND COMMAND CAPABILITY IS LOST
	20-30	LOSS OF LCRU VHF RECEIVER	EVA	CONTINUE EVA UTILIZE TV VISUAL RESPONSES OF CREW AS CUE TO RECEIPT OF MCC UPLINKS.	
	20-31	LOSS OF LCRU VHF TRANSMISSION	EVA	CONTINUE EVA RETURN TO VHF RANGE OF LM	
	20-32	LOSS OF LCRU TV (GCTA)	EVA	CONTINUE EVA A. BYPASS TCU BY RECABLING. LOSS OF COMMAND CONTROL WILL RESULT B. IF STILL NO TV, SELECT PM1/WB AND CONTINUE WITHOUT TV.	A. CREW CAN MANUALLY CONTROL CAMERA
	20-33	LOSS OF COMMAND TO LCRU TV (GCTA)	EVA	CONTINUE EVA CREW MANUALLY CONTROL TV.	
	20-34	LOSS OF LCRU/GCTA TM	LUNAR STAY	CONTINUE MISSION	*ONBOARD CREW READOUTS WILL BE REQUIRED.*
	20-35	LCRU TEMP MORE THAN 120 DEG F	LUNAR STAY	CONTINUE MISSION BEGIN DUTY CYCLE OPERATIONS	DUTY CYCLE: 5 MIN ON AND 10 MIN OFF
	20-36	GCTA TEMP MORE THAN 122 DEG F	LUNAR STAY	CONTINUE MISSION REPOSITION CAMERA	MANUAL OR BY GROUND COMMAND
		RULE NUMBERS 20-37 THROUGH 20-40 ARE RESERVED.			

R	ITEM	

CSM - GENERAL

20-41 A. BASELINE REQUIREMENT (ALL PHASES EXCEPT LAUNCH)

CRITICAL INSTRUMENTATION - CRITICAL INSTRUMENTATION IS THAT INSTRUMENTATION REQUIRED TO VERIFY MISSION GO/NO-GO CRITERIA.

B. LAUNCH

THERE ARE NO CSM INSTRUMENTATION FAILURES FOR WHICH THE LAUNCH/INSERTION PHASE WILL BE TERMINATED.

C. POWERED DESCENT ADDITIONAL REQUIREMENTS

THERE ARE NO CSM INSTRUMENTATION SYSTEMS FAILURES FOR WHICH LM POWERED DESCENT WILL BE TERMINATED.

20-42 THE MISSION WILL BE CONTINUED WITH THE LOSS OF THE:

A. CSM UPDATA LINK
B. CSM CAUTION AND WARNING SYSTEM
C. CSM DSE
D. CSM HIGH GAIN ANTENNA
E. CSM FM DOWNLINK
F. CSM USB RANGING (PRN)
G. VHF RANGING
H. SDS

RULES 20-43 THROUGH 20-45 ARE RESERVED

R	ITEM	
		CSM - MANAGEMENT
	20-46	DSE MANAGEMENT

A. LM AND CSM LOW-BIT-RATE TELEMETRY WILL BE RECORDED CONTINUOUSLY WHEN NOT IN CONTACT WITH GROUND TELEMETRY SITES EXCEPT DURING PERIODS OF ORBITAL SCIENCE OPERATIONS WHEN CSM HBR WILL BE RECORDED WITH THE EXPERIMENT DATA AND DURING PERIODS OF VHF RANGING WHEN NO LM TM WILL BE RECORDED. LM AND CSM LOW-BIT-RATE TELEMETRY WILL BE NORMALLY PLAYED BACK AT LEAST ONCE PER REVOLUTION IN LUNAR ORBIT.

B. CM HIGH-BIT-RATE DSE RECORDINGS WILL BE MADE DURING THE FOLLOWING OPERATIONS:

1. LAUNCH
2. TLI
3. S-IVB/CSM SEPARATION
4. TD&E
5. ALL SPS MANEUVERS AND MIDCOURSE CORRECTIONS
6. DOCKING AND UNDOCKING
7. CM/SM SEPARATION AND ENTRY
8. DTO REQUIREMENTS
9. LM FINAL SEP
10. ORBITAL SCIENCE OPERATIONS

C. DURING SLEEP PERIODS

USING HIGH GAIN ANTENNAS, DSE RECORDING AND DUMPING WILL BE MANAGED PER "A" ABOVE.

20-47 CTE MANAGEMENT

A. CTE WILL BE CONFIGURED TO CLOCK IN GET FOR FLIGHT. HOWEVER, IF A HOLD OCCURS AFTER T-15 MINUTES, CTE WILL NOT BE CORRECTED UNTIL COMPLETION OF POWERED FLIGHT.

B. CTE WILL BE ALLOWED TO DRIFT ±5 SEC BEFORE BEING UPDATED AFTER ORBIT INSERTION.

RULE NUMBERS 20-48 THROUGH 20-50 ARE RESERVED

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
				CSM - SPECIFIC	
	20-51	LOSS OF CSM TM			REF CSM MAL PROCEDURE COMM 10 - MSFN REPORTS LOSS OF REAL-TIME PCM. DSE MAY BE UTILIZED FOR TM IF AVAILABLE.
		A. HBR OR LBR	ALL	A. CONTINUE MISSION	
		B. ALL TM	LAUNCH	B.1. CONTINUE MISSION	
			EO	2. ENTER NEXT BEST PTP	
			ALL	3. CONTINUE MISSION	
	20-52	LOSS OF CRITICAL INSTRUMENTATION	LAUNCH	CONTINUE MISSION	
			EO	ENTER NEXT BEST PTP	
				NO-GO FOR TLI	
			TLC	CONTINUE MISSION	
				NO-GO FOR LOI	
			LO	NO-GO FOR LUNAR OPERATIONS	
	20-53	LOSS OF ONE CSM PMP POWER SUPPLY	ALL	CONTINUE MISSION	
	20-54	LOSS OF BOTH CSM POWER AMPLIFIERS	EPO	NO-GO FOR TLI	
			ALL	CONTINUE MISSION IF HIGH GAIN ANT IS AVAILABLE	
			SCIENCE	CONTINUE MISSION BASED ON AMOUNT OF SCIENCE DATA THAT CAN BE OBTAINED	
	20-55	LOSS OF THE SCE	ALL	CONTINUE MISSION	
	20-56	COMPLETE OR PARTIAL LOSS OF SCIENTIFIC TM	ALL	CONTINUE MISSION	
			SCIENCE	CONTINUE MISSION BASED ON AMOUNT OF SCIENCE DATA THAT CAN BE OBTAINED.	

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	20-57	LOSS OF FM TRANSMITTER	ALL	CONTINUE MISSION	
			SCIENCE	CONTINUE MISSION BASED ON AMOUNT OF SCIENTIFIC DATA THAT CAN BE OBTAINED	
	20-58	LOSS OF HGA	ALL	CONTINUE MISSION	
			SCIENCE	CONTINUE MISSION BASED ON AMOUNT OF SCIENTIFIC DATA THAT CAN BE OBTAINED	
	20-59	LOSS OF DSE	ALL	CONTINUE MISSION	
			SCIENCE	CONTINUE MISSION ONLY REAL-TIME DATA WILL BE AVAILABLE	
		RULE NUMBERS 20-60 THROUGH 20-65 ARE RESERVED.			

R	ITEM	

LM - GENERAL

20-66 A. BASELINE REQUIREMENT

CRITICAL INSTRUMENTATION - CRITICAL INSTRUMENTATION IS THAT INSTRUMENTATION, ONBOARD OR TM DURING MSFN AOS, OR ONBOARD ONLY DURING MSFN LOS, REQUIRED TO VERIFY MISSION GO/NO-GO CRITERIA.

B. LUNAR STAY ADDITIONAL REQUIREMENTS

LM LBR OR HBR TM IS REQUIRED. IF LM TM DATA IS LOST DURING AN EVA, THAT EVA WILL BE CONTINUED.

20-67 THE MISSION WILL BE CONTINUED WITH THE LOSS OF THE:

A. LM UPDATA LINK
B. LM CAUTION AND WARNING SYSTEM
C. LM DSEA
D. EVA TELEMETRY
E. LM FM DOWNLINK
F. LM USB RANGING (PRN)
G. VHF RANGING
H. GCTA
I. LCRU

RULE NUMBERS 20-68 THROUGH 20-70 ARE RESERVED.

R	ITEM	
		LM - MANAGEMENT
	20-71	LM USB/TM MANAGEMENT A. FOR NORMAL LM POWERED-UP PHASES, THE LM STEERABLE ANTENNA WITH THE POWER AMPLIFIER WILL BE USED. DURING LUNAR STAY, THE POWER AMPLIFIER WILL BE TURNED OFF. LBR TM, PLSS AND VOICE CIRCUIT MARGINS ARE ADEQUATE. B. DURING PERIODS OF LM OUT-OF-STATION CONTACT (LUNAR FAR SIDE), THE TM BIT RATE WILL BE SWITCHED FROM HBR TO LBR AND TRANSMITTED TO THE CSM OVER VHF B EXCEPT DURING VHF RANGING AND PERIODS OF CRITICAL VOICE COMMUNICATIONS.
	20-72	SYSTEM MONITORING DURING SLEEP PERIODS TBD CREWMEN WILL SLEEP WITH HEADSETS TO MONITOR FOR MASTER ALARMS OR GROUND COMMUNICATIONS.
		RULE NUMBERS 20-73 THROUGH 20-75 ARE RESERVED.

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
				LM - SPECIFIC	
	20-76	LOSS OF LM TM			REF LM MAL PROC COMM 6
		A. LOSS OF LBR ONLY	ALL	A. CONTINUE MISSION	
		B. LOSS OF HBR ONLY	ALL	B. CONTINUE MISSION	MSFN REPORTS LOSS OF PCM. ADEQUATE DATA TO MAKE FINAL GO/NO-GO TO CONTINUE POWERED DESCENT.
		C. LOSS OF ALL TM	DOCKED	C.1. CONTINUE MISSION NO-GO FOR UNDOCKING	
			PRE PDI	2. RETURN TO VICINITY OF CSM	
			POWERED DESCENT	3. CONTINUE MISSION IF ADEQUATE DATA IS AVAILABLE TO MAKE FINAL GO/NO-GO DECISION (TM OR ONBOARD DISPLAY)	
			LUNAR STAY	4. NO-GO FOR NORMAL STAY TIME AND TWO MAN EVA. ONE MAN EVA ACCEPTABLE IF O/B MONITORING IS AVAILABLE.	
			DUAL EVA	5. CONTINUE EVA ATTEMPT TO RE-ESTABLISH TM AFTER EVA.	
	20-77	LOSS OF CRITICAL INSTRUMENTION	DOCKED	DO NOT UNDOCK	
			UNDOCKED	DOCK ASAP	
			LUNAR STAY	LIFT OFF NEXT BEST OPPORTUNITY	
		RULE NUMBERS 20-78 THROUGH 20-80 ARE RESERVED.			

R | ITEM

CSM - INSTRUMENTATION REQUIREMENTS

20-81

MEAS DESCRIPTION	PCM	ONBOARD	TRANSDUCERS	CATEGORY	MISSION RULE REF
UDL VALIDITY SIGNAL	CT0262V	-	-	HD	20-42
USB RECEIVER AGC	CT0620E	METER	COMMON	HD	20-42,20-7A(9), 20-88
USB RECEIVER ERROR	CT0604F	-	-	HD	
DSE TAPE MOTION	CT0012X	TB	-	HD	20-42,20-46
CTE TIME	CT0145F	-	-	HD	20-47
SCE 10 VDC	CT0018V	-	-	HD	
SCE 5 VDC	CT0017V	-	-	HD	
SCE 20 VDC	CT0015V	-	-	HD	
SCE -20 VDC	CT0016V	-	-	HD	
PCM HI REF 85 PERCENT	CT0125V	-	-	HD	
PCM HI REF 15 PERCENT	CT0126V	-	-	HD	
HI GAIN ANT POS-PITCH	ST0152H	-	-	HD	
HI GAIN ANT POS-YAW	ST0153H	-	-	HD	
HGA BEAM WIDTH SW POS - NAR	CT0161X	-	-	HD	
HGA BEAM WIDTH SW POS - MED	CT0162X	-	-	HD	
HGA TRACK SW POS - AUTO	CT0163X	-	-	HD	
HGA TRACK SW POS - REACQ	CT0164X	-	-	HD	
MASTER UNIT TEMP	ST0562T			HD	20-56
SLAVE UNIT TEMP	ST0563T			HD	20-56

LM - INSTRUMENTATION REQUIREMENTS

20-82

MEAS DESCRIPTION	PCM	ONBOARD	TRANSDUCERS	CATEGORY	MISSION RULE REF
PCM OSC FAIL 2	GL0422V	-	-	1 OF 2	
PCM OSC FAIL 3	GL0423V	-	-	HD	
CAL 85 PCT	GL0401V	-	-	HD	
CAL 15 PCT	GL0402V	-	-	HD	
MET	GL0501W	-	-	HD	
C AND W FAIL	GL4054X	CAUTION	-	HD	
MASTER ALARM	GL4069X	MASTER ALARM	-	HD	
DUA STATUS	GT0441X	-	-	HD	20-67
S-BND ST PH ERR	GT0992B	-	-	HD	
S-BND RCVR SIG	GT0994V	METER /CAUTION	-	HD	20-67
STEERABLE ANT TEMP	GT0454	METER /CAUTION	-	HD	20-9B,20-71
XMTR PO	GT0993	-	-	HD	20-67,20-76
LCRU RADIATOR TEMP	RT8001T	METER	REDUNDANT	HD	20-34
LCRU SUBSYSTEMS VOLTAGE	RT8003T	METER	-	HD	20-34

NOTE

SECTION 21 NOW COVERS LM/EMU INSTRUMENTATION.

FORMER LM SECTIONS 21 THROUGH 27 HAVE BEEN DELETED TO ELIMINATE DUPLICATION BETWEEN THEM AND THE LM TELMU AND CONTROL SUMMARY RULES IN SECTION 3.

21 LM/EMU INSTRUMENTATION
21 LM SEQUENTIAL AND PYROTECHNIC
22 LM ELECTRICAL POWER
23 LM ENVIRONMENTAL CONTROL
24 LM GUIDANCE AND CONTROL
25 LM DPS
26 LM APS
27 LM REACTION CONTROL SYSTEM
28 SPACE ENVIRONMENT
29 RECOVERY
30 AEROMEDICAL
31 LUNAR SURFACE OPERATIONS
32 ALSEP
33 LUNAR ORBIT EXPERIMENTS
APPENDICES
A ACRONYMS AND SYMBOLS
B DISTRIBUTION LIST
C CHANGE CONTROL

21 LM/EMU
INSTRUMENTATION

R	ITEM

INSTRUMENTATION REQUIREMENTS

SYSTEM	MEAS DESCRIPTION	PCM	ONBOARD		CATEGORY
SEQUENTIAL/ PYROTECHNIC	ED RLY A K1-K6	GY0201X	SYS A STAGING LIGHT		HD
				COMMON CAUTION LIGHT	HD
	ED RLY B K1-K6	GY0202X	SYS B STAGING LIGHT		HD
	ED RLY A K7-K15	GY0231X	----------		HD
	ED RLY B K7-K15	GY0232X	----------		HD
	SELECTED ED BAT	-------	METER		HD
ELECTRICAL POWER	AC BUS FREQ	GC0155F	CAUT		1 OF 2
	AC BUS VOLTS	GC0071V	METER, CAUT		M
	BAT 1 CUR	GC1201C	METER		1 OF 3
	BAT 2 CUR	GC1202C	METER		M PCM
	BAT L CUR	GC1207C	METER		
	BAT 3 CUR	GC1203C	METER		1 OF 3
	BAT 4 CUR	GC1207C	METER		M PCM
	LMP BUS VOLTS	GC0302V	METER, CAUT		
	BAT 1 VOLTS	GC0201V	METER		2 OF 3
	BAT 2 VOLTS	GC0202V	METER		M
	BAT 5 VOLTS	GC0205V	METER		
	CDR BUS VOLTS	GC0301V	METER, CAUT		
	BAT 3 VOLTS	GC0203V	METER		2 OF 3
	BAT 4 VOLTS	GC0204V	METER		M
	BAT 6 VOLTS	GC0206V	METER		
	BAT L VOLTS	GC0207V	METER		HD
	BAT 5 CUR	GC1205C	METER		1 OF 2
	BAT 6 CUR	GC1206C	METER		M PCM
	BAT 1 MAL	GC9961U	CAUT, COMP		HD
	BAT 2/L MAL	GC9962U	CAUT, COMP		HD
	BAT 3/L MAL	GC9963U	CAUT, COMP		HD
	BAT 4 MAL	GC9964U	CAUT, COMP		HD
	BAT 5 MAL	GC9965U	CAUT, COMP		HD
	BAT 6 MAL	GC9966U	CAUT, COMP		HD
	BATTERY MAL	GL4047X	COMP		HD
	BAT 1 LOW TAP	GC4362X	FLAG		HD
	BAT 4 LOW TAP	GC4368X	FLAG		HD
	BAT 5 B/U CDR	GC4369X	FLAG		HD
	BAT 6 NORM CDR	GC4372X	FLAG		HD

NOTE

LOSS OF SEVERAL HD MEASUREMENTS WILL CAUSE SEVERELY DEGRADED MISSION MONITORING CAPABILITY.

R	ITEM

SYSTEM	MEAS DESCRIPTION	PCM	ONBOARD	CATEGORY
ENVIRONMENTAL CONTROL	SUIT PRESS	GF1301P	METER	HD
			WARNING	HD
	CABIN PRESS	GF3571P	METER	1 OF 3
	U/H RLF PRESS	GF3591P	-----	M
	F/H RLF PRESS	GF3592P	-----	
	DES 2 O2 PRESS	GF0584P	METER	1 OF 2
	DES 1 O2 PRESS	GF3584P	METER, CAUT	M
	ASC 1 O2 PRESS	GF3582P	METER, CAUT	1 OF 2
	ASC 2 O2 PRESS	GF3583P	METER, CAUT	M
	GLYCOL PUMP DELTA P	GF2021P	-----	
	SEC GLYCOL PUMP PRESS	GF2921P	-----	1 OF 2
	GLYCOL PUMP PRESS	GF9997U	METER	M
	SEL GLYCOL LVL LOW	GF9986U	CAUT	
	GLYCOL TEMP	GF9998U	METER, CAUT	
	GLYCOL OUTLET TEMP	GF2581T	----------	
	SUIT TEMP	GF1281T	METER	1 OF 2
	GLYCOL INLET TEMP	GF2531T	-----	M
	DES 2 H2O PRESS	GF0500P	METER	1 OF 2
	DES 1 H2O PRESS	GF4500P	METER	M
	ASC 1 H2O QTY	GF4502P	METER	1 OF 2
	ASC 2 H2O QTY	GF4503P	METER	M
	PRI H2O REG DELTA P	GF4101P	----------	HD
	REPR ELEC OPEN	GF3572X	WARNING	HD
	CO2 PART PRESS	GF1521P	METER, CAUT, COMP	HD
	H2O SEP RATE	GF9999U	CAUT, COMP	HD
	SUIT DIV EGRESS	GF1221X	----------	HD

NOTE

LOSS OF SEVERAL HD MEASUREMENTS WILL CAUSE SEVERELY DEGRADED MISSION MONITORING CAPABILITY.

R	ITEM

SYSTEM	MEAS DESCRIPTION	FM/FM PAM	ONBOARD	CATEGORY
EMU/EVA	FEED H2O PRESS	GT8110P/GT8210P		HD
	LOW FEED H2O PRESS		TONE-FLAG	HD
	LOW VENT FLOW		TONE-FLAG	1 OF 2
	PLSS BAT CUR	GT8140C/GT8240C		M
	PLSS BAT VOLT	GT8141V/GT8241V		HD
	LCG H2O TEMP	GT8154T/GT8254T		HD
	PGA PRESS	GT8168P/GT8268P		
	PGA PRESS		CUFF GAGE	1 OF 3
	LOW PGA PRESS		TONE-FLAG	M
	SUBL O2 OUT TEMP	GT8170T/GT8270T		HD
	PLSS-CO2 PP	GT8175P/GT8275P		HD
	PLSS O2 PRESS	GT8182P/GT8282P		HD
	PLSS O2 QTY IND		METER	HD
	HIGH O2 FLOW		TONE-FLAG	HD
	LCG H2O Δ T	GT8196T/GT8296T		HD
	OPS PRESS GAGE		METER	HD
	OPS REG PRESS GAGE		METER	HD
	EVC CAL 0 VDC	GT8101V/GT8201V		HD
	EVC CAL 5 VDC	GT8102V/GT8202V		HD

NOTE

LOSS OF SEVERAL HD MEASUREMENTS WILL CAUSE SEVERELY DEGRADED MISSION MONITORING CAPABILITY.

R | ITEM

INSTRUMENTATION REQUIREMENTS

SYSTEM	MEAS DISCRIPTION	PCM	ONBOARD	CATEGORY
GUIDANCE	LGC DOWNLINK	GG0001X	-	M
AND	PLS TORQ REF	GG1040V	-	HD
CONTROL	2.5 VDC TM BIAS	GG1110V	-	HD
	IMU 28 VAC 800	GG1201V	-	HD
	IRIG SUSP 3.2 KC	GG1331V	-	HD
	IMU STBY	GG1513X	-	HD
	LGC OPR	GG1523X	-	HD
	X PIPA OUT IN PHASE	GG2001V	-	HD
	Y PIPA OUT IN PHASE	GG2021V	-	HD
	Z PIPA OUT IN PHASE	GG2041V	-	HD
	IG SVO ERR IN PHASE	GG2101V	-	HD
	IG 1X RSVR OUT SIN	GG2112V	FDAI	HD
	IG 1X RXVR OUT COS	GG2113V	FDAI	HD
	MG SVO ERR IN PHASE	GG2137V	-	HD
	MG 1X RSVR OUT SIN	GG2142V	FDAI	HD
	MG 1X RSVR OUT COS	GG2143V	FDAI	HD
	OG SVO ERR IN PHASE	GG2167V	-	HD
	OG RSVR OUT SIN	GG2172V	FDAI	HD
	OG RSVR OUT COS	GG2173V	FDAI	HD
	PITCH ATT ERR	GG2219V	FDAI	HD-PCM
	YAW ATT ERR	GG2249V	FDAI	HD-PCM
	ROLL ATT ERR	GG2279V	FDAI	HD-PCM
	PIPA TEMP	GG2300T*	C&W	HD-PCM
	RR SHIFT SIN	GG3304V	FDAI	HD-PCM
	RR SHIFT COS	GG3305V	FDAI	HD-PCM
	RR TRUN SIN	GG3324V	FDAI	HD-PCM
	RR TRUN COS	GG3325V	FDAI	HD-PCM
	LGC WARNING	GG9001X	C&W	HD-PCM
	ISS WARNING	GG9002X	C&W	HD-PCM
	LR ANT TEMP	GN7563T	TEMP MONITOR	HD-PCM
	RR NO TRACK	GN7621X	C&W	HD-PCM
	RR ANT TEMP	GN7723T	TEMP MONITOR	HD-PCM
	LR RNG BAD	GN7521X	C&W	HD
	LR VEL BAD	GN7557X	C&W	HD
	YAW ERR CMD	GH1247V	-	HD
	PITCH ERR CMD	GH1248V	-	HD
	ROLL ERR CMD	GH1249V	-	HD
	JD A4D OUTPUT	GH1419V	-	HD
	RCS TCP A4D	GR5023X	-	HD
	JD B3D OUTPUT	GH1423V	-	HD
	JD A2D OUTPUT	GH1427V	-	HD
	RCS TCP A2D	GR5040X	-	HD
	JD B1D OUTPUT	GH1431V	-	HD
	RCS TCP B1D	GR5044X	-	HD
	JD B4U OUTPUT	GH1418V	-	HD
	JD B4F OUTPUT	GH1420V	-	HD
	JD A4R OUTPUT	GH1421V	-	HD
	JD A3U OUTPUT	GH1422V	-	HD
	JD B3A OUTPUT	GH1424V	-	HD
	JD A3R OUTPUT	GH1425V	-	HD
	JD B2U OUTPUT	GH1426V	-	HD
	JD A2A OUTPUT	GH1428V	-	HD
	JD B2L OUTPUT	GH1429V	-	HD
	JD A1U OUTPUT	GH1430V	-	HD
	JD A1F OUTPUT	GH1432V	-	HD
	JD B1L OUTPUT	GH1433V	-	HD

* INDICATES SEPARATE TRANSDUCERS USED FOR ONBOARD AND PCM

NOTE

LOSS OF SEVERAL HD MEASUREMENTS WILL CAUSE SEVERELY DEGRADED MISSION MONITORING CAPABILITY.

R	ITEM	SYSTEM	MEAS DESCRIPTION	PCM	ONBOARD	CATEGORY
		GUIDANCE AND CONTROL (CONTINUED)	RCS TCP B4U	GR5031X	-	HD
			RCS TCP B4F	GR5033X	-	HD
			RCS TCP A4R	GR5034X	-	HD
			RCS TCP A3U	GR5035X	-	HD
			RCS TCP B3A	GR5037X	-	HD
			RCS TCP A3R	GR5038X	-	HD
			RCS TCP B2U	GR5039X	-	HD
			RCS TCP A2A	GR5041X	-	HD
			RCS TCP B2L	GR5042X	-	HD
			RCS TCP A1U	GR5043X	-	HD
			RCS TCP A1F	GR5045X	-	HD
			RCS TCP B1L	GR5046X	-	HD
			YAW ATT ERR	GH1455V	FDAI	HD
			PITCH ATT ERR	GH1456V	FDAI	HD
			ROLL ATT ERR	GH1457V	FDAI	HD
			RGA YAW RATE	GH1461V	FDAI	HD
			RGA PITCH RATE	GH1462V	FDAI	HD
			RGA ROLL RATE	GH1463V	FDAI	HD
			AGS SEL	GH1621X	-	HD
			ROLL PLS/DIR	GH1628X	-	HD
			PITCH PLS/DIR	GH1629X	-	HD
			YAW PLS/DIR	GH1630X	-	HD
			AUTO ON	GH1214X	-	HD
			APS ARM	GH1230X	-	HD
			ENG FIRE OVRD	GH1286X	-	HD
			MAN THRUST CMD	GH1311V	METER	HD
			PITCH GDA POS	GH1313V	-	HD
			ROLL GDA POS	GH1314V	-	HD
			P TRM FAIL	GH1323X	C&W	HD
			R TRM FAIL	GH1330X	C&W	HD
			AUTO THRUST CMD	GH1331V	METER	HD
			DPS ARM	GH1348X	-	HD
			DPS VAR ACT	GQ6806H	-	HD
			CES AC PWR FAIL	GL4026X	C&W	HD
			CES DC PWR FAIL	GL4027X	C&W	HD
			AGS DOWNLINK	GI0001X	-	HD
			ASA TEMP	GI3301T	-	HD
			AGS PWR FAIL	GL4028X	C&W	HD
			AUTO OFF	GH1217X	-	HD
			AGS AUTO	GH1641X	-	HD
			AGS ATT HOLD	GH1642X	-	HD
			PGNS AUTO	GH1643X	-	HD
			PGNS ATT HOLD	GH1644X	-	HD
		DESCENT PROPULSION	START TNK PRESS	GQ3015P	HE MON	HD
			HE REG PRESS	GQ3018P	C&W	HD
			HE REG PRESS	GQ3025P		HD
			HE PRESS	GQ3435P		1 OF 2 M
			HE PRESS	GQ3436P	PRESS	
			FU TNK 1 QTY	GQ3603Q	QTY	1 OF 4 M
			FU TNK 2 QTY	GQ3604Q	QTY	
			OX TNK 1 QTY	GQ4103Q	QTY	SEE NOTE 2
			OX TNK 2 QTY	GQ4104Q	QTY	
			FU 1 TEMP	GQ3718T	TEMP MON	HD
			FU 2 TEMP	GQ3719T	TEMP MON	HD
			OX 1 TEMP	GQ4218T	TEMP MON	HD
			OX 2 TEMP	GQ4219T	TEMP MON	HD
			FU PRESS	GQ3611P		2 OF 3 M
			OX PRESS	GQ4111P		
			TCP	GQ6510P	THRUST	
			LOW LEVEL	GQ4455X	DPS LOW	HD SEE NOTE 3

R | ITEM

SYSTEM	MEAS DESCRIPTION	PCM	ONBOARD	CATEGORY
ASCENT PROPULSION	APS He 1 PRESS	GP0001P	HEL MON C&W	1 OF 2 M
	APS He LR PRESS	GP0041P		PCM
	APS He 2 PRESS	GP0002P	HEL MON C&W	1 OF 2 M
	APS He 2R PRESS	GP0042P		PCM
	APS He REG PRESS	GP0018P		1 OF 2
	APS He REG PRESS	GP0025P	C&W	M - PCM
	APS FUEL TEMP	GP0713T	TEMP	HD
	APS FUEL LOW	GP0908X	C&W	HD
	APS OXID TEMP	GP1218T	TEMP	HD
	APS OXID LOW	GP1408X	C&W	HD
	APS FUEL PRESS	GP1501P		1 OF 2 M
	APS FUEL PRESS		GP0501P	
	APS OXID PRESS	GP1503P		1 OF 2 M
	APS OXID PRESS		GP1001P	
	VLVS A DELTA POS	GP2997U		HD
	VLVS B DELTA POS	GP2998U		HD
	APS TCP	GP2010P		HD
REACTION CONTROL	RCS "A" PROP QTY	GR1085Q	QUANTITY	1 OF 2 M
	RCS "A" He PRESS	GR1101P	PRESS MON C&W	
	RCS "A" REG PRESS	GR1201P	PRESS MON C&W	2 OF 3 M
	RCS "A" FUEL MFLD PRESS	GR2201P	PRESS MON	
	RCS "A" OX MFLD PRESS	GR3201P	PRESS MON	1 OF 2 M
	RCS "B" OX MFLD PRESS	GR3202P	PRESS MON	1 OF 2 M
	RCS "B" FUEL MFLD PRESS	GR2202P	PRESS MON	2 OF 3 M
	RCS "B" REG PRESS	GR1202P	PRESS MON C&W	
	RCS "B" PROP QTY	GR1095Q	QUANTITY	1 OF 2 M
	RCS "B" He PRESS	GR1102P	PRESS MON C&W	
	RCS "A" FUEL TEMP	GR2121T	TEMP MON	HD
	ACS 2 H2O TEMP	GR4586T		HD
	RCS "B" FUEL TEMP	GR2122T	TEMP MON	HD
	ACS 1 H2O TEMP	GR4585T		HD
	RCS MAIN "A" CLSD	GR9609U	MAIN SOV	HD
	RCS MAIN "B" CLSD	GR9610U	MAIN SOV	HD
	A/B XFEED OPEN	GR9613P	CRSFD	HD
	QUAD 1 TEMP	GR6004T	TEMP MON	HD
	QUAD 2 TEMP	GR6003T	TEMP MON	HD
	QUAD 3 TEMP	GR6002T	TEMP MON	HD
	QUAD 4 TEMP	GR6001T	TEMP MON	HD
	ASC FEED OXID "A" OPEN	GR9641U	SYS A ASC OXID ASC FUEL	HD
	ASC FEED FUEL "A" OPEN	GR9631U	SYS A ASC OXID ASC FUEL	HD
	ASC FEED FUEL "B" OPEN	GR9632U	SYS B ASC OXID ASC FUEL	HD
	ASC FEED OXID "B" OPEN	GR9642U	SYS B ASC OXID ASC FUEL	HD

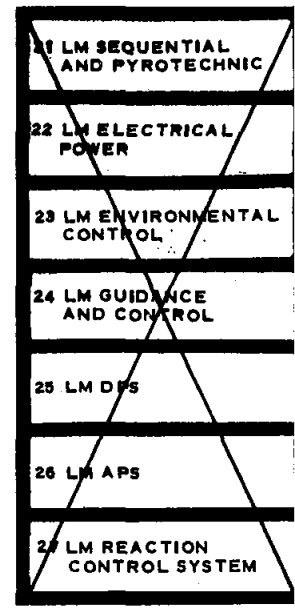
NOTES

1. LOSS OF SEVERAL HD MEASUREMENTS WILL CAUSE SEVERELY DEGRADED MISSION MONITORING CAPABILITY.
2. FOR THE LOSS OF EITHER THE FU OR OX MEASUREMENTS, AN APPROXIMATE 20 SEC HOVER TIME PENALTY IS REALIZED. FOR LOSS OF BOTH SYSTEMS, A PENALTY OF 60 SEC HOVER TIME RESULTS.
3. LOSS OF LO-LEVEL RESULTS IN AN APPROXIMATE 28 SEC HOVER TIME PENALTY.

SECTIONS 21 THROUGH 27 ARE DELETED. REFERENCE TELMU AND CONTROL MISSION RULES IN SECTION 3 OF THIS DOCUMENT.

THE LM DETAILED RULES WERE DELETED TO ELIMINATE DUPLICATION BETWEEN THEM AND THE SUMMARY RULES IN SECTION 3.

IN SOME CASES, THE SUMMARY RULES HAVE BEEN EXPANDED TO INCLUDE DATA PREVIOUSLY COVERED ONLY IN THE DETAILED RULES.



R	ITEM	
		GENERAL
	28-1	ALL DECISIONS WILL BE BASED ON CONFIRMED MEASUREMENTS AND/OR EVENTS AND PROJECTIONS BASED ON CONFIRMED EVENTS.
	28-2	DEFINITIONS

A. THE MAXIMUM OPERATIONAL DOSE (MOD) IS THE MAXIMUM RADIATION DOSE TO WHICH THE CREW WOULD BE SUBJECTED BASED ON A SKIN DOSE OF 400 RAD AND/OR A DEPTH (GASTROINTESTINAL) DOSE OF 50 RAD.

B. THE PLANNING OPERATIONAL DOSE (POD) IS THE MAXIMUM RADIATION DOSE TO THE CREW FOR WHICH ANY MISSION WOULD BE DESIGNED DURING THE PLANNING PERIOD BASED ON AN ASSUMED SKIN DOSE OF 250 RAD AND/OR A DEPTH DOSE OF 25 RAD.

C. THESE DOSES REPRESENT THE CUTOFF POINT WHERE A DECISION MUST BE MADE WHETHER TO CONTINUE OR TERMINATE THE MISSION.

D. THE RADIATION ABSORBED DOSE (RAD) IS A UNIT OF ABSORBED DOSE WHICH IS EQUAL TO AN ENERGY DEPOSITION OF 100 ERGS/GRAM.

E. THE RELATIVE BIOLOGICAL EFFECTIVENESS (RBE) EXPRESSES THE EFFECTIVENESS OF PARTICULAR TYPES OF RADIATION IN PRODUCING THE SAME BIOLOGICAL RESPONSE.

THE AVERAGE RBE THAT WILL BE USED FOR SOLAR PARTICLE EVENT RADIATION FROM PROTONS IS 1.2.

F. THE ROGENTGEN EQUIVALENT MAN (REM) IS THE PRODUCT OF THE RAD AND THE RBE (REM = RAD X RBE).

G. A CONFIRMED EVENT IS DEFINED AS AN EVENT THAT HAS BEEN MEASURED BY TWO OR MORE INDEPENDENT SOURCES.

H. A SIGNIFICANT INCREASE OF THE MOD WILL BE DEFINED BY THE FLIGHT SURGEON IN REAL TIME BASED ON THE CHARACTER AND ACCURACY OF THE DATA AT THE TIME.

R	ITEM	
		MANAGEMENT
	28-3	THE EXISTING AND PROJECTED RADIATION ENVIRONMENT WILL BE A PART OF THE GO/NO-GO DECISION PROCESS.
	28-4	PRIORITY OF DATA

A. NATURAL (SOLAR PARTICLE EVENT)

1. PRELAUNCH AND EPO
   - (A) SOLAR PARTICLE ALERT NETWORK (SPAN)
   - (B) VELA NATURAL RADIATION SATELLITE
   - (C) PIONEER RADIATION SATELLITE
   - (D) EXPLORER RADIATION SATELLITE
   - (E) SOLAR PARTICLE MONITORING SYSTEM (SPMS)

2. ALL OTHER PHASES
   - (A) S/C INSTRUMENTATION
     - (1) VAN ALLEN BELT DOSIMETER (VABD)
     - (2) PERSONAL RADIATION DOSIMETER (PRD)
     - (3) NUCLEAR PARTICLE DETECTION SYSTEM (NPDS)
   - (B) SOLAR PARTICLE ALERT NETWORK (SPAN)
   - (C) VELA NATURAL RADIATION SATELLITE
   - (D) PIONEER RADIATION SATELLITE
   - (E) EXPLORER RADIATION SATELLITE
   - (F) SOLAR PARTICLE MONITORING SYSTEM (SPMS)

B. ARTIFICIAL

1. ALL PHASES EXCEPT EPO
   - (A) JAEIC
   - (B) RIOMETER

2. EPO
   - (A) JAEIC
   - (B) RIOMETER
   - (C) PRD

3. EARTH ORBITAL MISSION
   - (A) PRD
   - (B) JAEIC
   - (C) RIOMETER

RULE NUMBERS 28-5 THROUGH 28-9 ARE RESERVED.

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
				SPECIFIC MISSION RULES	
	28-10	ANY SOURCE REPORTS A POSSIBLE ARTIFICIAL EVENT	ALL	PROCEED UNTIL VERIFICATION FROM ALL OTHER SOURCES.	
	28-11	DEFINITE ARTIFICIAL EVENT CONFIRMED BY REPORTING SOURCES	PRELAUNCH	A. HOLD UNTIL INFORMATION FROM REPORTING SOURCES INDICATES THE MOD WILL NOT BE EXCEEDED.	
			EPO	B.1. CONTINUE MISSION UNLESS DATA ANALYSIS INDICATES THAT THE DOSE PROJECTED THROUGH TLI WILL EXCEED THE MOD BY A SIGNIFICIANT AMOUNT. IF THE MOD WILL BE EXCEEDED BY A SIGNIFICANT AMOUNT, PERFORM A LOW EARTH ORBIT ALTERNATE MISSION. 2. FOR DOSES APPROACHING THE MOD CONTINUE MISSION WITH CONTINUOUS PRD MONITORING AND CREW ASSESSMENT. CONSIDERATION WILL BE GIVEN TO CHANGING THE TRAJECTORY TO A LOW EARTH ORBIT OR REENTERING ASAP BASED ON ACTUAL	B.1. CREW SHOULD BEGIN PERSONAL DOSIMETER READOUTS PER FCOH SOP 2.8.
			ALL OTHER	C. CONTINUE MISSION	
	28-12	RADIATION CONFIRMED BY PRD READOUTS OR ONBOARD TM AND PROJECTED TO EXCEED THE MOD	ALL	REENTER NEXT BEST PTP	ALSO APPLIES TO ALTERNATE EARTH ORBIT MISSION.
	28-13	MAJOR SOLAR FLARE PREDICTED	ALL	CONTINUE MISSION	

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	28-14	MAJOR SOLAR FLARE HAS OCCURRED			
		A. UNCONFIRMED PARTICLE EVENT	ALL	A. CONTINUE MISSION	
		B. CONFIRMED PARTICLE EVENT AND SOLAR PARTICLE ALERT NETWORK/RTACF ANALYSIS INDICATES THE MOD WILL BE EXCEEDED DURING THE MISSION	PRELAUNCH	B.1. HOLD UNTIL DATA ANALYSIS INDICATES THAT THE MOD WILL NOT BE EXCEEDED.	
			EPO	2. CONTINUE MISSION IF DATA ANALYSIS INDICATES THAT THE MOD WILL BE EXCEEDED BY A SIGNIFICIANT AMOUNT PRIOR TO MISSION COMPLETION, TLI IS NO-GO.	
			ALL OTHERS	3. CONTINUE MISSION CONSIDERATION WILL BE GIVEN TO EARLY (OR EXTENDED) TEI AND INHIBITING CREW TRANSFER TO LM.	
		C. CONFIRMED PARTICLE EVENT AND S/C TM OR PRD READOUT PROJECTIONS INDICATE THE MOD WILL BE EXCEEDED DURING THE MISSION	TLC	C.1. CONTINUE MISSION CONSIDERATION SHOULD BE GIVEN TO ENTERING NEXT BEST PTP IF THE TOTAL DOSE CAN BE REDUCED SIGNIFICANTLY WITHOUT INCREASING THE TOTAL RISK TO THE CREW.	C.1. CREW SHOULD BEGIN PERSONAL DOSIMETER AND RADIATION SURVEY METER READOUTS PER FCOH SOP 2.8.
			LO	2. CONTINUE MISSION CONSIDER EXTENDING LUNAR ORBIT STAY TIME IF THE TOTAL DOSE TO THE CREW WOULD BE REDUCED SIGNIFICANTLY BY LUNAR SHIELDING.	2.(A) HATCH-DOWN ATTITUDE MAY BE USED TO REDUCE THE TOTAL DOSE. (B) IF A PARTICLE EVENT IS CONFIRMED, THE CREW WILL TRANSFER FROM THE LM TO THE CSM ASAP.
			LUNAR STAY	3. CONSIDER REDUCING THE LUNAR STAY TIME AND/OR EVA IF THE TOTAL DOSE TO THE CREW CAN BE REDUCED SIGNIFICANTLY WITHOUT INCREASING THE TOTAL RISK TO THE CREW.	
			ALL OTHER PHASES	4. CONTINUE MISSION	

R | ITEM

INSTRUMENTATION REQUIREMENTS

28-15

MEAS DESCRIPTION	PCM	ONBOARD	TRANSDUCERS	CATEGORY	MSN RULE REF
RADIATION DOSIMETER 1 (CM DEPTH DOSE RATE)	CK1051K	-	-	HD	28-12
VABD					
RADIATION DOSIMETER 2 (CM SKIN DOSE RATE)	CK1052K	-	-	HD	28-12
DOSIMETER RATE CHANGE	CK1053R	-	-	HD	28-12
NPDS					
PROTON COUNT RATE CHAN 1	ST0820K	-	-	HD	28-14
PROTON COUNT RATE CHAN 2	ST0821K	-	-	HD	28-14
PROTON COUNT RATE CHAN 3	ST0822K	-	-	HD	28-14
PROTON COUNT RATE CHAN 4	ST0823K	-	-	HD	28-14
ALPHA COUNT RATE CHAN 1	ST0830K	-	-	HD	28-14
ALPHA COUNT RATE CHAN 2	ST0831K	-	-	HD	28-14
ALPHA COUNT RATE CHAN 3	ST0832K	-	-	HD	28-14
PROTON INTEGER COUNT RATE	ST0838K	-	-	HD	28-14
TEMP NUCLEAR PART. DET	ST0840T	-	-	HD	28-14
TEMP NUCLEAR PART. ANAL	ST0841T	-	-	HD	28-14
PERSONAL RADIATION DOSIMETER (PRD)	-	3 ONBOARD		MANDATORY TO BE ONBOARD	28-14
RATE SURVEY METER (RSM)	-	1 ONBOARD		MANDATORY TO BE ONBOARD	28-14

29 RECOVERY

MISSION RULES

SECTION 29 - RECOVERY

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
				SPECIFIC	
	29-1	ACCEPTABLE WEATHER CONDITIONS AND RECOVERY CAPABILITY* IN THE LAUNCH SITE AREA	PRELAUNCH	MANDATORY	
	29-2	ACCEPTABLE WEATHER CONDITIONS AND RECOVERY CAPABILITY* IN THE LAUNCH ABORT AREA TO 1000 NM DOWNRANGE AND IN THE MIDPACIFIC RECOVERY ZONE	PRELAUNCH	HIGHLY DESIRABLE	
	29-3	MINIMUM OF 71 AMP-HOURS OF CM POSTLANDING POWER AVAILABLE AT LANDING		HIGHLY DESIRABLE	TO PROVIDE 40 HOURS OF CM POSTLANDING POWER PLUS ONE UPRIGHTING.
	29-4	MINIMUM OF 35 AMP-HOURS OF CM POSTLANDING POWER AVAILABLE AT LANDING		MANDATORY	TO PROVIDE 18 HOURS OF CM POSTLANDING POWER PLUS ONE UPRIGHTING
	29-5	UNTIL ENTRY MINUS 24 HOURS, RETAIN ΔV CAPABILITY TO MOVE ENTRY POINT ±500 NM		HIGHLY DESIRABLE	TO PROVIDE WEATHER AVOIDANCE CAPABILITY.

*RECOVERY CAPABILITY WILL BE BASED PRIMARLY UPON THE LOCAL RECOVERY UNIT COMMANDER'S EVALUATION OF HIS CAPABILITY TO PERFORM THE RECOVERY OPERATION. WEATHER CONDITIONS AT THE TIME OF CM LANDING AFFECT BOTH RECOVERY CAPABILITY AND STRUCTURAL INTEGRITY OF THE CM. THE FOLLOWING GUIDELINES ARE USED TO INDICATE WHEN IT MAY BE NECESSARY TO RE-EVALUATE:

	WORLD WIDE	LAUNCH SITE
SURFACE WINDS	25 KNOTS	25 KNOTS
CEILING	1500 FT	500 FT
VISIBILITY	3 NM	1/2 NM
WAVE HEIGHT	8 FT	8 FT

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	29-6	AN ELLIPSE 163 NM UPRANGE, 152 NM DOWNRANGE AND 50 NM TO EITHER SIDE OF 55 DEG/55 DEG TARGET POINT, AND AN ELLIPSE 105 NM UPRANGE AND DOWNRANGE AND 40 NM TO EITHER SIDE OF THE ROLL RIGHT 90 DEG (DELAYED) TARGET POINT WILL BE CLEAR OF ALL LAND.	EARTH ORBITAL	MANDATORY	
	29-7	REMAINDER OF MANEUVER FOOTPRINT AND AN ELLIPSE 109 NM UPRANGE AND DOWNRANGE AND 40 NM TO EITHER SIDE OF 90 DEG/90 DEG TARGET POINT, AND AN ELLIPSE 105 NM UPRANGE AND DOWNRANGE AND 40 NM TO EITHER SIDE OF ROLL RIGHT 90 DEG TARGET POINT WILL BE CLEAR OF LARGE LAND MASSES.	EARTH ORBITAL	HIGHLY DESIRABLE	
	29-8	A 5 NM RADIUS CIRCLE CENTERED ON THE GNCS TARGET POINT AND AN ELLIPSE 26 NM UPRANGE, 26 NM DOWNRANGE AND 52 NM EITHER SIDE OF THE EMS TARGET POINT WILL BE CLEAR OF ALL LAND.	POST-TLI	MANDATORY	
	29-9	REMAINDER OF OPERATIONAL FOOTPRINT (SEE RULE 1-40) WILL BE CLEAR OF LARGE LAND MASSES	POST-TLI	HIGHLY DESIRABLE	

30 AEROMEDICAL

R	ITEM	
		GENERAL
	30-1	PRELAUNCH PRIOR TO COMMITTING TO LAUNCH, THE FOLLOWING CONDITIONS MUST BE MET: A. SATISFACTORY FLIGHT CREW PHYSIOLOGICAL STATUS. B. THE MINIMUM CABIN OXYGEN CONCENTRATION FOR LAUNCH IS 60 PERCENT. C. THE MINIMUM SUIT OXYGEN CONCENTRATION FOR LAUNCH IS 95 PERCENT.
	30-2	THE SUIT CIRCUIT MUST BE MAINTAINED AT LEAST 2 INCHES OF WATER PRESSURE ABOVE THE CABIN PRESSURE. SUIT LOOP PURGE IS REQUIRED IF THE SUIT-TO-CABIN DELTA PRESSURE REMAINS AT ZERO FOR A PERIOD OF 5 MINUTES.
	30-3	THE POTABLE WATER PH MUST BE WITHIN 6.0 TO 8.0 AT SERVICING AND FINAL SAMPLING.
	30-4	THE MAXIMUM ALLOWABLE CONCENTRATION OF PCO_2 IS 5 MM OF Hg.
	30-5	LAUNCH THERE ARE NO MEDICAL REASONS FOR ABORTING DURING THE LAUNCH PHASE OTHER THAN THOSE CONDITIONS INTOLERABLE TO THE CREW.
	30-6	EARTH ORBIT AND DEEP SPACE OPERATIONS EARLY MISSION TERMINATION FOR MEDICAL REASONS FALLS INTO TWO CATEGORIES: A. ONSET OF CONDITIONS WHICH ADVERSELY AFFECT CREW SAFETY, OR FUNCTION AND PERFORMANCE B. FAILURE OF SPACECRAFT SYSTEMS TO MAINTAIN A PHYSIOLOGICALLY SATISFACTORY ENVIRONMENT
	30-7	WATER PALATABILITY CREW EVALUATION OF THE DRINKING WATER TASTE WILL BE THE BASIS FOR DETERMINING WATER PALATABILITY, EVEN FOR KOH CONTAMINATION.
		RULE NUMBERS 30-8 THROUGH 30-14 ARE RESERVED.

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
				SPECIFIC MISSION RULES	
	30-15	LOSS OF OR UNREADABLE EKG	ALL PHASES	A. CONTINUE MISSION	A. ARTIFACTS ANTICIPATED DURING LAUNCH. MCC SURGEON WILL EVALUATE THE PROBLEM AND MAY RECOMMEND EARLY MISSION TERMINATION IF CORRECTIVE ACTION IS NOT EFFECTIVE.
			EVA	B. CONTINUE MISSION	B. MCC SURGEON WILL EVALUATE PROBLEM AND RECOMMEND CORRECTIVE ACTION. IF NOT EFFECTIVE, CEVA MAY BE RECOMMENDED.
	30-16	ABONORMAL HEART RATE, RHYTHM, OR EKG	LAUNCH	A. CONTINUE MISSION	MCC SURGEON WILL EVALUATE THE PROBLEM AND MAY RECOMMEND EARLY MISSION TERMINATION IF CORRECTIVE ACTION IS NOT EFFECTIVE.
			EPO	B. NO-GO FOR TLI	
			TLC	C. NO-GO FOR LOI	
			LO	D. ENTER NEXT BEST PTP	
			EVA	E. TERMINATE EVA	
			TEC	F. ENTER NEXT BEST PTP	
	30-17	ABNORMAL RESPIRATORY RATE	LAUNCH	A. CONTINUE MISSION	THE ABNORMAL RATES WILL BE EVALUATED BY THE MCC SURGEON AND EARLY MISSION TERMINATION MAY BE RECOMMENDED IF CORRECTIVE ACTION IS NOT EFFECTIVE.
			EPO	B. NO-GO FOR TLI	
			TLC	C. NO-GO FOR LOI	
			LO	D. ENTER NEXT BEST PTP	
			TEC	E. ENTER NEXT BEST PTP	
	30-18	ONSET OF SERIOUS MEDICAL PROBLEM	LAUNCH	A. CONTINUE MISSION CREW MAY ELECT TO ABORT IF INTOLERABLE	MCC SURGEON WILL EVALUATE THE PROBLEM AND MAY RECOMMEND EARLY MISSION TERMINATION IF CORRECTIVE ACTION IS NOT EFFECTIVE.
			EPO	B. ENTER NEXT BEST PTP	
			TLC	C. ENTER NEXT BEST PTP	
			LO	D. ENTER NEXT BEST PTP	
			EVA	E. TERMINATE EVA	
			TEC	F. ENTER NEXT BEST PTP	

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	30-19	DYSBARISM IN ANY CREWMAN	LAUNCH	A. CONTINUE MISSION CREW MAY ELECT TO ABORT IF CONDITION IS INTOLERABLE	A.1. CHECK SUIT INTEGRITY. 2. IF CONDITIONS PERMIT, CREW MAY ELECT TO OVER-PRESSURIZE BY SELECTING SUIT DEMAND REG TO PRESS POSITION.
			ALL	B. TERMINATE PHASE ENTER NEXT BEST PTP	B. MCC SURGEON WILL EVALUATE AND MAY RECOMMEND EARLY MISSION TERMINATION IF CORRECTIVE ACTION IS NOT EFFECTIVE.
	30-20	ORAL TEMP EXCEEDS 100°F DESPITE CORRECTIVE			MCC SURGEON MAY RECOMMEND EARLY MISSION TERMINATION IF TREATMENT IS UNSUCCESSFUL.
		A. IF DUE TO ILLNESS	LAUNCH	A.1. NOT APPLICABLE	
			ALL	2. TERMINATE PHASE ENTER NEXT BEST PTP	
		B. IF RESULTANT FROM THERMAL OVERLOAD	LAUNCH	B.1. NOT APPLICABLE	
			ALL	2. TERMINATE PHASE ENTER NEXT BEST PTP	
	30-21	PLSS METABOLIC OVERLOAD	EVA	A. IF AMBER LINE IS EXCEEDED: DECREASE ACTIVITY.	A. AMBER LINE LIMIT IS WORK SUSTAINED AT A RATE GREATER THAN 2500 BTU/HR FOR A PERIOD LONGER THAN 5 MINUTES, AS DETERMINED BY PREFLIGHT ERGOMETRY CALIBRATIONS. THE MCC SURGEON WILL EVALUATE AND MAY RECOMMEND DECREASED CREW ACTIVITY.
				B. IF RED LINE IS EXCEEDED: STOP ACTIVITY AND REST.	B. RED LINE LIMIT IS WORK SUSTAINED AT A RATE GREATER THAN 3000 BTU/HR FOR A PERIOD LONGER THAN 2 MINUTES, AS DETERMINED BY PREFLIGHT ERGOMETRY CALIBRATIONS. MCC SURGEON WILL EVALUATE AND MAY RECOMMEND THAT THE CREW STOP ACTIVITY AND REST.
		RULE NUMBERS 30-22 THROUGH 30-24 ARE RESERVED.			

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	30-25	INCREASE IN PCO2			
		A. IS GREATER THAN OR EQUAL TO 7.6 MM Hg	LAUNCH	A.1. CONTINUE MISSION	A. PCO2 SHOULD DECREASE BELOW 2 MM Hg WITHIN 30 MINUTES.
			ALL	2. CONTINUE MISSION CHANGE LiOH CANISTER	
		B. GREATER THAN OR EQUAL TO 7.6 MM Hg AND UNABLE TO DECREASE	LAUNCH	B.1. CONTINUE MISSION	
			ALL	2. CONTINUE MISSION	B.2. LiOH CANISTERS MAY BE CHANGED IN AN UNPRESSURIZED CABIN.
				(A) OPEN SUITS AND BREATHE FROM CABIN	
				(B) CHANGE SECOND LiOH CANISTER	
				(C) TEST PCO2 SENSOR	B.2. (C) PCO2 SENSOR TEST: PURGE PCO2 SENSOR WITH DIRECT O2 VALVE OPEN FOR 10 SEC (REF ECS MALF NO. 12). IF ABOVE PROCEDURE RESULTS IN A PCO2 READING NEAR ZERO, THE PCO2 SENSOR IS OPERATING PROPERLY.
		C. GREATER THAN OR EQUAL TO 10 MM Hg	LAUNCH	C.1. CONTINUE MISSION	
			ALL	2. TERMINATE PHASE ENTER NEXT BEST PTP	C.2. PLSS ACCEPTABLE CO2 LEVEL IS 15 MM Hg (REFERENCE EVA MISSION RULES CHART)
	30-26.	PCO2 INSTRUMENTATION FAILURE	ALL	CONTINUE MISSION	
		RULE NUMBERS 30-27 THROUGH 30-34 ARE RESERVED.			

R	ITEM
	30-35

INSTRUMENTATION REQUIREMENTS

MEAS DESCRIPTION	PCM	ONBOARD	TRANSDUCERS	CATEGORY	MSN RULE REFERENCE
CSM					
ELECTROCARDIOGRAM	CJ0060J	NOT DISPLAYED		M*	30-15,16
ELECTROCARDIOGRAM	CJ0061J	NOT DISPLAYED		M*	30-15,16
ELECTROCARDIOGRAM	CJ0062J	NOT DISPLAYED		M*	30-15,16
CO2 PARTIAL PRESSURE	CF0005P	METER	COMMON	HD	30-2,27,28
SUIT CABIN DELTA PRESS	CF0003P	NOT DISPLAYED		HD	30-3,19
ORAL TEMPERATURE		CLINICAL THERMOMETER		M	30-20
PNEUMOGRAM	CJ0200P	NOT DISPLAYED		HD	30-17
PNEUMOGRAM	CJ0201P	NOT DISPLAYED		HD	30-17
PNEUMOGRAM	CJ0202P	NOT DISPLAYED		HD	30-17
LM					
CO2 PARTIAL PRESSURE	GF1521P	METER		HD	
ELECTROCARDIOGRAM	GT9999	NOT DISPLAYED		M**	30-15,16
PNEUMOGRAM		NOT DISPLAYED		HD	30-17
PLSS					
PLSS ELECTROCARDIOGRAM	GT8124J			M**	30-15,16
	GT8224J			M**	30-15,16

*MANDATORY UNTIL SUIT ROOM DEPARTURE.

**MANDATORY UNTIL LM CLOSEOUT.

31 LUNAR SURFACE OPERATIONS

R	ITEM

CONSTRAINTS AND OPTIONS

31-1 LRV MOBILITY RATES WILL BE DETERMINED IN REAL TIME. THESE RATES WILL BE PROJECTED FOR MAINTAINING THE EFFECTIVE OPERATIONAL ENVELOPE AND REASSESSING THE TRAVERSE PLAN. THE PROJECTED RATES MAY BE ADJUSTED UPWARD OR DOWNWARD FROM COMPUTED RATES BASED ON QUALITATIVE JUDGEMENT OF:

A. TERRAIN DIFFERENCES

B. LOSSES IN DRIVING TIME ATTRIBUTABLE TO SURFACE OBSERVATIONS

C. UNSCHEDULED STOPS

RULE NUMBERS 31-2 THROUGH 31-30 ARE RESERVED

R | ITEM

PRECEDENCE/SCHEDULING

31-31 IN ESTABLISHING THE SURFACE EXPLORATION PLAN, THE TRAVERSE PLANS PREPARED BEFORE LAUNCH WILL BE USED AS BASELINES AND MODIFIED AS NECESSARY TO ACCOMMODATE THE ACTUAL LANDING POINT, RADIUS OF OPERATIONS, TIMELINE AND MOBILITY CONSTRAINTS, AND LUNAR SURFACE HARDWARE CAPABILITY TO REACH THE SE SELENOLOGICAL FEATURES. THE MINIMUM TIME REQUIRED FOR EACH REGION ARE INCLUDED:

A.	SOUTH MASSIF	TBD	MINIMUM TIME
B.	NORTH MASSIF	TBD	MINIMUM TIME
C.	DARK MANTLE	TBD	MINIMUM TIME
D.	LIGHT MANTLE	TBD	MINIMUM TIME

31-32 FOR SITUATIONS WHERE ALL SURFACE TASKS CANNOT BE ACCOMPLISHED, THE FOLLOWING ORDER OF PRECEDENCE WILL BE USED IN MAKING STATION/TASK TRADE-OFFS.

EVA 1		EVA 2		EVA 3	
STATION	PRIORITY	STATION	PRIORITY	STATION	PRIORITY
ALSEP	1	2	1	6	1
1	2	3	2	7	
		4	3	8	2
		5	4	10	3
				9	4

31-33 REASSESSMENT OF THE OPERATIONAL EVA PLAN WILL BE DONE IF ANY OF THE FOLLOWING CONDITIONS EXIST:

A. BEHIND TIMELINE BY MORE THAN 10 PERCENT OF EVA TIME REMAINING
B. AHEAD OF TIMELINE BY MORE THAN 15 MINUTES
C. DEGRADATION OF THE LRV TO SUCH AN EXTENT THAT A MIMIMUM OF 4 KM/HR VEHICLE SPEED CANNOT BE MAINTAINED OR THE PLANNED TRAVERSE VIOLATES THE REDEFINED OPERATIONAL ENVELOPE

31-34 IF A REALIGNMENT OF THE TRAVERSE IS REQUIRED, EITHER BY EXTENSIONS OR REDUCTIONS, THE REVISION WILL NORMALLY BE PASSED TO THE CREW AS EVA PAD UPDATES AT APPROXIMATELY THE 1/3 AND 2/3 EVA COMPLETION POINTS.

31-35 TOTAL DRIVING TIME FROM THE LM TO STATION 2 WILL BE LIMITED TO 1 HOUR. DEPARTURE TIME FROM STATION 2 WILL BE LIMITED TO 2 HOURS AND 50 MIN TO MAINTAIN MARGINS FOR STATION 3 AND 4 WALKBACK.

31-36 THROUGH 31-50 ARE RESERVED.

R	ITEM

SYSTEMS MANAGEMENT

31-51 THE LRV RADIATOR COVERS WILL BE DUSTED BEFORE OPENING. THE RADIATOR SURFACES WILL BE DUSTED EACH TIME THE COVERS ARE OPENED WITH RADIATORS IN THE SUN.

31-52 THE AUXILIARY PWR BYPASS SWITCH WILL BE PUT IN THE ON POSITION ONLY AFTER EVA 3.

31-53 THE DRIVE ENABLE SWITCHES WILL NOT BE OPERATED AFTER INITIAL CONFIGURATION EXCEPT AS REQUIRED FOR FAILURES OR MALFUNCTION ISOLATION.

31-54 LRV PARKING CONSTRAINTS FOR LRV AND PAYLOAD THERMAL CONSIDERATIONS ARE AS FOLLOWS:

A. THE LRV WILL BE PARKED A MINIMUM OF 20 FT FROM THE NEAREST LM SIDE.

B.

PARKING DURATION	REQUIRED SUN AZIMUTH	CRITICAL ITEM
LESS THAN:		
6 HRS IN SUN	ANY	N/A
2 HRS IN SHADE	ANY	N/A
MORE THAN:		
6 HRS IN SUN	80°-110° CCW FROM UPSUN*	LCRU, C&D CONSOLE
2 HRS IN SHADE	NOT RECOMMENDED	C&D CONSOLE
		LRV NAVIGATION
		LCRU

*FOR BETWEEN EVA'S PARKING, THE LRV NAVIGATION HEADING WILL BE USED TO PARK THE LRV 85° CCW FROM UPSUN. HEADING WILL BE SPECIFIED BY MCC BASED ON SUN AZIMUTH.

31-55 LRV BATTERY POWER/THERMAL MANAGEMENT WILL BE ACCOMPLISHED THROUGH CONFIGURATION OF THE BATTERY LOADS, LIMITING USE OF NON-CRITICAL SYSTEMS AND BY OPENING THE BATTERY COVERS WHILE PARKING UPSUN AT TRAVERSE STOPS GREATER THAN 30 MIN. THE CONDITIONS TO BE MAINTAINED THROUGH THIS MANAGEMENT IN ORDER OF PRIORITY ARE:

A. BATTERIES SHALL BE MAINTAINED IN TEMPERATURE RANGE OF:

1. 40° F - 125° F FOR EVA 1 AND 2
2. 40° F - 140° F FOR EVA 3

B. RELATIVE STATE-OF-CHARGE BETWEEN BATTERIES BALANCED TO WITHIN 20 AMP-HOURS

R	ITEM	
	31-56	LRV BATTERY COVERS WILL BE OPENED DURING EVA/LRV CLOSEOUT AT THE LM.
	31-57	DELETED
	31-58	THE LRV MUST REMAIN STATIONARY FOR 1 MINUTE 30 SECONDS FOLLOWING NAVIGATION SYSTEM TURN-ON TO ALLOW THE DIRECTIONAL GYRO UNIT (DGU) TO ATTAIN OPERATING SPEED. DURING THIS WARM-UP PERIOD THE GYRO TORQUING SWITCH MAY NOT BE OPERATED. USE OF THE SYSTEM RESET SWITCH IS NOT CONSTRAINED BY THIS RULE.
	31-59	THE LRV DGU WILL BE ALIGNED BEFORE DEPARTURE FROM THE LM ON EACH EVA. THE DGU WILL BE CHECKED AT DESIGNATED POINTS ON THE TRAVERSE. IT WILL BE TORQUED TO REALIGN IF IT HAS DRIFTED >2 DEGREES.

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
				SPECIFIC	
	31-60	RESERVED			
	31-61	FORWARD OR REAR STEERING UNIT FAILS TO RESPOND TO HAND-CONTROLLER COMMAND		ELECTRICALLY DISABLE THE FAILED STEERING UNIT.	MAY EVENTUALLY REQUIRE PINNING IF UNPOWERED STEERING WANDERS EXCESSIVELY.
	31-62	FORWARD OR REAR STEERING UNIT DRIVE HARDOVER WITH HAND CONTROLLER IN NEAR CENTER POSITION		ELECTRICALLY DISABLE AND MECHANICALLY DECOUPLE AFFECTED UNIT AND LOCK AFFECTED WHEELS IN STRAIGHT AHEAD POSITION.	MECHANICAL DECOUPLING AND STEERING LOCKING ARE IRREVERSIBLE FOR THE FRONT WHEELS.
	31-63	BOTH STEERING UNITS DRIVE HARDOVER CONTRARY TO STEERING COMMAND OR FAIL TO RESPOND TO HAND CONTROLLER		ELECTRICALLY DISABLE, DECOUPLE, AND LOCK STEERING. CREW ASSESS DIRECTIONAL CONTROL USING LEFT/RIGHT DRIVE POWER TO DETERMINE TRAVERSE LIMITS.	

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	31-64	DELETED			
	31-65	TRACTION DRIVE MOTOR TEMP EXCEEDS 400°F OR PREDICTED TO EXCEED 450°F			
		A. MOTOR IS NOT NEEDED TO MAINTAIN LRV MOBILITY		A. REMOVE MOTOR FROM SERVICE ELECTRICALLY. DECOUPLE MECHANICALLY AT NEXT STOP.	A. MOTOR IS REUSABLE AFTER COOLDOWN TO BELOW 400 DEG F. DUST REMOVAL MAY HELP COOLDOWN.
		B. MOTOR IS REQUIRED TO MAINTAIN ACCEPTABLE LRV MOBILITY		B. MOTOR WILL BE KEPT IN SERVICE. TRAVERSE WILL BE AJUSTED TO BE WITHIN WALKING ENVELOPE BEFORE TDS REACHES 450°F.	V. ATTEMPT MOTOR COOLDOWN WHILE IN USE BY: 1. DRIVING AT LEAST 4 KM/HR 2. AVOIDING PROLONGED UPSLOPES 3. BRUSHING ACCUMULATED DUST
	31-66	INSUFFICIENT POWER TO COMPLETE THE NOMINAL MISSION		TAKE ACTION IN THE FOLLOWING ORDER AS REQUIRED: 1. REMOVE THE LCRU FROM LRV POWER 2. CURTAIL THE TRAVERSE TO WITHIN THE LRV POWER AVAILABLE	
	31-67	BRAKE WILL NOT RELEASE ON ONE WHEEL			
		A. TRACTION DRIVE IS NOT REQUIRED FOR LRV MOBILITY		A. REMOVE POWER AND DECOUPLE WHEEL BEFORE CONTINUING MISSION.	A. IT WOULD BE WORTH TIME TO CHECK THE WHEEL AFTER EACH STOP AS WORKING VIBRATION AND SHOCK MAY FREE MECHANISM.
		B. TRACTION DRIVE IS REQUIRED FOR LRV MOBILITY		B. ATTEMPT TO FREE BRAKE BY BACKING/FORWARD MOTION, LEFT AND RIGHT STEERING COMMANDS, AND INDUCED SHOCKS AND VIBRATION. IF ALL FAILS, USE TRACTION DRIVE TO ACHIEVE LRV MOBILITY.	B. IT IS DUBIOUS IF TRACTION DRIVE WILL OVERCOME BRAKE, BUT ALL EFFORTS SHOULD BE EXPENDED BEFORE ABANDONING LRV.
	31-68	ABNORMAL AMPERE UNBALANCE BETWEEN BATTERY 1 AND BATTERY 2		REDISTRIBUTE LOADS TO MAINTAIN BATTERY REDUNDANCY. IF A DEFINITE MOTOR SHORT EXISTS (LOSS OF POWER OUTPUT OF TRACTION DRIVE), SHUT DOWN TRACTION DRIVE AND DECOUPLE AT NEXT STOP IF EXCESSIVE MECHANICAL DRAG IS SUSPECTED.	
	31-69	RESERVED			

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	31-70	TRACTION DRIVE MOTOR POWER CIRCUITRY:			
		A. FAILS ON		A. REMOVE POWER FROM AFFECTED TRACTION DRIVE. USE AS NECESSARY TO ACHIEVE ACCEPTABLE MOBILITY.	A. DRIVE POWER CB WILL POP IF FAILURE OCCURS WHILE BRAKE IS SET. CURRENT LIMITING IS BYPASSED.
		B. FAILS OFF		B. REMOVE POWER FROM AFFECTED TRACTION DRIVE	B. NO "JACKRABBIT" MODE CAPABILITY WITH AFFECTED TRACTION DRIVE.
	31-71	TRACTION DRIVE MOTOR CONTROL CIRCUITRY:			
		A. FAILS ON		A. USE AFFECTED TRACTION DRIVE AS DESIRED TO ACHIEVE MAX MOBILITY. POWER DOWN IF MOTOR IS UNMANAGEABLE AND FOR STOPS.	A. USE DRIVE POWER SWITCH TO TURN AFFECTED MOTOR ON OR OFF.
		B. FAILS OFF		B. POWER DOWN AFFECTED TRACTION DRIVE. DECOUPLE IF EXCESSIVE WHEEL DRAG IS SUSPECTED.	
		RULE NUMBERS 31-72 THROUGH 31-100 ARE RESERVED.			

R	ITEM	
		SURFACE EXPLORATION SYSTEMS
	31-101	THE FILM-REMAINING STATUS FOR 70-MM FILM WILL BE TRACKED VIA PERIODIC CREW READ-OUTS TO ENSURE RETENTION OF ADEQUATE FILM FOR TASKS REMAINING ON THE EVA. FOR FILM-LIMITED SITUATIONS, PHOTO DOCUMENTATION WILL BE REDUCED IN THE FOLLOWING SEQUENTIAL STEPS: A. ELIMINATE HIGHLY DESIRABLE PHOTOGRAPHY BEGINNING WITH LOWEST PRIORITY TASKS. B. ELIMINATE MANDATORY PHOTOGRAPHY WHERE TV COVERAGE CAN ADEQUATELY FULFILL THE PHOTO DOCUMENTATION REQUIREMENT. C. ELIMINATE MANDATORY PHOTOGRAPHY BEGINNING WITH LOWEST PRIORITY TASK.

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
				TRAVERSE GRAVIMETER	
	31-102	TGE MEASUREMENT MADE WHILE MOUNTED TO THE LRV INDICATES A PHASE LOCKED LOOP RATE ALARM		THE MEASUREMENT WILL BE REPEATED WITH THE TGE PLACED ON THE LUNAR SURFACE. ALL FUTURE MEASUREMENTS WILL BE MADE WITH THE TGE PLACED ON THE LUNAR SURFACE.	A PHASE LOCKED LOOP RATE ALARM IS INDICATED BY THE THREE MOST SIGNIFICANT DIGITS OF THE DISPLAY BEING ZERO.
	31-103	TGE MEASUREMENT MADE WHILE PLACED ON LUNAR SURFACE INDICATES A PHASE LOCKED LOOP RATE ALARM		PHASE LOCK LOOP BYPASS MODE WILL BE USED TO REPEAT THE MEASUREMENT AND FOR ALL FUTURE MEASUREMENTS.	1. PHASE LOCKED LOOP RATE ALARM IS INDICATED BY THE THREE MOST SIGNIFICANT DIGITS OF THE DISPLAY BEING ZERO. 2. PHASE LOCKED LOOP BYPASS MODE IS INITIATED BY DEPRESSING BOTH "GRAV" AND "READ" SWITCHES SIMULTANEOUSLY. 3. ALL MEASUREMENTS IN PHASE LOCKED LOOP BYPASS MODE HAVE A ZERO IN THE MOST SIGNIFICANT DIGIT OF THE DISPLAY.
	31-104	INTERMEDIATE OVEN HOT ALARM IS EXPERIENCED PRIOR TO DEPARTURE ON EVA-1.		PLACE TGE IN LM SHADE WITH RADIATOR COVER OPENED PRIOR TO DEPARTING ON EVA TRAVERSE.	1. INTERMEDIATE OVEN HOT ALARM IS INDICATED BY A 6 OR 7 IN THE EIGHTH MOST SIGNIFICANT DIGIT OF THE DISPLAY. 2. TGE WILL BE USED ON EVA'S II AND III.
	31-105	PRECISION OVEN TEMP REACHES MAXIMUM POSITIVE DEVIATION		NO FURTHER MEASUREMENTS WILL BE TAKEN DURING THE REMAINDER OF THE CURRENT TRAVERSE. TGE WILL BE PLACED IN THE LM SHADOW WITH THE RADIATOR *SURFACE EXPOSED AT THE EARLIEST* CONVENIENCE.	MAXIMUM POSITIVE DEVIATION IS INDICATED BY AN ODD NUMBER IN THE EIGHTH MOST SIGNIFICANT DIGIT OF THE DISPLAY AND A "7" IN THE NINTH (LEAST) SIGNIFICANT DIGIT.
	31-106	RESERVED			

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	31-107	TGE PHASE LOCK LOOP FAILS TO ACQUIRE LOCK DURING A NORMAL GRAVITY MEASUREMENT		PHASE LOCK LOOP BYPASS MODE WILL BE USED TO REPEAT THE MEASUREMENT AND FOR ALL FUTURE MEASUREMENTS	1. FAILURE OF PHASE LOCK LOOP TO ACQUIRE LOCK IS INDICATED BY A "9" IN THE MOST SIGNIFICANT DIGIT OF THE DISPLAY. 2. PHASE LOCKED LOOP BYPASS MODE IS INITIATED BY DEPRESSING BOTH "GRAV" AND "READ" SWITCHES SIMULTANEOUSLY. 3. ALL MEASUREMENTS MADE IN THE PHASE LOCKED LOOP BYPASS MODE HAVE A ZERO IN THE MOST SIGNIFICANT DIGIT OF THE DISPLAY.
	31-108	TGE IS OPERATED IN PHASE LOCKED LOOP BYPASS MODE.		TGE WILL BE PLACED ON LUNAR SURFACE FOR ALL MEASUREMENTS TAKEN IN THE PLL BYPASS MODE.	PLL BYPASS MODE HAS NO FILTERING REQUIRED FOR LRV MOUNTED MEASUREMENTS.
	31-109	TGE MEASUREMENT IN PHASE LOCKED LOOP BYPASS MODE INDICATES ZEROS IN THE SEVEN MOST SIGNIFICANT DIGITS OF THE DISPLAY		ABANDON THE TRAVERSE GRAVIMETER EXPERIMENT	LOSS OF VIBRATING STRING SIGNAL ACCELEROMETER.
	31-110	BIAS MEASUREMENT LIGHT FAILS TO EXTINGUISH AFTER 5 MINUTES OF MEASUREMENT TIME.		ABANDON TRAVERSE GRAVIMETER EXPERIMENT	LOSS OF VIBRATING STRING ACCELEROMETER OUTPUT.

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
				SURFACE ELECTRICAL PROPERTIES	
	31-111	SEP RECEIVER TEMP AT INITIAL DEPLOYMENT IS > TBD° F		OPEN RADIATOR COVERS 100% DURING EVA 1.	1. SEP IS NOT USED DURING EVA 1. 2. COVERS NORMALLY REMAIN CLOSED DURING EVA 1.
	31-112	SEP RECEIVER TEMP PRIOR TO A TRAVERSE IS: A. > TBD° F B. < 20° F		A. OPEN RADIATOR COVERS 100% DURING THE EVA B. CLOSE RADIATOR COVERS DURING THE EVA PLACE THE RECEIVER IN STBY MODE PRIOR TO THE TRAVERSE.	
	31-113	SEP RADIATORS ARE EXPOSED		A. THE RADIATOR SURFACES WILL BE DUSTED AFTER OPENING THE COVERS AT THE END OF EACH TRAVERSE B. THE RADIATOR SURFACES WILL BE DUSTED AT THE BEGINNING OF EACH STOP DURING WHICH THE COVERS WILL BE OPEN.	
	31-114	RESERVED			
	31-115	BETWEEN EVA SEP CONFIGURATION		RADIATOR COVERS WILL NORMALLY BE OPENED 20% FOR BETWEEN EVA COUNTDOWN. THIS WILL BE ADJUSTED TO 80% OR 100% DEPENDING ON REAL-TIME THERMAL CONDITIONS AT THE END OF THE EVA.	

R	ITEM

GENERAL

THE FOLLOWING MISSION RULES APPLY TO FLIGHT CREW INVOLVEMENT WITH THE APOLLO LUNAR SURFACE EXPERIMENT PACKAGE (ALSEP) WHILE THE CREW IS ON THE LUNAR SURFACE. THESE RULES ARE EXCERPTED FROM THE EMRD FOR APOLLO 17, AND MISSING LETTERS ON RULES OR MISSING RULE NUMBERS PERTAINING TO GUIDELINES OR RULINGS WILL BE FOUND IN THAT DOCUMENT.

ALSEP OPERATIONAL GUIDELINES

32-1 GENERAL

A. THESE ALSEP GENERAL OPERATIONAL GUIDELINES ARE BASED ON OBJECTIVES IN THE FOLLOWING PRIORITIES:

1. HFE
2. LSF
3. LSG
4. LMS
5. LEAM

NOTE

RIPPLE-OFF SEQUENCE IS:

1. PDR 1 (7 W)
2. PDR 2 (14 W)
3. LMS
4. LEAM
5. HFE

B. THROUGH H. REFERENCE EMRD FOR APOLLO 17

I. THE ALSEP SHORTING PLUG SWITCH WILL BE ACTIVATED ASAP AFTER CENTRAL STATION DEPLOYMENT.

J. IF THE GROUND IS UNABLE TO OBTAIN DOWNLINK, THE GROUND WILL REQUEST THE ASTRONAUT TO ROTATE THE RESET POWER SWITCH CW AND THEN CCW.

K. REFERENCE APOLLO 17 EMRD

L. A SINGLE COMMAND CARRIER WILL BE MAINTAINED ON AND IN THE SAFED CONFIGURATION EXCEPT TO SEND COMMANDS AND REMOTE SITE HANDOVERS FROM DEPLOYMENT INITIATION UNTIL AFTER LM LIFT-OFF TO PROVIDE ADDITIONAL PROTECTION AGAINST THE GENERATION OF SPURIOUS COMMANDS.

M. THE HFE BORE HOLES WILL HAVE PRIORITY OVER THE DRILL CORE STEM. THE HFE BORE HOLES WILL BE ATTEMPTED FIRST. IF PROBLEMS ARE ENCOUNTERED, EFFORTS ON BORE HOLES WILL BE TERMINATED AFTER A TOTAL OF 20 MINUTES ACCUMULATED DRILL ON TIME.

R	ITEM
	32-1 (CONT)

N. IF A HARD OBJECT IS ENCOUNTERED WHICH REDUCES DRILL RATE TO LESS THAN 5 INCHES PER MINUTE ON EITHER HFE PROBE HOLE, THE FOLLOWING WILL BE ACCOMPLISHED:

1. IF THE SECOND STEM SECTION IS NOT ATTACHED, WITHDRAW AND START AT A NEW LOCATION FOR A MAXIMUM OF TWO WITHDRAWALS.

2. IF THE SECOND STEM SECTION IS ATTACHED, CONTINUE UNTIL 10 MINUTES OF POWER ON TIME FOR DRILL STRING HAS ELAPSED.

O. REFERENCE APOLLO 17 EMRD

P. IF THE CREW MUST RETURN TO THE LM PRIOR TO COMPLETE ALSEP DEPLOYMENT, THE SHORTING PLUG SWITCH WILL BE ACTIVATED "ON" IF THE ANTENNA IS EMPLACED. IF THE ANTENNA IS NOT EMPLACED, THIS SWITCH WILL NOT BE ACTIVATED (PICK UP HERE ON EVA 2)

Q. THROUGH R. REFERENCE APOLLO 17 EMRD

S. FOR ANY MALFUNCTION DURING A SURFACE TASK, A MAXIMUM OF 10 MIN WILL BE SPENT ON THE CONTINGENCY PROCEDURE BEFORE THE TASK IS ABANDONED, WITH THE FOLLOWING EXCEPTIONS:

1. RTG FUELING - UP TO 20 MIN WILL BE ALLOWED IN EXERCISING RTG FUELING CONTINGENCY PROCEDURES.

2. ALSEP PACKAGE 1 TO PACKAGE 2 CABLE CONNECTIONS - UP TO 20 MIN WILL BE ALLOWED FOR MAKING THE CABLE CONNECTION.

3. ALSEP ANTENNA - UP TO 30 MIN WILL BE ALLOWED FOR ANTENNA ERECTION AND ALIGNMENT.

4. ALSEP DEPLOYMENT MAY BE CONTINUED ON A LATER EVA IF ADDITIONAL TIME TO SPEND ON CONTINGENCY PROCEDURES IS REQUIRED TO ATTAIN AN OPERATIONAL ALSEP.

T. FOR EVA TERMINATION OR OTHER INTERRUPTIONS DURING ALSEP DEPLOYMENT, THE FOLLOWING DEPLOYMENT INTERRUPTION POINTS WILL BE OBSERVED IF PERMITTED BY CREW SAFETY CONSIDERATION:

1. REMOVE ALSEP PACKAGES 1 AND 2. CLOSE SEQ. BAY DOOR. REPLACE ALSEP PACKAGES WITH HANDLES UP AND WITH EXPERIMENTS FACING THE SUN WITHIN ±15°.

2. TILT FUEL CASK (DOME NOT REMOVED).

3. TILT FUEL CASK. REMOVE DOME. DO NOT DEFUEL.

4. FUEL RTG. THEN CARRY ALSEP TO DEPLOYMENT SITE. REMOVE ALL COMPONENTS FROM PACKAGE 2. CARRY PACKAGE 1 TO EMPLACEMENT SITE. DO NOT CONNECT RTG CABLE TO CS UNLESS SUFFICIENT TIME IS AVAILABLE TO ERECT THE CS SUNSHIELD.

5. CONNECT HFE CABLE TO CS. REMOVE PSE, ASE, AND LSM FROM SUBPACKAGE 1. ALIGN CS AND RAISE SUNSHIELD. MOUNT ANTENNA MAST, GIMBAL, AND ANTENNA. LEVEL AND ALIGN ANTENNA, DEPRESS SHORTING PLUG ON WAY BACK TO LM.

6. DEPLOY ALSEP EXPERIMENTS AND COMPLETE TASKS. A HOLD POINT EXISTS AFTER EACH TASK IS COMPLETED. DEPRESS SHORTING PLUG SWITCH AND ROTATE ASTRO SWITCH 1 CLOCKWISE ON WAY BACK TO LM (SEE CONTINGENCY PROCEDURES FOR HOLD POINTS).

R	ITEM	
	32-1 (CONT)	U. IF ALL SPOTS ON TEMP LABLE ON HORSE COLLAR ARE BLACK AFTER FUELING RTG, CREW MUST NOT TOUCH SHORTING PLUG UNTIL IT HAS COOLED SUFFICIENTLY (10 MIN ON PKG 1). V. ALSEP DEPLOYMENT WILL NOT BE STARTED IF IT IS KNOWN THAT LESS THAN 1 HR 30 MIN IS AVAILABLE FOR ALSEP IN EVA 1.
	32-2 AND 32-3	REFERENCE APOLLO 17 EMRD
	32-4	A. REFERENCE APOLLO 17 EMRD B. THE CREW WILL REPORT RECHECK OF THE LSG LEVEL AND ALIGNMENT AFTER EXPERIMENT UNCAGING.
	32-5	A. REFERENCE APOLLO 17 EMRD B. THE LSP CHARGES WILL BE DEPLOYED IN LINE OF SIGHT WITH THE LSP XMTR ANTENNA AND IN AN AREA WHERE THE CHARGE WILL HAVE UNIFORM CONTACT WITH THE LUNAR SURFACE C. THROUGH D REFERENCE APOLLO 17 EMRD E. DEPLOYMENT OF THE LSP EXPLOSIVE PACKAGE (EP) WILL BE TERMINATED ANY TIME ONLY ONE SAFETY FEATURE REMAINS. THE FOLLOWING CONDITIONS MUST BE MET BEFORE THE EP CAN DETONATE: 1. ASTRO SW #2 ROTATED TO CW (ENABLE) POSITION. ENABLES 29 V TO THE LSP CENTRAL ELECTRONICS. 2. LSP "OPERATE" CMD (OCTAL 055) RECEIVED BY LSP CENTRAL ELECTRONICS. 3. LSP TRANSMITTER PULSES ENABLE CMD (OCTAL 156) RECEIVED BY LSP CENTRAL ELECTRONICS. 4. LSP FORMAT ON CMD (OCTAL 003) RECEIVED BY THE ALSEP CENTRAL STATION DDP. 5. TIME-OUT OF SAFE/ARM SLIDE TIMER TO THE ARM CONDITION. 6. TIME-OUT OF THERMAL BATTERY TIMER. STATUS OF EACH OF THESE SAFETY FEATURES DURING NORMAL CREW HANDLING IS AS FOLLOWS:

	FEATURES SAFED	TOTAL NUMBER SAFED
1. ALSEP DEPLOYMENT	1, 2, 3, 4, 5, 6	6
2. CHARGE DEPLOYMENT	2, 3, 4, 5, 6	5
3. LSP PASSIVE LISTENING	3, 5, 6	3

	MISSION	REV	DATE	SECTION	GROUP	PAGE	
	APOLLO 17	FNL	9/1/72	ALSEP	GENERAL	32-3	Tape 60.1

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	32-81	UNABLE TO DRILL NORMAL HFE EMPLACEMENT HOLES			
		A. IF EITHER HOLE IS LESS THAN 24 INCHES DEEP AND DRILL IS INOPERABLE		A.1. HAND-AUGER BORE STEMS INTO SUBSURFACE AT LEAST 40 INCHES 2. IF UNSUCCESSFUL INSERT PROBE INTO HOLE MADE BY A DOUBLE CORE TUBE. FILL HOLE AROUND PROBE. 3. IF UNABLE TO OBTAIN DEPTH >24 INCHES, DIG TRENCH APPROX. 4 FT LONG, SLOPING FROM 1 INCH DEEP AT ONE END TO APPROX. 18 INCHES DEEP AT OTHER END. PLACE PROBE IN TRENCH WITH CABLE AT SHALLOW END. COVER PROBE AND FIRST 6 FT OF CABLE WITH AS MUCH SOIL AS POSSIBLE.	
		B. NEITHER HOLE IS 24 INCHES DEEP AND DRILL IS STILL OPERABLE		B. DRILL DEEP CORE AT PROBE NO. 1 LOCATION AND INSERT PROBE IN HOLE THROUGH TREADLE, AND CAVE SOIL IN AROUND PROBE.	B. USE TREADLE AND EXTRACTOR TO HOLD SOIL IN PLACE. MOVE TREADLE AT LEAST 10 FEET DOWN THE CABLE TOWARD THE ELECTRONICS.
		C. IF HOLE IS NOT NOMINAL DEPTH		C. PLACE PROBE IN HOLE AS FAR AS IT WILL GO. EMPLACE LOWER RADATION SHIELD ON THE TOP OF THE PROBE REGARDLESS OF PROBE DEPTH.	
	32-82	HAVE CHOICE OF DRILLING SECOND HFE HOLE OR CORE SAMPLE HOLE		DRILL SECOND HFE PROBE EMPLACEMENT HOLE.	HFE HAS PRIORITY OVER CORE SAMPLE.
	32-83	DRILL RATE REDUCED TO LESS THAN 5 INCHES PER MINUTE		A. IF LESS THAN TWO STEM SECTIONS ARE ATTACHED TO THE POWER HEAD, WITHDRAW AND START AT NEW LOCATION FOR MAXIMUM OF TWO WITHDRAWALS. B. IF TWO OR MORE STEM SECTIONS ARE ATTACHED TO THE POWER HEAD, CONTINUE UNTIL 10 MINUTES OF POWER ON TIME FOR THE DRILL STRING HAS ELAPSED.	
	32-84 THRU 32-110	REFERENCE APOLLO 17 EMRD			

SECTION 33 IS DELETED.
REFERENCE LUNAR ORBIT
EXPERIMENT MISSION
RULES IN SECTION 3 OF
THIS DOCUMENT.

THIS SECTION WAS DELETED
TO ELIMINATE DUPLICATION
OF RULES IN SECTION 3
OF THIS DOCUMENT.

33 LUNAR ORBIT EXPERIMENTS

APPENDICES

A ACRONYMS AND SYMBOLS

R	ITEM

ACRONYMS

AC	ALTERNATING CURRENT
ACA	ATTITUDE CONTROLLER ASSEMBLY
ACCEL	ACCELEROMETER
ACCUM	ACCUMULATOR
ACS	ATTITUDE CONTROL AND STABILIZATION SYSTEM
ACT	ACTUATOR
ADEG	AUXILIARY DISPLAY EQUIPMENT GROUP
AEA	ABORT ELECTRONICS ASSEMBLY
AELD	ASCENT ENGINE LATCHING DEVICE
AFD	ASSISTANT FLIGHT DIRECTOR
AFETR	AIR FORCE EASTERN TEST RANGE
A/G	AIR-TO-GROUND
AGS	ABORT GUIDANCE SECTION
ALDS	APOLLO LAUNCH DATA SYSTEM
ALT	ALTERNATE
AM	AMPLITUDE MODULATION
AMP	AMPERE(S)
ANT	ANTENNA
AOA	ANGLE OF ATTACK
AOH	APOLLO OPERATIONS HANDBOOK
AOT	ALIGNMENT OPTICAL TELESCOPE
APS	ASCENT PROPULSION SYSTEM
APS	AUXILIARY PROPULSION SYSTEM
ARIA	APOLLO RANGE INSTRUMENTATION AIRCRAFT
ASA	ABORT SENSOR ASSEMBLY
ASAP	AS SOON AS PRACTICAL
ASC	ASCENT
ATCA	ATTITUDE AND TRANSLATION CONTROLLER ASSEMBLY
ATP	ALTERNATE TARGET POINT
ATT	ATTITUDE
AUX	AUXILIARY
AZUSA	ELECTRONIC TRACKING AND VECTORING SYSTEM, ETR
BA	BANK ANGLE
BAP	BEST ADOPTIVE PATH
BAT	BATTERY
BDA	BERMUDA, MSFN REMOTED SITE
B/H	BLOCK HOUSE
BMAG	BODY MOUNTED ATTITUDE GYRO
BRSO	BERMUDA RANGE SAFETY OFFICER
BSE	BOOSTER SYSTEMS ENGINEER
BTU	BRITISH THERMAL UNIT
CAL	CALIBRATE
CASTS	COUNTDOWN AND STATUS TRANSMISSION SYSTEM
CB	CIRCUIT-BREAKER
CCATS	COMMAND, COMMUNICATIONS, AND TELEMETRY SYSTEM
CCW	COUNTERCLOCKWISE
CDH	CONSTANT DELTA HEIGHT
CDP	COMMAND DATA PROCESSOR
CDR	COMMANDER
CDU	COUPLING DATA UNIT
CES	CONTROL ELECTRONICS SYSTEM
CEVT	CONTINGENCY EXTRAVEHICULAR TRANSFER
CFM	CUBIC FEET PER MINUTE
CIF	CENTRAL INSTRUMENTATION FACILITY
CIM	COMPUTER INPUT MATRIX
CKT	CIRCUIT
CLTC	CHIEF LAUNCH VEHICLE TEST CONDUCTOR
CM	COMMAND MODULE
CMC	COMMAND MODULE COMPUTER
CMD	COMMAND
CMP	COMMAND MODULE PILOT
C/O	CUTOFF
CO2	CARBON DIOXIDE
COAS	CREW OPTICAL ALIGNMENT SIGHT
COI	CONTINGENCY ORBIT INSERTION
COMM	COMMUNICATION
CONF	CONFERENCE
CONTROL	LM GNC SYSTEMS ENGINEER
CP	COMMUNICATIONS PROCESSOR
CRO	CARNARVON, MSFN REMOTED SITE
CRYO	CRYOGENICS

R	ITEM	
		CSI — CONCENTRIC SEQUENCE INITIATE
		CSM — COMMAND SERVICE MODULE
		CTE — CENTRAL TIMING EQUIPMENT
		CVS — CONTINUOUS VENT SYSTEM
		CVTS — CHIEF VEHICLE TEST SUPERVISOR
		CW — CLOCKWISE
		C&W — CAUTION AND WARNING
		CYI — CANARY ISLAND
		DAP — DIGITAL AUTO PILOT
		DB — DEADBAND
		DC — DIRECT CURRENT
		DCA — DIGITAL COMMAND ASSEMBLY
		DCS — DIGITAL COMMAND SYSTEM
		DDD — DIGITAL DISPLAY DRIVER
		DECA — DESCENT ENGINE CONTROL ASSEMBLY
		DEDA — DATA ENTRY AND DISPLAY ASSEMBLY
		DEG — DEGREE
		DESC — DESCENT
		DFI — DEVELOPMENT FLIGHT INSTRUMENTATION
		DIC — DPS INSERTION CAPABILITY
		DK — DOCK
		DKD — DOCKED
		DOD — DEPARTMENT OF DEFENSE
		DPS — DESCENT PROPULSION SYSTEM
		DRA — DISCRETE RECOVERY AREA
		DRS — DATA RECEIVING STATION
		DSC — DYNAMIC STANDBY COMPUTER
		DSE — DATA STORAGE EQUIPMENT
		DSKY — DISPLAY KEYBOARD
		DTO — DETAILED TEST OBJECTIVE
		D/TV — DIGITAL TO TELEVISION
		ECS — ENVIRONMENTAL CONTROL SYSTEM
		EDS — EMERGENCY DETECTION SYSTEM
		EECOM — ELECTRICAL, ENVIRONMENTAL, AND COMMUNICATIONS
		EKG — ELECTROCARDIOGRAM
		EMR — ERROR MONITOR REGISTER
		EMRD — EXPERIMENTS MISSION RULE DOCUMENT
		EMS — ENTRY MONITORING SYSTEM
		EMU — EXTRAVEHICULAR MOBILITY UNIT
		ENG — ENGINE
		EPS — ELECTRICAL POWER SYSTEM
		ERR — ERROR
		ESE — ELECTRONIC SUPPORT EQUIPMENT
		ETDM — RANGE SAFETY SUPERVISOR, KSC CALLOUT
		ETR — EASTERN TEST RANGE
		EVA — EXTRAVEHICULAR ACTIVITY
		EVAP — EVAPORATOR
		EVT — EXTRAVEHICULAR TRANSFER
		EVVA — EXTRAVEHICULAR VISOR ASSEMBLY
		F/A — FORWARD/AFT
		FC — FUEL CELL OR FLIGHT CONTROL
		FCSM — FLIGHT COMBUSTION STABILITY MONITOR
		FD — FLIGHT DIRECTOR
		FDAI — FLIGHT DIRECTOR ATTITUDE INDICATOR
		FDO — FLIGHT DYNAMICS OFFICER
		FIDO — FLIGHT DYNAMICS OFFICER
		FIG — FIGURE
		FITH — FIRE IN THE HOLE
		FL — FULL LIFT
		FM — FREQUENCY MODULATION
		FPS — FEET PER SECOND
		FQR — FLIGHT QUALIFICATION RECORDER
		FTP — FIXED THROTTLE POINT
		G — GRAVITY
		G&C — GUIDANCE AND CONTROL
		GASTA — GIMBAL ANGLE SEQUENCE TRANSLATION ASSEMBLY
		GBI — GRAND BAHAMA ISLAND

R	ITEM

GCTA	GROUND COMMAND TV ASSEMBLY
GDA	GIMBAL DRIVE ASSEMBLY
GDC	GYRO DISPLAY COUPLER
GET	GROUND ELAPSED TIME
GETI	GROUND ELAPSED TIME OF IGNITION
GMT	GREENWICH MEAN TIME
GMTLO	GREENWICH MEAN TIME OF LIFTOFF
G&N	GUIDANCE AND NAVIGATION
GN2	GASEOUS NITROGEN
GNC	GUIDANCE, NAVIGATION, AND CONTROL
GNCS	GUIDANCE, NAVIGATION, AND CONTROL SYSTEM
GND	GROUND
GRR	GUIDANCE REFERENCE RELEASE
GRS	GAMMA-RAY SPECTROMETER
GSFC	GODDARD SPACE FLIGHT CENTER
GTS	GIMBAL TRIM SYSTEM
GUIDO	GUIDANCE OFFICER
H2	HYDROGEN
H2O	WATER
Ha	HEIGHT OF APOGEE
HAW	HAWAII
HBR	HIGH BIT RATE
HF	HIGH FREQUENCY
HFE	HEAT FLOW EXPERIMENT
Hp	HEIGHT OF PERIGEE
HS	HIGH-SPEED
HZ	HERTZ
IC	INTERCOMMUNICATIONS EQUIPMENT
IGA	INNER GIMBAL AXIS
IMU	INERTIAL MEASUREMENT UNIT
INJ	INJECTOR
INST	INSTRUMENTATION
INV	INVERTER
IP	IMPACT POINT OR IMPACT PREDICTION
IRIG	INERTIAL RATE INTEGRATING GYRO
ISOL	ISOLATION
ISS	INERTIAL SUBSYSTEM
IU	INSTRUMENTATION UNIT
IVT	INTRAVEHICULAR TRANSFER
JD	JET DRIVER
KOH	POTASSIUM HYDROXIDE
KSC	KENNEDY SPACE CENTER
LB	POUND
LBR	LOW BIT RATE
LCG	LIQUID COOLING GARMENT
LCRU	LUNAR COMM RELAY UNIT
LEAM	LUNAR EJECTA AND METEORITES
LES	LAUNCH ESCAPE SYSTEM
LET	LAUNCH ESCAPE TOWER
LGC	LM GUIDANCE COMPUTER
LH2	LIQUID HYDROGEN
LiOH	LITHIUM HYDROXIDE
LM	LUNAR MODULE
LMDE	LM DESCENT ENGINE
LMP	LUNAR MODULE PILOT
LMS	LUNAR MASS SPECTROMETER
L/O	LIFT OFF
LOI	LUNAR ORBIT INSERTION
LOS	LINE-OF-SIGHT
LOX	LIQUID OXYGEN
L/R	LEFT/RIGHT
LRV	LUNAR ROVING VEHICLE
LSG	LUNAR SURFACE GRAVIMETER
LSP	LUNAR SEISMIC PROFILING
LV	LOW VOLTAGE
L/V	LAUNCH VEHICLE
LVDA	LAUNCH VEHICLE DATA ADAPTER
LVDC	LAUNCH VEHICLE DIGITAL COMPUTER

R	ITEM

MALF	MALFUNCTION
MC	MAPPING CAMERA
MCC	MISSION CONTROL CENTER
MCC	MIDCOURSE CORRECTION
MC&W	MASTER CAUTION AND WARNING
MDAS	MEDICAL DATA ACQUISITION SYSTEM
MED	MANUAL ENTRY DEVICE
MFSC	MASTER EVENTS SEQUENCE CONTROLLER
MFCO	MANUAL FUEL CUTOFF
MFV	MAIN FUEL VALVE
MGA	MIDDLE GIMBAL AXIS
MIL	MERRITT ISLAND
MITE	MASTER INSTRUMENTATION TIMING EQUIPMENT
MNFLD	MANIFOLD
M&O	MAINTENANCE AND OPERATION
MOC	MISSION OPERATIONS COMPUTER
MS	MASS SPECTROMETER
MSFN	MANNED SPACE FLIGHT NETWORK
MSK	MANUAL SELECT KEYBOARD
MSTC	CSM SPACECRAFT TEST CONDUCTOR
MTVC	MANUAL THRUST VECTOR CONTROL
MUX	MULTIPLEXER
NASA	NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
NCC	COMBINED CORRECTIVE MANEUVER
NM	NAUTICAL MILES
NPV	NON-PROPULSIVE VENT
NSR	COELLIPTICAL MANEUVER
O2	OXYGEN
O/B	ONBOARD
ODOP	OFFSET DOPPLER AND POSITION
OGA	OUTER GIMBAL AXIS
OMSF	OFFICE OF MANNED SPACE FLIGHT
OPS	OXYGEN PURGE SYSTEM
ORDEAL	ORBITAL RATE DRIVE ELECTRONICS APOLLO LM
OXID	OXIDIZER
PAFB	PATRICK AIR FORCE BASE
PAM	PULSE AMPLITUDE MODULATION
PB	PUSH-BUTTON
PC	PAN CAMERA
PC	PERICYNTHION
PCM	PULSE CODE MODULATION
PCMGS	PULSE CODE MODULATION GROUND STATION
PCO2	PARTIAL PRESSURE CARBON DIOXIDE
PDR	POWER DISSIPATION RESISTOR
PDS/DD	PLOTTING DISPLAY SUBCHANNEL/DATA DISTRIBUTION
P&FS	PARTICLES AND FIELDS SUBSATELLITE
PGA	PRESSURE GARMENT ASSEMBLY
PGNCS	PRIMARY GUIDANCE AND NAVIGATION CONTROL SYSTEM, CSM
PGNS	PRIMARY GUIDANCE AND NAVIGATION SYSTEM, LM
PIPA	PULSE INTEGRATING PENDULOUS ACCELEROMETER
PLSS	PORTABLE LIFE SUPPORT SYSTEM
PO	POWER OUT
PO2	PARTIAL PRESSURE OXYGEN
POS	POSITION
POS	PRIMARY OXYGEN SYSTEM
PPM	PARTS PER MILLION
PQGS	PROPELLANT QUANTITY GAGING SYSTEM
PRELN	PRELAUNCH
PRESS	PRESSURE
PRI	PRIMARY
PROC	PROCEDURE
PROP	PROPELLANT
PSA	POWER SERVO AMPLIFIER
PSI	POUNDS PER SQUARE INCH
PSID	POUNDS PER SQUARE INCH DIFFERENTIAL
PSS	PAD SAFETY SUPERVISOR
PTA	PULSE TORQUE ASSEMBLY
PTP	PREFERRED TARGET POINT
PTV	PITCH THRUST VECTOR
PU	PROPELLANT UTILIZATION
PUGS	PROPELLANT UTILIZATION AND GAGING SYSTEM
PVT	PRESSURE-VOLUME-TEMPERATURE
PYRO	PYROTECHNICS

R	ITEM	
		QTY — QUANTITY
		RAD — RADIATOR
		RET — RETRACT
		RCS — REACTION CONTROL SYSTEM
		RCU — REMOTE CONTROL UNIT
		RCVR — RECEIVER
		REF — REFERENCE
		REFSMMAT — REFERENCE TO STABLE MEMBER MATRIX
		REQD — REQUIRED
		RETRB — RETRO ELAPSED TIME TO REVERSE B
		RETRO — RETROFIRE OFFICER
		REV — REVOLUTION
		RF — RADIO FREQUENCY
		RFO — RETROFIRE OFFICER
		RGA — RATE GYRO ASSEMBLY
		RHC — ROTATION HAND CONTROLLER
		RIP — RANGE OF IMPACT POINT
		RL — ROLL LEFT
		RNDZ — RENDEZVOUS
		RP-RT — DOWNRANGE ERROR
		RR — RENDEZVOUS RADAR
		RR — ROLL RIGHT
		RSI — ROLL STABILITY INDICATOR
		RSO — RANGE SAFETY OFFICER
		RSVR — RESOLVER
		RTACF — REAL-TIME AUXILIARY COMPUTING FACILITY
		RTC — REAL-TIME COMMAND
		RTCC — REAL-TIME COMPUTER COMPLEX
		S/C — SPACECRAFT
		SCE — SIGNAL CONDITIONING EQUIPMENT
		SCS — STABILIZATION AND CONTROL SYSTEM
		SDS — SCIENTIFIC DATA SYSTEM
		SEC — SECONDARY
		SEC — SECOND
		SECO — SUSTAINER ENGINE CUTOFF, S-IVB CUTOFF
		SECS — SEQUENTIAL EVENTS CONTROL SYSTEM
		SEP — SURFACE ELECTRICAL PROPERTIES
		SHe — SUPER-CRITICAL HELIUM
		SIG — SIGNAL
		SLA — SPACECRAFT LM ADAPTER
		SLV — SATURN LAUNCH VEHICLE
		SM — SERVICE MODULE
		SMJC — SERVICE MODULE JETTISON CONTROLLER
		SODB — SPACECRAFT OPERATIONAL DATA BOOK
		SOL — SOLENOID
		SOP — STANDARD OPERATING PROCEDURE
		SOV — SHUT-OFF VALVE
		SPAN — SPACECRAFT PLANNING AND ANALYSIS
		SPS — SERVICE PROPULSION SYSTEM
		SRO — SUPERINTENDENT RANGE OPERATIONS
		SSC — SPACE SUIT COMMUNICATOR
		STBY — STANDBY
		SW — SWITCH
		SXT — SEXTANT
		TB — TIME BASE
		TBD — TO BE DETERMINED
		TC — TEST CONDUCTOR
		T/C — TELEMETRY AND COMMUNICATIONS
		TCE — CONDENSER EXHAUST TEMPERATURE
		TCP — THRUST CHAMBER PRESSURE
		TD&E — TRANSPOSITION, DOCKING, AND EJECTION
		TDP — TELEMETRY DATA PROCESSOR
		TELCOM — LM EECOM
		TEMP — TEMPERATURE
		TFF — TIME OF FREE FALL
		THC — THRUST AND CONTROLLER
		TIG — TIME OF IGNITION
		TLI — TRANSLUNAR INJECTION
		TM — TELEMETRY
		TMG — THERMAL METEROID GARMENT
		TNK — TANK
		TOK — THRUST OKAY

R	ITEM

TPF	TERMINAL PHASE FINALIZATION
TPI	TERMINAL PHASE INITIATE
TRNS	TRANSFER
TRUN	TRUNNION
TTC	TRANSLATION THRUST CONTROLLER
TTY	TELETYPE
TVC	THRUST VECTOR CONTROL
U/D	UP/DOWN
UDL	UPDATA LINK
UHF	ULTRAHIGH FREQUENCY
UNDKD	UNDOCKED
USB	UNIFIED S-BAND
VC	VELOCITY COUNTER
VEI	INERTIAL VELOCITY AT ENTRY
VGX	VELOCITY TO BE GAINED X-AXIS
VGY	VELOCITY TO BE GAINED Y-AXIS
VGZ	VELOCITY TO BE GAINED Z-AXIS
VHF	VERY HIGH FREQUENCY
VLV	VALVE
VSM	VIDEO SWITCHING MATRIX
WBD	WIDE-BAND DATA
WMS	WASTE MANAGEMENT SYSTEM
WT	WEIGHT
XFEED	CROSSFEED
XMIT	TRANSMIT
XMTR	TRANSMITTER
Y	YAW OR Y-AXIS
YTV	YAW THRUST VECTOR
Z	Z-AXIS

SYMBOLS

H	ALTITUDE
ΔVIN	DELTA VELOCITY IN INSERTION
ΔTB	DELTA BURN TIME
ΔH	DELTA ATTITUDE

B DISTRIBUTION LIST

R | ITEM

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C CHANGE CONTROL

R	ITEM

CHANGE CONTROL

1.0 INTRODUCTION

1.1 PURPOSE

THE PURPOSE OF THIS APPENDIX IS TO DELINEATE CHANGE CONTROL PROCEDURES FOR THE MISSION RULES. THIS WILL INSURE THE PROPER COORDINATION OF CHANGES, PROVIDE A RECORD OF PROPOSED CHANGES (INCLUDING THE RATIONALE FOR MAKING THEM), AND WILL PROVIDE A MEANS FOR PROMULGATING INDIVIDUAL RULE UPDATES BETWEEN REVISIONS (INTERIM CHANGES).

1.2 EFFECTIVITY

SEPTEMBER 1, 1972

2.0 CHANGE PROCEDURES

2.1 SUBMISSION OF CHANGES

PROPOSED CHANGES ARE SOLICITED FROM ANY INDIVIDUAL OR ORGANIZATION HAVING A VALID INPUT. CHANGES ORIGINATING OUTSIDE THE FLIGHT CONTROL TEAM WILL BE SUBMITTED DIRECTLY TO THE ASSISTANT FLIGHT DIRECTOR (AFD). CHANGES ORIGINATING WITHIN THE FLIGHT CONTROL TEAM WILL BE SUBMITTED TO THE AFD VIA THE PRIME MISSION OPERATIONS CONTROL ROOM (MOCR) POSITION CONCERNED.

2.1.1 FORMAT

PERSONS DESIRING TO SUBMIT A PROPOSED CHANGE WILL COMPLETE ALL ITEMS ON THE FORM SHOWN IN FIGURE C-1 (FORM MUST BE TYPED). ADDITIONAL PAGES MAY BE USED IF THE SPACE PROVIDED IS NOT ADEQUATE. THE COMPLETED ORIGINAL FORM AND ONE COPY WILL THEN BE FORWARDED TO THE AFD.

THE AFD WILL REVIEW THE FORM FOR COMPLETENESS AND PROPER MISSION RULE FORMAT, AND MAKE CORRECTIONS AS REQUIRED. THE ORIGINATOR WILL BE ADVISED OF ANY SUCH CHANGES.

2.2 APPROVAL

2.2.1 COORDINATION

THE ORIGINATOR OF THE CHANGE MAY OBTAIN PRELIMINARY CONCURRENCES. THE AFD WILL, HOWEVER, OBTAIN FORMAL CONCURRENCES OR DISAPPROVALS (VERBALLY OR BY INITIATING) FROM THE NECESSARY PERSONNEL. VERBAL CONCURRENCES WILL BE INDICATED IN THE APPROPRIATE SIGNATURE BOX.

2.2.2 SIGNOFF/DISAPPROVAL

UPON OBTAINING THE REQUIRED CONCURRENCES OR NEGATIVE COMMENTS, THE AFD WILL PRESENT THE PROPOSED CHANGE TO THE FLIGHT DIRECTOR FOR FINAL APPROVAL OR DISAPPROVAL. THE AFD MAY SIGN OFF OR DISAPPROVE PROPOSED CHANGES IN THE ABSENCE OF THE FLIGHT DIRECTOR.

2.2.3 DISAPPROVED CHANGES

IF A CHANGE IS DISAPPROVED THE AFD WILL RETURN THE COPY TO THE ORIGINATOR. A COPY OF THE REQUESTED CHANGE WILL BE RETAINED FOR FUTURE REFERENCE.

R	ITEM

2.3 PUBLICATION AND DISTRIBUTION OF INTERIM CHANGES

INTERIM CHANGES WILL BE DISTRIBUTED VIA AN ABBREVIATED DISTRIBUTION LIST CONSISTING OF THE MISSION CONTROL TEAM, PERTINENT NASA ORGANIZATIONS, AND THE APPROPRIATE VEHICLE CONTRACTOR(S).

3.0 REVISIONS

3.1 DEVELOPMENT

THE AFD WILL COMPILE THE EFFECTIVE INTERIM CHANGES AND CORRECTIONS OF MINOR TYPOGRAPHICAL ERRORS INTO COMPLETE PAGE CHANGES TO THE BASIC DOCUMENT. ("PEN AND INK" CHANGES MAY BE USED TO CORRECT TYPOGRAPHICAL ERRORS IF THERE ARE NO OTHER CHANGES IN THE PAGE CONCERNED).

3.2 APPROVAL

SINCE ALL INTERIM CHANGES WILL HAVE RECEIVED PRIOR CONCURRENCES AND APPROVAL, ONLY THE FLIGHT DIRECTOR (OR THE AFD IN THE FLIGHT DIRECTOR'S ABSENCE) WILL BE REQUIRED TO APPROVE REVISIONS.

3.3 PUBLICATION

3.3.1 SCHEDULE

REVISIONS WILL BE MADE ON AN "AS REQUIRED" BASIS.

3.3.2 DISTRIBUTION

REVISIONS WILL BE PRINTED AND DISTRIBUTED THROUGH THE NORMAL ADMINISTRATIVE CHANNELS.

NASA-MANNED SPACECRAFT CENTER
MISSION RULE REQUEST/REVISION

DATE _____

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	NOTES/COMMENTS

CHANGE RATIONALE: ☐ NEW TECHNICAL DATA ☐ CLARIFICATION

ORIGINATOR: _____ NAME _____ ORGANIZATION _____ EXT

APPROVED: _____ COGNIZANT BRANCH CHIEF

APPROVED: _____ FLIGHT DIRECTOR

AFD: _____ CAPCOM: _____	BSE: _____ O&P: _____	FIDO: _____	AEROMED: _____	GUIDO: _____ RETRO: _____	CONTROL: _____ GNC: _____	TELCOM: _____ EECOM: _____	OTHER: _____

MSC FORM 1555 (Rev. Dec 68)

FIGURE C-1. - MISSION RULE CHANGE REQUEST FORM

☆ U.S. GOVERNMENT PRINTING OFFICE: 1972—779-469/428

NASA — MSC

APOLLO

FFMR

FINAL FLIGHT MISSION RULES

APOLLO 17
(AS-514/114/LM-12)

SEPTEMBER 1, 1972

FCD
MSC
NASA

Parker

MSC-01807

APOLLO 17

FINAL FLIGHT MISSION RULES

REV A

PREFACE

THIS DOCUMENT CONTAINS REVISION A TO THE FINAL FLIGHT MISSION RULES FOR APOLLO 17 AS OF NOVEMBER 10, 1972. ALL SUBSEQUENT REVISIONS TO THIS DOCUMENT WILL BE PRINTED ON A DIFFERENT COLORED PAPER FOR EASY RECOGNITION.

THIS DOCUMENT HAS BEEN PREPARED BY THE FLIGHT CONTROL DIVISION, MANNED SPACECRAFT CENTER, HOUSTON, TEXAS, WITH TECHNICAL ASSISTANCE BY LTV/KENTRON HAWAII, LTD.

IT IS REQUESTED THAT ANY ORGANIZATION HAVING COMMENTS, QUESTIONS, OR SUGGESTIONS CONCERNING THESE MISSION RULES CONTACT MR. JOHN H. TEMPLE, FLIGHT OPERATIONS AND RECOVERY BRANCH, BUILDING 30, ROOM 2058, PHONE 713-483-4126.

ANY REQUESTS FOR ADDITIONAL COPIES OR CHANGES TO THE DISTRIBUTION LIST IN APPENDIX B OF THIS DOCUMENT MUST BE MADE IN WRITING TO MR. HOWARD W. TINDALL, JR., DIRECTOR OF FLIGHT OPERATIONS, MANNED SPACECRAFT CENTER, HOUSTON, TEXAS.

THIS IS A CONTROL DOCUMENT AND ANY CHANGES ARE SUBJECT TO THE CHANGE CONTROL PROCEDURES DELINEATED IN APPENDIX C. THIS DOCUMENT IS NOT TO BE REPRODUCED WITHOUT THE WRITTEN APPROVAL OF THE CHIEF, FLIGHT CONTROL DIVISION, MANNED SPACECRAFT CENTER, HOUSTON, TEXAS.

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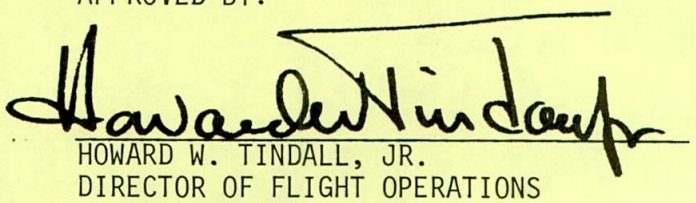

HOWARD W. TINDALL, JR.
DIRECTOR OF FLIGHT OPERATIONS

APOLLO 17

FINAL FLIGHT MISSION RULES

REV A

REVISION INSTRUCTION SHEET

Update this document in accordance with the following instructions:

Remove and replace the following pages:

ii	5-24	32-4
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5-16	32-1	
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Add the following new page:

iia

R	ITEM	
	1-44	LUNAR ABORT MODES AFTER EARLY LOI SHUTOFF (REFERENCE RULE 5-61 FOR ABORT MANEUVER DEFINITION) DPS: A. MODE I - 0 TO 613 FPS (IGN TO 1 + 31) B. MODE II - 613 TO 1200 FPS (1 + 31 TO 2:54) C. MODE III - 1200 TO 2980 (2 + 54 TO C/O)
A	1-45	SATURN L/V TIME BASES

TIME BASE	DEFINITION	NOMINAL INITIATE TIME
TB1	LIFTOFF TO S-IC INBOARD ENGINE CUTOFF	0:00
TB2	S-IC INBOARD ENGINE CUTOFF TO S-IC OUTBOARD ENGINE CUTOFF (S-IC/S-II STAGING)	2:19
TB3	S-IC OUTBOARD ENGINES CUTOFF TO S-II CUTOFF (S-II/S-IVB STAGING)	2:41
TB4	S-II CUTOFF TO S-IVB FIRST BURN CUTOFF	9:20
TB5	S-IVB FIRST BURN CUTOFF TO S-IVB RESTART PREPARATIONS (RESTART MINUS 9 MIN 38 SEC)	11:50
TB6	S-IVB RESTART MINUS 9 MIN 38 SEC TO S-IVB SECOND BURN CUTOFF	3:11:41
TB7	S-IVB SECOND CUTOFF TO START OF S-IVB EVASIVE MANEUVER BURN	3:27:04
TB8	START EVASIVE BURN TO END OF S-IVB/IC LIFETIME.	5:31:00 (BY GROUND CMD)

RULE NUMBERS 1-45 THROUGH 1-47 ARE RESERVED.

R	ITEM
	2-27

LUNAR SURFACE EVA'S

A. FOR THE NOMINAL (TWO-MAN) EVA, TOTAL EMU LIFE SUPPORT SYSTEMS CAPABILITY AND CRITICAL INSTRUMENTATION FOR BOTH ASTRONAUTS ARE REQUIRED.

B. A ONE-MAN EVA MAY BE INITATED.

C. THE ACTIVATION OF THE OPS IN THE MAKEUP MODE WILL REQUIRE EXPEDITIOUS COMPLETION OF THE SPECIFIC ACTIVITY BEING PERFORMED, FOLLOWED BY IMMEDIATE RETURN IO THE LM. ACTIVATION OF THE OPS HIGH OR LOW PURGE MODE WILL REQUIRE IMMEDIATE RETURN TO THE LM.

D. THE OPERATIONAL EVA PLAN WILL BE CONSTRAINED TO A MAXIMUM DURATION OF 7 HOURS.

E. AN EVA TRAVERSE LIMIT WILL BE APPLIED ALLOWING ONE FAILURE (LRV OR PLSS) WITH THE CAPABILITY TO RETURN TO THE LM. THE MAXIMUM ACCEPTABLE CREW HEAT STORAGE IS 300 BTU'S.

F. ALL PLANNED EVA'S WILL INCLUDE A 30-MINUTE, POST-EVA RESERVE ON EMU CONSUMABLES.

1. TWO-MAN EVA

OPERATIONAL LRV

(A) EVA EXCURSIONS WILL BE LIMITED TO ALLOW PLSS WALKBACK ASSUMING NO PLSS FAILURES.

(B) EVA EXCURSIONS WILL BE LIMITED TO SUPPORT RIDEBACK WITH A FAILED PLSS, USING BSLSS AND THE OPS IN LOW PURGE FLOW. WITH NO BSLSS, A COMBINATION OF HI AND LO PURGE FLOW WILL BE USED FOR RETURN AND INGRESS WITH A PAD ADDED TO THE LO PURGE FLOW PHASE.

NO LRV AVAILABLE

(A) EVA EXCURSIONS WILL BE LIMITED TO A BSLSS WALKBACK CAPABILITY USING THE OPS IN LOW PURGE FLOW.

(B) WITH NO BSLSS, THE EVA EXCURSIONS WILL BE LIMITED, ALLOWING LM RETURN USING THE OPS IN HIGH PURGE FLOW.

2. ONE-MAN EVA

OPERATIONAL LRV

(A) EVA EXCURSIONS WILL BE LIMITED TO PLSS WALKBACK CAPABILITY ASSUMING NO PLSS FAILURES.

(B) EVA EXCURSIONS WILL BE LIMITED, ALLOWING DRIVEBACK AND INGRESS USING THE OPS IN A COMBINATION OF LO AND HI PURGE FLOW WITH A PAD ADDED TO THE LO PURGE FLOW PHASE.

NO LRV AVAILABLE

(A) EVA EXCURSIONS WILL BE LIMITED TO ALLOW WALKBACK TO THE LM, USING THE OPS IN HIGH PURGE FLOW.

G. COMMUNICATIONS

1. FOR THE NORMAL (TWO-MAN) EVA, MSFN UPLINK VOICE AND DOWNLINK VOICE FROM ONE CREWMAN (OR TV DOWNLINK) ARE THE MINIMUM COMMUNICATION REQUIREMENTS.

2. FOR NORMAL OPERATIONS, BOTH EVA CREWMEN WILL NOT REMAIN OUTSIDE OF MSFN COVERAGE FOR A PERIOD EXCEEDING 5 MINUTES. WITH LCRU/ANTENNA PROBLEMS PREVENTING COMM DURING A TRAVERSE, THE SURFACE OPERATIONS WILL CONTINUE IF MINIMUM COMM CAN BE RE-ESTABLISHED AT THE END OF EACH TRAVERSE LEG. (A)

3. WITH THE LOSS OF TOTAL LCRU COMM CAPABILITY, THE CREW WILL RETURN TO THE VICINITY OF THE LM AND RE-ESTABLISH COMM WITH THE MCC VIA LM RELAY.

4. WITH LOSS OF LM VHF COMMUNICATIONS THE CREW WILL EGRESS, ACTIVATE THE LCRU, AND CONTINUE NORMAL SURFACE OPERATIONS.

5. THE LCRU MAY BE HAND CARRIED TO EXTEND THE ALLOWABLE TRAVERSE DISTANCES FROM THE LM OR THE LRV (AS REQUIRED) TO MAINTAIN COMMUNICATIONS.

R	ITEM	
A	3-2	THE S-IVB EARLY STAGING WILL BE USED AFTER "S-IVB TO COI" CAPABILITY FOR THE FOLLOWING: S-II GIMBAL ACTUATOR INBOARD HARDOVER S-II LOSS OF CONTROL S-II ENGINE FAILURES S-IVB COLD He SHUTOFF VALVE(S) FAILS OPEN (AFTER TWR JETT) S-IVB CRYO REPRESS VLV FAILS OPEN (TIME DEPENDENT, REF. RULE 6-5)
	3-3	SWITCHOVER TO CSM GUIDANCE WILL BE PERFORMED FOR: SATURN GUIDANCE REFERENCE FAILURE
		RULE NUMBERS 3-4 THROUGH 3-10 ARE RESERVED.

R	ITEM	
		TRANSLUNAR COAST
	3-30	THE G&N WILL BE THE PRIMARY MODE OF EXECUTING TRANSLUNAR MCC.
A	3-31	MIDCOURSE CORRECTION NOMINAL EXECUTION POINTS WILL BE AT THE FOLLOWING: A. TLI C/O + 5 HOURS B. TLI C/O + 32 HOURS C. LOI - 22 HOURS D. LOI - 5 HOURS

R	ITEM	
	3-41	AT AOS AFTER DOI_1 THE REQUIREMENT FOR THE BAILOUT MANEUVER WILL BE DETERMINED BY EVALUATION OF THE THREE TRAJECTORY MONITORING SOURCES. THESE SOURCES - G&N, EMS, AND MSFN - WILL BE EXAMINED WITH THE FOLLOWING CRITERIA: A. IF MSFN RADAR DATA IS VALID AND REASONABLE, A STAY VOTE FROM MSFN IS REQUIRED TO REMAIN IN THE LOW ORBIT. B. IF MSFN RADAR DATA IS INVALID OR UNAVAILABLE, THE FOLLOWING CRITERIA APPLY: 1. IF THE G&N AND EMS ARE AVAILABLE, BOTH SOURCES MUST INDICATE STAY TO REMAIN IN THE LOW ORBIT. 2. IF ONLY ONE OF THE ONBOARD SOURCES (G&N, EMS) IS AVAILABLE, BOTH THAT SYSTEM AND BURN TIME MUST INDICATE STAY TO REMAIN IN THE LOW ORBIT. NOTES 1. THE EMS VOTE IS NO STAY IF THE EMS INDICATES A 18-FPS OVERSPEED AFTER TRIMMING THE G&N.
A		
		2. THE MSFN VOTE IS NO STAY IF THE INCOMING RADAR DATA INDICATES A CLOSEST APPROACH ALTITUDE OF EQUAL TO OR LESS THAN 1.0 NM ABOVE THE ACTUAL LUNAR
A		TERRAIN. THIS ALTITUDE CORRESPONDS TO A PERICYNTHION ALTITUDE OF 3.88 NM.
A		THE CORRESPONDING DOPPLER RESIDUALS ARE APPROXIMATELY -84 CYCLES PER SEC. BUT THE ACTUAL NUMBER WILL BE DETERMINED REAL TIME.
A		3. BURN TIME IS NO STAY IF AN OVERBURN OF 2.0 SECONDS IS INDICATED.
	3-42	THE FOLLOWING CRITERION APPLY TO DOI_2: A. VOICE CONFIRMATION OF CIRC IS REQUIRED FOR EXECUTION. B. DOI_2 WILL BE SCHEDULED AT LEAST 2 MIN AFTER CIRC. C. LM RCS BURN TIME WILL BE $\leq$ 30 SEC. D. TARGETED PERILUNE AT PDI WILL BE NO LESS THAN 40K FT.
	3-43	THE FOLLOWING RNDZ/RESCUE OPTIONS WILL BE UTILIZED AS NECESSARY FOR FAILURES REQUIRING TERMINATION OF LUNAR LANDING: A. FOR FAILURES FROM SEPARATION TO CIRCULARIZATION, THE NOMINAL RNDZ IS A P34 PROFILE WITH DOCKING OCCURRING 2 HRS AFTER SEP. B. FOR FAILURES FROM CIRCULARIZATION TO PDI, EXECUTE THE NO PDI +12 ABORT SEQUENCE WITH DOCKING IN ABOUT 3-1/4 HR. C. ABORT DURING POWERED DESCENT WILL INSERT THE LM INTO ORBIT UTILIZING THE ONBOARD VARIABLE ABORT TARGETING. FOR ABORTS DURING THE FIRST 11 MIN, DOCKING SHOULD OCCUR WITHIN 3-1/4 HR. FOR ABORTS AFTER 11 MIN, DOCKING WILL OCCUR WITHIN 5-1/4 HR. D. FOR COMPLETE LM FAILURES PRIOR TO PDI, THE CSM WILL EXECUTE A 5-IMPULSE RESCUE WITH DOCKING IN ABOUT 7-1/4 HR FROM PDI. RULE NUMBERS 3-44 THROUGH 3-48 ARE RESERVED.

R	ITEM	
	3-51	POWERED DESCENT WILL BE TERMINATED FOR THE FOLLOWING: A. PGNS NAVIGATION ERRORS, CONFIRMED BY MSFN OR DOPPLER RESIDUALS, THAT RESULT IN THE FOLLOWING AGS-PGNS VELOCITY DIFFERENCES: $\Delta\dot{X}$ (DOWNRANGE) GREATER THAN +90 OR -35 FPS $\Delta\dot{Y}$ (CROSSRANGE) GREATER THAN ±90 FPS $\Delta\dot{Z}$ (RADIAL) GREATER THAN +60 OR -35 FPS B. PGNS NAVIGATION ERRORS, CONFIRMED BY DOPPLER RESIDUAL BUT NOT BY AGS, THAT RESULT IN THE FOLLOWING MSFN-PGNS VELOCITY DIFFERENCES: $\Delta\dot{Y}$ (CROSSRANGE) GREATER THAN ±200 FPS $\Delta\dot{Z}$ (RADIAL) GREATER THAN +45 OR -35 FPS C. COMMANDED THRUST INCREASING PRIOR TO THROTTLE-DOWN OR P63 TGO = 80 SEC D. GTC GREATER THAN 57 PERCENT BY P63/64 PROGRAM SWITCH PLUS 15 SEC E. FAILURE TO ACHIEVE FTP (AUTO OR MANUAL) BY NOMINAL TIG PLUS 31 SEC. (ABORT AT GTC DIVERGENCE.) F. THE FOLLOWING PGNS ALARMS: 20105, 00214, 20430, 20607, 21103, 01107, 21204, 21302, 21501, 00402 (CONTINUING), 01406 (CONTINUING), 01410 (CONTINUING). G. VIOLATION OF THE TIME BIASED DPS ABORT BOUNDARY H. NO THROTTLE RECOVERY (AUTO OR MANUAL) WITHIN 40 SEC AFTER GTC EQUALS 57 PERCENT
A		
	3-52	AN ABORT WILL NOT BE PERFORMED FOR PGNS FAILURE AFTER OBTAINING PITCHOVER IN THE APPROACH PHASE.
	3-53	THE DESCENT TARGET POINT WILL BE SHIFTED DOWNTRACK IF GTC INDICATES NO THROTTLEDOWN BY P63/64 PROGRAM SWITCH. THE MAXIMUM SHIFT IS AS FOLLOWS: A. 20,000 FT DOWNTRACK IF VALID LANDMARK SIGHTINGS WERE OBTAINED. B. 10,000 FT DOWNTRACK IF NO VALID LANDMARK SIGHTINGS WERE OBTAINED. C. NO DOWNTRACK SHIFT WILL BE ALLOWED IF THE APPROACH AZIMUTH IS BETWEEN 95 AND 100 DEGREES. NOTE ONE MINUTE OF RCS WILL BE USED TO ALLOW LANDING WITHIN THE ABOVE LIMITS.
	3-54	IN THE EVENT MSFN AND DOPPLER DATA ARE NOT AVAILABLE FOR CONFIRMATION OF PGNS/AGS ERRORS, POWERED DESCENT WILL BE TERMINATED FOR THE FOLLOWING AGS-PGNS VELOCITY DIFFERENCES: $\Delta\dot{X}$ > -35 FPS $\Delta\dot{Z}$ > +60 OR -35 FPS

R	ITEM	
		LUNAR SURFACE EVA PHASE
	3-62	INITIATION/TERMINATION/CURTAILMENT

A. AFTER START OF A DRIVING TRAVERSE, THE TIMELINE WILL BE OPTIMIZED TO REMAIN WITHIN THE LRV DRIVING CAPABILITY TO RETURN TO THE LM.

B. IF LRV MOBILITY IS DEGRADED, THE FOLLOWING WILL BE EVALUATED TO ACCOMPLISH MAXIMUM SCIENTIFIC RETURN:

1. TRAVERSE DISTANCE
2. TIME AT EACH STOP
3. DELETION OF STOPS

C. THE LRV WILL BE UTILIZED BECAUSE OF ITS SCIENCE AND EQUIPMENT PAYLOAD CAPABILITY AND IIS ABILITY TO REDUCE METABOLIC RATES IF ITS SPEED IS APPROXIMATELY THE AVERAGE WALKING SPEED.

D. FOR EVA TERMINATION OR OTHER INTERRUPTIONS DURING ALSEP DEPLOYMENT, THE FOLLOWING PREFERRED DEPLOYMENT INTERRUPTION POINTS WILL BE OBSERVED IF PERMITTED BY CREW SAFETY CONSIDERATION:

1. REMOVE ALSEP PACKAGES 1 AND 2. CLOSE SEQ BAY DOOR. EMPLACE ALSEP PACKAGES WITH HANDLES UP AND EXPERIMENTS IN AND FACING THE SUN WITHIN ± 15°.

2. TILT FUEL CASK. DOME NOT REMOVED.

3. TILT FUEL CASK. REMOVE DOME. DO NOT DEFUEL.

A 4. FUEL RTG. CARRY ALSEP TO DEPLOYMENT SITE. REMOVE SUBPALLETS FROM PACKAGE 2. CARRY PACKAGE 1 TO EMPLACEMENT SITE. DO NOT ACTUATE SWITCHES.

A 5. CONNECT RTC, HFE AND LEAM CABLES TO C/S. REMOVE LSP GEOPHONE MODULE, LSG, AND LMS FROM SUBPACKAGE 1. ALIGN C/S AND RAISE SUNSHIELD. RAISE ANTENNA MAST, MOUNT GIMBAL, AND ANTENNA. LEVEL AND ALIGN ANTENNA. ROTATE SHORTING SWITCH TO ON BEFORE DEPARTING FOR LM.

A 6. DEPLOY ALSEP EXPERIMENTS AND COMPLETE TASKS. A HOLD POINT EXISTS AFIER EACH EXPERIMENI IS DEPLOYED. ROTATE SHORTING SWITCH TO ON BEFORE DEPARTING FOR LM.

E. IN REPLANNING THE LRV TRAVERSES BETWEEN EVA'S, BATTERY THERMAL MANAGEMENT TECHNIQUES WILL BE SCHEDULED AS NECESSARY TO KEEP THE PREDICTED LRV BATTERY TEMPS BETWEEN 40° F AND 125° F ON EVA'S 1 AND 2, AND BETWEEN 40° F AND 140° F ON EVA 3.

R	ITEM	
	3-63	PRECEDENCE/SCHEDULING GUIDELINES

A. FOR ANY MALFUNCTION ON A SURFACE TASK, A MAXIMUM OF 10 MINUTES WILL BE SPENT ON THE CONTINGENCY PROCEDURE BEFORE THE TASK IS ABANDONED, WITH THE FOLLOWING EXCEPTIONS:

1. RTG FUELING - UP TO 20 MINUTES WILL BE ALLOWED IN EXERCISING RTG FUELING CONTINGENCY PROCEDURES.

2. ALSEP PACKAGE 1 TO PACKAGE 2 CABLE CONNECTIONS - UP TO 20 MINUTES WILL BE ALLOWED FOR MAKING THE CABLE CONNECTION.

3. ALSEP ANTENNA - UP TO 30 MINUTES WILL BE ALLOWED FOR ANTENNA ERECTION AND ALIGNMENT.

4. LRV ANOMALIES - UP TO 10 MINUTES WILL BE ALLOWED FOR ISOLATING MALFUNCTIONS. UP TO 30 MINUTES WILL BE ALLOWED TO RECOVER UTILIZATION OF THE VEHICLE.

5. ALSEP DEPLOYMENT MAY BE CONTINUED ON A LATER EVA IF ADDITIONAL TIME TO SPEND ON CONTINGENCY PROCEDURES IS REQUIRED TO ATTAIN AN OPERATIONAL ALSEP.

B. IF A TASK IS NOT ABANDONED AND IS LEFT INCOMPLETE AT THE END OF AN EVA, IT WILL BE SCHEDULED DURING A SUBSEQUENT EVA CONSISTENT WITH ITS RANK WITHIN THE PRIORITIES DEFINED.

A C. ALSEP DEPLOYMENT WILL NOT BE STARTED IF IT IS KNOWN THAT LESS THAN 1 HR 15 MIN IS AVAILABLE FOR ALSEP IN EVA 1.

	3-64	LRV SYSTEMS/NAVIGATION

A. THERE ARE NO MINIMUM LRV SYSTEMS REQUIREMENTS WHICH WOULD CAUSE ABANDONMENT OF THE LRV IF THE CREW EVALUATES THE FOLLOWING AS ACCEPTABLE:

1. MOBILITY AND CONTROL
2. TRAVERSE RATE IS AT LEAST APPROXIMATELY EQUAL TO WALKING RATE
3. REDUNDANT LIFE SUPPORT CAPABILITY FOR LM RETURN

B. WITH A NONOPERATIONAL LRV NAVIGATION SYSTEM, ONE OF THE FOLLOWING RETURN TRAVERSE CAPABILITIES IS REQUIRED TO INITIATE OR CONTINUE A TRAVERSE:

1. REASONABLE VISUAL ACCESS OF THE LM
2. REASONABLE VISUAL ACCESS OF THE OUTBOUND TRAVERSE PATH
3. SUN RELATIVE BEARING TO THE LM

C. CONTINGENCY POWER/THERMAL MANAGEMENT AND/OR TRAVERSE ADJUSTMENT MUST BE EXERCISED TO KEEP THE LRV BATTERY TEMPERATURE BELOW 125° F ON EVA'S 1 AND 2 AND 140° F ON EVA 3. EXCEEDING THIS LIMIT WILL RESULT IN AN UNPREDICTABLE DEGRADATION OF BATTERY PERFORMANCE AND NAVIGATION ELECTRONICS.

D. THE LRV WILL NOT BE ABANDONED BECAUSE OF EXCESSIVE BATTERY TEMPERATURE(S).

R	ITEM	
	3-66	ALSEP
A		A. ALSEP SHORTING PLUG SWITCH WILL BE ROTATED ON ASAP AFTER CENTRAL STATION DEPLOYMENT.
A		B. IF THE GROUND IS UNABLE TO OBTAIN DOWNLINK, THE GROUND WILL REQUEST THE ASTRONAUT TO ROTATE THE RESET POWER SWITCH TO RESET AND THEN TO POWER.
A		C. IF THE CREW MUST RETURN TO THE LM PRIOR TO COMPLETE ALSEP DEPLOYMENT, THE SHORTING SWITCH WILL BE ROTATED "ON" IF THE ANTENNA IS EMPLACED. IF THE ANTENNA IS NOT EMPLACED, THIS SWITCH WILL NOT BE ROTATED (PICK UP HERE ON EVA 2).
		D. THE HFE WILL HAVE PRIORITY OVER DRILL CORE STEM. THE HFE BORE HOLES WILL BE ATTEMPTED FIRST. IF PROBLEMS ARE ENCOUNTERED, EFFORTS ON BORE HOLES WILL BE TERMINATED AFTER A TOTAL OF 20 MIN ACCUMULATED DRILL ON TIME.
		E. IF A HARD OBJECT IS ENCOUNTERED WHICH REDUCES DRILL RATE TO LESS THAN 5 INCHES PER MINUTE ON EITHER HFE PROBE HOLE, THE FOLLOWING WILL BE ACCOMPLISHED:
		1. IF THE SECOND STEM SECTION IS NOT ATTACHED, WITHDRAW AND START AT A DIFFERENT LOCATION FOR MAXIMUM OF TWO WITHDRAWALS.
		2. IF SECOND STEM IS ATTACHED, CONTINUE UNTIL 10 MINUTES OF POWER "ON" TIME FOR THE DRILL STRING HAS ELAPSED.
		F. IF UNABLE TO DRILL NORMAL HFE BORE HOLES, THE FOLLOWING SHOULD BE ACCOMPLISHED:
A		1. IF HFE BORE HOLE LESS THAN 40 INCHES, ATTEMPT TO INSERT PROBE INTO LUNAR SUBSURFACE BY HAND-AUGER AND HAMMERING BORE STEM, USE DOUBLE CORE TUBE HOLE, OR LAY PROBE ON SURFACE AND ORIENT BLACK TAPE ON CABLE NORTH/SOUTH, IN THAT ORDER.
A		2. IF BORE HOLE IS AT LEAST 40 INCHES DEEP, PLACE PROBE IN HOLE AS FAR AS IT WILL GO.
A		G. THE LSG WILL BE RECHECKED FOR LEVEL AND ALIGNMENT AND FREEDOM OF GIMBAL, AND READINGS REPORTED BY THE ASTRONAUT AFTER THE EXPERIMENT IS MANUALLY UNCAGED. IF OUTSIDE ± 3° AZ, ± 3° LEVEL, THE LSG WILL BE RELEVELED AND REALIGNED.
A		H. DELETED

R	ITEM
A	3-67

GEOPHYSICS EXPERIMENTS

A. IF THE TRAVERSE GRAVIMETER READING ON THE LRV IS DIFFERENT FROM READING ON THE SURFACE > 5 MGALS, A BIAS READING WILL BE INITIATED. IF THE GRAVIMETER HAS NOT SHIFTED, SUBSEQUENT READINGS WILL BE TAKEN ON THE SURFACE.

B. IF THE TRAVERSE GRAVIMETER PHASE LOCK LOOP IS NOT USABLE, SUBSEQUENT READINGS WILL BE TAKEN ON THE SURFACE IN BYPASS MODE. REFERENCE MSN RULES 31-102, 103, 104.

C. IF THE TRAVERSE GRAVIMETER INTERMEDIATE OVEN TEMPERATURE (DIGIT EIGHT) INDICATES A 6 OR 7 BEFORE THE EVA I ALSEP TRAVERSE IT WILL BE LEFT IN THE LM SHADOW WITH THE RADIATOR EXPOSED. IF 6 OR 7 PRIOR TO EVA II, III TRAVERSE, READINGS WILL BE TAKEN UNTIL UNREASONABLE DATA IS RECEIVED.

D. IF A READING IS DIFFERENT FROM THE BASE READING WITH TRENDS WHICH REACH > 60 MGAL OR SUDDEN SHIFTS > 20 MGALS, A BIAS READING WILL BE REQUESTED.

NOTE

ELEVATION DIFFERENCES WILL BE ELIMINATED
WHEN DETERMINING TRENDS OR SHIFTS.

E. IF THE LRV IS DISTURBED WHILE A READING IS IN PROCESS, THE STBY/ON SWITCH WILL BE CYCLED AND THE READING REINITIATED.

F. SEP EXPERIMENT THERMAL CONTROL WILL BE ACCOMPLISHED BY OPENING OR CLOSING OF THE RADIATOR COVERS, BRUSHING DUST FROM THE RADIATOR SURFACES, AND TURNING THE DSEA TAPE CASSETTE OFF AT TRAVERSE STOPS GREATER THAN 30 MINUTES, OR BY TURNING THE POWER CONTROL TO STBY.

G. SEP RADIATOR SURFACES WILL BE DUSTED:

1. PRIOR TO EACH COOL-DOWN PERIOD.
2. AT EACH TRAVERSE STOP AT WHICH THE COVERS ARE OPEN.

H. IF THE NEUTRON FLUX PROBE EXPERIMENT DOES NOT HAVE THE DRILL CORE HOLE AVAILABLE OR ENCOUNTERS DIFFICULTY IN PENETRATING THE CORE HOLE, ALTERNATE METHODS WILL BE USED TO IMPLACE THE EXPERIMENT TO A MINIMUM DEPTH OF 1 METER WITH AN EXPENDITURE OF UP TO 10 MINUTES ADDITIONAL TIME.

I. NO MORE THAN ONE MINUTE OF ACTIVE HAMMERING OR APOLLO LUNAR SURFACE DRILL IMPACTING WILL BE USED TO IMPLACE THE NEUTRON PROBE EXPERIMENT.

J. USE OF THE APOLLO LUNAR SURFACE DRILL FOR THE NEUTRON PROBE WILL BE RESTRICTED TO THE LOWER SECTION.

RULE NUMBERS 3-68 THROUGH 3-79 ARE RESERVED.

R	ITEM	
		MANEUVERS
	3-85	THE FOLLOWING GUIDELINES WILL APPLY TO LM MANEUVERS:
		A. TRIMMING
		1. DESCENT ABORTS/ASCENTS
A		(A) WITH COMM - TRIM CONTROLLING SYSTEM X-AXIS < 2 FPS, UNLESS GROUND ADVISES DIFFERENTLY.
A		(B) WITHOUT COMM - TRIM CONTROLLING SYSTEM X-AXIS < 2 FPS, UNLESS PGNS/AGS V_X DIFFERENCE IS GREATER THAN 10 FPS. IF SO, DETERMINE CORRECT SYSTEM USING RENDEZVOUS RADAR.
		2. ALL RENDEZVOUS MANEUVERS WILL BE NULLED.
		3. DOCKED DPS MANEUVERS WILL NOT BE TRIMMED.
		B. ALTERNATE MISSION DOCKED DPS MANEUVERS WILL BE COMPLETED VIA AGS TAKEOVER FOR VIOLATION OF THE FOLLOWING LIMITS:
		1. ATTITUDE RATES - 10 DEG/SEC 2. ATTITUDE ERRORS - 10 DEG 3. ATTITUDE EXCURSIONS - 10 DEG
		C. ALTERNATE MISSION DOCKED DPS MANEUVERS WILL BE TERMINATED AFTER VIOLATION OF THESE OVERBURN CRITERIA:
		1. DPS LOI - 10 SEC AND ΔV AGS GREATER THAN 10 FPS 2. DPS TEI - 10 SEC AND ΔV AGS GREATER THAN 2 FPS 3. DPS LOI ABORTS - 10 SEC AND ΔV AGS GREATER THAN 2 FPS
		NOTE A CMC ΔV OF 2 FPS (OVERSPEED) AND 10-SEC OVERBURN IS ALSO A VALID CUE FOR SHUTDOWN.
	3-86	THE TABLE ON THE NEXT PAGE, INCLUDING NOTES AND REFERENCES, SUMMARIZES THE TAKEOVER, RESTART, SHUTDOWN, AND TRIMMING REQUIREMENTS, AND SPS ENGINE LIMITS FOR ALL SPS MANEUVERS.
		RULE NUMBERS 3-87 THROUGH 3-89 ARE RESERVED.

R | ITEM

MANEUVER	ENGINE LIMITS		RATES/ERRORS FOR		MANUAL START ACTION	OVERBURN SHUTDOWN CRITERIA	EARLY C/O RESTART CRITERIA	RCS TRIM GUIDELINES
	INHIBIT	TERMINATE	TAKEOVER	ACTION				
MODE III	NONE	ERRATIC ENG	5/5	COMPLETE	START	g	Hp > 40	N/A
MODE IV	NONE	ERRATIC ENG	5/5	COMPLETE	START	g	Hp < 95 IF G&N GO ΔVTG > 60 OR C/O > 6 SEC EARLY	N/A
APOGEE KICK	NONE	ERRATIC ENG	5/5	COMPLETE	START	g	Hp < 95 IF G&N GO ΔVTG > 60 OR C/O > 6 SEC EARLY	N/A
TLC MCC	TIGHT[i]	TIGHT[i]	10/10	TERMINATE	DELAY	1 SEC	NO	X = 0.2[b]
LOI	TIGHT[h]				START[l]			NO
MODE I								
0 TO 0 + 53		TIGHT	10/10	COMPLETE			YES	
0 + 53 TO 1 + 31		LOOSE	10/10	COMPLETE			YES	
MODE II								
1 + 31 TO 2 + 54		LOOSE	10/10	COMPLETE			YES	
MODE III[c]								
2 + 54 TO 3 + 40		LOOSE	10/10	COMPLETE			YES	
3 + 40 TO C/O		TIGHT[h]	10/10	COMPLETE		10 SEC	VGO > 50 AND G&N GO	
DOI_1	TIGHT[i]	TIGHT[i]	10/10	TERMINATE	DELAY	BT	NO	j
CIRC	TIGHT[i]	TIGHT	10/10	TERMINATE	START	1 SEC	ΔV TO GO > 20	ALL = 0.2
RESCUE	LOOSE	LOOSE	10/10	COMPLETE	START	1 SEC	ΔV TO GO > 12	ALL = 0.2
LOPC	TIGHT[i]	TIGHT	10/10	TERMINATE	DELAY	1 SEC	NO	Y = 0.2
TEI (G&N)	NONE	NONE	10/10	COMPLETE	DELAY	2 SEC AND ΔV_C = -40[c]	C/O > 3 SEC EARLY AND ΔV_C > 50[c]	X AND Z = 0.2
TEI (SCS)	NONE	NONE	10/10	COMPLETE	START	2 SEC	ΔV_C > 50 OR C/O > 5 SEC EARLY	NO
TEC MCC								
CORRIDOR	LOOSE	LOOSE	10/10	COMPLETE	DELAY	1 SEC AND ΔV_C = 0	NO	X = 0.2
IP CONTROL[b]	TIGHT	TIGHT	10/10	TERMINATE	DELAY	1 SEC AND ΔV_C = 0	NO	X AND Z = 0.2
TLC ABORT	TIGHT	LOOSE	10/10	COMPLETE	START	10 SEC AND ΔV_C = -70	C/O > 10 SEC EARLY AND ΔV_C > 70	NO
EARTH DEOB	TIGHT[d]	LOOSE	10/10	COMPLETE	START	1 SEC AND ΔV_C = 0	ΔV TO GO > 30 AND C/O > 3 SEC EARLY[e]	ALL = 0.2

TIGHT LIMITS: Fuel Ox ΔP > 20 and low P_c; either prop tank press < 160 psi and low P_c; P_c < 80 or decays 10 psi and V_M vs BT low; inhibit burn for any leak in He or prop tank. (Certain burns may be allowed with He tank leak if blowdown ΔV exceeds remaining mission requirements)[f]; GN_2 A or B < 400 psi (for LOI only, GN_2 A and B < 400 psi).

LOOSE LIMITS: P_c < 70 psi and other cues; either prop tank < 115 psi and low P_c; erratic engine (popping, vibration, etc.)[f].

NOTES:

a. Reserved.

b. Trim all MCC (except MCC4) only if X $\leq$ 2 fps.

c. See Rule 5-131.

d. If SM RCS deorbit not available, use loose limits.

e. See Rule 5-27.

f. Some limits bay be downgraded if warranted by mission circumstance.

g. See Rule 5-3.

h. If indication of ball valve failure, start on good bank (with LM available). If thrusting, shut down good bank 10 sec prior to nominal cutoff to verify indication.

i. If indication of ball valve failure, start on suspect bank. For dual bank burns, if indication of ball valve failure while thrusting, shut down good bank to verify failure. If thrusting continues, reenable good bank.

j. See Rule 3-39.

k. Reserved.

l. Ignition may be delayed up to but no more than 220 sec.

A

SPECIFIC MISSION RULES

REV A

PANORAMIC CAMERA

CONDITION/MALFUNCTION		TLC	LUNAR ORBIT
1. SIM TEMP SL1211T ≤ 45° OR ≥ 105° F (1) (2)		TURN 64K BIT DATA SYSTEM ON AND APPLY POWER TO THE CAMERA	[redacted]
2. FORWARD LENS TEMP (SL1040T)	NONOPERATE ≤ 45° F	LEAVE HEATERS ENABLED	
	NONOPERATE ≥ 120° F (14)	DISABLE HEATERS. GO TO COLD SOAK	
	OPERATE ≤ 75° F	[redacted]	LEAVE HEATERS ENABLED
	OPERATE ≥ 105° F		TERMINATE PHOTO PASS
3. CAPPING SHUTTER FAILS OPEN OR CLOSED			CONTINUE OPERATION (4)
4. TEST CYCLE FAILS		OPER CAMERA FOR 1 MIN	
5. STEREO MODE FAILS		[redacted]	OPER CAMERA IN MONO MODE
6. TB REMAINS GREY AT TURN-ON			CYCLE OPER/STBY SWITCH TO STBY FOR 30 SEC THEN BACK TO OPERATE. REMAIN IN OPERATE FOR GROUND ANALYSIS
7. TB - BP DURING OPERATE (5)		CYCLE OPER/STBY SWITCH TO STBY FOR 30 SEC THEN BACK TO OPERATE. IF TB RETURNS TO TB - BP, GO TO STBY AND WAIT FOR GROUND ANALYSIS	
8. FORWARD MOTION COMPENSATION FAILS		[redacted]	CONTINUE OPERATION
9. LOSS OF DOWNLINK DATA		CONTINUE OPERATION	

MAPPING CAMERA

CONDITION/MALFUNCTION		TLC	LUNAR ORBIT
1. SIM TEMP SL1217T ≤ 40° F OR ≥ 105° F (2)		TURN 64K BIT DATA SYSTEM ON AND APPLY POWER TO THE CAMERA	[redacted]
2. FORWARD LENS TEMP (SL1060T)	NONOPERATE ≤ 40° F	REMAIN IN STBY	
	NONOPERATE ≥ 100° F	TURN CAMERA OFF	
	OPERATE ≥ 90° F	[redacted]	TERMINATE PHOTO PASS
3. TB - BP (6)		CONFIGURE FOR STBY MODE AND WAIT FOR GROUND ANALYSIS	
4. FORWARD MOTION COMPENSATION FAILS		CONTINUE OPERATION	
5. DEPLOYMENT MECHANISM FAILS (7)	RETRACTED	[redacted]	CONTINUE OPERATION (8)
	EXTENDED	INHIBIT SM RCS JETS A_2, A_4, B_1, B_4 (13)	
6. LOSS OF DOWNLINK DATA		CONTINUE OPERATION	

LASER ALTIMETER

CONDITION/MALFUNCTION		TLC	LUNAR ORBIT
1. SIM TEMP SL1217T ≤ -30° F OR ≥ 150° F (2)		SCHEDULE SIM BAY HOT/COLD SOAK AS REQUIRED	[redacted]
2. CAVITY TEMP SL1094T	< -10° F	[redacted]	LEAVE LASER ALTIMETER POWERED
	>131° F AND INTERMITTENT RANGE READOUT OR >160° F		POWER DOWN LASER
3. LOSS OF AUTO MODE			LIMIT OPER TO NOMINAL CAMERA MODE SEQUENCES
4. LOSS OF VALID RANGE DATA IN CAMERA MODE			LIMIT OPER TO NOMINAL AUTO MODE SEQUENCES
5. PFN VOLTAGE >2900V			POWER DOWN LASER
6. LOSS OF DOWNLINK DATA			LIMIT OPER TO NOMINAL CAMERA MODE SEQUENCES

MC/LA DOOR

CONDITION/MALFUNCTION		TLC	LUNAR ORBIT
1. FAILS (10)	CLOSED	[redacted]	OPERATE CAMERA TO OBTAIN BASELINE ENGINEERING DATA AND THEN POWER DOWN (9)
	OPEN		MINIMIZE AND DELAY AS LONG AS POSSIBLE ANY URINE DUMPS, H_2O DUMPS, FUEL CELL PURGES AND UNDESIRABLE THRUSTER ACTIVATIONS

GN_2

CONDITION/MALFUNCTION		TLC	LUNAR ORBIT
1. EXCESSIVE GN_2 USAGE	MECHANICAL FAILURE	[redacted]	SCHEDULE PC OPERATION TO EXHAUST FILM PRIOR TO GN_2 DEPLETION (11)
	ELECTRICAL FAILURE		RESTRICT PC OPERATION TO HIGHEST PRIORITY TARGETS WITHIN GN_2 REMAINING
2. GN_2 DEPLETED			OPER MAPPING CAMERA AND ATTEMPT OPER OF PAN CAMERA (12)

NOTES

REV A

(1) AFTER FILM ADVANCE AVERAGE EITHER 1201T, 1204T, OR 1206T WITH 1211T. ΔT 5° F

(2) THIS RULE ONLY APPLICABLE PRE SIM DOOR JETT

(3) DELETED

(4) INSUFFICIENT DATA TO DISTINGUISH BETWEEN A FAILED CAPPING SHUTTER AND A FAILED T/M POINT

(5) A NO-GO INDICATION WILL BE RECEIVED IF ANY OF THE FOLLOWING CONDITIONS ARE SENSED:

A. STEREO MALFUNCTION
B. FILM PATH FAILURE
C. CAPPING SHUTTER NOT ACTIVATED
D. LENS ROTATION SIGNAL LOST
E. OUT OF FILM SIGNAL

(6) A NO-GO INDICATION WILL BE RECEIVED IF ANY ONE OF THE FOLLOWING PARAMETERS IS IN THE IMPROPER STATE:

A. MC FRONT LENS TEMP
B. STELLAR CAMERA FRONT ELEMENT TEMP
C. SUPPLY CASSETTE TEMP

(7) REFERENCE MALFUNCTION PROCEDURE X.X.

(8) THIS RULE ALSO APPLICABLE TO THE TEC PHASE

(9) CONSIDERATION WILL BE GIVEN TO OPENING THE DOOR DURING THE TEC EVA

(10) REFERENCE MALFUNCTION PROCEDURE X.X.

(11) CUE:

FOR MECHANICAL FAILURE, SL1031X READS "ON" CONTINUOUSLY EVEN WHEN PC IS IN STBY. GN_2 WILL BE SUPPLIED TO THE AIR BARS CONTINUOUSLY AT A MAX FLOW RATE OF 1.55 LB/HR. GN_2 WOULD BE DEPLETED IN 6.09 HOURS. FOR ELECTRICAL FAILURE, SL1031X READS "ON" CONTINUOUSLY BUT ONLY DURING PC OPERATION.

(12) CUE:

SL1031X READS "OFF" CONTINUOUSLY DURING PC OPERATION. PC FILM MAY JAM IF GN_2 IS NOT SUPPLIED TO AIR BARS

(13) B4 WILL BE ENABLED FOR TRANSLATION MANEUVERS, FOR RESCUE CAPABILITY DURING LM DESCENT AND LM ASCENT AND FROM 8 HOURS BEFORE MCC-7 TO ENTRY INTERFACE TO PROVIDE COUPLED ATTITUDE CONTROL WHEN FORWARD FIRING RCS THRUSTERS ARE REQUIRED.

(14) PRIOR TO SIM DOOR JET, THE UPPER NONOPERATING LIMIT IS 100° F.

GENERAL

REV

1. PRIOR TO SIM DOOR JETTISON THE SIM EXPERIMENTS AND SCIENTIFIC DATA SYSTEM (SDS) WILL BE POWERED AS REQUIRED TO SUPPORT THE FOLLOWING FUNCTIONS:
   A. THERMAL MONITORING AND THERMAL MANAGEMENT OF THE SIM BAY.
   B. PERIODIC ADVANCEMENT OF THE PANORAMIC AND MAPPING CAMERA FILM.
2. RESCHEDULING OF EXPERIMENT OPERATION IF REQUIRED DUE TO EXCESSIVE CONSUMABLES USAGE (RCS, PWR, ETC.) OR ANOMALOUS EXPERIMENT OPERATION WILL BE ACCOMPLISHED WITHIN THE GUIDELINES OF THE EXPERIMENT PRIORITIES.
3. LUNAR ORBIT SIM BAY EXPERIMENTS ARE LISTED BELOW IN THEIR ORDER OF PRIORITY.
   A. LUNAR SOUNDER
   B. SM ORBITAL PHOTOGRAPHIC TASKS
   C. IR SCANNING RADIOMETER (ISR)
   D. FAR UV SPECTROMETER (UVS)
4. IF CORONA IS DETECTED IN AN EXPERIMENT AND IS DEGRADING ONLY THAT EXPERIMENT, THAT EXPERIMENT'S OPERATION WILL NOT BE TERMINATED FOR THE MISSION BUT MAY BE RESCHEDULED TO MAXIMIZE THE SCIENTIFIC RETURN.
5. ALL EXPERIMENT COVERS WILL NORMALLY BE CLOSED FOR THE FOLLOWING CONDITIONS AFTER SIM DOOR JETTISON:
   A. ACTIVATION OF SM RCS JETTS A2, A4, B1, or B4
   B. SPS BURNS
   C. WATER AND URINE DUMPS*
   D. FUEL CELL PURGES*
   E. VIOLATION OF THE SUN-AVOIDANCE CONSTRAINTS
   F. CSM EVAPORATOR OR LM SUBLIMATOR OPERATION*
   *N/A TO UVS COVER AFTER 2 DAYS IN CIRCULAR LUNAR ORBIT.
6. SM RCS THRUSTERS A2, A4, B1, AND B4 WILL BE DISABLED DURING ALL EXPERIMENT OPERATIONS.
7. WATER AND URINE DUMPS WILL BE INHIBITED FROM 3 HOURS BEFORE UNTIL IMMEDIATELY AFTER PC AND MC OPERATIONS.
8. A FAILURE OF ANY EXPERIMENT COVER OR EXTENSION MECHANISM WILL NOT PRECLUDE AN EVA FOR FILM RETRIEVAL.
9. THERE ARE THREE ACCEPTABLE CUES ON ANTENNA POSITION. THESE ARE THE APPROPRIATE TALKBACK INDICATOR, VISUAL VERIFICATION FROM AN UNDOCKED LM, AND THE ANTENNA SAFE SIGNAL ON TELEMETRY. ANY ANTENNA THAT CANNOT BE VERIFIED AS RETRACTED BY ONE OF THESE MEANS WILL BE ASSUMED TO BE EXTENDED BEYOND THE SPS BURN LIMIT.
10. SIM BAY HARDWARE REDLINES WILL NOT BE VIOLATED IN THE PURSUIT OF SCIENCE DATA UNLESS THE DATA BEING COLLECTED IS JUDGED TO BE MORE IMPORTANT THAN ALL SUBSEQUENT DATA.
11. A "NO-GO" FOR LOI WILL NOT PRECLUDE SIM BAY DOOR JETTISON.
12. AN ATTITUDE DEADBAND OF 0.5 DEGREES WILL BE USED DURING THE FOLLOWING OPERATIONS:
    A. ALL CAMERA OPERATIONS
    B. MANDATORY LASER ALTIMETER OPERATION
    C. HF AND VHF ACTIVE SOUNDING MODES
    D. UVS INERTIAL ATTITUDE HOLD TARGETS

    A DEADBAND OF 3.0 DEGREES MAXIMUM WILL BE USED FOR ALL OTHER EXPERIMENT OPERATION.

OPTICS MANAGEMENT

REV A

1. THE FILM IN THE PANORAMIC AND MAPPING CAMERAS (PC AND MC) WILL BE CYCLED AT INTERVALS OF 24 ± 6 HOURS. THE CAMERAS AND SDS SYSTEM WILL BE ACTIVATED TO MONITOR THESE FUNCTIONS.
2. DURING ALL SPS POWERED FLIGHT PHASES, THE PC WILL BE PLACED IN THE "BOOST" MODE AND THE MC IN THE "STANDBY" MODE WITH IMAGE MTN "OFF".
3. THE PC LENS STOW POSITION WILL BE VERIFIED PRIOR TO SIM DOOR JETTISON AND PRIOR TO INITIATING THERMAL PRECONDITIONING OF THE PC. ADDITIONAL STOW VERIFICATION WILL BE SCHEDULED AS REQUIRED.
4. A PC PHOTO SEQUENCE WILL NOT EXCEED 30 MINUTES.
5. THE PC HEATERS WILL BE ENABLED PRIOR TO THE FIRST CAMERA OPERATION TO ALLOW FOR THERMAL STABILIZATION. THE PC HEATERS WILL REMAIN ENABLED BETWEEN PHOTO PASSES.
6. THE MC WILL BE PLACED IN "STANDBY" PRIOR TO THE FIRST CAMERA OPERATION TO ALLOW FOR THERMAL STABILIZATION. THE MC WILL REMAIN IN STBY BETWEEN PHOTO PASSES.
7. IN THE EVENT OF EXCESSIVE GN_2 USAGE, THE OPERATION OF ONE CAMERA WILL NOT BE TERMINATED TO SAVE GN2 FOR THE OTHER CAMERA.
8. TOTAL FAILURE OF THE GN_2 SYSTEM WILL NOT PRECLUDE ATTEMPTS TO OPERATE THE MC AND PC.
9. THE IMAGE MOTION RATE ON THE MC WILL BE ADJUSTED TO MINIMUM ERROR FOR THE ORBIT OF OPERATION.
10. DELETED
11. LA OPERATION WILL NOT BE ATTEMPTED WITH THE MC/LA DOOR CLOSED.
12. IF EXCESSIVE TRAVEL TIMES ARE DETECTED DURING MC/LA POSITIONING, SUBSEQUENT CYCLES FOR CONTAMINATION PROTECTION WILL BE DELETED.
13. IF THE LASER ALTIMETER LIFETIME IS JUDGED TO BE SHORTER THAN THE REMAINING MISSION REQUIREMENT, THE LA OPERATING PROFILE WILL BE REDUCED TO INSURE COVERAGE OF PRIORITY OJBECTIVES.

SPECIFIC MISSION RULES

REV

FAR ULTRAVIOLET SPECTROMETER

CONDITION/MALFUNCTION		TLC	LUNAR ORBIT/TEC
1. SIM TEMP SL1109T, UVS ELECT-BOX T. (1)	<TBD° F	APPLY POWER TO SPECTROMETER	[redacted]
	>TBD° F	GO TO COLD SOAK ATTITUDE	
2. SPECTROMETER TEMPS SL1101T OR SL1102T	<- 35° F	LEAVE SPECTROMETER POWERED	
	>180° F	POWER DOWN SPECTROMETER (2)	
3. CORONA IN THE UVS		TURN OFF SPECTROMETER	ENHANCE OPERATING ENVIRONMENT
4. SUN APPROACHING FIELD-OF-VIEW		[redacted]	CLOSE SPECTROMETER COVER
5. COVER FAILS	CLOSED		OPERATE TO OBTAIN ENGINEERING DATA
	OPEN		MINIMIZE DUMPS, PURGES, AND JET FIRINGS

INFRARED SCANNING RADIOMETER

CONDITION/MALFUNCTION		TLC	LUNAR ORBIT/TEC
1. SIM TEMP SL1220T (1)	<TBD° F	APPLY POWER TO RADIOMETER	[redacted]
	>TBD° F	GO TO COLD SOAK ATTITUDE	
2. PRIMARY MIRROR TEMP SL1129T	<15° F	LEAVE RADIOMETER POWERED	
	>122° F	POWER DOWN RADIOMETER (3)	
3. SUN APPROACHING FIELD-OF-VIEW		[redacted]	CLOSE RADIOMETER COVER
4. COVER FAILS	CLOSED		OPERATE TO OBTAIN ENGINEERING DATA
	OPEN		MINIMIZE DUMPS, PURGES, AND JET FIRINGS

LUNAR SOUNDER

CONDITION/MALFUNCTION		TLC	LUNAR ORBIT/TEC
1. SIM TEMP SL1206T (1)	<TBD° F	APPLY STBY PWR TO CSAR AND OPTICAL RECORDER	[redacted]
	>TBD° F	GO TO COLD SOAK ATTITUDE	
2. FILM CASSETTE TEMP SL1275T	<TBD° F	APPLY STBY PWR TO OPTICAL RECORDER	
	>TBD° F	GO TO COLD SOAK ATTITUDE	REMOVE PWR FROM OPTICAL RECORDER (4)
3. CSAR INTERNAL TEMP SL1256T	<TBD° F	APPLY STBY PWR TO CSAR	
	>TBD° F	GO TO COLD SOAK ATTITUDE	REMOVE PWR FROM CSAR
4. FILM MOTION FAILURE		[redacted]	CONTINUE ACTIVE SOUNDER OPERATIONS (5)
5. LOSS OF PRF-1 AND PRF-2 TO OPTICAL RECORDER			TERMINATE SOUNDER OPERATION IN THE HF MODE
6. LOSS OF PRF-3 TO OPTICAL RECORDER			TERMINATE SOUNDER OPERATION IN THE VHF MODE
7. RECORDER CLOCK FAILURE			CONTINUE ACTIVE SOUNDER OPERATION (5)
8. LOSS OF OSC FREQ LOCK			CONTINUE ACTIVE SOUNDER OPERATION
9. LOSS OF VIDEO TO RECORDER			CONTINUE ACTIVE SOUNDER OPERATION (5)
10. LOSS OF HF RF PWR OUTPUT			TERMINATE SOUNDER OPERATION IN HF MODE
11. LOSS OF VHF RF PWR OUTPUT			TERMINATE SOUNDER OPERATION IN VHF MODE
12. EMI INTO LS ISOLATED TO	HGA		RESCHEDULE VHF OPERATIONS
	HBR TM		PERFORM FLIGHT PLAN ON LBR
13. TB-BP DURING OPERATE		GO TO STBY. IF BP PERSISTS, PWR DOWN RADAR AND RECORDER. IF TB-GRAY, GO TO OPERATE. IF BP RETURNS, PWR DOWN THE RADAR AND RECORDER.	

HF ANTENNAS

CONDITION/MALFUNCTION	TLC	LUNAR ORBIT/TEC
1. FAILURE TO FULLY EXTEND	OPERATE IN DEGRADED MODE (6)	
2. FAILURE TO RETRACT SAFE DISTANCE	JETTISON PRIOR TO NEXT SPS BURN	

REV

NOTES

(1) THIS RULE ONLY APPLIES TO PRE SIM DOOR JETTISON PHASE

(2) THE SPECTROMETER WILL BE POWERED DOWN IF THE TEMPS GET ABOVE 125° F AND VALID DATA IS NOT BEING COLLECTED.

(3) THE RADIOMETER WILL BE POWERED DOWN IF THE TEMPS GET ABOVE 100° F AND VALID DATA IS NOT BEING COLLECTED.

(4) IF TEMP CONTINUES TO INCREASE, COLD SOAK WILL BE REQUIRED.

A (5) SPECULAR POWER WILL BE THE PRIME SOURCE OF SCIENCE DATA. COVERAGE CAN BE TRADED OFF FOR HBR TM.

A (6) EXTEND ANTENNAS AS FAR AS POSSIBLE.

REV

GENERAL

1. PRIOR TO SIM DOOR JETTISON THE SIM EXPERIMENTS AND SCIENTIFIC DATA SYSTEM (SDS) WILL BE POWERED AS REQUIRED TO SUPPORT THE FOLLOWING FUNCTIONS:
   A. THERMAL MONITORING AND THERMAL MANAGEMENT OF THE SIM BAY.
   B. PERIODIC ADVANCEMENT OF THE PANORAMIC AND MAPPING CAMERA FILM.
2. RESCHEDULING OF EXPERIMENT OPERATION IF REQUIRED DUE TO EXCESSIVE CONSUMABLES USAGE (RCS, PWR, ETC.) OR ANOMALOUS EXPERIMENT OPERATION WILL BE ACCOMPLISHED WITHIN THE GUIDELINES OF THE EXPERIMENT PRIORITIES.
3. LUNAR ORBIT SIM BAY EXPERIMENTS ARE LISTED BELOW IN THEIR ORDER OF PRIORITY.
   A. LUNAR SOUNDER
   B. SM ORBITAL PHOTOGRAPHIC TASKS
   C. IR SCANNING RADIOMETER (ISR)
   D. FAR UV SPECTROMETER (UVS)
4. IF CORONA IS DETECTED IN AN EXPERIMENT AND IS DEGRADING ONLY THAT EXPERIMENT, THAT EXPERIMENT'S OPERATION WILL NOT BE TERMINATED FOR THE MISSION BUT MAY BE RESCHEDULED TO MAXIMIZE THE SCIENTIFIC RETURN.
5. ALL EXPERIMENT COVERS WILL NORMALLY BE CLOSED FOR THE FOLLOWING CONDITIONS AFTER SIM DOOR JETTISON:
   A. ACTIVATION OF SM RCS JETS A2, A4, B1, OR B4
   B. SPS BURNS
   C. WATER AND URINE DUMPS*
   D. FUEL CELL PURGES*
   E. VIOLATION OF THE SUN-AVOIDANCE CONSTRAINTS
   F. CSM EVAPORATOR OR LM SUBLIMATOR OPERATION*
   *N/A TO UVS COVER AFTER 2 DAYS IN CIRCULAR LUNAR ORBIT.
6. SM RCS THRUSTERS A2, A4, B1, AND B4 WILL BE DISABLED DURING ALL EXPERIMENT OPERATIONS.
7. WATER AND URINE DUMPS WILL BE INHIBITED FROM 3 HOURS BEFORE UNTIL IMMEDIATELY AFTER PC AND MC OPERATIONS.
8. A FAILURE OF ANY EXPERIMENT COVER OR EXTENSION MECHANISM WILL NOT PRECLUDE AN EVA FOR FILM RETRIEVAL.
9. THERE ARE THREE ACCEPTABLE CUES ON ANTENNA POSITION. THESE ARE THE APPROPRIATE TALKBACK INDICATOR, VISUAL VERIFICATION FROM AN UNDOCKED LM, AND THE ANTENNA SAFE SIGNAL ON TELEMETRY. ANY ANTENNA THAT CANNOT BE VERIFIED AS RETRACTED BY ONE OF THESE MEANS WILL BE ASSUMED TO BE EXTENDED BEYOND THE SPS BURN LIMIT.
10. SIM BAY HARDWARE REDLINES WILL NOT BE VIOLATED IN THE PURSUIT OF SCIENCE DATA UNLESS THE DATA BEING COLLECTED IS JUDGED TO BE MORE IMPORTANT THAN ALL SUBSEQUENT DATA.
11. A "NO-GO" FOR LOI WILL NOT PRECLUDE SIM BAY DOOR JETTISON.
12. AN ATTITUDE DEADBAND OF 0.5° WILL BE USED DURING THE FOLLOWING OPERATIONS:
    A. ALL CAMERA OPERATIONS
    B. MANDATORY LASER ALTIMETER OPERATION
    C. HF AND VHF ACTIVE SOUNDING MODES
    D. UVS INERTIAL ATTITUDE HOLD TARGETS

    A DEADBAND OF 3.0 DEGREES MAXIMUM WILL BE USED FOR ALL OTHER EXPERIMENT OPERATION.

REV

FAR UV SPECTROMETER MANAGEMENT

1. UNTIL THE COMPLETION OF TWO DAYS IN CIRCULAR ORBIT, THE EXPERIMENT COVER WILL BE CLOSED FOR DUMPS AND PURGES. DUMPS AND PURGES WILL NOT BE SCHEDULED WITHIN 15 MINUTES OF THE START OF A DATA TAKE.
2. THE EXPERIMENT COVER WILL BE CLOSED FOR THE ACTIVATION OF RCS JETS A2, A4, B1 AND B4 BEFORE THE SUN ENTERS THE SPECTROMETER FOV.

INFARED SCANNING RADIOMETER

A 1. THE EXPERIMENT COVER WILL REMAIN CLOSED FOR 30 MINUTES FOLLOWING A DUMP OR PURGE.

2. THE ISR SCAN DRIVE MOTOR WILL BE POWERED FOR SIM DOOR JETT.

LUNAR SOUNDER

A 1. A MINIMUM OF 1 MINUTE OF HBR/HF MODE DATA WILL BE COLLECTED DURING THE START OF AN END OF THE 2 REV HF ACTIVE MODE.

2. SIM BAY JET CONFIGURATION WILL BE INITIATED A MINIMUM OF 30 MINUTES PRIOR TO OPTICAL RECORDER OPERATION.

3. THE SOUNDER RDR AND OPTICAL RCDR WILL BE THERMALLY PRECONDITIONED PRIOR TO DATA COLLECTION.

4. ALL OTHER SIM BAY EXPERIMENTS AND THE SDS WILL BE POWERED DOWN DURING SOUNDER OPERATIONS.

5. THE HGA WILL BE POWERED DOWN DURING THE HF AND RECEIVE ONLY MODES.

A 6. THE LS TRANSMITTERS WILL NOT BE OPERATED WITHIN 1000 FEET OF AN UNSTAGED L/M.

7. FAILURE OF THE HF ANTENNAS TO FULLY EXTEND WILL NOT PRECLUDE SOUNDER OPERATION IN THE HF AND LISTEN MODES.

8. THE OPTICAL RECORDER FILM WILL NOT BE TRANSPORTED WITH LESS THAN 10 FEET OF FILM REMAINING.

9. A CSM CONFIGURATION WILL BE ESTABLISHED FOR THE EMI TEST AND LS OPERATION. NO CONFIGURATION CHANGES WILL BE MADE TO RESOLVE EMI EXCEPT FOR POSSIBLE DOWNGRADING OF THE TELECOMMUNICATIONS SYSTEMS.

R	ITEM	
		PRECEDENCE/SCHEDULING
A	31-31	DELETED
A	31-32	DELETED
	31-33	REASSESSMENT OF THE OPERATIONAL EVA PLAN WILL BE DONE IF ANY OF THE FOLLOWING CONDITIONS EXIST: A. BEHIND TIMELINE BY MORE THAN 10 PERCENT OF EVA TIME REMAINING B. AHEAD OF TIMELINE BY MORE THAN 15 MINUTES C. DEGRADATION OF THE LRV TO SUCH AN EXTENT THAT A MIMIMUM OF 4 KM/HR VEHICLE SPEED CANNOT BE MAINTAINED OR THE PLANNED TRAVERSE VIOLATES THE REDEFINED OPERATIONAL ENVELOPE
	31-34	IF A REALIGNMENT OF THE TRAVERSE IS REQUIRED, EITHER BY EXTENSIONS OR REDUCTIONS, THE REVISION WILL NORMALLY BE PASSED TO THE CREW AS EVA PAD UPDATES AT APPROXIMATELY THE 1/3 AND 2/3 EVA COMPLETION POINTS.
A	31-35	TOTAL DRIVING TIME FROM THE LM TO STATION 2 WILL BE LIMITED TO 1 HOUR.
		31-36 THROUGH 31-50 ARE RESERVED.

R	ITEM	

SYSTEMS MANAGEMENT

31-51 THE LRV RADIATOR COVERS WILL BE DUSTED BEFORE OPENING. THE RADIATOR SURFACES WILL BE DUSTED EACH TIME THE COVERS ARE OPENED WITH RADIATORS IN THE SUN.

31-52 THE AUXILIARY PWR BYPASS SWITCH WILL BE PUT IN THE ON POSITION ONLY AFTER EVA 3.

31-53 THE DRIVE ENABLE SWITCHES WILL NOT BE OPERATED AFTER INITIAL CONFIGURATION EXCEPT AS REQUIRED FOR FAILURES OR MALFUNCTION ISOLATION.

31-54 LRV PARKING CONSTRAINTS FOR LRV AND PAYLOAD THERMAL CONSIDERATIONS ARE AS FOLLOWS:

A A. BETWEEN EVA'S, THE LRV WILL BE PARKED A MINIMUM OF 20 FT FROM THE NEAREST LM SIDE AND 6 FT FROM THE SHADOW.

B.

PARKING DURATION	REQUIRED SUN AZIMUTH	CRITICAL ITEM
LESS THAN:		
6 HRS IN SUN	ANY	N/A
2 HRS IN SHADE	ANY	N/A
MORE THAN:		
6 HRS IN SUN	80°-110° CCW FROM UPSUN*	LCRU, C&D CONSOLE
2 HRS IN SHADE	NOT RECOMMENDED	C&D CONSOLE
		LRV NAVIGATION
		LCRU

*FOR BETWEEN EVA'S PARKING, THE LRV NAVIGATION HEADING WILL BE USED TO PARK THE LRV 85° CCW FROM UPSUN. HEADING WILL BE SPECIFIED BY MCC BASED ON SUN AZIMUTH.

31-55 LRV BATTERY POWER/THERMAL MANAGEMENT WILL BE ACCOMPLISHED THROUGH CONFIGURATION OF THE BATTERY LOADS, LIMITING USE OF NON-CRITICAL SYSTEMS AND BY OPENING THE BATTERY COVERS WHILE PARKING UPSUN AT TRAVERSE STOPS GREATER THAN 30 MIN. THE CONDITIONS TO BE MAINTAINED THROUGH THIS MANAGEMENT IN ORDER OF PRIORITY ARE:

A. BATTERIES SHALL BE MAINTAINED IN TEMPERATURE RANGE OF:

1. 40° F - 125° F FOR EVA 1 AND 2
2. 40° F - 140° F FOR EVA 3

B. RELATIVE STATE-OF-CHARGE BETWEEN BATTERIES BALANCED TO WITHIN 20 AMP-HOURS

R	ITEM	
	31-56	LRV BATTERY COVERS WILL BE OPENED DURING EVA/LRV CLOSEOUT AT THE LM.
	31-57	DELETED
	31-58	THE LRV MUST REMAIN STATIONARY FOR 1 MINUTE 30 SECONDS FOLLOWING NAVIGATION SYSTEM TURN-ON TO ALLOW THE DIRECTIONAL GYRO UNIT (DGU) TO ATTAIN OPERATING SPEED. DURING THIS WARM-UP PERIOD THE GYRO TORQUING SWITCH MAY NOT BE OPERATED. USE OF THE SYSTEM RESET SWITCH IS NOT CONSTRAINED BY THIS RULE.
A	31-59	THE LRV DGU WILL BE ALIGNED BEFORE DEPARTURE FROM THE ALSEP OR SEP ON EACH EVA. THE DGU WILL BE CHECKED AT DESIGNATED POINTS ON THE TRAVERSE. IT WILL BE TORQUED TO REALIGN IF IT HAS DRIFTED >2 DEGREES.

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
				TRAVERSE GRAVIMETER	
A	31-102	TWO CONSECUTIVE READINGS INDICATE PHASE LOCK LOOP DID NOT CAPTURE		INITIATE A BYPASS READING ON THE SURFACE 1. WHEN LEVEL AND READING IS 000 000 0YY, VSA HAS FAILED. TGE IS NOT USABLE. 2. READING IS GOOD, PLL IS NOT USABLE. ALL SUBSEQUENT READINGS TAKEN ON SURFACE	$\leq$ 610 XXX XXY $\geq$ 730 XXX XYY
A	31-103	TWO CONSECUTIVE READINGS INDICATE PHASE LOCK LOOP RATE ALARM		INITIATE A BYPASS READING ON THE SURFACE 1. IF READING IS 000 000 0YY, VSA HAS FAILED. TGE IS NOT USABLE. 2. IF NOT ALL ZEROS, ALL IS NOT USABLE. ALL SUBSEQUENT READINGS TAKEN ON SURFACE	PLL RATE ALARM IS INDICATED BY 000 XXX XYY
A	31-104	LEVEL LIGHT REMAINS ON AFTER NORMAL MEASUREMENT TIME 1. READING IS 000 000 0YY 2. INDICATOR IS COUNTING		1. INITIATE BYPASS READING A. IF READING IS 000 000 0YY, VSA HAS FAILED. B. IF READING IS GOOD, PLL IS NOT USABLE. ALL SUBSEQUENT READINGS TAKEN ON SURFACE. 2. INITIATE BYPASS READING A. IF INDICATOR IS COUNTING, TIMING FAILURE HAS OCCURRED. TGE IS NOT USABLE. B. IF READING IS REASONABLE, ALL IS NOT USABLE. ALL SUBSEQUENT READINGS TAKEN ON SURFACE.	
A	31-105	TWO CONSECUTIVE READINGS INDICATE RANDOM NUMBERS OR REPEATED MEASUREMENTS		INITIATE BYPASS MEASUREMENT 1. IF READING IS 000 000 0YY, VSA OR ELECTRONICS HAS FAILED. 2. IF READING IS SAME, INITIATE BYPASS READING A. IF SAME AS LAST, ELECTRONICS HAS FAILED B. IF VALID READING, USE BIAS READINGS ONLY	

R	ITEM	
		GENERAL
	20-1	A. BASELINE REQUIREMENTS (ALL PHASES EXCEPT LAUNCH) 1. TWO-WAY VOICE COMM BETWEEN SPACECRAFT 2. TWO-WAY VOICE COMM BETWEEN CSM OR LM AND MSFN DURING ALL DOCKED ACTIVITIES AND BETWEEN CSM, LM/LCRU AND MSFN DURING UNDOCKED ACTIVITIES B. LAUNCH THERE ARE NO COMMUNICATIONS FAILURES FOR WHICH THE LAUNCH/INSERTION PHASE WILL BE TERMINATED. C. LUNAR STAY ADDITIONAL REQUIREMENTS 1. FOR TWO-MAN EVA: VOICE COMM BETWEEN MSFN AND ONE EVA CREWMAN 2. FOR ONE-MAN EVA: VOICE COMM BETWEEN MSFN AND LM/LCRU AND EVA CREWMAN NOTE MSFN-TO-EVA-ONLY VOICE IS ACCEPTABLE IF TV IS AVAILABLE TO MONITOR CREW. D. THE LM WILL BE RETAINED FOR TEC COMM IN EVENT OF LOSS OF ALL COMM BETWEEN THE CSM AND THE GROUND. E. FAILURE OF VOICE OR TM TO THE MSFN, OR FAILURE OF TWO-WAY VOICE COMMUNICATIONS TO THE CMP, OR BOTH, WILL NOT PRECLUDE THE NOMINAL CMP EVA.
	20-2	VHF EVA COMMUNICATIONS PRIORITIES ARE: A. TWO-MAN EVA 1. PRIME: EVA-1 AR/EVA-2 AR (RELAY MODE ALLOWS DUPLEX VOICE BETWEEN EVA'S PLUS THE TRANSMISSION OF VOICE AND DATA FROM BOTH EVA'S TO LM/LCRU PLUS THE RECEPTION OF VOICE VIA LM/LCRU BY BOTH EVA'S
A		2. BACKUP: EVA-1B/EVA-2A or EVA-1A/EVA-2B OR EVA-1 AR/EVA-2B (ANY OF THE THREE MODE COMBINATIONS ALLOWS DUPLEX VOICE BETWEEN EVA'S PLUS THE TRANSMISSION OF VOICE FROM BOTH THE EVA'S TO THE LM PLUS THE TRANSMISSION OF VOICE FROM ONE OF THE EVA'S TO THE LCRU PLUS THE TRANSMISSION OF DATA FROM ONE EVA TO THE LM/LCRU AND THE RECEIVING OF LM/LCRU VOICE BY ONE EVA.) B. ONE-MAN EVA 1. PRIME: EVA-1A OR EVA-2A (ALLOWS DUPLEX VOICE BETWEEN EVA AND THE LM/LCRU PLUS THE TRANSMISSION OF DATA FROM EVA TO LM/LCRU) 2. BACKUP: EVA-1B OR EVA-2B (ALLOWS DUPLEX VOICE BETWEEN EVA AND LM) NOTE NO VOICE CAPABILITY VIA LCRU IN THIS MODE.
		RULES 20-3 THROUGH 20-6 ARE RESERVED.

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	20-15	LOSS OF TWO CSM AUDIO CENTERS	EPO	CONTINUE MISSION NO-GO FOR TLI	
			TLC	CONTINUE MISSION	
			DOCKED	CONTINUE MISSION NO-GO FOR DOI OR UNDOCKING	
			UNDOCKED	NO-GO FOR CIRC	
			PRE-PDI/ DESCENT/ LUNAR STAY	CONTINUE MISSION	
			POST DOCK	RETAIN ASCENT STAGE	
	20-16	FAILURE OF LM VHF RELAY. NO TWO-WAY VOICE WITH EITHER CREWMAN.	LUNAR STAY	CONTINUE MISSION PROCEED WITH EVA AND ACTIVATE THE LCRU ASAP	
A	20-17	LOSS OF VOICE FROM EVA-2 TO EVA-1	DUAL EVA	CONTINUE MISSION A. EVA-2 GO TO POSITION "A" B. EVA-1 GO TO POSITION "B"	EVA-1 (CDR) HAS EVC-1, EVA-2 (LMP) HAS EVC-2. 1. IF ON LCRU, EVA-1 CANNOT COMMUNICATE WITH MSFN. 2. NO TM FROM EVA-1. 3. EVA-1 MUST PROCEDURALLY TIME-SHARE ALL VOICE TRANSMISSIONS WITH MSFN. 4. MODES WILL BE SWITCHED EVERY 45 MIN TO MONITOR PLSS DATA ON BOTH CREWMEN.
A	20-18	LOSS OF VOICE FROM EVA-1 TO EVA-2	DUAL EVA	CONTINUE MISSION A. EVA-2 GO TO POSITION "A" B. EVA-1 GO TO POSITION "B"	B.1. IF ON LCRU, EVA-1 CANNOT COMMUNICATE WITH MSFN. 2. NO TM FROM EVA-1. 3. EVA-1 MUST PROCEDURALLY TIME-SHARE ALL VOICE TRANSMISSIONS WITH MSFN. 4. MODES WILL BE SWITCHED EVERY 45 MINUTES TO MONITOR PLSS DATA ON BOTH CREWMEN.

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
A	20-19	LOSS OF DUPLEX VOICE BETWEEN EVA-1 AND EVA-2	DUAL EVA	CONTINUE EVA, IF ONE CREWMAN CAN RELIEVE MSFN VOICE AND TRANSMIT DOWNLINK VOICE.	
	20-20	LOSS OF TWO-WAY VOICE BETWEEN MSFN AND EVA	DUAL EVA	VOICE UPLINK WITH TV AVAILABLE FOR MSFN MONITORING OF CREW RESPONSES IS ACCEPTABLE	
		A. LCRU		A. CONTINUE EVA 1. EVA-2 GO TO POSITION "A" EVA-1 GO TO POSITION "B" 2. IF SUCCESSFUL, CONTINUE EVA. 3. IF UNSUCCESSFUL, RETURN TO VHF RANGE OF LM.	A.1. EVCS MODE-B WILL NOT COMMUNICATE WITH LCRU.
		B. LM		B. CONTINUE EVA 1. IF LCRU AVAILABLE, ACTIVATE ASAP AND CONTINUE EVA. 2. IF LCRU NOT AVAILABLE, EVA 2 RETURN TO LM AND RECONFIGURE COMM. THEN CONTINUE EVA WITHIN VHF RANGE OF LM.	
	20-21	LOSS OF TWO-WAY VOICE BETWEEN MSFN AND EVA	ALT EVA (ONE-MAN)	VOICE UPLINK WITH TV AVAILABLE FOR MSFN MONITORING OF CREW RESPONSES IS ACCEPTABLE	
		A. LCRU		A.1. ATTEMPT TO RECONFIGURE EVCS. 2. IF SUCCESSFUL, CONTINUE EVA. 3. IF NOT SUCCESSFUL, RETURN TO VHF RANGE OF LM AND CONTINUE EVA.	
		B. LM		B.1. IF LCRU AVAILABLE, ACTIVATE ASAP AND CONTINUE EVA 2. IF LCRU NOT AVAILABLE, RETURN TO LM AND RECONFIGURE COMM. THEN CONTINUE EVA WITHIN VHF RANGE OF LM	

CSM - INSTRUMENTATION REQUIREMENTS

20-81

R	MEAS DESCRIPTION	PCM	ONBOARD	TRANSDUCERS	CATEGORY	MISSION RULE REF
	UDL VALIDITY SIGNAL	CT0262V	-	-	HD	20-42
	USB RECEIVER AGC	CT0620E	METER	COMMON	HD	20-42,20-7A(9), 20-8B
A	USB RECEIVER ERROR	CT0640F	-	-	HD	
	DSE TAPE MOTION	CT0012X	TB	-	HD	20-42,20-46
	CTE TIME	CT0145F	-	-	HD	20-47
	SCE 10 VDC	CT0018V	-	-	HD	
	SCE 5 VDC	CT0017V	-	-	HD	
	SCE 20 VDC	CT0015V	-	-	HD	
	SCE -20 VDC	CT0016V	-	-	HD	
	PCM HI REF 85 PERCENT	CT0125V	-	-	HD	
	PCM HI REF 15 PERCENT	CT0126V	-	-	HD	
	HI GAIN ANT POS-PITCH	ST0152H	-	-	HD	
	HI GAIN ANT POS-YAW	ST0153H	-	-	HD	
	HGA BEAM WIDTH SW POS - NAR	CT0161X	-	-	HD	
	HGA BEAM WIDTH SW POS - MED	CT0162X	-	-	HD	
	HGA TRACK SW POS - AUTO	CT0163X	-	-	HD	
	HGA TRACK SW POS - REACQ	CT0164X	-	-	HD	
	MASTER UNIT TEMP	ST0562T			HD	20-56
	SLAVE UNIT TEMP	ST0563T			HD	20-56

LM - INSTRUMENTATION REQUIREMENTS

20-82

R	MEAS DESCRIPTION	PCM	ONBOARD	TRANSDUCERS	CATEGORY	MISSION RULE REF
A	PCM OSC FAIL 2	GL0422V	-	-	HD	
	PCM OSC FAIL 3	GL0423V	-	-	HD	
	CAL 85 PCT	GL0401V	-	-	HD	
	CAL 15 PCT	GL0402V	-	-	HD	
	MET	GL0501W	-	-	HD	
	C AND W FAIL	GL4054X	CAUTION	-	HD	
	MASTER ALARM	GL4069X	MASTER ALARM	-	HD	
	DUA STATUS	GT0441X	-	-	HD	20-67
	S-BND ST PH ERR	GT0992B	-	-	HD	
	S-BND RCVR SIG	GT0994V	METER /CAUTION	-	HD	20-67
	STEERABLE ANT TEMP	GT0454T	METER /CAUTION	-	HD	20-9B,20-71
	XMTR PO	GT0993E	-	-	HD	20-67,20-76
	LCRU RADIATOR TEMP	RT8001T	METER	REDUNDANT	HD	20-34
	LCRU SUBSYSTEMS VOLTAGE	RT8003T	METER	-	HD	20-34

INSTRUMENTATION REQUIREMENTS

R	ITEM	SYSTEM	MEAS DESCRIPTION	PCM	ONBOARD	CATEGORY
		SEQUENTIAL/ PYROTECHNIC	ED RLY A K1-K6	GY0201X	SYS A STAGING LIGHT	HD
					COMMON CAUTION LIGHT	HD
			ED RLY B K1-K6	GY0202X	SYS B STAGING LIGHT	HD
			ED RLY A K7-K15	GY0231X	----------	HD
			ED RLY B K7-K15	GY0232X	----------	HD
			SELECTED ED BAT	-------	METER	HD
		ELECTRICAL POWER	AC BUS FREQ	GC0155F	CAUT	1 OF 2
			AC BUS VOLTS	GC0071V	METER, CAUT	M
A			BAT 1 CUR	GC1201C	METER	1 OF 3
			BAT 2 CUR	GC1202C	METER	M PCM
			BAT L CUR	GC1207C	METER	
			BAT 3 CUR	GC1203C	METER	1 OF 3
			BAT 4 CUR	GC1204C	METER	M PCM
A			LMP BUS VOLTS	GC0302V	METER, CAUT	
			BAT 1 VOLTS	GC0201V	METER	2 OF 3
			BAT 2 VOLTS	GC0202V	METER	M
			BAT 5 VOLTS	GC0205V	METER	
A			CDR BUS VOLTS	GC0301V	METER, CAUT	
			BAT 3 VOLTS	GC0203V	METER	2 OF 3
			BAT 4 VOLTS	GC0204V	METER	M
			BAT 6 VOLTS	GC0206V	METER	
			BAT L VOLTS	GC0207V	METER	HD
			BAT 5 CUR	GC1205C	METER	1 OF 2
			BAT 6 CUR	GC1206C	METER	M PCM
			BAT 1 MAL	GC9961U	CAUT, COMP	HD
			BAT 2/L MAL	GC9962U	CAUT, COMP	HD
			BAT 3/L MAL	GC9963U	CAUT, COMP	HD
			BAT 4 MAL	GC9964U	CAUT, COMP	HD
			BAT 5 MAL	GC9965U	CAUT, COMP	HD
			BAT 6 MAL	GC9966U	CAUT, COMP	HD
			BATTERY MAL	GL4047X	COMP	HD
			BAT 1 LOW TAP	GC4362X	FLAG	HD
			BAT 4 LOW TAP	GC4368X	FLAG	HD
			BAT 5 B/U CDR	GC4369X	FLAG	HD
			BAT 6 NORM CDR	GC4372X	FLAG	HD

NOTE

LOSS OF SEVERAL HD MEASUREMENTS WILL CAUSE SEVERELY DEGRADED MISSION MONITORING CAPABILITY.

INSTRUMENTATION REQUIREMENTS

R	ITEM	SYSTEM	MEAS DISCRIPTION	PCM	ONBOARD	CATEGORY
		GUIDANCE	LGC DOWNLINK	GG0001X	-	M
		AND	PLS TORO REF	GG1040V	-	HD
		CONTROL	2.5 VDC TM BIAS	GG1110V	-	HD
			IMU 28 VAC 800	GG1201V	-	HD
			IRIG SUSP 3.2 KC	GG1331V	-	HD
			IMU STBY	GG1513X	-	HD
			LGC OPR	GG1523X	-	HD
			X PIPA OUT IN PHASE	GG2001V	-	HD
			Y PIPA OUT IN PHASE	GG2021V	-	HD
			Z PIPA OUT IN PHASE	GG2041V	-	HD
A			IG SVO ERR IN PHASE	GG2107V	-	HD
			IG 1X RSVR OUT SIN	GG2112V	FDAI	HD
			IG 1X RXVR OUT COS	GG2113V	FDAI	HD
			MG SVO ERR IN PHASE	GG2137V	-	HD
			MG 1X RSVR OUT SIN	GG2142V	FDAI	HD
			MG 1X RSVR OUT COS	GG2143V	FDAI	HD
			OG SVO ERR IN PHASE	GG2167V	-	HD
			OG RSVR OUT SIN	GG2172V	FDAI	HD
			OG RSVR OUT COS	GG2173V	FDAI	HD
			PITCH ATT ERR	GG2219V	FDAI	HD-PCM
			YAW ATT ERR	GG2249V	FDAI	HD-PCM
			ROLL ATT ERR	GG2279V	FDAI	HD-PCM
			PIPA TEMP	GG2300T*	C&W	HD-PCM
			RR SHIFT SIN	GG3304V	FDAI	HD-PCM
			RR SHIFT COS	GG3305V	FDAI	HD-PCM
			RR TRUN SIN	GG3324V	FDAI	HD-PCM
			RR TRUN COS	GG3325V	FDAI	HD-PCM
			LGC WARNING	GG9001X	C&W	HD-PCM
			ISS WARNING	GG9002X	C&W	HD-PCM
			LR ANT TEMP	GN7563T	TEMP MONITOR	HD-PCM
			RR NO TRACK	GN7621X	C&W	HD-PCM
			RR ANT TEMP	GN7723T	TEMP MONITOR	HD-PCM
			LR RNG BAD	GN7521X	C&W	HD
			LR VEL BAD	GN7557X	C&W	HD
			YAW ERR CMD	GH1247V	-	HD
			PITCH ERR CMD	GH1248V	-	HD
			ROLL ERR CMD	GH1249V	-	HD
A			JD A4D OUTPUT	GH1419V	-	HD
			RCS TCP A4D	GR5032X	-	HD
			JD B3D OUTPUT	GH1423V	-	HD
			JD A2D OUTPUT	GH1427V	-	HD
			RCS TCP A2D	GR5040X	-	HD
			JD B1D OUTPUT	GH1431V	-	HD
			RCS TCP B1D	GR5044X	-	HD
			JD B4U OUTPUT	GH1418V	-	HD
			JD B4F OUTPUT	GH1420V	-	HD
			JD A4R OUTPUT	GH1421V	-	HD
			JD A3U OUTPUT	GH1422V	-	HD
			JD B3A OUTPUT	GH1424V	-	HD
			JD A3R OUTPUT	GH1425V	-	HD
			JD B2U OUTPUT	GH1426V	-	HD
			JD A2A OUTPUT	GH1428V	-	HD
			JD B2L OUTPUT	GH1429V	-	HD
			JD A1U OUTPUT	GH1430V	-	HD
			JD A1F OUTPUT	GH1432V	-	HD
			JD B1L OUTPUT	GH1433V	-	HD

* INDICATES SEPARATE TRANSDUCERS USED FOR ONBOARD AND PCM

NOTE

LOSS OF SEVERAL HD MEASUREMENTS WILL CAUSE SEVERELY DEGRADED MISSION MONITORING CAPABILITY.

R	ITEM	SYSTEM	MEAS DESCRIPTION	PCM	ONBOARD	CATEGORY
A		GUIDANCE AND CONTROL (CONTINUED)	RCS TCP B4U	GR5031X	-	HD
			RCS TCP B4F	GR5033X	-	HD
			RCS TCP A4R	GR5034X	-	HD
			RCS TCP A3U	GR5035X	-	HD
			RCS TCP 3D	GR5036X	-	HD
			RCS TCP B3A	GR5037X	-	HD
			RCS TCP A3R	GR5038X	-	HD
			RCS TCP B2U	GR5039X	-	HD
			RCS TCP A2A	GR5041X	-	HD
			RCS TCP B2L	GR5042X	-	HD
			RCS TCP A1U	GR5043X	-	HD
			RCS TCP A1F	GR5045X	-	HD
			RCS TCP B1L	GR5046X	-	HD
			YAW ATT ERR	GH1455V	FDAI	HD
			PITCH ATT ERR	GH1456V	FDAI	HD
			ROLL ATT ERR	GH1457V	FDAI	HD
			RGA YAW RATE	GH1461V	FDAI	HD
			RGA PITCH RATE	GH1462V	FDAI	HD
			RGA ROLL RATE	GH1463V	FDAI	HD
			AGS SEL	GH1621X	-	HD
			ROLL PLS/DIR	GH1628X	-	HD
			PITCH PLS/DIR	GH1629X	-	HD
			YAW PLS/DIR	GH1630X	-	HD
			AUTO ON	GH1214X	-	HD
			APS ARM	GH1230X	-	HD
			ENG FIRE OVRD	GH1286X	-	HD
			MAN THRUST CMD	GH1311V	METER	HD
			PITCH GDA POS	GH1313V	-	HD
			ROLL GDA POS	GH1314V	-	HD
			P TRM FAIL	GH1323X	C&W	HD
			R TRM FAIL	GH1330X	C&W	HD
			AUTO THRUST CMD	GH1331V	METER	HD
			DPS ARM	GH1348X	-	HD
			DPS VAR ACT	GQ6806H	-	HD
			CES AC PWR FAIL	GL4026X	C&W	HD
			CES DC PWR FAIL	GL4027X	C&W	HD
			AGS DOWNLINK	GI0001X	-	HD
			ASA TEMP	GI3301T	-	HD
			AGS PWR FAIL	GL4028X	C&W	HD
			AUTO OFF	GH1217X	-	HD
			AGS AUTO	GH1641X	-	HD
			AGS ATT HOLD	GH1642X	-	HD
			PGNS AUTO	GH1643X	-	HD
			PGNS ATT HOLD	GH1644X	-	HD
		DESCENT PROPULSION	START TNK PRESS	GQ3015P	HE MON	HD
			HE REG PRESS	GQ3018P	C&W	HD
			HE REG PRESS	GQ3025P		HD
			HE PRESS	GQ3435P		1 OF 2 M
			HE PRESS	GQ3436P	PRESS	
			FU TNK 1 QTY	GQ3603Q	QTY	1 OF 4 M
			FU TNK 2 QTY	GQ3604Q	QTY	
			OX TNK 1 QTY	GQ4103Q	QTY	SEE NOTE 2
			OX TNK 2 QTY	GQ4104Q	QTY	
			FU 1 TEMP	GQ3718T	TEMP MON	HD
			FU 2 TEMP	GQ3719T	TEMP MON	HD
			OX 1 TEMP	GQ4218T	TEMP MON	HD
			OX 2 TEMP	GQ4219T	TEMP MON	HD
			FU PRESS	GQ3611P		2 OF 3 M
			OX PRESS	GQ4111P		
			TCP	GQ6510P	THRUST	
			LOW LEVEL	GQ4455X	DPS LOW	HD SEE NOTE 3

R	ITEM	SYSTEM	MEAS DESCRIPTION	PCM	ONBOARD	CATEGORY
		ASCENT PROPULSION	APS He 1 PRESS	GP0001P	HEL MON C&W	1 OF 2 M
			APS He LR PRESS	GP0041P		PCM
			APS He 2 PRESS	GP0002P	HEL MON C&W	1 OF 2 M
			APS He 2R PRESS	GP0042P		PCM
			APS He REG PRESS	GP0018P		1 OF 2
			APS He REG PRESS	GP0025P	C&W	M - PCM
			APS FUEL TEMP	GP0718T	TEMP	HD
			APS FUEL LOW	GP0908X	C&W	HD
			APS OXID TEMP	GP1218T	TEMP	HD
			APS OXID LOW	GP1408X	C&W	HD
			APS FUEL PRESS	GP1501P		1 OF 2 M
			APS FUEL PRESS		GP0501P	
			APS OXID PRESS	GP1503P		1 OF 2 M
			APS OXID PRESS		GP1001P	
			VLVS A DELTA POS	GP2997U		HD
			VLVS B DELTA POS	GP2998U		HD
			APS TCP	GP2010P		HD
		REACTION CONTROL	RCS "A" PROP QTY	GR1085Q	QUANTITY	1 OF 2 M
			RCS "A" He PRESS	GR1101P	PRESS MON C&W	
			RCS "A" REG PRESS	GR1201P	PRESS MON C&W	2 OF 3 M
			RCS "A" FUEL MFLD PRESS	GR2201P	PRESS MON	
A			RCS "A" OX MFLD PRESS	GR3201P	PRESS MON	1 OF 2 M; 1 OF 2 M
			RCS "B" OX MFLD PRESS	GR3202P	PRESS MON	
			RCS "B" FUEL MFLD PRESS	GR2202P	PRESS MON	2 OF 3 M
A			RCS "B" REG PRESS	GR1202P	PRESS MON C&W	
			RCS "B" PROP QTY	GR1095Q	QUANTITY	1 OF 2 M
			RCS "B" He PRESS	GR1102P	PRESS MON C&W	
			RCS "A" FUEL TEMP	GR2121T	TEMP MON	HD
			ACS 2 H2O TEMP	GF4586T		HD
			RCS "B" FUEL TEMP	GR2122T	TEMP MON	HD
			ACS 1 H2O TEMP	GF4585T		HD
			RCS MAIN "A" CLSD	GR9609U	MAIN SOV	HD
			RCS MAIN "B" CLSD	GR9610U	MAIN SOV	HD
			A/B XFEED OPEN	GR9613U	CRSFD	HD
			QUAD 1 TEMP	GR6004T	TEMP MON	HD
			QUAD 2 TEMP	GR6003T	TEMP MON	HD
			QUAD 3 TEMP	GR6002T	TEMP MON	HD
			QUAD 4 TEMP	GR6001T	TEMP MON	HD
			ASC FEED OXID "A" OPEN	GR9641U	SYS A ASC OXID ASC FUEL	HD
			ASC FEED FUEL "A" OPEN	GR9631U	SYS A ASC OXID ASC FUEL	HD
			ASC FEED FUEL "B" OPEN	GR9632U	SYS B ASC OXID ASC FUEL	HD
			ASC FEED OXID "B" OPEN	GR9642U	SYS B ASC OXID ASC FUEL	HD

NOTES

1. LOSS OF SEVERAL HD MEASUREMENTS WILL CAUSE SEVERELY DEGRADED MISSION MONITORING CAPABILITY.

2. FOR THE LOSS OF EITHER THE FU OR OX MEASUREMENTS, AN APPROXIMATE 20 SEC HOVER TIME PENALTY IS REALIZED. FOR LOSS OF BOTH SYSTEMS, A PENALTY OF 60 SEC HOVER TIME RESULTS.

3. LOSS OF LO-LEVEL RESULTS IN AN APPROXIMATE 28 SEC HOVER TIME PENALTY.

R	ITEM
A	

CREW PROCEDURES DIVISION

CG3/ZEDEKAR, R. G. (5)
CG4/KRAMER, P. (4)
CG5/HOLLOWAY, T. W. (8)

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DD/MEDICAL OPERATIONS (7)

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PD/KUBICKI, R. L.
PD12/MISSION STAFF ENGINEER
PG/GOREE, J. F. (2)
PD12/KOHRS, D.
PD4/SILVER, M. (25)
PD9/WILLIAMS, L.
PE/CORCORAN, D. M. (3)
PA23/TASH, H. L. (5)
PT/ARABIAN, D. D.
PT3/DATA LIBRARY (8)
KT/DOUGLAS, W. H.
NA/BLAND, W. M., JR.
PF/ (2)
PD12/SEGNA, D. (2)

DIRECTOR OF ENGINEERING AND DEVELOPMENT

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EB5/BURTZLOFF
EB3/MUNFORD
JOHNSON, G. W.
EC/SMYLIE, R. E.
HURT, P. F.
EC2/GIBSON, J. L.
EC3/SAMONSKI, F. H. (2)
EC4/HINNERS, A. H.
EC7/RADNOFSKY, M. I.
EC9/LUTZ, C. C.
EE13/IRWIN (9)
EF/GIESECKE, R. L.
EG2/COX, K. J.
EG7/HANAWAY, J.
EG8/WILSON, R. E.
EG/MIT/IL-LAWTON, T. M.
EP/WHITE
EP2/YODZIS, C. W. (4)
EP4/POHL, H. O. (3)
ES42/ROGERS, W. F. (2)
EX/REDD, B.

R	ITEM
A	3-101

CSM BATTERY ENERGY AND CRYOGENIC O_2 AND H_2

THE FOLLOWING MINIMUM USABLE ENERGY/QUANTITIES MUST BE AVAILABLE TO INITIATE THE SPECIFIC PHASES.

		LAUNCH	LOI	DOI	UNDOCK	LOPC 1
BAT AMP-HOURS REMAINING	3 BAT	96	76.6	70.9	68.4	61.7
	2 BAT	62.2	45.2	44.4	41.5	40.3
O_2 TOTAL LBS	3 TANKS	803.4	631	621.7	584.4	457.1
H_2 TOTAL LBS	3 TANKS	66.5	49.8	48.7	44.7	29.7

1 ENERGY REQUIREMENT TO PERFORM NOMINAL MISSION WITHOUT CHARGER. REDLINE DOES NOT ALLOW PRE-LOI GIMBAL DRIVE CHECK OR BACKUP SPS BURN PREPS AND REQUIRES POWER DOWN OF ECS RADIATOR HEATERS OVERLOAD SENSING.

NOTES

(A) PRELAUNCH BATTERY REDLINES ARE BASED ON FAILURE OF THE BATTERY CHARGER BEFORE ACCOMPLISHING ANY CHARGING.

(B) THE TWO BATTERY REDLINES REFLECT THE ENERGY REQUIRED IN THE TWO LOWEST BATTERIES TO PROVIDE CAPABILITY FOR A SAFE RETURN FROM ANY POINT IN THE MISSION. THE REDLINES ARE BASED ON LOSS OF THE HIGHEST BATTERY SUBSEQUENT TO LOSS OF THE BATTERY CHARGER WITH A TWO-BATTERY ENTRY (WITH G&N) AND 12 HOURS OF POSTLANDING TIME.

(C) IF RESCUE IS REQUIRED, THE THREE-BATTERY ENERGY REQUIREMENTS WILL BE RECOVERED BY POWERING DOWN TO A TWO-BATTERY G&N ENTRY.

(D) AUX BAT ENERGY IS NOT INCLUDED IN BAT REDLINES.

(E) CONSIDERATION WILL BE GIVEN TO PERFORMING SPS BURNS WITHOUT BATTERY SUPPLEMENT IF REDLINE NOT MET.

(F) CRYOGENIC REDLINES ARE BASED ON CAPABILITY TO PERFORM NOMINAL MISSION WITH CAPABILITY TO RETURN TO EARTH AT A 40 AMP AVERAGE POWER LEVEL AFTER LOSS OF ANY CRYO TANK AT THE WORST CASE TIME FOR FAILURE.

(G) THREE-TANK CRYOGENIC REDLINE IS BASED ON THE TOTAL QUANTITY REQUIRED TO PERFORM NOMINAL LENGTH MISSION.

RULE NUMBERS 3-102 THROUGH 3-110 ARE RESERVED.

R	ITEM	
	5-27	IF SPS FAILS AFTER EPO RETROFIRE IGNITION OR NO SLA SEP: A. Hp > 70 NM - RETARGET FOR NEXT BEST PTP USING RCS. B. 40 < Hp < 70 - PITCH UP TO LOCAL HORIZONTAL ATTITUDE AND BURN SM RCS USING FOLLOWING PRIORITIES: 1. BURN Hp TO PAD VALUE 2. BURN MAXIMUM SM RCS ΔV AVAILABLE 3. BURN CM RCS TO Hp = 40 NM IF SM RCS ΔV NOT SUFFICIENT TO OBTAIN Hp = 40 NM. IF Hp $\leq$ 40 NM, TERMINATE ALL THRUSTING AT T_{FF} = 7 MIN. C. Hp < 40 NM - REMAIN IN RETRO ATTITUDE AND BURN SM RCS USING THE FOLLOWING PRIORITY: 1. BURN ΔV RESIDUALS. 2. BURN MAXIMUM SM ΔV AVAILABLE. NOTE THE S-IVB LOX DUMP CAPABILITY MAY BE USED TO SHAPE THE ORBIT FOR RETROFIRE MANEUVER OR TO REDUCE THE S-IVB WEIGHT TO OBTAIN MORE SM RCS ΔV.
	5-28	THE G&N IS NO-GO FOR ENTRY IF: A. THE CMC VALUE OF DOWNRANGE ERROR (RP- RT) AT .2G DIFFERS > $\pm$100 NM FROM GROUND VALUE. CREW B. V AND VTY. B. V AND GAMMA AT 400K ARE OUTSIDE THE CORRIDOR. GROUND WILL PROVIDE ENTRY PROFILE.
	5-29	BOOSTER NAVIGATION UPDATES FOR TLI: A. AN IU NAVIGATION UPDATE WILL BE PERFORMED (AND TIME TAGGED TO INSURE INCORPORATION OVER A MSFN STATION PRIOR TO TB6 INITIATION) FOR THE FOLLOWING SITUATIONS: 1. WHERE AN IU ACCELEROMETER FAIL OCCURRED PRIOR TO EARTH ORBIT INSERTION. 2. FOR ALL TLI OPPORTUNITIES WHERE MSFN VERSUS IU DIFFERENCE VIOLATES ANY OF THE FOLLOWING: A AT GET = 56 MIN: DOWNRANGE POSITION $\geq$ 21,174 FT SEMI-MAJOR $\geq$ .78 NM CROSSRANGE VELOCITY (MAXIMUM) $\geq$ 8 FPS A AT GET = 1 HR 45 MIN: DOWNRANGE POSITION $\geq$ 36,814 FT SEMI-MAJOR AXIS $\geq$ .84 NM CROSSRANGE VELOCITY (MAXIMUM) $\geq$ 9 FPS

MISSION RULES

SECTION 31 - LUNAR SURFACE OPERATIONS - CONTINUED

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
A	31-106	PRECISION OVEN TEMP REACHES MAXIMUM POSITIVE DEVIATION		NO FURTHER MEASUREMENTS WILL BE TAKEN DURING THE REMAINDER OF THE CURRENT TRAVERSE. TGE WILL BE PLACED IN THE LM SHADOW WITH THE RADIATOR SURFACE EXPOSED AT THE EARLIEST CONVENIENCE.	MAXIMUM POSITIVE DEVIATION IS INDICATED BY AN ODD NUMBER IN THE EIGHTH MOST SIGNIFICANT DIGIT OF THE DISPLAY AND A "7" IN THE NINTH (LEAST) SIGNIFICANT DIGIT.
A	31-107	INTERMEDIATE OVEN HOT ALARM IS EXPERIENCED PRIOR TO DEPARTURE TO ALSEP.		PLACE TGE IN LM SHADE WITH RADIATOR COVER OPENED PRIOR TO DEPARTING LM.	1. INTERMEDIATE OVEN HOT ALARM IS INDICATED BY A 6 OR 7 IN THE EIGHTH MOST SIGNIFICANT DIGIT OF THE DISPLAY. 2. TGE WILL BE USED ON EVA'S II AND III.
A	31-108	PRECISION OVEN TEMP REACHES MAXIMUM POSITIVE DEVIATION		READINGS WILL BE TAKEN UNTIL UNREASONABLE DATA IS RECEIVED.	MAXIMUM POSITIVE DEVIATION IS INDICATED BY AN ODD NUMBER IN THE EIGHTH MOST SIGNIFICANT DIGIT OF THE DISPLAY AND A "7" IN THE NINTH (LEAST) SIGNIFICANT DIGIT.
A	31-109	DELETED			
A	31-110	DELETED			

R	ITEM

GENERAL

THE FOLLOWING MISSION RULES APPLY TO FLIGHT CREW INVOLVEMENT WITH THE APOLLO LUNAR SURFACE EXPERIMENT PACKAGE (ALSEP) WHILE THE CREW IS ON THE LUNAR SURFACE. THESE RULES ARE EXCERPTED FROM THE EMRD FOR APOLLO 17, AND MISSING LETTERS ON RULES OR MISSING RULE NUMBERS PERTAINING TO GUIDELINES OR RULINGS WILL BE FOUND IN THAT DOCUMENT.

ALSEP OPERATIONAL GUIDELINES

32-1 GENERAL

A. THESE ALSEP GENERAL OPERATIONAL GUIDELINES ARE BASED ON OBJECTIVES IN THE FOLLOWING PRIORITIES:

1. HFE
2. LSP
3. LSG
4. LMS
5. LEAM

NOTE

RIPPLE-OFF SEQUENCE IS:

1. PDR 1 (7 W)
2. PDR 2 (14 W)
3. LMS
4. LEAM
5. HFE

A 6. LSG

A 7. LSP

B. THROUGH H. REFERENCE EMRD FOR APOLLO 17

I. THE ALSEP SHORTING PLUG SWITCH WILL BE ACTIVATED ASAP AFTER CENTRAL STATION DEPLOYMENT.

A J. IF THE GROUND IS UNABLE TO OBTAIN DOWNLINK, THE GROUND WILL REQUEST THE ASTRONAUT TO ROTATE THE RESET POWER SWITCH TO RESET AND THEN POWER.

K. REFERENCE APOLLO 17 EMRD

A L. DELETED

M. THE HFE BORE HOLES WILL HAVE PRIORITY OVER THE DRILL CORE STEM. THE HFE BORE HOLES WILL BE ATTEMPTED FIRST. IF PROBLEMS ARE ENCOUNTERED, EFFORTS ON BORE HOLES WILL BE TERMINATED AFTER A TOTAL OF 20 MINUTES ACCUMULATED DRILL ON TIME.

R	ITEM	
	32-1 (CONT)	N. IF A HARD OBJECT IS ENCOUNTERED WHICH REDUCES DRILL RATE TO LESS THAN 5 INCHES PER MINUTE ON EITHER HFE PROBE HOLE, THE FOLLOWING WILL BE ACCOMPLISHED: 1. IF THE SECOND SECTION IS NOT ATTACHED, WITHDRAW AND START AT A NEW LOCATION FOR A MAXIMUM OF TWO WITHDRAWALS. 2. IF THE SECOND STEM SECTION IS ATTACHED, CONTINUE UNTIL 10 MINUTES OF POWER ON TIME FOR DRILL STRING HAS ELAPSED. O. REFERENCE APOLLO 17 EMRD P. IF THE CREW MUST RETURN TO THE LM PRIOR TO COMPLETE ALSEP DEPLOYMENT, THE SHORTING SWITCH WILL BE ACTIVATED "ON" IF THE ANTENNA IS EMPLACED. IF THE ANTENNA IS NOT EMPLACED, THIS SWITCH WILL NOT BE ACTIVATED (PICK UP HERE ON EVA 2) Q. THROUGH R. REFERENCE APOLLO 17 EMRD S. FOR ANY MALFUNCTION DURING A SURFACE TASK, A MAXIMUM OF 10 MIN WILL BE SPENT ON THE CONTINGENCY PROCEDURE BEFORE THE TASK IS ABANDONED, WITH THE FOLLOWING EXCEPTIONS: 1. RTG FUELING - UP TO 20 MIN WILL BE ALLOWED IN EXERCISING RTG FUELING CONTINGENCY PROCEDURES. 2. ALSEP PACKAGE 1 TO PACKAGE 2 CABLE CONNECTIONS - UP TO 20 MIN WILL BE ALLOWED FOR MAKING THE CABLE CONNECTION. 3. ALSEP ANTENNA - UP TO 30 MIN WILL BE ALLOWED FOR ANTENNA ERECTION AND ALIGNMENT. 4. ALSEP DEPLOYMENT MAY BE CONTINUED ON A LATER EVA IF ADDITIONAL TIME TO SPEND ON CONTINGENCY PROCEDURES IS REQUIRED TO ATTAIN AN OPERATIONAL ALSEP. T. FOR EVA TERMINATION OR OTHER INTERRUPTIONS DURING ALSEP DEPLOYMENT, THE FOLLOWING DEPLOYMENT INTERRUPTION POINTS WILL BE OBSERVED IF PERMITTED BY CREW SAFETY CONSIDERATION: 1. REMOVE ALSEP PACKAGES 1 AND 2. CLOSE SEQ. BAY DOOR. REPLACE ALSEP PACKAGES WITH HANDLES UP AND WITH EXPERIMENTS FACING THE SUN WITHIN ±15°. 2. TILT FUEL CASK (DOME NOT REMOVED). 3. TILT FUEL CASK. REMOVE DOME. DO NOT DEFUEL.
A		4. FUEL RTG. THEN CARRY ALSEP TO DEPLOYMENT SITE. REMOVE SUBPALLETS FROM PACKAGE 2. CARRY PACKAGE 1 TO EMPLACEMENT SITE. DO NOT ACTUATE SWITCHES.
A		5. CONNECT RTG, HFE, AND LEAM CABLES TO CS. REMOVE LSP, GEOPHONE MODULE LSG, AND LMS FROM SUBPACKAGE 1. ALIGN CS AND RAISE SUNSHIELD. RAISE ANTENNA MAST, MOUNT GIMBAL, AND ANTENNA. LEVEL AND ALIGN ANTENNA. ROTATE SHORTING SWITCH ON WAY BACK TO LM.
A		6. DEPLOY ALSEP EXPERIMENTS AND COMPLETE TASKS. A HOLD POINT EXISTS AFTER EACH EXPERIMENT IS DEPLOYED. ROTATE SHORTING SWITCH ON WAY BACK TO LM.

R	ITEM	
A	32-1	U. IF ALL SPOTS ON TEMP LABLE ON HORSE COLLAR ARE BLACK AFTER FUELING RTG, CREW MUST REMOVE HORSE COLLAR WITH UHT AND SET IT ASIDE. CREW MUST NOT TOUCH HORSE COLLAR UNTIL IT HAS COOLED SUFFICIENTLY (10 MINUTES).
A		V. ALSEP DEPLOYMENT WILL NOT BE STARTED IF IT IS KNOWN THAT LESS THAN 1 HR 15 MIN IS AVAILABLE FOR ALSEP IN EVA L.
	32-2 AND 32-3	REFERENCE APOLLO 17 EMRD
	32-4	A. REFERENCE APOLLO 17 EMRD
A		B. THE CREW WILL REPORT RECHECK OF THE LSG LEVEL AND ALIGNMENT AND FREEDOM OF GIMBAL AFTER EXPERIMENT IS MANUALLY UNCAGED.
	32-5	A. REFERENCE APOLLO 17 EMRD
A		B. DELETED
		C. THROUGH D REFERENCE APOLLO 17 EMRD
A		E. DEPLOYMENT OF AN LSP EXPLOSIVE PACKAGE (EP) WILL BE TERMINATED ANY TIME LESS THAN 4 SAFETY FEATURES REMAIN. THE FOLLOWING CONDITIONS MUST BE MET BEFORE THE EP CAN BE DETONATED :
		1. ASTRO SW #2 ROTATED TO CW (ENABLE) POSITION. ENABLES 29 V TO THE LSP CENTRAL ELECTRONICS.
		2. LSP "OPERATE" CMD (OCTAL 055) RECEIVED BY LSP CENTRAL ELECTRONICS.
		3. LSP TRANSMITTER PULSES ENABLE CMD (OCTAL 156) RECEIVED BY LSP CENTRAL ELECTRONICS.
		4. LSP FORMAT ON CMD (OCTAL 003) RECEIVED BY THE ALSEP CENTRAL STATION DDP.
A		5. SAFE/ARM SLIDE TO THE ARM POSITION.
A		STATUS OF EACH OF THESE SAFETY FEATURES IS AS FOLLOWS:

		FEATURES SAFED	TOTAL NUMBER SAFED
A	1. ALSEP DEPLOYMENT	1, 2, 3, 4, 5	5
A	2. CHARGE DEPLOYMENT	2, 3, 4, 5	4
A	3. LSP PASSIVE LISTENING (NOT PLANNED WITH CREW ON SURFACE)	3, 5	2
A			

A NOTE: BATTERY TIMER AND CIRCUIT ACTIVATION IS NOT CONSIDERED IN THE ABOVE SAFETY FEATURES BECAUSE NO STATUS INDICATION EXISTS AFTER THE PIN HAS BEEN PULLED.

	32-6 THRU 32-80	REFERENCE APOLLO 17 EMRD

	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	32-81	UNABLE TO DRILL NORMAL HFE EMPLACEMENT HOLES			
A		A. IF EITHER HOLE IS LESS THAN 40 INCHES DEEP AND DRILL IS INOPERABLE		A.1. HAND-AUGER AND HAMMER BORE STEMS INTO SUBSURFACE AT LEAST 40 INCHES 2. IF SUCCESSFUL INSERT PROBE INTO HOLE MADE BY A DOUBLE CORE TUBE. FILL HOLE AROUND PROBE.	
A				3. IF LESS THAN 40 INCHES, LAY PROBE ON SURFACE AND ORIENT BLACK TAPE ON CABLE NORTH/SOUTH.	
A A		B. IF EITHER HOLE IS LESS THAN 40 INCHES DEEP AND DRILL IS STILL OPERABLE		B. DRILL DEEP CORE AT SHALLOW BORE LOCATION AND INSERT PROBE IN HOLE THROUGH TREADLE, AND CAVE SOIL IN AROUND PROBE.	B. USE TREADLE AND EXTRACTOR TO HOLD SOIL IN PLACE. MOVE TREADLE AT LEAST 10 FEET DOWN THE CABLE TOWARD THE ELECTRONICS.
A		C. IF HOLE IS NOT NOMINAL DEPTH		C. PLACE PROBE IN HOLE AS FAR AS IT WILL GO. EMPLACE LOWER RADATION SHIELD ON THE TOP OF THE PROBE. EMPLACE MIDDLE RADIATION SHIELD BELOW LUNAR SURFACE OR ON TOP OF PROBE.	
	32-82	HAVE CHOICE OF DRILLING SECOND HFE HOLE OR CORE SAMPLE HOLE		DRILL SECOND HFE PROBE EMPLACEMENT HOLE.	HFE HAS PRIORITY OVER CORE SAMPLE.
	32-83	DRILL RATE REDUCED TO LESS THAN 5 INCHES PER MINUTE		A. IF LESS THAN TWO STEM SECTIONS ARE ATTACHED TO THE POWER HEAD, WITHDRAW AND START AT NEW LOCATION FOR MAXIMUM OF THREE LOCATIONS FOR EACH BORE.	
A				B. IF TWO OR MORE STEM SECTIONS ARE ATTACHED TO THE POWER HEAD, CONTINUE UNTIL 10 MINUTES OF POWER ON TIME FOR THE DRILL STRING HAS ELAPSED.	
	32-84 THRU 32-110	REFERENCE APOLLO 17 EMRD			

R	ITEM	
	5-30	RESERVED
	5-31	RESERVED
	5-32	THE MAXIMUM ALLOWABLE MISALIGNMENT RATES BETWEEN THE IU AND IMU ARE 0.6 DEG/HR (IU) AND 1.5 DEG/HR (IMU).
	5-33	RESERVED
	5-34	TLI UNDERBURNS
A		A. FOR APOGEE ALTITUDES ABOVE 118K NM, A LUNAR LANDING MISSION IS AVAILABLE. THE TRADEOFFS THAT WILL BE MADE TO ACHIEVE THIS MISSION ARE, IN ORDER OF PRIORITY: (ITEMS ARE ADDITIVE) 1. PROVIDE ADDITIONAL ΔV FOR MCC 1 BY FOREGOING ANY NOMINAL CONSTRAINTS ON TEC RETURN INCLINATION. 2. EXECUTE MCC 1 AT TLI + 3 HRS 3. PROVIDE ADDITIONAL ΔV FOR MCC 1 BY: (A) UTILIZE THE LM YAW STEERING BUDGET DURING ASCENT A (B) ADD 24 HRS TO TEC 4. EXECUTE MCC 1 AT TLI + 1 HR 5. PROVIDE ADDITIONAL ΔV FOR MCC 1 BY: (A) REOPTIMIZE TLC (INCREASE DESCENT SEA) A (B) REOPTIMIZE THE DESCENT APPROACH AZ A (C) SHORTEN LUNAR PARKING ORBIT TIME (D) SHORTEN THE PLANNED LUNAR STAY TIME TO DECREASE THE LOPC NOTE THE ADDITIONAL CAPABILITY ACHIEVED BY EACH ITEM IS HIGHLY MISSION DEPENDENT.
A		B. FOR APOGEE ALTITUDES BETWEEN 118K NM AND 28,000 NM, A LUNAR ORBIT ALTERNATE MISSION IS AVAILABLE. THE NOMINAL PLAN FOR THIS MISSION IS: 1. EXECUTE MCC 1 ASAP (BETWEEN TLI + 1 AND TLI + 3 HRS) 2. EXECUTE A DPS LOI 3. EXECUTE ALL REMAINING MANEUVERS (CIRC, LOPC, TEI) WITH THE SPS
		C. FOR APOGEE ALTITUDES BELOW 28,000 NM, AN EARTH ORBIT ALTERNATE MISSION OR DIRECT ABORT WILL BE PERFORMED.

R	ITEM	
		LUNAR ORBIT
	5-76	THE DOI_1 MANEUVER WILL BE TARGETED TO OPTIMIZE THE GROUND TRACK FOR LUNAR LANDING. NOTE THE TARGETED Hp IN REV 12 IS 80K FT.
A	5-77	A "GO" FOR DOI_1 REQUIRES COMMITMENT TO AT LEAST 4 HRS IN LUNAR ORBIT. NOTE THIS PROVIDES ONE FULL REV OF TRACK AFTER DOI FOR CALCULATION OF TEI
	5-78	AFTER AOS FOLLOWING DOI_1, EXECUTION OF THE BAILOUT ABORT MANEUVER WILL BE RECOMMENDED IF INCOMING MSFN RADAR DATA INDICATES A CLOSEST APPROACH ALTITUDE OF EQUAL TO OR LESS THAN 1.0 NM ABOVE THE LUNAR TERRAIN. NOTES 1. THE PERICYNTHION ALTITUDE WHICH CORRESPONDS TO 1.0 NM CLOSEST APPROACH IS 3.88 NM. 2. THE VALUE OF DOPPLER RESIDUALS AT AOS WHICH CORRESPONDS TO THIS PERICYNTHION IS APPROXIMATELY -84 CYCLES PER SEC BUT THE ACTUAL VALUE WILL BE DETERMINED IN REAL TIME.
A		
A		
	5-79	PRIOR TO UNDOCKING, CSM MANEUVERS WILL BE SCHEDULED ASAP TO CORRECT THE FOLLOWING SITUATIONS: A. MISS DISTANCE OVER THE LLS GREATER THAN 0.5 DEG OUT OF PLANE B. DEVIATION IN APPROACH AZIMUTH GREATER THAN ±10 DEG FROM THE NOMINAL C. CURRENT PERICYNTHION ALTITUDE LESS THAN 30,000 FT

R	ITEM	
		RULES 5-85 THROUGH 5-89 ARE RESERVED.
	5-90	LR DATA IS REQUIRED FOR LANDING.
		A. LOCK-ON
		1. LR DATA ACCEPTED AND CONVERGED CONTINUOUS TO P64 - CONTINUE MISSION IF LOSS OF LOCK OCCURS IN P64.
		2. LR DATA ACCEPTED AND CONVERGED WITH SUBSEQUENT DROPOUT - CONTINUE TO P64.
		(A) LANDING RADAR REGAINED IN P64.
		(1) DATA ACCEPTED BY LGC - CONTINUE MISSION
		(2) DATA NOT ACCEPTED BY LGC - ATTEMPT MANUAL LANDING IF LR/PGNS ΔH <1500 FT
		(B) LANDING RADAR NOT REGAINED AT P64 - ABORT
		3. LATE LR LOCK-ON WITH DATA BEING INCORPORATED AND CONVERGING - CONTINUE TO P64
		(A) DATA ACCEPTED BY LGC - CONTINUE MISSION
		(B) DATA NOT ACCEPTED BY LGC - ATTEMPT MANUAL LANDING
		B. MINIMUM ALTITUDE WITHOUT LR ALTITUDE INCORPORATION
		1. PGNS ALTITUDE LESS THAN 22,000 FEET AND PGNS NAVIGATION ERRORS, CONFIRMED BY MSFN OR DOPPLER RESIDUALS, THAT CAUSE AN AGS-PGNS RADIAL VELOCITY DIFFERENCE
A		(A) RADIAL N69 NOT INCORPORATED AND DIFFERENCE EXCEEDS -10 FPS - ABORT
A		(B) RADIAL N69 INCORPORATED AND DIFFERENCE EXCEEDS -20 FPS - ABORT
		2. PGNS ALTITUDE LESS THAN 18,000 FEET AND PGNS NAVIGATION ERRORS, CONFIRMED BY DOPPLER BUT NOT BY AGS, CAUSE THE MSFN-PGNS RADIAL VELOCITY DIFFERENCE TO EXCEED -20 FPS - ABORT
		3. PGNS ALTITUDE LESS THAN 10,000 FT
		(A) RADIAL N69 NOT INCORPORATED - ABORT
		(B) LOSS OF WORKING PGNS (AS DEFINED BY RULE 5-91) - ABORT
		4. PGNS ALTITUDE LESS THAN 6000 FT - ABORT
		NOTE FOR FAILURES IN THE PGNS/LR INTERFACES, INCORPORATION MAY BE SATISFIED BY A PGNS/LR COMPARISON RESULTING IN ΔH < 1500 FT.
		C. MINIMUM ALTITUDE WITHOUT LR VELOCITY INCORPORATION
		1. PGNS ALTITUDE LESS THAN 10,000 FEET WITH LANDMARK TRACKING OBTAINED AND PGNS NAVIGATION ERRORS CONFIRMED BY AGS OR DOPPLER THAT CAUSE MSFN - PGNS DOWNRANGE OR CROSSRANGE VELOCITY DIFFERENCES
		(A) NAV N69 INCORPORATED AND $\Delta\dot{X}$ EXCEEDS +50 OR -35 FPS OR $\Delta\dot{Y}$ EXCEEDS +90 OR -70 FPS - ABORT
		(B) NAV N69 NOT INCORPORATED AND $\Delta\dot{X}$ EXCEEDS ±20 FPS OR $\Delta\dot{Y}$ EXCEEDS +45 OR -25 FPS - ABORT
		2. PGNS ALTITUDE LESS THAN 10,000 FEET WITHOUT LANDMARK TRACKING OBTAINED AND PGNS NAVIGATION ERRORS CONFIRMED BY AGS OR DOPPLER THAT CAUSE MSFN - PGNS DOWNRANGE OR CROSSRANGE VELOCITY DIFFERENCES
		(A) NAV N69 INCORPORATED AND $\Delta\dot{X}$ EXCEEDS ±35 FPS OR $\Delta\dot{Y}$ EXCEEDS +70 OR -25 FPS - ABORT
		(B) NAV N69 NOT INCORPORATED AND $\Delta\dot{X}$ EXCEEDS ±15 FPS OR $\Delta\dot{Y}$ EXCEEDS +30 OR -10 FPS - ABORT.

R	ITEM	
A	5-91	POWERED DESCENT WILL BE TERMINATED FOR THE FOLLOWING: A. PGNS NAVIGATION ERRORS, CONFIRMED BY MSFN OR DOPPLER RESIDUALS, THAT RESULT IN THE FOLLOWING AGS-PGNS DIFFERENCES: $\Delta\dot{X}$ (DOWNRANGE) > +90 OR -35 FPS $\Delta\dot{Y}$ (CROSSRANGE) > ±90 FPS $\Delta\dot{Z}$ (RADIAL) > +60 OR -35 FPS B. PGNS NAVIGATION ERRORS, CONFIRMED BY DOPPLER RESIDUAL BUT NOT BY AGS, THAT RESULT IN THE FOLLOWING MSFN-PGNS VELOCITY DIFFERENCES: $\Delta\dot{Y}$ (CROSSRANGE) > ±200 FPS $\Delta\dot{Z}$ (RADIAL) > +45 OR -35 FPS C. COMMANDED THRUST INCREASING PRIOR TO THROTTLEDOWN OR P63 T_{GO} = 80 SECONDS D. GTC GREATER THAN 57 PERCENT BY P63/P64 PROGRAM SWITCH PLUS 15 SECONDS E. FAILURE TO ACHIEVE FTP (AUTO OR MANUAL) BY NOMINAL T_{IG} + 31 SECONDS (ABORT AT GTC DIVERGENCE)
A		F. THE FOLLOWING PGNS ALARMS: 20105, 00214, 20430, 20607, 21103, 01107, 21204, 21302, 21501, 00402 (CONTINUING), 01406 (CONTINUING), 01410 (CONTINUING). G. CONSIDERATION WILL BE GIVEN TO ABORTING FOR VIOLATION OF THE TIME BAISED DPS ABORT BOUNDARY.
	5-92	THE DESCENT TARGET POINT WILL BE SHIFTED DOWNTRACK IF GTC INDICATES NO THROTTLEDOWN BY P63/64 PROGRAM SWITCH - THE MAXIMUM SHIFT IS AS FOLLOWS: A. 20,000 FT DOWNTRACK IF VALID LANDMARK SIGHTINGS WERE OBTAINED.
A		B. 10,000 FT DOWNTRACK IF NO VALID LANDMARK SIGHTINGS C. NO DOWNTRACK SHIFT WILL BE ALLOWED IF THE APPROACH AZIMUTH IS BETWEEN 95 AND 100 DEG NOTE ONE MINUTE OF RCS WILL BE USED TO ALLOW LANDING WITHIN THE ABOVE LIMITS.
	5-93	AN ABORT WILL NOT BE REQUESTED FOR A PGNS FAILURE AFTER PITCHOVER IN THE APPROACH PHASE.
	5-94	IN THE EVENT MSFN AND DOPPLER DATA ARE NOT AVAILABLE FOR CONFIRMATION OF PGNS/AGS ERRORS, POWERED DESCENT WILL BE TERMINATED FOR THE FOLLOWING AGS-PGNS VELOCITY DIFFERENCES: $\Delta\dot{X}$ > -35 FPS $\Delta\dot{Z}$ > +60 FPS OR -35 FPS

R	ITEM	
		ASCENT
	5-101	LM LIFTOFF WILL BE DELAYED ONE REVOLUTION RATHER THAN ACCEPTING A SLIP IN NOMINAL LIFTOFF TIME GREATER THAN
A		A. 30 SECONDS FOR THE DIRECT RNDZ TECHNIQUE B. 90 SECONDS FOR THE COELLIPTIC SEQUENCE RNDZ
	5-102	FOLLOWING A DESCENT ABORT, GUIDANCE SWITCHOVER TO AGS WILL BE PERFORMED FOR
		A. THE FOLLOWING PGNS ALARMS: 20105, 00214, 20430, 20607, 21103, 01107, 21204, 21302, AND 21501
		B. PGNS NAVIGATION ERRORS THAT RESULT IN:
		1. AGS PREDICTED INSERTION Hp < 40,000 FEET. 2. AGS PREDICTED INSERTION Ha GREATER THAN TARGET VALUE PLUS 40 NAUTICAL MILES. 3. AGS PREDICTED INSERTION WEDGE ANGLE GREATER THAN 1.0 DEGREE.
	5-103	DURING ASCENT, GUIDANCE SWITCHOVER TO AGS WILL BE PERFORMED FOR
		A. THE FOLLOWING PGNS ALARMS: 20105, 00214, 20430, 20607, 21103, 01107, 21204, 21302, AND 21501
		B. PGNS NAVIGATION ERRORS, CONFIRMED BY AGS RESIDUALS, THAT RESULT IN THE FOLLOWING MSFN-PGNS VELOCITY DIFFERENCES:
		$\Delta\dot{X}$ (DOWNRANGE) > ±24 FPS $\Delta\dot{Y}$ (CROSSRANGE) > ±90 FPS (COELLIPTIC SEQUENCE RENDEZVOUS), > ±45 FPS (DIRECT RENDEZVOUS) $\Delta\dot{Z}$ (RADIAL) > ±37 FPS
		C. PGNS NAVIGATION ERRORS THAT RESULT IN
		1. AGS PREDICTED INSERTION Hp < 40,000 FEET. 2. AGS PREDICTED INSERTION Ha GREATER THAN TARGET VALUE PLUS 40 NAUTICAL MILES. 3. AGS PREDICTED INSERTION WEDGE ANGLES GREATER THAN 1.0 DEGREE (COELLIPTIC SEQUENCE RENDEZVOUS), GREATER THAN 0.5 DEG (DIRECT RENDEZVOUS)
		D. IF MSFN NOT VALID DURING ASCENT THE FOLLOWING DOPPLER RESIDUALS WILL BE USED TO CONFIRM SWITCHOVER:
A		1. AGS-PGNS $\Delta\dot{X}$ (DOWNRANGE) > ±24 FPS AND DOPPLER-PGNS RESIDUAL > ±14 FPS
A		2.(A). AGS-PGNS $\Delta\dot{Y}$ (CROSSRANGE) > ±45 FPS AND DOPPLER-PGNS RESIDUAL > ±14.6 FPS FOR THE DIRECT RNDZ
A		(B). AGS-PGNS $\Delta\dot{Y}$ (CROSSRANGE) > ±90 FPS AND DOPPLER-PGNS RESIDUAL > ±29.2 FPS FOR THE COELLIPTIC RNDZ
A		3. AGS-PGNS $\Delta\dot{Z}$ (RADIAL) > ±37 FPS AND DOPPLER-PGNS RESIDUAL > ±27.5 FPS

R	ITEM	

RENDEZVOUS

5-111 THE PGNS IS PRIME FOR EITHER THE DIRECT RNDZ (TPI ONLY) OR THE COELLIPTIC SEQUENCE (CSI,CDH, AND TPI) MANEUVER COMPUTATION/EXECUTION WITH THE AGS AS BACKUP UTILIZING THE ACCEPTED SOLUTION. THE AVAILABLE SOLUTIONS FOR THESE MANEUVER(S) ARE, (IN ORDER OF PRIORITY) PGNS, AGS, CMC, AND CHARTS.

A. THE FOLLOWING VOTING LOGIC WILL BE OBSERVED FOR ALL MANEUVERS:

1. IF VHF AND RR AGREE - VOTE 2 OUT OF 3 SOURCES AND EXECUTE THE PRIORITY SOLUTION
2. IF VHF AND RR DISAGREE - MSFN WILL BE UTILIZED TO ISOLATE THE FAILED SYSTEM

B. AGREEMENT BETWEEN SOURCES IS DEFINED AS

1. DIRECT RNDZ - TIP

(A) 3 FPS IN ΔV_X
(B) 7 FPS IN ΔV_Y
(C) 9 FPS IN ΔV_Z

NOTE

LM BIASES OF 1 FPS IN ΔV_X AND -2 FPS IN ΔV_Z WILL BE APPLIED TO THE LM SOLUTION FOR COMPARISON WITH THE CSM SOLUTION

2. COELLIPTIC SEQUENCE RNDZ - ALL MANEUVERS

(A) 3 FPS IN ΔV_X
(B) 7 FPS IN ΔV_Y
(C) 9 FPS IN ΔV_Z

C. THE CMC SOLUTION FOR THE PLANE CHANGE MANEUVER WILL ALWAYS BE EXECUTED IF GREATER THAN 5 FPS.

5-112 LIFTOFF WILL BE COMPUTED TO SATISFY THE FOLLOWING CONSTRAINTS:

A. DIRECT RNDZ

1. THE ΔH AT TPI WILL BE 15 NM.
2. THE $\Delta\Theta$ AT TPI WILL BE +1.69 DEG.
3. THE WEDGE ANGLE AT INSERTION WILL BE ZERO DEGREES.

A 4. TPI WILL OCCUR 47 MIN AFTER INSERTION.

B. COELLIPTIC SEQUENCE RNDZ

1. THE ΔH AT TPI WILL BE 15 NM.
2. THE NOMINAL ELEVATION ANGLE (26.6 DEG) WILL OCCUR 16 MIN PRIOR TO SUNRISE.
3. THE CDH MANEUVER WILL BE APPROXIMATELY ZERO ΔV.

R	ITEM	
		RANGE SAFETY RULES AND AGREEMENTS
		GENERAL
	5-140	RANGE SAFETY POLICIES AND CRITERIA ARE SPECIFIED IN AFETR MANUAL (AFETRM) 127-1 DATED 1 JANUARY 1969. THE FOLLOWING MISSION RULES CONCERNING SPECIFIC AFETR/NASA INTERFACE SUPPLEMENT AFETRM 127-1.
	5-141	THE RSO WILL ACCOMPLISH THE PAD EMERGENCY RANGE CUTOFF PROCEDURE IF THE SPACE VEHICLE WILL NOT LIFT OFF AFTER IGNITION AND NASA IS UNABLE TO ACCOMPLISH CUTOFF. THE RSO WILL SEND "ARM/MFCO" ONLY IN RESPONSE TO A CODED VERBAL REQUEST FROM THE NASA LAUNCH VEHICLE TEST CONDUCTOR (CLTC). THE CLTC WILL CALL THE RSO ON THE CLTC-RSO DIRECT LINE TO TRANSMIT THIS REQUEST. THE RSO WILL NOT EXECUTE THIS PROCEDURE IF HE HAS A LIFTOFF INDICATION.
	5-142	THE FLIGHT DIRECTOR (FD) WILL INITIATE ABORT IN RESPONSE TO A CODED VERBAL REQUEST FROM THE RSO. THIS PROCEDURE WILL BE EXECUTED IF RANGE SAFETY FLIGHT TERMINATION CRITERIA HAVE BEEN VIOLATED AND RSO EFFORTS TO TERMINATE THRUST HAVE FAILED. THE REQUEST FROM RSO TO FD WILL BE TRANSMITTED ON THE FLIGHT DIRECTOR LOOP WITH THE FIDO-RSO PRIVATE LINE AS BACKUP.
	5-143	THE RSO WILL SEND "ARM/MFCO" IN RESPONSE TO A CODED VERBAL REQUEST FROM THE FLIGHT DIRECTOR (FD) OR THE FLIGHT DYNAMICS OFFICER (FIDO). THIS PROCEDURE WILL BE EXECUTED IF ABORT LIMITS HAVE BEEN EXCEEDED AND ABORT ACTION HAS BEEN UNSUCCESSFUL. THE REQUEST FROM FD/FIDO TO THE RSO WILL BE TRANSMITTED ON THE RSO LOOP (CAPE 111) WITH THE FIDO-RSO PRIVATE LINE AS BACKUP.
A	5-144	THE FD WILL INFORM THE RSO WHEN THE S-IC NO. 3 ENGINE HAS SHUT DOWN BY STATING "RSO, NO. 3 OUT" ON THE RSO LOOP (CAPE 111). THE FD WILL ACTIVATE THE ENGINE OUT LIGHT ONLY IF NO OTHER KNOWN ANOMOLIES EXIST. THE ENGINE OUT LIGHT CIRCUIT FROM FD TO RSO IS HIGHLY DESIRABLE. THE PROCEDURE WILL ALSO BE EXCUTED IF THE SIC NO. 4 ENGINE SHUTS DOWN AND THE INTENDED FLIGHT AZIMUTH IS GREATER THAN 96 DEGREES AND THE LAUNCH AREA WIND PROFILE IS GREATER THAN 0.75 SIGMA.
	5-145	IF RANGE SAFETY DESTRUCT LINES ARE VIOLATED, THE RSO WILL SEND "ARM/MFCO" AND NOTIFY THE FD/FIDO. NO SPS THRUSTING WILL BE INITIATED FOLLOWING SUCH RANGE SAFETY ACTION EXCEPT TO PROVIDE CREW SAFETY AS DETERMINED BY THE FD.
	5-146	IF AN ESTABLISHED IMPACT PREDICTION (IP) POINT IS ON THE CAPE KENNEDY LAND AREA, "DESTRUCT/PD" WILL BE TRANSMITTED.
	5-147	IF AN ATTEMPT TO TERMINATE THRUST BY "ARM/MFCO" IS UNSUCCESSFUL WHILE THE IP IS ON THE CAPE KENNEDY LAND AREA, "DESTRUCT/PD" WILL BE SENT.

R	ITEM	
	5-148	WHEN THE IP HAS MOVED OFF THE CAPE, FLIGHT TERMINATION ACTION WILL BE LIMITED TO "ARM/MFCO" OR CREW INITIATED ABORT. THE "DESTRUCT/PD" FUNCTION WILL BE SENT ONLY AFTER FD/FIDO CONFIRMATION OF SATISFACTORY SPACECRAFT SEPARATION, AND ONLY IF FUEL DISPERSION IS NECESSARY.
	5-149	IF AN IP POINT IS ESTABLISHED AND "DESTRUCT/PD" IS DEEMED UNNECESSARY, THE RSO WILL NOTIFY FD/FIDO, "SAFE WILL BE SENT UPON FD/FIDO'S REQUEST, 'RSO SEND SAFE'".
	5-150	FD/FIDO WILL DECLARE TO THE RSO WHEN THERE IS NO POSSIBILITY OF INSERTING THE SPACECRAFT INTO AN ORBIT, AND THE RSO WILL NOT ALLOW THE AFRICAN GATE TO BE OVERFLOWN.
	5-151	AN ETR RANGE SAFETY OFFICER (BRSO) IS REQUIRED AT BERMUDA TO MONITOR PRESENT POSITION AND IMPACT PREDICTION CHARTS, TO OBSERVE TELEMETRY DISPLAYS, AND TO TRANSMIT THE RANGE SAFETY FUNCTIONS WHEN COMMANDED TO DO SO BY THE RSO. FOR FLIGHT AZIMUTHS LESS THAN 090 DEGREES, THE BRSO WILL ASSUME PRIMARY RANGE SAFETY RESPONSIBILITY IN THE EVENT OF LOSS OF COMMUNICATIONS BETWEEN THE BRSO AND THE RSO.
A	5-152	SAFING BY THE RSO WILL BE TRANSMITTED AFTER GATE PENETRATION AND FIRST S-IVB CUTOFF WHEN THE FD/FIDO REQUESTS, "RSO SEND SAFE." WHEN SAFING IS CONFIRMED, THE RSO WILL STATE "SAFING CONFIRMED." IN THE EVENT OF LOSS OF COMM WITH FD/FIDO, THE RSO WILL SEND SAFE ONLY IF HE CAN CONFIRM S-IVB CUTOFF AND HE HAS NO INDICATION THAT THE EBW'S ARE CHARGED.
	5-153	IF SAFING CANNOT BE CONFIRMED BY THE RSO, ANOTHER SAFING ATTEMPT WILL BE MADE BY THE RSO ON THE FIRST ORBITAL PASS OVER THE CAPE. COORDINATION WILL BE EFFECTED WITH THE SUPERINTENDENT OF RANGE OPERATIONS (SRO) AND FIDO TO ENSURE COMMAND COVERAGE AND TELEMETRY DISPLAY AVAILABILITY. AT THE AGREED TIME, FIDO WILL STATE, "RSO SEND SAFE." UPON CONFIRMATION, THE RSO WILL STATE, "SAFING CONFIRMED".
	5-154	THE FD/FIDO WILL INFORM THE RSO IMMEDIATELY UPON DETERMINATION OF A SPACECRAFT SEPARATION. THIS NOTIFICATION WILL BE TRANSMITTED ON THE RSO LOOP (CAPE 111) WITH THE FIDO-RSO PRIVATE LINE AS BACKUP.

R	ITEM	
		RANGE SAFETY WEATHER RESTRICTIONS
	5-168	WIND RESTRICTIONS AN ANNUAL PROFILE WIND RESTRICTION OF 1.25 SIGMA (11 PERCENT) WILL BE IN EFFECT FOR LAUNCH.
A	5-169	CEILING AND VISIBILITY RESTRICTIONS NO CEILING OR VISIBILITY RESTRICTIONS WILL BE IMPOSED PROVIDING IU C-BAND BEACON NO. 1 AND TWO OF THE FOLLOWING THREE DATA SOURCES ARE AVAILABLE: CAPE FPS-16, MLA TPQ-18, AND TM IP. FAILURE OF C-BAND BEACON NO. 1 WILL RESULT IN CEILING AND VISIBILITY LIMITS OF APPROXIMATELY 1400 FEET AND 11.5 NM RESPECTIVELY. ADDITIONAL FAILURES WILL RESULT IN CEILING AND VISIBILITY LIMITS AS DETERMINED BY THE AVAILABILTY OF OTHER INSTRUMENTATION.

R	ITEM	
		A. BSE GENERALIZED SWITCH SELECTOR COMMAND CAPABILITY EXISTS: 1. WHEN CREW ENABLES IU COMMAND SYSTEM (EXCEPT AS NOTED BELOW IN ITEM D) 2. AFTER TB7 + 20 MIN 3. AFTER SPACECRAFT SEPARATION B. BSE MANEUVER UPDATE AND INHIBIT CAPABILITY EXISTS FOR TB7 MANEUVERS ONLY.
A		C. BSE HAS NAVIGATION UPDATE CAPABILITY (FMR 6-3) AND TARGET UPDATE CAPABILITY.
		D. BSE HAS NO COMMAND CAPABILITY DURING POWERED BURN PHASES.
		E. A SAFE DISTANCE BETWEEN THE SPACECRAFT AND S-IVB/IU IS DEFINED AS 7000 FT.
		F. BSE WILL RECOMMEND NO S-IVB RESTART FOR ANY CONFIRMED CONDITION/MALFUNCTION IN THE LAUNCH VEHICLE WHICH RESULTS IN: 1. A CATASTROPHIC HAZARD 2. ACHIEVEMENT OF AN S-IVB ENGINE MAINSTAGE BURN WITH EXPECTED CUTOFF OR SHUTDOWN CONDITIONS DEFINITELY PRECLUDING AN ACCEPTABLE LUNAR MISSION. IN APPLYING THIS CRITERIA TO SPECIFIC MISSION RULES, A GO/NO GO RECOMMENDATION WILL BE REQUIRED IF INSUFFICIENT S-IVB CONSUMABLES OR PROPULSION PERFORMANCE IS AVAILABLE TO ASSURE ANY FINITE PROBABILITY OF ACHIEVING A CUTOFF ORBIT WITH 28K NM APOGEE ALTITUDE (FMR 7-1).
		G. IN THE EVENT OF NO S-IVB IGNITION AT RESTART OR AN EARLY S-IVB SECOND BURN CUTOFF, THE SPACECRAFT SHOULD REMAIN ATTACHED TO THE S-IVB/IU AND MONITOR LH_2 AND LOX ULLAGE PRESSURES UNTIL THE STAGE STATUS CAN BE ASSESSED BY GROUND. IF EMERGENCY SEPARATION IS REQUIRED IMMEDIATELY AFTER S-IVB CUTOFF, THE SPACECRAFT SHOULD IMMEDIATELY GO TO A SAFE DISTANCE (7000 FT) FROM THE S-IVB/IU.
		H. ABORT OR SPACECRAFT SEPARATION DURING LAUNCH PHASE WILL BE RECOMMENDED FOR THE FOLLOWING:
A		6-1 S-IC LOSS OF THRUST 6-2 LOSS OF ATTITUDE CONTROL 6-5 S-IVB LOX CRYO REPRESS VALVE(S) FAIL OPEN 6-6 EXCESSIVE ATTITUDE ERRORS IN PITCH OR YAW DURING S-II BURN **6-7 S-II LOSS OF THRUST **6-8 S-II ANY SINGLE ACTUATOR HARDOVER INBOARD 6-9 S-II SECOND PLANE SEPARATION FAILS TO OCCUR AT TB3 + 31 SEC 6-10 S-IVB LOSS OF ENGINE HYDRAULIC FLUID PRIOR TO FIRST S-IVB BURN 6-11 S-IVB STAGE LOSS OF THRUST 6-12 S-IVB COLD HELIUM SHUTOFF VALVE(S) FAILS OPEN
		I. SPACECRAFT GUIDANCE TAKEOVER WILL BE RECOMMENDED FOR THE FOLLOWING: 6-4 LAUNCH VEHICLE INERTIAL PLATFORM FAILURE-ATTITUDE REFERENCE 7-8 LOSS OF ATTITUDE CONTROL DURING TB5, TB7
		J. S-II/S-IVB EARLY STAGING WILL BE RECOMMENDED FOR THE FOLLOWING: 6-5 S-IVB LOX CRYO REPRESS VALVE(S) FAIL OPEN **6-6 EXCESSIVE ATTITUDE ERROR IN PITCH OR YAW DURING S-II BURN **6-7 S-II LOSS OF THRUST **6-8 S-II ANY SINGLE ACTUATOR HARDOVER INBOARD **6-12 S-IVB COLD HELIUM SHUTOFF VALV(S) FAILS OPEN ** TIME DEPENDENT

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
A	6-2	LOSS OF ATTITUDE CONTROL			CUES
		A. PRIOR TO DEACTIVATION OF EDS AUTO ABORT	LAUNCH	A. ABORT BSE TRANSMIT ABORT REQUEST	A.1. ANGULAR RATES - PITCH (R4-602) OR YAW (R5-602) GREATER THAN 4 DEG/SEC. ROLL (R34-602) GREATER THAN OR EQUAL TO 20 DEG/SEC. 2. ANGULAR RATES - PITCH (R13-602) OR YAW (R8-602) GREATER THAN 4 DEG/SEC. 3. EDS OVERRATE, PITCH OR YAW (K84-602), ROLL (K83-602). NOTES A.1. THESE CUES ARE VALID IF RATE CHANNEL SWITCHOVER HAS NOT OCCURRED.
		B. BETWEEN DEACTIVATION OF EDS AUTO ABORT AND TB5 INITIATE	LAUNCH	B. ABORT BSE TRANSMIT ABORT REQUEST	CUES B.1. ANGULAR RATES - PITCH (R4-602), YAW (R5-602), GREATER THAN OR EQUAL TO 10 DEG/SEC, ROLL (R34-602) GREATER THAN OR EQUAL TO 20 DEG/SEC. 2. ANGULAR RATES - PITCH (R13-602), YAW (R8-602), GREATER THAN OR EQUAL TO 10 DEG/SEC. 3. EDS OVERRATE - PITCH OR YAW (K84-602), ROLL (K83-602). NOTES B.1. R13-602 AND R8-602 ARE VALID IF RATE CHANNEL SWITCHOVER HAS NOT OCCURRED. 2. DELETED 3. DELETED

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
A	6-8	S-II STAGE ANY SINGLE ACTUATOR HARDOVER INBOARD A. PRIOR TO S-IVB TO COI CAPABILITY B. BETWEEN S-IVB TO COI CAPABILITY AND 30 SEC PRIOR TO S-II CUTOFF C. AFTER S-II CUTOFF MINUS 30 SEC	LAUNCH	ABORT/EARLY STAGE/CONTINUE MISSION A. ABORT BSE INFORM FLIGHT AND TRANSMIT ABORT REQUEST B. EARLY STAGE BSE INFORM FLIGHT AND RECOMMEND EARLY STAGING C. CONTINUE MISSION BSE INFORM FLIGHT	CUES 1. YAW ACTUATOR POSITION EXCEEDS +6 DEG (G8-201 THRU 204, G30-201 THRU 204) 2. PITCH ACTUATOR POSITION EXCEEDS +6 DEG (G9-201 THRU 204, G31-201 THRU 204) 3. ADJACENT CONTROL ENGINE ACTUATOR IN SAME PLANE MOVES 4-1/2 DEG INBOARD (SAME MEASUREMENTS AS CUES 1 AND 2) NOTES POSSIBLE CATASTROPHIC ENGINE FAILURE MAY OCCUR BEFORE ABORT CAN BE IMPLEMENTED. ANALYSES INDICATE A POSSIBILITY OF VEHICLE LOSS WITHIN 10 SEC. AFTER THE FAILURE OCCURS.
	6-9	S-II SECOND PLANE SEPARATION FAILS TO OCCUR AT TB3 + 31.7 SEC	LAUNCH	ABORT BSE INFORM FLIGHT AND TRANSMIT ABORT REQUEST. CREW ABORT PRIOR TO TB3 + 1 MIN 45 SEC.	CUES 1. SECOND PLANE SEPARATION INDICATION SHOWS NO SEPARATION (M86-206, M87-206) 2. GUIDANCE MODE WORD 1 MODE CODE 25 BIT D15 REMAINS ZERO (H60-603). 3. IGNITION BUS VOLTAGE REMAINS AT APPROXIMATELY 28 VOLTS (M125-207). 4. RECIRCULATION BUS VOLTAGE REMAINS AT APPROXIMATELY 56 VOLTS (M111-207). NOTES THE CREW SHOULD ABORT AS SOON AS POSSIBLE AFTER MALFUNCTION OCCURS TO PRECLUDE EXCESSIVE THERMAL PROBLEMS IN AFT INTERSTAGE.
	6-10	S-IVB LOSS OF HYDRAULIC FLUID PRIOR TO FIRST S-IVB BURN	LAUNCH	ABORT BSE INFORM FLIGHT AND FIDO AND RECOMMEND NO S-IVB START. BSE TRANSMIT ABORT REQUEST AT S-II CUTOFF.	CUES 1. HYDRAULIC RESERVOIR OIL LEVEL APPROX ZERO PERCENT (L7-403). 2. HYDRAULIC SYSTEM PRESSURE LESS THAN 1700 PSIA (D41-403). 3. HYDRAULIC RESERVOIR PRESSURE APPROX ZERO PSIA (D42-403). NOTES 1. IF L7-403 IS FUNCTIONING PROPERLY, IT IS REQUIRED FOR IMPLEMENTATION OF THIS RULE. 2. SPACECRAFT SHOULD HAVE COI CAPIBILITY AT S-II CUTOFF 3. AT S-II CUTOFF, THE CREW SHOULD INHIBIT THE S-IVB START WITH THE TRANSLATION HANDCONTROLLER.

PRELAUNCH INSTRUMENTATION

STAGE COMMUNICATIONS SYSTEM AND FLIGHT CONTROL MEASUREMENT CATEGORIZATION

R	ITEM	MEASUREMENT DESCRIPTION	MEAS NUMBER	ONBOARD	TRANSDUCERS	CATEGORY	EFFECTIVITY	MISSION RULE REF
		STAGE COMMUNICATIONS SYSTEM						
		S-II STAGE						
		LINK BP1				HD		
		MUX BP1AO				HD		
		MUX BP1BO				HD		
		MUX CP1AO				HD		
		S-IVB STAGE						
		LINK CP1				HD		
		MUX DP1BO (VIA IU)				M		
		MUX CP1BO				HD		
		INSTRUMENT UNIT						
		LINK DP1				HD		
		LINK DP1B				M		
		MUX CP1AO (VIA S-IVB)				HD		
		MUX DP1AO				HD		
		EMERGENCY DETECTION SYSTEM (EDS)				M		
		COMMAND COMMUNICATIONS SYSTEM (CCS) UPLINK				M		
		FLIGHT CONTROL MEASUREMENTS						
		S-IVB STAGE						
		PRESS, FUEL PUMP INLET	D2-403					7-14
		PRESS, FUEL TANK ULLAGE EDS 1	D177-408	METER*	COMMON	2 OF 3		7-14
		PRESS, FUEL TANK ULLAGE EDS 2	D178-408	METER*	COMMON	M		7-14/19
		PRESS, OXID PUMP INLET	D3-403					
		PRESS, OXID TANK ULLAGE EDS 1	D179-406	METER*	COMMON	2 OF 3		7-14/19,8-5
		PRESS, OXID TANK ULLAGE EDS 2	D180-406	METER*	COMMON	M		7-14/19,8-5
A		VOLT-F/U 1EBW RANGE SAFETY	M30-411			HD		7-5
A		VOLT-F/U 2EBW RANGE SAFETY	M31-411			HD		7-5
A		RSCR NO. 1, SIGNAL STRENGTH LOW LEVEL	N57-411			HD		7-5
A		RSCR NO. 2, SIGNAL STRENGTH LOW LEVEL	N62-411			HD		7-5
		INSTRUMENT UNIT						
		GUIDANCE COMPUTER OPERATION	H60-603			M		6-1/4/7/9, 7-8/11,8-1/8
		COMPUTER RESET PULSE NO. 1-GUIDANCE DECODER	J71-603			1 OF 2 M		REQUIRED TO COMPLETE MULTIPLE WORD GROUND COMMANDS
		COMPUTER RESET PULSE NO. 2-GUIDANCE DECODER	J72-603					

*ONBOARD DISPLAY MANDATORY

INSTRUMENTATION REQUIREMENTS

R	ITEM	MEAS DESCRIPTION	PCM	ONBOARD	TRANSDUCERS	CATEGORY	MSN RULE REFERENCE
	16-50	OX TK PRESS	SP0003P	METER/C&W	COMMON	1 OF 2 M O/B	16-20,28
		OX TK PRESS	SP0033P	METER/C&W	COMMON		16-20,28
		OX SM/ENG INTERFACE P	SP0931P	-	-	HD	16-20,29
		FU TK PRESS	SP0006P	METER/C&W	COMMON	1 OF 2 M O/B	16-20,28
		FU TK PRESS	SP0066P	METER/C&W	COMMON		16-20,28
		FU SM/ENG INTERFACE P	SP0930P	-	-	HD	16-20,28
A		SPS VLV ACT PRESS-PRI	SP0600P	METER	COMMON	HD	16-21,22
A		SPS VLV ACT PRESS-SEC	SP0601P	METER	COMMON	HD	16-21,22
		SPS FU FEEDLINE TEMP	SP0048T	METER	COMMON	HD	16-24
		SPS OX FEEDLINE TEMP	SP0049T	SYS TEST	COMMON	HD	
A		ENG CHAMBER PRESS	SP0661P	h METER	COMMON	HD	16-26
		He TK PRESS	SP0001P	METER	SEPARATE	1 OF 2 M	16-29
		FU/OX VLV 1 POS	SP0022H	DISPLAY	SEPARATE	1 OF 2 M	16-21,26
		FU/OX VLV 2 POS	SP0023H	DISPLAY	SEPARATE	1 OF 2 M	16-21,26
		FU/OX VLV 3 POS	SP0024H	DISPLAY	SEPARATE	1 OF 2 M	16-21,26
		FU/OX VLV 4 POS	SP0025H	DISPLAY	SEPARATE	1 OF 2 M	16-21,26
		OX TK 1 QTY - TOTAL AUX	SP0655Q	DISPLAY	COMMON	HD	16-10,11,13
		OX TK 2 QTY	SP0656Q	DISPLAY	COMMON	HD	16-10,11,13
		FU TK 1 QTY - TOTAL AUX	SP0657Q	DISPLAY	COMMON	HD	16-10,11,13
		FU TK 2 QTY	SP0658Q	DISPLAY	COMMON	HD	16-10,11,13
		ENG INJ FLANGE TEMP	SP0062T	-	-	HD	16-25

R	ITEM	
		SYSTEMS MANAGEMENT
	17-15	PROPELLANT GAGING
A		A. PRIME METHOD: RTCC EQUATION (5 PERCENT) B. BACKUP METHOD: HELIUM PRESSURE/TEMPERATURE (6.3 PERCENT) (ONBOARD)
	17-16	QUAD PROPELLANT BALANCE
		PROP ISOLATION VALVES WILL NOT BE USED FOR QUAD PROPELLANT BALANCE. PROPELLANT BALANCE WILL BE ACCOMPLISHED BY SELECTING TWO-JET +X AND -X TRANSLATIONS WITH EITHER THE PITCH OR YAW QUAD AND BY CHOOSING SUITABLE JETS FOR ATTITUDE CONTROL. PROPELLANT DIFFERENCES BETWEEN QUADS WILL BE MAINTAINED WITHIN ±50 POUNDS.
	17-17	SECONDARY PROPELLANT FUEL PRESSURE VALVE
		THE RCS SECONDARY FUEL PRESSURIZATION VALVE WILL BE OPENED WHEN THE FUEL MANIFOLD PRESSURE REACHES 150 PSIA OR RTCC SHOWS 115 LBS WILL BE EXCEEDED DURING A TRANSLATION MANEUVER.
		RULE NUMBERS 17-18 THROUGH 17-19 ARE RESERVED.

*

MSC-01807

APOLLO 17

FINAL FLIGHT MISSION RULES

REV B

PREFACE

THIS DOCUMENT CONTAINS REVISION B TO THE FINAL FLIGHT MISSION RULES FOR APOLLO 17 AS OF NOVEMBER 28, 1972. ANY SUBSEQUENT REVISION TO THIS DOCUMENT WILL BE PRINTED ON A DIFFERENT COLORED PAPER FOR EASY RECOGNITION.

THIS DOCUMENT HAS BEEN PREPARED BY THE FLIGHT CONTROL DIVISION, MANNED SPACECRAFT CENTER, HOUSTON, TEXAS, WITH TECHNICAL ASSISTANCE BY LTV/KENTRON HAWAII, LTD.

IT IS REQUESTED THAT ANY ORGANIZATION HAVING COMMENTS, QUESTIONS, OR SUGGESTIONS CONCERNING THESE MISSION RULES CONTACT MR. JOHN H. TEMPLE, FLIGHT OPERATIONS AND RECOVERY BRANCH, BUILDING 30, ROOM 2058, PHONE 713-483-4126.

ANY REQUESTS FOR ADDITIONAL COPIES OR CHANGES TO THE DISTRIBTUION LIST IN APPENDIX B OF THIS DOCUMENT MUST BE MADE IN WRITING TO MR. HOWARD W. TINDALL, JR., DIRECTOR OF FLIGHT OPERATIONS, MANNED SPACECRAFT CENTER, HOUSTON, TEXAS.

THIS IS A CONTROL DOCUMENT AND ANY CHANGES ARE SUBJECT TO THE CHANGE CONTROL PROCEDURES DELINEATED IN APPENDIX C. THIS DOCUMENT IS NOT TO BE REPRODUCED WITHOUT THE WRITTEN APPROVAL OF THE CHIEF, FLIGHT CONTROL DIVISION, MANNED SPACECRAFT CENTER, HOUSTON, TEXAS.

APPROVED BY:

Howard W. Tindall

HOWARD W. TINDALL, JR.
DIRECTOR OF FLIGHT OPERATIONS

CONCURRED BY:

R. Scott Hamner

R. SCOTT HAMNER
MSFC FLIGHT CONTROL OFFICE

*

APOLLO 17

FINAL FLIGHT MISSION RULES

REV B

REVISED INSTRUCTION SHEET

Update this document in accordance with the following instructions:

Remove and replace the following pages:

ii	7-7
iia	7-10
2-3	7-11
3-18	7-13
3-32	7-14
3-33	7-15
3-34	7-16
6-5	7-17
6-7	7-18
6-10	7-21
7-2	9-3
7-4	31-10
7-5	31-11

Add the following new pages:

7-18A
7-18B
7-23
7-24
7-25

R	ITEM	
	2-11	TRANSLUNAR INJECTION

A. THE TLI WILL BE GO IF THE S/C AND L/V SATISFY THE FOLLOWING CRITERIA:

1. THERE HAVE BEEN NO FAILURES IN THE LAUNCH VEHICLE WHICH RESULT IN A CATASTROPHIC HAZARD.

2. A "GO FOR TLI" RECOMMENDATION WILL BE GIVEN IF ENOUGH PROPELLANT IS AVAILABLE AND THE SLV HARDWARE STATUS IS DEEMED ADEQUATE FOR A REASONABLE PROBABILITY OF REACHING A 28,000 NM APOGEE. THE FINAL DECISION RESTS WITH THE FLIGHT DIRECTOR FOR DETERMINING A REASONABLE PROBABILITY.

3. THE CSM HAS TOTAL SYSTEMS CAPABILITY WITH REDUNDANCY. REDUNDANCY VERIFICATION IS SUBJECT TO THE NUMBER AND TYPE OF REDUNDANT COMPONENT CHECKS WHICH CAN BE PERFORMED IN EARTH ORBIT.

B. THE TLI MANEUVER WILL BE DELAYED UNTIL THE SECOND OPPORTUNITY FOR SUSPECTED FAILURE OF A CRITICAL SYSTEM (PRIME OR BACKUP - MANEUVER, LIFE SUPPORT, COOLING, POWER SEQUENTIAL, COMMUNICATIONS) WHICH REQUIRES
B TIME FOR EVALUATION. IN THE EVENT OF LAUNCH VEHICLE FAILURES WHICH JEOPARDIZE ACHIEVEMENT OF TLI AND/OR
B TD&E, CONSIDERATION WILL BE GIVEN TO PERFORMING TLI ONE ORBIT EARLY IF THIS INCREASES THE PROBABILITY OF
B A SUCCESSFUL LUNAR MISSION.

C. TLI TARGETING WILL BE SUCH THAT A SAFE CIRCUMLUNAR RETURN TO EARTH CAN BE RE-ESTABLISHED WITHIN LM DPS CAPABILITY AS LATE AS PC + 2 HRS. THE CAPABILITY WILL EXIST TO ESTABLISH A SAFE CIRCUMLUNAR RETURN TO EARTH WITH THE SM-RCS UNTIL TLI + 5 HRS.

	2-12	TRANSPOSITION, DOCKING AND EJECTION (TD&E)

A. THE NORMAL MINIMUM CABIN PRESSURE REDLINE OF 4.0 PSIA FOR TUNNEL/LM PRESSURIZATION SEQUENCES MAY BE WAIVED DURING TD&E. THE CM WILL BE DEPRESSURIZED AS REQUIRED TO ACCOMPLISH HATCH REMOVAL FOR UMBILICAL HOOKUP OR DOCKING INTERFACE INSPECTION.

B. IF NORMAL LM EJECTION IS NOT SUCCESSFUL, NO ATTEMPT WILL BE MADE TO MAN THE LM AND "STAGE" TO RECOVER THE ASCENT STAGE.

R	ITEM	
A	3-67	GEOPHYSICS EXPERIMENTS

A. IF THE TRAVERSE GRAVIMETER READING ON THE LRV IS DIFFERENT FROM READING ON THE SURFACE > 5 MGALS, A BIAS READING WILL BE INITIATED. IF THE GRAVIMETER HAS NOT SHIFTED, SUBSEQUENT READINGS WILL BE TAKEN ON THE SURFACE.

B. IF THE TRAVERSE GRAVIMETER PHASE LOCK LOOP IS NOT USABLE, SUBSEQUENT READINGS WILL BE TAKEN ON THE SURFACE IN BYPASS MODE. REFERENCE MSN RULES 31-102, 103, 104.

C. IF THE TRAVERSE GRAVIMETER INTERMEDIATE OVEN TEMPERATURE (DIGIT EIGHT) INDICATES A 6 OR 7 BEFORE THE EVA I ALSEP TRAVERSE IT WILL PE LEFT IN THE LM SHADOW WITH THE RADIATOR EXPOSED. IF 6 OR 7 PRIOR TO EVA II, III TRAVERSE, READINGS WILL BE TAKEN UNTIL UNREASONABLE DATA IS RECEIVED.

D. IF A READING IS DIFFERENT FROM THE BASE READING WITH TRENDS WHICH REACH > 60 MGAL OR SUDDEN SHIFTS > 20 MGALS, A BIAS READING WILL BE REQUESTED.

NOTE

ELEVATION DIFFERENCES WILL BE ELIMINATED
WHEN DETERMINING TRENDS OR SHIFTS.

E. IF THE LRV IS DISTURBED WHILE A READING IS IN PROCESS, THE STBY/ON SWITCH WILL BE CYCLED AND THE READING REINITIATED.

B F. THE SEP EXPERIMENT RECEIVER TEMPERATURE WILL BE MAINTAINED WITHIN 25° - 115°F WHILE OPERATING AND WITHIN -20° - 160°F WHILE NOT OPERATING. THE RECIEVER WILL ROUTINELY BE PLACED IN STBY AT THE BEGINNING OF EVA II AND III TO ALLOW THE THERMOSTATICALLY CONTROLLED HEATERS TO ENSURE A STABLE TEMPERATURE OF AT LEAST 25°F BEFORE RECEIVER OPERATION.

B G. THE FOLLOWING ACTIONS WILL BE TAKEN TO PREVENT EXCESSIVE TEMPERATURES:

B 1. IF THE RECEIVER TEMPERATURE IS > 50°F AT THE BEGINNING OF EVA II OR III, THE DSEA TAPE WILL BE TURNED OFF AND MIRROR COVERS OPENED AT TRAVERSE STOPS AS REQUIRED.

B 2. IF THE NON-OPERATING TEMPERATURE IS PROJECTED TO BE > 160°F, THE DSEA TAPE MODULE WILL BE REMOVED FROM THE RECEIVER AND PLACED UNDER THE LRV CDR'S SEAT.

H. IF THE NEUTRON FLUX PROBE EXPERIMENT DOES NOT HAVE THE DRILL CORE HOLE AVAILABLE OR ENCOUNTERS DIFFICULTY IN PENETRATING THE CORE HOLE, ALTERNATE METHODS WILL BE USED TO IMPLACE THE EXPERIMENT TO A MINIMUM DEPTH OF 1 METER WITH AN EXPENDITURE OF UP TO 10 MINUTES ADDITIONAL TIME.

I. NO MORE THAN ONE MINUTE OF ACTIVE HAMMERING OR APOLLO LUNAR SURFACE DRILL IMPACTING WILL BE USED TO IMPLACE THE NEUTRON PROBE EXPERIMENT.

J. USE OF THE APOLLO LUNAR SURFACE DRILL FOR THE NEUTRON PROBE WILL BE RESTRICTED TO THE LOWER SECTION.

RULE NUMBERS 3-68 THROUGH 3-79 ARE RESERVED.

SPECIFIC MISSION RULES

FAR ULTRAVIOLET SPECTROMETER

CONDITION/MALFUNCTION		TLC	LUNAR ORBIT/TEC
1. SIM TEMP SL1109T, UVS ELECT-BOX T. (1)	<0° F	APPLY POWER TO SPECTROMETER	[redacted]
	>120° F	GO TO COLD SOAK ATTITUDE	
2. SPECTROMETER TEMPS SL1101T OR SL1102T	<-20° F	LEAVE SPECTROMETER POWERED	
	>140° F	POWER DOWN SPECTROMETER (2)	
3. CORONA IN THE UVS		TURN OFF SPECTROMETER	ENHANCE OPERATING ENVIRONMENT
4. SUN APPROACHING FIELD-OF-VIEW		[redacted]	CLOSE SPECTROMETER COVER
5. COVER FAILS	CLOSED		OPERATE TO OBTAIN ENGINEERING DATA
	OPEN		MINIMIZE DUMPS, PURGES, AND JET FIRINGS

INFRARED SCANNING RADIOMETER

CONDITION/MALFUNCTION		TLC	LUNAR ORBIT/TEC
1. SIM TEMP SL1220T (1)	<TBD° F	APPLY POWER TO RADIOMETER	[redacted]
	>TBD° F	GO TO COLD SOAK ATTITUDE	
2. PRIMARY MIRROR TEMP SL1129T	<7° F	LEAVE RADIOMETER POWERED	
	>122° F	POWER DOWN RADIOMETER (3)	
3. SUN APPROACHING FIELD-OF-VIEW		[redacted]	CLOSE RADIOMETER COVER
4. COVER FAILS	CLOSED		OPERATE TO OBTAIN ENGINEERING DATA
	OPEN		MINIMIZE DUMPS, PURGES, AND JET FIRINGS

LUNAR SOUNDER

CONDITION/MALFUNCTION		TLC	LUNAR ORBIT/TEC
1. SIM TEMP SL1206T (1)	<TBD° F	APPLY STBY PWR TO CSAR AND OPTICAL RECORDER	[redacted]
	>TBD° F	GO TO COLD SOAK ATTITUDE	
2. FILM CASSETTE TEMP SL1275T	<32° F	APPLY STBY PWR TO OPTICAL RECORDER	
	>TBD° F	GO TO COLD SOAK ATTITUDE	REMOVE PWR FROM OPTICAL RECORDER (4)
3. CSAR INTERNAL TEMP SL1256T	<0° F	APPLY STBY PWR TO CSAR	
	>147° F	GO TO COLD SOAK ATTITUDE	REMOVE PWR FROM CSAR
4. FILM MOTION FAILURE		[redacted]	CONTINUE ACTIVE SOUNDER OPERATIONS (5)
5. LOSS OF PRF-1 AND PRF-2 TO OPTICAL RECORDER			TERMINATE SOUNDER OPERATION IN THE HF MODE
6. LOSS OF PRF-3 TO OPTICAL RECORDER			TERMINATE SOUNDER OPERATION IN THE VHF MODE
7. RECORDER CLOCK FAILURE			CONTINUE ACTIVE SOUNDER OPERATION (5)
8. LOSS OF OSC FREQ LOCK			CONTINUE ACTIVE SOUNDER OPERATION
9. LOSS OF VIDEO TO RECORDER			CONTINUE ACTIVE SOUNDER OPERATION (5)
10. LOSS OF HF RF PWR OUTPUT			TERMINATE SOUNDER OPERATION IN HF MODE
11. LOSS OF VHF RF PWR OUTPUT			TERMINATE SOUNDER OPERATION IN VHF MODE
12. EMI INTO LS ISOLATED TO	HGA		RESCHEDULE VHF OPERATIONS
	HBR TM		PERFORM FLIGHT PLAN ON LBR
13. TB-BP DURING OPERATE		GO TO STBY. IF BP PERSISTS, PWR DOWN RADAR AND RECORDER. IF TB-GRAY, GO TO OPERATE. IF BP RETURNS, PWR DOWN THE RADAR AND RECORDER.	

HF ANTENNAS

CONDITION/MALFUNCTION	TLC	LUNAR ORBIT/TEC
1. FAILURE TO FULLY EXTEND	OPERATE IN DEGRADED MODE (6)	
2. FAILURE TO RETRACT SAFE DISTANCE	JETTISON PRIOR TO NEXT SPS BURN	

NOTES

(1) THIS RULE ONLY APPLIES TO PRE SIM DOOR JETTISON PHASE

(2) THE SPECTROMETER WILL BE POWERED DOWN IF THE TEMPS GET ABOVE 125° F AND VALID DATA IS NOT BEING COLLECTED.

(3) THE RADIOMETER WILL BE POWERED DOWN IF THE TEMPS GET ABOVE 100° F AND VALID DATA IS NOT BEING COLLECTED.

(4) IF TEMP CONTINUES TO INCREASE, COLD SOAK WILL BE REQUIRED.

(5) SPECULAR POWER WILL BE THE PRIME SOURCE OF SCIENCE DATA. COVERAGE CAN BE TRADED OFF FOR HBR TM.

(6) EXTEND ANTENNAS AS FAR AS POSSIBLE.

GENERAL

1. PRIOR TO SIM DOOR JETTISON THE SIM EXPERIMENTS AND SCIENTIFIC DATA SYSTEM (SDS) WILL BE POWERED AS REQUIRED TO SUPPORT THE FOLLOWING FUNCTIONS:
   A. THERMAL MONITORING AND THERMAL MANAGEMENT OF THE SIM BAY.
   B. PERIODIC ADVANCEMENT OF THE PANORAMIC AND MAPPING CAMERA FILM.
2. RESCHEDULING OF EXPERIMENT OPERATION IF REQUIRED DUE TO EXCESSIVE CONSUMABLES USAGE (RCS, PWR, ETC.) OR ANOMALOUS EXPERIMENT OPERATION WILL BE ACCOMPLISHED WITHIN THE GUIDELINES OF THE EXPERIMENT PRIORITIES.
3. LUNAR ORBIT SIM BAY EXPERIMENTS ARE LISTED BELOW IN THEIR ORDER OF PRIORITY.
   A. LUNAR SOUNDER
   B. SM ORBITAL PHOTOGRAPHIC TASKS
   C. IR SCANNING RADIOMETER (ISR)
   D. FAR UV SPECTROMETER (UVS)
4. IF CORONA IS DETECTED IN AN EXPERIMENT AND IS DEGRADING ONLY THAT EXPERIMENT, THAT EXPERIMENT'S OPERATION WILL NOT BE TERMINATED FOR THE MISSION BUT MAY BE RESCHEDULED TO MAXIMIZE THE SCIENTIFIC RETURN.
5. ALL EXPERIMENT COVERS WILL NORMALLY BE CLOSED FOR THE FOLLOWING CONDITIONS AFTER SIM DOOR JETTISON:
   A. ACTIVATION OF SM RCS JETS A2, A4, B1, OR B4
   B. SPS BURNS
   C. WATER AND URINE DUMPS*
   D. FUEL CELL PURGES*
   E. VIOLATION OF THE SUN-AVOIDANCE CONSTRAINTS
   F. CSM EVAPORATOR OR LM SUBLIMATOR OPERATION*
   *N/A TO UVS COVER AFTER 2 DAYS IN CIRCULAR LUNAR ORBIT.
6. SM RCS THRUSTERS A2, A4, B1, AND B4 WILL BE DISABLED DURING ALL EXPERIMENT OPERATIONS.
7. WATER AND URINE DUMPS WILL BE INHIBITED FROM 3 HOURS BEFORE UNTIL IMMEDIATELY AFTER PC AND MC OPERATIONS.
8. A FAILURE OF ANY EXPERIMENT COVER OR EXTENSION MECHANISM WILL NOT PRECLUDE AN EVA FOR FILM RETRIEVAL.
9. THERE ARE THREE ACCEPTABLE CUES ON ANTENNA POSITION. THESE ARE THE APPROPRIATE TALKBACK INDICATOR, VISUAL VERIFICATION FROM AN UNDOCKED LM, AND THE ANTENNA SAFE SIGNAL ON TELEMETRY. ANY ANTENNA THAT CANNOT BE VERIFIED AS RETRACTED BY ONE OF THESE MEANS WILL BE ASSUMED TO BE EXTENDED BEYOND THE SPS BURN LIMIT.
10. SIM BAY HARDWARE REDLINES WILL NOT BE VIOLATED IN THE PURSUIT OF SCIENCE DATA UNLESS THE DATA BEING COLLECTED IS JUDGED TO BE MORE IMPORTANT THAN ALL SUBSEQUENT DATA.
11. A "NO-GO" FOR LOI WILL NOT PRECLUDE SIM BAY DOOR JETTISON.
12. AN ATTITUDE DEADBAND OF 0.5° WILL BE USED DURING THE FOLLOWING OPERATIONS:
    A. ALL CAMERA OPERATIONS
    B. MANDATORY LASER ALTIMETER OPERATION
    C. HF AND VHF ACTIVE SOUNDING MODES
    D. UVS INERTIAL ATTITUDE HOLD TARGETS

    A DEADBAND OF 3.0 DEGREES MAXIMUM WILL BE USED FOR ALL OTHER EXPERIMENT OPERATION.

FAR UV SPECTROMETER MANAGEMENT

1. UNTIL THE COMPLETION OF TWO DAYS IN CIRCULAR ORBIT, THE EXPERIMENT COVER WILL BE CLOSED FOR DUMPS AND PURGES. DUMPS AND PURGES WILL NOT BE SCHEDULED WITHIN 15 MINUTES OF THE START OF A DATA TAKE.
2. THE EXPERIMENT COVER WILL BE CLOSED FOR THE ACTIVATION OF RCS JETS A2, A4, B1 AND B4 BEFORE THE SUN ENTERS THE SPECTROMETER FOV.

INFARED SCANNING RADIOMETER

1. THE EXPERIMENT COVER WILL REMAIN CLOSED FOR 30 MINUTES FOLLOWING A DUMP OR PURGE.
2. THE ISR SCAN DRIVE MOTOR WILL BE POWERED FOR SIM DOOR JETT.

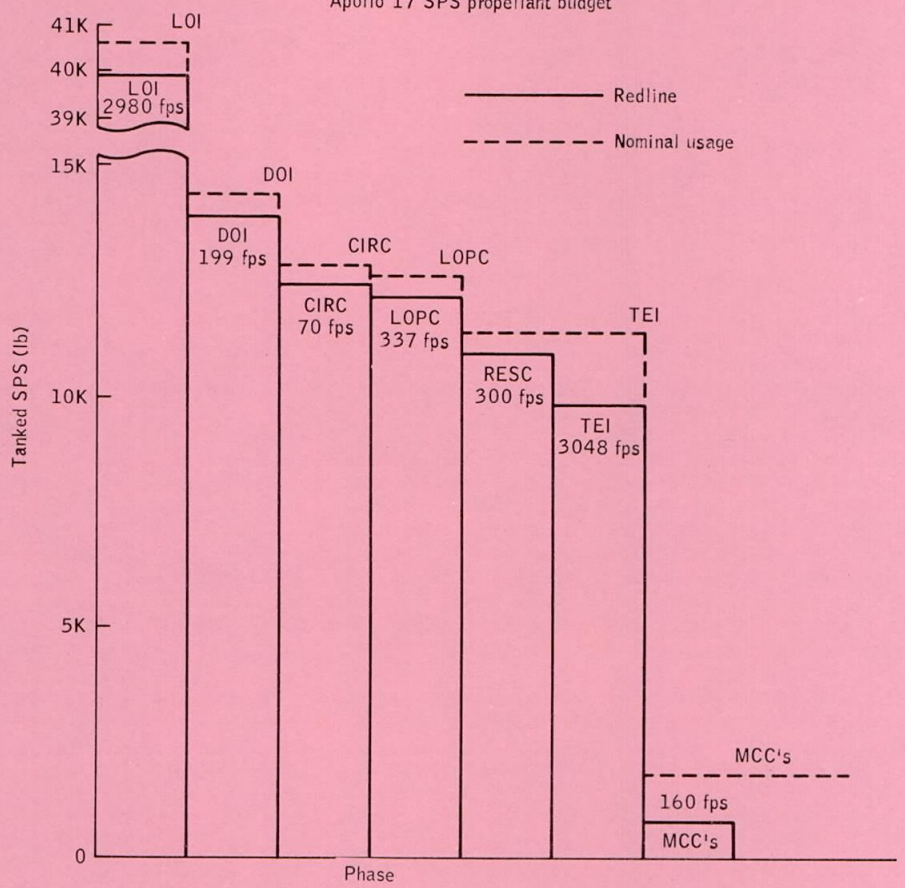
LUNAR SOUNDER

1. A MINIMUM OF 1 MINUTE OF HBR/HF MODE DATA WILL BE COLLECTED DURING THE START OF AN END OF THE 2 REV HF ACTIVE MODE.
2. SIM BAY JET CONFIGURATION WILL BE INITIATED A MINIMUM OF 30 MINUTES PRIOR TO OPTICAL RECORDER OPERATION.
3. THE SOUNDER RDR AND OPTICAL RCDR WILL BE THERMALLY PRECONDITIONED PRIOR TO DATA COLLECTION.
4. ALL OTHER SIM BAY EXPERIMENTS AND THE SDS WILL BE POWERED DOWN DURING SOUNDER OPERATIONS.
5. THE HGA WILL BE POWERED DOWN DURING THE HF AND RECEIVE ONLY MODES.
6. THE LS TRANSMITTERS WILL NOT BE OPERATED WITHIN 1000 FEET OF THE LM (STAGED OR UNSTAGED).
7. FAILURE OF THE HF ANTENNAS TO FULLY EXTEND WILL NOT PRECLUDE SOUNDER OPERATION IN THE HF AND LISTEN MODES.
8. THE OPTICAL RECORDER FILM WILL NOT BE TRANSPORTED WITH LESS THAN 10 FEET OF FILM REMAINING.
9. A CSM CONFIGURATION WILL BE ESTABLISHED FOR THE EMI TEST AND LS OPERATION. NO CONFIGURATION CHANGES WILL BE MADE TO RESOLVE EMI EXCEPT FOR POSSIBLE DOWNGRADING OF THE TELECOMMUNICATIONS SYSTEMS.

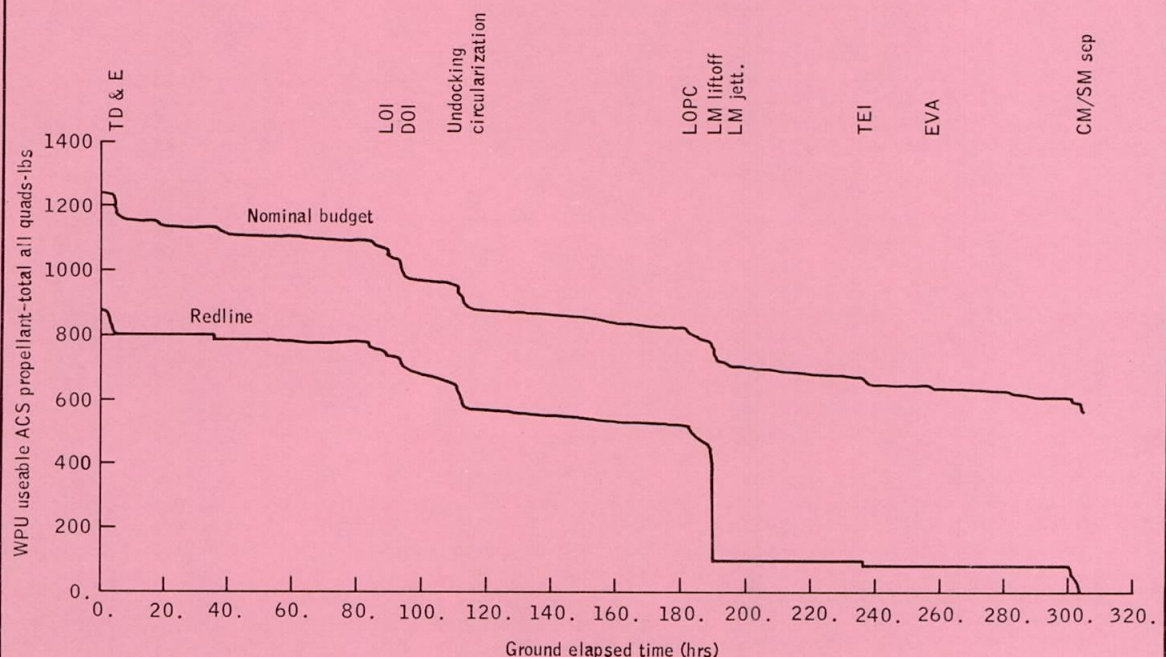
R	ITEM	
		CONSUMABLES
	3-90	SPS (APOLLO 17 DATA)
		A. THE SPS REDLINE WILL GUARANTEE SUFFICIENT PROPELLANT TO ACHIEVE A NOMINAL LUNAR ORBIT, LANDING, LM RESCUE AND A SAFE RETURN TO EARTH. VIOLATION OF THE SPS REDLINE WILL REQUIRE MNVR TRADE-OFFS AS SHOWN IN FMR 5-34. THE SPS REDLINE INCLUDES:
B		LOI 26021 LBS 2980 FPS
B		DOI 1474 LBS 199 FPS
B		CIRC 260 LBS 70 FPS
B		LOPC 1 1211 LBS 337 FPS
B		RESCUE 1098 LBS 300 FPS
B		TEI 9041 LBS 3046 FPS (NOMINAL RETURN, 68 HRS)
B		TEC MCC 418 LBS 160 FPS (3 SIGMA SCS C/O ON TEI)
B		UNUSABLE 400 LBS 0 FPS
		B. THE MINIMUM SPS REQUIREMENTS FOR A LUNAR ORBIT MISSION ARE BASED ON A MINIMUM SOLO MISSION. THE SEQUENCE OF MANEUVERS WOULD BE LOI 1 (60 X 170), LOI 2 (60 X 60), TEI AND TEMC'S. THE FOLLOWING NUMBERS REPRESENT MINIMUMS WITHOUT RESPECT TO TRAJECTORIES OR OTHER VARIABLES AND SHOULD BE USED AS BASELINE DATA ONLY.
B		LOI 1 12494 LBS 2875 FPS
B		LOI 2 515 LBS 138 FPS
B		TEI 9595 LBS 3000 FPS
B		TEMC'S 1343 LBS 500 FPS
B		UNUSABLE 400 LBS 0 FPS
B		THESE VALUES ARE BASED ON A 3 SIGMA LOW PERFORMANCE SPS. THE ΔV AVAILABLE FOR MCC1 WOULD BE 2758 FPS.
	3-91	SM RCS (APOLLO 17 DATA)
		A. THE SM RCS REDLINE INCLUDES:
		1. NOMINAL USAGE FROM LAUNCH THRU TD&E (75 LBS)
B		2. POST TD&E TO MCC-2. INCLUDES ALLOWANCE FOR 2 PTC'S, MANEUVER, TRIM & DAMPING FOR MCC-2. (29 LBS)
B		3. MCC-2 TO MCC-4. INCLUDES ALLOWANCE FOR TWO PTC'S, MANEUVER, TRIM AND DAMPING FOR MCC-4. (29 LBS)
B		4. MCC-4 THRU LM UNDOCKING NOMINAL USAGE (152 LBS)
		5. CSM SOLO ATTITUDE HOLD FROM POST UNDOCKING THRU LM LIFT-OFF. INCLUDES ULLAGES AND TRIMS FOR CIRC AND PC-1.
B		NO ALLOWANCE FOR SOLO EXPERIMENTS OR PHOTOGRAPHY THAT REQUIRES ADDITIONAL PROPELLANT (122 LBS)
B		6. NOMINAL BUDGETED USAGE FROM LM LIFT-OFF TO DOCKING. ALSO INCLUDED ARE FOUR 10 SECOND 4 JET ULLAGES,
B		THREE 1 FPS TRIMS AND CSM ACTIVE BRAKING, LM JETTISION AND SEPARATION (369 LBS)
		7. TWO REVS ATTITUDE HOLD PLUS TEI. INCLUDES ALLOWANCE FOR ONE P52, ULLAGE AND DAMPING (30 LBS)
		8. SEVEN FPS MCC (1 SIGMA G&N TEI CUTOFF) (22 LBS)
		9. PTC ALLOWANCE (20 LBS)
B		10. NOMINAL USAGE FROM MCC 7 TO CM/SM SEP (26 LBS)
		B. THE LUNAR ORBIT REDLINE REPRESENTS THE MINIMUM SMRCS PROPELLANT REQUIRED TO LEAVE LUNAR ORBIT AND PROVIDE A NOMINAL TRANSEARTH RETURN. VIOLATION OF THE LUNAR ORBIT REDLINE WILL RESULT IN TERMINATION OF LUNAR ORBIT ACTIVITIES. THE LO REDLINE INCLUDES:
B		117 LBS 2 REVS LO, TEI ULLAGE AND DAMPING, NOMINAL TEC BUDGET.
		64 LBS 20 FPS MCC (3 SIGMA G&N TEI CUTOFF)
B		181 LBS TOTAL
-		RULE NUMBERS 3-92 THROUGH 3-100 ARE RESERVED.

R	ITEM
B	
B	

Apollo 17 SPS propellant budget



Apollo 17 SM RCS propellant budget



	MISSION	REV	DATE	SECTION	GROUP	PAGE	
	APOLLO 17	B	11/28/72	MISSION RULE SUMMARY	CONSUMABLES	3-34	Tape 12.2

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
A	6-2	LOSS OF ATTITUDE CONTROL			CUES
		A. PRIOR TO TB1 + 120 SEC	LAUNCH	A. ABORT BSE TRANSMIT ABORT REQUEST	A.1. ANGULAR RATES - PITCH (R4-602) OR YAW (R5-602) GREATER THAN 4 DEG/SEC ROLL (R34-602) GREATER THAN OR EQUAL TO 20 DEG/SEC. 2. ANGULAR RATES - PITCH (R13-602) OR YAW (R8-602) GREATER THAN 4 DEG/SEC. 3. EDS OVERRATE, PITCH OR YAW (K84-602), ROLL (K83-602). NOTES A.1. THESE CUES ARE VALID IF RATE CHANNEL SWITCHOVER HAS NOT OCCURRED.
		B. BETWEEN TB1 + 120 SEC AND TB5 INITIATE	LAUNCH	B. ABORT BSE TRANSMIT ABORT REQUEST	CUES B.1. ANGULAR RATES - PITCH (R4-602), YAW (R5-602), GREATER THAN OR EQUAL TO 10 DEG/SEC, ROLL (R34-602) GREATER THAN OR EQUAL TO 20 DEG/SEC. 2. ANGULAR RATES - PITCH (R13-602), YAW (R8-602), GREATER THAN OR EQUAL TO 10 DEG/SEC. 3. EDS OVERRATE - PITCH OR YAW (K84-602), ROLL (K83-602). NOTES B.1. R13-602 AND R8-602 ARE VALID IF RATE CHANNEL SWITCHOVER HAS NOT OCCURRED.
B B B B B					2. ROLL ATTITUDE ERRORS GREATER THAN 3.5 DEG DURING THE S-IVB BURN MAY BE A RESULT OF LOSS OF BOTH APS MODULES. THE CREW SHOULD ATTEMPT TO CONTROL ROLL WITH RCS.
A					3. DELETED

	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
B B B B	6-5	S-IVB LOX CRYO REPRESS VALVE(S) FAILS OPEN A. PRIOR TO S-II CUTOFF 1. DURING S-IC BURN	LAUNCH	A. CONTINUE MISSION/EARLY STAGE/ ABORT 1. CONTINUE MISSION/ EARLY STAGE/ABORT BSE INFORM FLIGHT AND RECOMMEND CREW HOLD TOWER. AT TB3 + 35 SECONDS, BSE RECOMMEND EARLY STAGE. IF S-IVB DOES NOT START, BSE TRANSMIT ABORT REQUEST IF S-IVB STARTS, BSE RECOMMEND CREW JETTISON TOWER AND CONTINUE MISSION.	CUES A.1. LOX TANK ULLAGE PRESSURE AT RELIEF (41-44 PSIA) AND RELIEVING (D179-406, D180-406) 2. COLD HELIUM REGULATOR DISCHARGE PRESSURE REMAINS LESS THAN 50 PSIA (D105-403). 3. COLD HELIUM BOTTLE PRESSURE DECAYING (D261-403, D263-403). 4. BURNER LOX REPRESS COIL TEMPERATURE BELOW -100° F (C378-403).
		2. DURING S-II BURN		2. CONTINUE MISSION/ EARLY STAGE BSE INFORM FLIGHT AND RECOMMEND EARLY STAGE 3 MINUTES FROM MALFUNCTION. IF THE LOX TANK ULLAGE PRESSURE IS AT 50 PSIA OR OFF-SCALE HIGH, BSE INFORM FLIGHT AND TRANSMIT ABORT REQUEST IF PRIOR TO TOWER JETT. IF AFTER TOWER JETT, RECOMMEND IMMEDIATE EARLY STAGE.	
		B. IN TB5	EARTH ORBIT	B. CONTINUE MISSION/EMERGENCY SPACECRAFT SEPARATION BSE INFORM FLIGHT AND 1. CYCLE AND CLOSE LOX CRYO REPRESS VALVE IF 1 IS UNSUCCESSFUL, 2. VENT LOX TANK 3. OPEN LH2 CRYO REPRESS VLV 4. TERMINATE LOX VENT ASAP AFTER 8 MIN 5. CLOSE LH2 CRYO REPRESS VALVE ASAP AFTER 40 MIN IF THE LOX TANK ULLAGE PRESSURE IS AT 50 PSIA OR OFF-SCALE HIGH, BSE INFORM FLIGHT AND TRANSMIT ABORT REQUEST AND REQUEST EMERGENCY SEPARATION.	B.1. COLD HELIUM REGULATOR DISCHARGE PRESSURE REMAINS LESS THAN 50 PSIA (D105-403). 2. LOX TANK ULLAGE PRESSURE INCREASING (D179-406, D180-406). 3. BURNER LOX REPRESS COIL TEMPERATURE BELOW -100° F (C378-403). 4. COLD HELIUM BOTTLE PRESSURE DECAYING (D261-403, D263-403). NOTES 1. ACTION REQUIRED TO AVOID EXCEEDING LOX TANK OVER-PRESSURE OR BULKHEAD POSITIVE DELTA PRESSURE LIMITS (FMR 7-14). 2. SEE FMR 7-18 FOR RESTART CRITERIA FOR OFF-NOMINAL COLD HELIUM PRESSURE. 3. IF THE LOX NPV VALVE FAILS TO OPEN, THE LOX VENT VALVE CAN BE OPENED AS BACKUP. 4. IF THE LH2 CRYO REPRESS VALVE IS OPENED, THE IU STATE VECTOR WILL BE IN ERROR SINCE THE IU USES A STORED PROGRAM. A NAV UP-DATE MAY BE REQUIRED. 5. THIS FAILURE WILL REQUIRE EVALUATION OF RESIDUALS TO DETERMINE ADEQUACY FOR TLI VELOCITY CUTOFF AND LUNAR IMPACT OPERATIONS.

	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	6-11	S-IVB STAGE LOSS OF THRUST			CUES
		A. FAILS TO ATTAIN THRUST OR PREMATURE SHUTDOWN PRIOR TO OBTAINING PARKING ORBIT	LAUNCH	A. ABORT BSE TRANSMIT ABORT REQUEST.	1. THRUST CHAMBER PRESSURE - ZERO (D1-401). 2. THRUST OK SWITCHES - OFF (K14-401, K157-401). 3. LONGITUDINAL ACCELERATION - ZERO (A2-603).
		B. SHUTDOWN PRIOR TO ACHIEVING MINIMUM REQUIRED APOGEE ALTITUDE AND ENTRY INTO TB7 FOR REASONS OTHER THAN A PROPELLANT DEPLETION	TLI	B. CONTINUE MISSION BSE INFORM FLIGHT AND COMMAND TO EARTH ORBITAL CONFIGURATION THE SPACECRAFT SHOULD REMAIN ATTACHED TO THE S-IVB/IU AND MONITOR LH2 AND LOX TANK ULLAGE PRESSURES. IF SEPARATION IS REQUIRED, THE SPACECRAFT SHOULD IMMEDIATELY GO TO A SAFE DISTANCE (7000 FT) FROM THE S-IVB/IU.	4. TB5 IS INITIATED. GUID MODE WORD 1 (MODE CODE 25); BIT D2 SET TO ONE (H60-603). 5. TB7 IS INITIATED. GUID MODE WORD 2 (MODE CODE 26); BIT D20 SET TO ONE (H60-603). NOTES 1. SEPARATION WILL BE REQUIRED FOR VIOLATION OF FMR 7-6 OR FMR 7-14. 2. FOR A FAILURE OF THE S-IVB TO RESTART, THE ONBOARD PROGRAM WILL RECYCLE TO TB5 THROUGH TB6C FOR A SECOND RESTART OPPORTUNITY.
	6-12	S-IVB COLD HELIUM SHUTOFF VALVES FAIL OPEN	LAUNCH		CUES
		A. PRIOR TO S-II ENGINE START.		A. ABORT BSE INFORM FLIGHT AND TRANSMIT ABORT REQUEST	1. COLD HELIUM REG DISCHARGE PRESSURE REMAINS GREATER THAN 200 PSIA (D105-403) 2. LOX ULLAGE PRESSURE AT RELIEF SETTING (41-44 PSIA) AND RELIEVING (D179-406, D180-406)
		B. BETWEEN S-II ENGINE START AND 30 SEC PRIOR TO S-II CUTOFF		B. EARLY STAGE BSE INFORM FLIGHT AND RECOMMEND EARLY STAGING IMMEDIATELY. IF PRIOR TO TOWER JETTISON, THE CREW SHOULD HOLD THE TOWER UNTIL AFTER S-IVB START	3. COLD HELIUM BOTTLE PRESSURE DECAYING (D261-403, D263-403).
		C. AFTER S-II CUTOFF MINUS 30 SEC		C. CONTINUE MISSION BSE INFORM FLIGHT	
B B B B B B B B B B B B B B B B	6-13	IMPENDING LOSS OF INERTIAL PLATFORM BEFORE NOMINAL FIRST AND SECOND OPPORTUNITY TD&E GET.	LIFTOFF TO MAX "O" OPPORTUNITY DECISION TIME	CONTINUE MISSION IF LOSS OF PLATFORM IS EXPECTED BEFORE NOMINAL SECOND OPPORTUNITY TD&E BUT AFTER ZERO OPPORTUNITY TD&E, BSE INFORM FLIGHT, FIDO, AND GUIDO AND RECOMMEND ZERO OPPORTUNITY RESTART	CUES 1. GAS BEARING STORAGE SPHERE PRESSURE MEASURED AT REGULATOR INLET (D10-603) DECAYING AT AN AVERAGE RATE THAT WILL FALL BELOW 300 PSIA BEFORE 6:30 HOURS GET. NOTES 1. IT IS PREFERABLE TO RESTART ON ZERO OPPORTUNITY IF SECOND OPPORTUNITY CANNOT BE SUPPORTED BY THE PLATFORM. 2. INERTIAL PLATFORM BEARING GN_2 STORAGE SHPERE PRESSURE BELOW 300 PSIA INTRODUCES PROBABILITY OF ERRONEOUS ACCELLEROMETER OUTPUTS DUE TO "BOTTOMING."

	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	7-1	PRIOR TO S-IVB RESTART, PROPELLANT QUANTITIES PRECLUDE ACHIEVEMENT OF AN ACCEPTABLE LUNAR MISSION AND:	EARTH ORBIT	NO S-IVB RESTART/CONTINUE MISSION	CUES 1. PROPELLANT REMAINING AS ASCERTAINED DURING R/T EVALUATIONS.
		A. NO FAILURES HAVE BEEN IDENTIFIED WHICH RESULTED IN AN EXCESSIVE PROPELLANT IMBALANCE, AND INSUFFICIENT PROPELLANT REMAINS FOR ACHIEVEMENT OF AN ACCEPTABLE ALT MISSION		A. NO S-IVB RESTART BSE INFORM FLT OF PREDICTED CAPABILITY	NOTES 1. FAILURES REQUIRING EVALUATION OF PROPELLANT REMAINING ARE DEFINED BY FMR'S 6-5, 6-7, 6-12, 7-3, 7-4, 7-6, 7-9, 7-12, 7-17, 7-18, 7-19, 7-21, 7-24, 7-30, 8-4.
B B		B. FAILURES HAVE BEEN IDENTIFIED WHICH RESULTED IN AN EXCESSIVE IMBALANCE OF PROPELLANTS		B. CONTINUE MISSION/NO S-IVB RESTART	2. FAILURES WHICH RESULT IN A LOX DUMP REQUIREMENT ARE: (A) LOX CRYO REPRESS VALVES FAIL OPEN (FMR 6-5). (B) COLD HELIUM SHUTOFF VALVES FAIL OPEN (FMR 7-6)
B B B B B B B B B B B B B B B B		1. ZERO OPPORTUNITY RESTART, SECOND OPPORTUNITY MRCV PROFILE AND/OR LOX DUMP WOULD SIGNIFICANTLY IMPROVE PROBABILITY OF A MINIMUM LUNAR LANDING OR A MINIMUM LUNAR ORBIT MISSION		1. CONTINUE MISSION, BSE INFORM FLIGHT AND RECOMMEND ZERO OPPORTUNITY MRCV PROFILE AND/OR LOX DUMP TO MAXIMIZE ACCEPTABLE LUNAR MISSION CAPABILITY. IF C199-401 IS EXPECTED TO BE COLDER THAN 320 DEG. R, OR C200-401 IS EXPECTED TO BE COLDER THAN 160 DEG. R AT ENGINE START, BSE COMMAND a. MAINSTAGE ENABLE NO. 2 ON. b. BURN MODE A ON	(C) LOW LOX TANK ULLAGE PRESS (FMR 7-18, 7-19) (D) J-2 ENGINE MAIN FUEL VLV FAILS TO CLOSE (FMR 7-3). DO NOT DUMP LOX IF MFV IS OPEN. (E) MRCV FAILS TO 4.5 POSITION (FMR 7-24) (F) LOX BLEED VLV FAILS OPEN (FMR 7-21) (G) OTBV FAILS OPEN (FMR 7-30) 3. IMPLEMENTATION OF A LOX DUMP MAY REQUIRE A STATE VECTOR UPDATE. 4. CORRECTIVE ACTION MUST BE TAKEN ON ITEMS 2(A), 2(B), 2(C), 2(D), 2(F), AS NOTED BY THE REFERENCED FMR.
B B B B B B B B B B		2. ZERO OPPORTUNITY RESTART, SECOND OPPORTUNITY MRCV PROFILE AND/OR LOX DUMP WOULD NOT SIGNIFICANTLY IMPROVE THE PROBABILITY OF A MINIMUM LUNAR ORBIT MISSION.		2. NO S-IVB RESTART BSE INFORM FLIGHT OF PREDICTED CAPABILITY	

	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	7-3	J-2 ENGINE MAIN FUEL VALVE (MFV) FAILS TO CLOSE AT:			CUES 1. MAIN FUEL VALVE POSITION (G4-401). 2. MAIN FUEL VALVE OPEN (K118-401). 3. FUEL FLOWMETER FLOWRATE (F2-401). 4. LH_2 PUMP INLET PRESS (D02-403)
		A. FIRST S-IVB CUTOFF	EARTH ORBIT	A. CONTINUE MISSION BSE INFORM FLIGHT AND COMMAND (ASAP) 1. PREVALVES AND RECIRC SHUTOFF VALVES CLOSED (SEE NOTE 1) 2. ATTEMPT TO CYCLE AND CLOSE MFV IF SUCCESSFUL, BSE COMMAND 3. PREVALVE AND RECIRC SHUTOFF VALVES OPEN IF UNSUCCESSFUL AND MFV CONFIRMED FULLY OPEN, BSE COMMAND 4. MAINSTAGE ENABLE NO. 2 - ON 5. BURN MODE A - ON	NOTES 1. IF THE MFV IS OPEN, THE LH2 PUMP INLET PRESSURE WILL GO TO ZERO AFTER COMMAND ACTION (A.1). 2. THIS FAILURE WILL REQUIRE EVALUATION OF LH2 RESIDUALS TO DETERMINE ADEQUACY FOR TLI VELOCITY CUTOFF (REF FMR 7-1). 3. A FAILURE FOLLOWING SECOND BURN CUTOFF WILL REQUIRE A RE-EVALUATION OF LUNAR IMPACT VELOCITY DESIRED. 4. IMPLEMENTATION OF PART A4 AND 5 WILL RESULT IN AN EXTENDED FUEL LEAD JUST PRIOR TO TLI IGN, AND THERE WILL BE NO LOX AND LH2 RECIRCULATION. ENGINE M/S WILL OCCUR 7 SECONDS EARLY.
B		B. SECOND S-IVB CUTOFF	TLC	B. CONTINUE MISSION BSE INFORM FLIGHT AND 1. ATTEMPT TO CLOSE MFV. IF UNSUCCESSFUL, BSE CMD ASAP IN TB 8. 2. ENGINE PUMP PURGE OFF. 3. EDS CUTOFF NO 2 ENABLE PROCEED WITH LH2 DUMP AT NOMINAL LOX DUMP TIME (SEE NOTE 6) BSE TERMINATE LH2 DUMP AFTER 200 SECONDS BY COMMANDING 4. PREVALUES AND RECIRC VALVES CLOSED PRIOR TO TIME FOR ENGINE CONTROL HELIUM DUMP, BSE COMMAND: 5. EDS CUTOFF NO. 2 DISABLE.	5. IF THE MFV DOES NOT CLOSE, FMR 8-4 SHOULD NOT BE IMPLEMENTED SINCE IT WILL RESULT IN A SIMULTANEOUS LOX AND LH2 DUMP. 6. FUEL DUMP WILL INITIATE 3.2 SEC. EARLIER THAN NOMINAL LOX DUMP TIME. 7. THIS FAILURE WILL REQUIRE REAL-TIME ASSESSMENT BY THE LUNAR IMPACT TEAM.
B					
B					

	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	7-4	J-2 ENGINE MAIN OXIDIZER VALVE (MOV) FAILS TO CLOSE AT:			CUES
B		A. FIRST S-IVB CUTOFF	EARTH ORBIT	A. CONTINUE MISSION/ NO S-IVB RESTART	1. MAIN OXIDIZER VALVE POSITION (G3-401) INDICATES OPEN GREATER THAN 9 PERCENT.
B				BSE INFORM FLIGHT AND COMMAND (ASAP)	2. MAIN OXIDIZER VALVE OPEN-ON (K120-401).
B				1. PREVALVES AND RECIRC SHUTOFF VALVES CLOSED	3. LOX FLOWMETER FLOWRATE F1-401 INDICATING FLOW GREATER THAN 10 LBM/SEC
B				2. ATTEMPT TO CLOSE MOV	4. LOX INJECTOR PRESSURE (D0005-401)
				IF A.2 IS SUCCESSFUL, BSE INFORM FLIGHT AND COMMAND	5. LOX PUMP INLET PRESS (D3-403)
				3. PREVALVES AND RECIRC SHUTOFF VALVES OPEN	NOTES
				IF A.2 IS UNSUCCESSFUL, BSE INFORM FLIGHT AND RECOMMEND NO S-IVB RESTART	1. IF THE MOV IS OPEN, THE LOX PUMP INLET PRESSURE WILL GO TO ZERO AFTER COMMAND (A.1).
		B. SECOND S-IVB CUTOFF	TLC	B. CONTINUE MISSION	2. THIS FAILURE WILL REQUIRE EVALUATION OF RESIDUALS TO DETERMINE ADEQUACY FOR LLI VELOCITY CUTOFF AND LUNAR IMPACT OPERATIONS.
				BSE INFORM FLIGHT AND:	3. LOX DUMP WILL BE INITIATED 3.2 SEC EARLY.
				1. ATTEMPT TO CLOSE MOV IF UNSUCCESSFUL, BSE CMD ASAP IN TB 8	4. THIS FAILURE WILL REQUIRE REAL-TIME ASSESSMENT BY LUNAR IMPACT TEAM.
				2. ENGINE PUMP PURGE OFF	
				BSE TERMINATE LOX DUMP 120 SEC AFTER GAS INGESTION OBSERVED BY COMMANDING: (SEE NOTE 3)	
				3. PREVALVES AND RECIRC VALVES CLOSED	
		C. AT END OF LOX DUMP		C. CONTINUE MISSION BSE INFORM FLIGHT AND TERMINATE LOX DUMP 120 SEC AFTER GAS INGESTION OBSERVED BY COMMANDING:	
				1. PREVALVES AND RECIRC VALVES CLOSED	
				2. ATTEMPT TO CLOSE MOV	
				IF C.2. IS SUCCESSFUL	
B				3. OPEN PREVALVES AND RECIRC VALVES	

	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	7-7	S-IVB AUXILIARY HYDRAULIC PUMP FAILS			CUES
		A. TO TURN OFF AS SEQUENCED	EARTH ORBIT	A. CONTINUE MISSION BSE INFORM FLIGHT AND ATTEMPT TO TURN OFF AUXILIARY HYDRAULIC PUMP AS SOON AS POSSIBLE	A.1. SYSTEM PRESSURE (D41-403). 2. RESERVOIR LEVEL (L7-403). 3. AFT BATTERY NO. 2 CURRENT (M22-404). 4. HYDRAULIC RESERVOIR OIL PRESSURE (D42-403).
B				IF TURNOFF IS UNSUCCESSFUL, BSE INFORM FLIGHT OF IMPENDING LOSS OF AFT NO. 2 BATTERY (REF. FMR 7-34)	NOTES A. FAILURE TO TURN OFF HYDRAULIC PUMP DEPLETES AFT NO. 2 BATTERY IN APPROXIMATELY 90 MIN AND OVERHEATS HYDRAULIC SYSTEM IN APPROXIMATELY 70 MIN.
B		B. TO TURN ON AS SEQUENCED	EARTH ORBIT	B. CONTINUE MISSION	CUES
B		1. FOR THE FIRST THERMAL CYCLE DURING COAST		1. BSE INFORM FLIGHT AND ATTEMPT TO TURN ON AUXILIARY HYDRAULIC PUMP IF TURN-ON IS UNSUCCESSFUL, BSE INFORM FLIGHT AND RECOMMEND ZERO OPPORTUNITY RESTART.	B.1. SYSTEM PRESSURE (D41-403). 2. RESERVOIR OIL LEVEL (L7-403). 3. AFT BAT NO. 2 CURRENT (M22-404). 4. RESERVOIR PRESSURE (D42-403). 5. HYDRAULIC PUMP INLET OIL TEMP (C50-401). 6. RESERVOIR OIL TEMP (C51-403).
B		2. FOR THE SECOND OR SUBSEQUENT THERMAL CYCLE DURING COAST AND THE RESERVOIR OIL TEMPERATURE IS BELOW OR PREDICTED TO BE BELOW 35 DEG F PRIOR TO THE NEXT STATION ADS.		2. BSE INFORM FLIGHT AND ATTEMPT TO TURN ON AUXILIARY HYDRAULIC PUMP.	NOTES B.1. HYDRAULIC LINE SEGMENTS ARE SUBJECT TO MINIMUM THERMAL RADIATION DURING TB5 AND CAN DECREASE AT A RATE WHICH MAY RESULT IN HYDRAULIC OIL FREEZING BEFORE SECOND OPPORTUNITY TLI.
B		3. FOR RESTART AT TB6 + 3 MIN 39 SEC.	TLI	3. BSE INFORM FLIGHT AND COMMAND AUXILIARY HYDRAULIC PUMP OFF.	CUES
		C. TO TURN ON FOR LOX DUMP (J-2 ENGINE NOT CENTERED IN PITCH PLANE PRIOR TO LOX DUMP)	TLC	C. CONTINUE MISSION	C.1. ACTUATOR POSITION (G1-403) 2. SYSTEM PRESSURE (D41-403) 3. CHI MINUS THETA GREATER THAN 10 DEGREES (H60-603)
		1. ENGINE GIMBAL ANGLE LESS THAN ± DEGREES		1. CONTINUE MISSION BSE INFORM FLIGHT	NOTES 1. A PITCH ACTUATOR DEFLECTION IN EXCESS OF ± DEGREES IS ONLY EXPECTED FOR THE FOLLOWING CONDITIONS: (A) ERRONEOUS COMMAND SIGNAL (B) ACTUATOR FAILURE
		2. ENGINE GIMBAL ANGLE GREATER THAN ±3 DEGREES		2. CONTINUE MISSION BSE INFORM FLIGHT AND INHIBIT LOX DUMP	2. SINCE TWO APS ENGINES ARE AVAILABLE FOR ATTITUDE CONTROL IN THE YAW PLANE, ATTITUDE CONTROL IN THIS PLANE WILL BE MAINTAINED FOR AN ACTUATOR IN A HARDOVER CONDITION.
		3. ATTITUDE ERROR GREATER THAN 10 DEGREES DURING DUMP		3. CONTINUE MISSION BSE INFORM FLIGHT AND TERMINATE LOX DUMP	3. IF APS PROPELLANT IS INSUFFICIENT AND EITHER CONDITION C.2. OR C.3. PRECLUDES LOX DUMP, CONSIDERATION WILL BE GIVEN TO CONDUCTING A CYCLE LOX DUMP TO ATTAIN THE REQUIRED ΔV FOR LUNAR IMPACT BASED ON REAL-TIME DECISION OF LUNAR IMPACT TEAM. 4. ANY TIME THE HYDRAULIC OIL TEMP (C51-403) DROPS BELOW 35° F, THE AUX HYDRAULIC PUMP SHOULD BE CYCLED.

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
B B B B B B	7-11	IU STATE VECTOR IS IN ERROR WHEN COMPARED TO MSFN STATE VECTOR (I.E., SOME COMPONENT OF IU PLATFORM AND/OR COMPUTER HAS FAILED OR EXHIBITS A LARGE ERROR)	LAUNCH	CONTINUE MISSION BSE XMIT IU NAV UPDATE BASED ON GUIDO RECOMMENDATION PER FMR 5-29	CUES IF IU AND MSFN ΔA, ΔRV, AND $\Delta\dot{W}$ MAX DIFFER BY THE FOLLOWING AMOUNTS: 1. AT T + 56 MIN. (A) ΔA = .78 NM (B) ΔRV = 21,174 FT (C) $\Delta\dot{W}$ MAX = 8.0 FPS WHEN ΔW = 2168 FT 2. AT T + 1 HOUR 45 MIN. (A) ΔA = 0.84 NM (B) ΔRV = 36,814 FT (C) $\Delta\dot{W}$ MAX = 9.0 FPS WHEN ΔW = 3461 FT NOTES 1. ANY HARDWARE FAILURE OR MALFUNCTION, SUCH AS CVS FAILURE, OR ACCELEROMETER FAILURE MAY BE CAUSE TO PERFORM A NAVIGATION UPDATE. 2. THERE ARE TWO TIMES DURING EPO THAT THESE VECTOR COMPARISONS ARE MADE. THESE TIMES CORRESPOND TO A VECTOR TIME TAGGED AT TL + 56 MIN AND A VECTOR TIME TAGGED AT TL + 1 HR 45 MIN. THE VECTOR COMPARISONS WILL BE MADE ON THE FOLLOWING PARAMETERS: (A) ΔA - BASICALLY, THE DELTA SEMIMAJOR AXIS OF EPO (B) ΔRV - THE LOCAL DELTA DOWNRANGE COMPONENT (C) $\Delta\dot{W}$ MAX - THE LOCAL CROSSRANGE VELOCITY. THIS IS A FUNCTION OF W AND CHANGES AS W CHANGES.

	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
B	7-12	J-2 ENGINE MAIN FUEL VALVE OR MAIN OXIDIZER VALVE LEAKAGE	EARTH ORBIT	CONTINUE MISSION BSE INFORM FLIGHT AND COMMAND 1. PREVALVES CLOSED 2. MAIN ENGINE VALVES CLOSED 3. MEASURE PROPELLANT FLOW ON RECIRC FLOWMETERS (NOTE 2)	CUES 1. THRUST CHAMBER TEMP (C199-401) DECREASING 2. FUEL INJECTION TEMP (C200-401) DECREASING (EXCEPT DURING FIRST 100 SEC AFTER FIRST BURN CUTOFF) 3. MAIN FUEL VALVE POSITION (G4-401) 4. MAIN OXIDIZER VALVE POSITION (G3-401) 5. LH2 RECIRC FLOW (F5-404) 6. LOX RECIRC FLOW (F4-404) 7. LOX ENG. FLOW (F1-401) 8. LH2 PUMP INLET PRESS (D2-403) 9. LOX PUMP INLET PRESS (D3-403)
B		A. FOR ANY PROP LEAK FOR WHICH THE PREDICTED PROP REMAINING AT ZERO OPPORTUNITY RESTART IS LESS THAN REQUIRED TO ASSURE 50 PERCENT PROBABILITY OF A MINIMUM LUNAR LANDING CAPABILITY.		A. CONTINUE MISSION BSE INFORM FLIGHT, RECOMMEND FIRST OPPORTUNITY RESTART, AND CMD 1. RECIRC VALVES CLOSED REASSESS REQUIREMENTS FOR A 50 PERCENT PROBABILITY OF A FIRST OPPORTUNITY MINIMUM LUNAR LANDING MISSION. DETERMINE THE TIME AT WHICH REINITIATING THE LEAK WILL NOT VIOLATE THESE REQUIREMENTS. AT THE EARLIEST OPPORTUNITY FOLLOWING THIS TIME, BSE CMD: (NOTE 3). 2. RECIRC VALVES OPEN IF C199-401 IS EXPECTED TO BE COLDER THAN 320° R AND C200-401 IS EXPECTED TO BE COLDER THAN 160° R PRIOR TO ENGINE START, BSE CMD: (NOTE 4) 3. MAINSTAGE ENABLE NO. 2 ON 4. BURN MODE A ON	NOTES 1. THIS FAILURE WILL REQUIRE EVALUATION OF TRAJECTORY UPDATE AND CONSUMABLES (REF FMR 7-1). 2. IF THE LOX LEAK IS GREATER THAN 31 GPM FROM RECIRC FLOWMETER WITH PREVALVES CLOSED, USE LEAKAGE RATE PREVIOUSLY DETERMINED FROM MAIN ENGINE FLOWMETER (F1-401) WITH PREVALVES OPEN TO ASSESS PROPELLANT LOSS. 3. IF CMD A.2. IS NOT SENT, RECIRCULATION CHILLDOWN WILL NOT BE ACCOMPLISHED DUE TO RECIRCULATION VLAVES CLOSED CONDITION. (REFER TO FMR 8-3 AND 8-4) 4. IMPLEMENTATION OF CMDS 3 AND 4 UNDER RULING A OR 2 AND 3 OF B WILL RESULT IN A 1 SECOND FUEL LEAD PRIOR TO TLI IGN AND ENGINE M/S APPROXIMATELY 7 SECONDS EARLY. 5. A LOX DUMP SHOULD NOT BE ATTEMPTED WITH A LEAKING MFV DUE TO THE HAZARDS OF SIMULTANEOUS DUMPING. 6. THE LH2 DUMP MUST BE COMPLETED PRIOR TO THE TIME OF THE NOMINAL TANK VENTING SEQUENCE. 7. THIS FAILURE WILL REQUIRE REAL-TIME ASSESSMENT BY THE LUNAR IMPACT TEAM. 8. IF EITHER MAIN VALVE IS NOT FULLY CLOSED, PUMP INLET PRESSURE SHOULD APPROACH ZERO WHEN PREVALVES AND RECIRC VALVES ARE SEQUENCED CLOSED.
B		B. FOR ANY LEAK FOR WHICH THE PREDICTED PROPELLANT REMAINING AT ZERO OPPORTUNITY RESTART IS MORE THAN REQUIRED TO ASSURE 50 PERCENT PROBABILITY OF A LUNAR LANDING CAPABILITY.	EARTH ORBIT	B. CONTINUE MISSION BSE INFORM FLIGHT AND RECOMMEND ZERO OPPORTUNITY RESTART, AND CMD: 1. PREVALVES OPEN IF C199-401 IS EXPECTED TO BE COLDER THAN 320° R, OR C200-401 IS EXPECTED TO BE COLDER THAN 160° R AT ENGINE START, BSE CMD: (NOTE4). 2. MAINSTAGE ENABLE NO. 2 ON 3. BURN MODE A ON	

	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	7-13	IU ECS WATER VALVE FAILS TO CYCLE OPEN OR CLOSE			
		A. WATER VALVE CLOSED AND COOLANT INLET CONTROL TEMPERATURE IS 64° F OR HIGHER, AND THE INERTIAL GIMBAL TEMPERATURE IS 117° F OR HIGHER, OR THE LVDA MEMORY TEMP NO. 1 OR NO. 2 IS 147° F OR HIGHER, OR THE LVDC MEMORY TEMP IS 115° F OR HIGHER, OR THE LVDC LOGIC TEMP IS 142° F OR HIGHER, OR COOLANT MANIFOLD PUMP INLET PRESS IS 17.5 PSIA OR HIGHER.	EARTH ORBIT TLI TO APS BURN NO. 1	A. CONTINUE MISSION BSE INFORM FLIGHT AND SEND 1. ECS LOGIC INHIBIT COMMAND 2. WATER VALVE OPEN	CUES 1. WATER VALVE CLOSED/OPEN (G5-601, G6-601) 2. COOLANT TEMP (C15-601) 3. ST-124 INERTIAL GIMBAL TEMP (C34-603) 4. SUBLIMATOR INLET TEMP (C11-601) 5. LVDC MEMORY TEMP (C54-603) 6. LVDA TEMP NO. 1 (C55-603) 7. LVDA TEMP NO. 2 (C46-603) 8. LVDC LOGIC TEMP (C53-603) 9. COOLANT MANIFOLD INLET PRESS (D24-601)
B		B. WATER VLV CLOSED AND COOLANT INLET CONTROL TEMP IS 64° F OR HIGHER, AND THE INERTIAL GIMBAL TEMP IS 149° F OR HIGHER, OR THE LVDA TEMP NO. 1 OR NO. 2 IS 147° F OR HIGHER, OR THE LVDC MEMORY TEMP IS 115° F OR HIGHER, OR THE LVDC LOGIC TEMP IS 142° F OR HIGHER, OR COOLANT MANIFOLD PUMP INLET PRESS IS 17.5 PSIA	APS BURN NO. 1 TO EOM	B. CONTINUE MISSION BSE INFORM FLT AND SEND: 1. WATER VLV OPEN 2. WATER VLV CLOSED WHEN THE TEMP WHICH WAS IN VIOLATION DECREASES 27° F OR IF VLV OPENED AS A RESULT OF PRESS VIOLATION, VLV WILL BE CLOSED WHEN PRESS DECREASES TO A NOMINAL LEVEL AND ANY ONE CRITICAL TEMP DECREASES 27° F.	NOTE 1. RULING "B" IS IN EFFECT ONLY IF ECS LOGIC HAS BEEN INHIBITED WITH THE WATER VLV IN THE CLOSED POSITION TO COMPENSATE FOR SUBLIMATOR VENTING FROM 20 MINUTES BEFORE APS BURN NO. 1 TO EOM.
		C. WATER VLV OPEN AND COOLANT INLET CONTROL TEMP IS 55° F OR LESS, AND THE INERTIAL GIMBAL TEMP IS 102° F OR LESS, OR THE LVDA TEMP NO. 1 OR NO. 2 IS 50° F OR LESS, OR THE LVDC MEMORY OR LOGIC TEMPS ARE 50° F OR LESS.	EARTH ORBIT TLI TLC	C. CONTINUE MISSION BSE INFORM FLT AND SEND: 1. ECS LOGIC INHIBIT CMD 2. WATER VLV CLOSED	
B B B B B B B B B B B B B		D. WATER VALVE CLOSED AND DOES NOT RESPOND TO WATER VALVE OPEN COMMAND AND IU TEMPERATURES CONTINUE TO RISE.	LIFTOFF TO MAX ZERO OPPORTUNITY DECISION TIME	D. COMMAND ZERO OPPORTUNITY BSE INFORM FLIGHT AND SEND SEND ZERO OPPORTUNITY TARGET UPDATE CMD.	CUES 1. WATER VALVE CLOSED/OPEN (G5-601, G6-601) 2. COOLANT TEMP (C15-601) 3. ST-124 INERTIAL GIMBAL TEMP (C34-603) 4. SUBLIMATOR INLET TEMP (C11-601) 5. LVDC MEMORY TEMP (C54-603) 6. LVDA TEMP NO. 1 (C55-603) 7. LVDA TEMP NO. 2 (C46-603) 8. LVDC LOGIC TEMP (C53-603) 9. COOLANT MANIFOLD INLET PRESS (D24-601)

	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	7-14	S-IVB STAGE COMMON BULKHEAD DELTA PRESSURE	EARTH ORBIT TLC		CUES 1. LH2 TANK ULLAGE PRESSURE (K177-408, D178-408). 2. LOX TANK ULLAGE PRESSURE (D180-406, D179-406) 3. LH2 PUMP INLET PRESSURE (D2-403). 4. LOX PUMP INLET PRESSURE (D3-403). NOTES 1. MINUS DELTA PRESSURE IS DEFINED AS A FUEL TANK ULLAGE PRESSURE GREATER THAN THE LOX TANK ULLAGE PRESSURE. 2. PLUS DELTA PRESSURE IS DEFINED AS A LOX TANK ULLAGE PRESSURE GREATER THAN THE FUEL TANK ULLAGE PRESSURE. 3. THE MINIMUM RECOMMENDED DISTANCE BETWEEN THE S-IVB AND THE SPACECRAFT IS 7,000 FT. 4. THE BULKHEAD WILL STRUCTURALLY FAIL AT THE ULTIMATE LIMITS OF -32.5 PSID OR +42.0 PSID. 5. PROJECTION OF BULKHEAD DELTA P VALUES MUST INCLUDE REPRESSURIZATION EFFECTS. 6. TANK LOCKUP OR VENTING MAY REQUIRE EVALUATION OF CONSUMABLES TO ATTAIN ACCEPTABLE MISSION. (REF. FMR 7-1).
B		A. PROJECTED TO EXCEED MINUS 26 PSID OR PLUS 36 PSID PRIOR TO SECOND OPPORTUNITY RESTART (NOTE 5)	EARTH ORBIT	A. CONTINUE MISSION IF DELTA P IS PROJECTED TO EXCEED LIMITS PRIOR TO ZERO OPPORTUNITY RESTART, BSE INFORM FLIGHT AND CMD: 1. LH2 AND/OR LOX VENT VALVES OPEN OR CLOSED TO PRECLUDE REACHING SEPARATION LIMITS. IF CMD ACTION IS SUCCESSFUL, BSE RECOMMEND FIRST OPPORTUNITY RESTART IF DELTA P IS PROJECTED TO BE WITHIN LIMITS UNTIL ZERO OPPORTUNITY RESTART, BSE RECOMMEND ZERO OPPORTUNITY RESTART	
B		B. EXCEEDS MINUS 20 OR PLUS 30 PSID DURING TLC	TLC	B. CONTINUE MISSION BSE INFORM FLIGHT AND CMD: 1. LH2 AND/OR LOX VENT VALVES OPEN OR CLOSED TO PRECLUDE REACHING SEPARATION LIMITS.	
B		C. REACHES OR EXCEEDS MINUS 26 OR PLUS 36 PSID.	TLC	C. EMERGENCY S/C SEPARATION BSE TRANSMIT ABORT REQUEST AND REQUEST EMERGENCY S/C SEPARATION.	

	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	7-15	S-IVB STAGE PNEUMATIC SUPPLY PRESSURE DECAY EXCESSIVE IN:		A. CONTINUE MISSION BSE INFORM FLIGHT AND	CUES 1. ENGINE PUMP PURGE PRESSURE (D50-403)
B		A. TB5 (NOTE 1)	EARTH ORBIT	1. ATTEMPT TO TERMINATE PUMP PURGE AND/OR CLOSE AMBIENT HELIUM SUPPLY SHUTOFF VALVE DURING PERIODS WHEN PNEUMATICS ARE NOT RE-REQUIRED.	2. AMBIENT HELIUM PNEUMATIC SPHERE PRESSURE (D236-403, D256-403). 3. LOX REPRESS SUPPLY PRESSURE (D88-403, D254-403).
B B B					NOTE
B B B B B				2. IF PRESSURE DECAY IS EXCESSIVE AFTER CMD ACTION, BSE INFORM FLIGHT AND RECOMMEND ZERO OPPORTUNITY RESTART	1. AN EXCESSIVE PNEUMATIC SUPPLY PRESSURE DECAY IS ONE WHICH WILL RESULT IN DEPLETION OF STAGE PNEUMATICS PRIOR TO COMPLETION OF LM EJECTION FOR SECOND OPPORTUNITY RESTART.
B		B. TB7 (NOTE 2)	TLC	B. CONTINUE MISSION	2. AN EXCESSIVE PNEUMATIC SUPPLY PRESSURE DECAY IS ONE WHICH WILL RESULT IN DEPLETION OF STAGE PNEUMATICS PRIOR TO COMPLETION OF TB8 FUNCTIONS.
B B B B B B B B				BSE INFORM FLIGHT AND 1. PRIOR TO LOX AMBIENT REPRESS SPHERE DUMP CMD: "AMBIENT REPRESS SYSTEM MODE SELECTOR OFF AND CRYO ON"	
B B				2. OPEN PREVALVES AND CHILL-DOWN SHUTOFF VALVES. IF EXCESSIVE PRESSURE DECAY CONTINUES, BSE	
B				3. CLOSE AMBIENT HELIUM SUPPLY SHUTOFF VALVES WHEN PNEUMATICS REQUIRED.	
	7-16	CONTROL SIGNAL PROCESSOR NULL SHIFT IN TB7 OR TB8	TLC	CONTINUE MISSION BSE INFORM FLIGHT AND COMMAND LADDER LIMITS TO 12.0 DEG	CUES: 1. PRIME RATE GYRO MINUS REFERENCE RATE GYRO GREATER THAN 0.3 DEG/SEC (PITCH, R4-602, R13-602; YAW, R5-602, R8-602; ROLL, R6-602, R12-602) 2. GUIDANCE CHI MINUS THETA GIMBAL ANGLE (H60-603) GREATER THAN 10 DEG AND NOT CONVERGING. 3. LADDER ERRORS GREATER THAN 1.6 DEG(H54-603, H55-603, H56-603) EXCEPT DURING PROGRAMED MANEUVER. NOTES 1. IF BOTH RATE GYRO MEASUREMENTS ARE VALID, CUE 1 MUST BE USED. 2. FOR AS-511 ONLY, IF A NULL SHIFT OCCURS PRIOR TO TB - 69 SECONDS, A DCS CMD TO OPEN THE LADDER LIMITS TO 12 DEGREES MUST BE SENT AFTER TB - 69 SECONDS TO PREVENT THE LVDC FROM SWITCHING BACK TO THE LOWER LIMITS DURING TB7 AND TB8.

	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
B B B B B B B B B B B B B B B B B	7-17	LOW LH2 TANK ULLAGE PRESSURE PROJECTED TO BE LESS THAN 17 PSIA PRIOR TO TB6, FIRST OPPORTUNITY	EARTH ORBIT/ TLI	CONTINUE MISSION BSE INFORM FLIGHT AND COMMAND 1. LH2 TANK VENT VALVES BOOST CLOSE ON AND OFF AND/OR CVS REGULATOR CLOSED (ORIFICE OPEN) (NOTE 1). IF THE CONDITION CANNOT BE CORRECTED AND PRESSURE IS PREDICTED TO BE LESS THAN 17 PSIA AT TB6, ZERO OPPORTUNITY, BSE RECOMMEND FIRST OPPORTUNITY RESTART AND: 2. INHIBIT O2/H2 BURNER IF CONDITION CANNOT BE CORRECTED, AND PRESS IS PREDICTED TO BE GREATER THAN 17 PSIA AT TB6, ZERO OPPORTUNITY, BSE RECOMMEND ZERO OPPORTUNITY RESTART	CUES 1. LH2 ULLAGE PRESSURE (D177-408, D178-408). 2. LH2 PUMP INLET PRESSURE (D2-403). 3. LH2 VENT CLOSED DISCRETES (K1-410, K210-410). NOTES 1. IF THE ULLAGE PRESSURE RISES ABOVE 21 PSIA AFTER THE REGULATOR HAS BEEN CLOSED, THE REGULATOR SHOULD BE CYCLED TO MAINTAIN A 17 TO 21 PSIA ULLAGE PRESSURE IN LH2 TANK. 2. IF LH2 TANK ULLAGE PRESSURE IS EXPECTED TO BE LESS THAN 19.5 PSIA AT TB6 INITIATE, RESULTING PROPELLANT LOSSES AND CONDITIONS SHOULD BE INCLUDED IN THE EVALUATION OF CAPABILITY TO ACHIEVE ACCEPTABLE ALTERNATE MISSION PER FMR 7-1.

MISSION RULES

SECTION 7 - SLV - TB 5 AND TB7 - CONTINUED

	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
B	7-18	LOW COLD HELIUM SUPPLY PRESSURE (EXCESSIVE COLD HELIUM SUPPLY DECAY (NOTE 1)	EARTH ORBIT	CONTINUE MISSION BSE INFORM FLIGHT AND RECOMMEND ZERO OPP RESTART	CUE COLD HELIUM SPHERE PRESSURE (D261-403, D263-403).
B		A. PRIOR TO BURNER START		A. IF PROJECTED PRESSURE AT TB6 INITIATE IS LESS THAN 1000 PSIA, BSE INFORM FLT AND CMD FROM LAST STATION PRIOR TO TB6 INITIATION 1. BURNER LOX SHUTDOWN VALVE CLOSE ON.	NOTE 1. AN EXCESSIVE COLD HELIUM SUPPLY PRESSURE DECAY IS ONE WHICH WILL RESULT IN A COLD HELIUM BOTTLE PRESSURE OF LESS THAN 1000 PSIA AT SECOND OPP TB6 INITIATE OR LESS LESS THAN 450 PSIA AT COMPLETION OF CRYOGENIC REPRESSURIZATION. 2. THIS FAILURE WILL REQUIRE EVALUATION OF RESIDUALS TO DETERMINE ADEQUACY FOR TLI VELOCITY CUTOFF AND LUNAR IMPACT OPERATIONS.
B		B. DURING BURNER OPERATION		B. CONTINUE MISSION BSE INFORM FLIGHT AND CMD: 1. LH2 AND LOX REPRESS VALVE CLOSED.	
B	7-19	LOW LOX TANK ULLAGE PRESSURE	EARTH ORBIT		CUES 1. LOX ULLAGE PRESSURE (D179-406, D180-406) 2. LOX PUMP INLET PRESS (D3-403) NOTE: 1. IF THE LOX TK ULLAGE PRESS DROPS BELOW 17 PSIA DURING TB5, RESULTING PROPELLANT LOSSES SHOULD BE INCLUDED IN EVALUATION OF CAPABILITY TO ACHIEVE ACCEPTABLE ALTERNATE MISSION PER FMR 7-1
B		A. LOX TK ULLAGE PRESS LESS THAN 35 PSIA DURING ORBITAL COAST		A. CONTINUE MISSION BSE INFORM FLT AND CMD: 1. LOX TK VENT VLV BOOST CLOSE	
B		B. LOX TK ULLAGE PRESS EXPECTED TO LESS THAN 31 PSIA BY TB6 ZERO OPPORTUNITY		B. CONTINUE MISSION BSE INFORM FLT AND RECOMMEND ZERO OPPORTUNITY RESTART	
B		C. LOX TK ULLAGE PRESS EXPECTED TO BE LESS THAN 31 PSIA BY TB6 INITIATE		C. CONTINUE MISSION 1. BSE INFORM FLT IF LOX TK ULLAGE PRESS PLUS AMBIENT REPRESS DELTA P CAPABILITY IS GREATER THAN THE REQUIRED ULLAGE PRESS, BSE CMD. 2. LOX TK REPRESS CONTROL VLV OPEN ON UNTIL TK PRESS GREATER THAN REQUIRED, THEN OFF IF LOX TK ULLAGE PRESS PLUS AMBIENT REPRESS DELTA P CAPABILITY IS LESS THAN THE REQUIRED ULLAGE PRESSURE, OR IF THE REQUIRED ULLAGE PRESSURE IS GREATER THAN THE FLIGHT CONTROL PRESSURE SWITCH SETTING, BSE CMD. 3. BURNER LOX SHUTDOWN VLV CLOSE AS CLOSE AS POSSIBLE TO TB6 + 7 MIN 30 SEC CMD: 4. LOX AMBIENT REPRESS ON	

	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	7-20	J-2 ENGINE START BOTTLE PRESSURE OUTSIDE RE-START LIMITS	EARTH ORBIT		CUES START BOTTLE PRESSURE (D17-401, D241-401)
B B B B B B B B B B B B B		A. ABOVE 1400 PSIA DURING ORBITAL COAST FOR ZERO OPPORTUNITY RESTART, ABOVE 1450 PSIA FOR FIRST OPPORTUNITY RESTART, OR ABOVE 1500 PSIA FOR SECOND OPPORTUNITY RESTART.		A. CONTINUE MISSION BSE INFORM FLIGHT AND SENT 1. START BOTTLE VENT OPEN FOR 3 SEC 2. REPEAT COMMAND AS NECESSARY TO INSURE A PRESSURE OF LESS THAN 1400 PSIA FOR ZERO OPPORTUNITY RESTART, 1450 PSIA FOR FIRST OPPORTUNITY RESTART, OR 1500 PSIA FOR SECOND OPPORTUNITY RESTART.	NOTES 1. EXCESSIVE START BOTTLE DECAY DURING ORBITAL COAST IS DEFINED AS A PRESSURE DECAY WHICH WILL RESULT IN A START BOTTLE PRESSURE BELOW 800 PSIA AT SECOND BURN ENGINE START COMMAND (TB6 + 9 MIN 30 SEC). 2. A START BOTTLE PRESSURE OF 300 PSIA MAXIMUM IS ALLOWABLE AT START BOTTLE RECHARGE COMMAND.
		B. ABOVE 1800 PSIA PRIOR TO RESTART		B. EMERGENCY SPACECRAFT SEPARATION BSE TRANSMIT ABORT REQUEST AND RECOMMEND EMERGENCY SPACECRAFT SEPARATION	
B B B B B B B B B B B B B B B B B B B B B		C. EXPECTED TO BE BETWEEN 800 AND 1100 PSIA FOR FIRST OPPORTUNITY RESTART		C. CONTINUE MISSION BSE INFORM FLIGHT AND: IF PRESSURE EXPECTED TO BE GREATER THAN 1100 PSIA FOR ZERO OPPORTUNITY RESTART, RECOMMEND A ZERO OPPORTUNITY RESTART. IF PRESS EXPECTED TO BE LESS THAN 1100 PSIA AT ZERO OPPORTUNITY, RECOMMEND A FIRST OPPORTUNITY RESTART AND CMD PRIOR TO ENGINE RESTART (NOTE 1 BELOW): 1. START TANK RECHARGE ARM ON 2. OPEN START TANK RECHARGE VLV AND RECHARGE AS REQUIRED, THEN CLOSE 3. START TANK RECHARGE ARM OFF.	

	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
B	7-20 (CONT)	D. EXPECTED TO BE LESS THAN 800 PSIA FOR FIRST OPPORTUNITY RESTART		D. CONTINUE MISSION BSE INFORM FLIGHT AND: IF PRESS EXPECTED TO BE BETWEEN 800 AND 1100 PSIA FOR ZERO OPPORTUNITY RESTART, RECOMMEND ZERO OPPORTUNITY RESTART AND CMD PRIOR TO RESTART (NOTE 1 BELOW): 1. START TANK RECHARGE ARM ON 2. OPEN START TANK RECHARGE VALVE AND RECHARGE AS REQUIRED, THEN CLOSE 3. START TANK RECHARGE ARM OFF IF PRESS EXPECTED TO BE LESS THAN 800 PSIA FOR ZERO OPPORTUNITY RESTART, REC-OMMEND FIRST OPPORTUNITY RESTART AND CMD ASAP: 1. START TANK RECHARGE ARM ON 2. START TANK VENT OPEN UNTIL TANK PRESS IS WITHIN ACCEPTABLE RECHARGE LIMITS.	
	7-21	LOX BLEED VLV FAILS OPEN DURING S-IVB FIRST BURN	LAUNCH	CONTINUE MISSION BSE INFORM FLT ASAP AFTER CUTOFF, BSE: 1. CYCLE LOX BLEED VLV; IF 1. IS UNSUCCESSFUL, BETWEEN TB6 + 7 MIN 30 SEC AND TB6 + 9 MIN 30 SEC, BSE: 2. CLOSE MRCV (5.0 POSITION)	CUES: 1. OXIDIZER BLEED VLV CLOSED OFF (K126-401) DURING S-IVB FIRST BURN. 2. REDUCED ENGINE PERFORMANCE (REFER TO REAL-TIME PERFORMANCE RESULTS) NOTES: 1. THIS FAILURE WILL RESULT IN PROPELLANT IMBALANCE AND WILL REQUIRE EVALUATION OF RESIDUALS TO DETERMINE ADEQUACY FOR TLI VELOCITY CUTOFF (REF FMR 7-1)

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
B B B B B	7-22	S-IVB CONFIRMED LOSS OF HYDRAULIC FLUID A. CONFIRMED PRIOR TO RESTART	EARTH ORBIT/ TLI	NO S-IVB RESTART (TB5)/TLI INHIBIT (TB6) A. NO S-IVB RESTART 1. BSE INFORM FLIGHT AND RECOMMEND NO S-IVB RESTART	CUES A.1. HYDRAULIC RESERVOIR OIL LEVEL APPROX ZERO PERCENT (L7-403). 2. HYDRAULIC SYSTEM PRESSURE LESS THAN 1700 PSIA (D41-403). 3. HYDRAULIC RESERVOIR PRESSURE APPROXIMATELY ZERO PSIA (D42-403).
B B B B B B		B. HYDRAULIC FLUID LEVEL DECREASE NOTED PRIOR TO ZERO OPPORTUNITY S-IVB BURN.		B. CONTINUE MISSION 1. BSE INFORM FLIGHT AND RECOMMEND ZERO OPPORTUNITY RESTART.	NOTES A.1. IF L7-403 IS FUNCTIONING PROPERLY, IT IS REQUIRED FOR IMPLEMENTATION OF THIS RULE. CUES B.1. CORRECTED RESERVOIR LEVEL L_C DECREASING (NOTES 1 AND 2) NOTES B.1. ONE MINUTE AFTER THE FOLLOWING AUXILIARY PUMP CYCLES CALCULATED L_C (a) VAPX PRIOR TO LIFTOFF (b) FIRST S-IVB BURN (c) FIRST AUXILIARY PUMP THERMAL CYCLE. L7-403(L_A) AND C51-403(T_A) ARE REQUIRED FOR IMPLEMENTATION OF THIS RULE. $L_C = (L_{AT})(.115)(160-T_A)$ 2. A CONFIRMED HYDRAULIC LEAK IS DEFINED AS A DECREASE OF FIVE PERCENT OR GREATER FROM THE LEVEL DETERMINED IN NOTE 1(a) ABOVE. (VAPX PRIOR TO LIFTOFF)
B B B B					

	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	7-27	ENGINE START BOTTLE DUMP FAILS TO INITIATE	TLC	CONTINUE MISSION BSE INFORM FLIGHT AND ATTEMPT TO OPEN THE START BOTTLE VENT VALVE FOR A MINIMUM OF 40 SECONDS	CUES GH2 START BOTTLE PRESSURE (D17-401, D241-401). NOTES THE MAXIMUM SAFE PRESSURE LIMIT TO PRECLUDE REACHING BOTTLE PROOF PRESSURE PRIOR TO LUNAR IMPACT IS 615 PSIA.
	7-28	S-IVB STAGE COLD HELIUM DUMP FAILS TO INITIATE	TLC	CONTINUE MISSION BSE INFORM FLIGHT AND 1. ATTEMPT TO INITIATE THE COLD HELIUM DUMP THROUGH LH2 COIL ON O2/H2 BURNER FOR A MINIMUM OF 45 MINUTES IF UNSUCCESSFUL, BSE INFORM FLIGHT AND, AFTER LOX NPV OPEN IN TB8, COMMAND 2. LOX PRESSURIZATION SHUTOFF VALVES OPEN FOR A MINIMUM OF 30 MINUTES	CUE COLD HELIUM BOTTLE PRESSURE (D261-403, D263-403). NOTE THE MAXIMUM SAFE PRESSURE LIMIT TO PRECLUDE REACHING BOTTLE PROOF PRESSURE PRIOR TO LUNAR IMPACT IS 100 PSIA.

	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
B	7-29	ENG HELIUM CONTROL VLV LEAKING AFTER FIRST ENGINE CUTOFF	EO	CONTINUE MISSION/TLI INHIBIT BSE INFORM FLT AND IF HELIUM PRESS EXPECTED TO BE LESS THAN 1575 PSIA FOR SECOND OPPORTUNITY RESTART AND/OR EITHER BLEED VALVE IS CLOSED (NOTE 4). 1. CYCLE ENGINE HELIUM CONTROL VALVE (NOTE 1) IF HELIUM PRESSURE EXPECTED TO BE LESS THAN 660 PSIA AT ZERO OPPORTUNITY RESTART, AND LOW PRESSURE SYSTEM LEAKAGE IS CONFIRMED, BSE CMD: 2. PREVALVES AND RECIRC SHUTOFF VALVES CLOSED. 3. IGNITION PHASE CONTROL SOLENOID ENERGIZED (NOTE 3). IF CMD ACTION 3 UNSUCCESSFUL IN REDUCING LEAKAGE TO AN ACCEPTABLE LEVEL, BSE CMD: 4. MAINSTAGE CONTROL SOLENOID ENERGIZED (NOTE 3). IF HELIUM PRESS EXPECTED TO BE LESS THAN 1575 PSIA AT SECOND OPPORTUNITY RESTART, BSE RECOMMEND ZERO OPPORTUNITY RESTART PRIOR TO RESTART, BSE VERIFY: 5. MAINSTAGE AND IGNITION PHASE SOLENOIDS DE-ENERGIZE IF MAINSTAGE CONTROL SOLENOID CANNOT BE DE-ENERGIZED, BSE RECOMMEND TLI INHIBIT. 6. RECIRC SHUTOFF VALVES OPEN. IF FUEL BLEED VALVE IS CLOSED AND MFV HAS OPENED DURING ORBITAL COAST, BSE: 7. INITIATE TB6D IF LOX LEAD EXCEEDS 20 SEC, BSE INFORM FLIGHT AND: 8. RECOMMEND TLI INHIBIT	CUES: 1. ENG REG OUTLET PRESS (D018-401) 60 PSIA OR GREATER 2. ENG CONTROL HELIUM PRESS (D019-401, D242-401) DECREASING 3. FUEL TK HELIUM REPRESS SPHERE PRESS (D20-403, D249-403) 4. BLEED VLVS CLOSED (K126-401, K127-401) NOTES: 1. RULING 1 MAY BE REPEATED AT DISCRETION OF BSE IN AN EFFORT TO TERMINATE LEAKAGE. 2. IF EXPECTED HELIUM PRESS AT RESTART IS 660 PSIA OR GREATER (1575 PSIA WITHOUT LH2 AMBIENT REPRESS BACKUP), A RESTART CAN BE ACCOMPLISHED. 3. ENERGIZING THE IGNITION PHASE AND MAINSTAGE CONTROL SOLENOIDS WILL OPEN THE MAIN FUEL AND OXIDIZER VALVES, RESPECTIVELY, IF THE PRESS DOWNSTREAM OF THE REGULATOR IS SUFFICIENTLY HIGH. 4. REFER TO FMR 7-32 FOR IMPACT OF ENGINE HELIUM LEAKAGE ON LH2 AMBIENT REPRESS SYSTEM.

	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	7-30	OXIDIZER TURBINE BYPASS VLV (OTBY) FAILS OPEN DURING S-IVB FIRST BURN	LAUNCH	CONTINUE MISSION BSE INFORM FLT AS SOON AS POSSIBLE AFTER FIRST BURN CUT-OFF, BSE: 1. CLOSE PREVALVES AND RECIRC VALVES 2. DRAIN AND PURGE LOX SYS 3. DRAIN LH2 SYSTEM AND PURGE (SEE NOTE 3) 4. CYCLE OTBV 5. RETURN SYSTEM TO NORMAL IF CYCLE OF OTBV IS UNSUCCESS-FUL, BETWEEN TB6 + 7 MIN 30 SEC AND TB6 + 9 MIN 30 SEC, BSE: 6. CLOSE MRCV (5.0 POSITION)	CUES: 1. OTBV POSITION (G8-401) INDICATES OPEN DURING S-IVB FIRST BURN. 2. OTBV CLOSED OFF (K125-401) DURING S-IVB FIRST BURN. 3. REDUCED ENG PERFORMANCE (REFER TO R/T ENGINE PERFORMANCE RESULTS). NOTES: 1. THIS FAILURE WILL RESULT IN PROPELLANT IMBALANCE AND WILL REQUIRE EVALUATION OF RESIDUALS TO DETERMINE ADEQUACY FOR TLI VEL. CUTOFF (REF FMR 7-1) 2. THIS RULE MUST BE IMPLEMENTED AS SOON AS POSSIBLE AFTER C/O. 3. THE ENGINE PUMP PURGE MUST BE OFF PRIOR TO CYCLING THE OTBV TO PREVENT BACKFLOW OF GASES TO THE GG WHEN OTBV CYCLED.
B B B B B B B B B	7-31	LOW APS HELIUM SUPPLY SUPPLY PRESSURE	EARTH ORBIT/ TLI	CONTINUE MISSION IF LEAKAGE IS DETECTED AND APS DEPLETION IS EXPECTED PRIOR TO SECOND OPPORTUNITY LM EJECTION, BSE RECOMMEND ZERO OPPORTUNITY RESTART (NOTE 1). IF APS HELIUM BOTTLE PRESSURE IS EXPECTED TO BE BELOW 350 PSIA PRIOR TO THE NEXT GROUND STATION, BSE INFORM FLIGHT AND RECHARGE APS HELIUM BOTTLE AS REQUIRED TO MAINTAIN ATTITUDE CONTROL.	CUES: 1. HELIUM SUPPLY PRESSURE MODULE 1 (D0035-414; D0250-414); MODULE 2 (D00036-415; D0251-415). NOTES: 1. APS HELIUM PRESSURE DECAY MUST BE ASSUMED TO RESULT FROM A PROPELLANT LEAK UNTIL CONFIRMED OTHERWISE.
B B	7-32	EXCESSIVE DECAY OF LH2 AMBIENT REPRESSURIZATION HELIUM PRESSURE	EARTH ORBIT	IF PRESSURE IS PREDICTED TO BE LESS THAN 1800 PSIA AT SECOND OPPORTUNITY TB6, BUT GREATER THAN 1500 PSIA FOR FITST OPPOR-TUNITY TB6, BSE RECOMMEND ZERO OPPORTUNITY RESTART.	CUES: LH2 AMBIENT REPRESSURIZATION SPHERE PRESSURE (D0020-403; D0249-403)
B B B B B B B	7-33	HYDRAULIC ACCUMULATOR GN2 PRESSURE DECAY	EARTH ORBIT/ TLI	CONTINUE MISSION BSE INFORM FLIGHT AND RECOMMEND ZERO OPPORTUNITY RESTART	CUES: 1. ACCUMULATOR GN2 PRESSURE LESS THAN 2,000 PSIA D43-403 (AUX PUMP OFF) 2. HYDRAULIC RESERVOIR PRESSURE LESS THAN 47 PSIA D42-403 (AUX PUMP OFF)

	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
B	7-34	EXCESSIVE CURRENT IS BEING DRAWN FROM FWD-1, AFT-1 OR AFT-2 BATTERIES AND: THERE IS PROJECTED TO BE INSUFFICIENT CAPACITY REMAINING IN THE BATTERY TO COMPLETE LM EJECTION SECOND OPPORTUNITY	EPO	CONTINUE MISSION BSE INFORM FLIGHT AND RECOMMEND ZERO OPPORTUNITY RESTART	CUE: BATTERY CONSUMPTION, AS ASCERTAINED DURING DURING REAL-TIME EVALUATIONS, AND PROJECTED TO LM EXTRACTION (FWD & AFT 1) OR ENG RESTART (AFT 2), SHALL BE LESS THAN THE FOLLOWING: FWD-1: 227.5 AMP-HOURS/ 6:15:10.1 GET AFT-1: 227.5 AMP-HOURS/ 6:15:10.1 GET AFT-2: 66.5 AMP-HOURS/ 4:49:28.4 GET NOTE: THE ABOVE CUE IS BASED ON THE FOLLOWING MEASUREMENTS: XM0019-411, FWD-1 CURRENT XM0021-404, AFT-1 CURRENT XM0022-404, AFT-2 CURRENT XM0014-404, AFT-1 VOLTAGE XM0015-404, AFT-2 VOLTAGE XM0016-411, FWD-1 VOLTAGE M0006-401, ENG CONT BUS VOLTAGE
B	7-35	EXPECTED LOSS OF ECS COOLANT CIRCULATION PRIOR TO LIFTOFF PLUS 4.1 HOURS	LIFTOFF TO MAX ZERO OPPOR-TUNITY DECISION TIME	CONTINUE MISSION BSE INFORM FLIGHT AND RECOMMEND ZERO OPPORTUNITY. BSE COMMAND: A. IF WATER VALVE IS OPEN, BSE COMMAND WATER VLAVE LOGIC INHIBIT. B. IF WATER VALVE IS CLOSED, BSE COMMAND: 1. WATER VLV LOGIC INHIBIT 2. WATER VALVE OPEN	CUES: LOSS OF COOLANT 1. COOLANT PUMP INLET PRESSURE (D24-601) BELOW 15.7 PSIA AND DECREASING AT A RATE THAT WILL FALL BELOW 5 PSIA BY 4.1 HOURS GET. 2. COOLANT MANIFOLD INLET PRESSURE (D17-601) BELOW 41.9 PSIA AND DECREASING AT A RATE THAT WILL FALL BELOW 30 PSIA AT 4.1 HOURS GET. LOSS OF GN2 3. GN2 REGULATOR INLET PRESSURE (D25-601) DECREASING AT A RATE THAT WILL FALL BELOW 300 PSIA BY 4.1 HOURS GET. LOSS OF PUMP POWER 4. LOSS OF 6D40 BATTERY POWER BEFORE 4.1 HOURS GET.

	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
B	7-36	LOSS OF REDUNDANCY IN THE FOLLOWING SYSTEMS: A. LVDC MEMORY	LIFTOFF TO MAX ZERO OPPOR-TUNITY DECISION TIME	CONTINUE MISSION IF LOSS OF REDUNDANCY OCCURS, BSE INFORM FLIGHT AND RECOMMEND ZERO OPPORTUNITY.	CUES A. ERROR MONITOR REGISTER BIT INDICATION ° D25 - MEMORY "B" FAILURE - THIS BIT IS AN INDICATION THAT A PARITY ERROR OR A CURRENT DRIVER ERROR HAS OCCURRED IN MEMORY MODULE B. ° D24 - MEMORY "A" FAILURE - THIS BIT IS AN INDICATION THAT A PARITY ERROR OR A CURRENT DRIVER ERROR HAS OCCURRED IN MEMORY MODULE A.
B		B. LVDC TMR LOGIC			B. ERROR MONITOR REGISTER BIT INDICATION ANY EMR BIT WITH THE EXCEPTION OF BIT D26, D25, D24, D12, D11, D9, D5
B		C. RATE GYRO PAIR AND SPARE			C. (R25 - 602) EDS COMPARATOR RELAY MONITOR 1 (ROLL) (R26 - 602) EDS COMPARATOR RELAY MONITOR 2 (YAW) (R27 - 602) EDS COMPARATOR RELAY MONITOR 3 (PITCH)
B		D. FLIGHT CONTROL COMPUTER SPATIAL OR SERVO AMPLIFIER SWITCH OVER			D. (K22-602) SERVO AMPLIFIER COMPARATOR PITCH (K23-602) SERVO AMPLIFIER COMPARATOR YAW (K24-602) SPITIAL AMPLIFIER COMPARATOR ROLL - YAW 1 (K25-602) SPATIAL AMPLIFIER COMPARATOR PITCH (K26-602) SPATIAL AMPLIFIER COMPARATOR ROLL - YAW II
B		E. SWITCH SELECTOR CHANNEL A FAILURE			E.1. MODE CODE 24 (GUIDANCE STATUS WORD BIT D9) 2. ICR-12
B		F. LADDER A FAILURE			F.1. MODE CODE 24 (GUIDANCE STATUS WORD BIT D10) 2. ICR-14
B		G. COD A FAILURE			G. MODE CODE 24 (GUIDANCE STATUS WORD BIT D12)
B		H. COD B FAILURE			H. MODE CODE 24 (GUIDANCE STATUS WORD BIT D11)
B		I. COD A MUX FAILURE			I. MODE CODE 24 (GUIDANCE STATUS WORD BIT D6)
B		J. COD B MUX FAILURE			J. MODE CODE 24 (GUIDANCE STATUS WORD BIT D5)

PRELAUNCH INSTRUMENTATION

STAGE COMMUNICATIONS SYSTEM AND FLIGHT CONTROL MEASUREMENT CATEGORIZATION

R	ITEM	MEASUREMENT DESCRIPTION	MEAS NUMBER	ONBOARD	TRANSDUCERS	CATEGORY	EFFECTIVITY	MISSION RULE REF
		STAGE COMMUNICATIONS SYSTEM						
		S-II STAGE						
		LINK BP1				HD		
		MUX BP1AO				HD		
		MUX BP1BO				HD		
		MUX CP1AO				HD		
		S-IVB STAGE						
		LINK CP1				HD		
		MUX DP1BO (VIA IU)				M		
		MUX CP1BO				HD		
		INSTRUMENT UNIT						
		LINK DP1				HD		
		LINK DP1B				M		
		MUX CP1AO (VIA S-IVB)				HD		
		MUX DP1AO				HD		
		EMERGENCY DETECTION SYSTEM (EDS)				M		
		COMMAND COMMUNICATIONS SYSTEM (CCS) UPLINK				M		
		FLIGHT CONTROL MEASUREMENTS						
		S-IVB STAGE						
		PRESS, FUEL PUMP INLET	D2-403					7-14
		PRESS, FUEL TANK ULLAGE EDS 1	D177-408	METER*	COMMON	2 OF 3		7-14
		PRESS, FUEL TANK ULLAGE EDS 2	D178-408	METER*	COMMON	M		7-14/19
		PRESS, OXID PUMP INLET	D3-403					
		PRESS, OXID TANK ULLAGE EDS 1	D179-406	METER*	COMMON	2 OF 3		7-14/19,8-5
		PRESS, OXID TANK ULLAGE EDS 2	D180-406	METER*	COMMON	M		7-14/19,8-5
A		VOLT-F/U 1EBW RANGE SAFETY	M30-411			HD		7-5
A		VOLT-F/U 2EBW RANGE SAFETY	M31-411			HD		7-5
A		RSCR NO. 1, SIGNAL STRENGTH LOW LEVEL	N57-411			HD		7-5
A		RSCR NO. 2, SIGNAL STRENGTH LOW LEVEL	N62-411			HD		7-5
		INSTRUMENT UNIT						
		GUIDANCE COMPUTER OPERATION	H60-603			M		6-1/4/7/9, 7-8/11,8-1/8
		COMPUTER RESET PULSE NO. 1-GUIDANCE DECODER	J71-603			1 OF 2		REQUIRED TO COMPLETE MULTIPLE WORD GROUND COMMANDS
		COMPUTER RESET PULSE NO. 2-GUIDANCE DECODER	J72-603			M		
B		*1 S-IVB OX PRESS M O/B, 1 S-IVB FU PRESS M O/B.						

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
B	31-106	DELETED			
A	31-107	INTERMEDIATE OVEN HOT ALARM IS EXPERIENCED PRIOR TO DEPARTURE TO ALSEP.		PLACE TGE IN LM SHADE WITH RADIATOR COVER OPENED PRIOR TO DEPARTING LM.	1. INTERMEDIATE OVEN HOT ALARM IS INDICATED BY A 6 OR 7 IN THE EIGHTH MOST SIGNIFICANT DIGIT OF THE DISPLAY. 2. TGE WILL BE USED ON EVA'S II AND III.
A	31-108	PRECISION OVEN TEMP REACHES MAXIMUM POSITIVE DEVIATION		READINGS WILL BE TAKEN UNTIL UNREASONABLE DATA IS RECEIVED.	MAXIMUM POSITIVE DEVIATION IS INDICATED BY AN ODD NUMBER IN THE EIGHTH MOST SIGNIFICANT DIGIT OF THE DISPLAY AND A "7" IN THE NINTH (LEAST) SIGNIFICANT DIGIT.
A	31-109	DELETED			
A	31-110	DELETED			

	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
				SURFACE ELECTRICAL PROPERTIES	
		REFERENCE RULE 3-67, F., and G. RULES 31-111 THROUGH 31-115 ARE DELETED.			
B	31-111	DELETED			
B	31-112	DELETED			
B	31-113	DELETED			
B	31-114	DELETED			
B	31-115	DELETED			

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