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FINAL FLIGHT MISSION RULES

APOLLO 15
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PREPARED BY
FLIGHT CONTROL DIVISION

MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

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PART I
GEN GUIDELINES
OMSF GENERAL RULES

PART II
1 GENERAL RULES AND SOP'S

2 FLIGHT OPERATIONS RULES

3 MISSION RULE SUMMARY

4 GROUND INSTRUMENTATION REQUIREMENTS

5 TRAJECTORY AND GUIDANCE

6 SLV – TB1 THROUGH TB4/TB4A (LAUNCH)

7 SLV – TB5 AND TB7 (COAST)

8 SLV – TB6 (RESTART)

9 SLV–TB8 (SAFING AND LUNAR IMPACT)

10 CSM ENVIRONMENTAL CONTROL SYSTEM

11 CSM CRYOGENICS

12 CSM ELECTRICAL POWER SYSTEM

13 DOCKING AND UMBILICAL

14 CSM SEQUENTIAL

15 CSM GUIDANCE AND CONTROL

16 CSM SERVICE PROPULSION SYSTEM

17 CSM SM–RCS

18 CSM CM–RCS

19 EMU/EVA

20 COMMUNICATIONS/ INSTRUMENTATION

21 LM SEQUENTIAL AND PYROTECHNIC

22 LM ELECTRICAL POWER

23 LM ENVIRONMENTAL CONTROL

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APOLLO 15

FINAL FLIGHT MISSION RULES

PREFACE

THIS DOCUMENT CONTAINS THE FINAL FLIGHT MISSION RULES FOR APOLLO 15 AS OF MAY 3, 1971. 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 CONTROL OPERATIONS BRANCH, BUILDING 30, ROOM 2030 PHONE 483-3838.

ANY REQUESTS FOR ADDITIONAL COPIES OR CHANGES TO THE DISTRIBUTION LIST IN APPENDIX B OF THIS DOCUMENT MUST BE MADE IN WRITING TO MR. SIGURD A. SJOBERG, 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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TABLE OF CONTENTS

		PAGE
INTRODUCTION AND PURPOSE		1
PART I - GENERAL GUIDELINES		
OMSF GENERAL RULES		I-1
PART II - FLIGHT MISSION RULES		
SECTION		
1	GENERAL RULES AND SOP'S	1-1
2	FLIGHT OPERATIONS RULES	2-1
3	MISSION RULE SUMMARY	3-1
4	GROUND INSTRUMENTATION REQUIREMENTS	4-1
5	TRAJECTORY AND GUIDANCE	5-1
6	SLV - TB1 THROUGH TB4/TB4A (LAUNCH)	6-1
7	SLV - TB5 AND TB7 (COAST)	7-1
8	SLV - TB6 (RESTART)	8-1
9	SLV - TB8 (SAFING AND LUNAR IMPACT)	9-1
10	CSM ENVIRONMENTAL CONTROL SYSTEM	10-1
11	CSM CRYOGENICS	11-1
12	CSM ELECTRICAL POWER SYSTEM	12-1
13	DOCKING AND UMBILICAL	13-1
14	CSM SEQUENTIAL	14-1
15	GUIDANCE AND CONTROL	15-1
16	CSM SERVICE PROPULSION SYSTEM	16-1
17	CSM SM-RCS	17-1
18	CSM CM-RCS	18-1
19	EMU/EVA	19-1
20	COMMUNICATIONS AND INSTRUMENTATION	20-1
21	LM SEQUENTIAL AND PYROTECHNIC	21-1
22	LM ELECTRICAL POWER	22-1
23	LM ENVIRONMENTAL CONTROL	23-1
24	LM GUIDANCE AND CONTROL	24-1
25	LM DPS	25-1
26	LM APS	26-1
27	LM RCS	27-1
28	SPACE ENVIRONMENT	28-1
29	RECOVERY	29-1
30	AEROMEDICAL	30-1
31	LUNAR SURFACE OPERATIONS	31-1
32	ALSEP	32-1
33	LUNAR ORBIT EXPERIMENTS	33-1

TABLE OF CONTENTS - CONCLUDED

R	ITEM	

APPENDIX A - ACRONYMS AND SYMBOLS A-1

APPENDIX B - DISTRIBUTION LIST B-1

APPENDIX C - CHANGE CONTROL C-1

R	ITEM

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 RULING.

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 MALFUNTION. 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 MADATORY 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 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 THE OPERATIONAL PERFORMANCE OF THAT UNIT IS ACCEPTABLE TO MEET THE PRIMARY OBJECTIVES. REDLINE FUNCTIONS ARE MANDATORY.
	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.

R	ITEM	
	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 RECYLCE 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 AND IS THE POINT IN TIME WHEN PLUS TIME COMMENCES.
	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, WHICH EVER OCCURS LATER.

NASA - Manned Spacecraft Center

MISSION RULES

SECTION 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 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 CONSONANCE WITH THE FOLLOWING CRITERIA--- (REFERENCE OMSF GENERAL RULE I-42). 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. THE MANDATORY INSTRUMENTATION LISTINGS IN THIS DOCUMENT WILL BE CROSS-REFERENCED TO THE APPROPRIATE MISSION RULE MEETING THE ABOVE CRITERIA.
	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 DELTA V OR (B) ANY REQUIRED BURN WHERE THE USE OF A DEGRADED SPS IS PREFERABLE TO THE USE OF ANY AVAILABLE ALTERNATIVE METHOD. THE MANUEVERS TABULATED ON MR 3-96 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 SOME BURNS CONSIDERED AS NON-CRITICAL MAY BE RECLASSIFIED IF, IN THE EXISTING MISSION SITUATION, THE FLIGHT DIRECTOR JUDGES ITS VALUE TO BE COMENSURATE 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 (HP GREATER THAN OR EQUAL TO 75 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, LH2, 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 AND 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 ACQUIRE THE LANDING SITE. 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 PROBABLITY 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 809 FPS (APPROX LOI IGN TO 1+57) B. MODE-II--- 809 TO 1313 FPS (APPROX 1+57 TO 3+07) C. MODE-III--- 1313 TO COMPLETION (APPROX 3+07 TO 0/0)
	1-45	SATURN L/V TIMEBASES---

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+15
TB3	S-IC OUTBOARD ENGINES CUTOFF TO S-II CUTOFF (S-II/S-IVB STAGING)	2+44
TB4	S-II CUTOFF TO S-IVB FIRST BURN CUTOFF	9+18
TB5	S-IVB FIRST BURN CUTOFF TO S-IVB RESTART PREPARATIONS (RESTART MINUS 9' 38'')	11+46
TB6	S-IVB RESTART MINUS 9' 38'' 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 OF EVASIVE BURN TO END OF S-IVB/IU 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 DELTA VC READOUTS AND TO PASS CREW BACKUP GUIDANCE QUANTITIES	9

*OR FINAL MCC MANEUVER

1-49 LUNAR RETURN ENTRY RANGE PRIORITY--- THE RELATIVE ENTRY RANGE (400,000 FEET TO SPLASH) PRIORITY IS AS FOLLOWS---

A. 1200 - 1400 NM (NOMINAL)

B. 1400 - 1800 NM (USED TO AVOID WEATHER VIOLATIONS IN PRIORITY A.)

C. 1800 - 2500 NM (USED TO AVOID EXTREME WEATHER VIOLATIONS IN PRIORITY 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 ITEM(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 MECC COMMAND WHICH ALSO LIGHTS THE ABORT REQUEST LIGHT IN THE SPACECRAFT. THE MECO WILL INITIATE AN AUTO-ABORT IF TRANSMITTED PRIOR TO EDS DISABLE. THE MECC COMMAND INITIATES A 4.1 SEC TIMER ON THE GROUND (CAPE RSC 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 RSC WILL ALWAYS SAFE THE S-IVB AFTER TRANSMITTING MECO 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 MECO, 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 (MECO)	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 CUT 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.

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MISSION RULES

SECTION 1 - GENERAL RULES AND SOP'S - CONTINUED

R	ITEM	
	1-77	ABORT MODES---

MODE I	BOUNDARY OF APPLICATION
1A	LES ABORT ENABLE (APPROX T-45 MIN) TO GET 42 SEC (10K FEET)
1B	GET 42 SEC TO 100K FEET ALTITUDE (GET APPROX 1 + 50)
1C	100K FEET ALTITUDE TO TOWER JETTISON (GET APPROX 3 + 07)

1-78 MODE II

BOUNDARY OF APPLICATION	PROCEDURES
TOWER JETTISON (GET APPROX 3 + 07) UNTIL FULL LIFT SPLASHPOINT 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 =3200 NM AND INSERTION.	A. MCC PROVIDES--- 1. GETI AT S-IVB CUTOFF PLUS 2-05 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 CCI LINE ON GAMMA VS V PLOT FOR NEAR NOMINAL ALTITUDE).	A. MCC PROVIDES--- 1. GETI AT S-IVB CUTOFF PLUS 2-05 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 CCI 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
		RULES 1-82 THROUGH 1-86 ARE RESERVED		

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MISSION RULES

SECTION 1 - GENERAL RULES AND SOP'S - CONCLUDED

R	ITEM		
		' CREW ABORT LIMITS '	
	1-87	MAX Q REGION	PROCEDURES
		A. (00-50 TO 02-00) AUA 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 - 9 DEG/SEC 3. YAW DEVIATION GREATER THAN 20 DEG. (SII AND S-IVB BURN ONLY)	ABORT MODE I ABORT MODE I, MODE II, MODE III, OR MODE IV
		B. ROLL 1. 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 ±.5 DEG/SEC ROLL 20.0 ±.5 DEG/SEC	
		B. ANY TWO ENGINES OUT	
		C. CM TO IU BREAKUP	
	1-90	S-IVB TANK PRESSURE LIMITS	
		A. BULKHEAD DELTA P (FIRST SIVB 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 3 OR MORE S-II ENGINES	ABORT MODE I OR MODE II
		PRIOR TO S-IVB TO COI CAPABILITY	

K	ITEM	

GENERAL

2-1 PRELAUNCH

A. LAUNCH AZIMUTH LIMITATIONS RESTRICT LAUNCHES TO OCCUR BETWEEN 80 DEGREES AND 130 DEGREES.

B. THE FLIGHT DIRECTOR WILL EVALUATE WIND SIMULATIONS ALONG THE MODE 1 (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 VOICE, TELEMETRY, AND TRACKING COVERAGE FOR THE SPACECRAFT IS REQUIRED FROM LIFTOFF THROUGH INSERTION PLUS 60 SECONDS.* CONTINUOUS TELEMETRY COVERAGE IS REQUIRED FROM THE SLV FROM LIFTOFF THROUGH INSERTION PLUS 60 SECONDS.* COMMAND IS HIGHLY DESIRABLE FOR BOTH VEHICLES.

*FOR THE NOMINAL AZIMUTH LAUNCH, 30 SECONDS OF DATA AFTER INSERTION WILL BE ACCEPTABLE. THIS WILL ALLOW LAUNCH WITH LOSS OF THE VANGUARD.

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.

30

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 DELTA V 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 (HP GREATER THAN OR EQUAL TO 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. SUFFICIENT S-IVB CONSUMABLES ARE AVAILABLE TO ACHIEVE A LUNAR ORBIT MISSION

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 AND E)

A. THE NORMAL MINIMUM CABIN PRESSURE REDLINE OF 4.0 PSIA FOR TUNNEL/LM PRESSURIZATION SEQUENCES MAY BE WAIVED DURING TD AND 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. THE ASCENT STAGE MAY BE MANNED FOR RETRIEVAL OF THE EQUIPMENT WHICH IS REQUIRED FOR CMP EVA OPERATIONS (OPS, ETC.).

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MISSION RULES

SECTION 2 - FLIGHT OPERATIONS RULES - CONTINUED

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.

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 CREWMAN WILL BE IN THE CSM FOR SIM BAY DOOR JETTISON.

2. SIM BAY EXPERIMENT RCCM OPERATION WILL BE FOR THERMAL CONTROL ONLY.

3. 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 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, AND MINIMUM LUNAR ORBIT OPERATIONS

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

R	ITEM	
	2-15	LUNAR ORBIT

A. FOR LCI 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 POINT 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 NORMAL MISSION OPERATIONS ARE INHIBITED, THE DPS WILL BE USED FOR TEI WHEN THERE IS A CHOICE BETWEEN THE DPS AND SPS.

G. LUNAR ORBIT SCIENCE OPERATIONS

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

2. RF ACTIVATION OF THE P AND FS WILL NOT OCCUR UNTIL MCC SUPPORT OF LM SYSTEMS HAS CEASED

3. THE SIM BAY DOOR WILL NOT BE JETTISONED IN LUNAR ORBIT UNLESS THE LM (WITH TEI CAPABILITY) IS DOCKED TO THE CSM AND ALL CREWMEN ARE IN THE CSM.

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MISSION RULES

SECTION 2 - FLIGHT OPERATIONS RULES - CONTINUED

K	ITEM	
	2-16	DESCENT ORBIT INSERTION (DOI) DOI WILL BE PERFORMED ONLY IF A LUNAR LANDING MISSION CAN BE ACCOMPLISHED. 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 OPERATION 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.
		RULE 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. A CEVA IS AN ACCEPTABLE CREW TRANSFER CAPABILITY TO ALLOW UNDOCKING AND CONTINUATION OF THE LANDING MISSION. 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.
	2-23	RESERVED
	2-24	LM-PDI FOR PDI, THE LM MUST MEET THE LUNAR STAY WITH EVA (STARTUP OR SURFACE) CRITERIA, HAVE THE CAPABILITY TO LAND, ASCEND, AND RENDEZVOUS WITHOUT VIOLATING ANY SPECIFIC MISSION RULES OR REDLINES.

K	ITEM	
	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 IS AVAILABLE. HOWEVER, FOR FAILURES EFFECTING VEHICLE LIFETIME (POWER OR COOLANT), CONSIDERATION WILL BE GIVEN TO CONTINUE POWERED DESCENT TO PDI + 6 + 10 TO ACHIEVE A SHORTER RENDEZVOUS.

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.

K	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 INITIATED.

C. THE ACTIVATION OF THE OPS IN THE MAKE UP MODE OR OF THE BSLSS (WITH SUFFICIENT CONSUMABLES) WILL REQUIRE EXPEDITIOUS COMPLETION OF THE SPECIFIC ACTIVITY BEING PERFORMED, FOLLOWED BY IMMEDIATE RETURN TO THE LM. ACTIVATION OF THE LM IN 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, PLSS, BSLSS) 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.

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 USING OPS ON HIGH PURGE FLOW.

NO LRV AVAILABLE

(A) EVA EXCURSIONS WILL BE LIMITED TO ALLOW WALKBACK TO THE LM, UTILIZING 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.

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

R	ITEM	
	2-27 CONT	I. THE LM WILL NOT BE PRESSURIZED WITH A CREWMAN ON THE LUNAR SURFACE.
		J. THE AMOUNT OF SCIENTIFIC EQUIPMENT AND PAYLOAD TAKEN INTO THE ASCENT STAGE AT THE CONCLUSION OF ANY EVA WILL BE LIMITED SO A DEPRESSURIZATION TO JETTISON EXCESS WEIGHT PRIO TO ASCENT WILL NOT BE REQUIRED.
		K. BOTH PLSS'S AND OPS 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 CEVA.
		L. 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.

R	ITEM	
	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 SHORT 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 LONG RNDZ (CSI, CDH) PROFILE WILL BE EXECUTED.
	2-30	RETENTION OF THE LM ASC STAGE CONSIDERATION WILL BE GIVEN TO RETAINING THE ASC STAGE TO PROVIDE REDUNDANT CAPABILITY AFTER CSM SYSTEM FAILURES. IF THE ASC STAGE MUST BE RETAINED FOR TEI, THE DELTA VELOCITY RESERVED FOR WEATHER AVOIDANCE MAY BE TRADED OFF TO ACCOMPLISH A FASTER EARTH RETURN TIME.
	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 AND 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 OR MAPPING CAMERA B. THE CSM OXYGEN SUPPLY, THE OPS, AND CRITICAL INSTRUMENTATION MUST ALL BE GO FOR EVA. C. ACTIVATION OF THE OPS DURING THE EVA WILL REQUIRE EXPEDITIOUS COMPLETION OF THE ACTIVITY BEING PERFORMED, FOLLOWED BY IMMEDIATE CM INGRESS. FIFTEEN MINUTES ON THE OPS WILL BE RESERVED FOR CM INGRESS AND REPRESSURIZATION. D. ALL RCS THRUSTER FIRE IN THE VICINITY OF THE TRANSFER PATH MUST BE INHIBITED. E. SPACECRAFT ATTITUDE AND ATTITUDE RATES MUST BE WITHIN LIMITS THAT ALLOW SAFE EVA OPERATIONS WITH SUFFICIENT SUNLIGHT THROUGHOUT THE PLANNED EVA PERIOD. F. A VACUUM TRANSFER WILL ONLY BE ATTEMPTED IN AN EMERGENCY. G. ALL SIM BAY POWER WILL BE DISABLED FOR THE EVA. H. THE EVA WILL BE INHIBITED FOR PROPELLANT LEAK.

R	ITEM	
	2-33	ALTERNATE MISSION

A. EO

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

2. CSM/LM - EO SCIENCE, INCLINATION CHANGE, ESTABLISH ORBIT FOR OPTIMUM SIM BAY PHOTOGRAPHY CONDITIONS.

B. LO

1. CSM ONLY - SIM BAY EXPERIMENTS. APPROXIMATELY 6-DAY STAY, 60 NM CIRCULAR ORBIT.

2. CSM/LM (NO LANDING CAPABILITY) - SIM BAY EXPERIMENTS. APPROXIMATELY 6-DAY STAY, 60 NM CIRCULAR ORBIT, DPS TEI.

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 CUT (TIME DEPENDENT)
		S-II GIMBAL ACTUATOR FAIRCOVER INBOARD PRIOR TO S-IVB TO CUT 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 CUT CAPABILITY)
		S-IVB COLD HE SHUTOFF VALVE(S) FAILED OPEN
		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 O2 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 PRESSURE (SOURCE OR MANIFOLD) 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

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MISSION RULES

SECTION 3 - MISSION RULE SUMMARY - CONTINUED

K	ITEM	
	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)
	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) *S-IVB RANGE SAFETY PROPELLANT DISPERSAL SYSTEM ARMS INADVERTENTLY AFTER INSERTION AND PRIOR TO SAFING *S-IVB LOX TANK PRESS IS GREATER THAN 50 PSI LOSS OF ATTITUDE CONTROL DURING TB5 (CREW DISCRETION) *S-IVB COMMON BULKHEAD DELTA PRESSURE EXCEEDS LIMITS *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--- INSUFFICIENT PROPELLANT REMAINS FOR ACHIEVING A TBD NM APOGEE ELLIPSE S-IVB ENGINE MAIN LOX VALVE FAILS TO CLOSE AT CUTOFF LOSS OF ATTITUDE CONTROL CONFIRMED ACTUATOR HARDOVER LOSS OF ENGINE HYDRAULIC FLUID MISALIGNMENT RATE BETWEEN THE IU AND IMU IS OUTSIDE LIMITS UNACCEPTABLE DIFFERENCES BETWEEN CMC AND IU PLATFORM VELOCITY COMPONENTS OR TOTAL VELOCITY AT INSERTION UNACCEPTABLE DIFFERENCE BETWEEN MSFN AND IU ORBITAL DECISION PARAMETERS

R	ITEM	
	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 DEG D. OVERBURN WHERE VI (CMC) EQUALS VI (PAD) PLUS 2 SECONDS
	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 SEPERATION (WITH 24-SEC RCS ASAP FROM THE S-IVB WILL BE DONE FOR LOSS OF S-IVB ATTITUDE CONTROL.
		RULES 3-17 THROUGH 3-20 ARE RESERVED.

R	ITEM	
		'TD AND E'
	3-21	TD AND E WILL NOT BE PERFORMED FOR--- A. PILOTS EVALUATION OF RATES AND ATTITUDES, AND SLA CONFIGURATION NOT ACCEPTABLE. B. THE SLV IS NO-GO FOR--- 1. VIOLATION OF S-IVB BULKHEAD DELTA P 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 AND 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

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 1+34	0 TO 642	DPS 2-HR DIRECT ABORT
	1+34 TO 1+55	642 TO 789	DPS 30-MIN DIRECT ABORT
	1+55 TO 1+57	789 TO 809	DPS TO DEPLETION 30-MIN DIRECT ABORT FOLLOWED BY AN APS BURN 2 HOURS LATER
II	1+57 TO 3+07	809 TO 1313	DPS 2-IMPULSE CIRCUMLUNAR ABORT
III	3+07 TO 6+32	1313 TO 2998	EXECUTE TEI (SPS OR DPS) AT NEXT OPPORTUNITY OR INITIATE ALTERNATE MISSION

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

B. CONTROL LIMITS APPLY AS FOLLOWS---

LOI DELTA T	LOI DELTA V	LIMITS
0 TO 1+34	0 TO 642	TIGHT
1+34 TO 3+50	642 TO 1641	LOOSE
3+50 TO C/O	1641 TO 2998	TIGHT

NOTE

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

NOTE

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

RULES 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. D. PREDICTED ALTITUDE AT PDI IGNITION LESS THAN 30,000 FT OR GREATER THAN 70,000 FT (PREDICTIONS WILL BE BIASED USING EXPECTED/CALCULATED WORST CASE PROPOGATION ERRORS). NOTE WHEN POSSIBLE ANY REQUIRED MANEUVERS(S) WOULD BE SCHEDULED SHORTLY AFTER CREW WAKE-UP ON PDI DAY.
	3-39	DOI RESIDUALS--- A. UNDERBURNS (POSITIVE RESIDUALS) WILL NOT BE TRIMMED. B. FOR OVERBURNS (NEGATIVE RESIDUALS), TRIM G AND N AXIS TO WITHIN 1 FPS. 1. FOR OVERBURNS LESS THAN 2.2 FPS, TRIM TO -1 FPS WITHIN THE -X SM RCS THRUSTERS 2. FOR OVERBURNS GREATER THAN 2.2 FPS BUT LESS THAN 10 FPS, PITCH 180 DEGREES AND TRIM TO FPS USING +X SM RCS THRUSTERS 3. RESIDUALS GREATER THAN 10 FPS WILL BE TRIMMED USING SPS C. IF EITHER THE G AND N HAS OBVIOUSLY MALFUNCTIONED, THE NEGATIVE RESIDUAL INDICATED BY THE EMS WILL BE TRIMMED.
	3-40	DOI TRIM MANEUVER RESIDUALS--- A. TRIM THE IN-PLANE HORIZONTAL RESIDUALS (UNDERBURNS AND OVERBURNS) TO ± 2 FPS. B. FOR OVERBURN RESIDUALS (IN-PLANE HORIZONTAL) 1. GREATER THAN 3.2 FPS BUT LESS THAN 10 FPS, PITCH 180 DEGREES AND TRIM TO 2 FPS WITH SM RCS +X THRUSTERS 2. GREATER THAN 10 FPS, THE SPS WILL BE USED TO TRIM C. IF THE G&N HAS OBVIOUSLY MALFUNCTIONED, THE EMS WILL BE UTILIZED TO TRIM THE IN-PLANE HORIZONTAL RESIDUAL. D. OUT-OF-PLANE AND RADIAL RESIDUALS WILL NOT BE TRIMMED.

R	ITEM	
	3-41	AT AOS AFTER DOI AND THE DOI TRIM MANEUVER, THE REQUIREMENT FOR THE BAILOUT MANEUVER WILL BE DETERMINED BY EVALUATION OF THE THREE TRAJECTORY MONITORING SOURCES. THESE SOURCES - G AND 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 THE G&N IS AVAILABLE, IT MUST INDICATE STAY TO REMAIN IN THE LOW ORBIT. 3. IF THE EMS RESIDUAL IS TRIMMED DUE TO CREW OBSERVATION OF A G&N MALFUNCTION, THE BAILOUT MANUVER WILL BE EXECUTED AT THE NOMINAL TIME. NOTE---- 1. THE EMS VOTE IS NO STAY IF THE EMS INDICATES A 6-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 GREATER THAN 1.0 NM ABOVE THE LUNAR TERRAIN. THIS ALTITUDE CORRESPONDS TO A PERICYNTHION ALTITUDE OF TBD NM AND DOPPLER RESIDUALS AT AOS OF TBD CYCLES PER SECOND.
	3-42	THE FOLLOWING RNDZ/RESCUE OPTIONS WILL BE UTILIZED AS NECESSARY FOR FAILURES REQUIRING TERMINATION OF LUNAR LANDING--- A. FOR FOLLOWING RN A. FOR FAILURES FROM CIRCULARIZATIONTO CIRCULARIZATION PLUS 1 HR, EXECUTE THE PDI ZERO ABORT SEQUENCE WITH DOCKING IN ABOUT 3-1/4 HR. B. FOR FAILURES FROM CIRCULARIZATION PLUS 1 HR TO PDI, EXECUTE THE NO PDI + 12 ABORT SEQUENCE WITH DOCKING IN ABOUT 5-1/4 HR. C. ABORT DURING POWERED DESCENT WILL INSERT THE LM INTO ORBIT UTILIZING THE ONBOARD AVARIABLE ABORT TARGETING. FOR ABORTS DURING THE FIRST 6 MIN 10 SEC, DOCKING SHOULD OCCUR WITHIN 5-1/4 HR. FOR ABORTS AFTER 6 MIN 10 SEC, DOCKING WILL OCCUR WITHIN 3-1/4 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 3-43 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
	3-50	LR DATA IS REQUIRED FOR LANDING--- A. LOCK ON 1. LR CONVERGENCE (ALTITUDE ONLY) - DATA NOT BEING ACCEPTED OR CONVERGING FOLLOWING LOCK-ON FOR 60 SECONDS - ABORT 2. LR DATA ACCEPTED AND CONVERGED CONTINUOUS TO P64 - CONTINUE MISSION IF LOSS OF LOCK OCCURS IN P64. 3. 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 (B) LANDING RADAR NOT REGAINED IN P64 - ABORT 4. 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 THE AGS-PGNS RADIAL VELOCITY DIFFERENCE TO EXCEED -10 FPS - ABORT 2. PGNS ALTITUDE LESS THAN 18,000 FEET AND PGNS NAVIGATION ERRORS, CONVIRMED 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) CONFIRMED PGNS CROSSRANGE VELOCITY ERROR (DELTA Y DOT) EXCEEDS +40 FPS (SOUTH) - ABORT (B) RAIDAL N69 NOT INCORPORATED - ABORT 4. PGNS ALTUTUDE LESS THAN 6,000 FEET---ABORT

R	ITEM	
	3-51	POWERED DESCENT WILL BE TERMINATED FOR THE FOLLOWING---

A. PGNS NAVIGATION ERRORS, CONFIRMED BY MSFN OR DOPPLER RESIDUALS, THAT RESULTS IN THE FOLLOWING AGS-PGNS VELOCITY DIFFERENCE---

DELTA X DOT (DOWNRANGE) GREATER THAN + TBD OR -45 FPS

DELTA Y DOT (CROSSRANGE) GREATER THAN ±90 FPS

DELTA Z DOT (RADIAL) GREATER THAN +TBD OR -35 FPS

B. PGNS NAVIGATION ERRORS, CONVIRMED BY DOPPLER RESIDUAL BUT NOT BY AGS, THAT RESULT IN THE FOLLOWING MSFN-PGNS VELOCITY DIFFERENCES---

DELTA Y DOT (CROSSRANGE) GREATER THAN ±200 FPS

DELTA Z DOT (RADIAL) GREATER THAN + TBD OR - 35 FPS

C. COMMANDED THRUST INCREASING PRIOR TO THROTTLE-DOWN OR P63 TGO = 80 SEC.

D. NO THROTTLE RECOVERY BY P63/P64 PROGRAM SWITCH PLUS 15 SEC

E. FAILURE TO ACHIEVE FTP BY NOMINAL TIG +31 SEC (ABORT AT GTC DIVERGENCE.)

F. FAILURE TO ENTER P64 WHEN TGO EQUALS 60 SECONDS

G. THE FOLLOWING PGNS ALARMS---20105,00214, 20430,20607,21103,20607,01107,21204,21302,21401,00402 (CONTINUING)

H. VIOLATION OF THE TIME BIASED DPS ABORT BOUNDARY

I. NO THROTTLE RECOVERY 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.

RULE NUMBER
3-53 IS RESERVED.

R	ITEM
--	-----

'LUNAR SURFACE EVA PHASE'

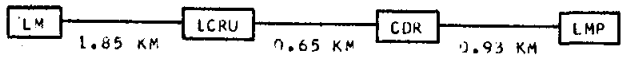
3-54 CONSTRAINTS AND OPTIONS

A. PLSS WALK-BACK CONSTRAINTS WILL INCLUDE A 10-MINUTE ALLOWANCE FOR THE CREW TO ASSEMBLE THE EQUIPMENT DESIRED TO RETURN TO THE LM AND 13 MINUTES FOR EVA CLOSE-OUT AND WILL BE BASED ON A WALKING RATE OF 3.3 KM/HR.

B. VARIOUS COMBINATIONS OF AVAILABLE EQUIPMENT AND CAPABILITY WILL BE UTILIZED AS REQUIRED TO ACCOMPLISH TRAVERSE OBJECTIVES (E.G., DRIVING THE LRV PART WAY AND WALKING THE REST, USE OF PLSS COMM RELAY AS A HALFWAY STATION ALLOWING ONE CREWMAN TO GO FURTHER, CARRYING THE LCRU, ETC.).

C. THE FOLLOWING CHARTS SUMMARIZE THE TRAVERSE DISTANCE CONSTRAINTS FOR THE NOMINAL EVA PLAN (NUMBERS TBD).

1. COMMUNICATIONS (VHF TRANSMISSION RANGE ASSUMING LEVEL SURFACE WITH LUNAR RADIUS OF CURVATURE)



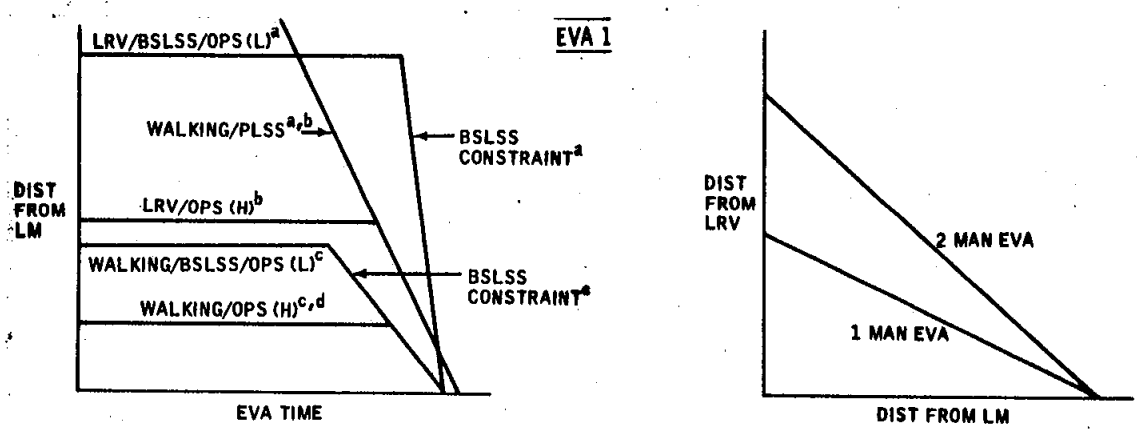
USING THIS RELAY TECHNIQUE, THE MAXIMUM TRAVERSE DISTANCE FROM THE LM IS APPROXIMATELY 3.4 KM.

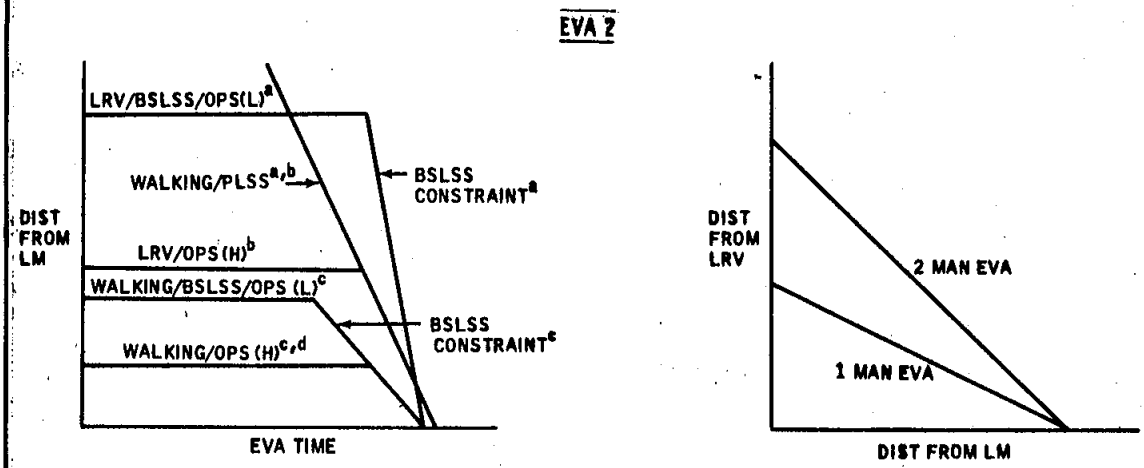
2. EMU CONSUMABLES - SEE FOLLOWING PAGE

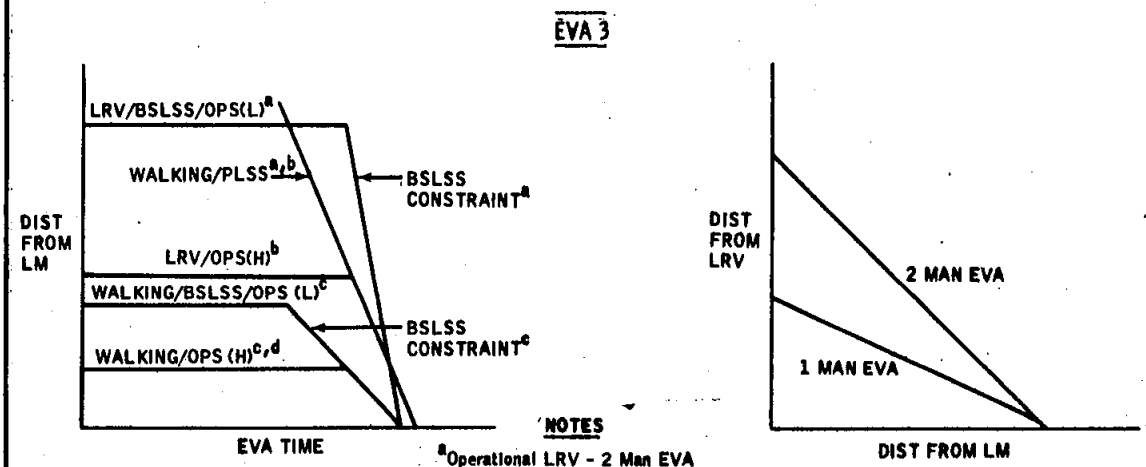
D. THE PREMISSION ESTIMATES USED IN DEFINING THE OPERATIONAL ENVELOPE, BSLSS RIDEBACK AND NORMAL RIDEBACK LIMITS, WILL BE UPDATED AS NECESSARY DURING THE TRAVERSE BASED ON A REAL-TIME ASSESSMENT OF MOBILITY AND CONSUMABLES.

REV	ITEM

EMU CONSUMABLES







NOTES

[a] Operational LRV - 2 Man EVA
[b] Operational LRV - 1 Man EVA
[c] LRV not available - 2 Man EVA
[d] LRV not available - 1 Man EVA

R	ITEM
	3-55

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, IF ITS SPEED IS APPROXIMATELY THE AVERAGE WALKING SPEED, BECAUSE OF ITS SCIENCE AND EQUIPMENT PAYLOAD CAPABILITY AND ITS ABILITY TO REDUCE METABOLIC RATES.

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 EXPERIMENTS IN AND FACING THE SUN.

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 SUBPALLET FROM PACKAGE 1 AND PACKAGE 2. CARRY PACKAGE 1 TO EMPLACEMENT SITE (DO NOT DEPLOY). CONNECT RTG CABLE TO C/S (DO NOT ACTUATE SWITCHES).

5. CONNECT SIDE CABLE AND HFE CABLE TO C/S. REMOVE PSE, SWS, AND LSM FROM SUBPACKAGE 1. ALIGN C/S AND RAISE SUNSHIELD. MOUNT ANTENNA MAST, GIMBAL AND ANTENNA. LEVEL AND ALIGN ANTENNA. DEPRESS SHORTING PLUG AND ROTATE ASTRO SWITCH 1 CLOCKWISE ON WAY BACK TO LM.

6. DEPLOY ALSEP EXPERIMENTS AND COMPLETE TASKS. A HOLD POINT EXISTS AFTER EACH EXPERIMENT IS DEPLOYED. DEPRESS SHORTING PLUG SWITCH AND ROTATE ASTRO SWITCH 1 CLOCKWISE ON WAY BACK TO LM.

E. EMU FAILURES

1. <u>TERMINATE EVA</u>

FOR THE FOLLOWING EMU FAILURES, THE CREW WILL CLOSE OUT THE ACTIVITY IN WHICH THEY ARE ENGAGED (5 TO 10 MINUTES), RETURN TO THE LM, AND EXPEDITIOUSLY COMPLETE CLOSEOUT ACTIVITIES---

(A) EMU REG PRESSURE LESS THAN 3.75 BUT MORE THAN 3.4 PSID

(B) LOSS OF THERMAL CONTROL

(C) LOSS OF PRIMARY OXYGEN SYSTEM

(D) LOSS OF CRITICAL INSTRUMENTATION

2. <u>TERMINATE EVA IMMEDIATELY</u>

FOR THE FOLLOWING EMU FAILURES, THE CREW WILL CEASE THEIR SURFACE ACTIVITIES AND IMMEDIATELY INGRESS AND REPRESSURIZE THE LM---

(A) EMU REG PRESSURE LESS THAN 3.4 PSID

(B) LOSS OF VENTILATION

(C) CONTAMINATION IN VENTILATION SYSTEM

(D) LOSS OF PLSS POWER

R	ITEM	
	3-56	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 CONNECTIONS.
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.

B. IF IT IS NECESSARY TO CURTAIL EVA TASKS, THEY WILL BE DELETED IN ACCORDANCE WITH THE FOLLOWING SPECIFIC TASK PRECEDENCE LISTING---

TBD

C. 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.

3-57 LRV SYSTEMS/NAVIGATION

A. THERE ARE NO MINIMUM LRV SYSTEMS REQUIREMENTS WHICH WOULD CAUSE ABANDONMENT OF THE LRV IF CREW EVALUATION OF THE FOLLOWING ARE PROTECTED---

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 CAPABILITIES IS REQUIRED FOR A RETURN TRAVERSE---

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

3-58 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 MONITERING 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. FOR APOLLO 15 THE MAXIMUM LOSS OF COMM WOULD BE APPROXIMATELY 30 MIN.

B. WHEN LCRU PROBLEMS PREVENT SIMULTANEOUS TV, VOICE, AND PLSS TM DATA, A TV SCAN MAY BE MADE AT EACH GEOLOGICIAL STOP. HOWEVER, VOICE AND PLSS TM DATA WILL HAVE PRIORITY AFTER THE SCAN.

C. THE MAXIMUM TIME OF CONTINUOUS OPERATION USING THE LCRU IN THE HAND-CARRY MODE WILL BE LIMITED TO TBD RESULTING FROM THERMAL CONSTRAINTS.

NOTE

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

R	ITEM	
	3-58	D. 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 TO 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. IF THE THERMAL CONSTRAINTS ON THE CAMERA OPERATING TIME IN THE MESA ARE VIOLATED, THE GROUND WILL REQUEST THE CAMERA BE TURNED OFF.

5. 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.

R	ITEM	
	3-59	ALSEP A. IF THE SIDE DUST COVER OR CCIG DUST COVER COMES OFF DURING DEPLOYMENT, THE CREW WILL NOT ATTEMPT TO REPLACE. B. ALSEP SHORTING PLUG SWITCH AND ASTRONAUT SWITCH 1 WILL BE ACTIVATED IN THIS ORDER ASAP AFTER DEPLOYMENT. C. IF THE GROUND IS UNABLE TO COMMAND TRANSMITTER A "ON" AND/OR EXPERIMENTS "ON", THE GROUND WILL REQUEST THE ASTRONAUT TO TURN ON ASTRONAUT SWITCHES 2 AND/OR 3. D. IF THE CREW MUST RETURN TO THE LM PRIOR TO COMPLETE ALSEP DEPLOYMENT, THE SHORTING PLUG SWITCH AND ASTRONAUT SWITCH 1 WILL BE ACTIVATED "ON" IF THE ANTENNA IS EMPLACED. IF THE ANTENNA IS NOT EMPLACED, THESE SWITCHES WILL NOT BE ACTIVATED (PICK UP HERE ON EVA 2). E. THE DRILL CORE STEM WILL HAVE PRIORITY OVER THE HFE BORE HOLES. THE HFE BORE HOLES WILL BE ATTEMPTED FIRST. EFFORTS WILL BE TERMINATED AFTER 20 MINUTES SHOULD PROBLEMS ARISE. HFE BORE HOLES WILL NOT BE ATTEMPTED AFTER THE ADAPTER HAS BEEN REMOVED FROM THE DRILL. F. 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 THIRD STEM SECTION IS NOT ATTACHED, WITHDRAW AND START AT A DIFFERENT LOCATION FOR MAXIMUM OF TWO WITHDRAWALS. 2. IF THIRD STEM IS ATTACHED, CONTINUE UNTIL 10 MINUTES OF POWER "ON" TIME FOR THE DRILL STRING HAS ELAPSED. G. UNABLE TO DRILL NORMAL HFE BORE HOLES. THE FOLLOWING SHOULD BE ACCOMPLISHED--- 1. IF THE HOLE IS NOT DEEP ENOUGH TO EMPLACE HFE PROBES, LAY THE PROBE HORIZONTAL ON THE LUNAR SURFACE AND COVER THE PROBE AND FIRST 6 FEET OF CABLE WITH SOIL TO A DEPTH OF SEVERAL INCHES. 2. IF THE HOLE IS NOT NORMAL DEPTH, ADD ONE DRILL STRING TO SUPPORT PROBE IF NECESSARY AND PLACE PROBE IN HOLE AS FAR AS IT WILL GO. RULE NUMBERS 3-60 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. 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 NAUTICAL MILES (C) AGS PREDICTED INSERTION WEDGE ANGLES GREATER THAN 1.0 DEG (DESCENT ABORT CASE OR COELLIPTIC SEQ RNDZ) GREATER THAN 0.5 DEG (SHORT RNDZ) 3. CONFIRMED PGNS NAVIGATION ERRORS THAT RESULT IN THE FOLLOWING MSFN PGNS VELOCITY DIFFERENCES--- (A) DELTA VX (DOWN RANGE) GREATER THAN +/- 24 FPS (B) DELTA VY (CROSS RANGE) GREATER THAN +/- 90 FPS (COELLIPTIC SEQ RNDZ) GREATER THAN +/- 45 FPS (SHORT RNDZ) (C) DELTA VZ (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 PLUG 40 NM 3. PGNS PREDICTED INSERTION WEDGE ANGLE GREATER THAN 1.0 (COELLIPTIC SEQ RNDZ) GREATER THAN 0.5 DEG (SHORT 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. WEDGE ANGLE AT LIFT-OFF LESS THAN 0.5 DEG. 3. NO VIOLATION OF THE NAVIGATION REQUIREMENTS (REFERENCE MATRIX PAGE 3-18) B. AT INSERTION (PRE-TWEAK) THE FOLLOWING IS REQUIRED--- 1. TWEAK DELTA V LESS THAN 60 FPS 2. POST-TWEAK H_p GREATER THAN 5 NM 3. NO VIOLATION OR THE NAVIGATION REQUIREMENTS (REFERENCE MATRIX PAGE 3-18). (NOTE---WITH THE EXCEPTION OF COMPUTERS, NO ONBOARD NAVIGATION SYSTEMS ARE VERIFIED AFTER LIFT-OFF)

ACCEPTABLE COMBINATIONS OF G&N SYSTEMS NEEDED FOR SHORT RDZ

COMPUTERS (G+N)			RR			VHF			OPTICS/LITES					
LGC	AEA	CMC	RR	TAPE-METER /RR	LGC/ RR	VHF	VHF/ CMC	VHF/ EMS	LM COAS	CSM LITE	CSM COAS	LM LITE	SXT	ACCEPTABLE COMBINATIONS OF NAV TECH
R_1	R_2		R_1		R_1	R_2	(R_2)	(R_2)	R_2	R_2				1. PGNCS+RR 2. AGS+VHF
R_1		R_2	R_1		R_1							R_2	R_2	1. PGNCS+RR 2. GNCS+SXT
R_1		R_2	R_1		R_1	R_2	R_2				(R_2)	REFLECT-ED LIGHT	(R_2)	1. PGNCS+RR 2. GNCS+VHF
	R_1	R_2	R_1	R_1								R_2	R_2	1. AGS+RR 2. GNCS+SXT
	R_1	R_2	R_1	R_1		R_2	R_2				(R_2)	REFLECT-ED LIGHT	(R_2)	1. AGS+RR 2. GNCS+VHF
	R_1	R_2				R_1	(R_1)	(R_1)	R_1	R_1		R_2	R_2	1. AGS+VHF 2. GNCS+SXT

1. R indicates that the system is required for the NAV technique to be available.
2. The numbers indicate which technique the system is required for.
3. The acceptable combinations of NAV techniques maintain two independent NAV methods.
4. EITHER SOURCE is adequate for ( ) cases.

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 A. ATTITUDE/RATES CONSTRAINTS--- THE SUN LOOK ANGLES WILL BE MAINTAINED AT THETA 145 DEGREES, PHI 350 DEGREES ± TBD DEGREES. B. SIM BAY CONSTRAINTS--- 1. A FAILURE OF ANY EXPERIMENT COVER OR EXTENSION MECHANISM WILL NOT PRECLUDE AN EVA FOR FILM RETRIEVAL. 2. FAILURE OF THE SATELLITE TO CLEAR THE LAUNCHER, FOLLOWING A VALID ONBOARD LAUNCH INDICATION (TB - GREY) WILL PRECLUDE THE NOMINAL CMP EVA.

R	ITEM	
		'MANEUVERS'
	3-85	THE FOLLOWING GUIDELINES WILL APPLY TO LM MANEUVERS--- A. TRIMMING 1. DESCENT ABORTS/ASCENT (A) WITH COMM - TRIM CONTROLLING SYSTEM UNLESS GROUND ADVISES DIFFERENTLY. (B) WITHOUT COMM - TRIM CONTROLLING SYSTEM UNLESS PGNS/AGS VX 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 DELTA V AGS GREATER THAN 10 FPS 2. DPS TEI - 10 SEC AND DELTA V AGS GREATER THAN 2 FPS 3. DPS LCI ABORTS - 10 SEC AND DELTA V AGS GREATER THAN 2 FPS NOTE--- A CMC DELTA V 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, TRIMMING REQUIREMENTS, AND SPS ENGINE LIMITS FOR ALL SPS MANEUVERS.
		RULE NUMBERS 3-87 THROUGH 3-89 ARE RESERVED.

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[a b]
LOI	TIGHT[h]				START			NO
a. MODE I								
0 TO 1 + 34		TIGHT	10/10	COMPLETE			YES	
1 + 34 TO 1 + 55		LOOSE	10/10	COMPLETE			YES	
1 + 55 TO 1 + 57		LOOSE	10/10	COMPLETE			YES	
b. MODE II		LOOSE	10/10	COMPLETE			YES	
c. MODE III								
3 + 07 TO 3 + 50		LOOSE	10/10	COMPLETE			YES	
3 + 50 TO C/O		TIGHT[h]	10/10	COMPLETE		10 SEC	V_{GO} > 50 AND G&N GO	
DOI	TIGHT[i]	TIGHT[i]	10/10	TERMINATE	DELAY	BT	NO	j
DOI TRIM MANEUVER	TIGHT[i]	TIGHT[i]	10/10	TERMINATE	DELAY	BT	NO	K
CIRC	TIGHT[i]	TIGHT	10/10	TERMINATE	DELAY	1 SEC	NO	X = 1.0 Y = 0.2
RESCUE	LOOSE	LOOSE	10/10	COMPLETE	START	1 SEC	ΔV TOGO > 12	ALL = 0.2
LOPC	TIGHT[i]	TIGHT	10/10	TERMINATE	DELAY	1 SEC	NO	Y = 1.0
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								
a. CORRIDOR	LOOSE	LOOSE	10/10	COMPLETE	DELAY	1 SEC AND ΔV_C = 0	NO	X = 0.2
b. IP CONTROL	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 DEORB	LOOSE[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. MCC_4: Trim X to 1.0 fps.

b. Trim all MCC (except MCC_4) only if X ≤ 2 fps.

c. See Rule 5-131.

d. Both prop tank pressures ≥ 140; one GN_2 tank press ≥ 400 if SM-RCS deorbit is available.

e. See Rule 5-27.

f. Some limits may 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. If indication of ball valve failure while thrusting, shut down good bank to verify failure. If thrusting continues, reenable good bank. For DOI or DOI trim, apply only when bringing second bank on line.

j. See Rule 3-39.

k. See Rule 3-40.

R	ITEM	

SIM BAY SCIENCE

3-90 GENERAL

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

1. GAMMA-RAY SPECTROMETER (GRS)
2. X-RAY FLUORESCENCE
3. ALPHA PARTICLE SPECTROMETER
4. SM ORBITAL PHOTOGRAPHIC TASKS
5. SUBSATELLITE (P&FS)
6. MASS SPECTROMETER

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

1. THERMAL MONITORING AND THERMAL MANAGEMENT OF THE SIM BAY
2. PERIODIC ADVANCEMENT OF THE PANORAMIC AND MAPPING CAMERA FILM

C. 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.

D. AFTER SIM DOOR JETTISON, THE CSM ATTITUDE WILL BE CONSTRAINED TO KEEP DIRECT SUNLIGHT FROM ENTERING THE EXPERIMENT SUN-AVOIDANCE ENVELOPES.

E. ALL EXPERIMENT COVERS WILL BE CLOSED FOR THE FOLLOWING CONDITIONS AFTER SIM DOOR JETTISON---

1. ACTIVATION OF SM RCS JETS A2, A4, B1, OR B4 (ALSO C1 AND C3 FOR MASS SPECTROMETER
2. SPS BURNS
3. WATER AND URINE DUMPS (MASS MAY BE FULLY EXTENDED BUT OFF)
4. FUEL CELL PURGES (MASS MAY BE FULLY EXTENDED BUT OFF)
5. VIOLATION OF THE SUN-AVOIDANCE ENVELOPE
6. EVAPORATOR OPERATION
7. CMP EVA

F. SM RCS THRUSTERS A2,A4,B1, AND B4 WILL BE DISABLED DURING ALL EXPERIMENT OPERATIONS WITH THRUSTERS C1 AND C3 ALSO DISABLED DURING MASS SPECTROMETER OUTGASSING AND OPERATION.

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

H. THERE ARE TWO AVAILABLE CUES ON BOOM POSITION. THESE ARE THE APPROPRIATE BOOM TALKBACK INDICATOR AND VISUAL VERIFICATION FROM AN UNDOCKED LM. ANY BOOM THAT CANNOT BE VERIFIED AS RETRACTED BY ONE OF THESE MEANS WILL BE ASSUMED TO BE EXTENDED BEYOND 18 INCHES.

I. 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.

J. IF REQUIRED, JETTISON OF THE SUBSATELLITE DURING TLC OR TEC WILL BE DONE IN ACCORDANCE WITH THE FOLLOWING CRITERIA---

TBD
TBD

K. CORRECTIVE ACTION FOR ANY EXPERIMENT MALFUNCTION WILL REQUIRE CREW PARTICIPATION. THE CREW WILL BE AWAKENED TO SUPPORT THIS EFFORT WITHIN THE MISSION CONSTRAINTS.

R	ITEM	
	3-91	OPTICS MANAGEMENT A. THE FILM IN THE PANORAMIC AND MAPPING CAMERAS WILL BE CYCLED AT INTERVALS OF 24 +/- 6 HOURS. THE CAMERAS AND SDS SYSTEM WILL BE ACTIVATED TO MONITOR THESE FUNCTIONS. B. THE PANORAMIC-CAMERA (PC) LENS-STOW POSITION WILL BE VERIFIED PRIOR TO SIM-DOOR JETTISON AND PRIOR TO INITIATING THERMAL PRECONDITIONING OF THE PANORAMIC CAMERA. ADDITIONAL STOW VERIFICATIONS WILL BE SCHEDULED AS REQUIRED. C. THE BOOM SPECTROMETERS WILL NORMALLY BE FULLY RETRACTED ON SURFACE PHOTOGRAPHY PASSES. BOOM EXTENSIONS UP TO 18 INCHES DURING PANORAMIC CAMERA OPERATION AND 29 INCHES DURING MAPPING CAMERA OPERATION ARE ACCEPTABLE. D. TOTAL FAILURE OF THE GN_2 SYSTEM WILL NOT PRECLUDE ATTEMPTS TO OPERATE THE MC AND PC.
	3-92	BOOM MANAGEMENT A. THE FIRST TIME THE SPECTROMETER BOOMS ARE USED THE INTEGRITY OF THE RETRACT FUNCTION WILL BE VERIFIED PRIOR TO EXTENDING THE BOOM BEYOND 18 INCHES. IF THE RETRACT CAPABILITY HAS BEEN LOST, THE FIRST EXTENSION WILL BE DELAYED UNTIL IMMEDIATELY AFTER THE CIRCULARIZATION MANEUVER. B. ANY BOOM EXTENDED BEYOND 18 INCHES THAT WILL NOT RETRACT WILL BE JETTISONED PRIOR TO ANY SPS MANEUVER. C. THE GRS BOOM WILL NOT BE JETTISONED TO ACHIEVE AN 'ON-TIME' SUBSATELLITE LAUNCH, BUT WILL EVENTUALLY BE JETTISONED TO CLEAR THE P AND FS LAUNCH ENVELOPE. D. A SPECTROMETER BOOM WILL NOT BE JETTISONED TO REMOVE AN OBSTRUCTION FROM THE CAMERA FOV'S.
	3-93	MASS SPECTROMETER MANAGEMENT A. THE MASS SPECTROMETER (MS) BOOM WILL BE FULLY EXTENDED BEFORE THE MS FILAMENTS ARE POWERED. B. DURING MS OUTGASSING, THE MS INSTRUMENTATION WILL BE POWERED. C. THE ION-SOURCE HEATER OPERATION WILL BE INHIBITED FROM 15 MINUTES BEFORE UNTIL 1 HOUR AFTER A WASTE WATER DUMP, URINE DUMP, OR FUEL-CELL PURGE. D. DATA COLLECTION WILL BE INHIBITED FROM 5 MINUTES BEFORE UNTIL 2 HOURS AFTER A WASTE WATER DUMP, URINE DUMP, OR FUEL-CELL PURGE. E. SM RCS THRUSTERS A2,A4,B1,B4,C1, AND C3 WILL BE INHIBITED DURING ION-SOURCE HEATER OPERATION AND DATA COLLECTION.
	3-94	GAMMA RAY SPECTROMETER MANAGEMENT THE GRS WILL BE ADJUSTED TO MINIMUM SENSITIVITY AT TURN ON IF THE UNSTAGED LM IS DOCKED TO THE CSM.
	3-95	X-RAY/ALPHA SPECTROMETER MANAGEMENT WHILE IN LUNAR ORBIT THE X-RAY AND ALPHA PARTICLE SPECTROMETERS WILL BE CALIBRATED ONCE EACH OPERATIONAL DAY BY POINTING THE LUNAR DETECTORS AT DEEP SPACE FOR 15 MINUTES ON THE DARK SIDE OF THE MOON.
	3-96	SUBSATELLITE MANAGEMENT A. THE P AND FS WILL BE LAUNCHED NORTHWARD PERPENDICULAR TO THE ECLIPTIC PLANE. B. SUBSATELLITE LAUNCH WILL NOT BE ATTEMPTED WITH THE GRS SPECTROMETER BOOM EXTENDED. C. SUBSATELLITE LAUNCH WILL NOT BE CONSTRAINED BY THE FAILURE OF EXPERIMENT COVERS.
		RULE NUMBERS 3-97 THROUGH 3-105 ARE RESERVED

SATURN LAUNCH VEHICLE GO/NO-GO CRITERIA

5/3/71

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 + 66 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 BEFORE TWR JETT	AFTER TWR JETT			
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) THESE LIMITS INVALID FOR AN ENGINE OUT PRIOR TO 50 SEC.

LEGEND: NO REQUIREMENT

CSM EECOM GO CRITERIA
5/3/71

	EARTH ORBIT			TLC			CONT L.O./DOI	UNDOCK AND SEP	CIRC	POWERED DESCENT		LUNAR STAY		LUNAR ORBIT		TEC
	CONT BOOST	CONT E.O.	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 CABIN →				← NO FIRE OR SMOKE IN CABIN					(2) →			← NO F OR S IN CAB		→	NO F OR S IN CAB
NO O_2 MANIFOLD LEAKS	← (7*) NO O_2 LEAKS →				← NO O_2 MANIFOLD LEAKS →									NO O_2 MANIF LEAK		NO LKS
MAIN O_2 REGULATORS	← (7*) 1 OF 2 →		1 OF 2		← 1 OF 2 →									1 OF 2		BOTH (8)
ECS COOLANT LOOPS		1 OF 2 (5)	PRIMARY		← (1) PRIMARY (1) →		← (1)	(1) - PRIMARY - (1)		(1) →			PRIMARY (1)	PRIMARY (1)		PRIMARY
ECS RADIATORS		1 OF 2 (5)	PRIMARY		← (1) PRIMARY (1) →		← (1)	(1) - PRIMARY - (1)		(1) →			PRIM (1)	PRIMARY (1)		
ECS GLYCOL EVAPS																
SUIT INTEGRITY	SI (7*)							SI								SI
NO GLYCOL LEAK		← NO LEAK →			← NO GLYCOL LEAK					→			← NO GLY LEAK		→	NO LKS
NO EXCESS HUMIDITY		← NO HUMID →			← NO EXCESSIVE HUMIDITY					(2) →			← NO HUMID		→	NO HUMID
POTABLE & WASTE H_2O TK																
SURGE TR/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 0	2 OF 3	2 OF 3		← 2 OF 3 →								← 2 OF 3 →		2 OF 3 (11)	1 OF 3
AUX BATTERY	1 + 0															
ENTRY BATTERIES	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		← BATT RELAY BUS →			← BAT RELAY BUS					→			← BAT RELAY BUS		→	
INVERTERS	1 OF 3 (9)	← 2 OF 3 →			← 2 OF 3					(2) →			← 2 OF 3		→	2 OF 3
AC ΦA (1 AND 2)	1 OF 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 →											

(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 IF 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 IF OTHER 2 TANKS MEET REDLINE CRITERIA

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

(12) 1 OF 2 SUIT COMPRESSORS OR VACUUM CLEANER

LEGEND: ■ NO REQUIREMENTS

CSM GNC GO CRITERIA
5/3/71

GO/NO-GO ITEM	EARTH ORBIT			TLC			LUNAR ORBIT (BEFORE UNDOCKING)			UNDOCK	CIRC	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			PDI	PDI TO TD	PAST TI	PAST T3 & SUBS	CONT L.O.	LM JETT	CSM EVA
GNCS/SCS							REFER TO MR 3-86											
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	1OF2 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 →								1 OF 2		
THC		← THC →							← THC →									
RHC		← 1 OF 2 →				1 OF 2		← 1 OF 2 →								1 OF 2		
EMS																		
CMC			CMC			CMC	CMC OR DPS	← CMC →							← CMC →		CMC	
ISS			ISS			ISS		← ISS →							← ISS →		ISS	
OSS									← OSS OR VHF →									
OPTICS DAC			O-DAC			O-DAC	O-DAC OR DPS	← O-DAC →							← O-DAC →			
NO SOLENOID DR GND																		
TVC SERVO LOOP		1 OF 2	BOTH			(6)	1 OF 2 AND DPS	← BOTH →							← BOTH →			
DSKY			1 OF 2			1 OF 2	1 OF 2 AND DPS	← 1 OF 2 →							← 1 OF 2 →		1 OF 2	
SPS																		
FU/OX TANK (W/O LEAK)		← FU/OX →				FU/OX		← FU/OX TANK →						← FU/OX TNK →				FU/OX/TK
GN_2 TANK (W/O LEAK)		1 OF 2	BOTH			1 OF 2 AND DPS	1 OF 2 AND DPS	← BOTH →							← BOTH →			
BALL VALVE BANK		1 OF 2	BOTH			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	N/A			>70		← >70 →										
ULLAGE CAPABILITY			ULLAGE						← ULLAGE →									
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			4 OF 4	3OF4	← ALL →							← 3 OF 4 →		← 4 OF 4 →	
PKG TEMP >55°		3 OF 4	ALL			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)	1 OF 2 MODE 1	←		BOTH	→			← BOTH →							← BOTH →	← BOTH →	← ONE →	
MANIFOLD (W/O LEAK)	1 OF 2 MODE 1	←		BOTH	→			← BOTH →							← BOTH →	← BOTH →	← ONE →	← BOTH →
NOT ARMED		←		NOT ARMED	→													

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

(2) MUST HAVE SUFFICIENT ULLAGE FOR DEORBIT

(3) AUTO OR MANUAL IN 3 AXIS

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

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

(6) 3 OF 4 TOTAL REQUIRED, CHANGE REFSMMAT IF NECESSARY TO KEEP REDUNDANCY IN YAW

NOTE

1 T_2 NO STAY CONDITIONS NONE

LEGEND: ■ NO REQUIREMENT

LM TELMU GO CRITERIA
5/3/71

GO/NO-GO ITEM	UNDOCK	CIRC	POWERED DESCENT: PDI	POWERED DESCENT: PDI TO PDI + 6:10	POWERED DESCENT: PDI + 6:10 TO HI GATE	POWERED DESCENT: HI GATE TO T/D	LUNAR STAY: STAY W/O EVA	LUNAR STAY: 2-MAN EVA	LUNAR STAY: 1-MAN EVA	RENDEZVOUS LM ACTIVE: LM ACTIVE	RENDEZVOUS LM ACTIVE: LM ACTIVE	DOCKING
PYRO												
BAT VOLT > TBD VDC, AND 1. NOT DEGRADING	BOTH (9)					(9)						
2. ARMING RELAY (K1) INTEGRITY (5)	BOTH ABLE TO ARM AND DE-ARM (10)					(10)	BOTH ABLE TO ARM					
3. STAGING RELAYS (K2-K6) INTEGRITY	BOTH			(11)	(11)	(11)						
ELECTRICAL												
1. CDR AND LMP BUS (1)	BOTH		BOTH								1 OF 2	
2. DC FEEDERS (1) (2) **** DESCENT	BOTH				BOTH							
2. DC FEEDERS (1) (2) **** ASCENT	BOTH		BOTH								1 OF 2	
3. BATTERIES (3) DESCENT	2 OF 5		2 OF 5					2 OF 5				
3. BATTERIES (3) **** ASCENT	BOTH		BOTH			(8)		BOTH			1 OF 2	
4. INVERTERS	1 OF 2		1 OF 2									
5. AC BUSES			BUS A OR B (7)									
ENVIRONMENTAL												
1. SUIT/CABIN INTEGRITY			SUIT AND CABIN			SUIT	SUIT AND CABIN					
2. SUIT FANS ****	1 OF 2		1 OF 2					1 OF 2				
3. O_2 DEMAND REGS ****		1 OF 2					(4)	1 OF 2				
4. H_2O SEPARATORS ****			1 OF 2 H_2O SEPARATORS					1 OF 2 H_2O SEPS				
5. O_2 TANKS (3) DESCENT		1 OF 2						1 OF 2				
5. O_2 TANKS (3) **** ASCENT		1 OF 2							1 OF 2			
6. COOLANT LOOPS PRIMARY		BOTH		(6)				BOTH				
6. COOLANT LOOPS **** SECONDARY												
7. H_2O FEED PATHS		BOTH		(6)				BOTH				
8. H_2O TANKS (3) DESCENT		1 OF 2						1 OF 2				
8. H_2O TANKS (3) **** ASCENT		1 OF 2						1 OF 2	(3)			
9. NO FIRE, SMOKE OR GLYCOL IN SUIT OR CABIN												
10. OPERATIONAL EMU	2 EVA XFER SYS							2	1			

(1) 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

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

(3) FUNCTIONAL CAPABILITY ONLY - SEE REDLINES FOR CONSUMABLES REQUIREMENTS

(4) DO NOT DEPRESS CABIN

(5) ABORT FOR ARMED SYSTEM THAT CAN NOT BE DEARMED

(6) CONSIDERATION WILL BE GIVEN TO CONTINUING DESCENT UNTIL THE SHORTER RDZ IS ACHIEVED AND THEN ABORT

(7) BUS A REQUIRED IF RR REQUIRED

(8) AFTER HI GATE IF TIME DOES NOT PERMIT TROUBLESHOOTING, CONFIG. FOR SINGLE BATT, 2 BUS ABORT BUT LAND AND TROUBLESHOOT.

(9) LAND, MANUALLY STAGE AND L/O NEXT BEST OPPPORTUNITY

(10) IF UNABLE TO ARM, LAND, MANUALLY STAGE, AND L/O NEXT BEST OPPORTUNITY

(11) WILL CONTINUE POWERED DESCENT SINCE CANNOT CONFIRM FAILURE WITHOUT STAGING

LEGEND: **** RETAIN DESCENT STAGE ALAP
NO REQUIREMENT

NOTE:

1. T_1 NO STAY CONDITIONS:
   - LOSS OF 1 ASC BATT
   - LOSS OF BOTH COOLANT LOOPS
2. T_2 NO STAY CONDITIONS:
   - NONE

LM CONTROL GO CRITERIA
5/3/71

ITEM	UNDOCKING	CIRC	PDI	PDI TO PDI 6:10	PDI 6+10 TO HI GATE	HI GATE TO LDG	STAY W/O EVA	2 MAN EVA	1 MAN EVA	LM ACT RNDZ		DOCKING
GNC												
1. GUID STEER — PGNS							PGNS (6) OR (6) AGS			PGNS OR AGS		
1. GUID STEER — AGS (3)												
2. 3-AXIS ATT CONT — PGNS RATE CMD OR PGNS AUTO	BOTH					(2)				PGNS OR AGS		
2. 3-AXIS ATT CONT — AGS RATE CMD (1)												
3. 3-AXIS TRANS (8)	3 AXIS		+X							1 AXIS		3 AXIS
4. FDAI-ATT/RATES/ERR			CREW OPTION									
5. T/D 40 SEC OF 57% GTC												
6. VHF RNG/CSM OPTICS	2 OF 3											
7. RR												
8. AOT												
9. LR												
10. DPS AUTO ON (8)												
11. REDNT APS ON (5)												
12. P&R GDA TRIM			NO IMPINGEMENT CONSTRAINT									
13. MAN THTL (7) (1 TTCA)			1 OF 2									
14. AUTO THTL												
DPS												
1. FU OR OX INLET/ ULLAGE PRESS PSI <65%	≥30/≥30											
1. FU OR OX INLET/ ULLAGE PRESS PSI >65%	NA			>150/>160								
2. ΔP OX AND FU	FU/OX ≤ 50			(10)	(10) ≤ 25	(10)						
3. PROP TEMP >50° <90°												
4. PROP ΔT < 10° F												
5. PROP QTY >BINGO/2%												
6. FTP BLOWDOWN CAPABILITY	<33% PQGS											
7. FU/OX PQGS ΔQ < 10% (4)												
8. 35% EROSION EXCEEDED												
APS												
1. NO PROP LEAKS							IMMEDIATE LIFTOFF			APS NOT REQ FOR RNDZ		
2. FU/OX INLET PRESS >62 & <220												
3. FU/OX ΔP (EITHER HIGH) < 90												
4. PROP TEMP >50° & < 90°												
5. PROP ΔT < 10° F												
6. NO HE LEAKS/ REDUNDANT PRESS PATH								(9)				
RCS												
1. RCS LEAKS	NO HE/PROP LEAKS			NO PROP LEAK		LEAK NO PROP LEAK A OR B	NO PROP LEAKS					
2. FU/OX MANIF PRESS >100			A AND B			A OR B		A AND B			A OR B	A & B
3. PROP TEMP (>40°F <100°F)			A AND B			A OR B		A AND B			A OR B	A & B
4. NO IMPINGEMENT LIMTIS EXCEEDED												

(1) AGS RATE CMD MAY CONSIST OF 2 AXIS RATE CMD AND ONE DIRECT, I.E. ONE RATE GYRO FAILED
(2) FOR SINGLE CONTROL MODE LANDING IS CREW OPTION
(3) LOSS OF AGS GUID STEERING IS ACCEPTABLE PROVIDED RDNT 3-AXIS ATTITUDE CONTROL EXISTS
(4) MSFN WILL EVALUATE CAPABILITY TO LAND WITH RESPECT TO PROPELLANT REMAINING
(5) MANUAL IS MANDATORY PLUS EITHER PNGS AUTO OR AGS AUTO
(6) LOSS OF PGNS GUID STEERING IS ACCEPTABLE PROVIDED RDNT 3-AXIS ATT CONTROL EXISTS
(7) WORK AROUND PROCEDURE EXISTS FOR MAXIMUM THRUST
(8) NO AUTO ULLAGE PLUS NO AUTO START - PDI NO GO
(9) APS HELIUM SOURCE LEAK AFTER PRESSURIZATION REQUIRES IMMEDIATE LIFTOFF
(10) MUST BE CONFIRMED BY OTHER CUES

LEGEND: ■ NO REQUIREMENT

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)

COMMUNICATIONS/INSTRUMENTATION GO CRITERIA
5/3/71

GO/NO-GO ITEM	EARTH ORBIT		TLC			LUNAR ORBIT (BEFORE UNDOCKING)			UNDOCKING	CIRC	POWERED DESCENT				LUNAR STAY			RENDEZVOUS LM ACTIVE	LUNAR ORBIT POST REND	POST DOCK	TEC
	CONT BOOST	CONT E.O.	TLI	TD&E	CONT TLC	LOI	CONT LOI	CONT L.O./DOI	NOMINAL MISSION		PDI	PDI TO PDI +6:10	PDI+6:10 TO HI GATE	HI GATE TO T/D	STAY W/O EVA	2-MAN EVA	1-MAN EVA		CONT L.O.	LM JETT	CSM EVA
USB 2-WAY VOICE COMM		(1)	CSM			CSM OR LM		CSM OR LM (5)	CSM & LM	CSM	CSM AND LM				CSM /LM (3)	CSM /LM (3)	CSM /LM (3)		CSM	CSM	
VHF COMM LM/CSM									SIMPLEX OR DUPLEX	→											
VHF COMM LM (LCRU)/EVA																SIMP (6)	SIMP (6)				
VHF COMM EVA/EVA																					
MSFN/EVA VOICE																(8)	(8)				
CRITICAL INSTRUMENTATION		← CSM →				CSM		CSM (7)	LM & CSM	CSM AND LM	CSM AND LM	← (4) LM (4)		(4) →	← LM AND CSM →			← LM →	CSM		
LM TELEMETRY									LBR OR HBR	LBR OR HBR	LBR OR HBR				← LBR OR HBR →						
CSM TELEMETRY		← HBR OR LBR →																			
CSM SCE			SCE																		

(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

LEGEND: ■ NO REQUIREMENT

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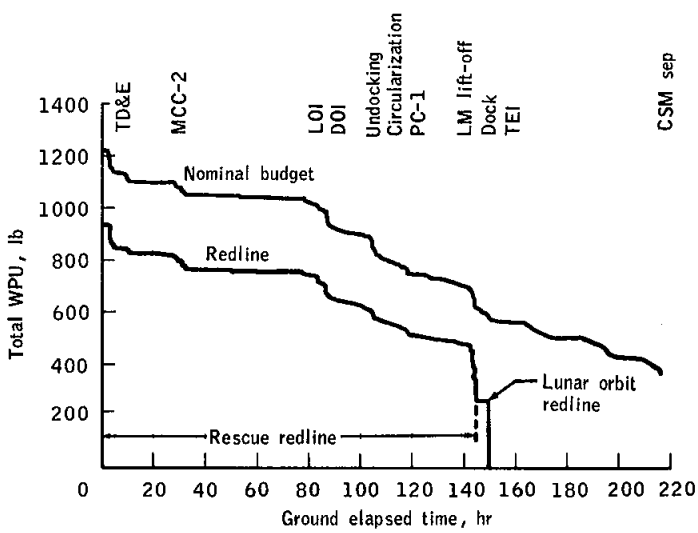
R	ITEM	
		' CONSUMABLES '
	3-106	SPS
		A. AFTER TD AND E AND THE FIRST DOCKED SPS MCC, THE DELTA V REQUIRED TO CONTINUE WITH A LUNAR MISSION IS 5500 FPS (CSM UNDOCKED CAPABILITY).
		B. THE DELTA V REQUIRED FOR LCI GO IS BASED ON A MINIMUM LUNAR ORBIT MISSION (NO LANDING BUT LUNAR ORBIT EXPERIMENTS). THE SEQUENCE OF MANEUVERS WOULD BE LOI 1 (60 X 170),LOI 2 (60 X 60), TEI AND TEMC'S. FOR THE NOMINAL TLI TRAJECTORY THE VALUE IS TBD FPS (TBD PERCENT PROPELLANT). THIS DELTA V INCLUDES---
		TBD LCI 1
		136 LOI 2
		TBD TEI (TBD HR RETURN)
		TBD MCC'S
		TBD FPS
		C. THE DELTA V REQUIRED FOR GO FOR UNDOCKING IS TBD FPS. THIS DELTA V INCLUDES---
		300 FPS, LM RESCUE (APPLY WITH TBD HR EARTH RETURN, FAST RETURN)
		75 FPS, CIRC
		TBD FPS, LOPCI
		TBD FPS, TEI (APPROXIMATELY TBD HR RETURN)
		TBD FPS, 3 SIGMA MCC BASED ON SCS-CONTROLLED TEI
		TBD FPS
		TBD FPS
	3-107	SM RCS
		A. THE CSM RESCUE REDLINE INCLUDES ---
		1. NOMINAL USAGE FROM LAUNCH TO CSM CIRCULARIZATION BURN
		2. ALLITUDE HOLD FROM CIRCULARIZATION BURN TO LM LIFTOFF (INCLUDED IN THIS PERIOD IS LOPC 1 ULLAGE AND DAMPING)
		3. RESCUE ALLOWANCE INCLUDING NOMINAL RENDEZVOUS BUDGET, THREE 10-SECOND 4-JET ULLAGES, AND CSM ACTIVE BRAKING
		4. TWO REVS ATTITUDE HOLD PLUS TEI (ULLAGE AND DAMPING)
		5. SEVEN FPS MCC (1 SIGMA G AND N TEI CUTOFF)
		6. PTC ALLOWANCE
		7. NOMINAL USAGE FROM MCC 7 TO CM/SM SEP
		THE REDLINE DOES NOT INCLUDE CSM SOLD EXPERIMENTS, BOOTSTRAP PHOTOGRAPHY, OR P23'S IN TEC. THE CSM RESCUE REDLINE AT EARTH LAUNCH IS TBD LB.
		B. VIOLATION OF THE LUNAR ORBIT REDLINE WILL RESULT IN TERMINATION OF LUNAR ORBIT ACTIVITIES. THE LO REDLINE INCLUDES---
		TBD LB 2 REVS LO, TEI ULLAGE AND DAMPING, NOMINAL TEC BUDGET
		TBD LB 20 FPS MCC (3 SIGMA G&N TEI CUT OFF)
		TBD LB TOTAL
		RULE NUMBERS 3-108 AND 3-109 ARE RESERVED.

APOLLO 14 DATA



(31 Jan 1971 Lift-off)
Apollo 14
SMRCS redline

R | ITEM

3-110 CSM BATTERY ENERGY AND CRYOGENIC O2 AND H2

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

		LAUNCH	LOI	UNDOCK	PC-1	PC-2
BAT AMP-HOURS REMAINING	3 BAT	TBD (1.)	TBD	TBD	TBD (3.)	N/A
	2 BAT	TBD	TBD	TBD	TBD	N/A
O2 TOTAL LBS	3 TANKS	TBD	TBD	TBD	TBD	N/A
	2 TANKS	TBD	TBD	TBD	TBD	N/A
H2 TOTAL LBS	3 TANKS	TBD	TBD	TBD	TBD	N/A
	2 TANKS	TBD	TBD	TBD	TBD	N/A

(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.

(2.) DELETED

(3.) ENERGY REQUIRED TO PERFORM PC-1 AND REMAINDER OF MISSION

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 AND 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 AND N ENTRY.

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

(E) 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 ONE CRYO TANK AT TEI-12 HRS (WORST CASE TIME FOR FAILURE).

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

(G) THE TWO-TANK CRYOGENIC REDLINE IS BASED ON THE QUANTITY REQUIRED IN THE TWO LOWEST TANKS TO PERFORM NOMINAL LENGTH MISSION AND STILL CAPABILITY TO RETURN TO EARTH AT A 40-AMP AVERAGE POWER LEVEL AFTER LOSS OF THE HIGHEST QUANTITY TANK AT TEI-12 HRS.

RULES 3-111 AND 3-112 ARE RESERVED.

R	ITEM	
	3-113	LM-RCS PROPELLANT GO/NO-GO'S AND REDLINES

A. ASSUMPTIONS

1. TOTAL LOADED 633 LBS EQUAL 100 PERCENT

UNUSABLE	
TRAPPED PROPELLANT	7.3 PERCENT
GROUND GAGING UNCERTAINTY	6.0 PERCENT
TOTAL UNUSABLE	13.3 PERCNT

2. OPS RESERVE

(A) PRIOR TO TPF - ONE REV LOS TRACKING OF CSM (STAGED) EQUALS 2.5 PERCENT

(B) AFTER TPF - CSM ACTIVE DOCKING EQUAL 1.0 PERCENT

3. ALL GO/NO-GO'S ARE THE AVERAGE OF SYSTEM A AND B. ALL REDLINES REQUIRE A PERCENT READING ON EACH INDIVIDUAL SYSTEM'S GAGE (OR AN EQUIVALENT AMOUNT OF PROPELLANT IF THE GAGE HAS FAILED) EQUAL TO OR GREATER THAN THE REDLINE VALUE.

4. THE TWEAK BURN IS ASSUMED TO BE 10 FPS IN THE X-AXIS AND 20 FPS IN THE Z-AXIS.

B. GO/NO-GO'S

1. UNDOCKING/SEPARATION

PROPELLANT REQUIRED FOR UNDOCKING, DESCENT, ASCENT, AND 1-REV RENDEZVOUS PLUS OPS RESERVE.

2. PDI

PROPELLANT REQUIRED FOR DESCENT, ASCENT, AND 1-REV RENDEZVOUS PLUS OPS RESERVE.

3. TWEAK

PROPELLANT REQUIRED FOR NOMINAL LM-ACTIVE 1-REV

4. TPI

PROPELLANT REQUIRED FOR REMAINDER OF 1-REV RNDZ PLUS OPS RESERVE.

5. TPF

PROPELLANT REQUIRED FOR REMAINDER OF 1-REV RNDZ PLUS OPS RESERVE.

R	ITEM	
	3-113 CONT	C. REDLINES

1. UNDOCKING TO CIRC

   PROPELLANT REQUIRED FOR NOMINAL DOCKING PLUS OPS RESERVE

2. CIRC TO PDI

   PROPELLANT REQUIRED FOR LOS IN LONGEST ABORT RNDZ WITH DPS ATTACHED UNTIL JUST BEFORE TPF (P-20 MAXIMUM DEADBAND), STAGING, BRAKING, AND DOCKING PLUS OPS RESERVE.

3. PDI TO TOUCHDOWN

   PROPELLANT REQUIRED FOR DESCENT, NOM ASCENT, LONGEST LOS FOR CSM RESCUE (P-20 MAXIMUM DEADBAND), BRAKING, AND DOCKING PLUS OPS RESERVE.

4. LUNAR STAY

   PROPELLANT REQUIRED FOR NOM ASCENT, LONGEST LOS FOR CSM RESCUE (P20 MAX DEADBAND), BRAKING, DOCKING, PLUS OPS RESERVE.

5. ASCENT TO TWEAK

   PROPELLANT REQUIRED FOR ASCENT, TWEAK, 1-REV RNDZ (CSM ACTIVE), AND DOCKING PLUS OPS RESERVE.

6. TWEAK TO TPF

   PROPELLANT REQUIRED FOR 1-REV RNDZ (CSM ACTIVE), AND DOCKING PLUS OPS RESERVE.

7. TPF TO DOCKING

   PROPELLANT REQUIRED FOR OPS RESERVE

RULES 3-114 THROUGH 3-117 ARE RESERVED.

K	ITEM
	3-118

LM EPS, ECS

THE LM EPS AND ECS MINIMUM CONSUMABLE REQUIREMENTS ARE DEFINED AS FOLLOWS---

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 4.5-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 H2O TANK AND ONE ASCENT O2 TANK (THE LM CABIN IS CONSIDERED A REDUNDANT O2 SOURCE) MUST CONTAIN THE CONSUMABLES REQUIRED FOR LIFTOFF AND A 4.5-HR RENDEZVOUS THROUGH CREW TRANSFER. THE 2-HR ORBITAL CONTINGENCY, INSOFAR AS ASCENT O2 AND ELECTRICAL POWER ARE CONCERNED, IS CONSIDERED TO BE SATISFIED BY THE REDUNDANCY REQUIREMENT. SHOULD TWO ASCENT H2O 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 FOUR 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-- SUFFICIENT CONSUMABLES BEING RETAINED FOR THIS PURPOSE.

R	ITEM	
	3-119	EMU

A. PLSS AMP HRS, O2, LIOH, ANC H2O REDLINES

NOMINAL AND ALTERNATE EVAS-THE PLSS AMP-HRS, O2, LIOH, AND H2O REDLINES FOR EACH OF THE NOMINAL OR ALTERNATE EVA'S ARE DEFINED AS THOSE VALUES REQUIRED FOR 30 MINUTES OF POST EVA RESERVE.

B. PLSS AMP-HR, O2, LICH ANC H2O GO/NC GC'S ARE DEFINED AS THOSE VALUES REQUIRED TO COMPLETE EVA PREP, EVA (NOMINAL OR ALTERNATE) PLUS THE VALUES REQUIRED FOR 30 MINUTES OF POST EVA RESERVE.

C. OPS O2, PLSS O2, H2C AND AMP-HR CEVA GO/NO-GO'S ARE DEFINED AS THOSE VALUES REQUIRED TO COMPLETE A 30-MINUTE CEVA.

D. OPS O2 GO/NO-GO'S ARE DESIGNED AS THOSE VALUES REQUIRED TO COMPLETE A 15-MINUTE TRANSFER TO CM, INGRESS, AND REPRESSURIZATION.

4 GROUND INSTRUMENTATION REQUIREMENTS

R	ITEM	
	4-1	GENERAL

A. THE FOLLOWING PRELAUNCH REQUIREMENTS DEFINE THE MCC/MSFN REQUIREMENTS WHICH MUST BE MET BEFORE A "GO" IS GIVEN FOR LAUNCH.

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.

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SECTION 4 - GROUND INSTRUMENTATION REQUIREMENTS - CONTINUED

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	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			
		ALDS	PRELAUNCH	BOTH DESIRABLE	
		MSFN			
		D. FM - GROUND STATION	PRELAUNCH	HIGHLY DESIRABLE	
	4-3	COMMAND			
		A. MOCR TOGGLE SWITCHES (BOTH A AND B)			A. FOR LAUNCH PHASE ABORT REQUEST
		1. BSE ABORT REQUEST	PRELAUNCH	HIGHLY DESIRABLE	
		2. FIDO ABORT REQUEST	PRELAUNCH	HIGHLY DESIRABLE	
		3. FD ABORT REQUEST	PRELAUNCH	HIGHLY DESIRABLE	
		B. COMMAND PANELS--- INCO, GUIDO, BSE, CCATS	PRELAUNCH	HIGHLY DESIRABLE	
		C. MOCR CONSOLE/SITE SELECT CAPABILITY			
		1. RTC CONSOLE (CCATS)	PRELAUNCH	HIGHLY DESIRABLE	
		2. CCATS CMD CONSOLE MED			
		D. FC/M AND U SWITCHING CAPABILITY			
		1. CCATS	PRELAUNCH	HIGHLY DESIRABLE	
		2. CCATS CMD MED			
		E. ABORT/CCATS TEST SWITCHING CAPABILITY	PRELAUNCH	HIGHLY DESIRABLE	
		1. FD CONSOLE			
		2. CCATS CMD MED			

SECTION 4 - GROUND INSTRUMENTATION REQUIREMENTS - CONTINUED

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 PLUS 60 SECONDS.	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---			
		AFD CONF LOOP FD LOOP	PRELAUNCH	1 OF 2 MANDATORY	FOR MISSION CONTROL
		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	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	FOR TRAJECTORY VERIFICATION AND BOOSTER SAFING
		D. MCC/REMOTED SITES---			
		ONE A/G PATH	PRELAUNCH	MANDATORY	USED FOR COMMUNICATION WITH CREW

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SECTION 4 - GROUND INSTRUMENTATION REQUIREMENTS - CONTINUED

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	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	PRELAUNCH	1 MANDATORY AND 1 HIGHLY DESIRABLE	TO THROUGH PROCESS MANDATORY S/V PARAMETERS TO MOC
		CCATS (UNIVAC 494) - STANDBY			
	4-7	TIMING			
		MITE (2)	PRELAUNCH	1 MANDATORY	MCC TIMING STANDARD TO SUPPORT MANDATORY RTCC/CCATS COMPUTERS

SECTION 4 - GROUND INSTRUMENTATION REQUIREMENTS - CONTINUED

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	4-8	MCC POWER			
		A. BUS A1	PRELAUNCH	MANDATORY	UNINTERRUPTABLE POWER FOR D/TV CONVERTERS
		B. BUS A2	PRELAUNCH	MANDATORY	UNINTERRUPTABLE POWER FOR D/TV DATA DISTRIBUTORS AND VSM
		C. BUS B1	PRELAUNCH	HIGHLY DESIRABLE	20 SECONDS INTERRUPTABLE POWER FOR THE FOLLOWING HIGHLY DESIRABLE ITEMS--- - FLT DYN SSR CONSOLES AND PLOTBOARDS - RTCC CONSOLES (EXCEPT COMP SUP) - PDSOD - CMCC - TTY
		D. BUS B2	PRELAUNCH	MANDATORY	20 SECONDS INTERRUPTABLE POWER FOR MOCR AND SSR CONSOLES AND 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 — 4	PRELAUNCH	10 OF 36 MANDATORY	FOR DISPLAY OF MANDATORY S/V PARAMETERS
		B. TRAJECTORY DISPLAY			
		1. FDL LAUNCH DIGITALS	PRELAUNCH	MANDATORY ON D/TV	FOR CONTINGENCY ORBIT INSERTION MANEUVER DATA AND TFF 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	FROM SELECTED TRACKING DATA SOURCE.
		3. RFO LAUNCH DIGITALS	PRELAUNCH	MANDATORY ON D/TV	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	MONITOR FOR G-LIMIT VIOLATION.

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SECTION 4 - GROUND INSTRUMENTATION REQUIREMENTS - CONTINUED

K	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	4-9 CONT	5. PHI VS LAMBDA	PRELAUNCH	HIGHLY DESIRABLE ON 1 OF 2--- PLOTBOARD (A) RTCC (B) SSR PLOTBOARD	MONITOR FOR CROSS-RANGE LIMITS
		6. T(FF) VS R(IP)	PRELAUNCH	HIGHLY DESIRABLE ON 1 OF 2--- (A) D/TV (B) SRR PLOTBOARD	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	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	MONITOR FOR L/V AND S/C NAVIGATION PERFORMANCE
		10. GUIDC ANALOG CHART RECORDERS ONE AND TWC	PRELAUNCH	HIGHLY DESIRABLE ON TV	
		11. INSERTION/INJECTION DIGITALS	PRELAUNCH	MANDATORY ON D/TV	FOR G&N GO/NO-GO
		C. ADEG CHANNELS 90-93	PRELAUNCH	HIGHLY DESIRABLE	FOR DSC DISPLAYS
		D. VSM	PRELAUNCH	MANDATORY	FOR D/TV
		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.

K	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	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	PRELAUNCH	1 HIGHLY DESIRABLE	
		2. MILA VHF ANTENNA			
		B. USB TM FROM THE FOLLOWING---			B. USB IS THE CSM'S ONLY SOURCE OF DATA.
		1. MILA USB	PRELAUNCH	1 MANDATORY	
		2. CIF USB			

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 PLUS 60 SECONDS.* REFER TO DECISION MATRIX (RULE 4-17 AND CHARTS 1 THROUGH 3 4-1 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 8 + 36 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 PLUS 60 SEC	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	

* FOR THE NOMINAL 80.1 DEGREE LAUNCH AZIMUTH, THE COVERAGE PROVIDED BY THE VANGUARD IS CONSIDERED HIGHLY DESIRABLE. IF THE VANGUARD IS LOST, THE COVERAGE PROVIDED BY BDA IS APPROXIMATELY INSERTION PLUS 30 SECONDS. FOR OTHER LAUNCH AZIMUTHS, THE COVERAGE PROVIDED BY THE VANGUARD IS MANDATORY BECAUSE OF DECREASED BDA COVERAGE.

K	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 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)	PRELAUNCH	1 OF 2 MANDATORY	DOWNLINKS REQUIRED TO RECOVER S-IVB DATA.
		IU VHF (DP-1)			
		CSM USB	PRELAUNCH	MANDATORY	
		C. TRACK			
		C-BAND	PRELAUNCH	HIGHLY DESIRABLE	
		USB	PRELAUNCH	MANDATORY	
		D. A/G COMMUNICATIONS			
		VHF	PRELAUNCH	1 OF 2 MANDATORY	USB MANDATORY AT LEAST ONE STATION PRIOR TO TLI TO CONFIRM ONBOARD CSM USB A/G CAPABILITY.
		USB	PRELAUNCH		
	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.

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MISSION RULES

SECTION 4 - GROUND INSTRUMENTATION REQUIREMENTS - CONTINUED

K	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	KIDMETER NETWORK SITES	PRELAUNCH		
		A. LIMA		HIGHLY DESIRABLE	
		B. CRO CYI		1 OF 2 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.

CHART 1--- 80.1 DEGREE AZIMUTH (APOLLO 15 NOMINAL)

	SITES FAILED					APPROXIMATE MANDATORY COVERAGE LOST FOR NO-GO ITEMS FOR ALL LAUNCH AZIMUTHS	CAPABILITY LOST			
	ALDS TM	MIL/CAPE	BDA	VAN	ANT		TELEMETRY	CMD	TRACK	A/G
	00-00 TO 08-49	00-00 TO 08-49	04-10 TO 12-40	09-10 TO 16-05	TBD TO TBD		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		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 NOTES 2 AND 3	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		SEE NOTE 3	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.

CHART 2--- 80.11 TO 90.00 DEGREES AZIMUTH

	SITES FAILED					APPROXIMATE MANDATORY COVERAGE LOST FOR NO-GO ITEMS FOR ALL LAUNCH AZIMUTHS	CAPABILITY LOST			
	ALDS TM	MIL/CAPE	BDA	VAN	ANT		TELEMETRY	CMD	TRACK	A/G
	00-00 TO 08-49	00-00 TO 08-49	04-10 TO 12-40	09-10 TO 16-05	TBD TO TBD		USB OR CCS AND VHF	USB AND CCS	BOTH S AND C BAND	LSB AND VHF
SINGLE	X					NONE SEE NOTE 1	GO	N/A	N/A	N/A
SITE		X				00-00 TO 04-10 SEE NOTE 2	GO	GO	NO-GO	NO-GO
FAILURE			X			08-49 TO 09-10 SEE NOTE 3	GO	GO	GO	GO
				X		11.00 TO INS + 60	NO-GO	GO	GO	NO-GO
					X	NONE	N/A	N/A	N/A	GO
MULTIPLE	X	X				00-00 TO 04-10	NO-GO	GO	NO-GO	NO-GO
SITE		X	X			00-00 TO 09-10 SEE NOTE 2	GO	GO	NO-GO	NO-GO
FAILURES		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
				X	X	11.00 TO INS + 60	NO-GO	GO	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 ENOUGHT FOR A NO-GO CONDITION.

CHART 3--- 90.1 TO 100.0 DEGREE AZIMUTH

	SITES FAILED					APPROXIMATE MANDATORY COVERAGE LOST FOR NO/GO ITEMS FOR ALL LAUNCH AZIMUTHS	CAPABILITY LOST			
	ALDS TM	MIL/CAPE	BDA	VAN	ANT		TELEMETRY	CMD	TRACK	A/G
	00-00 TO 08-49	00-00 TC 08-49	04-10 TC 12-40	09-10 TC 16-05	TBD TC TBD		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		SEE NOTES 3 AND 4	NO-GO	GO	GO	GO
					X	NONE	N/A	N/A	N/A	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
				X	X	11.00 TO INS + 60	NO-GO	GO	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.
4. VHF A/G VOICE PROVIDED BY ANT.

5 TRAJECTORY AND GUIDANCE

R	ITEM	
	5-1	THE LAUNCH PHASE WILL BE TERMINATED FOR ANY OF THE FOLLOWING CONDITIONS--- A. VIOLATION OF THE VEHICLE BREAKUP LINE B. TFF IS LESS THAN OR EQUAL TO 1 + 40 AND DECREASING AFTER TOWER JETTISON C. VIOLATION OF ENTRY "G" LIMIT D. VS INCREASING E. OVERSPEED CONDITIONS AT INSERTION F. VIOLATION OF EXIT HEATING LINE G. IF H IS LESS THAN OR EQUAL TO 75 NM AND DECREASING BEFORE ACHIEVING MODE IV CAPABILITY
	5-2	THE LES WILL NOT BE JETTISONED UNTIL MODE II CAPABILITY IS ESTABLISHED BY TFF IS GREATER THAN OR EQUAL TO 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 AND 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 TFF = 1 + 00 AND DECREASING. C. MODE IV MANEUVERS AND APOGEE KICK MANEUVERS WILL BE INTERRUPTED WHEN TFF = 1 + 40 AND DECREASING. D. MODE IV MANEUVERS WILL BE INTERRUPTED IF THE CURRENT ALTITUDE IS 70 NM, DECREASING, AND HP IS LESS THAN 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 IS LESS THAN 40 - EXECUTE CM/SM SEP BY TFF = 1 + 40. 2. HP IS BETWEEN 40 AND 70 - GROUND WILL DECIDE TO USE SM RCS ASAP OR AT APOGEE TO REDUCE HP TO 40 NM.
	5-4	MODE III ABORTS. A. PREDICTED TFF AFTER SPS C/C IS LESS THAN 1 + 40. 1. FULL LIFT IP ON WATER - DO NOT BURN. 2. G AND N GO AND FULL LIFT IP ON LAND - BURN TO TFF = 1 + 40, RL 90 DEG. 3. G AND N NO-GO AND FULL LIFT IP ON LAND - BURN A REDUCED DELTA V TO MAINTAIN TFF AFTER C/O AND RL 90 DEG. B. IF DELTA TB IS LESS THAN OR EQUAL TO 2 SEC, DO NOT BURN. C. IF IGNITION OCCURS AFTER GETI +10 SEC, BURN UNTIL G AND N DELTA R = 0, RL 55 DEG. (IF UNABLE TO BURN DELTA R = 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, 21103, 21204, 21206, 21210, 21302, 21501, 21502, 21521, 31104, 31201, 31202, 31203, 31207, 31211 B. RTCC AND CMC TFF DIFFERENCE OF GREATER THAN 40 SEC. C. CONFIRMED ERROR IN S/C PLATFORM VELOCITY COMPONENTS OF GREATER THAN 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 IS GREATER THAN OR EQUAL TO 70 NM.
		RULES 5-7 THROUGH 5-19 ARE RESERVED.

R	ITEM	
	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 LESS THAN 70 NM AND MANEUVER TO RAISE HP IS NOT POSSIBLE--- 1. HP IS BETWEEN 40 AND 70 - EXECUTE SPS RETROGRADE ASAP UNTIL HP IS LESS THAN 40. IF NO SPS, USE SM-RCS. 2. HP IS LESS THAN 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/O TIME IF THE TWO ARE DIFFERENT BY 10 SEC.
	5-23	TIME BETWEEN EPO RETROFIRE GETI AND 400K MUST BE GREATER THAN 9 MIN. IF NOT, RETARGET FOR NEXT PTP.
	5-24	RESERVED
	5-25	PLANNED G AND N AND SCS RETROFIRE MANEUVERS WILL BE UPDATED IF--- A. THE COMPUTED RETROFIRE POSITION CHANGES BY GREATER THAN 0.5 DEG LONGITUDE PRIOR TO GETI -30 MIN. B. THE COMPUTED RETROFIRE POSITION CHANGES BY GREATER THAN 2 DEG LONGITUDE AFTER GETI -30 MIN.

K	ITEM	
	5-26	RESERVED
	5-27	IF SPS FAILS AFTER EPO RETROFIRE IGNITION OR NO SLA SEP--- A. HP IS GREATER THAN 70 NM - RETARGET FOR NEXT BEST PTP USING RCS. B. HP BETWEEN 40 AND 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 DELTA V AVAILABLE 3. BURN CM RCS TO HP = 40 NM IF SM RCS DELTA V NOT SUFFICIENT TO OBTAIN HP = 40 NM IF HP IS LESS THAN OR EQUAL TO 40 NM TERMINATE ALL THRUSTING AT TFF = 7 MIN. C. HP IS LESS THAN 40 NM - REMAIN IN RETRO ATTITUDE AND BURN SM RCS USING THE FOLLOWING PRIORITY--- 1. BURN DELTA V RESIDUALS. 2. BURN MAXIMUM SM DELTA V 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 DELTA V.

R	ITEM	
	5-28	THE G AND N IS NO-GO FOR ENTRY IF--- A. THE CMC VALUE OF DOWNRANGE ERROR (RP - RT) AT .2G DIFFERS GREATER THAN +/- 100 NM FROM GROUND VALUE. CREW FAILOVER TO EMS ENTRY AS FIRST PRIORITY OR GROUND BANK ANGLE AND RETRO AS SECOND PRIORITY. 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 PRIOR TO LOS OF THE LAST SITE PRIOR TO T86 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 GREATER THAN +/- 48575 FT SEMI-MAJOR GREATER THAN +/- 1.6 NM CROSSRANGE VELOCITY (MAXIMUM) GREATER THAN +/- 18.2 FPS AT GET = 1 HR 45 MIN--- DOWNRANGE POSITION GREATER THAN +/- 83675 FT SEMI-MAJOR AXIS GREATER THAN +/- 1.8 NM CROSSRANGE VELOCITY (MAXIMUM) GREATER THAN +/- 19.4 FPS B. THERE WILL BE NO IU TARGET UPDATES FOR EITHER TLI OPPORTUNITY.
	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	DISPERSED TLI C/O--- PREDICTED DELTA V CAPABILITY (CSM ALONE) AFTER TD E AND DOCKED SPS MIDCOURSE--- A. GREATER THAN 5500 FPS - CONTINUE MISSION B. LESS THAN 5500 FPS - EXECUTE EARTH ORBIT ALTERNATE

K	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 XDOT IS GREATER THAN +/- 38 FPS DELTA YDOT IS GREATER THAN +/- 73 FPS DELTA ZDOT IS GREATER THAN +/- 87 FPS DELTA VT IS GREATER THAN +/- 34 FPS B. VIOLATION OF ANY OF THE FOLLOWING MEANS TLI IS TEMPORARILY NO-GO--- DELTA XDOT IS BETWEEN +/- 7.5 AND +/- 38 FPS DELTA YDOT IS BETWEEN +/- 41 AND +/- 73 FPS DELTA ZDOT IS BETWEEN +/- 28 AND +/- 87 FPS DELTA VT IS BETWEEN +/- 14 AND +/- 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 IS GREATER THAN +/- 3.28 NM CROSSRANGE VELOCITY IS GREATER THAN +/- 32 FPS
	5-36	DIFFERENCE IN MSFN AND IU DOWNRANGE POSITION (DELTA RV) IS GREATER THAN +/- 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 IS GREATER THAN +/- 535,900 FEET AT GET = 56 MIN. B. DIFFERENCE IN SEMIMAJOR AXIS IS GREATER THAN +/- 11.6 N. MI AT GET = 1 HR 45 MIN. C. DIFFERENCE IN CROSSRANGE VELOCITY IS GREATER THAN +/- 78.7 FPS AT GET = 1 HR 45 MIN.
		RULES 5-38 THROUGH 5-45 ARE RESERVED.

R	ITEM	
	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, 10777, 13777, 14777

CONTINUOUS OCCURRENCE - 20430, 20607, 20610, 21103, 21204, 21206, 21210, 21302, 21501, 21502, 21521, 31104, 31201, 31202, 31203, 31207, 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 IS GREATER THAN 4 DEG FOR RETROFIRE FROM EPO.

C. LGC/IMU ALIGNMENT DISCREPANCY INDICATE BY GREATER THAN 2 DEG FROM PREDICTED COAS COORDINATES.

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

1. LATITUDE IS GREATER THAN .02 DEG.

2. LONGITUDE IS GREATER THAN .02 DEG.

3. H IS GREATER THAN .2 NM.

5-47 SPACECRAFT TIMING MUST BE MAINTAINED WITHIN THE 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	.5	.3	.3
H. ASCENT	.5	.3	.3
I. RENDEZVOUS	.5	.5	.5
J. SXT TRACKING	.5	---------	---------

RULES 5-48 THRU 5-55 ARE RESERVED.

R	ITEM	
	5-56	RESERVED
	5-57	TRANSLUNAR MCC EXECUTION CRITERIA A. MCC 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. C. WHEN THE NOMINAL MISSION IS HYBRID, THE MANEUVER TO GO NON-FREE WILL BE EXECUTED AT MCC 2.
	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 1+34

LOI DELTA VM FROM 0 TO 642

EXECUTE A DPS 30 MIN DIRECT ABORT FOR---

LOI BURN TIME FROM 1+34 TO 1+55

LOI DELTA VM FROM 642 TO 789

EXECUTE A DPS TO DEPLETION 30-MIN DIRECT ABORT FOLLOWED BY A SUPPLEMENTARY APS BURN 2 HRS LATER---

LOI BURN TIME FROM 1+55 TO 1+57

LOI DELTA V FROM 789 TO 809

B. SHUTDOWN IN MODE II REGION -

EXECUTE A DPS 2-IMPULSE CIRCUMLUNAR ORBIT---

LOI BURN TIME FROM 1+57 TO 3+07

LOI DELTA VM FROM 809 TO 1313

C. SHUTDOWN IN MODE III REGION -

EXECUTE TEI (SPS OR DPS) AT NEXT OPPORTUNITY OR INITIATE AN ALTERNATE MISSION---

LOI BURN TIME FROM 3+07 TO 6+32

LOI DELTA V FROM 1313 TO 2998

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 1+34	0 TO 642	TIGHT
1+34 TO 3+50	642 TO 1641	LOOSE
3+50 TO 6+32	1641 TO 2998	TIGHT

R	ITEM	
	5-62	IF THE SPS FAILS AT IGNITION---

A. MCC - RESCHEDULE MCC FOR FLYBY TRAJECTORY WITH DPS/SM-RCS EXECUTION.

B. LOI - EXECUTE ABORT MANEUVER WITH DPS/SM-RCS.

C. DOI - EXECUTE GROUND COMPUTED TEI WITH DPS AS SOON AS PRACTICAL.

RULES 5-63 THROUGH 5-75
ARE RESERVED.

R	ITEM	
	5-76	THE DOI MANEUVER WILL BE TARGETED TO PRODUCE A 50K FT HP AT PDI AND TO OPTIMIZE THE GROUND TRACK FOR LUNAR LANDING AND FOR LANDMARK PHOTOGRAPHS.
	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, 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 3.6 NM. 2. THE VALUE OF DOPPLER RESIDUALS AT AOS WHICH CORRESPONDS TO THIS PERICYNTHION IS -32 CYCLES PER SECOND.

R	ITEM	
	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 30000 FT D. PREDICTED ALTITUDE AT PDI IGNITION LESS THAN 30000 FT OR GREATER THAN 7000 FT (PREDICTIONS WILL BE BIASED USING EXPECTED/CALCULATED WORST CASE PROPAGATION ERRORS). NOTE ---- WHEN POSSIBLE ANY REQUIRED MANEUVER(S) WOULD BE SCHEDULED SHORTLY AFTER CREW WAKE-UP ON PDI DAY.
	5-80	THE DOI TRIM MANEUVER WILL BE TARGETED TO ACHIEVE THE FOLLOWING CONDITIONS--- A. ALTITUDE AT PDI BETWEEN 35,000 AND 50,000 FT B. MISS DISTANCE OVER THE LLS EQUAL TO ZERO C. APPROACH AZIMUTH RETURNED TO NORMAL NOTE ---- MR 5-79 MUST BE VIOLATED BEFORE THE DOI TRIM MANEUVER IS REQUIRED
	5-81	AFTER AOS FOLLOWING THE DOI TRIM MANEUVER, EXECUTION OF THE BAILOUT ABORT MANEUVER WILL BE RECOMMENDED IF INCOMING MSFN DATA INDICATES A CLOSEST APPROACH ALTITUDE OF EQUAL TO OR LESS THAN 1.0 NM ABOVE THE LUNAR TERRAIN NOTES ----- 1. THIS RULE APPLIES TO A RETROGRADE SPS MANEUVER APPROXIMATELY 180 DEGREES FROM PERICYNTHION. 2. THE PERICYNTHION ALTITUDE WHICH CORRESPONDS TO 1.0 NM CLOSEST APPROACH IS TBD NM. 3. THE VALUE OF DOPPLER RESIDUALS AT AOS WHICH CORRESPONDS TO THIS PERICYNTHION IS TBD CYCLES PER SECOND.

K	ITEM	
	5-82	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.
	5-83	THE CIRCULARIZATION MANEUVER WILL BE TARGETED TO ACHIEVE A CIRCULAR ORBIT AT RENDEZVOUS AND AN ORBITAL PERIOD THAT MAINTAINS THE CSM SOLO TIMELINE.
	5-84	A. THE LLS LANDMARK SIGHTINGS WILL BE CONSIDERED ACCEPTABLE IF THE PREMISSION LLS POSITION IS CHANGED BY LESS THAN- $\phi \leq$ 21,000 FT; $\lambda \leq$ 10,000 FT; $R \leq$ 10,000 FT B. POWERED DESCENT WILL BE SLIPPED AS REQUIRED TO ACHIEVE AN ACCEPTABLE SET OF LANDMARK SIGHTINGS. IF THE DELAY IN PDI COMPROMISES EITHER LANDING OR ABORT CAPABILITY, AN ALTERNATIVE TARGET WILL BE SELECTED TO MAXIMIZE CLEARANCE OF MOUNTAINOUS TERRAIN.
	5-85	ALLOWABLE MISALIGNMENTS AT PDI ARE 0.6 DEG ABOUT THE X AND Y AXES. IF THE SECOND P52 ALIGNMENT DETECTS DRIFT RATES INDICATIVE OF GREATER MISALIGNMENT, PDI WILL BE SLIPPED ONE REV.
		RULES 5-86 THROUGH 5-89 ARE RESERVED.

R	ITEM	
	5-90	LR DATA IS REQUIRED FOR LANDING.

A. LOCK-ON

1. LR CONVERGENCE (ALTITUDE ONLY) - DATA NOT BEING ACCEPTED OR CONVERGING FOLLOWING LOCK-ON FOR 60 SECONDS.

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

3. 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

(B) LANDING RADAR NOT REGAINED AT P64 - ABORT

4. LATE LR LOCK-ON WITH DATA BEING INCORPORATED AND CONVERGING - CONTINUE TO P-64.

(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 TO EXCEED MINUS 10 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 MINUS 20 FPS - ABORT.

3. PGNS ALTITUDE LESS THAN 10,000 FT

(A) CONFIRMED PGNS CROSSRANGE VELOCITY ERROR (DELTA Y DOT) EXCEEDS ± 40 FPS (SOUTH) - ABORT

(B) RADIAL N69 NOT INCORPORATED - ABORT

4. PGNS ALTITUDE LESS THAN 6000 FT - 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 X DOT (DOWNRANGE)	GREATER THAN + TBD OR -45 FPS
DELTA Y DOT (CROSSRANGE)	GREATER THAN +/- 90 FPS
DELTA Z DOT (RADIAL)	GREATER THAN + TBD 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 Y DOT (CROSSRANGE)	GREATER THAN +/- 200 FPS
DELTA Z DOT (RADIAL)	GREATER THAN + TBD OR -35 FPS

C. COMMANDED THRUST INCREASING PRIOR TO THROTTLE DOWN OR P63 TGO = 80 SECONDS.

D. NO THROTTLE RECOVERY BY P63/64 PROGRAM SWITCH PLUS 15 SECONDS.

E. FAILURE TO ACHIEVE FTP BY NOMINAL TIG +31 SECONDS (ABORT AT GTC DIVERGENCE)

F. FAILURE TO ENTER P64 WHEN TGO = 60 SECONDS

G. THE FOLLOWING PGNS ALARMS--- 20105, 00214, 20430, 20607, 21103, 01107, 21204, 21302, 21501, 00402 (CONTINUING)

5-92 AN ABORT WILL NOT BE REQUESTED FOR A PGNS FAILURE AFTER PITCHOVER IN THE APPROACH PHASE.

RULES 5-93 THROUGH 5-100 ARE RESERVED

R	ITEM	
	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 SHORT 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 LESS THAN 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. PNGS NAVIGATION ERRORS, CONFIRMED BY AGS RESIDUALS, THAT RESULT IN THE FOLLOWING MSFN-PNGS VELOCITY DIFFERENCES--- DELTA X DOT (DOWNRANGE) GREATER THAN +/- 24 FPS DELTA Y DOT (CROSSRANGE) GREATER THAN +/- 90 FPS (COELLIPTIC SEQUENCE RENDEZVOUS) GREATER THAN +/- 45 FPS (SHORT RENDEZVOUS) DELTA Z DOT (RADIAL) GREATER THAN +/- 37 FPS C. PGNS NAVIGATION ERRORS THAT RESULT IN--- 1. AGS PREDICTED INSERTION HP LESS THAN 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 (SHORT RENDEZVOUS) D. IF MSFN NOT VALID DURING ASCENT THE FOLLOWING DOPPLER RESIDUALS WILL BE USED TO CONFIRM SWITCHOVER--- 1. AGS - PGNS DELTA X DOT (DOWNRANGE) GREATER THAN +/- 24 FPS AND DOPPLER - PGNS RESIDUAL GREATER THAN 10 FPS. 2. AGS - PGNS DELTA Z DOT (RADIAL) GREATER THAN +/- 37 FPS AND DOPPLER - PGNS RESIDUAL GREATER THAN 33 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 LESS THAN 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 (SHORT RENDEZVOUS)
	5-105	THE GROUND WILL NOT REQUEST SWITCHOVER AFTER AGS TGO LESS THAN 30 SEC.
		RULE NUMBERS 5-106 THROUGH 5-110 ARE RESERVED

K	ITEM	
	5-111	THE PGNS IS PRIME FOR EITHER THE SHORT RNDZ (TPI ONLY) OR THE COELLIPTIC SEQUENCE (CSI,COH, 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. SHORT RNDZ - TPI--- (A) 3 FPS IN DELTA VX (B) 7 FPS IN DELTA VY (C) 9 FPS IN DELTA VZ NOTE ---- LM BIASES OF 1 FPS IN DELTA VX AND -2 FPS WILL BE APPLIED TO THE LM SOLUTION FOR COMPARISON WITH THE CSM SOLUTION 2. COELLIPTIC SEQUENCE RNDZ - ALL MANEUVERS--- (A) 3 FPS IN DELTA VX (B) 7 FPS IN DELTA VY (C) 9 FPS IN DELTA VZ 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. SHORT RNDZ 1. THE DELTA H AT TPI WILL BE 15 NM. 2. THE DELTA THETA AT TPI WILL BE + 1.69 DEG. 3. TPI WILL OCCUR 44 MINUTES AFTER INSERTION. 4. THE WEDGE ANGLE AT INSERTION WILL BE ZERO DEGREES. B. COELLIPTIC SEQUENCE RNDZ 1. THE DELTA H AT TPI WILL BE 15 NM. 2. THE NOMINAL ELEVATION ANGLE (26.6) DEG WILL OCCUR 16 MIN PRIOR TO SUNRISE. 3. THE COH MANEUVER WILL BE APPROXIMATELY ZERO DELTA V.
	5-113	COELLIPTIC SEQUENCE RNDZ EXECUTION SHALL, WHERE POSSIBLE, OBSERVE THE FOLLOWING CONSTRAINTS-- A. THE ACTUAL DELTA H MAY BE SLIPPED +/- 5 NM FROM 15 NM. B. TPI MAY OCCUR NO EARLIER THAN 31 MIN PRIOR TO SUNRISE. C. THE DELTA T BETWEEN COH AND TPI MUST BE GREATER THAN 30 MIN.

R	ITEM	
	5-114	THE 'BAILOUT' MANEUVER TO TRANSFER FROM THE SHORT RNDZ TECHNIQUE TO THE COELLIPTIC SEQUENCE RNDZ WILL BE EXECUTED IF--- A. THE DELTA VG 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.
	5-115	TWO INDEPENDENT METHODS OF RNDZ NAVIGATION ARE REQUIRED TO COMMIT TO THE SHORT RNDZ. THE ACCEPTABLE RNDZ NAVIGATION TECHNIQUES ARE---- A. LGC AND RNDZ RADAR B. AEA AND RNDZ RADAR C. AEA, VHF EMS, LM COAS AND CSM LIGHT D. AEA, VHF CMC, LM COAS AND LIGHT E. CMC, SEXTANT, AND LM LIGHT F. CMC, VHF CMC, SEXTANT, AND REFLECTED SUNLIGHT G. CMC, VHF CMC, CSM COAS, AND LM LIGHT H. CMC, VHF CMC, CSM COAS, AND REFLECTED SUNLIGHT
		RULES 5-116 THROUGH 5-120 ARE RESERVED.

R	ITEM	
	5-121	TRANSEARTH MCC WILL BE TARGETED TO ACHIEVE ENTRY CONDITIONS AS FOLLOWS--- A. IF VEI GREATER THAN 31000 FPS OR G&N NO-GO, USE STEEP TARGET LINE. B. IF VEI LESS THAN 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, EXECUTE MCC ASAP (EXCEPT---MCC5). 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-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-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.

R	ITEM	
	5-127	PREDICTED ENTRY CORRIDOR VIOLATION AFTER THE LAST MCC OPPORTUNITY--- A. UNDERSHOOT LINE EXCEEDED--- GROUND ADVISE CREW TO FLY FULL LIFT UNTIL PEAK G IS PASSED, THEN FLY G&N. B. OVERSHOOT LINE EXCEEDED---GROUND ADVISE CREW TO FLY NEGATIVE LIFT TO 2 G'S FOLLOWED BY 4-G CONSTANT ENTRY.
	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 DIFFERS 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.

K	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 DELTA V 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 DELTA V REMAINING GREATER THAN THE RCS DELTA V CAPABILITY MINUS 20 FPS - RESTART SPS AND COMPLETE THE TARGETED BURN. NO TRIM.

(B) TEI DELTA V REMAINING LESS THAN THE RCS DELTA V 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 DELTA V LESS THAN 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 DELTA V GREATER THAN 1700 FPS) - TARGET THE SPS AT TEI + 2 HR.

RULES 5-132 THRU 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/MFCC' 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/MFCC' 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 FC.
	5-146	IF AN ESTABLISHED IMPACT PREDICTION (IP) POINT IS ON THE CAPE KENNEDY LAND AREA, 'DESTRUCT/PC' WILL BE TRANSMITTED.

R	ITEM	
	5-147	IF AN ATTEMPT TO TERMINATE THRUST BY ''ARM/MFCU'' IS UNSUCCESSFUL WHILE THE IP IS ON THE CAPE KENNEDY LAND AREA, ''DESTRUCT/PD'' WILL BE SENT.
	5-148	WHEN THE IP HAS MOVED OFF THE CAPE, FLIGHT TERMINATION ACTION WILL BE LIMITED TO ''ARM/MFCU'' 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 PLOTS 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/MECC'' 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 WINC 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)

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MISSION RULES

SECTION 6 - SLV - TB1 THROUGH TB4/TB4A

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

6-6 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. FIVE SECONDS AFTER SPACECRAFT SEPARATION

B. BSE MANEUVER UPDATE AND INHIBIT CAPABILITY EXISTS FOR T87 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 TBD NM APOGEE ALTITUDE.

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 LH2 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

6-2 LOSS OF ATTITUDE CONTROL

**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 T83 + 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 T85, T87

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

**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 VALVE(S) FAILS OPEN

** TIME DEPENDENT

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MISSION RULES

SECTION 6 - SLV - TB1 THROUGH TB4/TB4A - CONTINUED

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 LOSS OF ENGINE HYDRAULIC FLUID
		8-6 S-IVB ACTUATOR CONFIRMED HARDOVER PRIOR TO TB6 + 9 MIN 10 SEC
		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
		* 7-4 S-IVB COLD HELIUM SHUTOFF VALVES FAIL TO CLOSE
		* 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 SIVB 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)
		B. ANY TWO OR MORE ENGINES PRIOR TO DEACTIVATION OF ENGINE AUTO ABORT		B. ABORT BSE INFORM FLIGHT AND TRANSMIT ABORT REQUEST.	3. LONGITUNDINAL ACCELERATION (A2-603) 4. FINAL THRUST OK CUTTOFF - ON (K52-115 THROUGH K56-115)
		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. 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.
		D. LOSS OF TWO ADJACENT CONTROL ENGINES AFTER TB2 + 8 SEC		D. CONTINUE MISSION BSE INFORM FLIGHT AND FIDO.	D.1. ALL ENGINES WILL SHUT DOWN IMMEDIATELY. S-IC/S-II STAGING IS ENABLED AT TB2 + 18.4 SEC.
		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.	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)
		1. VOICE COMM WITH RSO		1.(A) FLIGHT CONFIRM ENGINE 3 OR 4 OUT VIA RSO PRIVATE LINE. (B) FLIGHT CONFIRM NO OTHER KNOWN ANOMALIES BY LIGHT ACTIVATION AND VOICE REPORT.	NOTES--- E.1. RSO LOOP 111 OR FD LOOP BACKUP TO PL. 2. CONFIRMATION OF NO OTHER KNOW ANOMALIES WILL BE BASED ON---
		2. NO VOICE COM WITH RSO		2. FLIGHT CONFIRM ENGINE 3 OR 4 OUT AND NO OTHER KNOWN ANOMALIES BY LIGHT ACTIVATION.	(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 A. PRIOR TO TB1 + 2 MIN	LAUNCH	A. CONTINUE MISSION BSE INFORM FLIGHT AND FIDO CREW WILL ABORT ON ONBOARD LIMITS	CUES--- 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. 2. LOSS OF ATTITUDE CONTROL ALERT WILL BE GIVEN FOR THE FOLLOWING CONDITIONS--- (A) LVDC/LVDA COMPUTATIONAL FAILURE (B) ATTITUDE ERROR SIGNALS GREATER THAN +/- 5 DEG. (C) FAILURE TO INITIATE PROPER GUIDANCE SEQUENCE (D) S-IC ENGINE ACTUATOR HARDOVER GREATER THAN +/- 5 DEG.
		B. BETWEEN TB1 + 2 MIN AND TB5 INITIATE	LAUNCH	B. CONTINUE MISSION BSE INFORM FLIGHT AND FIDO CREW WILL ABORT ON ONBOARD LIMITS	CUES--- B.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 B.2) 3. LOSS OF ATTITUDE CONTROL ALERT. (SEE NOTE B.2) NOTES--- B. 1. THESE CUES 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 AND S-II BURN) - ROLL GREATER THAN +/- 3.5 DEG - PITCH AND YAW GREATER THAN +/- 5 DEG (S-IVB BURN ONLY) (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)

K	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 REALTIME ANALYSIS INDICATES A NAVIGATION UPDATE IS NOT REQUIRED (SEE FMR S-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.

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	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 MODE CODE 26 BIT D8 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--- 1. IN THE EVENT OF THIS FAILURE PRIOR TO T86, THE CREW WILL HAVE TO INITIATE T86.
	6-5	S-IVB LOX CRYO REPRESS VALVE(S) FAILS OPEN A. PRIOR TO S-II CUTOFF 1. PRIOR TO TOWER JETT 2. BETWEEN TOWER JETT AND S-II CUTOFF	LAUNCH	A. ABORT/EARLY STAGE 1. ABORT -- BSE INFORM FLIGHT AND RECOMMEND ABORT 2. EARLY STAGE - BSE INFORM FLIGHT AND RECOMMEND EARLY STAGE	A.1. COLD HELIUM REGULATOR DISCHARGE PRESSURE REMAINS LESS THAN 50 PSIA (D 105-403) 2. LOX TK ULLAGE PRESSURE 50 PSIA OR OFF SCALE HIGH (D 179-406, D 180-406) 3. BURNER LOX REPRESS COIL TEMPERATURE BELOW-100 DEG F (C 378-403) 4. COLD HELIUM BOTTLE PRESSURE DECAYING (D 261-403, D 263-403)
	6-6	EXCESSIVE ATTITUDE ERROR IN PITCH OR YAW DURING S-II BURN A. PRIOR TO S-IVB TO COI CAPABILITY B. BETWEEN S-IVB TO COI AND S-II CUT OFF	LAUNCH	ABORT/EARLY STAGE A. ABORT - BSE INFORM FLIGHT AND TRANSMIT ABORT REQUEST B. EARLY STAGE - BSE INFORM FLIGHT AND FIDO AND RECOMMEND EARLY STAGING	CUES--- 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) 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, AND 6-9.

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	6-7	S-II LOSS OF THRUST	LAUNCH		A. 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.	1. THRUST OK SWITCHES-OFF (K285-201 THROUGH 205, K286-201 THROUGH 205). 2. THRUST CHAMBER PRESSURE- ZERO (D13-201 THROUGH 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. CUES--- 1. THRUST OK SWITCHES OFF (K231-201 THROUGH 205-- K232-201 THRU 205) 2. THRUST CHAMBER PRESSURE ZERO (D13-201 THROUGH 205) 3. LONGITUDINAL ACCELERATION (A2-603)
		C. THREE OR MORE ENGINES OUT		C. ABORT/EARLY STAGE/ CONTINUE MISSION	C. CUES--- 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 PROGRAMMED S-II CENTER ENGINE CUTOFF, ENGINES OUT REFERS ONLY TO CONTROL ENGINES.
		1. PRIOR TO S-IVB TO COI CAPABILITY		1. ABORT - BSE INFORM FLIGHT AND TRANSMIT ABORT REQUEST.	
		2. AFTER S-IVB TO COI CAPABILITY BUT PRIOR TO LOW LEVEL SENSE ARM		2. EARLY STAGE - BSE INFORM FLIGHT AND RECOMMEND EARLY STAGING.	
		3. AFTER LOW LEVEL SENSE ARM		3. EARLY STAGE/ CONTINUE MISSION	
		(A) 3 CONTROL ENGINES OUT		(A) EARLY STAGE - BSE INFORM FLIGHT AND RECOMMEND EARLY STAGE.	
		(B) ALL ENGINES OUT		(B) CONTINUE MISSION - BSE INFORM FLIGHT	

MISSION RULES

SECTION 6 - SLV - TB1 THROUGH TB4/TB4A - CONTINUED

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	6-8	S-II STAGE ANY SINGLE ACTUATOR HARDOVER INBOARD	LAUNCH	ABORT/EARLY STAGE/CONTINUE MISSION	
		A. PRIOR TO S-IVB TO CDI CAPABILITY		A. ABORT- BSE INFORM FLIGHT AND TRANSMIT ABORT REQUEST	CUES--- 1. YAW ACTUATOR POSITION EXCEEDS +6 DEG (G8-201 THRU 204, G30-201 THRU 204)
		B. BETWEEN S-IVB TO CDI CAPABILITY AND 30 SEC PRIOR TO S-II CUTOFF		B. EARLY STAGE - BSE INFORM FLIGHT AND RECOMMEND EARLY STAGING	2. PITCH ACTUATOR POSITION EXCEEDS +6 DEG (G9-201 THRU 204, G31-201 THRU 204)
		C. AFTER S-II CUTOFF MINUS 30 SEC		C. CONTINUE MISSION- BSE INFORM FLIGHT	3. ADJACENT CONTROL ENGINE ACTUATOR IN SAME PLANE MOVES 4 1/2 DEG INBOARD (SAME MEASUREMENTS AS CUES 1 AND 2)
					NOTES--- 1. 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 SEC	LAUNCH	ABORT - BSE INFORM FLIGHT AND TRANSMIT ABORT REQUEST. CREW ABORT PRIOR TO TB3 + 66 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.

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	6-10	S-IVB LOSS OF HYDRAULIC FLUID PRIOR TO FIRST S-IVB BURN	LAUNCH	NO S-IVB START - BSE INFORM FLIGHT AND FIDO AND RECOMMEND NO S-IVB START CAPCOM ADVISE CREW	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. L7-403 PLUS ONE OF THE OTHER CUES ARE REQUIRED FOR IMPLEMENTATION OF THIS RULE. 2. IF ALL THREE CUES ARE FUNCTIONING PROPERLY, THEY ARE REQUIRED FOR IMPLEMENTATION OF THIS RULE. 3. SPACECRAFT SHOULD HAVE CCI CAPABILITY AT S-II CUTOFF 4. AT S-II CUTOFF, THE CREW SHOULD INHIBIT THE S-IVB START WITH THE TRANSLATION HANDCONTROLLER.
	6-11	S-IVB STAGE LOSS OF THRUST A. FAILS TO ATTAIN THRUST OR PREMATURE SHUTDOWN PRIOR TO OBTAINING PARKING ORBIT B. SHUTDOWN PRIOR TO ACHIEVING MINIMUM REQUIRED APOGEE ALTITUDE AND ENTRY INTO TB7 FOR REASONS OTHER THAN A PROPELLANT DEPLETION	LAUNCH TLI	A. SPACECRAFT SEPARATION - BSE INFORM FLIGHT AND FIDO B. CONTINUE MISSION - BSE INFORM FLIGHT AND COMMAND TO EARTH ORBBITAL 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.	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. MODE CODE 25, BIT D2 SET TO ONE (H60-603). 5. TB7 IS INITIATED. 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.

MISSION RULES

SECTION 7 - SLV - TB5 AND TB7 - CONCLUDED

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	6-12	S-IVB COLD HELIUM SHUTOFF VALVES FAIL OPEN A. PRIOR TO LAUNCH ESCAPE TOWER JETTISON B. BETWEEN LAUNCH ESCAPE TOWER JETTISON AND 50 SEC PRIOR TO S-II CUTOFF C. AFTER S-II CUTOFF MINUS 50 SEC	LAUNCH	A. ABORT - BSE INFORM FLIGHT AND TRANSMIT ABORT REQUEST B. EARLY STAGE - BSE INFORM FLIGHT AND RECOMMEND EARLY STAGING IMMEDIATELY C. CONTINUE MISSION - BSE INFORM FLIGHT	CUES--- 1. COLD HELIUM REG DISCHARGE PRESSURE REMAINS GREATER THAN 200 PSIA FOR A MINIMUM OF 20 SECONDS (D105-403) 2. LOX ULLAGE PRESSURE AT RELIEF SETTING (41-44 PSIA) AND RELIEVING (D179-406, D180-406) 3. COLD HE BOTTLE PRESSURE DECAYING (D261-403, D263-403) NOTE--- ALL CUES MUST INDICATE THE FAILURE FOR IMPLEMENTATION OF THIS RULE.

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 RESERVED

7-13 IU ENVIRONMENTAL CONTROL SYSTEM FAILS

7-14 COMMON BULKHEAD DELTA P

7-15 LOSS OF S-IVB STAGE PNEUMATICS

7-16 RESERVED

7-17 LH2 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 LOSS OF HYDRAULIC FLUID

7-23 RESERVED

7-24 RESERVED

7-25 LOX NON-PROPULSIVE VENT FAILS TO OPEN

7-26 LH2 LATCHING VENT VALVE FAILS TO OPEN

7-27 GH2 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 - ATTITUE REFERENCE

NASA - Manned Spacecraft Center

MISSION RULES

SECTION 7 - SLV - TB5 AND TB7 - CONTINUED

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	7-1	PRIOR TO RESTART, INSUFFICIENT PROPELLANT REMAINS FOR ACHIEVEMENT OF ACCEPTABLE ALTERNATE MISSION.	EARTH ORBIT	NO S-IVB RESTART BSE INFORM FLIGHT AND RECOMMEND NO S-IVB RESTART.	CUE--- PROPELLANT REMAINING AS ASCERTAINED DURING REAL-TIME EVALUATIONS
	7-2	LOSS OF ONE APS MODULE			
		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	CUES--- 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 STABLIZE 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. AFTER ULLAGE BURN, COMMAND - S-IVB BURN MODE ON 2. AFTER LOX DUMP AND PRIOR TO APS BURN, COMMAND - S-IVB BURN MODE OFF 3. AFTER COMPLETION OF LUNAR IMPACT BURNS, COMMAND FCC POWER OFF	NOTES--- LIMITS IN FMR 7-8 CONDITION/MALFUNCTION "D" DO NOT APPLY TO THE FAILURE IN 7-2 CONDITION/MALFUNCTION E.

MISSION RULES

SECTION 7 - SLV - TB5 AND TB7 - CONTINUED

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). 4. FUEL RECIRC FLOWRATE (F5-404).
		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 MRV 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. IF THE MRV DOES NOT CLOSE, THE RESULT WILL BE AN EXTENDED FUEL LEAD JUST PRIOR TO TLI IGN, AND THERE WILL BE NO LOX AND LH2 RECIRCULATION. ENGINE START WILL OCCUR 7 SECONDS EARLY. 5. IF THE MRV DOES NOT CLOSE, FMR 8-4 SHOULD NOT BE IMPLEMENTED SINCE IT WILL RESULT IN A SIMULTANEOUS LOX AND LH2 DUMP.
		B. SECOND S-IVB CUTOFF	TLC	B. CONTINUE MISSION BSE INFORM FLIGHT AND 1. ATTEMPT TO CLOSE MFV WHEN LOX DUMP IS COMPLETE, BSE CMD. 2. PREVALVES AND RECIRC VALVES CLOSE	

K	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) GREATER THAN 10 DEG. 2. MAIN OXIDIZER VALVE OPEN-ON (K120-401). 3. LOX FLOWMETER FLOWRATE F1-401 GREATER THAN 47 LB/SEC. 4. LOX INJECTOR PRESSURE (D2005-401)
		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 (A1). 2. THIS FAILURE WILL REQUIRE EVALUATION OF LOX RESIDUALS TO DETERMINE ADEQUACY FOR TLI VELOCITY CUTOFF (REF FMR 7-1)
		B. SECOND BURN CUTOFF	TLC	B. CONTINUE MISSION BSE INFORM FLIGHT AND 1. ATTEMPT TO CLOSE MOV WHEN LOX DUMP IS COMPLETE, BSE COMMAND 2. PREVALVES AND RECIRC VALVES CLOSE.	DELTA VELOCITY REQUIREMENTS

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	7-5	RANGE SAFETY SYSTEM NOT SAFED AFTER INSERTION	EO		CUES--- 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. NOTES--- 1. RSO SHOULD NOT ATTEMPT TO SAFE THE RANGE SAFETY RECEIVERS ON REVS 2 AND 3 UNTIL MCC CONFIRMS 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 4 ARE VALID ONLY WHEN THE VEHICLE IS RECEIVING 450 MHZ RADIATION.
		A. PROPELLANT DISPERSION SYSTEM NOT ARMED		A. CONTINUE MISSION BSE INFORM FLIGHT AND RECOMMEND RSO SEND SAFE COMMAND	
		B. PROPELLANT DISPERSION SYSTEM ARMED AND RSO HAS NOT SENT MECO		B. SPACECRAFT SEPARATION BSE INFORM FLIGHT AND 1. RECOMMEND SPACECRAFT SEPARATION TO A SAFE DISTANCE (7000 FT). 2. WHEN SPACECRAFT HAS REACHED A SAFE DISTANCE, RECOMMEND RSO SEND SAFE COMMAND.	

K	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	7-6	S-IVB STAGE COLD HELIUM SHUTOFF VALVES FAIL TO OPEN IN			CUES--- 1. COLD HELIUM REGULATOR DISCHARGE PRESSURE GREATER THAN 200 PSIA (D0105-403).
		A. TB5	EARTH	A. CONTINUE MISSION/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 IMMEDIATELY IF 2 IS UNSUCCESSFUL, 4. TERMINATE LOX VENT AFTER 85 MINUTES IF LOX ULLAGE PRESSURE AT 50 PSIA OR SATURATED, BSE INFORM FLIGHT AND RECOMMEND IMMEDIATE SPACECRAFT SEPARATION TO A SAFE DISTANCE.	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 POSTIVE DELTA PRESS LIMITS (FMR7-14). 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
		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 1. ATTEMPT TO TURN OFF AUXILIARY HYDRAULIC PUMP AS SOON AS POSSIBLE	A.1. SYSTEM PRESSURE (D41-403). 2. RESERVOIR LEVEL (L7-403). 3. AFT BUS NO. 2 CURRENT (M22-404). 4. HYDRAULIC RESERVOIR OIL PRESSURE (D42-403). NOTES--- A.1. FAILURE IN HYDRAULIC PUMP DEPLETES AFT NO. 2 BATTERY IN APPROXIMATELY 90 MIN AND OVERHEATS HYDRAULIC SYSTEM IN APPROXIMATELY 70 MIN
		B. TO TURN ON		B. CONTINUE MISSION	CUES---
		1. AS SEQUENCED AND THE HYDRAULIC FLUID TEMP IS BELOW OR PREDICTED TO BE BELOW TO 10 DEG F BEFORE NEXT STATION AOS		BSE INFORM FLIGHT AND 1. ATTEMPT TO TURN AUXILIARY HYDRAULIC PUMP ON	B.1. SYSTEM PRESSURE (D41-403). 2. RESERVOIR OIL LEVEL (L7-403). 3. AFTER BUS NO. 2 CURRENT (M22-404). 4. RESERVOIR PRESSURE (D42-403). 5. HYDRAULIC PUMP INLET OIL TEMP (C50-401).
		2. AT TB6 + 3 MIN 39 SEC	TLI	BSE INFORM FLIGHT AND 2. COMMAND AUXILIARY HYDRAULIC PUMP OFF	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 DELTA V FOR LUNAR IMPACT BASED ON REAL-TIME DECISION OF LUNAR IMPACT TEAM

MISSION RULES

SECTION 7 - SLV - TB5 AND TB7 - CONTINUED

K	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 RATES-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 NOTE 2)
		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 ALER (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 B.1. ABOVE 2. SAME AS B.2. ABOVE 3. SAME AS B.3. ABOVE NOTES 1. IMMEDIATELY AFTER S-IVB CUTOFF, S/C RETURN OF CONTROL TO SATURN OR DURING PROGRAMMED 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 OCURRED. 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 ON 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	

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MISSION RULES

SECTION 7 - SLV - TB5 AND TB7 - CONTINUED

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	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).
	7-11	IU STATE VECTOR DIFFERS FROM THE MSFN STATE VECTOR BY 6 SIGMA IU ERRORS AND CVS UNCERTAINTIES AND IS CONFIRMED BY A COMPARISON OF IMU TO MSFN	LAUNCH	CONTINUE MISSION BSE INFORM FLIGHT AND RECOMMEND IU NAVIGATION UPDATE	CUES--- IF IU AND MSFN DELTA A, DELTA R V, AND DELTA W DOT MAX DIFFER BY THE FOLLOWING AMOUNTS--- 1. AT T PLUS 56 MIN. (A) DELTA A = 1.6 NM (B) DELTA RV = 48575 FT (C) DELTA W DOT MAX = 18.2 FT/SEC WHEN W = 6466 FT 2. AT T PLUS 1 HOUR 45 MIN. (A) DELTA A = 1.8 NM (B) DELTA RV = 83675 FT (C) DELTA W DOT MAX = 19.4 FT/SEC WHEN W = 10822 FT
	7-12	J-2 ENGINE MAIN FUEL VALVE LEAKAGE DURING COAST	EARTH ORBIT	A. CONTINUE ACTION BSE INFORM FLIGHT AND COMMAND (ASAP) 1. MAINSTAGE ENABLE NO. 2 2. BURN MODE A - ON	CUE 1. THRUST CHAMBER TEMP (C199-401) COLDER THAN 160 DEG R 2. FUEL INJECTION TEMP (C200-401) COLDER THAN 160 DEG R 3. MAIN FUEL VALVE POSITION (G4-401) NOTES--- 1. THIS FAILURE WILL REQUIRE EVALUATION OF TRAJECTORY UPDATE AND CONSUMABLES (REF FMR 7-1). 2. THIS FAILURE WILL REQUIRE A 1-SEC FUEL LEAD PRIOR TO TLI IGN AND ENGINE START APPROX 7 SECONDS EARLY.

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	7-13	IU ECS WATER VALVE FAILS TO CYCLE OPEN AND CLOSED A. WATER VALVE CLOSED AND COOLANT INLET CONTROL TEMPERATURE IS 64 DEG F OR HIGHER, AND THE INERTIAL GIMBAL TEMPERATURE IS 117 DEG F OR HIGHER, OR THE LVDA MEMORY TEMP NO.1 OR NO.2 IS 156 DEG F OR HIGHER, OR THE LVOC MEMORY TEMP IS 124 DEG F OR HIGHER	ALL	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. LVOC MEMORY TEMP (C54-603) 6. LVDA TEMP NO. 1 (C55-603) 7. LVDA TEMP NO. 2 (C56-603)
		B. WATER VALVE OPEN AND COOLANT INLET CONTROL TEMP IS 55 DEG F OR LESS, AND THE INERTIAL GIMBAL TEMPERATURE IS 102 DEG F OR LESS, OR THE LVDA TEMP NO.1 OR NO.2 IS 50 DEG F OR LESS, OR THE LVOC TEMPERATURE IS 50 DEG F OR LESS.	EARTH ORBIT TLI TLC	B. CONTINUE MISSION BSE INFORM FLIGHT AND SEND--- 1. ECS LOGIC INHIBIT COMMAND 2. WATER VALVE 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. SPACECRAFT SEPARATION BSE INFORM FLIGHT AND FIDO AND RECOMMEND SPACECRAFT SEPARATION TO A SAFE DISTANCE	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 MINUS 32.5 PSID OR PLUS 42.0 PSID.

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	7-15	S-IVB STAGE PNEUMATIC SUPPLY PRESSURE DECAY EXCESSIVE IN TB5 OR TB7	EARTH ORBIT/ TLC	CONTINUE MISSION BSE INFORM FLIGHT AND 1. ATTEMPT TO TERMINATE PUMP PURGE AND/OR CLOSE AMBIENT HELIUM SUPPLY SHUTOFF VALVE. 2. RE-OPEN AMBIENT HELIUM SUPPLY SHUTOFF VALVE AS REQUIRED.	CUES--- 1. ENGINE PUMP PURGE PRESSURE (D50-403) 2. AMBIENT HELIUM PNEUMATIC SPHERE PRESSURE (D236-403, D256-403). 3. LOX REPRESS SUPPLY PRESSURE (D88-403, D254-403). NOTE--- 1. AN EXCESSIVE PNEUMATIC SUPPLY PRESSURE DECAY IS ONE WHICH WILL RESULT IN DEPLETION OF STAGE PNEUMATIC PRIOR TO COMPLETION OF TB8 FUNCTIONS.
		RULE 7-16 IS RESERVED			
	7-17	LOW LH2 TANK ULLAGE PRESSURE A. LH2 TANK ULLAGE PRESSURE LESS THAN 17 PSIA IN TB 5	EARTH ORBIT/ TLI	CONTINUE MISSION A. CONTINUE MISSION BSE INFORM FLIGHT AND COMMAND--- 1. LH2 TANK VENT VALVES BOOST CLOSE ON AND OFF AND/OR CVS REGULATOR CLOSED. (ORIFICE OPEN) IF THE CONDITION CANNOT BE CORRECTED, 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 DROPS BELOW 19.5 PSIA DURING TB5, RESULTING PROPELLANT LOSSES SHOULD BE INCLUDED IN THE EVALUATION OF CAPABILITY TO ACHIEVE ACCEPTABLE ALTERNATE MISSION PER FMR 7-1.
	7-18	LOW COLD HELIUM SUPPLY PRESSURE A. EXCESSIVE COLD HELIUM SUPPLY PRESSURE DECAY (NOTE 1)	EARTH ORBIT	A. CONTINUE MISSION BSE INFORM FLIGHT AND COMMAND FROM LAST STATION PRIOR TO TB6-- 1. BURNER LOX SHUTDOWN VALVE CLOSE ON	CUE--- 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--- 1. LH2 AND LOX REPRESS VALVE CLOSED.	

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MISSION RULES

SECTION 7 - SLV - TB5 AND TB7 - CONTINUED

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	7-19	LOW LOX TANK ULLAGE PRESSURE 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	A. 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. AMBIENT REPRESS SYSTEM MODE SELECTOR OFF AND CRYO ON. 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)

K	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	7-20	J-2 ENGINE START BOTTLE PRESSURE OUTSIDE RESTART LIMITS	EARTH ORBIT		CUES--- 1. START BOTTLE PRESSURE (D17-401, D241-401)
		A. ABOVE 1400 PSIA DURING ORBITAL COAST FOR FIRST OPPORTUNITY RESTART OR ABOVE 1500 PSIA FOR SECOND OPPORTUNITY RESTART		A. CONTINUE MISSION BSE INFORM FLIGHT AND SEND--- 1. START BOTTLE VENT OPEN FOR 3 SEC 2. REPEAT COMMAND AS NECESSARY TO INSURE A PRESSURE OF LESS THAN 1400 PSIA FOR FIRST OPPORTUNITY RESTART OR 1500 PSIA FOR SECOND OPPORTUNITY RESTART	
		B. ABOVE 1800 PSIA PRIOR TO RESTART		B. SPACECRAFT SEPARATION BSE INFORM FLIGHT AND FIDO AND RECOMMEND SPACECRAFT SEPARATION	
		C. BELOW 800 PSIA (SEE NOTE)	EARTH ORBIT	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	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.

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MISSION RULES

SECTION 7 - SLV - TB5 AND TB7 - CONTINUED

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	7-21	RESERVED			
	7-22	S-IVB LOSS OF HYDRAULIC FLUID	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--- 1. L7-403 PLUS ONE OF THE OTHER CUES ARE REQUIRED FOR IMPLEMENTATION OF THIS RULE. 2. IF ALL 3 CUES ARE FUNCTIONING PROPERLY, THEY ARE REQUIRED FOR IMPLEMENTATION OF THIS RULE.
		RULE NUMBERS 7-23 AND 7-24 ARE RESERVED.			

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MISSION RULES

SECTION 7 - SLV - TB5 AND TB7 - CONTINUED

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	7-25	S-IVB STAGE LOX NONPROPULSIVE 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 + 23 MIN 22.2 SEC	TLC	B. CONTINUE MISSION BSE INFORM FLIGHT AND 1. ATTEMPT TO LATCH OPEN THE LOX VENT IF UNSUCCESSFUL, BSE COMMAND AT TB8 + 23 MIN 30 SEC.--- IF 1 IS UNSECCESSFUL, BSE COMMAND AT TB8 + 23 MIN 30 SEC--- 2. LH2 LATCHING VENT VALVE CLOSED	
	7-26	LH2 LATCHING VENT VALVE FAILS TO LATCH OPEN AS PROGRAMMED	TLC	CONTINUE MISSION BSE INFORM FLIGHT AND	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 (D2-433)
		A. IN TB7		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		CONTINUE MISSION BSE INFORM FLIGHT AND--- 1. ATTEMPT TO LATCH OPEN THE LH2 LATCHING VENT VALVE. IF 1 IS UNSUCCESSFUL, BSE COMMAND (ASAP) 2. LOX NPV UNLATCHED	

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MISSION RULES

SECTION 7 - SLV - TB5 AND TB7 - CONCLUDED

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	CUES--- 1. GH2 START BOTTLE PRESSURE (D17-401, D241-401). NOTES--- 1. THE MAXIMUM SAFE PRESSURE LIMIT IS 600 PSIA AT 70 DEG F.
	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. IF UNSUCCESSFUL, BSE INFORM FLIGHT AND, AFTER LOX NPV OPEN IN T88, COMMAND--- 2. LOX PRESSURIZATION SHUTOFF VALVES OPEN FOR A MINIMUM OF 30 MINUTES	CUES--- 1. COLD HELIUM BOTTLE PRESSURE (D261-403, D263-403). NOTES--- 1. THE MAXIMUM SAFE PRESSURE LIMIT IS 1000 PSIA AT 70 DEG F.
		RULE NUMBERS 7-29 AND 7-30 ARE RESERVED.			

8 SLV – TB6
(RESTART)

R	ITEM

SUMMARY OF RESTART PHASE RULES

8-1 RESERVED

8-2 O2/H2 BURNER LH2 VALVE FAILS

8-3 LH2 CHILLDOWN SYSTEM 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 T86 TO T86 + 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 MINUS 20 PSID OR PLUS 36 PSID (CREW IMPLEMENTATION) PSID OR PLUS 30 PSID, MINUS 26

7-17 LH2 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

MISSION RULES

SECTION 8 - SLV - TB6 - CONTINUED

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. CRYO 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). 3. AMBIENT REPRESSURIZATION MODE SELECT (K195-404). NOTE--- 1. 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	TLI	B. CONTINUE MISSION BSE INFORM FLIGHT AND CMD 1. BURNER SHUTDOWN 2. APS ULLAGE ENGINES ON 3. LH2 REPRESSURIZATION CONTROL VALVE CLOSE 4. LOX REPRESSURIZATION CONTROL VALVE CLOSE	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)
	8-3	LH2 CHILLDOWN SYSTEM FAILS DURING RESTART PREPARATIONS	TLI	CONTINUE MISSION BSE INFORM FLIGHT AND--- 1. ATTEMPT TO CORRECT SITUATION SPECIFIED IN NOTE 1.A, 1.B, 1.D IF UNSUCCESSFUL, USE INFORM FLIGHT	NOTES--- 1. 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

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MISSION RULES

SECTION 8 - SLV - TB6 - CONTINUED

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 DELTA P (D179-406,D180-406,D003-403) 3. LOX PUMP INLET TEMP NOT DECREASING(C4-403) LOX PREVALVE DISCRETES (K109-403,K110-403) LOX BLEED VALVE CLOSED (K126-401) LOX RECIRCULATION VALVE CLOSED (K139-424) CUES FOR MOV FAILURE 1. MOV POSITION GREATER THAN 10 DEG (G3-401) 2. MOV OPEN DISCRETE ON (K120-401) 3. LOX FLOWMETER (F1-401) 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 PROGRAMMED 8 SEC LOX LEAD BEGINNING AT TB6+7 MIN 37.8 SEC.

K	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	8-5	RESERVED			
	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--- 1. 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 CLOSE DURING RESTART SEQUENCE B. REGULATOR FAILS TO CLOSE OR ORIFICE SHUTOFF VALVE FAILS TO CLOSE AT TB7 + 2 MIN 30.9 SEC (NOTE 1)	TLI	CONTINUE MISSION BSE INFORM FLIGHT AND COMMAND--- 1. ATTEMPT TO CLOSE THE CVS REGULATOR IF 1 IS UNSUCCESSFUL, BSE INFORM FLIGHT AND COMMAND-- 2. O2/H2 BURNER SHUTDOWN 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	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 THROUGH D178-408). 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--- 1. THIS FAILURE WILL REQUIRE RE-EVALUATION OF DELTA V 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 NOTE2). 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.

9 SLV-TB8 (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 MINUS 20 PSID OR PLUS 30 PSID, MINUS 26 PSID OR PLUS 36 PSID.

7-25 S-IVB STAGE LOX NON-PROPULSIVE VENT (NPV) FAILS TO OPEN AT TB7 + 0.7 SEC, TO LATCH OPEN AT TB 8 + 17 MIN 3 SEC

7-26 LH2 LATCHING VENT VALVE FAILS TO LATCH OPEN AS PROGRAMMED

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 1. 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--- 1. THE MAXIMUM SAFE PRESSURE LIMIT IS 2000 PSIA AT 210 DEG F.
	9-2	S-IVB LOX DUMP FAILS TO INITIATE	TLC	CONTINUE MISSION BSE INFORM FLIGHT AND ATTEMPT TO INITIATE 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 DELTA VELOCITY WILL BE REQUIRED.
	9-3	ENGINE CONTROL BOTTLE DUMP FAILS TO INITIATE	TLC	CONTINUE MISSION BSE INFORM FLIGHT AND 1. ATTEMPT TO OPEN THE ENGINE HELIUM CONTROL VALVE	CUE--- 1. ENGINE CONTROL REG PRESS (D18-401). 2. ENGINE CONTROL HELIUM SPHERE PRESSURE (D19-401, D242-401). NOTES--- 1. THE MAXIMUM SAFE PRESSURE LIMIT IS 1850 PSIA AT 70 DEG F.
		RULES 9-4 AND 9-5 ARE RESERVED.			

R | ITEM

PRELAUNCH INSTRUMENTATION

MEASUREMENT DESCRIPTION	MEAS NUMBER ONBOARD	TRANSDUCERS	CATEGORY	EFFEC-TIVITY	MISSION RULE REF
STAGE COMMUNICATIONS SYSTEM AND FLIGHT CONTROL MEASUREMENT CATEGORIZATION					
STAGE COMMUNICATIONS SYSTEM					
S-II STAGE					
LINK BP1			HD		
MUX BP1AO			HD		
MUX BP1BO			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
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 DIS-
PLAY MANDATORY

10 CSM ENVIRONMENTAL CONTROL SYSTEM

R	ITEM	

GENERAL

10-1 LAUNCH

LAUNCH WILL BE CONTINUED AS LONG AS THE SUIT CIRCUIT AND O2 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.

K	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 INTEGRITY---

TOTAL PGA AND SUIT LOOP LEAKAGE IS GREATER THAN 0.5 PSI/MIN (1.5 LB/HR) DURING PGA SUIT LOOP PRESSURE CHECK.

LOSS OF SUIT CIRCUIT---

INABILITY OF THE SUIT CIRCUIT TO MANTAIN ADEQUATE CREW COMFORT AND/OR CO2 REMOVAL WITHOUT USING DIRECT O2.

LOSS OF O2 MANIFOLD---

AN O2 MANIFOLD OR REGULATOR FAILURE WITH WHICH THE SUIT CIRCUIT O2 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 COOLANT 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	O2 SYSTEM

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

B. NORMAL CM REPRESSURIZATION WITH LM MANNED WILL UTILIZE THE REPRESS PACK.

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

D. THE SUIT CIRCUIT MUST BE PURGED OF ACCUMULATED H2 ONCE EVERY 6 HOURS FOR ONE 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 AND E.

G. THE CM ECS WILL NORMALLY SUPPLY ALL O2 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 AND E.
3. GLYCOL LEAKS IN COMMAND MODULE
4. FIRE, SMOKE, CONTAMINATION IN CABIN

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, NORMALLY EITHER THE PRIMARY OR SECONDARY LOOP RADIATOR WILL 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 25 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 SEXTENT STAR CHECK IN MANEUVER PREPARATION - OR CISLUNAR NAVIGATION - OR NO LATER THAN ONE 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

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 DESCENT	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 UPON 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)
			EO	B. ENTER NEXT BEST PTP-	
				1. DOFF SUITS	
				2. OPEN WASTE OVERBOARD DRAIN VALVE TO OBTAIN CABIN BLEED FLOW	B.2. WASTE OVERBOARD BLEED = 1.0 LB O2/HR
				3. DON FACE MASKS AFTER 1 HOUR	3. TIME REQUIRED FOR CM CO2 PARTIAL PRESSURE TO INCREASE TO 7.6 MM HG--- 1 CREWMAN---4 HR 3 CREWMAN---80 MIN
			PRE-PDI	C. ENTER NEXT BEST PTP- NO-GO FOR PDI. RETAIN LM DESCENT STAGE FOR TEI IF POSSIBLE	
			POWERED DESCENT	D. CONTINUE MISSION- NO-GO FOR LUNAR STAY	
			ALL	E. ENTER NEXT BEST PTP	

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MISSION RULES

SECTION 10 - CSM ENVIRONMENTAL CONTROL SYSTEM - CONTINUED

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	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 LBS/OPS (TWO OPS AVAILABLE)
			TEC	C. CONTINUE MISSION DOFF SUITS FOR ENTRY. NO-GO FOR CSM EVA	
	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.	

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	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	
	10-28	LOSS OF O2 MANIFOLD			
		A. O2 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 O2 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 FOR CSM EVA	
		B. O2 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	LM O2 (IF AVAILABLE) MAY BE USED TO SUPPLEMENT CSM SUPPLY.
	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	
			ALL	2. CONTINUE MISSION	
		B. FAILED OPEN	ALL	B. CONTINUE MISSION	

RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
10-30	BOTH MAIN REGULATORS FAILED CLOSED			LM SYSTEMS (IF AVAILABLE) MAY BE USED IN LIEU OF CSM SYSTEMS.
		LAUNCH	A. CONTINUE MISSION	
		LO	B. NO-GO FOR UNDOCKING	
		UNDOCKED/ PRE-PDI POWERED DESCENT/ LUNAR STAY	C. CONTINUE MISSION	
		ALL	C. ENTER NEXT BEST PTP-NO-GO FOR CSM EVA	C. SUIT LOOP PRESSURE WILL DROP FROM 3.75 PSIA TO 2.5 PSIA IN APPROXIMATELY 9 MINUTES.
10-31	LOSS OF ONE SUIT COMPRESSOR	ALL	A. CONTINUE MISSION	
10-32	LOSS OF TWO SUIT COMPRESSORS	LAUNCH	A. CONTINUE MISSION-OPEN DIRECT O2 45 DEG FROM LAUNCH SETTING	VACUUM CLEANER MAY BE CONNECTED TO SUIT LOOP BUT WILL NOT PROVIDE SUIT INTEGRITY. CONSIDERATION WILL BE GIVEN TO RETAINING LM.
		E.O.	B. CONTINUE MISSION-NO-GO FOR TLI	
		LO	C. NO-GO FOR UNDOCKING	
		ALL	C. CONTINUE MISSION-NO-GO FOR CSM EVA	
	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 80 DEG F OR AS REQUIRED FOR CREW COMFORT.	A.2.(A) MAINTAIN PRI RAD OUT TEMP GREATER THAN-20 DEG F. 2.(B) WATER MANAGEMENT MAY DICTATE ACTIVATION AND DEACTIVATION OF SECONDARY LOOP TO MAINTAIN PRIMARY RAD OUT TEMP BETWEEN 45 AND 80 DEGREES 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.	

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	10-41	SECONDARY LOOP MALFUNCTIONS			
		A. LOSS OF EVAPORATOR	ALL	A. CONTINUE MISSION	
		B. LOSS OF RADIATORS	EO	B. CONTINUE MISSION	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	
	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	

K	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	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 O2.	
			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	
			FO	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.			

K	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	UNCONTROLABLE HIGH HUMIDITY			LM SYSTEMS MAY BE USED FOR HUMIDITY CONTROL.
			LAUNCH	A. CONTINUE MISSION	
			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			LM SYSTEMS (IF AVAILABLE) MAY BE USED TO SUPPLEMENT CSM WHEN POTABLE WATER TANK BECOMES FULL, FUEL CELL WATER WILL BE DUMPED THROUGH OVERBOARD PRESSURE RELIEF VALVES.
			ALL	CONTINUE MISSION	

SECTION 10 - CSM ENVIRONMENTAL CONTROL SYSTEM - CONCLUDED

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	10-53	CONFIRMED LEAK IN POTABLE WATER TANK OR UNABLE TO TRANSFER FUEL CELL WATER TO POTABLE TANK.			LM SYSTEMS (IF AVAILABLE) MAY BE USED TO SUPPLEMENT CSM. WATER STORAGE BAG (S) WILL BE USED AS BACKUP WATER TANK.
			LAUNCH	A. CONTINUE MISSION	
			ALL	B. CONTINUE MISSION	
		RULE NUMBERS 10-54 THROUGH 10-59 ARE RESERVED.			

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INSTRUMENTATION REQUIREMENTS

10-60 MEAS DESCRIPTION	FCM	ONBOARD	TRANSDUCER	CATEGORY	REFERENCE
CABIN PRESS	CF0031P	METER	COMMON	1 OF	10-20
SUIT PRESS	CF0012P	METER	COMMON	3 M	
TANK BLADDER PRESS	CF0120P	-----	------		
SUIT PRESS (CUFF GAGES)	-------	-----	------	MANDATORY (EACH CREWMAN)	10-21
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	CF0039Q	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	CF0072P	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	SF0236T	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 MUCH AS 3 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 O2 TANKS. IF THIS CAPABILITY IS POTENTIALLY JEOPARDIZED BY CRYO SYSTEMS DEPLETION OR MALFUNCTION, MISSION TERMINATION PROCEDURES WILL BE ENACTED IN WHATEVER TIME FRAME IS APPROPRIATE OR AVAILABLE. ANY ENTRY BATTERY OR ENTRY O2 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 O2 AND 100 PSIA FOR H2.

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 O2 TANK LOSS OF 2 HEATERS AND ONE FAN IN H2 TANKS 1 AND 2 OR BOTH FANS IN H2 TANK 3.

11-5 THE LUNAR MISSION WILL BE CONTINUED IF THE H2 AND O2 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 (O2,H2) IS AVAILABLE TO PERFORM AN ENTRY INTO THE NEXT DAILY GO/NO-GO AREA.

RULE NUMBERS 11-7 THROUGH
11-9 ARE RESERVED.

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* 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 H2 TANK 3, WHICH WILL UTILIZE AUTO FANS.

B. MANUAL PRESSURE CONTROL WILL NORMALLY BE USED AS REQUIRED TO MAINTAIN---

1. TANK PRESSURES GREATER THAN 750 PSIA O2 AND 200 PSIA FOR H2.

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. H2 TANK 3 FANS WILL NOT BE OPERATED IN THE AUTO MODE.

E. O2 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 O2 FOR THE ECS.

11-11 CRYO GAGING

A. ONBOARD CRYOGENIC QUANTITY GAGING IS PRIME. ACCURACY IS +/-2.65 PERCENT (+/-8.48 LB O2, +/-0.72 LB H2) PER TANK. INSTANTANEOUS O2 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.

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MISSION RULES

SECTION 11 - CSM CRYOGENICS - CONTINUED

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 IF OTHER TWO TANKS MEET REDLINE CRITERIA.	
			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	
			E.O.	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. CONTINUE MISSION-NO-GO TLI ENTER NEXT BEST PTP-NO-GO LOI CONTINUE MISSION-NO-GO LUNAR STAY	
			POST DOCK	C. ENTER NEXT BEST PTP-JETTISON LM.	
	11-23	LOSS OF 3 O2 TANKS AND/OR 3 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
	11-50

INSTRUMENTATION REQUIREMENTS

MEAS DESCRIPTION	PCM	ONBOARD	TRANSDUCERS	CATEGORY	MISSION RULE REFERENCE
O2 TANK 1 QTY	SC0032Q	METER	COMMON	2 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	2 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	2 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	2 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 DELTA V'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 +/- 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.

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 H2 LOOP IS CONTAMINATED WITH KOH.

C. REGULATED H2 PRESSURE IS LESS THAN 36.7 PSIA (CORRESPONDS TO N2 PRESSURE SHIFT DOWN TO 28.2 PSIA FOR CRITICAL OPERATION- LOWER N2 PRESSURE CAN BE MANAGED BY TURNING OFF H2O TANK PRESSURE).

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. 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.

H. THE AUX BATTERY WILL NOT BE USED FOR NORMAL MISSION OPERATIONS.

K	ITEM	
	12-22	FUEL CELL MANAGEMENT

A. FUEL CELL WILL BE 'SHUTDOWN' FOR THE FOLLOWING---

1. SUSTAINED CURRENT OUTPUT LESS THAN 5 AMPS
2. FUEL CELL H2 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 DEG F.
2. TCE TEMP GREATER THAN 225 DEG F.
3. FAILURE OF H2 PUMP OR GLYCOL PUMP
4. VOLTAGE MANAGEMENT
5. FUEL CELL CANNOT BE PURGED AND TIME TO GO IS GREATER THAN PREDICTED FUEL CELL LIFETIME

C. FUEL CELL O2 AND H2 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 H2 PURGE WILL NORMALLY BE PRECEDED BY 20 MINUTES OF H2 VENT HEATER OPERATION FOLLOWED BY 10 MINUTES OF HEATER OPERATION AFTER PURGE COMPLETION.

G. FC INLINE HEATERS WILL NORMALLY OPERATE IN 'AUTO' CONTINUOUSLY.

H. REACTANT VALVES MUST REMAIN OPEN AT ALL TIMES UNLESS THE FUEL CELL IS DECLARED FAILED.

I. ADDITIONAL POWER LOADS WILL BE ADDED AS REQUIRED TO MAINTAIN FC RAD OUT TEMP GREATER THAN -40 DEG. IF CRYO BUDGET JEOPARDIZED OR RAD OUT TEMPS NOT MAINTAINED GREATER THAN -40 DEG, 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 SHUTDOWN OR OPEN-CIRCUIT A FUEL CELL, THEN FUEL CELL 2 WILL BE SELECTED.

12-23 INVERTER MANAGEMENT

INVERTERS MAY BE REMOVED FROM LINE FOR ANY OF THE FOLLOWING REASONS---

A. INVERTER TEMP GREATER THAN 190 DEG F

B. SPACECRAFT LOAD MANAGEMENT

RULE NUMBERS 12-24 THROUGH
12-29 ARE RESERVED

K	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 1. 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 BATTERY OR AUX BAT MAY BE USED TO SUPPLEMENT REMAINING FC FOR G AND N ALIGNMENT PRIOR TO DEORBIT. E.2 REF CREW EMERGENCY POWERDOWN PROCEDURE.

K	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	12-32	LOSS OF THREE FUEL CELLS			LM SYSTEMS (IF AVAILABLE) MAY BE USED TO SUPPLEMENT FUEL CELL POWER.
		A. OUTPUT LESS THAN 10 AMPS EACH	LAUNCH	A. CONTINUE MISSION	
				1. AFTER 2 + 00 EDS AUTO/OFF TO OFF.	
				2. TIE BAT C TO BOTH MAIN BUSES.	
				3. TIE AUX BAT TO MAIN A.	A.3. 4.75 HOURS LEFT IN ORBIT BEFORE DEORBIT MANEUVER.
				4. POWER DOWN TO 50 AMPS AND ENTER 3-1 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.
			EC	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	

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SECTION 12 - CSM ELECTRICAL POWER SYSTEM - CONTINUED

K	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	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 BATTERY C TO BOTH MAINS.
	12-42	LOSS OF BATTERY CHARGER	EC	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 45.8 AMP HRS.	
			LO	C. NO-GO FOR UNDOCK IF SUM OF TWO LOWEST ENTRY BATTERIES LESS THAN 42.8 AMP HRS.	
	12-43	LOSS OF AUX BAT	ALL	CONTINUE MISSION	
		RULE NUMBERS 12-44 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.	
			ALL	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	ALL	B. CONTINUE MISSION USE CB'S AS MOTOR SWITCHES.	B. IF BOTH MOTOR SWITCHES FAIL CLOSED, BATTERIES CANNOT BE CHARGED.

K	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	A. BATTERY BUS SHORTED GREATER THAN 5 AMPS	LAUNCH	A.1. CONTINUE MISSION (A) PLACE EDS AUTO/OFF TO OFF. (B) OPEN ASSOCIATED MAIN BUS TO BAT BUS CB. (C) 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. BATTERY BUS SHORTED 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 CONTINOUSLY WITH BAT B POWER ENTRY AND POST LANDING CB OPEN. CONSIDER BATTERY CHARGER LOST FOR MISSION PLANNING.

K	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.RETAIN 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.			

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	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	
	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.			

201

R	ITEM
	12-70

INSTRUMENTATION REQUIREMENTS

MEAS DESCRIPTION	PCM	ONBOARD	TRANSDUCERS	CATEGORY	MISSION 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	12-32,52,20C
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	SC2141R	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	SC2142R	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 BATT (SM BATT)	SC0230V	------	------	HIGHLY DESIRABLE	

NOTE--- USE BAT C IN LIEU OF BATTERY WITH LOST INST

* COMMON SHUNT FOR FC 2 AND AUX BATT 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/UNLOCKED MECHANISM, THE NOMINAL MISSION WILL BE PERFORMED USING THE SECONDARY LOCK/UNLOCK MECHANISM.
	13-5	LOSS OF VISUAL DOCKING AIDS (CCAS AND TARGETS) WILL NOT INHIBIT DOCKING AND UNDOCKING.
	13-6	IF THE DOCKING PROBE FAILS TO INDICATE EXTENSION OR IF BOTH TALK BACK INDICATORS* ARE BARBER POLE, TD&E WILL BE ATTEMPTED. *NOTE---THE ONLY DOCKING PROBE INSTRUMENTATION CONSISTS OF TWO TALK BACK 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 ONE NITROGEN BOTTLE REMAINING IN AN OPERABLE SYSTEM.

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 JETTS
0 PSIA	NO MORE THAN 4 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	● ANUN/DOCK/COMPNT CB MUST BE OPENED BEFORE 9 HRS AFTER CSM SEPARATION BECAUSE OF THERMAL CONSTRAINTS OF THE LIGHTING CONTROL ASSEMBLY (LCA). ● NOMINAL MISSION MAY BE PERFORMED BECAUSE LCA, ECA, AND BATTERY THERMAL CONSTRAINTS WILL NOT BE VIOLATED. ● 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 TALK BACK 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.	

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MISSION RULES

SECTION 13 - DOCKING AND UMBILICAL - CONCLUDED

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 AND 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 OR SECONDARY DOCKING SYSTEM	ALL	CONTINUE MISSION	

14 CSM SEQUENTIAL

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			CD0170X AND/OR CD0123X SYSTEM A, CD0171X AND/OR CD0124X SYSTEM B
			LAUNCH	A. CONTINUE MISSION- ENTER 3-1 IF BUS NOT RESTORED	
			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. USE BATTERY TIE FOR PYRO POWER TO AFFECTED BUS.
		B. SHORTED LESS THAN 10 AMPS	ALL	B. CONTINUE MISSION	
		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 = TO BAT BUS VOLTAGE.

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	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.
	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 ALL	CONTINUE MISSION IF SOURCE OF ACTIVATION CAN BE DETERMINED AND ISOLATED. ENTER NEXT BEST PTP IF SOURCE OF ACTIVATION CAN NOT BE ISOLATED. 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

K	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	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 CDC124X
	14-27	UNABLE TO PERFORM SLA SEPARATION	TLC	ENTER NEXT BEST PTP	
	14-28	ACTIVATED APEX JETTISON LOGIC RELAYS	LUNAR ORBIT/ LUNAR STAY ALL	A. CONTINUE MISSION- DO NOT ARM PYRO BUSES UNTIL MALFUNCTION HAS BEEN ISOLATED B. ENTER NEXT BEST PTP- DO NOT ARM PYRO BUSES UNTIL MALFUNCTION HAS BEEN ISOLATED.	DETECTED AT SECS POWER UP (CD0230X AND CD023X)

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 ELS BAT A(B) CB CLOSED.
			ALL	B. ENTER NEXT BEST PTP- DO NOT ARM PYRO BUSES UNTIL MALFUNCTION HAS BEEN ISOLATED	
		RULE NUMBERS 14-31 THROUGH 14-49 ARE RESERVED.			

214

K | ITEM

INSTRUMENTATION REQUIREMENTS

14-5C	MEAS DESCRIPTION	PCM	ONBOARD	TRANSDUCERS	CATEGORY	MISSION RULE REFERENCE
	PYRO BUS A VOLTS	CD0035V	-----	------	1 OF	14-21
	PYRO BUS B VOLTS	CD0036V	-----	------	2 M	14-21
	SEQ LOGIC BUS A VOLTS	CD0230V	-----	------	HD	14-29
	SEQ LOGIC BUS B VOLTS	CD0231V	-----	------	HD	14-29
	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 CMC EXCLUDED).

3. BACKUP DEORBIT--- AS LONG AS ENOUGH PROPELLANT IS AVAILABLE FOR AN SM DEORBIT, THE G AND C SYSTEMS MUST PROVIDE THAT CAPABILITY. IF SM DEORBIT IS NOT POSSIBLE DUE TO LACK OF PROPELLANT OR A SYSTEMS FAILURE, THE G AND C SYSTEMS MUST PROVIDE CAPABILITY FOR A HYBRID DEORBIT.

(A) SM DEORBIT REQUIREMENTS---

- TRANSLATION CAPABILITY
- ONE OPERATIONAL FDAI
- RATE DAMPING IN ALL THREE AXES, DAP OR SCS

(B) HYBRID DEORBIT REQUIREMENTS---

- ALL SM DEORBIT REQUIREMENTS (RATE DAMPING MUST BE SCS)
- OPERATIONAL IMU, CMC, AND MAIN DSKY
- TWO OPERATIONAL RHC'S

B. IN ORDER TO PERFORM A NON-CRITICAL BURN AFTER THE STORAGE TANKS ARE EMPTY, THE G AND 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 SPS NON-CRITICAL GUIDANCE AND CONTROL SYSTEMS BURN CAPABILITY. THE FOLLOWING MINIMUM CAPABILITIES MUST ALSO BE AVAILABLE TO BE GO FOR TLI---

1. ATTITUDE CONTROL--- DIRECT RCS AND RATE DAMPING IN EACH AXIS.

2. TVC--- TWO SERVO LOOPS AND BOTH G AND N TVC AND ONE SCS TVC CONTROL MODE (ACCEL CMD EXCLUDED).

3. G AND N--- CMC, IMU, AND ONE DSKY FULLY OPERATIONAL AND OPTICS OR COAS CAPABLE OF ALIGNING PLATFORM.

4. DISPLAYS--- ONE OPERATIONAL FDAI.

5. ATTITUDE REFERENCE--- REDUNDANT ATTITUDE SOURCES ARE REQUIRED FOR HIGH-SPEED ENTRY

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 AND RATE DAMPING IN EACH AXIS.

B. RCS TRANSLATION--- X-AXIS VIA AUTO COILS OR DIRECT ULLAGE PUSHBUTTON.

K	ITEM	
	15-4	LOI IN ORDER TO COMMIT TO LOI, THE FOLLOWING MINIMUM CAPABILITIES MUST BE AVAILABLE--- A. ATTITUDE CONTROL--- DIRECT RCS 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 TVC CONTROL MODES (ACCEL CMD EXCLUDED). C. G AND N--- THE G AND N MUST BE FULLY OPERATIONAL WITH THE EXCEPTION OF OPTICS AND ONE DSKY D. SPS--- NONCRITICAL BURN CAPABILITY IS REQUIRED
	15-5	LUNAR ORBIT A. LUNAR ORBIT WILL BE TERMINATED EARLY IF EITHER REDUNDANT ATTITUDE CONTROL OR NONCRITICAL SPS CAPABILITY IS LOST. REDUNDANT SPS CONTROL IS REQUIRED IF LM DPS IS NOT AVAILABLE FOR TEI. B. IN ORDER TO PERFORM A NONCRITICAL BURN, THE G AND 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--- - OPERATIONAL OPTICS OR VHF SUBSYSTEM AND CLAS - ONE DSKY - TRANSLATION CAPABILITY IN EACH AXIS - RATE DAMPING IN TWO AXES - OPERATIONAL IMU AND CMC - ONE OPERATIONAL RHC - ONE OPERATIONAL FDAI - DIRECT RCS IN ALL THREE AXES - NONCRITICAL SPS BURN CAPABILITY

K	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 AND N---THE G AND 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 +/-.003 FT/SEC2. THE FAILURE LIMIT ON THE CSM ACCELEROMETER IS +/-.164 FT/SEC2. THE FIRST GYRO BIAS DRIFT WILL BE UPDATED IF THE DRIFT IS +/- 1 MERU (.015 DEG/HR). THEREAFTER, +/- 3 MERU (+/- .045 DEG/HR) WILL BE THE UPDATE CRITERIA. THE FAILURE LIMIT ON THE CSM GYRO IS +/- 100 MERU (+/- 1.5 DEG/HR).

15-12 DELTA V COUNTER DRIFT

A. FOR SPS BURNS, THE DELTA V COUNTER SHOULD BE APPROPRIATELY BIASED FOR DRIFTS OF GREATER THAN 0.03 FT/SEC2.

B. FOR RCS BURNS, THE DELTA V COUNTER WILL BE BIASED FOR DRIFTS GREATER THAN OR EQUAL TO 0.01 FT/SEC2. SHOULD THE DRIFT BE GREATER THAN 0.1 FT/SEC2 , THE EMS WILL BE CONSIDERED FAILED.

15-13 DAP INITIALIZATION

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.

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 CONSTRANTS

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 TBD LB THRUST.

RULE NUMBERS 15-15 THROUGH
15-19 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	A. REF MALF PROC--- G AND C-1,3,4+8 SCS-1,3,3A,+6 B. NO SCS AUTO TVC C. IF IN YAW CHANNEL, AFTER .05G RSI IS USABLE 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	IN EARTH ORBIT, LOSS OF PITCH CHANNEL RESULTS IN ALL THREE DEORBIT METHODS BEING SUBJECTED TO SINGLE FAILURES IN THE G AND N SYSTEM. THE YAW LOSS PRECLUDES HYBRID DEORBIT AND SUBJECTS BOTH REMAINING DEORBIT METHODS TO SINGLE FAILURES IN THE G AND 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.
			ALL OTHERS	D. 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 ALTERNATE EO 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-ENTER NEXT BEST PTP IF LM DPS NOT AVAILABLE FOR TEI	C. IN LUNAR ORBIT, PLAN DPS 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 AND C-1, G AND 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 ENTER NEXT BEST PTP	E. IN LUNAR ORBIT, DO DPS TEI.
	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 USE DIRECT RCS OR ACCEL CMD FOR MANUAL MANEUVERS	B. NO MTVC RATE OR MTVC ACCEL CMD CAPABILITY

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	
			LUNAR STAY	3. CONTINUE MISSION	
			CSM EVA	4. CONTINUE MISSION	
			ALL OTHERS	5. 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&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	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			- 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 . 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 OPS TEI.

K	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	15-31	LOSS OF AC2 PHASE A			- 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 . 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 AND C-4+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 AND C-1

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	VIOLATES LM RESCUE MINIMUM REQUIREMENTS.
			UNDOCKED	E. DOCKED	
			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 AND 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. NO-GO FOR LOI	
			LO	D. NO-GO FOR UNDOCKIG- ENTER NEXT BEST PTP IF LM DPS NOT AVAILABLE FOR TEI	D. IN LUNAR ORBIT, PLAN DPS TEI
			UNDOCKED	E. DOCK	F. VIOLATES LM RESCUE MINIMUM REQUIREMENTS
			DESCENT	F. CONTINUE MISSION	
			POST DOCK	G. RETAIN LM ASCENT	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	
	15-51	LOSS OF DSKY			REF MALF PROC G AND 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 LAUNCH/EO MISSION IF BOTH SPS AND SM DEORBIT CAPABILITY AVAILABLE	B.2. VIOLATES HYBRID DEORBIT MINIMUM REQUIREMENTS
			TLC	3. NO-GO FOR LOI	
			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
			DECENT	6. CONTINUE MISSION	
			POST DOCK	7. RETAIN LM ASCENT	7. USE LM FOR COMM B/U
			ENTRY	8. PERFORM BACKUP ENTRY	
			ALL OTHERS	9. TERMINATE PHASE AND ENTER NEXT BEST PTP	

MISSION RULES

SECTION 15 - GUIDANCE AND CONTROL - CONTINUED

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	15-52	LOSS OF INERTIAL SUBSYSTEM			REF MALF PROC G AND 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	G. USE LM G AND N TO MONITOR BURNS
			CSM EVA	H. CONTINUE MISSION	
			ENTRY	I. PERFORM BACK UP ENTRY	
			ALL OTHERS	J. TERMINATE PHASE AND ENTER NEXT BEST PTP	J.1. VIOLATES LM RESCUE MINIMUM REQUIREMENTS
	15-53	LOSS OF OPTICS SUBSYSTEM	ALL	CONTINUE MISSION-USE BACKUP ALIGNMENT PROCEDURE (COAS)	REF MALF PROC G AND N-5

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MISSION RULES

SECTION 15 - GUIDANCE AND CONTROL - CONTINUED

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	15-54	LOSS OF OPTICS SUBSYSTEM COUPLING DATA UNIT DIGITAL-TO-ANALOG CONVERTER			REF MALF PROC G AND G-1 CONSTITUTES LOSS OF TVC DAP
			LAUNCH	A. CONTINUE MISSION	
			EO	B. CONTINUE ALTERNATE EO MISSION IF BOTH SPS AND SM DEORBIT CAPABILITY AVAILABLE	
			TLC	C. NO-GO FOR LCI	
			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

15-60

INSTRUMENTATION REQUIREMENTS

MEAS DESCRIPTION	PCM	ONBOARD	TRANSDUCERS	CATEGORY	MISSION 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 -OB/HD-PCM	15-24/25
YAW GIMBAL POS 1 & 2	CH3518H	GPI	COMMON	1 OF 2 MANDATORY -OB/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 FAIL 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 A 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 SMRCS 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. HOWEVER, ONCE INITIATED WITH THE SPS, THESE BURNS ARE CONSIDERED NON-CRITICAL BECAUSE SUFFICIENT TIME IS AVAILABLE FOR ANALYSIS AND POSSIBLE CORRECTIVE ACTION. B. IF THE SPS IS INCAPABLE OF PERFORMING NON-CRITICAL MANEUVERS, FURTHER NON-CRITICAL BURNS AND LOI WILL BE INHIBITED. C. CERTAIN ABORT BURNS, BURNS TO ASSURE FREE RETURN OR BURNS TO AVOID LUNAR OR LAND IMPACT MAY USE THE LM DPS AND LM RCS.

R	ITEM	
	16-6	LUNAR ORBIT PHASE A. TEI IS THE ONLY CRITICAL BURN IN THIS PHASE. B. IF THE SPS IS INCAPABLE OF PERFORMING NON-CRITICAL BURNS, FURTHER NON-CRITICAL BURNS WILL BE INHIBITED. C. LM DPS MAY BE USED FOR TEI IF THE CAPABILITY EXISTS. D. TERMINATE PHASE FOR LOSS OF SPS REDUNDANCY WHEN DPS IS NOT AVAILABLE FOR TEI OR FOR COMPLETE LOSS OF SPS.
	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 ONLY FOR SPS PROPELLANT LEAKS.
	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. HOWEVER, ONCE INITIATED, THESE BURNS ARE CONSIDERED NON-CRITICAL BECAUSE SUFFICIENT TIME IS THEN AVAILABLE FOR ANALYSIS AND POSSIBLE CORRECTIVE ACTION. B. CSM EVA WILL BE NO-GO/TERMINATED FOR SPS PROPELLANT LEAKS.
	16-11	CONSIDERATION WILL BE GIVEN TO RETAINING THE LM ASCENT STAGE TO GAIN ADDITIONAL DELTA V FOR CERTAIN SPS FAILURES.

R | ITEM

SYSTEMS MANAGEMENT

16-12 PROPELLANT GAGING

A. FOR BURNS LESS THAN 25 SECONDS DURATION---

1. PRIME METHOD----IMU DELTA V OBTAINED

2. BACKUP METHOD----FLOW RATE X BURN TIME

B. FOR BURNS GREATER THAN 25 SECONDS DURATION---

1. PRIME METHOD----IMU DELTA V 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 OCCURING APPROXIMATELY 25 SEC AFTER LOI IGNITION.

B. AFTER CROSSOVER---WITHIN +/- 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 6 SECONDS. THE FIRST BURN WILL BE STARTED ON BANK A.

16-15 PROPELLANT MANAGEMENT

A. THE SPS PROPELLANT REDLINE PRE-UNDOCKING IS TBD PERCENT REMAINING. THIS PROVIDES FOR CIRC, PROVIDES FOR LOI, DOI, CIRC, LOPC, LM RESCUE, TEI (91 HR RETURN), AND TEMC'S (3 SIGMA SCS CUTOFF ON TEI). THIS REQUIRES A TOTAL DELTA V OF TBD FPS.

B. THE SPS PROPELLANT REDLINE PRE-UNDOCKING IS TBD PERCENT REMAINING. THIS PROVIDES FOR CIRC, LOPC, LM RESCUE, TEI (TBD-HR RETURN), AND TEMC'S (3 SIGMA SCS CUTOFF ON TEI). THIS REQUIRES A TOTAL OF DELTA V OF TBD FPS.

C. THE SPS PROPELLANT REDLINE PRE LOI FOR A MINIMUM PHOTO MISSION IS TBD REMAINING, THIS PROVIDES FOR LOI 1 (60 X 170), LOI 2 (60 X 60), TEI 99-HR RETURN, AND TEMC'S. THIS REQUIRES A TOTAL DELTA V OF TBD FPS ASSUMING A NOMINAL TLC TRAJECTORY.

16-16 PROPELLANT FEEDLINE TEMPERATURE MANAGEMENT

SPS LINE HEATERS WILL BE MANUALLY CYCLED TO MAINTAIN FEEDLINE TEMPERATURES BETWEEN 45 DEG F AND 75 DEG F AND ENGINE VALVE TEMPERATURE ABOVE 45 DEG 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)	LAUNCH	CONTINUE MISSION	MALF PROC--- SPS 18 REF MR 3-86 MANEUVER TABLE . MANUAL PRESSURIZATION OF THE TANKS SHOULD BE CONSIDERED PRIOR TO ANY REQUIRED SPS BURN.
				PLAN RCS DEORBIT AT NEXT BEST PTP 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 LCI-INHIBIT NON-CRITICAL SPS BURNS. ENTER NEXT BEST PTP-DO OPS TEI.	
			LO	PLAN TEI ASAP/NO-GO COI-USE LM 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	NO-GO/TERMINATE	
		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 GN_2 TANK PRESSURE (LESS THAN 400 PSI)	EO ALL OTHERS	1. NO-GO FOR TLI 2. VERIFY OPERATION OF SUSPECTED TANK BY STARTING ON SUSPECT BANK 3. IF LOSS CONFIRMED BY ENGINE OPERATION REF MR 16-22.	MALF PROC--- SPS 9 . TRANSDUCER INDICATION CANNOT BE VERIFIED WITHOUT ENGINE OPERATION.

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MISSION RULES

SECTION 16 - CSM SPS - CONTINUED

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 EO MISSION-NO-GO FOR TEI	
			TLC	B. GO FOR LOI	
			LO	C. NO-GO FOR UNDOCKING-ENTER NEXT BEST PTP IF LM OPS 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)	LAUNCH	A. CONTINUE MISSION	. MALF PROC--- SPS 9
			EO	B. ENTER NEXT BEST PTP-RCS DEORBIT	. TRANSDUCER INDICATION CANNOT BE VERIFIED WITHOUT ENGINE OPERATION.
			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 ASAP	
			TEC	H. CONTINUE MISSION	
		FUEL FEEDLINE AND/OR OXIDIZER FEEDLINE TEMP LESS THAN 40 DEG F AND UNABLE TO INCREASE.			MALF PROC--- SPS 11 LIMITATION FOR CRITICAL BURNS IS 25 DEG 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 DEG F DURING AN SPS BURN.			NOT APPLICABLE FOR APOLLO 15. THE FLANGE TEMP MEASUREMENT HAS BEEN REMOVED FROM TM FOR CSM 112 ONLY.
			LAUNCH	NOT APPLICABLE	
			EO	ENTER NEXT BEST PTP-	
				RCS DEORBIT	
			TLC	NO-GO FOR LCI/DOI/PDI	
			LC	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
			LAUNCH	A. NOT APPLICABLE	. CONFIRMING INSTRUMENTATION INCLUDES ONBOARD PC METER, CREW, DEGRADED THRUST, FU AND OX INTERFACE PRESSURES, F/O VALVE POSITIONS, FU AND OX TANK PRESSURES.
			EO	B. ENTER NEXT BEST PTP- RCS DEORBIT	
			TLC	C. NO-GO FOR LCI/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 NO-CRITICAL BURNS	

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MISSION RULES

SECTION 16 - C&M SPS - CONTINUED

K	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	16-27	LACK OF ULLAGE CAPABILITY	LAUNCH	A. NOT APPLICABLE	
			EO	B. NO-GO FOR TLI- CONTINUE MISSION IN EO WITH SUITABLE ALTERNATE	
			TLC	C. NO-GO FOR LOI	
			LO	D. NO-GO FOR UNDOCKING- ENTER NEXT BEST PTP IF OPS NOT AVAILABLE FOR TEI	D. PRECLUDES LM RESCUE. PLAN OPS TEI.
			UNDOCKED	E. REDOCK	
			ALL OTHERS	F. CONTINUE MISSION- INHIBIT NON-CRITICAL BURNS IF POSSIBLE	
	16-28	DELTA P BETWEEN FUEL AND OX TANK PRESSURES GREATER THAN 20 PSI AND UNABLE TO DECREASE	LAUNCH	A. CONTINUE MISSION	HALF PROC--- SPS IC
			EO	B. ENTER NEXT BEST PTP- RCS DECRBIT	
			TLC	C. NO-GO FOR LOI	
			LO	D. ENTER NEXT BEST PTP	D. DO OPS 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 DELTA V REMAINING IS A FUNCTION OF ULLAGE VOLUME AT TIME OF FAILURE.
			LAUNCH	A. CONTINUE MISSION	HALF PROC--- SPS 7 AND 8
			EO	B. NO-GO FOR TLI- CONTINUE MISSION IN EO IF SUFFICIENT ULLAGE BLOWDOWN DELTA V 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

16-50

INSTRUMENTATION REQUIREMENTS

MEAS DESCRIPTION	PCM	ONBOARD	TRANSDUCERS	CATEGORY	MISSION RULE REFERENCE
OX TK PRESS	SP0003P	METER/C&W	COMMON	M O/B	16-20, 28
OX SM/ENG INTERFACE P	SP0931P	-	-	HD	16-20,29
FU TK PRESS	SP0006P	METER/C&W	COMMON	M O/B	16-20, 28
FU SM/ENG INTERFACE P	SP0930P	-	-	HD	16-20, 28
SPS VLV ACT PRESS-PRI	SP0600P	METER	COMMON		16-21, 22
SPS VLV ACT PRESS-SEC	SP0601P	METER	COMMON	-1 OF 2 M O/B	16-21, 22
SPS FU FEEDLINE TEMP	SP0048T	METER	COMMON		16-24
SPS OX FEEDLINE TEMP	SP0049T	SYS TEST	COMMON	-1 OF 2 M	
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	O/B, PCM	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	O/B, PCM	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

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 3-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. TDSE WILL CONTINUE AS LONG AS THE SM RCS CAN PROVIDE 3-AXIS ATTITUDE CONTROL AND 3 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. PROPELLANT LEAK

B. LOSS OF ANY ONE OF THRUSTERS C2, C3, C4, D1, D3, D4 IF LM RCS CANNOT BE USED FOR ATITUDE CONTROL

RULE NUMBERS 17-6 THROUGH
17-14 ARE RESERVED.

R	ITEM	
		' SYSTEMS MANAGEMENT '
	17-15	PROPELLANT GAGING A. PRIME METHOD---RTCC EQUATION (6 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 119 LBS WILL BE EXCEEDED DURING A TRANSLATION MANEUVER.
		RULE NUMBERS 17-18 THROUGH 17-19 ARE RESERVED.

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
				SPECIFIC MISSION RULES	
	17-20	SUSTAINED LEAK IN HELIUM TANK			. MALF PROC--- RCS 2
		A. ONE OR MORE QUADS	LAUNCH	A. CONTINUE MISSION	. QUAD WILL REMAIN USABLE UNTIL HE MANIFOLD PRESSURE REACHES 75 PSI
		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 THRU TEI DEPENDING UPON LM RCS PROPELLANT REMAINING.

K	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	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) NO-GO FOR LOI (B) ENTER NEXT BEST PTP IF LM NOT AVAILABLE	
			LC	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. NO-GO/TERMINATE	
		C. MORE THAN ONE	DESCENT	C.1. CONTINUE MISSION	
			ALL OTHER	2. TERMINATE PHASE AND ENTER NEXT BEST PTP.	C.2. IN LUNAR ORBIT DO DPS TEI.
	17-22	PACKAGE TEMP LESS THAN 55 DEG F AND UNABLE TO INCREASE	LAUNCH	NOT APPLICABLE	MALF PROC--- RCS 1A
		A. ONE QUAD (ALL OTHER QUADS NORMAL)	EO	A.1. NO-GO FOR TLI	
			TLC	2. CONTINUE MISSION	
			LO	3. CONTINUE MISSION	
			UNDOCKED	4. CONTINUE MISSION	
			DESCENT	5. CONTINUE MISSION	
			LUNAR STAY	6. CONTINUE MISSION	
			CSM EVA	7. NO-GO/TERMINATE FOR QUADS C OR D	
		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 APS/ RCS PROPELLANT. (B) RETAIN LM ASCENT STAGE FOR TEI DEPENDING UPON LM APS/RCS PROPELLANT.

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	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---	EO	B.1. CONTINUE ALTERNATE EO MISSION IF BOTH SPS AND SM RCS DEORBIT CAPABILITY AND ALL AXIS ATTITUDE CONTROL AVAILABLE	
		TWO PITCH OR TWO YAW,			
		ONE PITCH AND ONE YAW			
		PITCH AND TWO ROLL IN SAME DIRECTION	TLC	2. NO-GO FOR LOI - 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 AXES
			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,C3,C4,D1 D3,D4	CSM EVA	C. NO-GO/TERMINATE	D. USE LM RCS FOR ATTITUDE CONTROL IF AVAILABLE
		RULE 17-24 THROUGH 17-49 ARE RESERVED.			

R | ITEM

17-50

* INSTRUMENTATION REQUIREMENTS *

MEAS DESCRIPTION	PCM	ONBOARD	TRANSDUCERS	CATEGORY	MISSION RULE
SM HE TK A PRESS	SR5001P	METER	COMMON		17-20, 21
QTY SM-RCS PROP SYS A	SR5025Q	METER	COMMON	-1 OF 2 M	17-20, 21
SM HE TK B PRESS	SR5002P	METER	COMMON		17-20, 21
QTY SM-RCS PROP SYS B	SR 5026Q	METER	COMMON	-1 OF 2 M	17-20, 21
SM HE TK C PRESS	SR5003P	METER	COMMON		17-20, 21
QTY SM-RCS PROP SYS C	SR 5027Q	METER	COMMON	-1 OF 2 M	17-20, 21
SM HE TK D PRESS	SR5004P	METER	COMMON		17-20, 21
QTY SM-RCS PROP SYS D	SR 5028Q	METER	COMMON	-1 OF 2 M	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

18 CSM CM–RCS

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 BEST PTP SINCE SYSTEMS ARE NO LONGER REDUNDANT.

B. A SUSTAINED LEAK IN OR THE LOSS OF HELIUM SUPPLY PRESSURE OR HELIUM MANIFOLD PRESSURE IN BOTH CM RCS RINGS PRIOR TO TOWER JETTISON IS JUSTIFICATION FOR A MODE I ABORT. 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 SPIN UP 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 SUPPLY PRESSURE OR 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 DELTA V 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 SPIN UP 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. ARMING OF THE CM RCS RINGS, WHETHER THE PROPELLANT ISOLATION VALVES ARE OPENED OR CLOSED, IS CAUSE FOR TERMINATING THE PHASE AND MISSION INTO THE NEXT BEST PTP, EXCEPT IN LUNAR ORBIT.

C. LOSS OF BOTH RINGS IS CAUSE FOR RETAINING THE LM ASCENT STAGE.

18-5 ALL PHASES

SUSTAINED LEAK IN (OR LOSS OF) HELIUM SUPPLY PRESSURES IN EITHER RING REQUIRES THAT THE CM RCS BE PRESSURIZED ASAP, AND 600 PSIA IN SUPPLY IS NECESSARY TO PROVIDE 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 DEG. 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			
		A. ONE RING	LAUNCH	A.1. CONTINUE MISSION AND ENTER NEXT BEST PTP	
			DESCENT	2. CONTINUE MISSION	
			ALL OTHERS	3. TERMINATE PHASE AND ENTER NEXT BEST PTP	A.3. NORMAL ENTRY
		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	
			ALL OTHERS	3. TERMINATE PHASE AND ENTER NEXT BEST PTP	B.3. CONTINGENCY SM RCS SPINUP PRIOR TO CM/SM SEP FOR DEORBIT AND TBD FOR LUNAR RETURN 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	
			ALL OTHERS	3. 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	
			ALL OTHERS	3. TERMINATE PHASE AND ENTER NEXT BEST PTP	B.3 CONTINGENCY SM RCS SPINUP PRIOR TO CM/SM SEP FOR DEORBIT AND TBD FOR LUNAR RETURN ENTRY.

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	18-22	CM RCS IS ARMED FOR ANY REASON	LO/ DESCENT/ LUNAR STAY	CONTINUE MISSION	
			ALL OTHERS	TERMINATE PHASE AND ENTER NEXT BEST PTP	
		RULE NUMBERS 18-23 THROUGH 18-49 ARE RESERVED.			

R	ITEM
	18-50

INSTRUMENTATION REQUIREMENTS

MEAS DESCRIPTION	PCM	ONBOARD	TRANSDUCERS	CATEGORY	MISSION RULE REFERENCE
CM HE TK A PRESS	CR0001P	METER	COMMON	M	18-20
CM HE TK B PRESS	CR0002P	METER	COMMON	M	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		1 OF 2/	18-21
CM HE MNFLD A PRESS	CR0037P	METER/C&W		M	
CM HE MNFLD B PRESS	CR0036P	C&W		1 OF 2/	
CM HE MNFLD B PRESS	CR0038P	METER/C&W		M	18-21

19 EMU/EVA

R	ITEM	

GENERAL

19-1 TO INITIATE AND CONTINUE THE FOLLOWING MISSION PHASES, THE EXTRAVEHICULAR MOBILITY UNIT (EMU) MUST PROVIDE AS AN OPERATIONAL EMU, THE FOLLOWING MINIMUM CAPABILITIES---

A. DOCKED (TUNNEL HARDWARE INSTALLED)/UNDOCKED/RNDZ

ANY COMBINATION OF TWO OPS AND/OR PLSS UNITS WITH SUFFICIENT O2 CONSUMABLES TO SUPPORT A 30 MINUTE CONTINGENCY EVA (CEVA)

B. LUNAR SURFACE EVA

1. CRITICAL INSTRUMENTATION
2. THERMAL CONTROL
3. EMU PRESSURE INTEGRITY
4. PRIMARY OXYGEN SUBSYSTEM
5. PLSS VENTILATION
6. PLSS POWER SUPPLY
7. CPS
8. CONTAMINATION CONTROL
9. SUFFICIENT PLSS CONSUMABLES TO SUPPORT CHECKOUT, PLANNED EVA, AND A 30-MINUTE POST-EVA RESERVE.
10. SUFFICIENT OPS CONSUMABLES TO SUPPORT 30-MINUTE PURGE OPERATIONS AT HIGH PURGE FLOW.

C. CMP EVA

1. CRITICAL INSTRUMENTATION
2. CMP EMU PRESSURE INTEGRITY
3. CPS O2 PRESSURE REGULATION
4. SUFFICIENT OPS CONSUMABLES TO SUPPORT 15-MINUTE PURGE OPERATIONS AT HIGH PURGE FLOW
5. CMP EMU ADEQUATE O2 FLOW VIA THE SUIT CONTROL UNIT (SCU)

K	ITEM

19-2 DEFINITIONS---

A. LOSS OF EMU PRESSURE INTEGRITY

1. UNABLE TO MEET PRESSURE DECAY CRITERIA DURING EMU PRESSURE INTEGRITY CHECK (HIGH O2 FLOW FLAG CLEARS AFTER INITIAL PRESSURIZATION)

2. EMU REGULATED PRESSURE LESS THAN 3.75 PSID (TM) AND DECREASING ON LUNAR SURFACE, WHICH REPRESENTS AN O2 USAGE RATE GREATER THAN 0.7 LBS/HR

B. LOSS OF PRIMARY OXYGEN SUBSYSTEM (POS)

1. SOURCE PRESSURE LESS THAN TBD PSIA OR TBD PERCENT (INDICATOR)

2. UNABLE TO SUPPLY OXYGEN TO OXYGEN VENTILATION LOOP (OVL)

3. IMPROPER PLSS PRESSURE REGULATION (LESS THAN 3.75 AND DECREASING OR GREATER THAN 4.05 PSID AND INCREASING)

C. LOSS OF PLSS POWER SUPPLY

1. PLSS BATTERY VOLTAGE LESS THAN 16.0 VDC AND DECREASING

2. PLSS BATTERY CURRENT DRAIN GREATER THAN 3.0 AMPS AND INCREASING (DOES NOT INCLUDE CHECKOUT)

D. LOSS OF THERMAL CONTROL

1. LOSS OF LCG/LTL CIRCULATION

2. LCG H2O INLET TEMPERATURE AND SUBLIMATOR O2 OUTLET TEMPERATURE OF 50 DEG F AND INCREASING AND LCG H2O DELTA T LESS THAN 5 DEG F AND DECREASING WITH DIVERTER VALVE IN 'MAX' POSITION (THIS CONSTITUES A FAILED SUBLIMATOR.)

3. DEPLETED FEEDWATER RESERVOIR OR INABILITY TO SUPPLY H2O TO SUBLIMATOR

E. LOSS OF VENTILATION

ABNORMAL BATTERY CURRENT (TOTAL CURRENT LESS THAN 2.0 AMPS OR MORE THAN 3.0 AMPS) AND SUBLIMATOR OXYGEN OUTLET TEMPERATURE LESS THAN 38 DEG F (THIS CONSTITUTES A DEGRADED OR FAILED FAN.)

F. LOSS OF CONTAMINATION CONTROL

1. LOSS OF VENTILATION (SEE 19-2, E ABOVE.)

2. PLSS CO2 PARTIAL PRESSURE GREATER THAN 15 MM OF HG

3. SUFFICIENT CONTAMINATION (LIOH AND BY-PRODUCTS) IN THE VENTILATION LOOP TO RESULT IN INTOLERABLE CREWMAN DISCOMFORT

G. LOSS OF OXYGEN PURGE SYSTEM (OPS)

1. OPS O2 SOURCE PRESSURE---

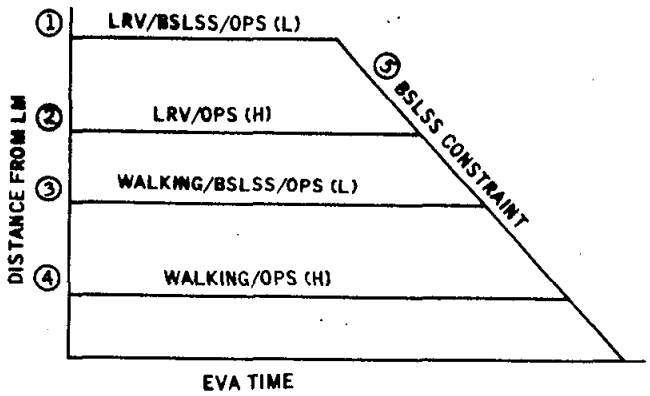
LESS THAN 500 PSIA AT 8 LB/HRPURGE
LESS THAN 300 PSIA AT 4 LB/HRPURGE
LESS THAN 100 PSIA AT MAKEUP

2. OPS O2 REGULATED PRESSURE LESS THAN 3.4 PSID OR MORE THAN 4.0 PSID OR OPS O2 REGULATED PRESSURE EXCEEDS 4.0 PSID IN LESS THAN 1 SECOND

3. THE OPS WILL BE CONSIDERED UNACCEPTABLE FOR MAKEUP MODE OPERATIONS IF THE OPS O2 REGULATED PRESSURE EXCEEDS 4.0 PSID.

R	ITEM
	19-2 CONT

H. EMERGENCY RETURN CAPABILITY



NOTE

ALL EMERGENCY RETURNS ARE CONSTRAINED BY THE 300 BTU MAXIMUM CREWMAN HEAT STORAGE AND THE 13 MINUTES REQUIRED FOR TERMINATION AND INGRESS. SPECIFIC RETURN CAPABILITIES AND CONSTRAINTS ARE SHOWN ON THE ADJACENT CHART AND ARE DESCRIBED IN DETAIL BELOW

RIDING TRAVERSE

① THE LRV/BLSS/OPS (L) RETURN TRAVERSE CAPABILITY REPRESENTS--- AN OPS LOW PURGE FLOW RATE OF 3.85 LB/HR, TIME FOR WALKBACK TO LRV, 5 MINUTES FOR BSLSS ACTIVATION, AND THE TIME REQUIRED FOR LRV RETURN TRAVERSE.

② THE LRV/OPS (H) RETURN TRAVERSE CAPABILITY REPRESENTS--- AN OPS HIGH PURGE FLOW RATE OF 7.5 LB/HR, TIME REQUIRED FOR WALKBACK TO THE LRV, AND THE LRV RETURN TRAVERSE.

WALKING TRAVERSES

③ THE WALKING/BSLSS/OPS (L) RETURN TRAVERSE CAPABILITY REPRESENTS--- AN OPS LOW PURGE RATE OF 3.85 LB/HR, 5 MINUTES FOR BSLSS ACTIVATION, AND THE TIME REQUIRED FOR THE WALKING RETURN TRAVERSE.

④ THE WALKING/OPS (H) RETURN TRAVERSE CAPABILITY REPRESENTS--- AN OPS HIGH PURGE FLOW RATE OF 7.5 LB/HR AND THE WALKING RETURN TRAVERSE.

BSLSS CONSTRAINT

⑤ THE BSLSS CONSTRAINT REPRESENTS--- THE FEEDWATER CAPABILITY OF A PLSS WITH BOTH CREWMEN OPERATING ON IT VIA THE BSLSS FOR RETURN TRAVERSE.

I. TERMINATE EVA

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

J. TERMINATE EVA IMMEDIATELY

THE CREWMEN WILL CEASE THEIR SURFACE ACTIVITIES AND IMMEDIATELY INGRESS THE LM AND REPRESSURIZE.

K. LOSS OF CMP EMU PRESSURE INTEGRITY

1. UNABLE TO MEET MAX TBD PSID/MIN DECAY CRITERIA DURING EMU PRESSURE INTEGRITY CHECK

2. CMP EMU REGULATED PRESSURE LESS THAN 3.70 PSID (CREWMAN) AND DECREASING OR MORE THAN 4.0 PSID AND INCREASING DURING CMP EVA

L. LOSS OF ADEQUATE 02 FLOW (FROM SCU)

CMP EMU 02 FLOW INTO SUIT LESS THAN 6.0 LB/HR (60-65 PSI UMBILICAL PRESS)

M. LOSS OF OXYGEN PURGE SYSTEM (OPS)

REFERENCE MR 19-2, G

N. TERMINATE CMP EVA

THE CREWMAN WILL CEASE PLANNED EVA ACTIVITIES, TRANSFER TO THE CM, INGRESS AND REPRESSURIZE.

K	ITEM	
	19-3	CREWMAN MAY ELECT TO ATTEMPT A WET SUBLIMATOR RESTART IF BREAKTHROUGH OCCURS.
	19-4	OPS PURGE CAPABILITY IS REQUIRED FOR EVA.
	19-5	VACUUM TRANSFERS WILL ONLY BE USED IN SUPPORT OF (1) CONTINGENCY INTRAVEHICULAR TRANSFERS OR CONTINGENCY EXTRAVEHICULAR ACTIVITIES (CIVT OR CEVA) BETWEEN S/C. AND (2) A LM CABIN REPRESS FAILURE.
	19-6	AN EMU/LM ECS HYBRID LIFE SUPPORT AND COMM CONFIGURATION IS ACCEPTABLE IF WITHIN SYSTEMS CAPABILITIES AND IF REQUIRED TO PRECLUDE TIMELINE IMPACT.
		RULES 19-7 THROUGH 14 ARE RESERVED
		MANAGEMENT
	19-15	FOR INTERMITTENT PURGING FOR VISOR DEFOGGING, DECONTAMINATION, OR ADDITIONAL COOLING, THE PRIMARY O2 SHUTOFF VALVE SHOULD BE TURNED OFF FOLLOWING OPS ACTIVATION BUT PRIOR TO PURGING. THE PURGE VALVE SHOULD BE TURNED TO THE OFF POSITION PRIOR TO REOPENING THE PRIMARY O2 SHUTOFF VALVE.
	19-16	THE BSLSS WILL BE CARRIED ON ALL TWO-MAN EVA TRAVERSES.
		RULES 19-17 THROUGH 19-19 ARE RESERVED.

RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
			SPECIFIC	
19-20	LOSS OF EMU PRESSURE INTEGRITY A. EMU REG PRESS LESS THAN 3.75 BUT GREATER THAN 3.4 PSID (TM) B. 2. EMU REG PRESS LESS THAN 3.4 PSID (TM)	EVA	ACTIVATE OPS A. TERMINATE EVA B. TERMINATE EVA IMMEDIATELY	REF MALF EMU 2,5,6,20. EMU REG PRESS IS 0.05 PSIA GREATER THAN PGA PRESS.
19-21	LOSS OF VENTILATION	EVA	TERMINATE EVA IMMEDIATELY 1. ACTIVATE OPS 2. OPEN PGA PURGE VALVE-LOW FLOW	REF MALF 1,5,28,29,30,31.
19-22	CONTAMINATION IN VENTILATION SYSTEM	EVA	TERMINATE EVA IMMEDIATELY 1. ACTIVATE OPS 2. OPEN PGA PURGE VALVE-LOW FLOW	
	RULES 19-23 THROUGH 19-29 ARE RESERVED.			

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	19-30	LOSS OF THERMAL CONTROL	EVA	TERMINATE EVA IF ADDITIONAL COOLING IS REQUIRED, ACTIVATE BLSS OR OPS PURGE AS REQUIRED	REF MALF EMU 4,4A,5,9,10,25,26,27,28,29.
	19-31	LOSS OF PCS	EVA	TERMINATE EVA 1. ACTIVATE OPS 2. IF EMU PRESSURE GREATER THAN 4.05 PSID (TM) CLOSE POS SHUTOFF VALVE	REF MALF EMU 3,5,6,7,8,21,22. NOTE--- IN THE EVENT OF HIGH PGA PRESSURE, PGA PURGE VALVE MAY BE OPENED FOR PRESSURE RELIEF FOLLOWING OPS ACTIVATION.
	19-32	LOSS OF PLSS POWER	EVA	TERMINATE EVA IMMEDIATELY 1. ACTIVATE OPS 2. OPEN PGA PURGE VALVE LOW FLOW 3. ACTIVATE BLSS OR OPS HIGH PURGE FLOW AS REQUIRED	REF MALF EMU 9,28,30.
	19-33	LOSS OF CRITICAL INSTRUMENTATION	EVA	TERMINATE EVA	REF MR 19-51
	19-34	LOSS OF EMU PRESS INTEGRITY	CMP EVA	TERMINATE EVA	REF EMU MALF
	19-35	LOSS OF ADEQUATE CMP EVA O2 FLOW (FROM SCU)	CMP EVA	TERMINATE EVA	REF EMU MALF
	19-36	LOSS OF CRITICAL INSTRUMENTATION	CMP EVA	TERMINATE EVA	REF MR 19-51
		RULE NUMBERS 19-37 THROUGH 19-40 ARE RESERVED			

R | ITEM

INSTRUMENTATION REQUIREMENTS

19-50 PRELAUNCH INSTRUMENTATION

MEAS DESCRIPTION	FM/FM PAM	ONBOARD	TRANSDUCERS	CATEGORY	MISSION RULE REFERENCE
FEED H2O PRESS	GT8110P/GT8210P		COMMON	HD	19-1,2,3,12,30
LOW FEED H2O PRESS		TONE-FLAG		M	
PLSS EKG	GT8124J/GT8224J			*	
PLSS BAT CUR	GT8140C/GT8240C			HD	19,1,2,10, 21,32
PLSS BAT VOLT	GT8141V/GT8241V				
LCG H2O TEMP	GT8154T/GT8254T			HD	19-1,2,10,32
PGA PRESS	GT8168P/GT8268P			HD	19-1,2,30
PGA PRESS GAGE		CUFF GAGE		HD	19-1,2,20,31
LOW PGA PRESS		TONE-FLAG		M	
SUBL O2 OUT TEMP	GT8170T/GT8270T			M	
PLSS-CO2 PP	GT8175P/GT8275P			HD	19-1,2,3,21, 30
PLSS O2 PRESS	GT8182P/GT8282P		COMMON	HD	19-1,13,15, 22
PLSS O2 QTY IND		METER		HD	19-1,2,20,31 11,14
HIGH O2 FLOW		TONE-FLAG		M	
LOW VENT FLOW		TONE-FLAG		M	19-1,2,20,31
LCG H2O DELTA T	GT8196T/GT8296T			M	19-1,21
OPS PRESS GAGE		METER		HD	19-1,2,30
OPS REG PRESS GAGE		METER		M	19-1,2,4,14
EVC SYNC	GT8100X/GT8200X			**M	19-1,2
EVC CAL 0 VDC	GT8101V/GT8201V			M	
EVC CAL 5 VDC	GT8102V/GT8202V			HD	
				HD	

* AEROMEDICAL PARAMETER REFERENCE SECTION 30.
**1 OF 2 OPS REG PRESS GAGES IS MANDATORY.

19-51 CRITICAL INSTRUMENTATION

A. LUNAR SURFACE

MEAS DESCRIPTION	PAM FM/FM	ONBOARD	
PGA PRESS GAGE		CUFF GAGE	
PGA PRESS	GT8168P/ GT8268P		1 OF 3 M
LOW PGA PRESS TONE		TONE	
LOW VENT FLOW TONE		TONE	
PLSS BAT CURRENT	GT8140C/ GT8240C		
SUBL O2 OUT TEMP	GT8170T/ GT8270T		1 OF 3 M

B. CMP EVA

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

20 COMMUNICATIONS/
INSTRUMENTATION

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 BOTH SPACECRAFT 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 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.

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 AND THE RECEIVING OF LM/LCRU VOICE BY ONE EVA.)

B. ONE-MAN EVA

1. PRIME---EVA-1A OR EVA-2A (ALLOW 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 CYI, REV 1. VHF SIMPLEX A AND USB WILL BE TRANSMITTED/RECEIVED SIMULTANEOUSLY FOR EARTH ORBIT AFTER CYI, 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 LORU.

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/LORU 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 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/CSM/EVA/MSFN

1. LM 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. DURING ALL PHASES THE STEERABLE ANTENNA TEMPERATURE SHOULD BE MAINTAINED BETWEEN -65 DEG F AND 185 DEG F. B. 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.
	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. IF THE THERMAL CONSTRAINTS ON THE CAMERA OPERATING TIME IN THE MESA ARE VIOLATED, THE GROUND WILL REQUEST THE CAMERA BE TURNED OFF. 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.
	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 NO-VOICE DOWNLINK AND WILL BE USED FOR LM ASCENT TV COVERAGE).
	20-12	SDS MANAGEMENT A. THE SDS WILL BE OPERATED IN HBR DURING ALL SCIENTIFIC 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-NO-GO FOR SEP MNVR	REF LM MAL PROC COMM 3 - LOSS OF VHF VOICE COMM WITH CSM
			UNDOCKED	DOCK ASAP NO-GO FOR CSM CIRC	REF CSM MAL PROCEDURE COMM 5 - LOSS OF VHF COMM WITH LM
			PRE-PDI	CONTINUE MISSION	
			POWERED DESCENT	CONTINUE MISSION	
			LUNAR STAY	CONTINUE MISSION	NOTE---MSFN RELAY MAY BE UTILIZED
	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.
			DOI	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-NO-GO FOR SEP MANEUVER	REF LM MAL PROC COMM 4 - LOSS OF S-BAND VOICE COMM
			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 LCRL IS ACCEPTABLE
	20-15	LOSS OF TWO CSM AUDIO CENTERS	EPO	CONTINUE MISSION-NO-GO FOR TLI	
			TLC	CONTINUE MISSION-NO-GO FOR LCI	
			DOCKED	CONTINUE MISSION-NO-GO FOR DCI OR UNDOCKING	
			UNDOCKED	NO-GO FOR CIRC	
			PRE-PDI/ DESCENT/ LUNAR STAY	CONTINUE MISSION	
			POST DOCK	RETAIN ASCENT STAGE	

NASA - Manned Spacecraft Center

MISSION RULES

SECTION 20 - COMMUNICATIONS AND INSTRUMENTATION - CONTINUED

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	20-16	UNABLE TO ESTABLISH VHF COMM BETWEEN LM AND BOTH EVA CREWMEN DURING EVA PREP	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 HAS EVC-1, EVA-2 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 1. EVA-2 GO TO POSITION 'A' 2. EVA-1 GO TO POSITION 'B'	IF ON LCRU--- 2.A. EVA-1 CANNOT COMMUNICATE WITH MSFN AND NO TM B. EVA-2 MUST PROCEDURALLY TIME-SHARE ALL VOICE TRANSMISSIONS WITH MSFN. C. MODES WILL BE SWITCHED EVERY 45 MINUTES TO MONITOR PLSS DATA ON BOTH CREWMEN.
	20-19	LOSS OF DUPLEX VOICE BETWEEN EVA-1 AND EVA-2	DUAL EVA	CONTINUE EVA 1. BOTH CREWMEN WILL GO TO POSITION 'A' 2. IF STILL NO COMM, SELECT POSITION 'B' 3. 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.	1.A. SIMPLEX CONFIGURATION WILL REQUIRE PTT OPERATION VICE VOX. B. DATA WILL ONLY BE TRANSMITTED WHEN THE TRANSMITTER IS KEYED. 2. EVCS MODE-B WILL NOT COMMUNICATE WITH LCRU.

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	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 1. CONTINUE EVA A. EVA-2 GO TO POSITION 'A' EVA-1 GO TO POSITION 'B' B. IF SUCCESSFUL, CONTINUE EVA. C. IF UNSUCCESSFUL, RETURN TO VHF RANGE OF LM. 2. CONTINUE EVA A. IF LCRU AVAILABLE, ACTIVATE ASAP AND CONTINUE EVA. B. IF LCRU NOT AVAILABLE, EVA 2 RETURN TO LM AND RECONFIGURE COMM. THEN CONTINUE EVA WITHIN VHF RANGE OF LM.	1.A. 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	
	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.

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	20-25	LOSS OF LCRU BATTERY	EVA	CONTINUE EVA 1. PRIOR TO TRAVERSE- INSTALL BATTERY ASSIGNED TO NEXT EVA. 2. DURING TRAVERSE- SWITCH TO LRV POWER UNTIL NEXT STOP THEN INSTALL BATTERY FROM PREVIOUS EVA.	1. THE LAST EVA TRAVERSE WILL BE PLANNED BASED ON LRV POWER AVAILABLE 2. 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 ON TV REMOTE MODE.	MOVING MODES PRI--- PM1/NB B/U--- PM1/NB CONT--- PM2/NB
	20-27	LOSS OF PM1 TRANSMITTER OR RECEIVER	EVA	CONTINUE EVA 1. MOVING COMM- SWITCH LGA TO HGA CONNECTION PORT. 2. STOPPED COMM- A. 210 FT SITE AVAILABLE, RETAIN SWITCHED CONFIGURATION B. 210 FT SITE NOT AVAILABLE, RETURN TO NORMAL CONFIG.	2.A. TV AVAILABLE TO 210 FT SITE ON LGA 2.B. 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
	20-29	LOSS OF RECEIVER 2	EVA	CONTINUE EVA- LOSS OF COMMAND AND UP VOICE 1. DURING GEOLOGICAL STOP, REMAIN IN FM/TV OR TV REMOTE 2. DURING WALKING PART OF THE STOP, SELECT PM1/WB	1. CREW CAN MANUALLY POSITION CAMERA. 2. TV AND COMMAND CAPABILITY IS LOST

SECTION 20 - COMMUNICATIONS AND INSTRUMENTATION - CONTINUED

K	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	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 1. BYPASS TCU BY RECABLING. LOSS OF COMMAND CONTROL WILL RESULT 2. IF STILL NO TV, SELECT PMI/WB AND CONTINUE WITHOUT TV.	1. 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 TBD DEG F	LUNAR STAY	CONTINUE MISSION-REPOSITION CAMERA	MANUAL OR BY GROUND COMMAND
		RULE NUMBERS 20-37 THROUGH 20-40 ARE RESERVED			

R	ITEM	
		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	
		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, AND IT 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. TC AND E
		5. ALL SPS MANEUVERS AND MIDCOURSE CORRECTIONS
		6. DOCKING AND UNDOCKING
		7. CM/SM SEPARATION AND ENTRY
		8. DTO REQUIREMENTS (TBD)
		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.
		RULES 20-48 THROUGH 20-50 ARE RESERVED.

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
				SPECIFIC	
	20-51	LOSS OF CSM TM			REF CSM MAL PROCEDURE.
		A. HBR ON LBR	ALL	A. CONTINUE MISSION	COMM 10 - MSFN REPORTS LOSS OF REAL-TIME PCM. DSE MAY BE UTILIZED FOR TM IF AVAILABLE.
		B. ALL TM	LAUNCH	B.1. CONTINUE MISSION	
			EO	2. ENTER NEXT BEST PTP	
			LO	3. NO-GO FOR LUNAR OPERATIONS	
			POWERED DESCENT	4. CONTINUE MISSION	
			LUNAR STAY	5. LM LIFTOFF AT THE NEXT ASCENT OPPORTUNITY.	
	20-52	LOSS OF CRITICAL INSTRUMENTATION	LAUNCH	CONTINUE MISSION	
			EO	ENTER NEXT BEST PTP NO-GO FOR TLI	
			TLC	CONTINUE MISSION NO-GO 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 HI GAIN ANT IS AVAILABLE	
			SCIENCE	CONTINUE MISSION BASED ON AMOUNT OF SCIENCE DATA THAT CAN BE OBTAINED	
	20-55	LOSS OF THE SCE	EPO	CONTINUE MISSION NO-GO FOR TLI	
			TLC	CONTINUE MISSION	
			LUNAR ORBIT	CONTINUE MISSION	
			LUNAR STAY	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 TRANSMITTER	ALL	CONTINUE MISSION	
			SCIENCE	CONTINUE MISSION BASED ON AMOUNT OF PHOTOGRAPHIC PHOTOGRAPHIC DATA THAT CAN BE OBTAINED.	
	20-58	LOSS OF HGA	ALL	CONTINUE MISSION	
			SCIENCE	CONTINUE MISSION BASED ON AMOUNT OF PHOTOGRAPHIC DATA THAT CAN BE OBTAINED	
	20-59	LOSS OF DSE	ALL	CONTINUE MISSION	
			SCIENCE	CONTINUE MISSION - ONLY REAL-TIME DATA WILL BE AVAILABLE	
	20-60	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 LOGIC B SC2140R FC 2 H2 FLOW ST0832K ALPHA CT RATE CHAN 3 PYRO A SC2143R FC 2 02 FLOW CT 0018V SCE 10 FDC 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.	
	20-61	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 20-60)
		RULE NUMBERS 20-62 THROUGH 20-65 ARE RESERVED.			

R	ITEM	
		GENERAL
	20-66	A. BASELINE REQUIREMENT CRITICAL INSTRUMENTATION - CRITICAL INSTRUMENTATION IS THAT INSTRUMENTATION, ONBOARD OR TM DURING MSFN AOS, OR ONBOARD ONLY DURING MFSN 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	
		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 ACEQUATE. 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.

RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
			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. CREW RETURN TO LM AND ATTEMPT TO RE-ESTABLISH TM	
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- INSTRUMENTATUON 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), 20-8B
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	
DOA 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

21 LM SEQUENTIAL
AND PYROTECHNIC

NASA - Manned Spacecraft Center

MISSION RULES

SECTION 21 - LM SEQUENTIAL AND PYROTECHNIC

R	ITEM	
		GENERAL
	21-1	TO INITIATE MANNED LM MISSION PHASES, THE PYROTECHNIC SYSTEM MUST PROVIDE THE MINIMUM CAPABILITIES AS DEFINED IN THE TELMU GO/NO-GO CRITERIA, PAGE 3-27.
	21-2	DEFINITIONS--- LOSS OF PYRO SYSTEM A. PYRO BATTERY VOLTAGE DEGRADING ON SUCCESSIVE INFLIGHT VOLTAGE READINGS OR VOLTAGE LESS THAN TBD VDC B. UNABLE TO ARM SYSTEM
	21-3	RESERVED
	21-4	THE ASCENT AND DESCENT STAGES ARE CONSIDERED NONRIGIDLY ATTACHED IF THE GILLOTINE FAILS TO SEVER THE INTERSTAGE UMBILICALS AND ALL OTHER INTERSTAGE ATTACHMENT POINTS HAVE RELEASED.
		RULE NUMBERS 21-5 THROUGH 21-9 ARE RESERVED

R	ITEM	
		MANAGEMENT
	21-10	APS WILL NOMINALLY BE PRESSURIZED IMMEDIATELY PRIOR TO STAGING. APS WILL NOT NORMALLY BE PRESSURIZED MORE THAN 24 HOURS PRIOR TO THE LAST APS BURN--- HOWEVER, IN A CONTINGENCY CASE, THE APS MAY BE PRESSURIZED UP TO 3-1/2 DAYS PRIOR TO THE LAST APS BURN.
	21-11	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.
	21-12	UNDOCKED STAGING WITH ONE PYRO SYSTEM WILL BE PERFORMED ONLY IF ABSOLUTELY NECESSARY TO MAINTAIN CREW SAFETY.
	21-13	RESERVED
	21-14	A FUNCTIONALLY CONFIRMED FAILED CLOSED K1 OR K2 RELAY IS CONSIDERED UNSAFE FOR THE VIBRATION/SHOCK ENVIRONMENT ASSOCIATED WITH THE LUNAR TOUCHDOWN.
	21-15	PRIOR TO PDI, A K2-K6 FAILURE WILL BE CONFIRMED. CONFIRMATION OF A FAILED RELAY REQUIRES PERFORMING THE STAGING FUNCTION.
	21-16	WITH THE IMPENDING LOSS OF A PYRO SYSTEM(S) DUE TO A DEGRADING PYRO BATTERY(S), MANUAL STAGING USING BOTH SYSTEMS WILL BE PERFORMED PRIOR TO THE LOSS OF THE BATTERY(S). IF ONLY A SINGLE PYRO SYSTEM REMAINS, MANUAL STAGING WILL BE DELAYED AS LONG AS POSSIBLE CONTINGENT ON MR 21-20.
	21-17	IF MANUAL STAGING ATTITUDE/DES GOX PRESSURE CONSTRAINTS CANNOT BE MET, MANUAL STAGING WILL NOT BE PERFORMED. DES GOX TANKS WILL BE VENTED, IF NECESSARY, TO INSURE SAFE MANUAL STAGING.
	21-18	NO DETECTABLE PYRO SYSTEM FAILURES WILL BE CAUSE FOR EVA TERMINATION.
	21-19	THERE IS NO REQUIREMENT TO MAINTAIN A LM STAGING CAPABILITY FOR ORBITAL ALTERNATE MISSIONS.

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
				SPECIFIC	
	21-20	LOSS OF ONE OR BOTH PYRO SYSTEMS			REF MALF PROC ED---
					1 ED RELAY
			DOCKED	1. CONTINUE MISSION	REF MF 21-12, 16
			UNDOCKED	2. NO-GO CIRC	
			PRE-PDI	3. NO-GO PDI	
			POWERED DESCENT	4.(A) PDI TO DIC-ABORT	
				(B) DIC TO TOUCHDOWN-CONTINUE MISSION	
			LUNAR STAY	5.(A) LIFT OFF AT NEXT BEST OPPORTUNITY	
				(B) MANUALLY STAGE	
	21-21	UNABLE TO DEARM PYRO SYSTEM(S)	ALL	CONTINUE MISSION-NO-GO PDI	REF MALF PROC ED---
					1 ED RELAY
				FOR UNSTAGED OPERATION, PLACE ONE ASCENT BATTERY ON BUS POWERING THE ACTIVE GUIDANCE SYSTEMS.	CSM RESCUE MAY BE REQUIRED DUE TO RCS REDLINE
				STAGE AS REQUIRED IN ORBIT	
			POWERED DESCENT	ABORT	
			LUNAR STAY	CONTINUE MISSION IF INADVERTENT STAGING IS ACCEPTABLE WITH RESPECT TO LANDING ATTITUDE/DES GOX TANK PRESSURES.	
				IF INADVERTENT STAGING IS UNACCEPTABLE, LIFT OFF AT NEXT BEST OPPORTUNITY.	
	21-22	RESERVED			

K	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	21-23	UNABLE TO STAGE			THIS RULE ONLY APPLIES TO ALTERNATE MISSIONS
		A. ASCENT AND DESCENT STAGES STILL RIGIDLY TIED TOGETHER	RNDZ	A. 1. CONTINUE MISSION 2. USE RCS FOR MANEUVERS	A. CSM RESCUE MAY BE INITIATED DUE TO RCS REDLINES
		B. INCOMPLETE STAGING, VEHICLE NOT RIGID	RNDZ	B. 1. EXECUTE CSM RESCUE 2. GO TO DRIFTING FLIGHT	B. EVT MAY BE REQUIRED BECAUSE OF INABILITY TO DOCK.
	21-24	A RELAY K2-K6 CONFIRMED CLOSED	DOCKED	A. NO-GO NOMINAL MISSION- STAGED ALTERNATE MISSION MAY BE PERFORMED	FOR ALL MISSIONS PHASES PRIOR TO PDI, THE TROUBLESHOOTING PROCEDURE CONFIRMING A VALID RELAY CLOSURE WILL RESULT IN LOSS OF DESCENT POWER AND MAY RESULT IN STAGING.
			UNDOCKED	B. NO-GO NOMINAL MISSION- STAGED ALTERNATE MISSION MAY BE PERFORMED	
			PRE-PDI	C. NO-GO PDI- STAGED ALTERNATE MISSION MAY BE PERFORMED	
			POWERED DESCENT	D. 1. ABORT 2. OPEN APPROPRIATE LOGIC POWER CB PRIOR TO MASTER ARM	MASTER ARM ON IN FAILED SYSTEM MAY STAGE LM. OPENING PYRO SYSTEM B LOGIC POWER CB WILL REMOVE REDUNDANT ENGINE ON SIGNAL.
			LUNAR STAY	E. 1. CONTINUE MISSION 2. OPEN APPROPRIATE LOGIC POWER CB PRIOR TO MASTER ARM	
		RULE NUMBERS 21-25 THROUGH 21-49 ARE RESERVED			

R	ITEM	MEAS DESCRIPTION	PCM	UNBOARD		CATEGORY	MISSION RULE REFERENCE
				PRELAUNCH INSTRUMENTATION			
	21-50	ED RLY A K1-K6	GY0201X	SYS A STAGING LIGHT		M	21-1, 2, 18, 20, 21
					COMMON CAUTION LIGHT	HD	
		ED RLY B K1-K6	GY0202X	SYS B STAGING LIGHT		M	21-1, 2, 18, 20, 21
		ED RLY A K7-K15	GY0231X	--------		HD	21-1, 18
		ED RLY B K7-K15	GY0232X	--------		HD	21-1, 18
		SELECTED ED BAT VOLT	------	METER		M	21-1, 2, 16, 19, 20

22 LM ELECTRICAL POWER

R	ITEM	

GENERAL

22-1 TO INITIATE MANNED LM MISSION PHASES, THE ELECTRICAL POWER SYSTEM MUST PROVIDE THE FOLLOWING MINIMUM CAPABILITIES---

NOTE

LM ACTIVE RENDEZVOUS/CONTINGENCY RETURN ASSUMED

A. DOCKED WITH HATCH OPEN AND TUNNEL CLEAR

1. CDR OR LMP BUS

2. TWO DESCENT BATTERIES WITH ASSOCIATED FEEDER OR ONE ASCENT BATTERY WITH ASSOCIATED FEEDER

3. SUFFICIENT AVAILABLE ASCENT OR DESCENT ELECTRICAL ENERGY TO COMPLETE THE PLANNED ACTIVITY PERIOD

B. DOCKED WITH HATCH CLOSED

1. CDR AND LMP BUSES

2. TWO DESCENT BATTERIES PLUS ONE ASCENT BATTERY OR BOTH ASCENT BATTERIES

3. BOTH ASCENT FEEDERS

4. SUFFICIENT AVAILABLE ASCENT OR DESCENT ELECTRICAL ENERGY TO COMPLETE THE PLANNED ACTIVITY PERIOD PLUS A RESERVE OF 1 HOUR

C. UNDOCKED/SEPARATION AND SUBSEQUENT PHASES - SEE LM TELMO GO/NO GO CRITERIA ON PAGE 3-27

K	ITEM	
	22-2	DEFINITIONS---

LOSS OF CDR OR LMP BUS

A. INABILITY TO MAINTAIN BUS VOLTAGE GREATER THAN 26.5 VDC

B. A BUS CURRENT GREATER THAN OR EQUAL TO 90 AMPS

LOSS OF AN EPS BATTERY

A. BATTERY OUTPUT LESS THAN OR EQUAL TO 2 AMPS WHEN CONNECTED TO A BUS

B. TEMPERATURE GREATER THAN OR EQUAL TO 145 DEG F WITH VOLTAGE EQUAL TO (UNSTAGED CONFIGURATION) OR LESS THAN NOMINAL (STAGED CONFIGURATION), AND CURRENT LESS THAN NOMINAL

C. INABILITY TO MEET VOLTAGE REGULATION AT REQUIRED LOAD

D. INABILITY TO BE CONNECTED TO A FEEDER DUE TO A MALFUNCTIONED ECA

E. BATTERY OPEN CIRCUIT VOLTAGE BELOW 31.8 VDC STEADY STATE

LOSS OF A DC BUS FEEDER

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

B. ASCENT - INABILITY 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

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) 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 OFF LINE

LOSS OF AN INVERTER AND/OR ASSOCIATED AC DISTRIBUTION

A. AC BUS VOLTAGE LESS THAN OR EQUAL TO 110.5 OR GREATER THAN OR EQUAL TO 120 VAC

B. AC BUS FREQUENCY LESS THAN OR EQUAL TO 390 OR GREATER THAN OR EQUAL TO 410 HZ

C. POWER CANNOT BE SUPPLIED TO AN AC BUS

22-3 ANY SPECIFIC EPS MISSION RULE REQUIRING A NEXT BEST OPPORTUNITY LIFT-OFF WILL BE CAUSE FOR TERMINATION OF AN EVA. ADDITIONALLY, A CREWMAN WILL RETURN FROM THE EVA TO CORRECT THE FOLLOWING---

A DESCENT BATTERY MALFUNCTION REQUIRING THE BATTERY TO BE TAKEN OFF LINE.

RULE NUMBERS 22-4 THROUGH 22-9 ARE RESERVED.

R	ITEM	
		' MANAGEMENT '
	22-10	THE MISSION WILL BE CONTINUED AFTER LIFTOFF WITH THE LOSS OF OVERCURRENT PROTECTION. IF THIS PROTECTION IS LOST PRIOR TO LIFT-OFF, A HOLD WILL BE CALLED. A. IF OVERCURRENT PROTECTION IS LOST ON AN INDIVIDUAL DESCENT BATTERY, THE BATTERY WILL BE LEFT ONLINE EXCEPT FOR EVA. B. TO MONITOR CURRENT AND OBTAIN A CONSUMABLE 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 CROSS-TIE CIRCUIT BREAKERS ON PNL 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.
	22-11	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 POI. 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.
	22-12	THE BAL LOAD CROSSTIES (30A) 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 (100A) WILL NOMINALLY NEVER BE CLOSED, EXCEPT DURING DESCENT BATTERY LOW TAP TO HIGH TAP SWITCHOVER.
	22-13	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.
	22-14	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.

R	ITEM	
	22-15	BATTERY MANAGEMENT WILL BE PERFORMED ONLY DURING LUNAR STAY PERIODS. THE DESCENT BATTERY STATE OF CHARGE WILL BE KEPT AS EQUAL AS PRACTICAL.
	22-16	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 THREE DESCENT BATTERIES THAT STILL HAVE AN OPERABLE FEED PATH WILL BE USED ONLY IF NECESSARY TO MAINTAIN CREW SAFETY.
	22-17	A. IF AN ASCENT BATTERY IS CONFIRMED LOST AT ANY TIME EXCEPT DURING POWERED DESCENT, THE REMAINING ASCENT BATTERY WILL BE USED IF REQUIRED BY PLACING THE BATTERY ON ITS NORMAL AND BACKUP FEEDPATHS WITH THE BUS CROSS-TIE (100A) CB'S CLOSED. PRIOR TO PRESSING THE ABORT STAGE BUTTON, THE DESCENT BATTERIES MUST BE TURNED OFF ONE AT A TIME WITH A 5 SECOND INTERVAL BETWEEN EACH SWITCH ACTION AND THE DESCENT ECA CB'S (2) MUST BE OPENED. B. IF AN ASCENT BATTERY IS CONFIRMED LOST DURING POWERED DESCENT, THE PANEL 11 DES ECA CB WILL BE OPENED AND THEN THE BUS CROSS-TIE (100A) CB'S WILL BE CLOSED WITH THE REMAINING BATTERY LEFT ON ITS NORMAL FEEDPATH. PRIOR TO PRESSING THE ABORT STAGE BUTTON, THE PANEL 16 DES ECA CB MUST BE OPENED. IF THIS CONFIGURATION (BOTH DES ECA CB'S OPEN) CANNOT BE PERFORMED, THE ABORT WILL BE ACCOMPLISHED ON A SINGLE BUS. IF TIME PERMITS (PRIOR TO HIGH GATE), THE REMAINING BATTERY WILL ALSO BE PLACED ON ITS BACKUP FEEDPATH IMMEDIATELY PRIOR TO STAGING AND THE DESCENT BATTERIES WILL BE TURNED OFF ONE AT A TIME WITH A 5 SECOND INTERVAL BETWEEN EACH SWITCH ACTION. C. A CONFIRMED LOSS OF AN ASCENT BATTERY DURING POWERED DESCENT IS CONSTRAINED TO A REVERSE CURRENT. D. UNDER NO CIRCUMSTANCES WILL THE BUSES BE CROSS TIED IF THE POSSIBILITY OF A FEEDER, BUS, OR CROSS-TIE SHORT IS THOUGHT TO EXIST.
	22-18	FOR AN OPEN DESCENT FEEDER OR FOR THE LOSS OF TWO DESCENT BATTERIES ON THE SAME BUS, THE CROSS TIE BAL LOAD CIRCUIT BREAKERS WILL BE CLOSED ON THE LUNAR SURFACE AND THE MISSION CONTINUED WITHIN THE CONSUMABLES BUDGET.
	22-19	FOR A SHORTED ASCENT FEEDER ON THE LUNAR SURFACE, THE ASCENT BATTERIES WILL NOT BE CONNECTED UNTIL THE NOMINAL TIME TO MEET PRECONDITIONING REQUIREMENTS.

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
				SPECIFIC	
	22-20	LOSS OF EITHER DC BUS			REF MALF PROC EPS---
			ALL	A. DELAY STAGING ALAP	1 UNSTAGED DC BUS
			DOCKED	B. CONTINUE MISSION	2 STAGED DC BUS
				1. DO NOT UNDOCK	
				2. CREWMEN OPERATE WITH CONNECTING HATCHES OPEN AND TUNNEL CLEAR	. LOSS OF DC BUS RESULTS IN LOSS OF ONE PYRO SYSTEM
				3. PERFORM LIMITED SYSTEMS EVALUATION	. LOSS OF EITHER DC BUS DURING DESCENT ENGINE BURNS RESULTS IN THROTTLING TO 100 PERCENT. IF ON INV 2, LOSS OF THE LMP BUS CAUSES THE ENG TO SHUT DOWN UNLESS ENG START PBI IS DEPRESSED.
			UNDOCKED	C. DOCK ASAP/ NO-GO CIRC	
			PRE-PDI	D. NO-GO PDI/DOCK ASAP	
			POWERED DESCENT	E. ABORT DOCK ASAP	
			LUNAR STAY	F. LIFTOFF AT NEXT BEST OPPORTUNITY	

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	22-21	SHORTED DC BUS FEEDER			REF MALF PROC EP6---
					1 UNSTAGED DC BUS
		A. DESCENT	ALL	A.1. CONTINUE MISSION	2 STAGED DC BUS
			UNDOCKED	2. NO GO CIRC/DOCK ASAP	. SEE MANAGEMENT RULE 22-16
			PRE-PDI	3. DOCK ASAP	
			POWERED DESCENT	4. ABORT DOCK ASAP	
			LUNAR STAY	5. LIFTOFF AT NEXT BEST OPPORTUNITY	
		B. ASCENT	ALL	B.1. DELAY STAGING ALAP	. SEE MANAGEMENT RULE 22-19
			DOCKED	2. CONTINUE MISSION	
				(A) DO NOT UNDOCK	
				(B) CREWMEN OPERATE WITH CONNECTING HATCHES OPEN AND TUNNEL CLEAR	
				(C) PERFORM LIMITED SYSTEMS EVALUATION	
			UNDOCKED	3. DOCK ASAP/NO GO CIRC	
			PRE-PDI	4. NO GO PDI DOCK ASAP	
			POWERED DESCENT	5. ABORT DOCK ASAP	
			LUNAR STAY	6. LIFTOFF AT NEXT BEST OPPORTUNITY	

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MISSION RULES

SECTION 22 - LM ELECTRICAL POWER - CONTINUED

K	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	22-22	LOSS OF ASCENT BATTERY(S)			REF MALF PROC EPS---
		A. LOSS OF ONE ASCENT BATTERY	DOCKED/ UNDOCKED	A. 1. CONTINUE MISSION- NO-GO CIRC DO NOT STAGE UNLESS DESCENT BATTERIES AND O2 ARE DEPLETED	2 STAGED DC BUS 4 STAGED BATTERY
			PRE-PDI	2. RETURN TO VICINITY OF CSM ASAP- NO-GO PDI DO NOT STAGE UNLESS DESCENT BATTERIES AND O2 ARE DEPLETED	
			POWERED DESCENT	3. (A) PDI TO HIGH GATE - ABORT (B) HIGH GATE TO TD- CONTINUE MISSION. CONFIGURE FOR SINGLE BAT TWO BUS ABORT	REFERENCE RULE 22-17 FOR REQUIRED CONFIGURATION
			LUNAR STAY	4. LIFTOFF AT NEXT BEST OPPORTUNITY	
		B. LOSS OF TWO ASCENT BATTERIES	ALL	B. DO NOT STAGE DO NOT UNDOCK DOCK ASAP IF UNDOCKED	NOTE--- THIS RULE DOES NOT APPLY AFTER PDI + 5+30

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	22-23	LOSS OF DESCENT BATTERY(S)			REF MALF PROC EPS---
		A. LOSS OF ONE TO THREE DESCENT BATTERIES	ALL	A. CONTINUE MISSION	1 UNSTAGED DC BUS 5 UNSTAGED BAT TB ABNORMAL NOTE--- SEE MANAGEMENT RULE 22-18. CONSUMABLES DICTATE GO/NO GO FOR REMAINING MISSION PHASES.
		B. LOSS OF FOUR OR MORE DESCENT BATTERIES	DOCKED	B. 1. DO NOT UNDOCK- OPERATE WITH CONNECTING HATCHES OPEN AND TUNNEL CLEAR	
			UNDOCKED	2. DOCK ASAP- NO-GO CIRC	
			PRE-PDI	3. NO-GO PDI- DOCK ASAP	
			POWERED DESCENT	4.(A) PDI TO HI GATE - ABORT DOCK ASAP (B) HI GATE TO TD - CONTINUE MISSION	
			LUNAR STAY	5. LIFT OFF AT NEXT BEST OPPORTUNITY	

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	22-24	LOSS OF INVERTER(S)			REF MALF PROC EPS---
		A. LOSS OF ONE INVERTER	ALL	A. 1. CONTINUE MISSION	6 INVERTER
			POWERED DESCENT	2. IF ON INV 2, PUSH ENG START PBI	
		B. LOSS OF BOTH INVERTERS	DOCKED UNDOCKED	B. 1. CONTINUE MISSION-NO-GO CIRC	. LOSS OF AC POWER RESULTS IN LOSS OF DPS GIMBALS, RR, S-BND STEERABLE ANT (HBR TM), AND BOTH FDAI SPHERES. . HBR TM IS AVAILABLE FROM AN OMNI ANTENNA AND A 210 FT. MSFN SITE.
			PRE-PDI	2. DO NOT PERFORM PDI	
			POWERED DESCENT	3.(A) PDI TO HI GATE - ABORT	
				(B) HI GATE TO TD - CONTINUE MISSION	
			LUNAR STAY	4. CONTINUE MISSION	
	22-25	LOSS OF AC BUSES			REF MALF PROC EPS---
		A. LOSS OF BUS A	DOCKED UNDOCKED	A. 1. CONTINUE MISSION-NO-GO CIRC	6 INVERTER
			PRE-PDI POWERED DESCENT/ LUNAR STAY	2. CONTINUE MISSION-PUSH ENG START PBI	LOSS OF AC BUS A RESULTS IN LOSS OF DPS GIMBAL CONTROL, RENDZ RADAR, AND INTEGRAL LIGHTING LOSS OF AC BUS B RESULTS IN LOSS OF S-BAND STEERABLE ANTENNA (HBR TM) AND NUMERIC LIGHTING, HBR TM IS AVAILABLE FROM AN OMNI ANTENNA AND A 210 FT MSFN SITE.
		B. LOSS OF BUS B	ALL	B. CONTINUE MISSION	LOSS OF BOTH AC BUSES RESULTS IN THE ABOVE PLUS LOSS OF BOTH FDAI SPHERES AND THE AOT.
		C. LOSS OF BOTH BUS A AND B	DOCKED/ UNDOCKED	C.1. CONTINUE MISSION-NO-GO CIRC	
			PRE-PDI	2. DO NOT PERFORM PDI-PUSH ENG START PBI	
			POWERED DESCENT	3.(A) PDI TO HI GATE-ABORT	
				(B) HI GATE TO TD - CONTINUE MISSION	
			LUNAR STAY	4. CONTINUE MISSION	
		RULE NUMBERS 22-26 THROUGH 22-49 ARE RESERVED.			

R | ITEM

22-50

INSTRUMENTATION REQUIREMENTS

MEAS DESCRIPTION	PCM	CRBOARD	CATEGORY	MISSION RULE REFERENCE
AC BUS FREQ	GC0155F	CAUT	1 OF 2	22-2,5,24,25
AC BUS VOLTS	GC0071V	METER, CAUT	M	
BAT 1 CUR	GC1201C	METER	1 OF 2	
BAT 2 CUR	GC1202C	METER	M PCM	
LMP BUS VOLTS	GC0302V	METER,CAUT	2 OF 3	
BAT 1 VOLTS	GC0201V	METER	M	
BAT 2 VOLTS	GC0202V	METER		22-2,10,14,20,21,22,23
BAT 5 VOLTS	GC0205V	METER		
BAT 3 CUR	GC1203C	METER	1 OF 2	
BAT 4 CUR	GC1204C	METER	M PCM	
BAT L CUR	GC1207C	METER	M PCM	
CDR BUS VOLTS	GC0301V	METER,CAUT	2 OF 3	
BAT 3 VOLTS	GC0203V	METER	M	
BAT 4 VOLTS	GC0204V	METER		
BAT 6 VOLTS	GC0206V	METER		
BAT L VOLTS	GC0207V	METER	HD	
BAT 5 CUR	GC1205C	METER	M PCM	
BAT 6 CUR	GC1206C	METER	M PCM	
BAT 1 MAL	GC9961L	CAUT, COMP	HD	
BAT 2/L MAL	GC9962U	CAUT, COMP	HD	22-2,10,14,20,21,23
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	22-2,10,20,21,22,23
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	GC4370X	FLAG	HD	22-2,10,17,20,21,22
BAT 5 NORM LMP	GC4371X	FLAG	HD	
BAT 6 B/U LMP	GC4372X	FLAG	HD	

NOTE--- LOSS OF SEVERAL OF THE HD MEASUREMENTS ABOVE WILL CAUSE SEVERELY DEGRADED MISSION MONITORING CAPABILITY.

23 LM ENVIRONMENTAL CONTROL

R	ITEM	
		GENERAL
	23-1	TO INITIATE THE MANNED LM PHASES THE ENVIRONMENTAL CONTROL SYSTEM MUST PROVIDE THE FOLLOWING MINIMUM CAPABILITIES---

NOTE

LM ACTIVE RENDEZVOUS/CONTINGENCY RETURN IS ASSUMED

A. DOCKED WITH HATCH OPEN AND TUNNEL CLEAR

1. COMBINED VEHICLE PRESSURE INTEGRITY

2. ONE LM COOLANT LOOP

B. DOCKED WITH HATCH CLOSED

1. CABIN PRESSURE INTEGRITY

2. SUIT LOOP INTEGRITY

3. ONE SUIT FAN

4. ONE COOLANT LOOP

5. SUFFICIENT O2, H2O, AND LIOH CONSUMABLES TO COMPLETE THE PLANNED ACTIVITY PERIOD PLUS A RESERVE OF 1 HOUR

C. UNDOCKED/SEPARATION AND SUBSEQUENT PHASES - SEE LM TELMU GO/NO-GO CRITERIA ON PAGE 3-27.

R	ITEM	
	23-2	DEFINITIONS---

LOSS OF CABIN INTEGRITY

LM PRESSURE VESSEL LEAKAGE SUCH THAT CABIN PRESSURE CANNOT BE MAINTAINED GREATER THAN OR EQUAL TO 4.6 PSIA WITH AN O2 FLOW RATE OF 1.4 LB/HR. FOR DOCKED ACTIVITIES THIS WILL BE RELAXED TO A FLOW RATE OF 6 LB/HR

LOSS OF SUIT LOOP INTEGRITY

TOTAL PGA/SUIT LOOP DECAY GREATER THAN OR EQUAL TO TBD PSI/MIN (TBD LB/HR) DURING SUIT LOOP PRESSURE CHECK OR A VISIBLE TEAR IN THE PGA

LOSS OF COOLANT LOOP

A. SUSTAINED GLYCOL TEMPERATURE GREATER THAN OR EQUAL TO 50 DEGREE F AND RISING EXCEPT DURING COOLANT LOOP STARTUP AND DRYOUT (SUBLIMATOR LOST)

B. GLYCOL PUMP DELTA P LESS THAN OR EQUAL TO 6 PSID (CIRCULATION LOST) OR KNOWN LOSS OF H2O FEED CAPABILITY TO THE SUBLIMATOR(S)

GLYCOL COOLANT LEAK

OBSERVED FLUID IN CABIN CONFIRMED BY TASTE OR PRESENCE OF GLYCOL LOW INDICATION CONFIRMED BY STATIC PRESSURE DROP

LOSS OF DESCENT O2 TANK

INABILITY TO TRANSFER O2 FROM DESCENT TANK

LOSS OF ASCENT O2 TANK

A. INABILITY TO TRANSFER O2 FROM AN ASCENT TANK - OR

B. IF VEHICLE IS UNSTAGED AND DESCENT O2 TANK QUANTITY GREATER THAN 35 PERCENT, CREW MAY CONFIRM LOSS BY BALANCING ONE TANK AGAINST THE OTHER, WITH MSFN COVERAGE - OR

C. IF STAGED OR IF DESCENT O2 LESS THAN 35 PERCENT, LOSS OF ONBOARD AND MSFN READOUT

LOSS OF DESCENT H2O TANK

A. MSFN CONFIRMATION OF LOSS OF DESCENT TANK PRESSURE WITH DES H2O P AND H2O DELTA P

B. INABILITY TO SUPPLY H2O TO W/B RESULTING IN RISING GLYCOL AND SUIT LOOP TEMPERATURE (CREW AND MSFN) AND DROP IN H2O DELTA P (MSFN ONLY)

LOSS OF ASCENT H2O TANK

A. LOSS OF MEASUREMENT AND REMAINING TANK FEEDING AT TWICE NORMAL RATE

B. ONE TANK FEEDING TWICE NORMAL RATE AND NO CHANGE IN MEASUREMENT ON OTHER TANK

23-3 RESERVED

23-4 OXYGEN PURGE SYSTEM AND PLSS CONSUMABLES WILL BE RESERVED FOR POSSIBLE EVT AND WILL NOT BE CONSIDERED FOR LM GO/NO-GO'S OR REDLINES.

23-5 TWO POUNDS OF OXYGEN CONTAINED IN THE LM CABIN AT 5.3 PSIA WILL BE CONSIDERED AVAILABLE IN CALCULATING GO/NO-GO'S OR REDLINES. THE CABIN CAN BE CONSIDERED, WHEN DISCUSSING FUNCTIONAL PRESSURE VESSEL REQUIREMENTS, AS A BACKUP TO THE ASCENT O2 TANKS.

23-6 ANY SPECIFIC MISSION RULES REQUIRING 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 FAILED OPEN DEMAND REGULATOR.

RULE NUMBERS 23-7 THROUGH 23-10 ARE RESERVED.

K	ITEM	
		* SYSTEMS MANAGEMENT *
	23-11	IF EITHER ASCENT O2 TANK IS LESS THAN OR EQUAL TO 90 PERCENT, IT WILL BE REPLENISHED FROM THE DESCENT O2 WHEN DESCENT TANK QUANTITY IS GREATER THAN OR EQUAL TO 35 PERCENT AND AS CLOSE TO STAGING AS POSSIBLE.
	23-12	RESERVED
	23-13	CREW WILL GO TO EGRESS MODE IF INSUFFICIENT O2 IS AVAILABLE TO MAINTAIN CABIN PRESSURE FOR THE REQUIRED TIME. ADDITIONALLY, A MISSION PHASE WILL NOT BE INITIATED IF THIS CONDITION CAN BE ANTICIPATED.
		RULE NUMBERS 23-14 THROUGH 23-19 ARE RESERVED.

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
				SPECIFIC MISSION RULES	
	23-20	LOSS OF SUIT LOOP INTEGRITY	DOCKED	CONTINUE MISSION	. REF MALF PROC ECS---
				1. PERFORM SYSTEMS EVALUATION WITHIN CONSUMABLES LIFETIME CONSTRAINTS WITH HATCH OPEN AND TUNNEL CLEAR	4A SUIT/FAN
				2. NO-GO FOR UNDOCKING	
			UNDOCKED	DOCK ASAP	
				DO NOT STAGE WHILE UNDOCKED	
				NO-GO FOR CIRC	
			PRE-PDI	DOCK ASAP	
				DO NOT STAGE WHILE UNDOCKED	
			POWERED DESCENT	1. PDI TO DIC - ABORT	
				DOCK ASAP	
				DO NOT STAGE WHILE UNDOCKED	
				2. DIC TO TD - ABORT	
				DOCK ASAP	
			LUNAR STAY	LIFTOFF AT NEXT BEST OPPORTUNITY	
			RNDZ	CONTINUE MISSION	
				DOCK ASAP	

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	23-21	LOSS OF CABIN PRESSURE INTEGRITY	DOCKED	CONTINUE MISSION 1. PERFORM SYSTEMS EVALUATION WITHIN CONSUMABLES LIFETIME CONSTRAINTS WITH ONE CREWMAN ON THE CSM UMBILICALS 2. NO-GO FOR UNDOCKING	REF MALF PROC ECS--- 2A CABIN
			UNDOCKED	DOCK ASAP- DO NOT STAGE WHILE UNDOCKED NO-GO FOR CIRC	
			PRE-PDI	DOCK ASAP- DO NOT STAGE WHILE UNDOCKED NO-GO FOR PDI	
			POWERED DESCENT	1. PDI TO DIC - ABORT DOCK ASAP DO NOT STAGE WHILE UNDOCKED 2. DIC TO HI GATE - ABORT DOCK ASAP 3. HI GATE TO TD - CONTINUE MISSION	
			LUNAR STAY	LIFTOFF AT NEXT BEST OPPORTUNITY	
			RNDZ	CONTINUE MISSION- DOCK ASAP	

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	23-22	SUIT FAN(S) FAILURE			. REF MALF PROC ECS---
		A. ONE SUIT FAN	ALL	A. CONTINUE MISSION	7A ECS
		B. TWO SUIT FANS	DOCKED	B.1. CONTINUE MISSION WITH TUNNEL CLEAR AND ON TRANSFER UMBILICAL OR CW GARMENT W/O SUIT	B. REMOVE HELMET AND GLOVES . REF MALF PROC ECS---
				NO-GO FOR UNDOCKING	4 SUIT FAN
			UNDOCKED	2. DOCK ASAP	
				DO NOT STAGE WHILE UNDOCKED	
				NO-GO FOR CIRC	
			PRE-PDI	3. DOCK ASAP	
				DO NOT STAGE WHILE UNDOCKED	
				NO GO FOR PDI	
			POWERED DESCENT	4.(A) PDI TO DIC - ABORT	PLACE DEMAND REG B TO "DIRECT O2" IMMEDIATELY OR REMOVE HELMETS (MUST BE REMOVED FOR STAGING.)
				DOCK ASAP	
				DO NOT STAGE WHILE UNDOCKED	
				(B) DIC TO HI GATE-ABORT	
				(C) HI GATE TO TD-CONTINUE MISSION	
			LUNAR STAY	5. LIFTOFF AT NEXT BEST OPPORTUNITY	RETAIN PLSS'S FOR ASCENT IF POSSIBLE.
			RNDZ	6. DOCK ASAP	

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MISSION RULES

SECTION 23 - LM ENVIRONMENTAL CONTROL - CONTINUED

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	23-23	DEMAND REGULATOR(S) FAIL OPEN OR CLOSED			. REF MALF PROC ECS---
		A. ONE REGULATOR	ALL	A. CONTINUE MISSION	3 CABIN PRESS IND HI 5 SUIT PRESS HI
		B. TWO REGULATORS	DOCKED/ UNDOCKED/	B.1. CONTINUE MISSION- DO NOT UNDOCK NO-GO CIRC	6 O2 QTY
			PRE-PDI	2. NO-GO PDI	
			POWERED DESCENT	3. PDI TO HI GATE - ABORT HI GATE TO TD- CONTINUE MISSION	
			LUNAR STAY	4. DO NOT DEPRESS CABIN LUNAR STAY MAY BE CONTINUED WITHIN CONSUMABLES BUDGET	
			RNDZ	5. CONTINUE MISSION	

K	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	23-24	LOSS OF H2O SEPARATOR(S)			. REF MALF PROC ECS---
					78 ECS
		A. ONE H2O SEPARATOR	ALL	A. CONTINUE MISSION	
		B. TWO H2O SEPARATORS	DOCKED	B.1. CONTINUE MISSION	
			UNDOCKED PRE-PDI	2. DOCK ASAP-	
				NO-GO CIRC NO-GO PDI	
				DO NOT STAGE WHILE UNDOCKED	
			POWERED DESCENT	3. PDI TO HI GATE - ABORT	
				HI GATE TO TD- CONTINUE MISSION	
			LUNAR STAY	4. LIFTOFF NEXT BEST OPPORTUNITY	
			RNDZ	5. CONTINUE MISSION AND DOCK ASAP	

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MISSION RULES

SECTION 23 - LM ENVIRONMENTAL CONTROL - CONTINUED

K	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	23-25	LOSS OF O2 TANK(S)			
		A. ONE ASCENT TANK	ALL	A. CONTINUE MISSION	
		B. TWO ASCENT TANKS	DOCKED	B.1. DO NOT UNDOCK	
			UNDOCKED PRE-PDI	2. NO-GO CIRC NO-GO PDI DELAY STAGING ALAP	
			POWERED DESCENT	3.(A) PDI TO DIC-ABORT DELAY STAGING ALAP (B) DIC TO HI GATE-ABORT (C) HI GATE TO TOUCHDOWN-CONTINUE MISSION	
			LUNAR STAY	4. STAY WITHOUT EVA	
			RNDZ	5. CONTINUE MISSION	
		C. ONE DESCENT TANK	ALL	C. CONTINUE MISSION	
		D. TWO DESCENT TANKS	DOCKED	D.1. CONTINUE MISSION-DO NOT UNDOCK	
			UNDOCKED/ PRE-PDI	2. DOCK ASAP- NO-GO CIRC NO-GO PDI	
			POWERED DESCENT	3. PDI TO HIGATE-ABORT HI GATE TO TD-CONTINUE MISSION	
			LUNAR STAY	4. LIFTOFF NEXT BEST OPPORTUNITY	

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	23-26	LOSS OF COOLANT LOOP(S)			. REF MALF PROC ECS---
		A. PRIMARY LOOP OR SECONDARY LOOP	DOCKED UNDOCKED	A. 1. CONTINUE MISSION ON SECONDARY LOOP	7E ECS -GLYCOL
				NO-GO FOR CIRC	9 GLYCOL
					10 GLYCOL PRESS LOW
			PRE-PDI	2. RETURN TO VICINITY OF C&M	
				NO-GO FOR PDI	
			POWERED DESCENT	3. PDI TO HI GATE - ABORT	
				HI GATE TO TD- CONTINUE MISSION	
			LUNAR STAY	4. LIFTOFF NEXT BEST OPPORTUNITY.	
			RNDZ	5. CONTINUE MISSION	
		B. BOTH LOOPS (ANY COMBINATION OF LOSS OF CIRCULATION, SUBLIMATION CAPABILITY, OR H2O FEED FOR BOTH LOOPS)	DOCKED	B. 1. INGRESS CSM ASAP-	
				NO-GO FOR UNDOCKING	
			UNDOCKED	2. DOCK ASAP NO-GO FOR CIRC	
			PRE-PDI	3. DOCK ASAP	
				DO NOT STAGE	
				NO-GO PDI	
			POWERED DESCENT	4. (A) PDI TO DIC-ABORT	
				DOCK ASAP	
				DO NOT STAGE	
				(B) DIC TO HI GATE- ABORT DOCK ASAP	
				(C) HI GATE TO TD- CONTINUE MISSION	B.4.(C) LIFT OFF IMMEDIATELY AFTER TOUCHDOWN.
			LUNAR STAY	4. LIFTOFF NEXT BEST OPPORTUNITY	
			RNDZ	5. CONTINUE MISSION	B.5. CREW MAY ELECT TO REMOVE PGA'S FOR COOLING.

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	23-27	LOSS OF PRIMARY H2O FEEDPATH	DOCKED UNDOCKED	CONTINUE MISSION	. REF MALF PROC ECS---
				NO-GO FOR UNDOCKING NO-GO FOR CIRC	8 GLYCOL
			PRE-PDI	RETURN TO VICINITY OF CSM	
			POWERED DESCENT	A. PDI TO HI GATE - ABORT	
				B. HI GATE TO TD- CONTINUE MISSION	
			LUNAR STAY	LIFTOFF NEXT BEST OPPORTUNITY	
			RNDZ	CONTINUE MISSION	
	23-28	LOSS OF H2O TANK(S)			
		A. ONE ASCENT TANK	ALL	A. CONTINUE MISSION	
		B. TWO ASCENT TANKS	DOCKED	B.1. CONTINUE MISSION- NO-GO CIRC	. REF MALF PROC ECS--- 1 H2O QTY LOW
			PRE-PDI	2. RETURN TO VICINITY OF CSM ASAP- DO NOT STAGE NO-GO PDI	
			POWERED DESCENT	3.(A) PDI TO DIC - ABORT DO NOT STAGE	
				(B) DIC TO HI GATE - ABORT	
				(C) HI GATE TO TOUCHDOWN TOUCHDOWN - CONTINUE MISSION	
			LUNAR STAY	4. LIFTOFF NEXT BEST OPPORTUNITY	
			RNDZ	5. CONTINUE MISSION	CREW MAY ELECT TO REMOVE PGA'S FOR COOLING.
		C. ONE DESCENT TANK	ALL	C. CONTINUE MISSION WITHIN CONSUMABLES	
		D. TWO DESCENT TANKS	DOCKED	D.1. CONTINUE MISSION	
			UNDOCKED/ PRE-PDI	2. NO-GO CIRC NO-GO PDI	
			POWERED DESCENT	3. (A) PDI TO HI GATE- ABORT	
				(B) HI GATE TO TD- CONTINUE MISSION	
			LUNAR STAY	4. LIFT-OFF NEXT BEST OPPORTUNITY	

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MISSION RULES

SECTION 23 - LM ENVIRONMENTAL CONTROL - CONTINUED

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	23-29	FIRE OR SMOKE IN CABIN OR SUIT	ALL	TROUBLE SHOOT/COMBAT FIRE ASSESS DAMAGE AND TRANSFER TO CSM IF NECESSARY	REF AOH PROC 5.3.2
	23-30	CONTAMINATION IN CABIN OR SUIT LOOP	ALL	CREW MAY ELECT TO DECOMPRESS CABIN OR PURGE SUIT LOOP	IF UNABLE TO CLEAR CONTAMINATION, MISSION MAY BE TERMINATED EARLY.
	23-31	GLYCOL COOLANT LEAK	ALL	TRANSFER TO CSM	REF MALF PROC ECS---
		A. CABIN	ALL	A. PURGE SUIT WITH DIRECT O2	B GLYCOL
		B. SUIT	ALL	B. DISCONNECT FROM SUIT LOOP	
		RULE NUMBERS 23-32 THROUGH 23-49 ARE RESERVED.			

310

R | ITEM

* INSTRUMENTATION REQUIREMENTS *

23-50	MEAS DESCRIPTION	PCM	ONBOARD	CATEGORY	MISSION RULE REF
	SUIT PRESS	GF1301P	METER	HD	23-1,2,6,20,21,23
			WARNING	HD	
	CABIN PRESS	GF3571P	METER	1 OF 3	
	U/H RLF PRESS	GF3591P	-----	M	23-1,2,5,13,20,21,
	F/H RLF PRESS	GF3592P	-----		23,29
	DES 1 O2 PRESS	GF3584P	METER, CAUT	1 OF 2	
	DES 2 O2 PRESS	GF0584P	METER		23-1,2,6,11,13,
	ASC 1 O2 PRESS	GF3582P	METER,CAUT	1 OF 2	21,23,25
	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	23-1,2,6,26,31
	SEC GLYCOL LVL LOW	GF9986U	CAUT		
	GLYCOL TEMP	GF9998U	METER,CAUT	1 OF 2	23-1,2,6,26,31
	GLYCOL OUTLET TEMP	GF2581T	----------	M	
	SUIT TEMP	GF1281T	METER		
	GLYCOL INLET TEMP	GF2531T	-----		
	DES 1 H2O TK PRESS	GF4500P	METER	1 OF 2	
	DES 2 H2O TK PRESS	GF0500P	METER	M	23-1,2,27,28
	ASC 1 H2O TK PRESS	GF4502P	METER	1 OF 2	
	ASC 1 H2O TK PRESS	GF4503P	METER	M	
	PRI H2O REG DELTA P	GF4101P	----------	HD	23-1,2,27,28
	RTG TEMP	GL8275T	----------	HD	
	REPR ELEC OPEN	GF3572X	WARNING	HD	23-1,2,5,13,20,21,23,
	CO2 PART PRESS	GF1521P	METER, CAUT, COMP	HD	23-1,24,30
	H2O SEP RATE	GF9999U	CAUT, COMP	HD	23-1,22,24
	SUIT DIV EGRESS	GF1221X	----------	HD	23-1,20,21,22,29

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

R | ITEM

GENERAL

24-1 RESERVED

24-2 DEFINITIONS

3-AXIS ATTITUDE CONTROL

3-AXIS ATTITUDE CONTROL IS DEFINED AS 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.

REDUNDANT 3-AXIS ATTITUDE CONTROL

REDUNDANT 3-AXIS ATTITUDE CONTROL IS DEFINED AS HAVING TWO AUTONOMOUS ATTITUDE CONTROL SYSTEMS INDEPENDENT OF SECONDARY COILS, I.E., NO SINGLE FAILURE WILL CAUSE LOSS OF BOTH AUTONOMOUS SYTEMS.

GUIDANCE STEERING

GUIDANCE STEERING IS DEFINED AS THE ABILITY TO CALCULATE AND STEER LM ALONG THE DESIRED THRUST VECTOR DURING A POWERED MANEUVER. TO HAVE THIS CAPABILITY, THE LM REQUIRES AN OPERATIONAL PGNS OR AGS.

OPERATIONAL PGNS

AN OPERATIONAL PGNS IS DEFINED AS NO LGC FAILURE, NO ISS FAILURE, NO DSKY FAILURES, AND NO CES FAILURES PREVENTING PGNS 3-AXIS ATTITUDE CONTROL.

OPERATIONAL AGS

AN OPERATIONAL AGS IS DEFINED AS NO AEA FAILURE, NO ASA FAILURE, NO DEDA FAILURE, AND NO CES FAILURE PREVENTING AGS 3-AXIS ATTITUDE CONTROL.

3-AXIS TRANSLATION

3-AXIS TRANSLATION IS DEFINED AS THE ABILITY TO CHANGE THE VEHICLE VELOCITY, PLUS AND MINUS, ALONG EACH BODY AXIS. TO HAVE THIS CAPABILITY THE LM REQUIRES ONE TTCA AND AN OPERATIONAL PGNS OR MANUAL (AGS MODE) TRANSLATION CAPABILITY.

K	ITEM	
		MANAGEMENT
	24-3	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 C. PIPA BIAS UPDATES WILL BE ACCOMPLISHED AS FOLLOWS--- 1. NO BIAS UPDATES WILL BE ACCOMPLISHED PRIOR TO 30 MIN OF IMU OPERATION. 2. THE INITAL BIAS UPDATES WILL NOT BE PERFORMED IF THE DELTA BIAS IS LESS THAN +/- 0.03 CM/SEC/SEC. SUBSEQUENT UPDATES WILL ONLY BE PERFORMED IF THE DELTA BIAS IS GREATER THAN +/- 0.1 CM/SEC/SEC. 3. PIPA BIAS WILL NOT BE UPDATED WHILE THE LM IS ON THE LUNAR SURFACE. D. IF LOSS OF IMU COOLING OCCURS, TURN ON/OPERATIONAL TIMES WILL BE DETERMINED BY REALTIME FLIGHT PLANNING REQUIREMENTS.
	24-4	RESERVED
	24-5	RENDEZVOUS RADAR THE RR ANTENNA WILL BE POSITIONED AFTER T/C TO PRECLUDE REPOSITIONING DUE TO ANTENNA HEATING ON THE LUNAR SURFACE.

R	ITEM	
	24-6	LANDING RADAR A. THE LR SHOULD NOT NORMALLY BE OPERATED AT AN ANTENNA TEMP LESS THAN + 50 DEG F. HOWEVER, THE LUNAR LANDING MISSION WILL BE ATTEMPTED IF THE ANTENNA TEMP IS ABOVE THE CRITICAL LIMIT OF -15 DEG F (HARDWARE DAMAGE). B. LR ACTIVATION WILL BE DELAYED SO THAT THE PREDICTED LR TEMP WILL BE NO GREATER THAN 145 DEG F AT HI GATE.
	24-7	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/OPERATIONAL TIMES WILL BE DETERMINED BY REALTIME FLIGHT PLANNING REQUIREMENTS.
	24-8	CES LOSS OF INVERTER ONE/AC BUS A REQUIRES A MANUAL ENGINE-ON SIGNAL TO MAINTAIN DPS ENGINE ELECTRICAL REDUNDANCY.
		RULE NUMBERS 24-9 THROUGH 24-19 ARE RESERVED.

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
				SPECIFIC	
	24-20	LOSS OF GUIDANCE STEERING			
		A. OPERATIONAL AGS	ALL	CONTINUE MISSION IF REDUNDANT 3-AXIS ATTITUDE CONTROL IS STILL AVAILABLE	. REF MALF PROC AGS--- 1 AGS WARNING LIGHT 2 DEDA RESPONSE IS ABNORMAL
		B. OPERATIONAL PGNS	DOCKED/ UNDOCKED	B.1. NO-GO FOR CIRC	. REF MALF PROC PGNS---
			PRE-PDI	2. NO-GO FOR PDI	1 LGC WARN 2 ISS WARN
			POWERED DESCENT	3.(A) PRIOR TO HI GATE ABORT (B) AFTER HI GATE (1) LAND MANUALLY (2) NO-GO FOR EXTENDED LUNAR STAY IF FAILURE ALSO AFFECTS REDUNDANT 3-AXIS ATT CONTROL	3 TEMP CAUTION 4 GIMBAL LOCK
			LUNAR STAY	4. ASCEND AT NEXT BEST OPPORTUNITY IF FAILURE ALSO AFFECTS REDUNDANT 3-AXIS ATT CONTROL	
			RNDZ	5. CONTINUE MISSION	
	24-21	LOSS OF FDAI FUNCTIONS (ATT, RATES, ERRORS)	ALL	CONTINUE MISSION CREW OPTION	
	24-22	LOSS OF AOT	ALL	CONTINUE MISSION	

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	24-23	LOSS OF RNDZ RADAR/ VHF RANGING/OPTICAL TRACKING			CSM OPTICAL TRACKING CAPABILITY REQUIRES THE LM TRACKING LIGHT AND THE ABILITY TO VISUALLY TRACK.
		A. LOSS OF ANY ONE	ALL	A. CONTINUE MISSION REF 3-81 FOR NAVIGATION AND TRACKING REQUIREMENTS FOR M=1 RNDZ	
		B. LOSS OF ANY TWO	DOCKED/ UNDOCKED	B. NO-GO FOR CIRC	
			PRE-PDI	C. NO-GO FOR PDI	
			ALL OTHER	D. CONTINUE MISSION REF 3-81 FOR NAVIGATION AND TRACKING REQUIREMENTS FOR M=1 RNDZ	
	24-24	LOSS OF LANDING RADAR	DOCKED/ UNDOCKED	A. NO-GO FOR CIRC	
			PRE-PDI	B. NO-GO FOR PDI	
			POWERED DESCENT	C.1. PRIOR TO ADEQUATE ALTITUDE UPDATING OF LM STATE VECTORS--- (A) NO-GO FOR LANDING (B) ABORT 2. AFTER ADEQUATE ALTITUDE UPDATING OF LM STATE VECTORS --- CONTINUE MISSION	C. GUIDO TO DECIDE WHEN ADEQUATE UPDATING OF LM STATE VECTORS HAS BEEN ACCOMPLISHED. REF MALF PROC PGNS--- 6 ALT LT 7 VEL LT REF MALF PROC HTRS--- 2 LR TEMP ABNORMAL
		RULE NUMBERS 24-25 THROUGH 24-27 ARE RESERVED.			

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MISSION RULES

SECTION 24 - LM GUIDANCE AND CONTROL - CONTINUED

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	24-28	LOSS OF REDUNDANT 3-AXIS ATTITUDE CONTROL	DOCKED/ UNDOCKED	A. NO-GO FOR CIRC	
			PRE-PDI	B. NO-GO FOR PDI	
			POWERED DESCENT	C.1. PRIOR TO HI GATE ABORT	
				2. AFTER HI GATE LANDING IS CREW OPTION	
			LUNAR STAY	C. ASCEND AT NEXT BEST OPPORTUNITY	
			RNDZ	E. CONTINUE MISSION	

K	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	24-29	LOSS OF TRANSLATION CAPABILITY			
		A. AUTOMATIC ULLAGE (+X)	DOCKED/ UNDOCKED PRE-PDI	A.1. CONTINUE MISSION	A.1. CAN NOT DETECT FAILURE UNTIL LGC COMMANDS ULLAGE
			POWERED DESCENT	2.(A) PRIOR TO PDI	. REF MALF PROC CES---
				(1) BACK UP ULLAGE MANUALLY IF NECESSARY	1 ABNORMAL VEHICLE DYNAMICS 6 TTCA CMDS ABNORMAL
				(2) PDI INHIBITED IF NO AUTO DPS START	
				(B) AFTER PDI CONTINUE MISSION	
		B. 3-AXIS TRANSLATION	DOCKED/ UNDOCKED	B. NO-GO FOR CIRC	
			PRE-PDI/ POWERED DESCENT/ LUNAR STAY	C. CONTINUE MISSION	
			RNDZ	D. NO-GO FOR LM ACTIVE DOCKING	

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	24-30	LOSS OF PITCH OR ROLL GDA	ALL	ENGINE GIMBAL - OFF CONTINUE MISSION UNLESS RCS IMPINGEMENT CONSTRAINTS ARE VIOLATED.	RCS IMPINGEMENT CONSTRAINTS ARE A FUNCTION OF THE GDA POSITION AT THE TIME OF FAILURE, SODB INFO WILL BE USED TO DETERMINE CAPABILITY TO COMPLETE DESCENT FOR A GIVEN GDA POSITION.
	24-31	LOSS OF REDUNDANT ASC ENG ON CAPABILITY	DOCKED/ UNDOCKED	A. NO-GO FOR CIRC	
			PRE-PDI	B. NO-GO FOR PDI	
			POWERED DESCENT	C.1. IF DPS INSERTION CAPABILITY EXISTS, ABORT 2. IF DPS INSERTION CAPABILITY DOES NOT EXIST, ABORT IF MANUAL START VERIFIED 3. AFTER HI GATE- CONTINUE MISSION	
			LUNAR STAY	D. ASCEND AT NEXT BEST OPPORTUNITY	
	24-32	LOSS OF DPS AUTO ON CAPABILITY	DOCKED/ UNDOCKED	A. CONTINUE MISSION	. REF MALF PROC CES ---10
			PRE-PDI	B. CONTINUE MISSION	DPS DOES NOT THRUST WHEN EVENT TIMER IND 00.00
			POWERED DESCENT	C.1. IF AUTOMATIC ULLAGE HAS OCCURRED --- (A) ATTEMPT MANUAL IGN (B) IF IGN DOES NOT OCCUR --- NO-GO PDI THIS REV 2. IF AUTOMATIC ULLAGE HAS NOT OCCURRED --- (A) INHIBIT PDI IGN (B) NO-GO FOR PDI	
		RULE NUMBER 24-33 IS RESERVED.			

K	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	24-34	LOSS OF AUTO/ MANUAL THROTTLE CONTROL			. REF MALF PROC CES--- 11 ENG THR AND CMD DO NOT AGREE/ OFF SCHEDULE.
		A. EITHER	ALL	A. CONTINUE MISSION	
		B. BOTH	DOCKED/ UNDOCKED PRE-PDI	B.1. NO-GO FOR CIRC 2. NO-GO FOR PDI	
			POWERED DESCENT	C. ABORT	
	24-35	RESERVED			
	24-36	LOSS OF LUNAR CONTACT LIGHTS	POWERED DESCENT	CONTINUE MISSION	
		RULE NUMBERS 24-37 THROUGH 24-39 ARE RESERVED			

K | ITEM

PRELAUNCH INSTRUMENTATION

ITEM	MEAS DESCRIPTION	PCM	ONBOARD	TRANSDUCERS	CATEGORY	MISSION RULE REFERENCE
24-40	LGC DOWNLINK	GG0001U	-	-	M	24-20
	PLS TORQ REF	GG1040V	-	-	HD	24-20
	2.5 VDC TM BIAS	GG1110V	-	-	HD	24-20
	IMU 28 VAC 800	GG1201V	-	-	HD	24-20
	IRIG SUSP 3.2 KC	GG1331V	-	-	HD	24-20
	IMU STBY	GG1513X	-	-	HD	24-20
	LGC OPR	GG1523X	-	-	HD	24-20
	X PIPA OUT IN PHASE	GG2001V	-	-	HD	24-20
	Y PIPA OUT IN PHASE	GG2021V	-	-	HD	24-20
	Z PIPA OUT IN PHASE	GG2041V	-	-	HD	24-20
	IG SVO ERR IN PHASE	GG2107V	-	-	HD	24-20
	IG IX RSVR OUT SIN	GG2112V	FDAI	COMMON	HD	24-20
	IG IX RXVR OUT COS	GG2113V	FDAI	COMMON	HD	24-20
	MG SVO ERR IN PHASE	GG2137V	-	-	HD	24-20
	MG IX RSVR OUT SIN	GG2142V	FDAI	COMMON	HD	24-20
	MG IX RSVR OUT COS	GG2143V	FDAI	COMMON	HD	24-20
	OG SVO ERR IN PHASE	GG2167V	-	-	HD	24-20
	OG RSVR OUT SIN	GG2172V	FDAI	COMMON	HD	24-20
	OG RSVR OUT COS	GG2173V	FDAI	COMMON	HD	24-20
	PITCH ATT ERR	GG2219V	FDAI	COMMON	HD - PCM	24-20
	YAW ATT ERR	GG2249V	FDAI	COMMON	HD - PCM	24-20
	ROLL ATT ERR	GG2279V	FDAI	COMMON	HD - PCM	24-20
	PIPA TEMP	GG2300T	C AND W	SEPARATE	HD - PCM	24-20
	RR SHFT SIN	GG3304V	FDAI	COMMON	HD - PCM	24-23
	RR SHFT COS	GG3305V	FDAI	COMMON	HD - PCM	24-23
	RR TRUN SIN	GG3324V	FDAI	COMMON	HD - PCM	24-23
	RR TRUN COS	GG3325V	FDAI	COMMON	HD - PCM	24-23
	LGC WARNING	GG9001X	C AND W	COMMON	HD - PCM	24-20
	ISS WARNING	GG9002X	C AND W	COMMON	HD - PCM	24-20
	LR ANT TEMP	GN7563T	TEMP MONITOR	COMMON	HD - PCM	
	RR NO TRACK	GN7621X	C AND W	COMMON	HD - PCM	24-23
	RR ANT TEMP	GN7723T	TEMP MONITOR	COMMON	HD - PCM	24-23
	YAW ERR CMD	GH1247V	-	-	M	24-28
	PITCH ERR CMD	GH1248V	-	-	M	24-28
	ROLL ERR CMD	GH1249V	-	-	M	24-28
	JD A4D OUTPUT	GH1419V	-	-	HD	24-28
	RCS TCP A4D	GR5032X	-	-	HD	24-28
	JD B3D OUTPUT	GH1423V	-	-	HD	24-28
	RCS TCP B3D	GR5036X	-	-	HD	24-28
	JD A2D OUTPUT	GH1427V	-	-	HD	24-28
	RCS TCP A2D	GR5040X	-	-	HD	24-28
	JD B1D OUTPUT	GH1431V	-	-	HD	24-28
	RCS TCP B1D	GR5044X	-	-	HD	24-28
	JD B4U OUTPUT	GH1418V	-	-	HD	24-28
	JD B4F OUTPUT	GH1420V	-	-	HD	24-28
	JD A4R OUTPUT	GH1421V	-	-	HD	24-28
	JD A3U OUTPUT	GH1422V	-	-	HD	24-28
	JD B3A OUTPUT	GH1424V	-	-	HD	24-28
	JD A3R OUTPUT	GH1425V	-	-	HD	24-28
	JD B2U OUTPUT	GH1426V	-	-	HD	24-28
	JD A2A OUTPUT	GH1428V	-	-	HD	24-28
	JD B2L OUTPUT	GH1429V	-	-	HD	24-28
	JD A1U OUTPUT	GH1430V	-	-	HD	24-28
	JD A1F OUTPUT	GH1432V	-	-	HD	24-28
	JD B1L OUTPUT	GH1433V	-	-	HD	24-28
	RCS TCP B4U	GR5031X	-	-	HD	24-28
	RCS TCP B4F	GR5033X	-	-	HD	24-28
	RCS TCP A4R	GR5034X	-	-	HD	24-28
	RCS TCP A3U	GR5035X	-	-	HD	24-28
	RCS TCP B3A	GR5037X	-	-	HD	24-28
	RCS TCP A3R	GR5038X	-	-	HD	24-28
	RCS TCP B2U	GR5039X	-	-	HD	24-28
	RCS TCP A2A	GR5041X	-	-	HD	24-28
	RCS TCP B2L	GR5042X	-	-	HD	24-28
	RCS TCP A1U	GR5043X	-	-	HD	24-28
	RCS TCP A1F	GR5045X	-	-	HD	24-28
	RCS TCP B1L	GR5046X	-	-	HD	24-28
	YAW ATT ERR	GH1455V	FDAI	COMMON	HD	24-28
	PITCH ATT ERR	GH1456V	FDAI	COMMON	HD	24-28

R	ITEM	MEAS DESCRIPTION	PCM	ONBOARD	TRANSDUCERS	CATEGORY		MISSION RULE REFERENCE
	24-40 CONT	ROLL ATT ERR	GH1457V	FDAI	COMMON	HD		24-28
		RGA YAW RATE	GH1461V	FDAI	COMMON	M	ON BOARD	24-28
		RGA PITCH RATE	GH1462V	FDAI	COMMON	M	PCM/HD	24-28
		RGA ROLL RATE	GH1463V	FDAI	COMMON	M		24-28
		AGS SEL	GH1621X	-	-	HD		24-28
		ROLL PLSD/DIR	GH1628X	-	-	HD		24-28
		PITCH PLSD/DIR	GH1629X	-	-	HD		24-28
		YAW PLSD/DIR	GH1630X	-	-	HD		24-28
		AUTO ON	GH1214X	-	-	HD		24-31
		APS ARM	GH1230X	-	-	M		24-31
		ENG FIRE OVRD	GH1286X	-	-	HD		24-31
		MAN THRUST CMD	GH1311V	METER	SEPARATE	M		24-34
		PITCH GDA POS	GH1313V	-	-	M		24-30
		ROLL GDA POS	GH1314V	-	-	M		24-30
		P TRM FAIL	GH1323X	C AND W	COMMON	HD		24-30
		R TRM FAIL	GH1330X	C AND W	COMMON	HD		24-30
		AUTO THRUST CMD	GH1331V	METER	SEPARATE	HD		24-34
		DPS ARM	GH1348X	-	-	HD		24-32,24-34
		VAR INJ ACT POS	GG6806H	-	-	HD		24-34
		CES AC PWR FAIL	GL4026X	C AND W	COMMON	HD		24-30,24-28
		CES DC PWR FAIL	GL4027X	C AND W	COMMON	HD		24-30,24-28,24-31
		AGS DOWNLINK DATA	GI0001X	-	-	HD		24-20
		ASA TEMP	GI3371T	-	-	HD		24-20
		ASA PWR/AEA FAIL	GL4028X	C AND W	COMMON	HD		24-20
		AUTO OFF	GH1217X	-	-	HD		24-32,24-31
		AGS AUTO	GH1641X	-	-	HD		24-28
		AGS ATT HOLD	GH1642X	-	-	HD		24-28
		PGNS AUTO	GH1643X	-	-	HD		24-28
		PGNS ATT HOLD	GH1644X	-	-	HD		24-28
		LR RNG DATA NO GOOD	GN7521X	C AND W	COMMON	HD		24-24
		LR VEL DATA NO GOOD	GN7557X	C AND W	COMMON	HD		24-24

R	ITEM	
		GENERAL
	25-1	RESERVED
	25-2	DEFINITIONS A. AN OPERATIONAL DPS IS DEFINED AS PRIOR TO IGNITION 1. FUEL AND/OR OXIDE ENGINE INLET PRESSURE GREATER THAN 30 PSIA 2. THE OXIDIZER AND FUEL BULK TEMPERATURES MUST BE GREATER THAN 50 F AND LESS THAN 90 DEG F 3. DELTA TEMP BETWEEN FUEL AND OXID LESS THAN 10 DEG F 4. DELTA PRESSURE (FUEL HIGH) LESS THAN 50 PSID 5. PROPELLANT AND SUPERCRITICAL HELIUM ADEQUATE TO COMPLETE MISSION AFTER PDI IGNITION 1. FUEL AND/OR OXID ENGINE INLET PRESSURES GREATER THAN 150 PSIA (ULLAGE PRESSURES GREATER THAN 160 PSIA) 2. THROAT AREA INCREASE LESS THAN 35 PERCENT 3. ADEQUATE PROPELLANT AND SUPERCRITICAL HELIUM TO COMPLETE MISSION B. DPS INSERTION CAPABILITY IS THE ABILITY TO OBTAIN A SAFE INSERTION WITH ONLY THE DPS.
		RULE NUMBERS 25-3 THROUGH 25-10 ARE RESERVED

R	ITEM	
		'SYSTEMS MANAGEMENT'
	25-11	RESERVED
	25-12	RESERVED
	25-13	RESERVED
	25-14	FROM A SAFETY STANDPOINT, SUPERCRITICAL HELIUM BURST DISC RUPTURE DURING MANNED OPERATION IS AN ALLOWABLE EVENT.
	25-15	PROPELLANT GAGING A. PRIME METHOD--- PQGS (TM, ONBOARD) (1.3 PERCENT) B. BACKUP METHOD--- GROUND MASS CALCULATION (3 PERCENT FOR GAGING)
	25-16	IF POWERED DESCENT IS ABORTED DURING DPS INSERTION CAPABILITY OR IF A DOCKED DPS CONTINGENCY IS REQUIRED, THE DES HE REG 1 AND REG 2 VALVES SHOULD BE CLOSED AT A PQGS READING OF 31 PERCENT TO INSURE A LOW ENOUGH TANK PRESSURE TO PREVENT A VIOLATION OF FRACTURE MECHANICS LIMITS FROM HEAT SOAK BACK.
		RULE NUMBERS 25-17 THROUGH 25-29 ARE RESERVED.

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
				SPECIFIC MISSION RULES	
	25-30	LOSS OF OPERATIONAL DPS (PRIOR TO LOW GATE, REF MR 25-2 FOR DEFINITION. AFTER LOW GATE, ONLY LOW INLET PRESSURES LESS THAN 150 PSIA)	DOCKED/ UNDOCKED	A. INHIBIT DPS BURNS	REF MAL PROC DPS---
			PRE-PDI	B.1. NO-GO FOR PDI 2. RNDZ WITH APS	1 DES REG 1A FUEL/OXID PRESS ABNORMAL 2 FUEL/OXID TEMP ABNORMAL
			POWERED DESCENT	C. ABORT STAGE	3 HE PRESS ABNORMAL
	25-31	START TANK LEAK PRIOR TO PRESSURIZATION			REF MAL PROC DPS--- 3 HE PRESS ABNORMAL
		A. FUEL AND OXID ENGINE INLET P GREATER THAN 30 PSIA	ALL	A. CONTINUE MISSION- INHIBIT FIRING DPS START TANK SQUIB	
		B. FUEL AND/OR OXID ENGINE INLET P LESS THAN 30 PSIA		B. CONTINUE MISSION- FIRE SQUIB TO START TANK	NOTE--- PRESSURIZATION SYSTEM MAY BE OPENED TO START TANK LEAK. CLOSE PRIMARY HE REG SOV AFTER EACH BURN AND REOPEN AT INITIATION OF EACH BURN.
	25-32	RESERVED			
	25-33	LOSS OF SUPERCRITICAL PRESSURE (DPS IN BLOWDOWN MODE)			REF MAL PROC DPS--- 3 HE PRESS ABNORMAL
		A. GREATER THAN 33 PERCENT PQGS	POWERED DESCENT	A. ABORT- ABORT STAGE PRIOR TO INLET PRESSURES LESS THAN OR EQUAL TO 150 PSIA. (ULLAGE PRESSURE LESS THAN 160 PSIA.)	
		B. LESS THAN OR EQUAL TO 33 PERCENT PQGS		B. CONTINUE MISSION	

K	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	25-34	DESCENT HE/PROP LEAK			REF MAL PROC DPS---
		A. LEAK SUCH THAT PDI CAN BE COMPLETED	PRE-PDI	A. CONTINUE MISSION	1 DES REG 3 HE PRESS ABNORMAL
		B. LEAK SUCH THAT PDI CAN NOT BE COMPLETED		B. NO-GO FOR PDI	
		RULE NUMBER 25-35 RESERVED.			

K	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	25-36	91 SEC AFTER LO LEVEL SENSE	POWERED DESCENT	CREW EVALUATION LAND OR ABORT	5 SEC CAPABILITY AT FTP 20 SEC CAPABILITY AT 27.5 PERCENT THROTTLE
	25-37	LOW LEVEL CONFIRMS INSUFFICIENT PROPELLANT TO LAND OR DELTA BETWEEN FUEL AND OXIDIZER PQGS READINGS GREATER THAN 10 PERCENT	POWERED DESCENT	ABORT ABORT STAGE AT DPS DEPLETION	REF MAL PROC DPS 6 DES QTY
	25-38	PQGS READING 2 PERCENT (EITHER FUEL OR OXID) AND NO VALID TIME ESTIMATE FROM LOW LEVEL REF MAL PROC DPS---	POWERED DESCENT	ABORT ABORT STAGE AT DPS DEPLETION	7 PQGS IND ABNORMAL NOTE--- THE GROUND CALC DPS QUANTITY WILL BE USED IF BOTH THE LOW LEVEL AND PQGS FAIL.
	25-39	EXCESSIVE PROPELLANT USAGE (PREDICTED MARGIN AT TOUCHDOWN LESS THAN -0.2 PERCENT.)	POWERED DESCENT	A. PRIOR TO P64 - CONTINUE MISSION B. AFTER P64 BUT PRIOR TO LO GATE - 1. ABORT 2. ABORT STAGE AT DPS DEPLETION	NOTE--- THROTTLE-DOWN TIME, THRUST LEVEL, AND SYSTEM PRESSURES ARE SECONDARY CUES WHICH INDICATE OFF NOMINAL DPS PERFORMANCE.

RULE NUMBERS 25-40 THROUGH 25-49 ARE RESERVED

K | ITEM

25-50

DPS - PRELAUNCH INSTRUMENTATION

MEAS DESCRIPTION	PCM	ONBOARD	TRANSDUCER	CATEGORY		MISSION RULE REFERENCE
START TNK PRESS	GQ3015P	HE MON	COMMON	HD		25-31
HE REG PRESS	GQ3018P	C AND W	COMMON	HD	1 OF 2	25-30,34
HE REG PRESS	GQ3025P			HD	M-PCM	25-30,34
HE PRESS	GQ3435P			HD	1 OF 2	25-33,30
HE PRESS	GQ3436P	PRESS		HD	M	25-33,30
FU TNK 1 QTY	GQ3603Q	QTY	COMMON	HD	1 OF 2	25-37,38,39
FU TNK 2 QTY	GQ3604Q	QTY	COMMON	HD	M	25-37,38,39
OX TNK 1 QTY	GQ4103Q	QTY	COMMON	HD	1 OF 2	25-37,38,39
OX TNK 2 QTY	GQ4104Q	QTY	COMMON	HD	M	25-37,38,39
FU 1 TEMP	GQ3718T	TEMP MON	COMMON	HD	1 OF 2	25-30
FU 2 TEMP	GQ3719T	TEMP MON	COMMON	HD	M	25-30
OX 1 TEMP	GQ4218T	TEMP MON	COMMON	HD	1 OF 2	25-30
OX 2 TEMP	GQ4219T	TEMP MON	COMMON	HD	M	25-30
FU PRESS	GQ3611P			M		25-30,31,32,33,35
OX PRESS	GQ4111P			M		25-30,31,32,33,35
TCP	GQ6510P	THRUST	COMMON	M-PCM		25-30,41
LOW LEVEL	GQ4455X	DPS LOW	COMMON	M		25-36

K | ITEM

GENERAL

26-1 RESERVED

26-2 DEFINITIONS---

A. AN OPERATIONAL APS (PREPRESSURIZATION) IS DEFINED AS FOLLOWS---

1. DELTA PRESS BETWEEN APS FUEL AND OXID ENGINE INLET PRESSURES LESS THAN 90 PSID
2. DELTA TEMP BETWEEN APS FUEL AND OXID LESS THAN 10 DEG F
3. APS FUEL AND/OR OXID TEMP GREATER THAN 50 DEG F AND LESS THAN 90 DEG F
4. APS FUEL OR OXID INLET PRESSURE GREATER THAN 62 PSIA AND LESS THAN 220 PSIA
5. REDUNDANT PRESSURIZATION PATHS AND NO HELIUM TANK OR HELIUM LINE LEAKS

B. AN OPERATIONAL APS (POST-PRESSURIZATION) IS DEFINED AS FOLLOWS---

1. ADEQUATE PROPELLANT AND SOURCE PRESSURE TO COMPLETE MISSION
2. APS FUEL AND/OR OXID INLET PRESSURES GREATER THAN 105 PSIA. (ULLAGE PRESSURE GREATER THAN 110 PSIA)
3. DELTA PRESSURE BETWEEN FUEL AND OXID INLET PRESSURES LESS THAN OR EQUAL TO 15 PSID.

RULE NUMBERS 26-3 THROUGH
26-12 ARE RESERVED

K	ITEM	
		SYSTEMS MANAGEMENT
	26-13	RESERVED
	26-14	RESERVED
	26-15	PROPELLANT GAGING (NO ONBOARD READOUT)--- A. PRIME METHOD--- APS QTY FROM LGC MASS CALCULATION (THREE PERCENT) B. BACKUP METHOD--- FLOW RATE X TIME (5 PERCENT)
	26-16	ASCENT FEED WILL NOT BE UTILIZED IF ANY APS HE/PROPELLANT LEAK OR VALID APS LOW LEVEL EXISTS DURING ANY PHASE OF THE MISSION.
	26-17	OPTIMIZATION OF APS HELIUM (ISOLATION OF LEAKING SOURCE, BLOW DOWN, ETC) SHOULD BE ACCOMPLISHED IF POSSIBLE FOR HE LEAKS.
		RULE NUMBERS 26-18 AND 26-19 ARE RESERVED.

K	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
				SPECIFIC	
	26-20	LOSS OF AN OPERATIONAL APS	DOCKED/ UNDOCKED	A. NO-GO FOR CIRC	REF MAL PROC APS
			PRE-PDI	B. NO-GO FOR PDI	1 ASC PRESS 2 FUEL OR OXID TEMP ABNORMAL
			POWERED DESCENT	C. ABORT- USE DPS AS LONG AS POSSIBLE	2A FUEL OR OXID PRESS ABNORMAL 3 HE PRESS ABNORMAL OR DECR.
			LUNAR STAY	D. ASCEND NEXT BEST OPPORTUNITY	
			RNDZ	E. USE RCS FOR TPI	
	26-21	APS HE SOURCE PRESSURE			REF MAL PROC APS
		A. LEAK PRIOR TO PRESSURIZATION	DOCKED/ UNDOCKED	A.1. NO-GO FOR CIRC	1 ASC PRESS 3 HE PRESS ABNORMAL OR DECR.
			PRE-PDI	2. NO-GO FOR PDI	NOTE
			POWERED DESCENT	3. ABORT- USE DPS AS LONG AS POSSIBLE	ONE HELIUM BOTTLE CAN SUPPLY SUFFICIENT APS DELTA V CAPABILTY FOR NONLANDING ALTERNATE MISSIONS.
			LUNAR STAY	4. ASCEND NEXT BEST OPPORTUNITY	
		B. LEAK AFTER PRESSURIZATION	LUNAR STAY	B.1. ASCEND IMMEDIATELY	
			RNDZ	2. CONTINUE MISSION	

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	26-22	APS HE LEAK BETWEEN QUAD CHECK VALUES AND ASC HE REG 1 AND 2 SHUTOFF VALVES	DOCKED/ UNDOCKED	A. NO-GO FOR CIRC	REF MAL PROC APS--- 3 HE PRESS ABNORMAL OR DECR.
			PRE-PDI	B. NO-GO FOR PDI	
			POWERED DESCENT	C. ABORT- USE DPS AS LONG AS POSSIBLE	
			LUNAR STAY	D. ASCEND NEXT BEST OPPORTUNITY	
			RNDZ	E. CONTINUE MISSION- CLOSE HE SOV'S	
	26-23	APS PROPELLANT/VAPOR LEAK DOWNSTREAM OF QUAD CHECK VALVES	UNDOCKED/ PRE-PDI	A. NO-GO FOR PDI	REF MAL PROC APS--- 1 ASC PRESS 2A FUEL OR OXID PRESS ABNORMAL 3 HE PRESS ABNORMAL OR DECR.
			POWERED DESCENT	B. ABORT- USE DPS AS LONG AS POSSIBLE	
			LUNAR STAY	C. ASCEND IMMEDIATELY	
			RNDZ	D. USE RCS FOR TPI	

K	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	26-24	APS PROP VALVE MISMATCH (DELTA POS)	ALL	CONTINUE MISSION A. IF MISMATCH PRESENT AFTER ENGINE SHUT DOWN INHIBIT SUBSEQUENT APS BURNS B. IF MISMATCH PRESENT ONLY WHILE BURNING, SUBSEQUENT APS BURNS ARE POSSIBLE WITHOUT A REDUNDANT SET OF BALL VALVES TO START THE ENGINE	THIS INDICATION PRIOR TO FIRST APS ENGINE ON WILL BE CONSIDERED A TM FAILURE
	26-25	APS FU AND/OR OXID LOW LEVEL			APS MAL PROC APS 4 ASC QTY
		A. DURING ASCENT	ASCENT	A. CONTINUE MISSION	
		B. CONFIRMS INSUFFICIENT PROPELLANT FOR APS TPI	RNDZ	B. USE RCS FOR TPI	
		RULES 26-26 THROUGH 26-29 ARE RESERVED.			

K | ITEM

26-30

APS - PRELAUNCH INSTRUMENTATION

MEAS DESCRIPTION	PCM	ONBOARD TRANSDUCER		CATEGORY	MISSION RULE REFERENCE
APS HE 1 PRESS	GP0001P	FEL MON C+W	COMMON	HD - 1 OF 2M	26-20,21,22
APS HE 1R PRESS	GP0041P			HD - PCM	26-20,21,22
APS HE 2 PRESS	GP0002P	FEL MON C+W	COMMON	HD - 1 OF 2M	26-20-21,22
APS HE 2R PRESS	GP0042P			HD - PCM	26-20,21,22
APS HE REG PRESS	GP0018P			HD 1 OF 2	26-20,22
APS HE REG PRESS	GP0025P	C AND W	COMMON	HD M - PCM	26-20,22
APS FUEL TEMP	GP0718T	TEMP	COMMON	M - PCM	26-20
APS FUEL LOW	GP0908X	C AND W	COMMON	HD	26-25
APS OXID TEMP	GP1218T	TEMP	COMMON	M - PCM	26-20
APS OXID LOW	GP1408X	C AND W	COMMON	HD	26-25
APS FUEL PRESS	GP1501P			M - PCM	26-20,21,22,23
APS OXID PRESS	GP1503P			M - PCM	26-20,21,22,23
VLVS A DELTA POS	GP2997U			HD	26-24
VLVS B DELTA POS	GP2998U			HD	26-24
APS TCP	GP2010F			HD	

27 LM REACTION CONTROL SYSTEM

K	ITEM	
		GENERAL
	27-1	RESERVED
	27-2	DEFINITIONS A. OPERATIONAL RCS SYSTEM 1. AN RCS SYSTEM CONTAINING EIGHT OPERATIONAL THRUSTERS SUPPLIED BY ITS OWN PRESSURIZATION AND PROPELLANT FEED SYSTEM INDEPENDENT OF ASCENT FEED AND CROSSFEED. 2. FUEL AND/OR OXID MANIFOLD PRESSURES GREATER THAN OR EQUAL TO 100 PSI. 3. FUEL TEMP GREATER THAN OR EQUAL TO 40 DEG F AND LESS THAN OR EQUAL TO 100 DEG F. 4. QUAD TEMP GREATER THAN 119 DEG F. RULE NUMBERS 27-3 THROUGH 27-9 ARE RESERVED.

K	ITEM	
		' SYSTEMS MANAGEMENT '
	27-10	RESERVED
	27-11	RESERVED
	27-12	PROPELLANT GAGING A. PRIME METHOD--- GROUND RCS PROGRAM (6.0 PERCENT) B. BACKUP METHOD--- PQMD (ONBOARD READOUT 13.0 PERCENT, GROUND READOUT 10.0 PERCENT)
	27-13	THE RCS SYSTEM SHOULD BE CROSSFED WHEN NECESSARY TO INSURE THAT NEITHER SYSTEM EXCEEDS ITS RCS CONSUMABLE REDLINE.
	27-14	ASCENT FEED WILL NOT BE UTILIZED IF AN RCS PROPELLANT LEAK EXISTS DOWNSTREAM OF THE MAIN SOV'S.
		RULE NUMBERS 27-15 THROUGH 27-19 ARE RESERVED.

K	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
				SPECIFIC MISSION RULES	
	27-20	LOSS OF OPERATIONAL RCS SYSTEM A OR B	ALL	A. CLOSE MAINS OF AFFECTED SYSTEM IF LOSS OF SYSTEM RESULTED FROM ANYTHING OTHER THAN DISABLING OF JETS. CROSSFEED FROM GOOD SYSTEM	REF MAL PROC RCS 1 RCS 1A HE PRESS LOW OR DECR. 1B PQMD ABNORMAL 2 RCS PRESS OR TEMP ABNORMAL 3 RCS A(B) REG
			DOCKED	B. DO NOT UNDOCK	
			UNDOCKED	C. NO-GO FOR CIRC	
			PRE-PDI	D. NO-GO FOR PDI	
			POWERED DESCENT	E.1. PDI TO HI GATE - ABORT 2. HI GATE TO TOUCHDOWN- CONTINUE MISSION	
			LUNAR STAY	F. ASCEND NEXT BEST OPPORTUNITY	
			RNDZ	G. CONTINUE MISSION- NO-GO FOR LM ACTIVE DOCKING	
	27-21	RESERVED			

K	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	27-22	DECREASING OR LOSS OF RCS HE PRESSURE	ALL	A. 1. CONTINUE USING BOTH SYSTEMS UNTIL MFLD PRESS IN BAD SYSTEM IS LESS THAN 100 PSI, THEN CLOSE MAINS OF BAD SYSTEM 2. CROSSFEED FROM GOOD SYSTEM	REF MAL PROC RCS 1 RCS 1A HE PRESS LOW OR DECR. 1B PQMD ABNORMAL WHEN MFLD PRESS DROPS BELOW 100 PSI, THE SYSTEM IS CONSIDERED NON-OPERATIONAL REF RULE 27-2
			DOCKED/ UNDOCKED	B. NO-GO FOR CIRC	
			PRE-PDI	C. NO-GO FOR PDI	
			POWERED DESCENT/ LUNAR STAY	C.1. CONTINUE MISSION IF SUFFICIENT BLOWDOWN CAPABILITY EXISTS IN FAILED SYSTEM TO MEET THE RCS REQLINES DEFINED IN MR3-113 2. IF THIS CAPABILITY DOES NOT EXIST--- (A) PDI TO HI GATE - ABORT (B) HI GATE TO TOUCHDOWN - CONTINUE MISSION (C) LUNAR STAY - ASCEND NEXT BEST OPPORTUNITY	D. RCS TROUBLESHOOTING WILL NOT BE PERFORMED AFTER HI GATE
			RNDZ	E. CONTINUE MISSION	
	27-23	RCS PROPELLANT LEAK DOWNSTREAM OF MAIN SOV'S	DOCKED UNDOCKED	A. NO-GO FOR CIRC	REF MAL PROC RCS 1 RCS 1A HE PRESS LOW OR DECR. 1B PQMD ABNORMAL
			PRE-PDI	B. NO-GO FOR PDI	
			POWERED DESCENT	C.1. PDI TO HI GATE - ABORT 2. HI GATE TO TOUCHDOWN- CONTINUE MISSION	
			LUNAR STAY	D. ASCEND NEXT BEST OPPORTUNITY	
			RNDZ	E. CONTINUE MISSION	E. WITH AN RCS SYSTEM ISOLATED SOME TRANSLATION CAPABILITY IS LOST

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MISSION RULES

SECTION 27 - LM REACTION CONTROL SYSTEM - CONTINUED

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	27-24	RESERVED			
	27-25	IMPINGEMENT CONSTRAINTS VIOLATED	DOCKED/ UNDOCKED	A. NO-GO FOR CIRC	REF MAL PROC RCS 1B PQMD ABNORMAL
			PRE-PDI	B. NO-GO FOR PDI	
			POWERED DESCENT	C.1. ABORT 2. ABORT STAGE AS SOON AS POSSIBLE	
			LUNAR STAY	D. CONTINUE MISSION	
			RNDZ	E. USE RCS + Z FOR TPI	
		RULE NUMBERS 27-26 THROUGH 27-29 ARE RESERVED.			

R | ITEM

PRELAUNCH INSTRUMENTATION

27-30 MEAS DESCRIPTION	PCM	ONBOARD	TRANSDUCER	CATEGORY	MISSION RULE REFERENCE
RCS 'A' PROP QTY	GR1085Q	QUANTITY	COMMON	HD 1OF2	27-23,22,20,12
RCS 'A' HE PRESS	GR1101P	PRESS MON C AND W	COMMON	HD M	27-23,20,22
RCS 'A' REG PRESS	GR1201P	PRESS MON C AND W	COMMON	HD - PCM	27,20,22,23
RCS 'B' REG PRESS	GR1202P	PRESS MON C AND W	COMMON	HD - PCM	27,20,22,23
RCS 'B' PROP QTY	GR1095Q	QUANTITY	COMMON	HD 1OF2	27-23,20,22
RCS 'B' HE PRESS	GR1102P	PRESS MON C AND W	COMMON	HD M	27-23,20,22,12
RCS 'A' FUEL TEMP	GR2121T	TEMP MON	COMMON	M - PCM	27-20
RCS 'B' FUEL TEMP	GR2122T	TEMP MON	COMMON	M - PCM	27-20
RCS MAIN 'A' CLSD	GR9609U	MAIN SOV	COMMON	HD	27-23
RCS MAIN 'B' CLSD	GR9610U	MAIN SOV	COMMON	HD	27-23
RCS 'A' FUEL MFLD PRESS	GR2201P	PRESS MON	COMMON	M	27-20,23
RCS 'B' FUEL MFLD PRESS	GR2202P	PRESS MON	COMMON	M	27-20,23
RCS 'A' OX MFLD PRESS	GR3201P	PRESS MON	COMMON	M	27-20,23
RCS 'B' OX MFLD PRESS	GR3202P	PRESS MON	COMMON	M	27-20,23
A/B XFEED OPEN	GR9613U	CRSFD	COMMON	HD	27-20,22
QUAD 1 TEMP	GR6004T	TEMP MON	COMMON	HD	27-20
QUAD 2 TEMP	GR6003T	TEMP MON	COMMON	HD	27-20
QUAD 3 TEMP	GR6002T	TEMP MON	COMMON	HD	27-20
QUAD 4 TEMP	GR6001T	TEMP MON	COMMON	HD	27-20
ASC FEED OXID 'A' OPEN	GR9641U	SYS A ASC OXID ASC FUEL	COMMON	HD	
ASC FEED FUEL 'A' OPEN	GR9631U	SYS A ASC OXID ASC FUEL	COMMON	HD	
ASC FEED FUEL 'B' OPEN	GR9632U	SYS B ASC OXID ASC FUEL	COMMON	HD	
ASC FEED OXID 'B' OPEN	GR9642U	SYS B ASC OXID ASC FUEL	COMMON	HD	

28 SPACE
ENVIRONMENT

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 WHICH ANY MISSION WOULD BE DESIGNED DURING THE PLANNING PERIOD BASED ON A SKIN DOSE OF 250 RAD AND/OR A DEPTH DOSE OF 25 RADS.
		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 ROENTGEN 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.

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MISSION RULES

SECTION 28 - SPACE ENVIRONMENT - CONTINUED

K	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	PRE-LAUNCH	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 SIGNIFICANT 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. CONSIDERATIONS WILL BE GIVEN TO CHANGING THE TRAJECTORY TO A LOW EARTH ORBIT OR REENTERING ASAP BASED ON ACTUAL CONDITIONS.	B.1. CREW SHOULD BEGIN PERSONAL DOSIMETER READOUTS PER 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.	

348

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	PRE-LAUNCH	B.1. HOLD UNTIL DATA ANALYSIS INDICATES THAT THE MOD WILL NOT BE EXCEEDED.	
			EPO	B.2. CONTINUE MISSION. IF DATA ANALYSIS INDICATES THAT THE MOD WILL BE EXCEEDED BY A SIGNIFICANT 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 TLM OR PRD READOUT PROJECTIONS INDICATE THE MOD WILL BE EXCEEDED DURING THE MISSION	TLC	C.1. CONTINUE MISSION. CONSIDERATION SHOULD BE GIVEN TO ENTER IN 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 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	MEAS DESCRIPTION	INSTRUMENTATION REQUIREMENTS PCM	ONBOARD	TRANSDUCERS	CATEGORY	MISSION RULE REF
	28-15	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

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MISSION RULES

SECTION 29 - RECOVERY

K	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 - 24 HOURS, RETAIN DELTA V CAPABILITY TO MOVE ENTRY POINT +/-500 NM		HIGHLY DESIRABLE	TO PROVIDE WEATHER AVOIDANCE CAPABILITY.

*RECOVERY CAPABILITY WILL BE BASED PRIMARILY 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

K	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/55DEG 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/90DEG TARGET POINT-- AND ELIPSE 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

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MISSION RULES

SECTION 30 - AEROMEDICAL

K	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 IN. 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 PCO2 IS 5MM 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 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	ABNORMAL 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	
	30-19	ONSET OF SERIOUS MEDICAL PROBLEM	LAUNCH	A. CONTINUE MISSION CREW MAY ELECT TO ABORT IF INTOLERABLE	MCC SURGEON WILL EVALUATE 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. (A) ALL THREE SUITS CONNECTED TO SUIT CIRCUIT. (B) SUIT DEMAND REG TO PRESS POSITION (C) MONITOR SUIT PRESS (SHOULD REACH 4 PSID IN 75 SEC). (D) SELECT SUIT DEMAND REG INLET SEL VALVE TO OFF WHEN SUIT PRESS REACHES 4.0 PSID. (E) MAINTAIN SUIT OVERPRESSURE BY OPENING INLET SELECTOR VALVE AS NECESSARY. NOTE--- RELIEF FUNCTION OF DEMAND REGULATOR IS ISOLATED WHEN USING THIS PROCEDURE.
			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 101 DEG F. DESPITE CORRECTIVE ACTION.			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 (A) OPEN SUITS AND BREATHE FROM CABIN (B) CHANGE SECOND LIOH CANISTER (C) TEST PCO2 SENSOR	B.2. LIOH CANISTERS WILL NOT BE CHANGED IN AN UNPRESSURIZED CABIN. B.2.(C) PCO2 SENSOR TEST--- . ISOLATE SUIT CIRCUIT BY DISCONNECTING SUIT HOSES FROM THE SPACECRAFT . SUIT CIR RET AIR VALVE CLOSED . CRACK O2 METERING VALVE TO OPEN . PURGE FOR 30 SECONDS . CLOSED O2 METERING VALVE . 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	
	30-26	PCO2 INSTRUMENTATION FAILURE	ALL	CONTINUE MISSION	
		RULE NUMBERS 30-27 THROUGH 30-34 ARE RESERVED.			

R	ITEM
	30-35

INSTRUMENTATION REQUIREMENTS

CSM

MEAS DESCRIPTION	PCM	ONBOARD	TRANSDUCERS	CATEGORY	MISSION RULE REFERENCE
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

*MANDATORY UNTIL SUIT ROOM DEPARTURE

**MANDATORY UNTIL LM CLOSEOUT

31 LUNAR SURFACE OPERATIONS

F	ITEM	
		CONSTRAINTS AND OPTIONS
	31-1	THE REAL TIME DETERMINATION OF LRV MOBILITY RATES WILL BE ACCOMPLISHED BY USING THE SPEED MADE GOOD BETWEEN KNOWN POINTS. THIS VALUE MAY BE BIASED DOWNWARD BY QUALITATIVE JUDGEMENTS OF TERRAIN CHARACTERISTICS OR PROJECTED MOBILITY DEGRADATIONS. IT MAY BE BIASED UPWARDS ONLY FOR KNOWN TIME LOST FOR SURFACE OBSERVATIONS. THE PROJECTED VALUE WILL BE UTILIZED IN MAINTAINING THE CURRENT OPERATIONAL ENVELOPE AND IN REASSEMENT OF EVA'S.
		RULE NUMBERS 31-2 THROUGH 31-30 ARE RESERVED

R	ITEM	

PRECEDENCE/SCHEDULING

31-31 IN ESTABLISHING THE OPERATIONAL 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 SELENOLOGICAL FEATURES THAT ARE ESTABLISHED IN THE FOLLOWING PRIORITY ORDER. THE APPROXIMATE PERCENTAGE SPLITS OF SCIENCE STATION TIME DESIRED FOR THE VARIOUS SELENOLOGICAL REGIONS AND THE MINIMAL TIME REQUIRED FOR EACH REGION ARE INCLUDED---

A.	APENNINE FORT	50 PERCENT	2+30	MINIMAL TIME
B.	HADLEY RILLE	20 PERCENT	1+00	MINIMAL TIME
C.	MARE AREAS	10 PERCENT	30	MINIMAL TIME
D.	NORTH COMPLEX	15 PERCENT	45	MINIMAL TIME
E.	SECONDARY CRATER CLUSTER	5 PERCENT	20	MINIMAL TIME

31-32 FOR SITUATIONS WHERE ALL SURFACE TASKS CANNOT BE ACCOMPLISHED, THE FOLLOWING ORDER OF PRECEDENCE WILL BE USED IN MAKING TASK TRADE-OFFS.

TBD

31-33 REASSESSMENT OF THE OPERATIONAL EVA PLAN WILL BE DONE IF ANY OF THE FOLLOWING CONDITIONS EXIST---

A. BEHIND TIMELINE BY MORE THAN 15 MINUTES

B. AHEAD OF TIMELINE BY MORE THAN 15 MINUTES

C. DEGRADATION OF THE LRV TO SUCH AN EXTENT THAT A MINIMUM OF 4 KM/HR VEHICLE SPEED CANNOT BE MAINTAINED

R	ITEM	
	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	SCIENCE STOPS TO BE SCHEDULED OR TO REMAIN SCHEDULED MUST PROVIDE A MINIMUM OF 10 MINUTES ACTIVE SCIENCE TIME AND 6 MINUTES OPERATIONAL OVERHEAD TIME WITHIN THE REQUIRED DEPARTURE TIME .
	31-36	HIGHLY DESIRABLE STATIONS WILL NOT BE CONSIDERED TO BE A PART OF THE NORMAL SURFACE EXPLORATION PLAN. HOWEVER, HIGHLY DESIRABLE STOPS WILL BE PREPLANNED AND STOPS WILL BE MADE IF A. THE CREW IS AHEAD OF THE TIMELINE BY SUFFICIENT TIME TO ALLOW A MINIMUM OF 10 MINUTES ACTIVE SCIENCE TIME BY EITHER TAKING TIME FROM A SUCCEEDING STATION OR HAVING THE SURPLUS TIME IN ADVANCE, OR B. THE STATION IS UPGRADED TO MANDATORY, AND GIVEN A HIGHER PRIORITY THAN A SUCCEEDING STATION, AND CORRESPONDING TIME IS DELETED DOWNSTREAM FROM THAT POINT IN THE TRAVERSE.
	31-37	SPECIFIC TASKS TO BE ACCOMPLISHED BY THE CREW AT A SCIENCE STOP WILL BE GIVEN A RELATIVE PRIORITY WITHIN THEMSELVES FOR THAT STOP. IN THE EVENT TASKS MUST BE DELETED, THE LOWEST PRIORITY TASK WILL BE DELETED FIRST AND SO ON UNTIL THE MINIMUM SCIENCE TIME HAS BEEN REDUCED TO LESS THAN 10 MINUTES IN WHICH CASE THE ENTIRE STOP WILL BE DELETED.
		RULE NUMBERS 31-38 THROUGH 31-50 ARE RESERVED

363

R | ITEM

SYSTEMS MANAGEMENT

31-51 LRV PRIME DRIVING CONFIGURATION IS DEFINED AS

A. FOUR WHEEL DRIVE WITH FRONT WHEELS POWERED FROM BATTERY 1 AND REAR WHEELS POWERED FROM BATTERY 2

B. FRONT AND REAR STEERING ENABLED WITH FRONT STEERING POWERED FROM BATTERY 1 AND REAR STEERING POWERED FROM BATTERY 2

C. PRIMARY +/- 15 VDC POWER SUPPLY SELECTED

D. BOTH PWM'S SELECTED

E. FRONT WHEELS CONTROLLED BY PWM 1 AND REAR WHEELS CONTROLLED BY PWM 2

F. NAVIGATION SYSTEM ON

G. REVERSE LOCKOUT SWITCH IN LOCKOUT POSITION

H. BATTERY COVERS CLOSED

31-52 DEVIATIONS TO THE PRIME DRIVING CONFIGURATION MAY BE INSTIGATED FOR THE FOLLOWING CAUSES---

A. INOPERABLE STEERING UNIT

B. HIGH/LOW CURRENTS INDICATING SHORTS/OPENS IN SPECIFIC COMPONENTS

C. BATTERY OR TRACTION DRIVE SYSTEMS OVERHEATING

D. ACCUMULATIVE IMBALANCE IN BATTERY LOADS

E. FAILURES IN TRACTION DRIVE SYSTEMS

F. EXCESSIVE DUST

G. DRIVING IN REVERSE REQUIRED

31-53 THE DRIVE ENABLE SWITCHES WILL NOT BE OPERATED AFTER INITIAL CONFIGURATION EXCEPT FOR FAILURES OR MALFUNCTION ISOLATION.

31-54 LRV PARKING CONSTRAINTS FOR LRV AND PAYLOAD THERMAL CONSIDERATIONS ARE AS FOLLOWS---

PARKING DURATION	REQUIRED SUN AZIMUTH	CRITICAL ITEM
LESS THAN ____ MINUTES		
____ TO ____ MINUTES		
MORE THAN ____ MINUTES		
MORE THAN ____ MINUTES IN SHADOW	NOT PERMITTED	

R	ITEM	
	31-55	LRV BATTERY POWER/THERMAL MANAGEMENT WILL BE ACCOMPLISHED THROUGH RECONFIGURATION OF THE BATTERY LOADS AND BY OPENING/CLOSING THE BATTERY COVERS. THE DESIRABLE CONDITIONS TO BE MAINTAINED THROUGH THIS MANAGEMENT IN ORDER OF PRIORITY ARE A. BATTERIES MAINTAINED IN TEMPERATURE RANGE OF 100 DEG F TO 125 DEG F DURING OPERATING PERIODS WITH NO EXCURSIONS ABOVE 140 DEG F B. RELATIVE STATE-OF-CHARGE BETWEEN BATTERIES BALANCED TO WITHIN 5 AMP-HOURS
	31-56	LRV BATTERY COVERS WILL BE OPENED DURING LRV CLOSEOUT AT THE LM ONLY IF BATTERY THERMAL PREDICTIONS SHOW A POSSIBLE REDLINE (140 DEG F) VIOLATION PRIOR TO THE END OF THE SUCCEEDING EVA.
	31-57	LRV BATTERY COVERS WILL BE OPENED AT TRAVERSE STOPS ONLY TO PREVENT BATTERY THERMAL REDLINE (140 DEG F) VIOLATION.
	31-58	THE LRV MUST REMAIN STATIONARY FOR 3 MINUTES FOLLOWING NAVIGATION SYSTEM TURN-ON TO ALLOW THE DIRECTIONAL GYRO UNIT (DGU) TO ATTAIN OPERATING SPEED.
	31-59	LRV DGU REALIGNMENT WILL BE ACCOMPLISHED BEFORE DEPARTURE FROM THE LM ON EACH EVA AND WHEN THE FOLLOWING CONDITIONS APPLY--- A. THE DGU HAS DRIFTED 2 DEGREES OR MORE AS DETERMINED BY COMPARING DGU HEADING WITH TRUE HEADING COMPUTED FROM LRV ATTITUDE AND SUN SHADOW DEVICE (SSD) READINGS. B. THE EVA TRAVERSE CONTINUATION WILL INCLUDE SEGMENTS WHERE THE LM IS NOT VISIBLE.

K	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
				---------- SPECIFIC ----------	
	31-60	TRACTION DRIVE MOTOR EXCEEDS 400 DEG F AND			
		A. MOTOR REQUIRED FOR ACCEPTABLE MOBILITY		A. IF FEASIBLE, SCHEDULE TRAVERSE STOP TO ALLOW MOTOR COOLDOWN WITH HOTTEST MOTOR IN SHADE. OTHERWISE, BEGIN FALLBACK TO WALKING TRAVERSE ENVELOPE WITH MOTOR IN SERVICE.	
		B. MOTOR NOT REQUIRED FOR ACCEPTABILITY		B. SHUT DOWN MOTOR ELECTRICALLY AND DECOUPLE AT NEXT STOP IF ACCEPTABLE COOLDOWN HAS NOT OCCURRED PRIOR TO DEPARTURE.	
	31-61	FORWARD OR REAR STEERING UNIT FAILS TO RESPOND TO HAND-CONTROLLER COMMAND		ELECTRICALLY DISABLE THE FAILED STEERING UNIT.	
	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		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	BATTERY TEMPERATURE EXCEEDS OR PREDICTED TO EXCEED 140 DEG F			BATTERY CELL BREAKDOWN MAY OCCUR ABOVE 140 DEG F.
		A. CONDITION PREVALENT WITH ONLY ONE BATTERY		A. SHIFT ELECTRICAL LOADS TO OTHER BATTERY.	
		B. CONDITION PREVALENT WITH BOTH BATTERIES		B. OPEN BATTERY COVERS AT TRAVERSE STOPS GREATER THAN 30 MINUTES.	B. MAY REQUIRE TRAVERSE CURTAILMENT IF OPENING BATTERY COVERS AT TRAVERSE STOPS WILL NOT ALLEVIATE CONDITION.
	31-65	TRACTION DRIVE MOTOR TEMP EXCEEDS 450 DEG 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.
		B. MOTOR IS REQUIRED TO MAINTAIN ACCEPTABLE LRV MOBILITY.		B. MOTOR WILL BE KEPT IN SERVICE.	B. ATTEMPT MOTOR COOLDOWN WHILE IN USE BY--- 1. DRIVING AT LEAST 4 KM/HR 2. AVOIDING PROLONGED UPSLOPES
	31-66	EITHER BATTERY TEMPERATURE EXCEEDS 140 DEG F			
		A. BATTERY IS NOT REQUIRED FOR LRV MOBILITY.		A. REMOVE FROM SERVICE ELECTRICALLY BY SHIFTING LOADS TO GOOD BATTERY.	A. COOLDOWN MAY BE IMPROVED AT NEXT STOP BY RAISING BATTERY COVERS. SEE GRAPH OF STOP-TIME VERSUS TEMPERATURE DROP.
		B. BATTERY IS REQUIRED FOR LRV MOBILITY		B. LEAVE BATTERY ON LINE WITH LOWEST POSSIBLE LOAD ON IT. ATTEMPT COOLDOWN AT EACH STOP BY RAISING DUST COVERS.	B. POSSIBILITY OF BATTERY STRUCTURAL FAILURE IS INCREASED. AS VOLTAGE WILL BE HIGHER WITH ELEVATED TEMPERATURES, CARE MUST BE TAKEN TO INSURE THE OVERHEATED BATTERY DOES NOT ASSUME ADDITIONAL LOADS IN THE SHARED POWER AREAS.

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	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 OVERCOME BRAKE 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.	AFTER EXHAUSTION OF MALFUNCTION PROCEDURES, SUSPECT BATTERY IS IN THE FAILING MODE AND BE PREPARED TO SWITCH ALL POWER LOADS TO GOOD BATTERY. A GOOD CUE IS THE VOLTAGE OF BATTERY UNDER LOAD.
	31-69	FRONT WHEELS DO NOT RESPOND TO HAND-CONTROLLER STEERING COMMANDS		DECOUPLE STEERING BOTH ELECTRICALLY AND MECHANICALLY. ATTEMPT TO FREE SYSTEM BY MOVING VEHICLE SHORT DISTANCES.	ASSURE THAT STEERING IS NOT JAMMED BY 'RUTS'. BE CAREFUL OF DECOUPLING FRONT STEERING AS IT IS IRREVERSIBLE. BE SURE TO NEUTRALIZE SERVO BEFORE RECOUPLING THE STEERING.

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	31-70	A. ONE OR MORE WHEELS DRIVE REGARDLESS OF HAND-CONTROLLER POSITION		A. USE AS NECESSARY AND AS POSSIBLE TO ACHIEVE MAX MOBILITY. DECOUPLE AND POWER DOWN IF AND ONLY IF MOTOR IS UNMANAGEABLE.	A. USE BY SWITCHING MOTOR ON OR OFF. REMEMBER A MOTOR RUNNING TOO FAST USES LESS POWER THAN ONE RUNNING TOO SLOWLY.
		B. LOSS OF DRIVE FROM ONE OR TWO WHEELS		B. DECOUPLE ONLY AFTER EXHAUSTING MALFUNCTION PROCEDURES. CONSIDER USING "JACK RABBIT" MODE IF IT IS AN ELECTRONICS FAILURE.	B. TRY TO AVOID SETTING THE LRV IN A SITUATION WHERE IT IS REQUIRED THAT IT MOVE SLOWER THAN 4 KM/HR.
	31-71	COMMAND VEHICLE ACCELERATION ABNORMALLY HIGH (SPEED NOT VARIABLE ON ONE OR MORE WHEELS)		DO NOT DECOUPLE UNLESS VEHICLE CONTROLLABILITY IS ADVERSELY AFFECTED. MONITOR MOTOR TEMPERATURES.	SPEED IS FREE, SO DO NOT DEGRADE LRV PERFORMANCE IN TERMS OF SPEED OR TORQUE LOADING UNLESS ABSOLUTELY NECESSARY.
		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 INSURE 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.

THE 16-MM FILM WILL BE USED AT THE CREW'S PREFERENCE EXCEPT FOR ONE MAGAZINE TO BE RESERVED FOR FILMING THE EXCAVATION OF THE SOIL MECHANICS TRENCH.

RULE NUMBERS 31-102 THROUGH
31-110 ARE RESERVED.

32 ALSEP

K	RULE

'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 15, 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. PSE
2. HFE
3. LSM
4. SWS
5. SIDE/CCGE
6. DTREM (M515)
7. ENGINEERING

NOTE

RIPPLE-OFF SEQUENCE IS---
1. SIDE/CCGE
2. SWS
3. PSE

B. THROUGH K. REFERENCE EMRD FOR APOLLO 15 (ALSEP A-2).

L. THE ALSEP TURN-ON SEQUENCE IS---

1. ASTRONAUT ACTIVATES SHORTING PLUG SWITCH ASAP AFTER DEPLOYMENT.
2. ASTRONAUT ACTIVATES ASTRO SWITCH NO. 1 AFTER ACTIVATING SHORTING PLUG SWITCH.

M. IF THE GROUND IS UNABLE TO COMMAND A TRANSMITTER ON AND/OR EXPERIMENTS ON, THE ASTRONAUT WILL TURN ASTRO SWITCHES NO. 2 AND/OR NO. 3 DURING EVA NO. 1 WHEN REQUESTED FROM THE GROUND.

N. REFERENCE APOLLO 15 EMRD (ALSEP A-2).

R	RULE
	32-1 CONT.

O. IF ALSEP DEPLOYMENT TIME BECOMES CONSTRAINED AND THE CREW MUST RETURN TO THE LM, THE RTG SHORTING PLUG AND THE ASTRONAUT SWITCH NO. 1 SHALL BE ACTIVATED BY THE CREW IF THE ANTENNA IS EMPLACED. IF THE ANTENNA IS NOT EMPLACED, THESE SWITCHES SHALL NOT BE ACTIVATED (PICK UP HERE ON EVA NO. 2).

P. THE 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.

Q. REFERENCE APOLLO 15 EMRD (ALSEP A-2).

R. 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 THIRD STEM SECTION IS NOT ATTACHED, WITHDRAW AND START AT A NEW LOCATION FOR A MAXIMUM OF TWO WITHDRAWALS.

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

32-2 THRU 32-10

REFERENCE APOLLO 15 EMRD (ALSEP A-2).

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	32-11 THRU 32-73	REFERENCE APOLLO 15 EMRD (ALSEP A-2)			
	32-74	SIDE DUST COVER COMES OFF DURING DEPLOYMENT		DO NOT REINSTALL- INSURE DUST COVER IS COMPLETELY OFF.	CONTINUE DEPLOYMENT.
	32-75 THRU 32-80	REFERENCE APOLLO 15 EMRD (ALSEP A-2)			
	32-81	CCGE DUST COVER COMES OFF DURING DEPLOYMENT.		DO NOT TRY TO REINSTALL	DUST FROM ASTRONAUT'S GLOVES DOES MORE HARM THAN HAVING COVER OFF.
	32-82 THRU 32-110	REFERENCE APOLLO 15 EMRD (ALSEP A-2)			

33 LUNAR ORBIT
EXPERIMENTS

R	ITEM	
		' GENERAL '
	33-1	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.
	33-2	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.
	33-3	LUNAR ORBIT SIM BAY EXPERIMENTS ARE LISTED BELOW IN THEIR ORDER OF PRIORITY. A. GAMMA-RAY SPECTROMETER (GRS) B. X-RAY FLUORESCENCE C. ALPHA PARTICLE SPECTROMETER D. SM ORBITAL PHOTOGRAPHIC TASKS E. SUBSATELLITE (P AND F S) F. MASS SPECTROMETER (MS)
	33-4	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.
	33-5	AFTER SIM DOOR JETTISON, THE CSM ATTITUDE WILL BE CONSTRAINED TO KEEP DIRECT SUNLIGHT FROM ENTERING THE EXPERIMENT SUN AVOIDANCE ENVELOPES.
	33-6	THE EXPERIMENT TIE DOWN RELEASE FUNCTIONS WILL BE ACTUATED JUST PRIOR TO THE FIRST BOOM EXTENSION.
	33-7	ALL EXPERIMENT COVERS WILL 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 (MASS MAY BE FULLY EXTENDED BUT OFF) D. FUEL CELL PURGES (MASS MAY BE FULLY EXTENDED BUT OFF) E. VIOLATION OF THE SUN-AVOIDANCE ENVELOPE F. H2O BOILER OPERATION
	33-8	SM RCS THRUSTERS A2, A4, B1, AND B4 WILL BE DISABLED DURING ALL EXPERIMENT OPERATIONS WITH THRUSTERS C1 AND C3 ALSO DISABLED DURING MASS SPECTROMETER OUTGASSING AND OPERATION.

K	ITEM	
	33-9	WATER AND URINE DUMPS WILL BE INHIBITED FROM 1 HOUR BEFORE UNTIL IMMEDIATELY AFTER P AND FS LAUNCH.
	33-10	WATER AND URINE DUMPS WILL BE INHIBITED FROM 3 HOURS BEFORE UNTIL IMMEDIATELY AFTER PC AND MC OPERATIONS.
	33-11	AN ATTITUDE DEADBAND OF 0.5 DEGREES WILL BE USED DURING ALL CAMERA OPERATIONS AND MANDATORY LASER ALTIMETER (LA) OPERATION. A 5 DEGREE DEADBAND WILL BE USED FOR ALL OTHER EXPERIMENT OPERATION.
	33-12	A FAILURE OF ANY EXPERIMENT COVER OR EXTENSION MECHANISM WILL NOT PRECLUDE AN EVA FOR FILM RETRIEVAL.
	33-13	FAILURE OF THE SUBSATELLITE TO CLEAR THE LAUNCHER FOLLOWING A VALID ONBOARD LAUNCH INDICATION WILL PRECLUDE AN EVA FOR FILM RETRIEVAL.
	33-14	THERE ARE TWO ACCEPTABLE CUES ON BOOM POSITION. THESE ARE THE APPROPRIATE BOOM TALKBACK INDICATOR AND VISUAL VERIFICATION FROM AN UNDOCKED LM. ANY BOOM THAT CANNOT BE VERIFIED AS RETRACTED BY ONE OF THESE MEANS WILL BE ASSUMED TO BE EXTENDED BEYOND 18 INCHES.
	33-15	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.
	33-16	CORRECTIVE ACTION FOR ANY EXPERIMENT MALFUNCTION WILL REQUIRE CREW PARTICIPATION. THE CREW WILL BE AWAKENED TO SUPPORT THIS EFFORT WITHIN THE MISSION CONSTRAINTS.
	33-17	A 'NO-GO' FOR LOI WILL NOT PRECLUDE SIM BAY DOOR JETTISON.
	33-18	FOR A LUNAR FLY-BY MISSION THE P AND FS LAUNCH TIME WILL BE SELECTED TO SATISFY THE FOLLOWING CRITERIA--- TBD RULE NUMBERS 33-19 THROUGH 33-29, REF THE EMRD FOR APOLLO 15

R	ITEM	
		'OPTICS MANAGEMENT'
	33-30	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.
	33-31	DURING ALL POWERED FLIGHT PHASES THE PC WILL BE PLACED IN THE 'BOOST' MODE AND THE MC IN THE 'STANDBY' MODE WITH IMAGE MTN 'OFF.'
	33-32	THE PC LENS STOW POSITION WILL BE VERIFIED PRIOR TO SIM DOOR JETTISON AND PRIOR TO INITIATING THERMAL PRECONDITIONING OF THE PC. ADDITIONAL STOW VERIFICATIONS WILL BE SCHEDULED AS REQUIRED.
	33-33	A PC PHOTO SEQUENCE WILL NOT EXCEED TBD MINUTES.
	33-34	THE PC HEATERS WILL BE ENABLED A MAXIMUM OF 25 HOURS PRIOR TO THE FIRST CAMERA OPERATION TO ALLOW FOR THERMAL STABILIZATION. THE PC HEATERS WILL REMAIN ENABLED BETWEEN PHOTO PASSES.
	33-35	THE MC WILL BE PLACED IN 'STANDBY' A MAXIMUM OF 25 HOURS PRIOR TO THE FIRST CAMERA OPERATION TO ALLOW FOR THERMAL STABILIZATION. THE MC WILL REMAIN IN STBY BETWEEN PHOTO PASSES.
	33-36	THE BOOM SPECTROMETERS WILL NORMALLY BE FULLY RETRACTED ON SURFACE PHOTOGRAPHY PASSES. BOOM EXTENSIONS UP TO 18 INCHES DURING PANORAMIC CAMERA OPERATION AND 29 INCHES DURING MAPPING CAMERA OPERATION ARE ACCEPTABLE IF REQUIRED FOR SYSTEMS MANAGEMENT.
	33-37	IN THE EVENT OF EXCESSIVE GN2 USAGE, THE OPERATION OF ONE CAMERA WILL NOT BE TERMINATED TO SAVE GN2 FOR THE OTHER CAMERA.
	33-38	TOTAL FAILURE OF THE GN 2 SYSTEM WILL NOT PRECLUDE ATTEMPTS TO OPERATE THE MC AND PC.
	RULE NUMBERS 33-39 THROUGH 33-44 ARE RESERVED.	

R	ITEM	
		'BOOM MANAGEMENT'
	33-45	THE FIRST TIME THE SPECTROMETER BOOMS ARE USED THE INTEGRITY OF THE RETRACT FUNCTION WILL BE VERIFIED PRIOR TO EXTENDING THE BOOMS BEYOND 18 INCHES. IF THE RETRACT CAPABILITY HAS BEEN LOST, THE FIRST EXTENSION WILL BE DELAYED UNTIL IMMEDIATELY AFTER THE CIRCULARIZATION MANEUVER.
	33-46	ANY BOOM EXTENDED BEYOND 18 INCHES THAT WILL NOT RETRACT WILL BE JETTISONED PRIOR TO ANY SPS MANEUVER.
	33-47	A GRS BOOM WILL NOT BE JETTISONED TO ACHIEVE AN 'ON-TIME' SUBSATELLITE LAUNCH BUT WILL EVENTUALLY BE JETTISONED TO CLEAR THE P AND FS LAUNCH ENVELOPE.
	33-48	A SPECTROMETER BOOM WILL NOT BE JETTISONED TO REMOVE AN OBSTRUCTION FROM THE CAMERA FOV'S.
	33-49	PARTIAL BOOM EXTENSIONS OR RETRACTIONS WILL BE ACCOMPLISHED BY TIMING THE BOOM EXTENSION/RETRACTION PER FIGURES TBD. THESE FIGURES WILL BE CALIBRATED IN FLIGHT.
		RULE NUMBERS 33-50 THROUGH 33-59 ARE RESERVED

K	ITEM	
		'MASS SPECTROMETER MANAGEMENT'
	33-60	THE MASS SPECTROMETER (MS) BOOM WILL BE FULLY EXTENDED BEFORE THE MS FILAMENTS ARE POWERED.
	33-61	THE MS WILL BE OUTGASSED PRIOR TO EACH DATA COLLECTION PERIOD.
	33-62	DURING MS OUTGASSING THE SPECTROMETER INSTRUMENTATION WILL BE POWERED.
	33-63	THE ION SOURCE HEATER OPERATION WILL BE INHIBITED FROM 15 MINUTES BEFORE UNTIL 1 HOUR AFTER A WASTE WATER DUMP, URINE DUMP, OR FUEL CELL PURGE.
	33-64	DATA COLLECTION WILL BE INHIBITED FROM 5 MINUTES BEFORE UNTIL 2 HOURS AFTER A WASTE WATER DUMP, URINE DUMP, OR FUEL CELL PURGE.
	33-65	SM RCS THRUSTERS A2, A4, B1, B4, C1, AND C3 WILL BE INHIBITED DURING ION SOURCE HEATER OPERATION AND DATA COLLECTION.
	33-66	THE MS WILL BE OPERATED NO SOONER THAN 6 HOURS AFTER ANY SPS MANEUVER.
		RULE NUMBERS 33-67 THROUGH 33-74 ARE RESERVED

K	ITEM	
		' GAMMA RAY SPECTROMETER MANAGEMENT '
	33-75	THE GAMMA RAY SPECTROMETER (GRS) WILL BE ADJUSTED TO MINIMUM SENSITIVITY AT TURN-ON IF THE UNSTAGED LM IS DOCKED TO THE CSM.
	33-76	THE GRS GAIN STEP CONTROL WILL BE USED TO KEEP THE CALIBRATION PEAK LOCATION ERRORS WITHIN 10 PERCENT.
	33-77	THE GRS VETO CIRCUITS WILL BE DISABLED FOR A 10-MINUTE PERIOD NEAR THE END OF THE FIRST HOUR OF OPERATION AND AT APPROXIMATELY 5-HOUR INTERVALS THEREAFTER.
	33-78	THE GRS WILL NOT BE POWERED WHILE IN THE VAN ALLEN BELT
		RULE NUMBERS 33-79 THROUGH 33-84 ARE RESERVED

R	ITEM	
		' X-RAY/ALPHA SPECTROMETER MANAGEMENT '
	33-85	THE X-RAY SPECTROMETER SOLAR MONITOR DOOR WILL BE OPENED PRIOR TO THE FIRST DATA COLLECTION PERIOD IN LUNAR ORBIT.
	33-86	WHILE IN LUNAR ORBIT, THE X-RAY AND ALPHA PARTICLE SPECTROMETERS WILL BE CALIBRATED ONCE EACH OPERATIONAL DAY BY POINTING THE LUNAR DETECTORS AT DEEP SPACE FOR 15 MINUTES WHEN ON THE DARK SIDE OF THE MOON.
		RULE NUMBERS 33-87 THROUGH 33-94 ARE RESERVED

R	ITEM	
		SUBSATELLITE MANAGEMENT
	33-95	THE P AND FS WILL BE LAUNCHED NORTHWARD PERPENDICULAR TO THE ECLIPTIC PLANE.
	33-96	THE P AND FS WILL BE LAUNCHED INTO AN ORBIT WITH A REV PERIOD OF 7134 +/- 30 SECONDS.
	33-97	SUBSATELLITE LAUNCH WILL NOT BE ATTEMPTED WITH THE GRS BOOM EXTENDED.
	33-98	SUBSATELLITE LAUNCH WILL NOT BE CONSTRAINED BY THE FAILURE OF EXPERIMENT COVERS.
	33-99	EFFLUENT DUMPS WILL BE AVOIDED, AND ALL RCS JETTS WILL BE INHIBITED FROM THE START OF THE P AND FS LAUNCH SEQUENCE UNTIL AFTER P AND FS LAUNCH.
		RULE NUMBERS 33-100 THROUGH 33-104 ARE RESERVED

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
				'OPTICS - SPECIFIC'	
	33-105	SIM BAY TEMP LESS THAN TBD DEG F OR MORE THAN TBD DEG F	TLC	MONITOR CAMERA TEMPS	
	33-106	MAPPING CAMERA LENS BARREL TEMP LESS THAN 45 DEG F	TLC	PLACE MC IN STANDBY	1. 41 DEG F IF OFF SCALE LOW. 2. 40 DEG F IS THE MINIMUM ALLOWABLE TEMP FOR CYCLING THE CAMERA FILM.
	33-107	MAPPING CAMERA LENS BARREL TEMP MORE THAN 100 DEG F	TLC	REQ COLD SOAK	90 DEG F IS THE APPROXIMATE TEMP AT WHICH FILM DEGRADATION BEGINS.
	33-108	PAN CAMERA MECHANISM TEMP LESS THAN 45 DEG F	TLC	ENABLE HEATERS	1. 40 DEG F IS THE MINIMUM ALLOWABLE TEMP FOR CYCLING THE CAMERA FILM. 2. 10 DEG F IS THE LOWER NONOPERATING LIMIT.
	33-109	PAN CAMERA MECHANISM TEMP MORE THAN 100 DEG F	TLC	REQ COLD SOAK	1. 90 DEG F IS THE APPROXIMATE TEMP AT WHICH FILM DEGRADATION BEGINS. 2. HARDWARE REDLINE FOR CYCLING CAMERA IS 120 DEG F.
	33-110	MC FRONT LENS TEMP	LO		
		A. EXCEEDS +90 DEG F		A. TURN MC MODE SWITCH TO 'STANDBY'	REDLINE FILM CYCLING--- 40 LESS THAN T LESS THAN TBD
		B. EXCEEDS +100 DEG F		B. TURN MC MODE SWITCH TO 'OFF'	SPEC 60 LESS THAN T LESS THAN 80 DEG F
	33-111	PC FRONT ELEMENT LENS TEMP	LO		REDLINE NONOPERATING--- 10 DEG F LESS THAN T LESS THAN 120 DEG F
		A. EXCEEDS +TBD DEG F		A. POWER DOWN PC	REDLINE FILM CYCLE--- 40 LESS THAN T LESS THAN 120 DEG F
		B. EXCEEDS 120 DEG F		B. DISABLE HEATERS	SPEC 85 DEG F LESS THAN T LESS THAN 96 DEG F
	33-112	PC CAPPING SHUTTER FAILS	ALL		
		A. OPEN		A. CONTINUE PC OPERATION	
		B. CLOSED		B. POWER DOWN PC	

RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
33-133	FAILURE OF PC TEST FUNCTION	ALL	OPERATE PC FOR 30 SEC.	
33-114	FAILURE OF PC STEREO MODE	ALL	OPERATE PC IN MONO MODE.	
33-115	CREW RECEIVES A PC NO-GO INDICATION (TB-BP).	ALL	CONFINE OPERATION TO STANDBY MODE PENDING GROUND ANALYSIS.	REF MALF X-X A NO-GO INDICATION WILL BE RECEIVED IF ANY ONE OF THE FOLLOWING PARAMETERS IS IN THE IMPROPER STATE --- 1. STEREO MALFUNCTION 2. FILM PATH FAILURE 3. CAPPING SHUTTER OPEN 4. LENS ROTATION SIGNAL 5. OUT OF FILM SIGNAL
33-116	FORWARD MOTION COMPENSATION FAILS.	ALL		
	A. PC		A. CONTINUE CAMERA OPERATION	
	B. MC		B. CONTINUE CAMERA OPERATION	
33-117	CREW RECEIVES AN MC NO-GO INDICATION WHILE OUT OF VOICE CONTACT WITH THE GROUND (TB-BP).	ALL	CONFINE OPERATION TO STANDBY MODE PENDING GROUND ANALYSIS.	A NO-GO INDICATION WILL BE RECEIVED IF ANY ONE OF THE FOLLOWING PARAMETERS IS IN THE IMPROPER STATE --- 1. MC FRONT LENS TEMP. 2. STELLER CAMERA FRONT ELEMENT TEMP. 3. SUPPLY CASSETTE TEMP. 4. FMC LOCK OUT. 5. V/H LEVEL.
33-118	MC DEPLOYMENT MECHANISM FAILS.	ALL		
	A. RETRACTED		A. CONTINUE EXPERIMENT OPERATION	
	B. EXTENDED		B. INHIBIT SM RCS JETS A2, A4, B1, B4	
33-119	EXCESSIVE GN2 USAGE	ALL		
	A. MECHANICAL		A. SCHEDULE PC OPERATION TO EXHAUST FILM PRIOR TO GN2 DEPLETION.	CUE --- SL1031X READS 'ON.' GN2 WILL BE SUPPLIED TO THE AIR BARS CONTINUOUSLY AT A MAX FLOW RATE OF 1.55 LB/HOUR. GN2 WOULD BE DEPLETED IN 6.09 HOURS.
	B. ELECTRICAL FAILURE		B. RESTRICT PC OPERATION TO HIGHEST PRIORITY TARGETS WITHIN GN2 REMAINING.	CUE --- SL1031X READS 'OFF.' PC FILM MAY BREAK IF GN2 IS NOT SUPPLIED TO AIR BARS.

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	33-120	GN2 DEPLETED	ALL	1. CONTINUE OPERATION OF MAPPING CAMERA. 2. ATTEMPT TO OPERATE PAN CAMERA	
	33-121	LOSS OF PC OR MC DOWNLINK	ALL	CONTINUE CAMERA OPERATION.	
	33-122	MC/LA DOOR FAILS IN CLOSED POSITION	LO	OPERATE CAMERA TO OBTAIN BASELINE ENGINEERING DATA AND THEN POWER DOWN.	
	33-123	MC/LA DOOR FAILS IN OPEN POSITION	LO	MINIMIZE AND DELAY AS LONG AS POSSIBLE ANY URINE DUMPS, H2O DUMPS, FUEL CELL PURGES AND UNDESIRABLE THRUSTER ACTIVATIONS.	
	33-124	SIM BAY TEMP LESS THAN TBD DEG F OR MORE THAN TBD DEG F	ALL	MONITOR LASER CAVITY TEMP.	
	33-125	LASER CAVITY TEMP A. APPROACHING 32 DEG F B. GREATER THAN 160 DEG F OR GREATER THAN 131 DEG F AND INTERMITTENT RANGE READOUT	ALL	A. APPLY POWER TO LA. B. REMOVE LA POWER OR GO TO COLD SOAK ATTITUDE.	THE LA WILL NEVER BE FIRED WITH THE LA COVER CLOSED.
	33-126	LOSS OF LA DOWNLINK	LO	LIMIT LA OPERATION TO NOMINAL CAMERA MODE SEQUENCES.	
	33-127	LOSS OF LA AUTO MODE	LO	LIMIT LA OPERATION TO NOMINAL CAMERA MODE SEQUENCES.	
	33-128	LOSS OF VALID RANGE DATA IN CAMERA MODE	LO	LIMIT LA OPERATION TO NOMINAL LA AUTO MODE SEQUENCES.	
	33-129	LA PEN VOLTAGE MORE THAN 2800V		POWER DOWN LA.	
		RULE NUMBERS 33-130 THROUGH 33-135 ARE RESERVED.			

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
				BOOMS - SPECIFIC	
	33-136	BOOM FAILS TO FULLY EXTEND	ALL	CONTINUE EXPERIMENT OPERATION--COLLECT DATA IN DEGRADED MODE.	
	33-137	BOOM FAILS TO FULLY RETRACT	ALL	JETT MALFUNCTIONING BOOM PRIOR TO THE NEXT SPS MANEUVER.	
		RULE NUMBERS 33-138 THROUGH 33-145 ARE RESERVED.			

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
				---- ---- -------- MASS SPEC SPECIFIC ---- ---- --------	
	33-146	SIM BAY TEMP SLXXXX LESS THAN -20 DEG F OR MORE THAN 180 DEG F.	ALL	MONITOR MS TEMPS.	
	33-147	MS ELECTRONICS TEMP	ALL		REDLINE TBD LESS THAN T LESS THAN TBD DEG F
		A. APPROACHING -20 DEG F.		A. ENABLE MS HEATER.	SPEC TBD LESS THAN T LESS THAN TBD DEG F
		B. APPROACHING 180 DEG F OR MORE THAN 160 DEG F AND DEGRADED SCIENCE DATA		B. REMOVE MS POWER OR GO TO COLD SOAK ATTITUDE.	
	33-148	MS DETECTOR TEMP	ALL		
		A. APPROACHING -65 DEG F		A. ENABLE ION SOURCE HEATER	
		B. APPROACHING 180 DEG F OR MORE THAN 160 DEG F AND DEGRADED SCIENCE DATA		B. DISABLE ION SOURCE HEATER OR GO TO COLD SOAK ATTITUDE.	
	33-149	EXCESSIVE COUNTS IN ZERO VOLTS PORTION OF CALIBRATION CYCLE	ALL	DISCRIMINATOR SWITCH TO 'LO'	10-15 COUNTS IS EXCESSIVE.
	33-150	ABSCENCE OF KNOWN PEAKS IN MS SPECTRUM	ALL	MULTIPLIER SWITCH TO 'HIGH'	
	33-151	FAILURE OF ION SOURCE HEATER	ALL	CONTINUE EXPERIMENT OPERATION.	
	33-152	FAILURE OF A SINGLE MS ION SOURCE FILAMENT	ALL	1. IF CREW IS AWAKE, REVERT TO MS OUT-GASSING FOR THE REMAINDER OF THAT DATA COLLECTION PERIOD. 2. PERFORM NORMAL OUT-GASSING FOR SUBSEQUENT OPERATIONS.	
	33-153	CORONA DETECTED IN THE MS	ALL	ATTEMPT TO REDUCE BY 1. OPERATING WITH THE MULTIPLIER GAIN SWITCH IN THE 'LO' POSITION 2. PERFORMING ADDITIONAL OUTGASSING WITH THE HV 'OFF'	
		RULE NUMBERS 3-154 THROUGH 33-160 ARE RESERVED			

K	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
				GAMMA RAY SPECT-SPECIFIC	
	33-161	SIM BAY TEMP SL1208T LESS THAN 10 DEG F OR MORE THAN 120 DEG F	ALL	MONITOR GRS TEMP.	
	33-162	GRS DETECTOR TEMP A. APPROACHING -4 DEG F B. APPROACHING 120 DEG F	ALL	A. APPLY POWER TO GRS. B. REMOVE GRS POWER OR GO TO COLD SOAK ATTITUDE.	1. REDLINE -4 DEG F LESS THAN T LESS THAN 120 DEG F. 2. SPEC -4 DEG F LESS THAN T LESS THAN 120 DEG F. 3. GRS WILL NOT BE POWERED EARLIER THAN TLI + TBD HRS.
	33-163	CORONA DETECTED IN GRS A. ISOLATED TO GRS SHIELD POWER SUPPLY B. ISOLATED TO GRS NAI DETECTOR POWER SUPPLY	ALL	A. SEQUENCE GAIN STEP TO STEP ZERO AND/OR ENHANCE OPERATING ENVIRONMENT. B. OPERATE AT MAXIMUM ALLOWABLE GAIN SETTING AND/OR ENHANCE OPERATING ENVIRONMENT.	
	33-164	EXCESSIVE COINCIDENCE REJECTION OF GAMMA RAY EVENTS	ALL	DISABLE VETO LOGIC	
		RULE NUMBERS 33-165 THROUGH 33-170 ARE RESERVED.			

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
				X-RAY/ALPHA SPECT-SPECIFIC	
	33-171	SIM TEMPS SL1202 AND/OR SL1205 LESS THAN 0 DEG F OR MORE THAN 120 DEG F	ALL	MONITOR X-RAY SPECTROMETER.	
	33-172	X-RAY SPECTROMETER TEMP. A. APPROACHING 0 DEG F B. APPROACHING +120 DEG F	ALL	A. ENABLE X-RAY SPECTROMETER HEATERS B. REMOVE SPECTROMETER POWER OR GO TO COLD SOAK ATTITUDE.	REDLINE -20 DEG F LESS THAN T LESS THAN 120 DEG F. SPEC 0 DEG F LESS THAN T LESS THAN 120 DEG F.
	33-173	SUN APPROACHING X-RAY SPECTROMETER SUN AVOIDANCE ENVELOPE	ALL	PLACE SPECTOMETER IN 'STANDBY' OR 'OFF' OR CLOSE COVER.	
	33-174	FAILURE OF ANY TWO X-RAY LUNAR DETECTORS	LO	CONTINUE EXPERIMENT OPERATION.	
	33-175	FAILURE OF ALL X-RAY LUNAR DETECTORS AT TURN-ON	LO	SCHEDULE LUNAR FLUORESCENT X-RAY MEASUREMENTS WITH THE SOLAR MONITOR FOR A MINIMUM OF TBD HRS NEAR THE END OF THE LO PERIOD.	
	33-176	FAILURE OF THE X-RAY SOLAR MONITOR	LO	CONTINUE EXPERIMENT OPERATION.	
	33-177	X-RAY/ALPHA SPECTROMETER DOOR FAILS IN CLOSED POSITION	ALL	OPERATE X-RAY AND ALPHA PARTICLE SPECTROMETERS TO OBTAIN BASELINE ENGINEERING DATA AND THEN POWER DOWN	CUE--- TB, THERMAL RESPONSE, AND COUNT RATE.
	33-178	X-RAY/ALPHA SPECTROMETER DOOR FAILS IN OPEN POSITION	LO	MINIMIZE AND DELAY AS LONG AS POSSIBLE ANY URINE DUMPS, H2O DUMPS, FUEL CELL PURGES AND UNDESIRABLE THRUSTER ACTIVATIONS.	CUE--- TB, THERMAL RESPONSE AND COUNT RATE.
	33-179	SIM BAY TEMP SL1202 AND/OR SL1205 LESS THAN 0 DEG F OR MORE THAN 120 DEG F	ALL	MONITOR ALPHA PARTICLE SPECTROMETER TEMPS.	

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	33-180	ALPHA PARTICLE SPECTROMETER TEMPERATURE. A. APPROACHING 0 DEG F B. APPROACHING 120 DEG F OR GREATER THAN 104 DEG F AND DEGRADED SCIENCE DATA.	ALL	A. APPLY POWER TO SPECTROMETER. B. REMOVE SPECTROMETER POWER OR GO TO COLD SOAK ATTITUDE.	REDLINE -40 DEG F LESS THAN T LESS THAN 120 DEG F. SPEC 0 DEG F LESS THAN T LESS THAN 104 DEG F.
	33-181	SUN APPROACHING ALPHA PARTICLE SPECTROMETER SUN AVOIDANCE ENVELOPE	ALL	CLOSE EXPERIMENT COVER.	
		RULE NUMBERS 33-182 THROUGH 33-199 ARE RESERVED			

APPENDICES

A ACRONYMS AND SYMBOLS

R	ITEM		
		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	ASSISTENT FLIGHT DIRECTOR
		AFETR	AIR FORCE EASTERN TEST RANGE
		A/G	AIR-TO-GROUND
		AGS	ABORT GUIDANCE SYSTEM
		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 TRANSLATION CONTROLLER ASSEMBLY
		ATP	ALTERNATE TARGET POINT
		ATT	ATTITUDE
		AUX	AUXILIARY
		AZUSA	ELECTRONIC TRACKING AND VECTORING SYSTEM ETR
		BA	BANK ANGLE
		BAP	BEST ADAPTIVE 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 EXTRA VEHICULAR 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
		CSI	CONCENTRIC SEQUENCE INITIATE
		CSM	COMMAND SERVICE MODULE
		CTE	CENTRAL TIMING EQUIPMENT
		CVS	CONTINUOUS VENT SYSTEM
		CVTS	CHIEF VEHICLE TEST SUPVISOR
		CW	CLOCKWISE
		C AND 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	EXTRA-VEHICULAR MOBILITY UNIT
		ENG	ENGINE
		EPS	ELECTRICAL POWER SYSTEM
		ERR	ERROR
		ESE	ELECTRONIC SUPPORT EQUIPMENT
		ETOM	RANGE SAFETY SUPERVISOR KSC CALLOUT
		ETR	EASTERN TEST RANGE
		EVA	EXTRA-VEHICULAR ACTIVITY
		EVAP	EVAPORATOR
		EVT	EXTRA-VEHICULAR TRANSFER
		EVVA	EXTRA-VEHICULAR 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

R	ITEM		
		FL	FULL LIFT
		FM	FREQUENCY MODULATION
		FPS	FEET PER SECOND
		FQR	FLIGHT QUALIFICATION RECORDER
		FTP	FIXED THROTTLE POINT
		G	GRAVITY
		G AND C	GUIDANCE AND CONTROL
		GASTA	GIMBAL ANGLE SEQUENCE TRANSLATION ASSEMBLY
		GBI	GRAND BAHAMA ISLAND
		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 AND N	GUIDANCE AND NAVIGATION
		GN2	GASEOUS NITROGEN
		GNC	GUIDANCE NAVIGATION 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
		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	LM MODULE PILOT
		L/O	LIFTOFF
		LOI	LUNAR ORBIT INSERTION
		LOS	LINE-OF-SIGHT
		LOX	LIQUID OXYGEN
		L/R	LEFT/RIGHT
		LRV	LUNAR ROVING VEHICLE
		LV	LOW-VOLTAGE
		L/V	LAUNCH VEHICLE
		LVDA	LAUNCH VEHICLE DATA ADAPTER
		LVDC	LAUNCH VEHICLE DIGITAL COMPUTER
		MALF	MALFUNCTION
		MC	MAPPING CAMERA
		MCC	MISSION CONTROL CENTER
		MCC	MIDCOURSE CORRECTION
		MC AND W	MASTER CAUTION AND WARNING
		MDAS	MEDICAL DATA ACQUISITION SYSTEM
		MED	MANUAL ENTRY DEVICE
		MESC	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 AND 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
		OXIC	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
		PDS/DD	PLOTTING DISPLAY SUBCHANNEL/DATA DISTRIBUTION
		P AND FS	PARTICLES AND FIELDS SUBSATELLITE
		PGA	PRESSURE GARMENT ASSEMBLY
		PGNCS	PRIMARY GUIDANCE AND NAVIGATION CONTROL SYSTEM CSM
		PGNS	PRIMARY GUIDANCE AND NAVIGATION SYSTEM LM

R	ITEM		
		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 DIFFERENCE
		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
		QTY	QUANTITY
		RAD	RADIATOR
		RET	RETRACT
		RCS	REACTION CONTROL SYSTEM
		RCU	REMOTE CONTROL UNIT
		RCVR	RECEIVER
		REF	REFERENCE
		REFSMMAT	REFERENCE 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	SEQUENTAL EVENTS CONTROL SYSTEM
		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 AND 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
		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	ULTRA HIGH 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

R	ITEM	
		SYMBOLS
		H ALTITUDE
		DELTA VIN DELTA VELOCITY IN INSERTION
		DELTA TB DELTA BURN TIME
		DELTA H 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

MAY 3, 1971

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 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.

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.)

R	ITEM

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:	BSE:	FIDO:	AEROMED:	GUIDO:	CONTROL:	TELCOM:	OTHER:
CAPCOM:	O&P:			RETRO:	GNC:	EECOM:	

MSC FORM 1555 (Rev. Dec 68)

FIGURE C-1. - MISSION RULE CHANGE REQUEST FORM

APOLLO

FFMR

FINAL FLIGHT MISSION RULES

APOLLO 15
(AS-510/112/LM-10)

MAY 3, 1971

FCD
MSC
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