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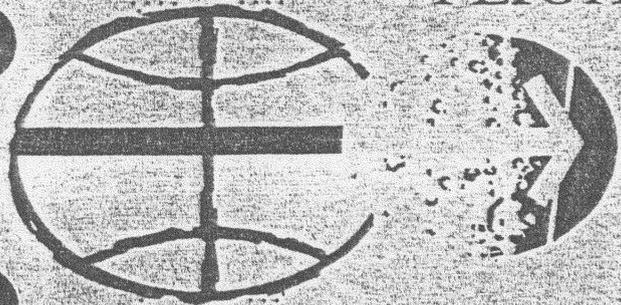
FLIGHT MISSION RULES

APOLLO 11
(AS-506/107/LM-5)

APRIL 16, 1969

PREPARED BY

FLIGHT CONTROL DIVISION



MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

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APOLLO

FLIGHT MISSION RULES

AS-506/107/LM-5

APOLLO 11

PREFACE

THIS DOCUMENT CONTAINS THE FLIGHT MISSION RULES FOR APOLLO 11. THESE RULES WILL RECEIVE AN EXTENSIVE EVALUATION DURING THE SIMULATIONS PRIOR TO THE APOLLO 11 MISSION. SUBSEQUENT REVISIONS TO THIS DOCUMENT WILL BE PRINTED ON COLORED PAGES FOR EASY RECOGNITION. INFORMATION CONTAINED WITHIN THIS DOCUMENT REPRESENTS THE FLIGHT MISSION RULES FOR THE APOLLO 11 MISSION AS OF APRIL 16, 1969.

IT IS REQUESTED THAT ANY ORGANIZATION HAVING COMMENTS, QUESTIONS, OR SUGGESTIONS CONCERNING THESE MISSION RULES CONTACT MR. LARRY W. KEYSER, FLIGHT CONTROL OPERATIONS BRANCH, BUILDING 45, ROOM 638, 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. CHRISTOPHER C. KRAFT, JR., DIRECTOR OF FLIGHT OPERATIONS, MANNED SPACECRAFT CENTER, HOUSTON, TEXAS.

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

APPROVED BY:


CHRISTOPHER C. KRAFT, JR.
DIRECTOR OF FLIGHT OPERATIONS

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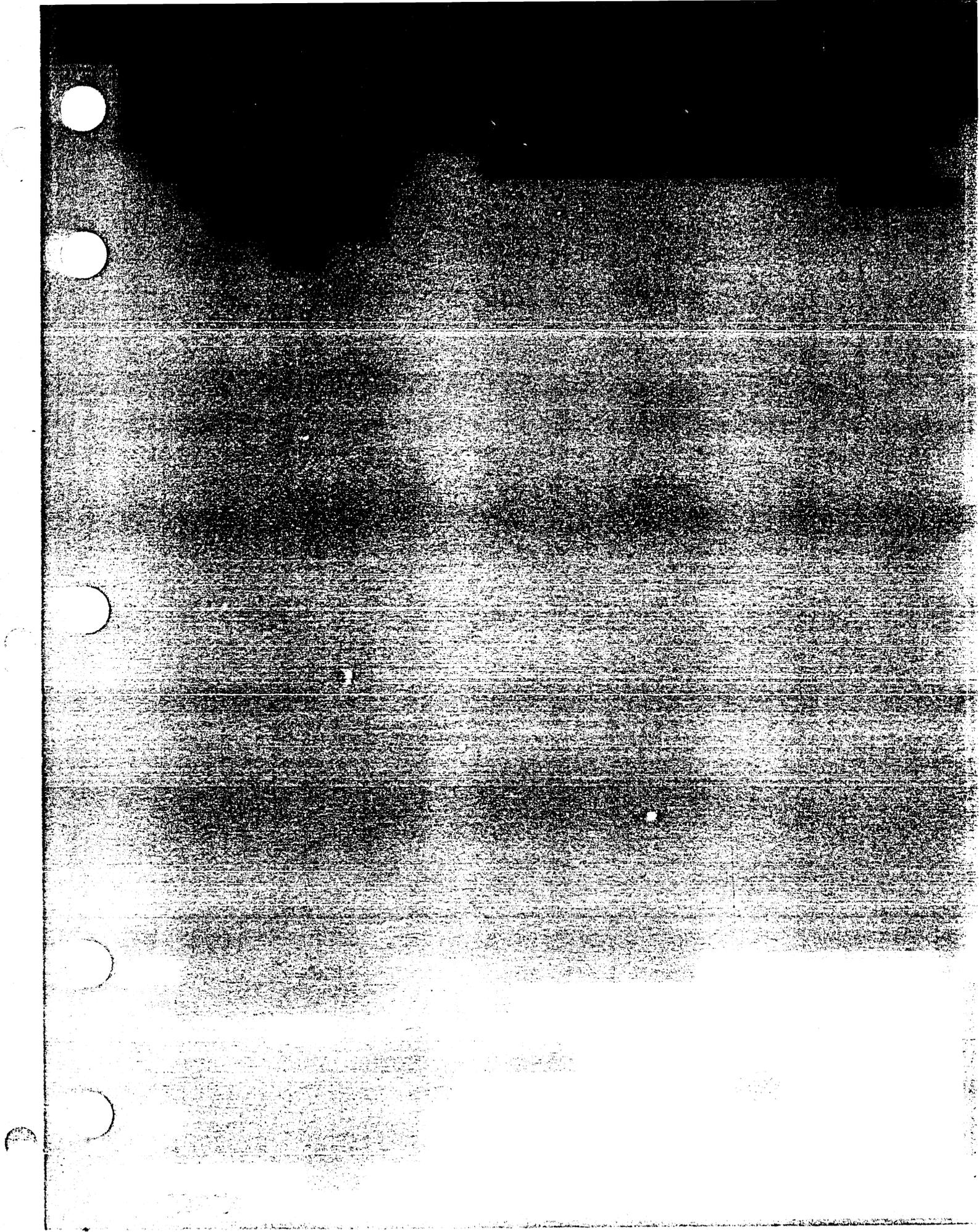
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MISSION RULES

REV ITEM

	R	ITEM							
			<p>-----</p> <p>INTRODUCTION & PURPOSE</p> <p>-----</p> <p>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.</p> <p>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---</p> <ul style="list-style-type: none"> 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. 						
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MISSION RULES

SECTION I - GENERAL GUIDELINES

REV ITEM

R	ITEM						
<p>----- ' OMSF GENERAL RULES ' -----</p>							
I-1		MISSION RULES ARE EFFECTIVE DURING THE LAUNCH COUNTDOWN, FLIGHT AND RECOVERY OPERATIONS, AND DURING PRELAUNCH TESTS WHEN APPLICABLE. THEY ARE BASED ON PRIMARY OBJECTIVES AS STATED IN THE APOLLO FLIGHT MISSION ASSIGNMENTS DOCUMENT M-D MA 500-11. PROPOSED CHANGES TO THE PRIMARY OBJECTIVES STATED IN THE MISSION ASSIGNMENTS DOCUMENT SHALL REQUIRE AA/MSF APPROVAL.					
I-2		THE DIRECTOR OF FLIGHT OPERATIONS AND THE DIRECTOR OF LAUNCH OPERATIONS OR THEIR DESIGNATED REPRESENTATIVE WILL INSURE COORDINATION OF THEIR RESPECTIVE MISSION RULE CHANGES WITH THE MISSION DIRECTOR AND OTHER APPROPRIATE ORGANIZATIONS.					
I-3		FOLLOWING THE CDDT OR FRT, WHICHEVER OCCURS FIRST, MISSION DIRECTOR APPROVAL AND CONCURRENCE WILL BE REQUIRED ON ALL RULES CHANGES AFFECTING SAFETY, ACCOMPLISHMENT OF TEST OBJECTIVES, DEVIATIONS FROM THE NOMINAL MISSION AND PRELAUNCH CONSTRAINTS. CONCURRENCE MAY BE OBTAINED VERBALLY IF TIME CONSIDERATIONS SO DICTATE.					
I-4		DURING THE CONDUCT OF THE MISSION, THE MISSION DIRECTOR WILL BE ADVISED OF ALL RECOMMENDATIONS THAT INVOLVE CHANGES TO---MISSION OBJECTIVES, MISSION RULES, FLIGHT PLAN CONTENT, OR LAUNCH/FLIGHT SAFETY.					
I-5		WITHIN THEIR RESPECTIVE AREAS OF RESPONSIBILITY, THE COMMAND PILOT, 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-6		THE COMMAND PILOT, SPACECRAFT TEST CONDUCTOR, LAUNCH VEHICLE TEST CONDUCTOR, SPACE VEHICLE TEST SUPERVISOR, LAUNCH OPERATIONS MANAGER, LAUNCH DIRECTOR, FLIGHT DIRECTOR, DOD MANAGER FOR MANNED SPACE FLIGHT SUPPORT OPERATIONS, OR THE MISSION DIRECTOR MAY REQUEST A HOLD FOR CONDITIONS WITHIN THEIR RESPECTIVE AREAS OF RESPONSIBILITY.					
I-7		DURING THE COUNTDOWN, THE LAUNCH VEHICLE AND SPACECRAFT PROGRAM MANAGERS AND RESPECTIVE CENTER OPERATIONS MANAGERS SHALL 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-8		WHEN TIME PERMITS, THE FAILURE OF A MANDATORY OR HIGHLY DESIRABLE ITEM WILL BE REPORTED TO THE MISSION DIRECTOR BY THE LAUNCH DIRECTOR OR THE FLIGHT DIRECTOR. THE INITIAL REPORT WILL INCLUDE: THE POSITION OR FACILITY THAT DETECTED THE MALFUNCTION. SUBSEQUENTLY, THE MISSION DIRECTOR WILL BE INFORMED OF ESTIMATED TIME TO REPAIR AND RECOMMENDED PROCEED, HOLD, RECYCLE, OR SCRUB ACTION AS IT DEVELOPS.					
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MISSION RULES

SECTION I - GENERAL GUIDELINES

REV ITEM

R	ITEM	
	I-18	FROM LIFTOFF TO TOWER CLEAR, THE LAUNCH DIRECTOR 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 RULES RESPECTIVELY.
	I-19	THE LAUNCH OPERATIONS MANAGER WILL INFORM MCC WHEN THE SPACE VEHICLE CLEARS THE UMBILICAL TOWER BY SAYING "CLEAR TOWER" OVER ONE OF THE LOOPS FROM KSC TO MCC.
	I-20	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 THE DAMAGE AND PROVIDE INFORMATION TO THE FLIGHT DIRECTOR FOR ANY ACTION NECESSARY AFTER UMBILICAL TOWER CLEARANCE.
	I-21	COMPLETE GROUND CONTROL OF THE SPACE VEHICLE PASSES TO THE FLIGHT DIRECTOR WHEN THE SPACE VEHICLE REACHES SUFFICIENT ALTITUDE TO CLEAR THE TOP OF THE UMBILICAL TOWER.
	I-22	IN THE MCC, THE FLIGHT DIRECTOR, FLIGHT DYNAMICS OFFICER AND BOOSTER SYSTEMS ENGINEER WILL HAVE THE CAPABILITY TO SEND AN ABORT REQUEST SIGNAL. THE CRITERIA FOR SENDING AN ABORT REQUEST WILL BE ESTABLISHED IN THE FLIGHT RULES.
	I-23	THE COMMAND PILOT MAY INITIATE SUCH INFIGHT ACTION AS HE DEEMS ESSENTIAL FOR CREW SAFETY.
	I-24	FLIGHT CREW SAFETY SHALL TAKE PRECEDENCE OVER THE ACCOMPLISHMENT OF MISSION OBJECTIVES.
	I-25	IN THE EVENT OF COMMUNICATIONS LOSS BETWEEN THE MANNED SPACE FLIGHT NETWORK AND THE SPACECRAFT, THE COMMAND PILOT WILL ASSUME RESPONSIBILITY FOR MISSION CONDUCT AS DESCRIBED WITHIN THE FLIGHT RULES.
	I-26	THE FLIGHT DIRECTOR, THROUGH THE RECOVERY COORDINATOR, WILL PROVIDE THE DOD MANAGER FOR MANNED SPACE FLIGHT SUPPORT OPERATIONS THE PREDICTED LOCATION AND TIME OF SPLASH-DOWN.
	I-27	THE DOD MANAGER FOR MANNED SPACEFLIGHT SUPPORT OPERATIONS IS RESPONSIBLE FOR RECOVERY AND 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.
		RULE NUMBERS I-28 THROUGH I-35 ARE RESERVED.

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SECTION I - GENERAL GUIDELINES

REV ITEM

R	ITEM
	----- DEFINITIONS -----
I-36	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 MISSION.
I-37	REDLINE FUNCTION---A REDLINE FUNCTION IS A PARAMETER THAT HAS BEEN IDENTIFIED TO MONITOR THE FUNCTIONING OF A UNIT TO INSURE THE OPERATIONAL PERFORMANCE OF THAT UNIT IS ACCEPTABLE TO MEET THE PRIMARY MISSION. REDLINE FUNCTIONS ARE MANDATORY.
I-38	PRIMARY OBJECTIVE---A STATEMENT OF THE PRIMARY PURPOSE OF FLIGHT. WHEN USED IN CENTER CONTROL DOCUMENTATION THE PRIMARY OBJECTIVE MAY BE AMPLIFIED BUT NOT MODIFIED. DETAILED TEST OBJECTIVES WILL BE GENERATED AND AMPLIFIED TO FULFILL EACH MISSION OBJECTIVE.
I-39	PRINCIPAL DETAILED TEST OBJECTIVE---A DETAILED TEST OBJECTIVE WHICH MUST BE ACCOMPLISHED PRIOR TO THE LUNAR LANDING MISSION. ANY PRINCIPAL DETAILED TEST OBJECTIVE NOT SATISFACTORILY COMPLETED ON THE ASSIGNED MISSION CAN BE ATTEMPTED ON A SUBSEQUENT MISSION WITHOUT MAJOR IMPACT.
I-40	MANDATORY DETAILED TEST OBJECTIVE---A PRINCIPAL DETAILED TEST OBJECTIVE WHICH MUST BE SATISFACTORILY COMPLETED ON THE ASSIGNED MISSION. FAILURE TO DO SO WOULD UNDOUBTLY COMPROMISE SUBSEQUENT FLIGHT SCHEDULES AND/OR REQUIRE SUBSEQUENT SPACE VEHICLE RECONFIGURATION.
I-41	SECONDARY DETAILED TEST OBJECTIVE---A DETAILED TEST OBJECTIVE WHICH WOULD PROVIDE SIGNIFICANT DATA OR EXPERIENCE BUT WHICH IS NOT A PREREQUISITE TO THE LUNAR LANDING MISSION.
I-42	MANDATORY ITEM---A MANDATORY ITEM IS A SPACE VEHICLE OR OPERATIONAL SUPPORT ELEMENT THAT IS ESSENTIAL FOR ACCOMPLISHMENT OF THE PRIMARY MISSION, WHICH INCLUDES PRELAUNCH, FLIGHT, AND RECOVERY OPERATIONS THAT INSURE CREW SAFETY AND EFFECTIVE OPERATIONAL CONTROL AS WELL AS THE ATTAINMENT OF THE MANDATORY DETAILED TEST OBJECTIVES.
I-43	HIGHLY DESIRABLE (H-D)---A HIGHLY DESIRABLE ITEM IS A SPACE VEHICLE OR OPERATIONAL SUPPORT ELEMENT THAT SUPPORTS AND ENHANCES THE ACCOMPLISHMENT OF THE PRIMARY MISSION AND IS ESSENTIAL FOR THE ACCOMPLISHMENT OF THE PRINCIPAL DETAILED TEST OBJECTIVES.
I-44	DESIRABLE (D)---A DESIRABLE ITEM IS A SPACE VEHICLE ELEMENT OR OPERATIONAL SUPPORT ELEMENT THAT IS NOT ESSENTIAL FOR THE ACCOMPLISHMENT OF THE PRIMARY MISSION.
I-45	PROCEED---CONTINUE IN ACCORDANCE WITH PRESCRIBED COUNTDOWN PROCEDURES.
I-46	HOLD---INTERUPTION OF THE COUNTDOWN FOR UNFAVORABLE WEATHER, REPAIR OF HARDWARE, OR CORRECTION OF CONDITIONS UNSATISFACTORY FOR LAUNCH OR FLIGHT.

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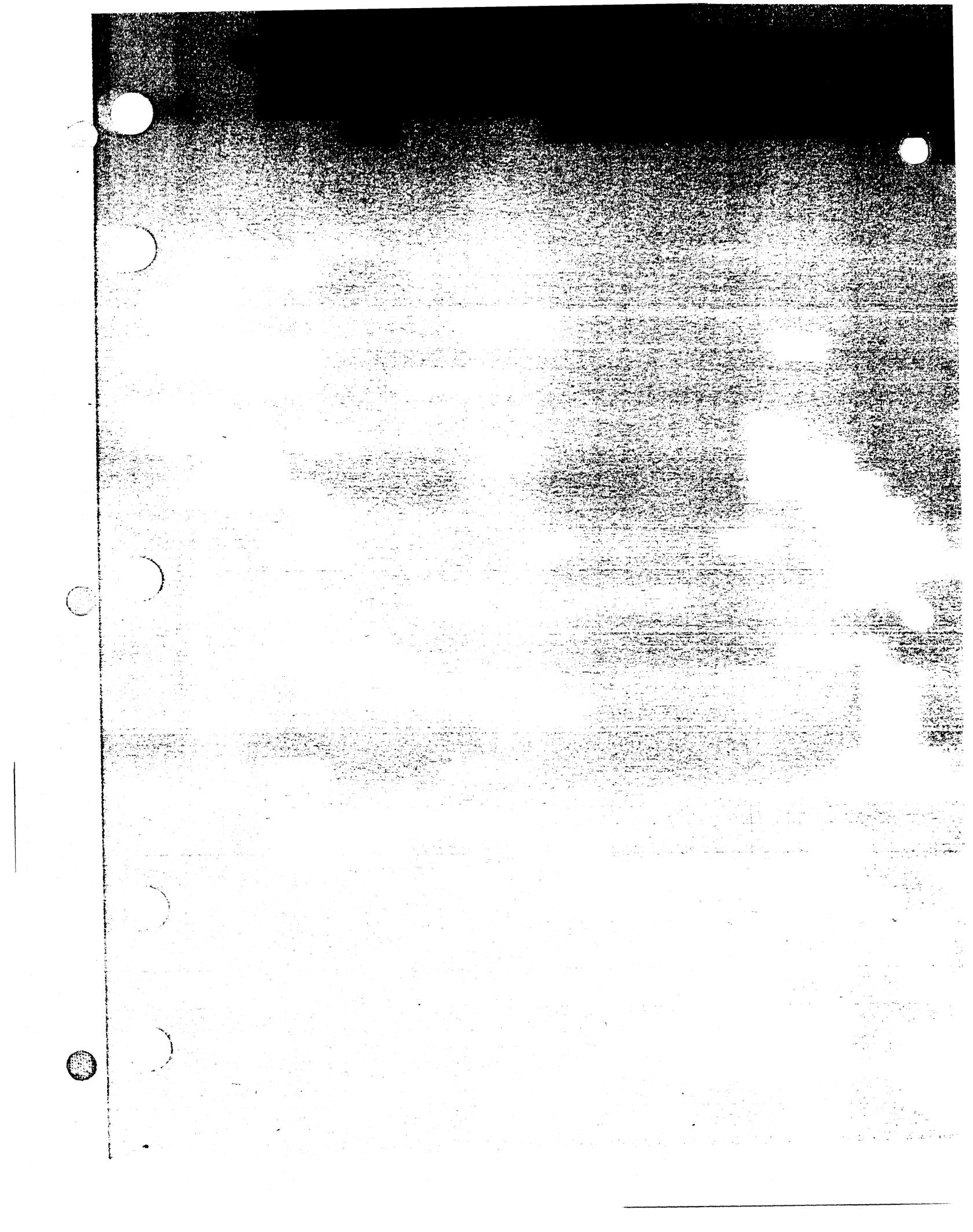
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MISSION RULES

SECTION I - GENERAL GUIDELINES

REV	ITEM	DESCRIPTION
	I-47	COUNTDOWN---THE PERIOD OF TIME STARTING WITH LAUNCH VEHICLE POWER UP FOR THE LAUNCH (OR SIMULATED LAUNCH) WHICH INCLUDES SERVICE STRUCTURE REMOVAL, LAUNCH VEHICLE CRYOGENIC TANKING, SPACECRAFT CLOSEDOUT, AND TERMINAL COUNT.
	I-48	HOLD-POINT---A PREDETERMINED POINT WHERE THE COUNTDOWN MAY BE CONVENIENTLY INTERRUPTED.
	I-49	RECYCLE---THE COUNTDOWN IS STOPPED AND RETURNED TO A DESIGNATED POINT OR AS SPECIFIED IN THE LAUNCH MISSION RULES.
	I-50	SCRUB---THE LAUNCH IS POSTPONED.
	I-51	CUTOFF---THE AUTOMATIC OR MANUAL COMMAND TO STOP THE LAUNCH SEQUENCE AFTER INITIATION OF THE "AUTOMATIC LAUNCH SEQUENCE START."
	I-52	LIFTOFF---THE EVENT DETERMINED BY THE INSTRUMENTATION UNIT UMBILICAL DISCONNECT SIGNAL AND IS THE POINT IN TIME WHEN PLUS TIME COMMENCES.
	I-53	ABORT---MISSION TERMINATION BY UNSCHEDULED INTENTIONAL SEPARATION OF THE SPACECRAFT FROM THE LAUNCH VEHICLE PRIOR TO ORBITAL INSERTION.
	I-54	EARLY MISSION TERMINATION--- UNSCHEDULED INTENTIONAL MISSION TERMINATION AT OR AFTER ORBITAL INSERTION.
	I-55	MEASUREMENT---A MEASUREMENT IS A SPECIFIC DATA CHANNEL OF INSTRUMENTATION MONITORING A SINGLE FUNCTION.
	I-56	INSTRUMENTATION---INSTRUMENTATION IS THE EQUIPMENT THAT ACQUIRES, TRANSMITS AND MONITORS DATA FOR PERFORMANCE EVALUATION OF SPACE VEHICLE AND OPERATIONAL SUPPORT ITEMS.

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SECTION 1 GENERAL RULES AND SOP'S

REV	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 PRINCIPAL OR MANDATORY DETAILED TEST 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 NSFN DATA/DISPLAY SYSTEMS.
1-9		UNLESS STATED OTHERWISE, MANDATORY AND HIGHLY DESIRABLE INSTRUMENTATION REQUIREMENTS ARE SATISFIED BY EITHER ONBOARD OR PCM CAPABILITY.

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MISSION RULES

SECTION 1 GENERAL RULES AND SOP'S

REV 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---FOR THE PURPOSE OF MISSION RULE ACTION, CRITICAL MANEUVERS ARE DEFINED AS THOSE MANEUVERS REQUIRED TO INSURE CREW SAFETY. THE VIOLATION OF PROPULSION SYSTEM LIMITS WILL BE ACCEPTED AS NECESSARY FOR SUCH BURNS. ALL MANEUVERS ARE CONSIDERED CRITICAL EXCEPT LO11, LO12, PLANE CHANGE, DOI, AND MCC'S NOT REQUIRED FOR ENTRY CORRIDOR CONTROL.

- 1-31 NON-CRITICAL BURN---A BURN WHICH NEED NOT BE ACCOMPLISHED TO MAINTAIN AN ACCEPTABLE LEVEL OF CREW SAFETY.

- 1-32 EARLY STAGING---UNSCHEDULED SEPARATION OF THE S-IVB STAGE FROM THE S-II STAGE.

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MISSION RULES

SECTION 1 GENERAL RULES AND SOP'S

REV 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	<p>FLIGHT PHASE---THE INTERVAL FROM LIFTOFF THROUGH SPLASH-DOWN. FOR MISSION RULE PURPOSES THE FLIGHT PHASE IS FURTHER SUBDIVIDED AS SHOWN BELOW---</p> <p>A. LAUNCH PHASE--- FROM LIFTOFF THROUGH INSERTION (TB1 THROUGH TB4).</p> <p>B. EARTH ORBIT PHASE---FROM INSERTION THROUGH S-IVB CUTOFF FOR TRANSLUNAR INJECTION (TLI).</p> <p>C. TIGE PHASE---FROM CSM/S-IVB SEPARATION THROUGH LM EJECTION FROM SLA (TB5).</p> <p>D. TRANSLUNAR COAST PHASE---FROM S-IVB CUTOFF FOR TLI THROUGH LC11 CUTOFF.</p> <p>E. DOCKED PHASE---THE TIME INTERVALS DURING WHICH THE LM AND CSM ARE DOCKED.</p> <p>F. LUNAR ORBIT PHASE---FROM LC11 CUTOFF TO UNDOCKING AND FROM PEDOCKING TO TEI CUTOFF.</p> <p>G. UNDOCKED PHASE---THE TIME INTERVAL DURING WHICH A MANNED LM IS SEPARATED FROM THE CSM STATION KEEPING (MAXIMUM SEPARATION DISTANCE OF APPROX. 500FT).</p> <p>H. DOI PHASE---THE TIME INTERVAL FROM THE DOI MANEUVER TO THE INITIATION OF THE PDI MANEUVER.</p> <p>I. POWERED DESCENT---THE TIME INTERVAL FROM THE INITIATION OF THE PDI MANEUVER TO TOUCH-DOWN.</p> <p>1. PDI TO PDI +5---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.</p> <p>2. PDI +5 TO LC GATE---LC GATE IS THE POINT AT WHICH THE CREW TAKES OVER AND MANUALLY FLIES THE DESCENT.</p> <p>3. LC GATE TO TOUCH-DOWN---THE TIME INTERVAL FROM CREW TAKEOVER (APPROXIMATELY 500 FT ALTITUDE) TO LANDING.</p> <p>J. LUNAR STAY PHASE---THE TIME INTERVAL FROM TOUCH-DOWN UNTIL LIFTOFF.</p> <p>EVA---THE TIME INTERVAL FROM LM DEPRESSURIZATION UNTIL LM REPRESSURIZATION.</p> <p>K. RENDEZVOUS---THE TIME INTERVAL FROM INSERTION INTO LUNAR ORBIT AFTER ASCENT OR AFTER AN ABORTED DESCENT UNTIL CSM/LM DOCKING. FOR AN ALTERNATE MISSION WHICH DOES NOT INCLUDE A LUNAR LANDING IT IS THE TIME FROM THE CSM PRE-DOI SEPARATION MANEUVER THROUGH CSM/LM DOCKING.</p> <p>L. TRANSEARTH COAST PHASE---FROM TEI CUTOFF TO CSM/SV SEPARATION.</p> <p>M. ENTRY PHASE---FROM CSM/SV SEPARATION TO SPLASH-DOWN.</p>						
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1-34	S-1VB DESTROY PACKAGE SAFING---THE EMERGENCY DESTROY PACKAGE IS SAFED BY THE RSD TRANSMITTING A COMMAND WHICH PERMANENTLY REMOVES POWER FROM THE RANGE SAFETY RECEIVERS.
1-35	S-1VB SAFING---A PASSIVATION SEQUENCE IN WHICH S-1VB 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	<p>FLIGHT PHASE---THE INTERVAL FROM LIFTOFF THROUGH SPLASHDOWN. FOR MISSION RULE PURPOSES THE FLIGHT PHASE IS FURTHER SUBDIVIDED AS SHOWN BELOW---</p> <p>A. LAUNCH PHASE--- FROM LIFTOFF THROUGH INSERTION (TB1 THROUGH TB4).</p> <p>B. EARTH ORBIT PHASE---FROM INSERTION THROUGH S-1VB CUTOFF FOR TRANSLUNAR INJECTION (TLI).</p> <p>C. TD&E PHASE---FROM CSM/S-1VB SEPARATION THROUGH LM EJECTION FROM SLA (TB5).</p> <p>D. TRANSLUNAR COAST PHASE---FROM S-1VB CUTOFF FOR TLI THROUGH LOI1 CUTOFF.</p> <p>E. DOCKED PHASE---THE TIME INTERVALS DURING WHICH THE LM AND CSM ARE DOCKED.</p> <p>F. LUNAR ORBIT PHASE---FROM LOI1 CUTOFF TO UNDOCKING AND FROM REDOCKING TO TEI CUTOFF.</p> <p>G. UNDOCKED PHASE---THE TIME INTERVAL DURING WHICH A MANNED LM IS SEPARATED FROM THE CSM FOR STATION KEEPING (MAXIMUM SEPARATION DISTANCE OF APPROX. 500FT).</p> <p>H. DCI PHASE---THE TIME INTERVAL FROM THE DCI MANEUVER TO THE INITIATION OF THE PDI MANEUVER.</p> <p>I. POWERED DESCENT---THE TIME INTERVAL FROM THE INITIATION OF THE PDI MANEUVER TO TOUCH DOWN.</p> <p style="margin-left: 20px;">1. PDI TO PDI #5---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.</p> <p style="margin-left: 20px;">2. PDI #5 TO LC GATE---LC GATE IS THE POINT AT WHICH THE CREW TAKES OVER AND MANUALLY FLIES THE DESCENT.</p> <p style="margin-left: 20px;">3. LC GATE TO TOUCH DOWN---THE TIME INTERVAL FROM CREW TAKEOVER (APPROXIMATELY 500 FT ALTITUDE) TO LANDING.</p> <p>J. LUNAR STAY PHASE---THE TIME INTERVAL FROM TOUCHDOWN UNTIL LIFTOFF.</p> <p style="margin-left: 20px;">EVA---THE TIME INTERVAL FROM LM DEPRESSURIZATION UNTIL LM REPRESSURIZATION.</p> <p>K. RENDEZVOUS---THE TIME INTERVAL FROM INSERTION INTO LUNAR ORBIT AFTER ASCENT OR AFTER AN ADOPTED DESCENT UNTIL CSM/LM DOCKING. FOR AN ALTERNATE MISSION WHICH DOES NOT INCLUDE A LUNAR LANDING IT IS THE TIME FROM THE CSM PRE-DCI SEPARATION MANEUVER THROUGH CSM/LM DOCKING.</p> <p>L. TRANSEARTH COAST PHASE---FROM TEI CUTOFF TO CSM/LM SEPARATION.</p> <p>M. ENTRY PHASE---FROM CSM/LM SEPARATION TO SPLASHDOWN.</p>

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REV	ITEM	DESCRIPTION
1-38		RECOVERY PHASE---THE TIME INTERVAL FROM SPLASHDOWN TO DELIVERY OF THE FLIGHT CREW AND SPACECRAFT TO DESIGNATED LAND BASED INSTALLATIONS.
1-39		<p>REENTRY DEFINITIONS---</p> <p>A. AUTOMATIC---REENTRY CONTROLLED BY CMC WHICH OUTPUTS BANK ANGLE COMMAND TO THE RCS.</p> <p>B. CLOSED LOOP---REENTRY CONTROLLED BY THE CREW MANUALLY FLYING BANK ANGLE MODULATION USING CMC ENTRY PROGRAM OUTPUTS.</p> <p>C. OPEN LOOP REENTRY---REENTRY CONTROLLED BY THE CREW USING SPACECRAFT DISPLAYS AND FLYING---</p> <ol style="list-style-type: none"> 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 SKIPOUT 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. <p>D. CONSTANT G ENTRY---CREW CONTROLS THE BANK ANGLE TO MAINTAIN A SPECIFIED G LEVEL.</p> <p>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.</p>
1-40		ALTERNATE MISSION---ANY DEVIATION FROM THE NOMINAL MISSION TIMELINE WHERE FURTHER MISSION OBJECTIVES ARE CONSIDERED BEFORE THE END OF THE MISSION.
1-41		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.
1-42		SLINGSHOT MANEUVER---USE OF RESIDUAL S-IVB PROPELLANTS TO PLACE THE SPENT STAGE IN A SOLAR OR NON-LUNAR IMPACTING TRAJECTORY.

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REV ITEM

	1-43	<p>LUNAR ABORT MODES AFTER EARLY LO11 SHUTOFF</p> <p>A. DPS</p> <ol style="list-style-type: none"> 1. MODE-I--- SHUTOFF OCCURS FROM LO11 + 0 SEC TO <u>LO11 + 104 SEC.</u> DIRECT RETURN BURN AT APPROXIMATELY LO11 + 2 HRS. 2. MODE-II--- SHUTOFF OCCURS FROM <u>LO11 + 104 SEC TO LO11 + 170 SEC.</u> TWO IMPULSE WITH FIRST BURN AT APPROXIMATELY LO11 + 2 HRS AND SECOND BURN AT NEXT PERICYNTHION. 3. MODE-III--- SHUTOFF OCCURS FROM <u>LO11 + 170 SEC</u> TO NOMINAL LO11 SHUTOFF. TEI AT APPROXIMATELY LO11 + 15 HRS (NEXT PERICYNTHION). <p style="text-align: center;">NOTE</p> <p style="text-align: center;">THE SHUTOFF TIMES ARE BASED ON A NOMINAL TRAJECTORY UP TO SHUTOFF. HANDOVER BETWEEN MODES I, II, AND III IS A FUNCTION OF ACCUMULATED LO11 DELTA VELOCITY.</p> <p>B. SPS (DOCKED)--- SHUTOFF OCCURS FROM LO11 + 0 SEC TO <u>LO11 + 170 SEC.</u> -RESTART AT LO11 + 15 MINUTES FOR A DIRECT RETURN.</p> <p>RULE NUMBERS 1-44 THROUGH 1-47 ARE RESERVED.</p>					
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 ' 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.

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REV 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.

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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.
- 1-73 THE RSO CAN SHUTDOWN THE SLV BY TRANSMITTING THE MFCD COMMAND WHICH ALSO LIGHTS THE ABORT REQUEST LIGHT IN THE SPACECRAFT. THE MFCD WILL INITIATE AN AUTO-ABORT IF TRANSMITTED PRIOR TO EDS DISABLE. THE MFCD COMMAND INITIATES A 4.1 SEC TIMER ON THE GROUND WHICH IN TURN ENABLES DESTRUCT CAPABILITY IF TRANSMITTED. THE RSO DESTRUCT COMMAND CAN THEN DESTROY THE SLV. THE RSO WILL ALWAYS SAFE THE S-IVB AFTER TRANSMITTING MFCD 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 MFCD, THE RSO WILL INITIATE SAFING AFTER VERIFICATION OF S-IVB CUTOFF.

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REV ITEM

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 SECO
ASTRONAUT	S-II/ S-IVB L/V STAGE SWITCH	S-II, S-IVB	T + 2-33 TO SECO
RSO	RF CMD (MFCO)	S-IC, S-II, S-IVB	T-0 TO SECO
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 SHUTDOWN

1-76 THE AUTOMATIC EDS (TWO ENGINE OUT AND OVERRATE AUTO-ABORT CAPABILITIES) WILL BE FLOWN CLOSED LOOP UNTIL T + 02-00. DURING LAUNCH, MALFUNCTIONS AFFECTING EDS OPERATION WILL BE MANAGED AS FOLLOWS---

THE EDS AUTO SWITCH WILL BE TURNED OFF WHENEVER ANY TWO CSM ENTRY BATTERIES ARE TIED TO THE SAME MAIN BUS OR FOR CONFIRMED LOSS OF ANY CSM ENTRY BATTERY.

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REV	ITEM	ABORT MODES---					
	1-77	MODE I	BOUNDARY OF APPLICATION	PROCEDURES			
		1A	LES ABORT ENABLE (APPROX. T-45 MIN) TO GET 42 SEC. (10 K FEET)	REFERENCE AOH <u>TBD</u>			
		1B	GET 42 SEC TO 100K FEET ALTITUDE (GET APPROX. 1 + 50)	REFERENCE AOH <u>TBD</u>			
		1C	100K FEET ALTITUDE TO TOWER JETTISON (GET APPROX. 3 + 07)	REFERENCE AOH <u>TBD</u>			
	1-78	MODE II	BOUNDARY OF APPLICATION	PROCEDURES			
			TOWER JETTISON (GET APPROX. 3 + 07) UNTIL FULL LIFT SPLASHPPOINT IS <u>3200</u> NM DOWNRANGE (GET APPROX. _____)	A. REFERENCE AOH <u>TBD</u>			
				B. MCC PROVIDES			
				1. GET OF 400K			
				2. PITCH AT .05G			
				3. GET DROGUE			
				C. ENTRY IS FULL LIFT			
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REV	ITEM	MODE	BOUNDARY OF APPLICATION	PROCEDURES				
1-79		MODE III	<p>BOUNDARY OF APPLICATION</p> <p>-----</p> <p>BETWEEN FULL LIFT SPLASH POINT =3200 NM AND INSERTION.</p>	<p>PROCEDURES</p> <p>-----</p> <p>A. REFERENCE AOH <u>TBD</u></p> <p>B. MCC PROVIDES---</p> <ol style="list-style-type: none"> 1. GETI AT S-IVB CUTOFF PLUS 2-05 2. DELTA V FOR <u>3350</u> NM SPLASH POINT 3. BURN DURATION 4. GET OF 400K 5. PITCH AT .05G 6. GET DROGUE <p>C. MANEUVER IS SCS AUTO.</p> <p>D. ENTRY IS ROLL LEFT 55 DEGREES.</p>				
			<p>NOTE</p> <p>MODE III "NO BURN" WILL BE CALLED IF THE ROLL LEFT 55 DEG. ENTRY RANGE IS LESS THAN 3350 NM.</p>					
1-80		MODE IV	<p>BOUNDARY OF APPLICATION</p> <p>-----</p> <p>CONTINGENCY ORBIT INSERTION CAPABILITY TO INSERTION (BASED ON COI LINE ON GAMMA VS V PLOT FOR NEAR NOMINAL ALTITUDE)</p>	<p>PROCEDURES</p> <p>-----</p> <p>A. REFERENCE AOH <u>TBD</u></p> <p>B. MCC PROVIDES---</p> <ol style="list-style-type: none"> 1. GETI AT S-IVB CUTOFF PLUS 2-05 2. DELTA V REQUIRED TO ACHIEVE PERIGEE GREATER THAN OR EQUAL TO 75 NM 3. BURN DURATION 4. PITCH AT GETI <p>C. MANEUVER IS SCS AUTO</p>				
1-81		MODE	<p>BOUNDARY OF APPLICATION</p> <p>-----</p> <p>APOGEE KICK PRE-APOGEE CUTOFF, OUTSIDE THE COI BOUNDARY, CORRECTABLE TO SAFE ORBITAL CONDITIONS BY A MANEUVER AT APOGEE.</p>	<p>PROCEDURES</p> <p>-----</p> <p>A. REFERENCE AOH <u>TBD</u></p> <p>B. MCC PROVIDES---</p> <ol style="list-style-type: none"> 1. GETI FOR BURN AT APOGEE 2. DELTA V REQUIRED TO ACHIEVE PERIGEE GREATER THAN OR EQUAL TO 75 NM 3. BURN DURATION 4. PITCH ATTITUDE <p>C. MANEUVER IS SCS AUTO</p>				
			<p>RULES 1-82 THROUGH 1-86 ARE RESERVED</p>					
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SECTION 1 GENERAL RULES AND SOP'S

REV ITEM

CREW ABORT LIMITS

1-87 MAX Q REGION PROCEDURES
 A. (00-50 TO 02-00)
 AOA GREATER THAN OR EQUAL TO 100 PCT AND ROLL,
 PITCH, OR YAW
 ERROR GREATER THAN OR EQUAL TO 5 DEGREES
 ABORT MODE I (ACTION ONLY AFTER BOTH HAVE
 REACHED THRESHOLD.)

1-88 RATES AND ATTITUDE PROCEDURES
 A. PITCH AND YAW
 1. L/O TO S-IC/S-II STAGING - 4
 DEG/SEC
 2. S-IC/S-II STAGING TO SECO - 9 DEG/SEC
 3. YAW ERROR GREATER THAN 45 DEG.
 ABORT MODE I
 ABORT MODE I, MODE II, MODE III, OR
 MODE IV
 B. ROLL
 1. L/O TO SECO - 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 (S-II/S-IVB SEP TO CSM/LV SEP)

A. BULKHEAD DELTA P
 FUEL GREATER THAN OXID = 26 PSID
 OXID GREATER THAN FUEL = 36 PSID

B. LOX TANK PRESS GREATER THAN OR EQUAL TO 50 PSIA

1-91 ENGINE FAILURES PROCEDURES
 LOSS OF 3 OR MORE S-II ENGINES
 PRIOR TO S-IVB TO ORBIT CAPABILITY
 ABORT MODE I, OR MODE II

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2 FLIGHT OPERATION
RULES

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SECTION 2 FLIGHT OPERATIONS RULES

REV ITEM

 ' GENERAL '

2-1 PRELAUNCH

- A. LAUNCH AZIMUTH LIMITATIONS RESTRICT LAUNCHES TO OCCUR BETWEEN 72 DEG. AND 107 DEG.
- B. THE FLIGHT DIRECTOR WILL EVALUATE WIND SIMULATIONS ALONG THE MODE 1 (TOWER) ABORT TRACK PRIOR TO THE START OF CRITICAL CCOUNTDOWN 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 (REF LMRD) 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. (REFERENCE SECTION 4 - GROUND INSTRUMENTATION REQUIREMENTS.) CONTINUOUS VOICE, TELEMETRY, AND TRACKING COVERAGE FOR THE SPACECRAFT IS REQUIRED FROM LIFTOFF THROUGH INSERTION PLUS 1 MIN + 30 SEC CONTINUOUS TELEMETRY COVERAGE IS REQUIRED FROM THE SLV FROM LIFTOFF THROUGH INSERTION PLUS 1 MIN + 30 SEC . COMMAND IS HIGHLY DESIRABLE FOR BOTH VEHICLES.

2-2 LAUNCH

IT IS PREFERABLE TO GO INTO ORBIT AND REENTER INTO THE WEST ATLANTIC 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.

2-3 EARLY STAGING

IF REQUIRED, EARLY S-IVB STAGING MAY BE INITIATED BY THE FLIGHT CREW AFTER S-IVB-TO-ORBIT CAPABILITY IS OBTAINED OR AFTER TOWER JETTISON IF LOX OVER PRESS OCCURS.

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REV ITEM

	2-4	<p>EARTH ORBIT</p> <p>A. ENTRY WILL BE MADE AT THE NEXT BEST PIP WHEN ONE MORE CSM FAILURE WILL RESULT IN AN ASAP ENTRY OR UNCONTROLLABLE CONDITIONS.</p> <p>B. ADEQUATE CONSUMABLES WILL BE MAINTAINED FOR ENTRY IN THE NEXT PTP, MAKING ALLOWANCES FOR SETUP AND ENTRY.</p> <p>C. THE DEORBIT CAPABILITIES REQUIREMENTS FOR EARTH ORBIT ARE---</p> <ol style="list-style-type: none"> 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 INTERGRITY 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--- <ol style="list-style-type: none"> (A) SM-RCS (B) LM PROP PLUS SM-RCS (C) SM-CM/RCS HYBRID (D) LM PROP PLUS SM-CM/RCS HYBRID 					
	2-5	<p>EARLY CSM/S-IVB SEPARATION (NO LM EXTRACTION), EARTH ORBIT</p> <p>A. AN S-IVB FAILURE OR SYSTEMS TREND THAT WILL RESULT IN A HAZARDOUS SITUATION FOR THE FLIGHT CREW IS CAUSE FOR AN IMMEDIATE CSM/S-IVB SEPARATION. THE FLIGHT CREW WILL PERFORM A SEPARATION MANEUVER ASAP. MINIMUM SAFE DISTANCE IS CONSIDERED TO BE <u>7,000-FT.</u></p> <p>B. LOSS OF ATTITUDE CONTROL DURING TB5.</p>					
		<p>RULE NUMBERS 2-6 THROUGH 2-10 ARE RESERVED</p>					
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	2-11	<p>TRANSLUNAR INJECTION</p> <p>A. THE TLI WILL BE GO IF THE S/C AND L/V SATISFY THE FOLLOWING CRITERIA---</p> <ol style="list-style-type: none"> 1. THERE ARE ADEQUATE S-IVB CONSUMABLES TO PROVIDE A <u>ONE SIGMA</u> PROBABILITY OF A GUIDED CUTOFF. 2. THERE HAVE BEEN NO FAILURES IN THE S-IVB THAT WOULD MAKE IT UNSAFE TO RESTART. 3. THERE HAVE BEEN NO FAILURES IN THE S-IVB THAT WOULD LEAD TO AN EARLY SHUTDOWN, OR THERE HAVE BEEN NO FAILURES DETECTED IN THE IU THAT WOULD PRECLUDE A NOMINAL TLI. 4. 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. <p>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.</p>					
	2-12	<p>TRANSPPOSITION, DOCKING AND EJECTION (TD&E)</p> <ol style="list-style-type: none"> A. IN THE EVENT OF ADVERSE LIGHTING, ATTITUDES, RATES, OR MECHANICAL ANOMALIES, THE FLIGHT CREW WILL MAKE THE FINAL DECISION TO ATTEMPT DOCKING AND EJECTION. B. THE NORMAL MINIMUM CABIN PRESSURE REDLINE OF 4.0 PSIA FOR TUNNEL/LM PRESSURIZATION SEQUENCES WILL BE WAIVED DURING TD&E. FOR TUNNEL OR LM LEAKS WHICH PREVENT NORMAL PRESSURIZATION, THE CM WILL BE DEPRESSURIZED AS REQUIRED FOR HATCH REMOVAL AND UMBILICAL HOOKUP. C. THREE LATCHED LATCHES LOCATED 120 DEGREES APART ARE REQUIRED TO PERFORM EJECTION. D. IF NORMAL LM EJECTION IS NOT SUCCESSFUL, NO ATTEMPT WILL MADE TO MAN THE LM AND 'STAGE' TO RECOVER THE ASCENT STAGE. 					
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	2-13	<p>TRANSLUNAR COAST</p> <ul style="list-style-type: none"> A. AN SPS BURN OF APPROXIMATELY 20 FPS IS PLANNED AFTER TLI TO PROVIDE A SEPARATION DISTANCE FROM THE S-1VB. B. NO MCC WILL BE PERFORMED IF LOI CAN BE TARGETED WITHIN OPERATIONAL CONSTRAINTS. C. TRANSLUNAR COAST WILL BE TERMINATED IF ADEQUATE CONSUMABLES ARE NOT AVAILABLE FOR A FREE RETURN + 12 HRS. D. THE CREW WILL USE THEIR DISCRETION TO MAN THE LM FOR BACKUP COMMUNICATIONS AND RETURN IF CSM COMMUNICATIONS ARE LOST WITH THE MSFN. E. LM PROPULSION CAPABILITY CANNOT BE CONSIDERED AS ACCEPTABLE BACKUP TO CSM SYSTEMS UNTIL AFTER 1VT AND LM SYSTEMS CHECKOUT. 					
	2-14	<p>LUNAR ORBIT INSERTION</p> <p>LJI WILL BE INHIBITED AND A LUNAR FLYBY PERFORMED IF THE CSM DOES NOT SATISFY ANY OF THE FOLLOWING CONDITIONS---</p> <ul style="list-style-type: none"> A. FULL CRITICAL SYSTEMS REDUNDANCY. B. ADEQUATE CONSUMABLES FOR MINIMUM LUNAR ORBIT OPERATIONS AND RETURN TO EARTH + 12 HOURS. C. SPS PROPELLANT RESERVE CAPABILITY FOR TEI AND TRANSEARTH MCC'S. D. RCS PROPELLANT RESERVE TO ACCOMPLISH TEI CONTROL, TRANSEARTH MCC CONTROL, PTC, AND MINIMUM LUNAR ORBIT OPERATIONS. E. LOSS OF ANY 4 DOCKING RING LATCHES WILL BE CAUSE FOR CSM ONLY LOI. 					
	2-15	<p>LUNAR ORBIT</p> <ul style="list-style-type: none"> A. LOI DISPERSIONS <ul style="list-style-type: none"> 1. IF A STABLE ORBIT HAS NOT BEEN ACHIEVED, AN SPS OR DPS ABORT WILL BE EXECUTED. 2. IF A STABLE ORBIT HAS BEEN ACHIEVED, AN SPS OR DPS TEI WILL BE PERFORMED AT THE NEXT PERICYNTHION OR AN ALTERNATE MISSION WILL BE FLOWN. B. DESIGNED 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 AND EARTH RETURN PLUS 12 HRS FOR CONTINUATION TO THE NEXT MISSION PHASE. 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, TRANSEARTH 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. 					
	2-16	<p>INTRAVEHICULAR TRANSFER</p> <p>ONE HARDSUIT 1VT 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 PROBLEM.</p>					
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REV ITEM

	<p>2-17 DOCKED LM OPERATION</p> <p>FOR AN IMPENDING HAZARDOUS SITUATION RESULTING FROM A DESCENT STAGE PROBLEM, THE STAGE WILL BE JETTISONED AND ASC STAGE OPERATIONS WILL CONTINUE AFTER THE VEHICLE HAS MOVED TO A SAFE DISTANCE (____-FT).</p> <p style="text-align: center;">RULE NUMBERS 2-18 THROUGH 2-20 ARE RESERVED</p> <p>2-21 CSM/LM UNDOCKING AND SEPERATION</p> <p>A. A MANNED LM WILL NOT BE UNDOCKED FROM THE CSM WITHOUT INDEPENDENT MANEUVER CAPABILITY OF BOTH VEHICLES TO TERMINATE UNDOCKED ACTIVITIES AND TO ACCOMPLISH DOCKING. THE LM CAPABILITY TO REDOCK MUST STILL EXIST IF THE LM IS REQUIRED TO STAGE.</p> <p>B. VHF VOICE COMMUNICATIONS BETWEEN THE LM AND CSM ARE MANDATORY FOR UNDOCKING.</p> <p>C. EVT CAPABILITY IS REQUIRED FOR MANNED UNDOCKING.</p> <p>D. CREWMEN WILL BE SUITED WHILE IN THE UNDOCKED CONFIGURATION AND UNTIL CM INTERGRITY IS ESTABLISHED AFTER RENDEZVOUS AND DOCKING.</p> <p>2-22 CSM LUNAR ORBIT UNDOCKED</p> <p>A. UNDOCKING TO PDI</p> <p>LOSS OF REDUNDANT CAPABILITY IN CRITICAL SYSTEMS WILL BE CAUSE TO TERMINATE THE MISSION AND PERFORM TEI ASAP. BETWEEN UNDOCKING AND DOI, THE VEHICLES WILL BE REDOCKED FOR LOSS OF CSM ACTIVE DOCKING OR LM RESCUE CAPABILITY.</p> <p>B. PDI TO LANDING</p> <p>NO CSM FAILURES, EXCEPT FOR TIME-CRITICAL SPS FAILURES, WILL BE CAUSE FOR ABORT DURING POWERED DESCENT.</p> <p>C. LUNAR STAY</p> <p>FAILURE TO MAINTAIN REDUNDANT CAPABILITY IN SYSTEMS REQUIRED FOR TEI OR LIFE SUPPORT WILL BE CAUSE FOR TERMINATION OF LUNAR STAY.</p> <p>2-23 LM-DOI</p> <p>FOR DOI, THE LM MUST HAVE THE CAPABILITY TO RENDEZVOUS AND DOCK WITHOUT VIOLATING ANY SPECIFIC MISSION RULES OR REDLINES.</p> <p>2-24 LM-PDI</p> <p>FOR PDI, THE LM MUST HAVE THE CAPABILITY TO LAND, COMPLETE ONE REV, ASCENT, RENDEZVOUS AND DOCK WITHOUT VIOLATING ANY SPECIFIC MISSION RULES OR REDLINES.</p>															
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	<p>2-25 LM-POWERED DESCENT</p> <p>IF A SYSTEMS FAILURE OCCURS AND A CHOICE IS AVAILABLE---</p> <p>A. EARLY IN POWERED DESCENT WHEN DPS-TO-ORBIT CAPABILITY IS AVAILABLE, IT IS PREFERABLE TO ABORT IN FLIGHT THAN TO CONTINUE DESCENT. REDUNDANT CAPABILITY OF CRITICAL LM SYSTEMS IS REQUIRED TO CONTINUE POWERED DESCENT DURING THIS PERIOD.</p> <p>B. DURING THE REMAINDER OF POWER DESCENT, IT IS PREFERABLE TO LAND AND LAUNCH FROM THE LUNAR SURFACE THAN TO ABORT. ONLY THOSE SYSTEMS FAILURES OR TRENDS THAT INDICATE IMPENDING LOSS OF THE CAPABILITY TO LAND, ASCEND AND ACHIEVE A SAFE ORBIT FROM THE LUNAR SURFACE, OR IMPENDING LOSS OF LIFE SUPPORT CAPABILITY WILL BE CAUSE FOR ABORT DURING THIS PERIOD.</p>						
	<p>2-26 LY-LUNAR STAY</p>	<p>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.</p> <p>B. LOSS OF REDUNDANT CAPABILITY IN CRITICAL LM SYSTEMS IS CAUSE FOR ABORT AT THE NEXT BEST OPPORTUNITY.</p>					
	<p>2-27 EVA</p>	<p>A. NOMINAL EVA</p> <p>FOR THE NOMINAL (TWO-MAN) EVA, TOTAL EMU LIFE SUPPORT SYSTEMS CAPABILITY IS REQUIRED. EVA TO EVA VOICE, EVA TO MSFN VOICE, AND 'CRITICAL INSTRUMENTATION' (SEE RULE 19-42) FOR BOTH ASTRONAUTS ARE REQUIRED.</p> <p>B. ALTERNATE EVA</p> <p>FAILURE OF ONE PLS, ONE OPS, EVA TO EVA DUPLEX VOICE, OR THE LOSS OF CRITICAL INSTRUMENTATION WILL BE CAUSE FOR A ONE-MAN ALTERNATE EVA.</p> <p>C. EARLY TERMINATION OF EVA (NOMINAL OR ALTERNATE)</p> <p>THE EARLY TERMINATION OF THE EVA WILL BE BASED ON THE ASTRONAUTS' CAPABILITY TO COMMUNICATE WITH EACH OTHER, THE CAPABILITY TO MONITOR THE EMU CRITICAL INSTRUMENTATION, AND THE CAPABILITY OF MSFN TO COMMUNICATE WITH THE EVA CREWMEN.</p> <p>D. ALL EVA EXCURSIONS WILL BE LIMITED TO THAT VICINITY OF THE LM WHICH WILL ALLOW A SAFE RETURN TO THE LM ECS WHILE OPERATING ON THE OPS.</p>					
	<p>2-28 ASCENT</p>	<p>IN THE EVENT OF PROCEDURAL ERRORS OR SYSTEMS PROBLEMS WHICH RESULT IN LOSS OF SOME CAPABILITY USED FOR ASCENT FOR OR 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.</p>					
	<p>2-29 RENDEZVOUS</p>	<p>SELECTION OF THE ACTIVE VEHICLE FOR RENDEZVOUS AND DOCKING WILL BE DETERMINED BY FLIGHT CONTROL AND THE FLIGHT CREW BASED UPON CONSUMABLES AND SYSTEMS PERFORMANCE. THE TOTAL LM CAPABILITY WILL BE DEDICATED TO ACCOMPLISHING THE RENDEZVOUS.</p>					
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REV ITEM

LAUNCH PHASE

3-1

THE LAUNCH WILL BE ABORTED FOR THE FOLLOWING REASONS---
CONDITION

A. SLV

- S-II GIMBAL ACTUATOR HARDOVER INBOARD PRIOR TO S-IVB TO ORBIT CAPABILITY
- VIOLATION OF AUTO/MANUAL EDS LIMITS
- S-II ENGINE FAILURES (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)
- S-IVB LOX TANK PRESS GREATER THAN 50 PSI BEFORE TWR JETT, AFTER TWR JETT PERFORM EARLY STAGING

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

- LOSS OF 3 FUEL CELLS AND 1 BATTERY
- 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

3-2

THE S-IVB EARLY STAGING WILL BE USED AFTER "S-IVB TO-ORBIT" CAPABILITY FOR THE FOLLOWING ---
CONDITION

- S-II GIMBAL ACTUATOR INBOARD HARDOVER
- S-II ENGINE FAILURE (TIME DEPENDENT)

3-3

SWITCH-OVER TO CSM GUIDANCE WILL BE PERFORMED FOR--

IU FLAT FAIL

RULE NUMBERS 3-4 THROUGH
3-10 ARE RESERVED.

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REV 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)

CONDITION

TIME BASE 5 FAILS TO INITIATE AT CUTOFF

*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

*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---

CONDITION

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---

CONDITION

SLV

INSUFFICIENT PROPELLANT REMAINS FOR A GUIDED TLI CUTOFF.

S-IVB ENGINE MAIN LOX VALVE FAILS TO CLOSE AT CUTOFF

LOSS OF ATTITUDE CONTROL

CONTINUOUS VENT SYSTEM REGULATOR FAILS.

LOSS OF ENGINE CONTROL BOTTLE PRESSURE

CONFIRMED ACTUATOR HARDOVER

LOSS OF ENGINE HYDRAULIC FLUID

COLD HE SPHERE PRESS LOW

LH2 ULLAGE PRESS LOW

LOX ULLAGE PRESS LOW

SATURN INERTIAL GUIDANCE SYSTEM IS NO-GO

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

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	3-14	<p>TLI WILL BE TERMINATED FOR---</p> <p>A. PITCH OR YAW BODY RATES GREATER THAN 10 DEG./SEC</p> <p>B. ROLL BODY RATE GREATER THAN 20 DEG/SEC</p> <p>C. PITCH OR YAW ATTITUDE DEVIATIONS FROM NOMINAL PROFILES EXCEED 45 DEG.</p> <p>RULES 3-15 THROUGH 3-20 ARE RESERVED.</p>					
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REV ITEM

! TD&E !

3-21 TD&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. LCX TANK OVERPRESSURE GREATER THAN 50 PSI
 - 3. TB7 FAILS TO INITIATE

RULE NUMBERS 3-22 THROUGH
3-29 ARE RESERVED.

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REV ITEM

 ' TRANSLUNAR COAST '

3-30

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

A. TERMINATE LOI FOR THE FOLLOWING SPS PROBLEMS (PERFORM THE 15 MINUTE ABORT IF THE BURN IS TERMINATED IN THE MODE 1 OR MODE 11 REGION)---

- 1. LOSS OF ONE GN2 BOTTLE (LESS THAN 400 PSI) AND DECAY IN OTHER
- 2. PRESSURE DECAY IN EITHER SPS PROPELLANT TANK TO 140 PSI
- * 3. FUEL - OXIDIZER DELTA P GREATER THAN 20 PSI
- * 4. CHAMBER PRESSURE LESS THAN 80 PSI OR DECAY OF 10 PSI DURING BURN
- 5. FLANGE TEMPERATURE LIGHT
- 6. ANY BALL VALVE FAILS TO OPEN AFTER ITS RESPECTIVE BANK IS COMMANDED ON OR FAILS CLOSED (TERMINATE LOI ONLY IN MODE 1 REGION)

* REFERENCE MALF. PROCEDURE--- SPS-1.

B. PERFORM MTVC TAKEOVER AND COMPLETE THE BURN FOR THE FOLLOWING CONTROL PROBLEMS---

- 1. G&N NO-GO
- 2. ATTITUDE EXCURSION GREATER THAN 10 DEG EXCLUDING START TRANSIENTS
- 3. RATES GREATER THAN 10 DEG./SEC

C. RESTART THE BURN AND COMPLETE UNDER SCS CONTROL FOR AN SPS SHUTDOWN.

RULES NUMBER 3-31 THROUGH 3-36 ARE RESERVED.

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 ' LUNAR ORBIT '

3-37 DEPENDING ON THE ANALYSIS OF A NON-NOMINAL LOI BURN, THE FOLLOWING COURSES OF ACTION ARE AVAILABLE---

- A. UNLESS A STABLE ORBIT HAS BEEN ACHIEVED, DIRECT (SPS OR DPS) ABORTS OR DPS TWO IMPULSE CIRCUMLUNAR ABORTS WILL BE EXECUTED.
- B. IF STABLE ORBIT HAS BEEN ACHIEVED, TEI (DPS OR SPS) WILL BE EXECUTED AT NEXT OPPORTUNITY OR AN ALTERNATE MISSION WILL BE INITIATED.

3-38 PRIOR TO UNDOCKING THE FOLLOWING TRAJECTORY CONDITIONS MUST BE SATISFIED---

- A. THE MISS DISTANCE OVER THE LLS IS LESS THAN 0.5 DEG. OUT OF PLANE AND +/-2 DEG. IN AZIMUTH

NOTE

ADDITIONAL MANEUVERS WILL BE SCHEDULED, AS NEEDED, BETWEEN LOI2 AND UNDOCKING TO CORRECT DISPERSIONS.

- B. ONE SET OF 5 SATISFACTORY LANDMARK SIGHTINGS ON THE LANDING SITE HAS BEEN OBTAINED.

NOTE

UNDOCKING WILL BE SLIPPED NO MORE THAN ONE REV IF THE SIGHTINGS ARE NOT SATISFACTORY.

RULE NUMBERS 3-39 THROUGH 3-44 ARE RESERVED

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REV ITEM

 ' DOI PHASE '

3-45 DOI IGNITION
 THE FLIGHT CREW WILL NOT ATTEMPT TO BACKUP THE DOI ULLAGE MANEUVER OR THE DPS IGNITION SHOULD EITHER FAIL TO OCCUR AUTOMATICALLY.

3-46 DOI TERMINATION
 THE FLIGHT CREW WILL TERMINATE DOI FOR THE FOLLOWING---

- A. ATTITUDE DEVIATIONS GREATER THAN 10 DEG.
- B. RATES GREATER THAN 10 DEG./SEC.
- C. DPS TANK PRESSURE LESS THAN 120 PSI
- D. OVERBURN OF 2 SECONDS AND 2 FPS
- E. NO MANUAL THROTTLE CAPABILITY
- F. PGNS FAIL

3-47 DOI TO PDI

- A. DOI RESIDUALS WILL BE NULLED ALONG THE X BODY AXIS
- B. THE FLIGHT CREW WILL PERFORM THE DIRECT RETURN TO THE CSM FOR THE FOLLOWING REASONS---

NOTE 1---CAPABILITY REMAINS TILL APPROXIMATELY DOI =10 MINUTES
 NOTE 2---RR IS MANDATORY FOR THIS MANEUVER

- 1. LM CONDITIONS---

- (A) ECS
 - (1) LOSS OF BOTH COOLANT LOOPS
 - (2) FIRE, SMOKE, OR FREE GLYCOL IN CABIN OR SUIT
- (B) G6C
 - (1) PGNS FAIL OR AGS FAIL
 - (2) PGNS, AGS POST-DOI REDIGUALS DIFFER BY GREATER THAN 2 FPS
 - (3) AT DOI CUTOFF, PRIOR TO TRIMMING, PGNS RESIDUALS ARE GREATER THAN 2 FPS IN ANY AXIS
- (C) CREW TERMINATES THE DOI MANEUVER

RULE 3-48 IS RESERVED

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REV ITEM

 ' POWERED DESCENT PHASE '

3-49 PDI IGNITION

THE FLIGHT CREW WILL NOT ATTEMPT TO BACK UP THE PDI ULLAGE MANEUVER. IF THE ULLAGE MANEUVER DOES OCCUR AUTOMATICALLY, THE FLIGHT CREW WILL ATTEMPT TO MANUALLY IGNITE THE DPS ENGINE IF IT DOES NOT IGNITE AUTOMATICALLY. THE MANUAL IGNITION MUST OCCUR BY LGC COMPUTED TIG = 7.5 SEC.

3-50 PDI TO LO GATE

POWERED DESCENT WILL BE ABORTED FOR THE FOLLOWING---

- A. LR DATA NOT INCORPORATED BY H LESS THAN OR EQUAL TO 13,000 FT.
- B. LR FAILURE AFTER INCORPORATION AND PRIOR TO CONVERGENCE.
- C. VIOLATION OF THE APS ABORT BOUNDARY.
- C. FAILURE TO ENTER P64 WHEN TG EQUALS 60 SEC.
- D. PGNS NAVIGATION ERRORS WHICH RESULT IN AGS-PGNS VELOCITY DIFFERENCES THAT VIOLATE THE PGNS FAILURE LIMITS.
- E. PGNS NAVIGATION ERRORS WHICH RESULT IN MSFN-PGNS VELOCITY DIFFERENCES THAT VIOLATE THE PGNS FAILURE LIMITS.

NOTE

ITEMS E AND F ARE VALID ONLY PRIOR TO LR INCORPORATION. FOR ITEM E, SWITCHOVER TO AGS WILL BE PERFORMED.

3-51 LO GATE TO TD

THERE ARE NO TRAJECTORY OR GUIDANCE CONSIDERATIONS WHICH ARE CAUSE FOR ABORT AFTER CREW TAKEOVER OF POWERED DESCENT

RULE NUMBERS 3-52 THROUGH 3-60 ARE RESERVED.

MISSION	REV	DATE	SECTION	GROUP	PAGE
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MISSION RULES

SECTION 3 MISSION RULE SUMMARY

REV ITEM

 ' ASCENT '

3-61 ASCENT

- A. GUIDANCE SWITCHOVER TO AGS WILL BE PERFORMED FOR ---
1. ONBOARD RECOGNIZED PGNS FAILURES (SEE RULES (HARDWARE) AND (SOFTWARE)).
 2. PGNS NAVIGATION ERRORS, DURING ASCENT OR FOLLOWING DESCENT ABORT, THAT RESULT IN ANY OF THE FOLLOWING CONDITIONS---
 - (A) AGS PREDICTED HP AT INSERTION LESS THAN 37000 FT
 - (B) AGS PREDICTED HA AT INSERTION GREATER THAN TBD NM
 - (C) AGS PREDICTED WEDGE ANGLE AT INSERTION GREATER THAN 1.7 DEG.
- B. THE GROUND WILL NOT REQUEST SWITCHOVER AFTER TGO LESS THAN 30 SECONDS.

RULE 3-62 THROUGH
 3-69 ARE RESERVED.

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MISSION RULES

SECTION 3 MISSION RULE SUMMARY

REV ITEM

7. SPS

- (A) LOSS OF BOTH GN2 BOTTLES (LESS THAN 400 PSI)
- (B) FUEL OR OXIDIZER FEEDLINE TEMP LESS THAN 27 DEG. F.
- (C) FLANGE TEMP GREATER THAN 480 DEG. F. ON PREVIOUS BURN
- (D) CHAMBER PRESSURE LESS THAN 70 PSI ON PREVIOUS BURN
- (E) FUEL/OXIDIZER DELTA P GREATER THAN 20 PSI
- (F) LOSS OF ULLAGE CAPABILITY FOR FIRST BURN SUBSEQUENT TO DOCKED DPS BURN, OR AFTER STORAGE TANKS EMPTY
- (G) FIRST BURN SUBSEQUENT TO DOCKED DPS WAS LESS THAN 40 SEC. CONTINUOUS
- (H) PRESSURE IN EITHER FUEL OR OXIDIZER TANK LESS THAN 140 PSI
- (I) DELTA V REMAINING LESS THAN MANEUVER PLUS DEORBIT REQUIREMENT

B. THE NON-CRITICAL DOCKED SPS BURNS WILL BE NO-GO IF THE FOLLOWING INTERFACE CONDITION EXISTS---

1. DOCKING SYSTEM

- (A) LESS THAN (TED) GOOD DOCKING RING LATCHES

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MISSION RULES

SECTION 3 MISSION RULE SUMMARY

REV ITEM

3-70

A NON-CRITICAL SPS MANEUVER WILL BE INHIBITED FOR---

A. THE CSM WILL BE NO-GO IF ANY OF THE FOLLOWING CONDITIONS EXIST---

1. ECS

- (A) LOSS OF CABIN INTEGRITY
- (B) LOSS OF SUIT CIRCUIT
- (C) LOSS OF O2 MANIFOLD
- (D) LOSS OF SURGE TANK AND REPRESS PACK
- (E) LOSS OF CYCLIC ACCUMULATOR OPERATION
- (F) LOSS OF SUIT INTEGRITY (FOR DOCKED SPS BURNS)
- (G) LOSS OF ALL COOLING
- (H) CONFIRMED LEAK OF GLYCOL IN EITHER COMMAND MODULE OR SUIT CIRCUIT

2. CRYO

- (A) INSUFFICIENT O2 AND H2 TO SUPPLY FUEL CELL AND ECS DEMANDS TO THE NEXT GO/NO-GO PTP PLUS _____.

3. EPS

- (A) LOSS OF TWO FUEL CELLS
- (B) LOSS OF TWO ENTRY BATTERIES
- (C) LOSS OF ONE MAIN BUS, ON BATTERY BUS, ONE AC BUS, OR THE BATTERY RELAY BUS
- (D) LOSS OF TWO INVERTERS

4. COMM/INSTRUMENTATION

- (A) LOSS OF INSTRUMENTATION (TM OR CNEBOARD) SUCH THAT IT IS NOT POSSIBLE TO VERIFY GO/NO-GO CRITERIA EITHER IN S/C OR ON GROUND.
- (B) LOSS OF TWO-WAY VOICE COMMUNICATION (CSM/MSEFN)

5. SEQUENTIAL

- (A) LOSS OF SEQUENTIAL LOGIC BUS A OR B
- (B) LOSS OF PYRO BUS A OR B

6. G&C

- (A) LOSS OF TWO TVC SERVO LOOPS
- (B) LOSS OF THREE TVC CONTROL MODES (G&N, SCS AUTO, AND MTVC - RATE CMD IF UNDOCKED)
- (C) LOSS OF THREE TVC CONTROL MODES (G&N, SCS AUTO, AND MTVC - ACCEL CMD IF DOCKED)

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MISSION RULES

SECTION 3 MISSION RULE SUMMARY

REV ITEM

3-74 LM RCS MANEUVERS WILL BE INHIBITED FOR THE FOLLOWING LM PROBLEMS---

A. G&C

TBD

B. RCS

PROPELLANT TEMP NOT WITHIN 40 TO 100 DEG. F. LIMITS

DELTA PRESS BETWEEN FUEL AND OXIDIZER GREATER THAN 80 PSID

MANIFOLD PRESSURE LESS THAN 100 PSI

PROPELLANT LEAKS

QUAD TEMPS LESS THAN 119 DEG. F.

MISSION	REV	DATE	SECTION	GROUP	PAGE
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LM TELCOM GO/NO-GO CRITERIA

REV	GO/NO-GO ITEM	UNDocking		DOI		POWERED DESCENT			LUNAR STAY			RENDEZVOUS		DOCKING	
		EVENT	NOMINAL MISSION	EVENT	NOMINAL MISSION	PDI	PDI TO PDI +5	PDI+5 TO LO GATE	LO GATE TO TO	STAY W/O EVA	2-MAN EVA	1-MAN EVA	CSI/CDH		TPI/TPF
	ELECTRICAL/PYRO														
	1. CDR AND LMP BUS							BOTH						1 OF 2	
	2. DC FEEDER(S) ②	DESCENT			1 OF 2						1 OF 2			1 OF 2	
		ASCENT							BOTH						1 OF 2
	3. BATTERY(S) **** ①	DESCENT	4 2	2 OF 4	4 2			2 OF 4			2 OF 4			2 OF 4	
		ASCENT	1 2	2 OF 2	1 2				BOTH			BOTH			1 OF 2
	4. INVERTERS(S)			BOTH	1 OF 2			BOTH			1 OF 2				
	5. AC BUS(S)			BOTH	BUS A			BOTH			BUS A				
	6. PYRO SYSTEM(S) ****		1 OF 2					BOTH			BOTH				
	ENVIRONMENTAL														
	1. SUIT LOOP/CABIN PRESS INTEGRITY							SUIT AND CABIN			SUIT			SUIT AND CABIN	
	2. SUIT FAN(S) ****		1 OF 2	BOTH	1 OF 2			BOTH			1 OF 2			BOTH	
	3. O ₂ DEMAND REGULATORS(S) ****				1 OF 2									1 OF 2 ⑤	
	4. H ₂ O SEPARATORS(S) AND LCG COOLANT LOOP ****				BOTH H ₂ O SEPARATORS OR 1 OF 2 H ₂ O SEPARATORS + LCG						BOTH H ₂ O SEPS OR 1 OF 2 H ₂ O SEPS + LCG			1 OF 2 H ₂ O SEPS OR LCG	
	5. O ₂ TANK(S) **** ①	DESCENT	ANY	DES				ANY			DES			DES	
		ASCENT	2 OF 3	1 OF 2				2 OF 3				1 OF 2			1 OF 2
	6. COOLANT LOOP(S) ****	PRIMARY	1 OF 2					BOTH			1 OF 2			BOTH	
		SECONDARY													1 OF 2
	7. H ₂ O FEED PATHS		PRI OR SEC					PRIMARY						PRIMARY	
	8. H ₂ O TANK(S) **** ①	DESCENT		DES	ANY			DES			DES			DES	
		ASCENT	1 OF 2	BOTH	2 OF 3				BOTH			BOTH			1 OF 2
	LM, CSM, EVA COMM/INST														
	1. TWO-WAY S-BAND VOICE COMM		CSM, LM & CSM					LM AND CSM						LM, CSM, EVA	
	2. TWO-WAY VHF VOICE COMM BETWEEN LM/CSM, LM/EVA, AND EVA/EVA		SIM OR DUP					SIMPLEX OR DUPLEX						③ DUPLEX ④ REQUIRED FOR EVA	
	3. CRITICAL INSTRUMENTATION							LM AND CSM			LM			LM AND CSM	
	4. LM TELEMETRY			HBR	HBR OR LBR			HBR						HBR OR LBR	
	5. CSM OPERATIONAL TELEMETRY							HBR OR LBR						HBR OR LBR	

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- NOTES: ① FUNCTIONAL CAPABILITY ONLY - SEE REDLINES FOR CONSUMABLE REQUIREMENTS
 ② DURING POWERED DESCENT A SHORT ON EITHER AN ASCENT OR DESCENT FEEDER WILL BE CONSIDERED LOSS OF A BUS AND THUS REQUIRE AN ABORT. AN OPEN WILL PROBABLY NOT BE DETECTED AND REGARDLESS NO ACTION WILL BE TAKEN
 ③ FOR TWO - MAN EVA, MSFN COMM WITH EVA REQUIRED. FOR LM/EVA COMM DUPLEX OR SIMPLEX IS ACCEPTABLE

- ④ FOR ONE-MAN EVA, MSFN COMM WITH EITHER EVA OR THE CREWMAN IN THE LM IS REQUIRED
 ⑤ ASSUMES CREWMAN IN LM OPERATING ON LM ECS

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

3-15

LM CONTROL GO/NO-GO CRITERIA															
REV	GO/NO-GO ITEM	UNDOCKING		DOI		POWERED DESCENT				LUNAR STAY			RENDEZVOUS		DOCKING
		EVENT	NOMINAL MISSION	EVENT	NOMINAL MISSION	PDI	PDI TO PDI + 5	PDI + 5 TO LO GATE	LO GATE TO TD	STAY W/O EVA	2-MAN EVA	1-MAN EVA	CSI/CDH	TPI/TPF	
	G AND C														
	1. PGNS	AGS OR PGNS													
	2. AGS														
	3. 3 AXIS AUTO ATT CNTL AND HOLD	3 AXIS													
	4. 3 AXIS CONTROL														
	5. ACA														
	6. 3 AXIS TRANSLATION														
	7. TTCA														
	8. FDAI														
	9. AOT														
	10. RR/TRANSPONDER														
	11. LR														
	12. REDUNDANT ASC ENG ON/OFF														
	13. PITCH AND ROLL GDA														
	14. MANUAL THROTTLE														
	15. AUTO THROTTLE														
	DPS														
	1. NO PROPELLANT LEAKS														
	2. OPERATIONAL DPS														
	3. NO EXCESSIVE PROP USAGE														
	4. LOW LEVEL/2"														
	APS														
	1. NO PROPELLANT LEAKS														
	2. OPERATIONAL APS														
	RCS														
	1. NO PROPELLANT LEAKS														
	2. OPERATIONAL RCS														
	3. 3 AXIS ATT CNTL CAPABILITY														
	4. 3 AXIS TRANSLATION														
	5. NO IMPINGEMENT LIMITS EXCEED														

LEGEND: [] NO REQUIREMENT

CSM EECOM GO/NO-GO CRITERIA

GO/NO-GO ITEM	EARTH ORBIT		TLC			LUNAR ORBIT		UNDOCKING		DOI		POWERED DESCENT				LUNAR STAY		
	CONT BOOST	CONT E.O.	TLI	TD&E	CONT TLC	LOI	CONT L.O.	EVENT	NOMINAL MISSION	EVENT	NOMINAL MISSION	PDI	PDI TO PDI-5	PDI-5 TO LO GATE	LO GATE TO T/D	STAY W/O EVA	2-MAN EVA	1-MAN EVA
ECS																		
CABIN INTEGRITY	(10)									CABIN INTEGRITY								CABIN INTEGRITY
NO FIRE OR SMOKE IN CABIN										NO FIRE OR SMOKE IN CABIN								NO FIRE/SMOKE IN CAB
NO O ₂ MANIFOLD LEAKS	(10*)									NO O ₂ MANIFOLD LEAKS								NO O ₂ MANIF LEAKS
MAIN O ₂ REGULATORS	(10*) 1 OF 2				BOTH					1 OF 2								1 OF 2
ECS COOLANT LOOPS		1 OF 2 (5)			BOTH					PRIMARY			1 OF 2					PRIMARY
ECS RADIATORS		1 OF 2 (5)			BOTH					PRIMARY								(1) PRIMARY (1)
ECS GLYCOL EVAPS		(5) 1 OF 2								1 OF 2								1 OF 2
SUIT INTEGRITY	S1 (10*)				S1					SUIT INTEGRITY								
NO GLYCOL LEAK										NO GLYCOL LEAK								NO GLYCOL LEAK
NO EXCESSIVE CABIN HUMIDITY										NO EXCESSIVE CABIN HUMIDITY								NO EXC CAB HUM
POTABLE H ₂ O TANK					POTABLE H ₂ O TANK					POTABLE H ₂ O TANK								(2) POTABLE H ₂ O TANK (2)
WASTE H ₂ O TANK										WASTE H ₂ O TANK								WASTE H ₂ O TANK
SUIT COMPRESSORS	(10) 1 OF 2				BOTH					1 OF 2								1 OF 2
SUIT CIRCUIT	(10*)									SUIT CIRCUIT								SUIT CIRCUIT
OVERBOARD DUMPS										1 OF 3								
CRYO																		
O ₂ TANKS		1 OF 2								BOTH			1 OF 2					BOTH
H ₂ TANKS		1 OF 2								BOTH			1 OF 2					BOTH
EPS																		
FUEL CELLS	2 0 OR 1 3	2 OF 3	ALL		2 OF 3	(6) ALL (6)	2 OF 3	(6)	(6)	ALL (6)	(6)		1 OF 3					(6) ALL (6) (6)
ENTRY BATTERIES		2 OF 3	ALL		2 OF 3	(6) ALL (6)	2 OF 3	(6)	(6)	ALL (6)	(6)							(6) ALL (6) (6)
MAIN BUSES	1 OF 2 (9)									BOTH								BOTH
BATTERY BUSES	1 OF 2 (9)									BOTH								BOTH
AC BUSES	1 OF 2 (9)									BOTH								BOTH
BATT RELAY BUS					BATT RELAY BUS													
INVERTERS	1 OF 3									2 OF 3								2 OF 3
AC # A (1 AND 2)	1 OF 2									BOTH								BOTH
INSTRUMENTATION																		
SCE					SCE													
CRITICAL INSTR					CRITICAL INSTR					CRITICAL INSTR								CRITICAL INSTR
SEQ																		
SMJC NOT ACTIVATED							SMJC NOT ACTIVATED											SMJC NOT ACTIVATED
SEQUENTIAL SYSTEMS					BOTH													
DOCKING																		
DOCKING LATCHES						(7) 3 OF 12 (7)	9 OF 12											

1. BASED ON H₂O AVAILABLE FOR EVAPORATIVE COOLING WILL CONSIDER CONTINUING IF SECONDARY LOOP STILL AVAILABLE

2. BASED ON WASTE H₂O AVAILABLE FOR EVAPORATIVE COOLING WILL CONSIDER CONTINUING

5. MUST BE IN SAME COOLANT LOOP

6. BASED ON FAILURE MODE, CONSIDERATION WILL BE GIVEN TO CONTINUING

7. 3 LATCHED LATCHES MUST BE 120° APART; IF DOCKED SPS BURNS ARE REQUIRED 9 ARE NECESSARY

9. MODE I AND II ONLY; 0 THEREAFTER

10. MUST HAVE CABIN INTEGRITY OR VIABLE SUIT LOOP. ITEMS MARKED BY * ARE REQUIRED TO MAINTAIN VIABLE SUIT LOOP

LEGEND: NO REQUIREMENT

CSM GNC GO/NO-GO CRITERIA

3-17

GO/NO-GO ITEM	EARTH ORBIT		TLC			LUNAR ORBIT		UNDOCKING		DOI		POWERED DESCENT				LUNAR STAY		
	CONT BOOST	CONT E.O.	TLI	TD&E	CONT TLC	LOI	CONT L.O.	EVENT	NOMINAL MISSION	EVENT	NOMINAL MISSION	PDI	PDI TO PDI +5	PDI +5 TO LO GATE	LO GATE TO T/D	STAY W/O EVA	2-MAN EVA	1-MAN EVA
GNC/SCS																		
DEORBIT CAPABILITY		METHODS																
AUTO ATTITUDE CONTROL																		3 AXIS
RATE DAMPING																		3 AXIS
DIRECT RCS																		3 AXIS
BMAGS P.Y		← 1 OF 2 →																1 OF 2
BMAGS R		← 1 OF 2 →					1 OF 2											
FDAI		← 1 OF 2 →																1 OF 2
THC				← THC →														
RHC		← 1 OF 2 →																1 OF 2
EMS																		
CMC				CMC														CMC
ISS				ISS														ISS
OSS				OSS														
OPTICS DAC				O-DAC														DAC
NO SOLENOID DR GND				BOTH														
FVC SERVO LOOP		1 OF 2		BOTH														BOTH
DSKY				1 OF 2														1 OF 2
SPS																		
FU/OX TNK (W/O LEAK)		← FU/OX →																FU/OX TNK
GN ₂ TNK (W/O LEAK)		1 OF 2 (CAN'T CONFIRM)																BOTH
BALL VALVE BANK		1 OF 2		BOTH														BOTH
FEEDLINE TEMP > 27° F		F/L T > 27°																F/L T > 27°
FR OX ΔP < 20 PSI		F/O ΔP < 20																F/O ΔP < 20
FLANGE TEMP < 480° F		< 480°		N/A														N/A
P _c > 70 PSI		> 70		N/A														N/A
ULLAGE CAPABILITY				BOTH														1 OF 2
HE TNK (W/O LEAK)				HE TNK														HE TNK
SM RCS																		
HE TNK (W/O LEAK)		2 OF 4		ALL														ALL
NO LEAK BELOW ISO VLV		2 OF 4																ALL
PKG TEMP > 55°		2 OF 4																ALL
THRUSTERS		ALL 3 OF 4 BY ROT AXES		7 OF 8	②													3 OF 4 P.Y 6 OF 8 R
CM RCS																		6 OF 8 R
HE TNK (W/O LEAK)		1 OF 2 MODE 1																1 OF 2
MANIFOLD (W/O LEAK)		1 OF 2 MODE 3																1 OF 2
NOT ARMED																		NOT ARMED

① FOR LEAKS AFTER PDI +10, WILL ASCEND FIRST REV OPPORTUNITY

② REQUIRES 3 AXIS ATTITUDE CONTROL AND TRANSLATION IN THREE AXES (ONE LATERAL AXIS MAY BE DEGRADED)

LEGEND: [SHADOWED] NO REQUIREMENTS

4 GROUND
INSTRUMENTATION
REQUIREMENTS

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MISSION RULES

SECTION 4 GROUND INSTRUMENTATION REQUIREMENTS

REV ITEM

R	ITEM						
	4-1	<p>GENERAL</p> <p>A. THE FOLLOWING PRELAUNCH REQUIREMENTS DEFINE THE MCC/MSFN REQUIREMENTS WHICH MUST BE MET BEFORE A 'GO' IS GIVEN FOR LAUNCH.</p> <p>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.</p> <p>C. WHERE REDUNDANCY EXISTS FOR MANDATORY ITEMS, A BACKUP CAPABILITY IS CONSIDERED HIGHLY DESIRABLE.</p> <p style="text-align: center;">NOTE</p> <p>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---</p> <p>A. RECEIVE AND DISPLAY TELEMETRY AND TRACKING DATA.</p> <p>B. MAINTAIN VOICE COMMUNICATIONS WITH THE CREW.</p>					

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REV ITEM

SECTION 4 GROUND INSTRUMENTATION REQUIREMENTS

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 CRBIT GO/NO-GO
	B. RTCC - DATA SELECT CAPABILITY	PRELAUNCH	MANDATORY		B. TO SELECT BEST AVAILABLE DATA SOURCE.
4-5	COMMUNICATIONS				
	A. MOCR---				
	FD LOOP } AFD CONF LOOP } MOCR SYS 1 & 2 } MOCR DYN } A/G 1 LOOP } A/G 2 LOOP }	PRELAUNCH	1 OF 2 MANDATORY		FOR MISSION CONTROL
		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. MISCELLANEOUS---				
	BSE TM MONITOR LOOP } C:F/USB LOOP }	PRELAUNCH	DESIRABLE		USED FOR MONITORING SPACE VEHICLES SUBSYSTEM CHECKOUT
	E. MCC/REMOVED SITES---				
	ONE A/G PATH VIA GSFC	PRELAUNCH	MANDATORY		USED FOR COMMUNICATION WITH CREW

MISSION	REV	DATE	SECTION	GROUP	PAGE
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MISSION RULES

REV ITEM

SECTION 4 GROUND INSTRUMENTATION REQUIREMENTS

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			
		D. CCATS (UNIVAC 494) - STANDBY						
		E. RTACF - 2	PRELAUNCH	1 HIGHLY DESIRABLE	PRELAUNCH IP PREDICTIONS FOR MODE 1 ABORTS.			
	4-7	TIMING						
		MITE (2)	PRELAUNCH	1 MANDATORY	MCC TIMING STANDARD TO SUPPORT MANDATORY RTCC/CCATS COMPUTERS			
	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			
		C. BUS B1	PRELAUNCH	MANDATORY	20 SECONDS INTERRUPTABLE POWER FOR MOCR AND SSR CONSOLES			
		D. BUS B2	PRELAUNCH	MANDATORY	20 SECONDS INTERRUPTABLE POWER FOR VSM			
		MISSION	REV	DATE	SECTION	GROUP	PAGE	
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SECTION 4 GROUND INSTRUMENTATION REQUIREMENTS

REV ITEM

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS		
		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			
<p>NOTE--- INDIVIDUAL FLIGHT CONTROLLERS WILL BE RESPONSIBLE FOR REPORTING LOSS OF DISPLAY CAPABILITY OF MANDATORY PARAMETERS TO THE FLIGHT DIRECTOR.</p>							
		MISSION	REV	DATE	SECTION	GROUP	PAGE
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MISSION RULES

SECTION 4 GROUND INSTRUMENTATION REQUIREMENTS

REV ITEM

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 4-16 AND FIGURES 4-1 THROUGH 4-5) TO DETERMINE CAPABILITY.						
		A. CMD						
		USB 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	MANDATORY HIGHLY DESIRABLE	FOR BULKHEAD DELTA P AFTER S/C SEP			
		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	PRELAUNCH	HIGHLY DESIRABLE				
		USB	PRELAUNCH	MANDATORY				
		2. MSFN						
		VHF } USB }	PRELAUNCH	1 OF 2 MANDATORY				
	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				
		MISSION	REV	DATE	SECTION	GROUP	PAGE	
		APOLLO 11		4/16/69	GROUND INSTR. REQUIREMENTS	GSFC/KSC/MSFN	4-8	

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REV ITEM

SECTION 4 GROUND INSTRUMENTATION REQUIREMENTS

P	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
		B. TELEMETRY			
		S-IVB VHF (CP-1)	PRELAUNCH	HIGHLY DESIRABLE	
		IU CCS (DP-18)	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	HIGHLY DESIRABLE	
		USB	PRELAUNCH	MANDATORY	
4-14		MSK, 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	
4-15		RIOMETER NETWORK SITES	PRELAUNCH		
		A. LIMA		HIGHLY DESIRABLE	
		B. CRO } CYI }		1 OF 2 HIGHLY DESIRABLE	

MISSION	REV	DATE	SECTION	GROUP	PAGE
APOLLO 11		4/16/69	GROUND INSTR. REQUIREMENTS	GSFC/KSC/MSFN	4-9

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SECTION 4 GROUND INSTRUMENTATION REQUIREMENTS

REV ITEM

REV	ITEM		MISSION	REV	DATE	SECTION	GROUP	PAGE	
	4-16	INTRODUCTION TO SITE FAILURE DECISION MATRICES (FIGURES 4-1 THROUGH 4-5)	APOLLO 11		4/16/69	GROUND INSTR. REQUIREMENTS	GSFC/KSC/MSFN	4-10	
<p>THESE DECISION MATRICES APPLY THE GROUND INSTRUMENTATION REQUIREMENTS TO THE POSSIBLE FAILURES OF SITE CAPABILITIES DURING LAUNCH PHASE.</p>									
<p>THESE MATRICES POINT OUT TIMES DURING LAUNCH WHEN A FAILURE WILL CAUSE A LOSS OF CONTINUOUS COVERAGE BETWEEN LIFTOFF AND INSERTION PLUS 60 SECONDS.</p>									
<p>TO USE THE MATRIX</p>									
<p>A. LOOK FOR AN X UNDER THE COLUMN FOR SITE WHERE THE FAILURE OCCURRED.</p>									
<p>B. GO ACROSS TO THE COLUMN FOR THE CAPABILITY THAT WAS LOST AND READ THE DECISION.</p>									
<p>C. THE COVERAGE THAT WAS LOST IS IN THE COLUMN LABELED 'MANDATORY COVERAGE LOST.'</p>									
<p>D. MORE THAN ONE X IN A ROW SPECIFIES A FAILURE OF THE SAME CAPABILITY AT MORE THAN ONE SITE.</p>									

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MISSION RULES

SECTION 4 GROUND INSTRUMENTATION REQUIREMENTS

REV ITEM

R	ITEM	SITES FAILED					CAPABILITY LOST				
		ALDS TM	MIL/CAPE	GBM	BDA	VAN	MANDATORY COVERAGE	TELEMETRY	CMD	TRACK	A/G
		00-00 08-49	00-00 08-49	01-07 09-13	04-11 12-42	09-30 15-32	LOST	USB OR VHF		BOTH S AND C BAND	
	S I N G L E	X					NONE SEE NOTE 4	GO	N/A	N/A	N/A
	F A I L U R E		X				00-00 TO 01-02	GO	GO	NO-GO	NO-GO
	F A I L U R E			X			S-IC/S-II SEP SEE NOTE 1	GO	GO	GO	GO
	F A I L U R E				X		NONE	GO	GO	GO	GO
	F A I L U R E					X	NONE	GO	GO	GO	GO
	M U L T I P L E	X	X				00-00 TO 01-02	NO-GO	GO	NO-GO	NO-GO
	M U L T I P L E		X	X			00-00	GO	GO	NO-GO	NO-GO
	M U L T I P L E	X	X	X			03-56	NO-GO	GO	NO-GO	NO-GO
	M U L T I P L E		X		X		00-00 TO 01-02	GO	GO	NO-GO	NO-GO
	M U L T I P L E	X	X		X			NO-GO	GO	NO-GO	NO-GO
	M U L T I P L E		X			X	00-00 TO	GO	GO	NO-GO	NO-GO
	F A I L U R E S	X	X			X	01-02	NO-GO	GO	NO-GO	NO-GO
	F A I L U R E S			X	X		08-51 TO 08-58 SEE NOTES 1 AND 3	GO	GO	GO	GO
	F A I L U R E S			X		X	S-IC/S-II SEP	GO	GO	GO	GO
	F A I L U R E S				X	X	9-14 TO INSR + 60	NO-GO	GO	NO-GO	GO *

NOTES---

1. FLAME ATTENUATION WILL CAUSE LOSS OF USB LOCK AT MIL DURING S-IC/S-II SEPARATION.
 2. INSR + 60 SECONDS IS APPROXIMATELY 12-21.
 3. LOSS OF COVERAGE IS NOT SEVERE ENOUGH FOR A NO-GO CONDITION.
 4. LOSS OF ALDS RESULTS IN LOSS OF S-IC TM; HOWEVER, IT IS NOT MANDATORY FOR LAUNCH.
- * GO FOR USB--- NO GO FOR USB AND VHF

FIGURE 4-1. - 72 DEG. LAUNCH AZIMUTH SITE FAILURE DECISION MATRIX.

MISSION	REV	DATE	SECTION	GROUP	PAGE
APOLLO 11		4/16/69	GROUND INSTR. REQUIREMENTS	GSFC/KSC/MSFN	4-11

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MISSION RULES

SECTION 4 GROUND INSTRUMENTATION REQUIREMENTS

REV ITEM

R	ITEM	SITES FAILED					MANDATORY COVERAGE LOST	CAPABILITY LOST			
		ALDS TM	MIL/CAPE	GBM	BDA	VAN		TELEMETRY	CMD	TRACK	A/G
		00-00 08-49	00-00 08-49	01-07 09-20	04-12 12-33	09-11 16-12		USB CR VHF		BOTH S AND C BAND	
	S I N G L E	X					NONE SEE NOTE 4	GO	N/A	N/A	N/A
	F A I L U R E		X				00-00 TO 01-02	GO	GO	NO-GO	NO-GO
	F A I L U R E			X			S-IC/S-II SEP SEE NOTE 2	GO	GO	GO	GO
	F A I L U R E				X		NONE	GO	GO	GO	GO
	F A I L U R E					X	NONE	GO	GO	GO	GO
	M U L T I P L E	X	X				00-00 TO 01-02	NO-GO	GO	NO-GO	NO-GO
	M U L T I P L E		X	X			00-00 TO	GO	GO	NO-GO	NO-GO
	M U L T I P L E	X	X	X			03-57	NO-GO	GO	NO-GO	NO-GO
	M U L T I P L E		X		X		00-00 TO	GO	GO	NO-GO	NO-GO
	M U L T I P L E	X	X		X		01-02	NO-GO	GO	NO-GO	NO-GO
	F A I L U R E S		X			X	00-00 TO	GO	GO	NO-GO	NO-GO
	F A I L U R E S	X	X			X	01-02	NO-GO	GO	NO-GO	NO-GO
	F A I L U R E S			X	X		S-IC/S-II SEP	GO	GO	GO	GO
	F A I L U R E S			X		X	S-IC/S-II SEP	GO	GO	GO	GO
	F A I L U R E S				X	X	09-21 TO INSR + 60	NO-GO	GO	NO-GO	GO *

NOTES---

1. ANG HAS ACQUISITION FROM 07-48 TO 11-20 HOWEVER, MAXIMUM ELEVATION IS 1.6 DEGREES.
 2. FLAME ATTENUATION WILL CAUSE LOSS OF USB LOCK AT MIL DURING S-IC/S-II SEPARATION.
 3. INSR + 60 SECONDS IS APPROXIMATELY 12-21.
 4. LOSS OF ALDS RESULTS IN LOSS OF S-IC TM HOWEVER, IT IS NOT MANDATORY FOR LAUNCH.
- * GO FOR USB--- NO GO FOR USB AND VHF

FIGURE 4-2.- 81 DEG. LAUNCH AZIMUTH SITE FAILURE DECISION MATRIX.

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SECTION 4 GROUND INSTRUMENTATION REQUIREMENTS

REV ITEM

R	ITEM	SITES FAILED						CAPABILITY LOST			
		ALDS TM 00-00 08-48	MIL/CAPE 00-00 08-48	GBM 01-06 09-26	BDA 04-15 12-13	ANG 07-23 12-48	VAN 09-07 16-19	MANDATORY COVERAGE LOST	TELEMETRY USB OR VHF	CMD	TRACK BOTH S AND C BAND
	S I N G L E F A I L U R E	X					NONE SEE NOTE 4	GO	N/A	N/A	N/A
			X				00-00 TO 01-02	GO	GO	NO-GO	NO-GO
				X			S-IC/S-II SEP SEE NOTE 2	GO	GO	GO	GO
					X		NONE	GO	GO	GO	GO
						X	NONE	GO	GO	GO	GO
						X	NONE	GO	GO	GO	GO
	M U L T I P L E	X	X				00-00 TO 01-02	NO-GO	GC	NO-GO	NO-GO
			X	X			00-00 TO	GO	GO	NO-GO	NO-GO
		X	X	X			03-59	NO-GO	GO	NO-GO	NO-GO
			X		X		00-00 TO	GO	GO	NO-GO	NO-GO
		X	X		X		01-02	NO-GO	GO	NO-GO	NO-GO
	F A I L U R E S		X			X	00-00 TO	GO	GO	NO-GO	NO-GO
		X	X			X	01-02	NO-GO	GO	NO-GO	NO-GO
				X	X		S-IC/S-II SEP	GO	GO	GO	GO
				X		X	S-IC/S-II SEP	GO	GO	GO	GO
					X	X	NONE	GO	GO	GO	GO
					X	X	12-11 TO INSR + 60	NO GO	GO	NO-GO	GO *

NOTES---

1. ANG HAS MAXIMUM ELEVATION OF 5 DEGREES.
 2. FLAME ATTENUATION WILL CAUSE LOSS OF USB LOCK AT MIL DURING S-IC/S-II SEPARATION.
 3. INSR + 60 SECONDS IS APPROXIMATELY 12-21.
 4. LOSS OF ALDS RESULTS IN LOSS OF S-IC TM. HOWEVER, IT IS NOT MANDATORY FOR LAUNCH.
- * GO FOR USB--- NO GO FOR USE AND VHF

FIGURE 4-3.- 90 DEG. LAUNCH AZIMUTH SITE FAILURE DECISION MATRIX.

MISSION	REV	DATE	SECTION	GROUP	PAGE
APOLLO 11		4/16/69	GROUND INSTR. REQUIREMENTS	GSFC/KSC/MSFN	4-13

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SECTION 4 GROUND INSTRUMENTATION REQUIREMENTS

REV ITEM

R	ITEM	SITES FAILED						MANDATORY COVERAGE LOST	CAPABILITY LOST			
		ALDS TM 00-00 08-48	MIL/CAPE 00-00 08-48	GBM 01-06 09-31	BDA 04-21 11-43	ANG. 07-00 13-40	VAN 09-16 15-57		TELEMETRY USB OR VHF	CMD	TRACK BOTH S AND C BAND	A/G
	SINGL E	X					NONE SEE NOTE 3	GO	N/A	N/A	N/A	
	F A I L U R E		X				00-00 TO 01-02	GO	GO	NO-GO	NO-GO	
				X			S-IC/S-II SEP SEE NOTE 1	GO	GO	GO	GO	
					X		NONE	GO	GO	GO	GO	
						X	NONE	GO	GO	GO	GO	
		X	X				00-00 TO 01-02	NO-GO	GO	NO-GO	NO-GO	
			X	X			00-00 TO	GO	GO	NO-GO	NO-GO	
	M U L T I P L E	X	X	X			04-04	NO-GO	GO	NO-GO	NO-GO	
			X		X		00-00 TO	GO	GO	NO-GO	NO-GO	
		X	X		X		01-02	NO-GO	GO	NO-GO	NO-GO	
			X			X	00-00 TO	GO	GO	NO-GO	NO-GO	
		X	X			X	01-02	NO-GO	GO	NO-GO	NO-GO	
	F A I L U R E S			X	X		S-IC/S-II SEP	GO	GO	GO	GO	
				X		X	S-IC/S-II SEP	GO	GO	GO	GO	
					X	X	NONE	GO	GO	GO	GO	
					X		NONE	GO	GO	GO	GO	
						X	11-41 TO INSR + 60	NO-GO	GO	GO	GO *	
			X			X	00-00 TO	GO	GO	NO-GO	NO-GO	
		X	X			X	01-02	NO-GO	GO	NO-GO	GO *	

NOTES---

1. FLAME ATTENUATION WILL CAUSE LOSS OF USB LOCK AT MIL DURING S-IC/S-II SEPARATION.
 2. INSR + 60 SECONDS IS APPROXIMATELY 12-21.
 3. LOSS OF ALDS RESULTS IN LOSS OF S-IC TM HOWEVER, IT IS NOT MANDATORY FOR LAUNCH.
- * GO FOR USB--- NO GO FOR USB AND VHF

FIGURE 4-4.- 99 DEG. LAUNCH AZIMUTH SITE FAILURE DECISION MATRIX.

MISSION	REV	DATE	SECTION	GROUP	PAGE
APOLLO 11		4/16/69	GROUND INSTR. REQUIREMENTS	GSFC/KSC/MSFN	4-14

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SECTION 4 GROUND INSTRUMENTATION REQUIREMENTS

REV ITEM

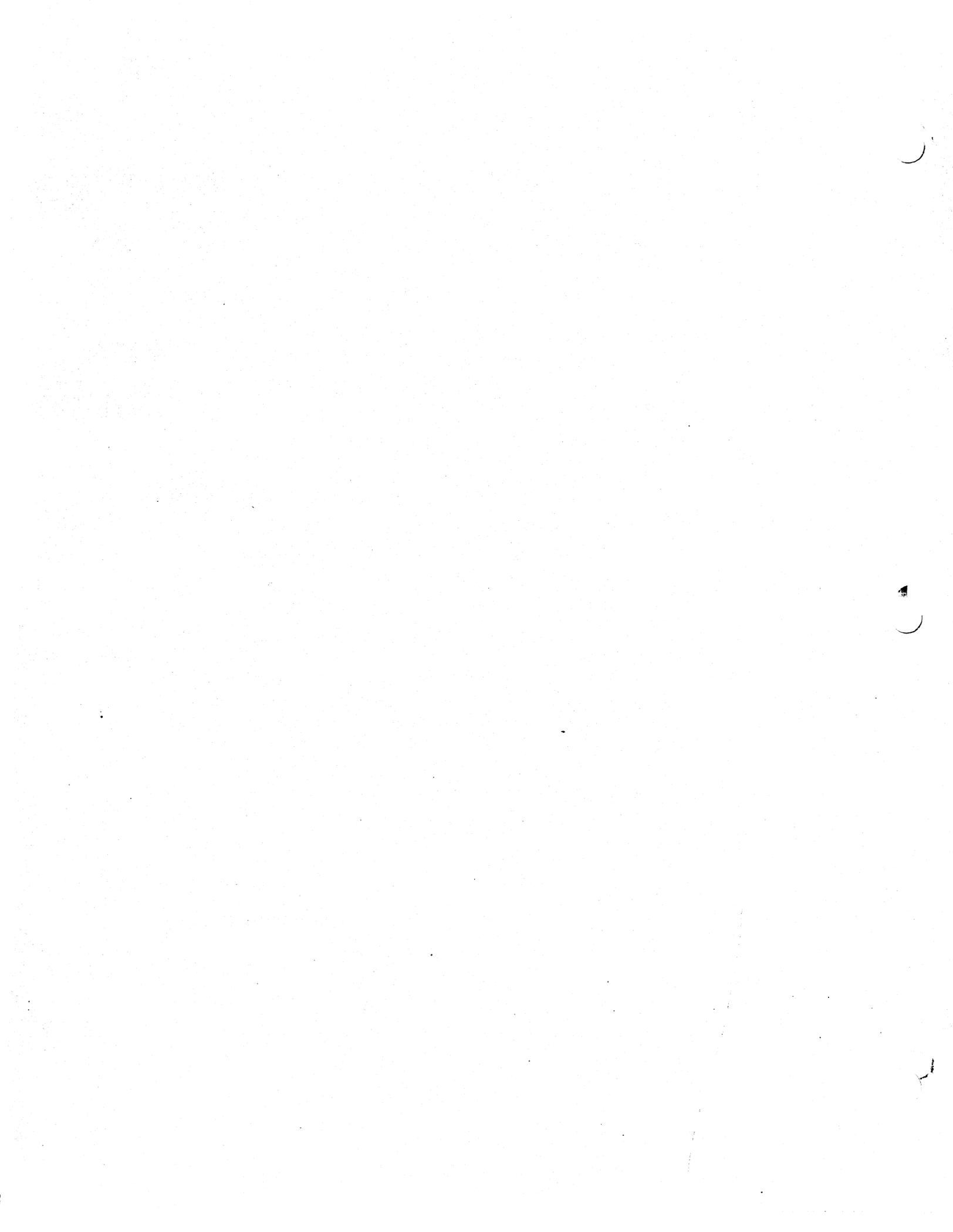
R	ITEM	SITES FAILED					MANDATORY COVERAGE LOST	CAPABILITY LOST			
		ALDS TM 00-00 08-48	MIL/CAPE 00-00 06-48	GBM 01-06 09-35	BDA 04-29 11-03	ANG. 06-48 14-10		VAN 09-42 14-59	TELEMETRY USB OR VHF	CMD	TRACK BOTH S AND C BAND
		X					NOTE SEE NOTE 3	GO	N/A	N/A	N/A
			X				00-00 TO 01-02	GO	GO	NO-GO	NO-GO
				X			S-IC/S-II SEP SEE NOTE 1	GO	GO	GO	GO
					X		NONE	GO	GO	GO	GO
						X	NONE	GO	GO	GO	GO
		X	X				00-00 TO 01-02	NO-GO	GO	NO-GO	NO-GO
			X	X			00-00 TO	GO	GO	NO-GO	NO-GO
		X	X	X			04-11	NO-GO	GO	NO-GO	NO-GO
			X		X		00-00 TO	GO	GO	NO-GO	NO-GO
		X	X		X		01-02	NO-GO	GO	NO-GO	NO-GO
			X			X	00-00 TO	GO	GO	NO-GO	NO-GO
		X	X			X	01-02	NO-GO	GO	NO-GO	NO-GO
				X	X		S-IC/S-II SEP	GO	GO	GO	GO
				X		X	S-IC/S-II SEP	GO	GO	GO	GO
					X	X	11-01 TO INSR + 60	NO-GO	GO	GO	GO *
				X	X		NONE	GO	GO	GO	GO

NOTES---

1. FLAME ATTENUATION WILL CAUSE LOSS OF USB LOCK AT MIL DURING S-IC/S-II SEPARATION.
2. INSR + 60 SECONDS IS APPROXIMATELY 12-21.
3. LOSS OF ALDS RESULTS IN LOSS OF S-IC TM. HOWEVER, IT IS NOT MANDATORY FOR LAUNCH.
- * GO FOR USB--- NO GO FOR USB AND VHF

FIGURE 4-5.- 108 DEG. LAUNCH AZIMUTH SITE FAILURE DECISION MATRIX.

MISSION	REV	DATE	SECTION	GROUP	PAGE
APOLLO 11		4/16/69	GROUND INSTR. REQUIREMENTS	GSFC/KSC/MSFN	4-15



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MISSION RULES

SECTION 5 TRAJECTORY AND GUIDANCE

REV ITEM

REV	ITEM
5-4	<p>MODE III ABORTS.</p> <p>A. PREDICTED TFF AFTER SPS C/O IS LESS THAN $1 + 40$.</p> <ol style="list-style-type: none"> 1. FULL LIFT IP ON WATER - DO NOT BURN. 2. G&N GO AND FULL LIFT IP ON LAND - BURN TO TFF = $1 + 40$, RL 90 DEG. 3. G&N NO-GO AND FULL LIFT IP ON LAND - BURN A REDUCED DELTA V TO MAINTAIN TFF AFTER C/O AND RL 90 DEG. <p>B. IF DELTA TB IS LESS THAN OR EQUAL TO <u>2</u> SEC, DO NOT BURN.</p> <p>C. IF IGNITION OCCURS AFTER GETI +10 SEC, BURN UNTIL G&N DELTA R = 0, RL 55 DEG. (IF UNABLE TO BURN DELTA R = 0, RL 90 DEG.)</p>
5-5	<p>THE S/C CMC WILL BE NO-GO FOR ABORT MANEUVER DETERMINATION AND MONITORING FOR ANY OF THE FOLLOWING---</p> <ol style="list-style-type: none"> A. CMC PROGRAM FAILURE. B. RTCC AND CMC TFF DIFFERENCE OF GREATER THAN 40 SEC. C. CONFIRMED ERROR IN S/C PLATFORM VELOCITY COMPONENTS OF GREATER THAN <u>50</u> FPS IN X OR <u>100</u> FPS IN Z. D. CMC TRAJECTORY SOURCE INDICATES 'GO' OR 'NO-GO' INCONSISTENT WITH BEST TRAJECTORY SOURCE(S) INDICATION.
5-6	<p>THE ORBIT IS 'GO' IF HP IS GREATER THAN OR EQUAL TO <u>75</u> NM.</p> <p>RULES 5-7 THROUGH 5-19 ARE RESERVED.</p>

MISSION	REV	DATE	SECTION	GROUP	PAGE
APOLLO 11		4/16/69	TRAJECTORY AND GUIDANCE	LAUNCH	5-2

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SECTION 5 TRAJECTORY AND GUIDANCE

REV ITEM

REV	ITEM	MISSION	REV	DATE	SECTION	GROUP	PAGE	
	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 - 75 NM MINIMUM (VIOLATIONS WILL BE CORRECTED ASAP) IF HP LESS THAN 75 NM AND MANEUVER TO RAISE HP IS NOT POSSIBLE---						
		1. 40 IS LESS THAN HP IS LESS THAN 75 - 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	THE CONTINGENCY SEPARATION MANEUVERS FOR THE CSM ARE---						
		A. IMPENDING S-IVB OR UNMANNED LM EXPLOSION - <u>55</u> FPS SPS ASAP (7000 FT SEPARATION REQUIRED IN <u>200</u> SEC.)						
		B. S-IVB ATTITUDE RATES IS GREATER THAN OR EQUAL TO 5 DEG/SEC - <u>5</u> FPS RCS ASAP.						
		C. S-IVB YAW ATTITUDE GREATER THAN 45 DEG - <u>5</u> FPS RCS ASAP.						
		D. CSM RETROFIRE REQUIRED WHILE ATTACHED TO THE S-IVB OR LM - SEPARATION 20 MINUTES PRIOR TO RETRO, <u>5</u> FPS RCS RETROGRADE WITH LINE ON HORIZON.						
	5-22	S/C COMPUTER TIMING UPDATES ARE REQUIRED FOR SET ERRORS AS FOLLOWS---						
		A. CMC OR LGC IS GREATER THAN <u>.1</u> SEC.						
		B. AGS IS GREATER THAN <u>.3</u> SEC.						
		C. S/C L/O TIME (GRR) WILL BE UPDATED WITH SRO L/O TIME IF THE TWO ARE DIFFERENT BY 10 SEC.						
	5-23	TIME BETWEEN EPO RETROFIRE GETI AND 400K MUST BE GREATER THAN <u>9</u> MIN. IF NOT, RETARGET FOR NEXT PTP.						
	5-24	IF SPS RETROFIRE DELTA TB IS LESS THAN <u>7</u> SEC. USE SCS AUTO TVC.						
		APOLLO 11		4/16/69	TRAJECTORY AND GUIDANCE	EARTH ORBIT AND TLI	5-3	

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MISSION RULES
SECTION 5 TRAJECTORY AND GUIDANCE

REV	ITEM	MISSION	REV	DATE	SECTION	GROUP	PAGE
5-25	<p>PLANNED G&N AND SCS RETROFIRE MANEUVERS WILL BE UPDATED IF---</p> <p>A. THE COMPUTED RETROFIRE POSITION CHANGES BY GREATER THAN 0.5 DEG LONGITUDE PRIOR TO GETI -30 MIN.</p> <p>B. THE COMPUTED RETROFIRE POSITION CHANGES BY GREATER THAN 2 DEG LONGITUDE AFTER GETI -30 MIN.</p>	APOLLO 11		4/16/69	TRAJECTORY AND GUIDANCE	EARTH ORBIT AND TLI	5-4
5-26	<p>IF A G&N FAILURE IS DETECTED PRIOR TO RETROFIRE, CREW USES SCS DELTA V MODE WITH AN EMS ENTRY.</p>						
5-27	<p>IF SPS FAILS AFTER EPO RETROFIRE IGNITION OR NO SLA SEP---</p> <p>A. HP IS GREATER THAN 75 NM - RETARGET FOR NEXT BEST PTP USING RCS.</p> <p>B. 40 IS LESS THAN HP IS LESS THAN 75 - PITCH UP TO LOCAL HORIZONTAL ATTITUDE AND BURN SM RCS USING FOLLOWING PRIORITIES---</p> <ol style="list-style-type: none"> 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. <p>C. HP IS LESS THAN 40 NM - REMAIN IN RETRO ATTITUDE AND BURN SM RCS USING THE FOLLOWING PRIORITY---</p> <ol style="list-style-type: none"> 1. BURN DELTA V RESIDUALS. 2. BURN MAXIMUM SM DELTA V AVAILABLE. 						
<p>NOTE</p> <p>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.</p>							
		MISSION	REV	DATE	SECTION	GROUP	PAGE
		APOLLO 11		4/16/69	TRAJECTORY AND GUIDANCE	EARTH ORBIT AND TLI	5-4

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MISSION RULES

SECTION 5 TRAJECTORY AND GUIDANCE

REV ITEM

REV	ITEM
5-28	<p>THE G&N IS NO-GO FOR ENTRY IF---</p> <p>A. THE CMC VALUE OF DOWNRANGE ERROR (RP - RT) AT .2G DIFFERS GREATER THAN +/- 100 NM FROM GROUND VALUE OR IS GRATER THAN +/- 130 NM FROM BACKUP CHART VALUE. CREW FALLOVER TO EYS ENTRY AS FIRST PRIORITY OR GROUND BANK ANGLE AND RETRB AS SECOND PRIORITY.</p> <p>B. V AND GAMMA AT 40CK ARE OUTSIDE THE CORRIDOR. GROUND WILL PROVIDE ENTRY PROFILE.</p>
5-29	<p>BOOSTER NAVIGATION AND TARGET UPDATES FOR TLI---</p> <p>A. THERE WILL BE NO IU TARGET UPDATES FOR EITHER TLI OPPORTUNITY.</p> <p>B. AN IU NAVIGATION UPDATE WILL BE PERFORMED FOR EITHER TLI OPPORTUNITY WHERE AN S-IVB GUID REF FAIL OCCURRED PRIOR TO EARTH-ORBIT INSERTION.</p>
5-30	<p>THE CMC STATE VECTOR WILL BE UPDATED PRIOR TO TLI WITH THE BEST MSFN VECTOR.</p>
5-31	<p>A PROPERLY OPERATING SPACECRAFT G&N (CMC, IMU AND OSS) SYSTEM IS MANDATORY FOR TLI.</p>
5-32	<p>THE MAXIMUM ALLOWABLE MISALIGNMENT RATES BETWEEN THE IU AND IMU ARE <u>0.6</u> DEG/HR (IU) AND <u>1.2</u> DEG/HR (IMU).</p>
5-33	<p>THE S/C L/O RESFMMAT WILL BE USED FOR BOTH TLI OPPORTUNITIES.</p>
5-34	<p>DISPERSED TLI C/O---</p> <p>A. PREDICTED END OF MISSION FUEL RESERVES (EOMFR) GREATER THAN <u>500</u> FPS - CONTINUE MISSION AND EXECUTE MCC CONSISTENT WITH LUNAR ORBIT MISSION. (EOMFR INCLUDES T&D, BAP MCC1, LO11, LO12, RENDEZVOUS RESCUE, AND TEI.)</p> <p>B. PREDICTED EOMFR LESS THAN <u>500</u> FPS AND---</p> <p>1. PREDICTED FUEL RESERVES AFTER T&D, BAP MCC1, LO11, LO12, AND TEI (NO RENDEZVOUS RESCUE) GREATER THAN 500 FPS - CONTINUE MISSION, EXECUTE MCC CONSISTENT WITH LUNAR ORBIT MISSION. (DPS LOI MAY BE CONSIDERED TO IMPROVE SPS DELTA V CAPABILITY.)</p> <p>2. PREDICTED FUEL RESERVES AFTER T&D, BAP MCC1, LO11 (DPS), LO12, AND TEI (NO RENDEZVOUS RESCUE LESS) LESS THAN 500 FPS, AND---</p> <p>(A) EOMFR AFTER LUNAR FLYBY (CSM AND LM) GREATER THAN <u>5500</u> FPS (CSM ONLY), EXECUTE MCC FOR FLYBY MISSION.</p> <p>(B) EOMFR AFTER LUNAR FLYBY LESS THAN <u>5500</u> FPS, EXECUTE ALTERNATE MISSION CONSISTENT WITH FINAL MISSION PLANNING.</p>

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MISSION RULES

SECTION 5 TRAJECTORY AND GUIDANCE

R	ITEM						
5-35		<p>DIFFERENCE IN CMC AND IU PLATFORM VELOCITY COMPONENTS OR TOTAL VELOCITY AT INSERTION---</p> <p>A. VIOLATION OF ANY OF THE FOLLOWING MEANS TLI IS NO-GO---</p> <p>DELTA XDOT IS GREATER THAN <u>35</u> FPS</p> <p>DELTA YDOT IS GREATER THAN <u>66</u> FPS</p> <p>DELTA ZDOT IS GREATER THAN <u>87</u> FPS</p> <p>DELTA VT IS GREATER THAN <u>33</u> FPS</p> <p>B. VIOLATION OF ANY OF THE FOLLOWING MEANS TLI IS TEMPORARILY NO-GO---</p> <p><u>7.4</u> IS LESS THAN DELTA XDOT LESS THAN <u>35</u> FPS</p> <p><u>45</u> IS LESS THAN DELTA YDOT LESS THAN <u>66</u> FPS</p> <p><u>27</u> LESS THAN DELTA ZDOT LESS THAN <u>87</u> FPS</p> <p><u>13</u> IS LESS THAN DELTA VT IS LESS THAN <u>33</u> FPS</p> <p style="text-align: center;">NOTE</p> <p style="text-align: center;">TLI IS NO-GO UNTIL PARTS C AND 5-36 ARE DETERMINED (ORBITAL PARAMETER DECISIONS).</p> <p>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.</p> <p>DELTA ALPHA IS GREATER THAN <u>19,300</u> FT</p> <p>DELTA OMEGA MAX IS GREATER THAN <u>32</u> FPS</p>					
5-36		<p>DIFFERENCE IN MSFN AND IU DOWNRANGE POSITION (DELTA RV) IS GREATER THAN <u>105,000</u> FT AT GET = <u>3</u> MIN MEANS TLI IS NO-GO.</p>					
		<p>RULES 5-37 THROUGH 5-45 ARE RESERVED.</p>					
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MISSION RULES

SECTION 5 TRAJECTORY AND GUIDANCE

REV ITEM

REV	ITEM
	<p>5-49 NON-CRITICAL MANEUVERS WILL BE TERMINATED AFTER MANUAL TAKEOVER FOR---</p> <p>A. ATTITUDE EXCURSIONS IS GREATER THAN OR EQUAL TO <u>10</u> DEG.</p> <p>B. ATTITUDE RATES IS GREATER THAN OR EQUAL TO <u>10</u> DEG/SEC.</p> <p>C. ATTITUDE ERRORS IS GREATER THAN OR EQUAL <u>10</u> DEG.</p>
	<p>5-50 GENERALLY, THE FOLLOWING MANEUVER RESIDUAL TRIMMING CRITERIA WILL APPLY---</p> <p>A. DOCKED SPS - TRIMMED TO <u>1</u> FPS IN X-AXIS ONLY (MCC, MCC1, MCC2, AND LO11 ARE NOT TRIMMED).</p> <p>B. DOCKED DPS WILL NOT BE TRIMMED.</p> <p>C. ALL UNDOCKED MANEUVERS (BY EITHER VEHICLE) WILL BE TRIMMED TO WITHIN 0.2 FPS IN X-AXIS. Y AND Z-AXIS RESIDUALS WILL NOT BE TRIMMED.</p>
	<p>5-51 THE FOLLOWING MANEUVERS WILL BE MANUALLY TERMINATED AFTER VIOLATION OF THESE OVERBURD CRITERIA---</p> <p>A. TLI - <u>6</u> SEC</p> <p>B. LO11 - <u>10</u> SEC</p> <p> 1. SPS - <u>10</u> SEC</p> <p> 2. DPS <u>TBD</u> SEC</p> <p>C. LO12 - <u>1</u> SEC</p> <p>D. DOI-2 SEC AND DELTA V GREATER THAN 2 FPS</p> <p>E. TEI</p> <p> 1. SPS - <u>2</u> SEC AND DELTA VC GREATER THAN <u>40</u> FPS</p> <p> 2. DPS - 10 SEC AND DELTA V GREATER THAN 2 FPS</p> <p>RULES 5-52 THROUGH 5-55 ARE RESERVED.</p>

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MISSION RULES

SECTION 5 TRAJECTORY AND GUIDANCE

REV ITEM

REV	ITEM	MISSION	REV	DATE	SECTION	GROUP	PAGE
5-62	<p>PREMATURE LOI SHUTDOWN</p> <p>A. DELTA VM LESS THAN 735 FPS (100 SEC) - EXECUTE AN SPS <u>15</u> MIN DIRECT ABORT OR A DPS <u>2</u> MIN DIRECT ABORT.</p> <p>B. 735 LESS THAN DELTA VM LESS THAN 1280 (100 TO 170 SEC) - EXECUTE AN SPS <u>15</u> MIN DIRECT ABORT OR A DPS TWO-IMPULSE CIRCULUNAR ABORT.</p> <p>C. DELTA VM GREATER THAN 1280 FPS (GREATER THAN 170 SEC TO END OF BURN) - EXECUTE TEI (SPS OR DPS) AT NEXT PERICYNTHIAN OR INITIATE AN ALTERNATE MISSION.</p>	APOLLO 11		4/16/69	TRAJECTORY AND GUIDANCE	TRANSLUNAR COAST	5-10
5-63	<p>IF THE SPS FAILS AT IGNITION---</p> <p>A. MCC - RESCHEDULE MCC FOR FLYBY TRAJECTORY WITH DPS/SM-RCS EXECUTION.</p> <p>B. LO11 - EXECUTE MCC5 ABORT MANEUVER WITH DPS/SM-RCS.</p> <p>C. LO12 - EXECUTE GROUND COMPUTED TEI WITH DPS AS SOON AS PRACTICAL.</p> <p>RULES 5-64 THROUGH 5-75 ARE RESERVED.</p>						

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SECTION 5 TRAJECTORY AND GUIDANCE

REV ITEM

	5-76	THE LO12 MANEUVER WILL BE TARGETED TO MINIMIZE THE LLS MISS DISTANCE.
	5-77	A "GO" FOR LO12 REQUIRES COMMITMENT TO AT LEAST 4 HRS IN LUNAR ORBIT. (NOTE--- THIS PROVIDES ONE FULL REV OF TRACK AFTER LO12 FOR CALCULATION OF TEI.)
		RULES 5-78 THROUGH 5-80 ARE RESERVED.

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REV	ITEM	DESCRIPTION
	5-81	PRIOR TO UNDOCKING, THE MAXIMUM ALLOWABLE MISS DISTANCE OVER THE LLS IS 0.5 DEG OUT OF PLANE AND +/- 2 DEG IN AZIMUTH. ADDITIONAL MANEUVERS WILL BE SCHEDULED, AS NEEDED, BETWEEN L012 AND UNDOCKING TO CORRECT DISPERSIONS.
	5-82	DOI RESIDUALS WILL BE NULLED ALONG THE X BODY AXIS. Y AND Z-AXIS RESIDUALS WILL NOT BE TRIMMED.
	5-83	UNDOCKING WILL BE SLIPPED 1 REV FOR FAILURE TO ACHIEVE ONE SET OF AT LEAST 5 SATISFACTORY LANDMARK SIGHTINGS.
	5-84	THE LLS POSITIONS STORED IN THE LGC WILL BE UPDATED IF THE LLS SXT SIGHTINGS CHANGE THE STORED VALUES BY--- A. DELTA H LESS THAN 5000 FT B. DELTA LATITUDE LESS THAN 12000 FT C. DELTA LONGITUDE LESS THAN 5000 FT
	5-85	THE PGNS AND AGS VARIABLE TARGETING CONSTANTS WILL BE UPDATED FOR CHANGES IN THE SEMI-MAJOR AXIS OF THE CSM ORBIT OF GREATER THAN 180 NM.
	5-86	POI WILL BE INHIBITED AND ABORT ACTION TAKEN FOR THE FOLLOWING REASONS--- A. AT DOI CUTOFF, PRIOR TO TRIMMING, PGNS RESIDUALS ARE GREATER THAN 2.0 FPS IN ANY AXIS. B. AFTER DOI, PGNS AND AGS RESIDUALS DIFFER BY GREATER THAN 2 FPS.
NOTE		
IN CASES OF DISAGREEMENT, THE RK WILL BE USED TO DETERMINE THE VALID SYSTEM.		
	5-87	THE LGC WILL BE NO-GO FOR POI IF THE ONBOARD STATE VECTOR DIFFERS FROM THE LATEST MSFN VECTOR BY 130.
	5-88	POI IGNITION - THE FLIGHT CREW WILL ATTEMPT TO MANUALLY IGNITE THE DPS ENGINE IF IT DOES NOT IGNITE AUTOMATICALLY. THE MANUAL IGNITION MUST OCCUR BY LGC COMPUTED TIG + 7.5 SEC. THE FLIGHT CREW WILL NOT ATTEMPT TO BACK UP THE POI ULLAGE MANEUVER.

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MISSION RULES

SECTION 5 TRAJECTORY AND GUIDANCE

R	ITEM						
	5-92	<p>THE FOLLOWING RENDEZVOUS OPTIONS/RESCUE MODES WILL BE UTILIZED AS NECESSARY FOR FAILURES REQUIRING TERMINATION OF THE LUNAR LANDING---</p> <p>A. DOI FAILURES---DIRECT RETURN ABORTS WILL BE PERFORMED WHENEVER POSSIBLE FOR FAILURE WHICH WILL CAUSE POWERED DESCENT TO BE INHIBITED. (DIRECT ABORTS CAN BE PERFORMED UNTIL DOI +10 MINUTES. THE RR IS MANDATORY FOR THESE ABORTS.)</p> <p style="text-align: center;">NOTE</p> <p style="text-align: center;">FOLLOWING DOI, THE PGNS AND AGS WILL BE COMPARED. IN CASE OF DISAGREEMENT, THE RR WILL BE USED FOR SYSTEM VALIDATION.</p> <p style="text-align: center;">PGNS FAIL - DIRECT RETURN.</p> <p style="text-align: center;">AGS FAIL - DIRECT RETURN.</p> <p style="text-align: center;">RR FAIL - FIVE IMPULSE RENDEZVOUS.</p> <p>B. FOR FAILURES FROM DOI +10 TO PDI EXECUTE THE DOI ABORT SEQUENCE (POWERED DESCENT ABORT AT PDI). DOCKING IN ABOUT 3-1/4 HOURS.</p> <p>C. ABORTS DURING POWERED DESCENT FROM PDI TO PDI +10 MINUTES WILL INSERT INTO LUNAR ORBIT USING THE ONBOARD VARIABLE TARGETING. THE LM WILL EXECUTE THE RENDEZVOUS USING THE CFP SEQUENCE. DOCKING WILL BE IN ABOUT 3-1/4 HOURS FROM INSERTION.</p> <p>D. ABORTS DURING POWERED DESCENT FROM PDI -10 MINUTES TO TO THE FIRST LUNAR SURFACE GO/NO-GO (APPROXIMATELY 4 MINUTES AFTER TOUCH-DOWN) WILL INSERT INTO LUNAR ORBIT USING THE ONBOARD VARIABLE TARGETS. RENDEZVOUS WILL BE ACCOMPLISHED BY A LM ACTIVE FIVE IMPULSE SEQUENCE. DOCKING WILL BE IN ABOUT 5-1/4 HOURS FROM INSERTION.</p> <p>E. FOR COMPLETE LM FAILURES PRIOR TO PDI, THE CSM WILL EXECUTE A FIVE IMPULSE RESCUE WITH DOCKING ABOUT 9-1/4 HOURS FROM PDI.</p> <p>RULES 5-99 THROUGH 5-100 ARE RESERVED.</p>					
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SECTION 5 TRAJECTORY AND GUIDANCE

R	ITEM						
5-101		LM LIFTOFF WILL BE DELAYED ONE REVOLUTION RATHER THAN ACCEPTING A SLIP IN NOMINAL LIFTOFF TIME.					
5-102		DURING ASCENT OR FOLLOWING A DESCENT ABORT, GUIDANCE SWITCHOVER TO AGS WILL BE PERFORMED FOR ---					
		A. ONBOARD RECOGNIZED PGNS FAILURES (SEE RULES 5-46A AND <u>IBD</u>).					
		B. PGNS NAVIGATION ERROR THAT RESULT IN---					
		1. AGS PREDICTED HP AT INSERTION LESS THAN <u>37000</u> FT.					
		2. AGS PREDICTED HA AT INSERTION GREATER THAN <u>TARGET VALUE PLUS 40 NM</u>					
		3. AGS PREDICTED WEDGE ANGLE AT INSERTION GREATER THAN <u>1.7</u> DEG.					
5-103		THE GROUND WILL NOT REQUEST SWITCHOVER AFTER TGO LESS THAN <u>30</u> SECONDS.					
5-104		RULES 5-104 THROUGH 5-110 ARE RESERVED.					
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MISSION RULES

SECTION 5 TRAJECTORY AND GUIDANCE

REV ITEM

R	ITEM	
	5-111	THE PGNCIS IS PRIME FOR CSI AND CDH MANEUVER COMPUTATION/EXECUTION WITH AGS AS BACKUP UTILIZING THE ACCEPTED SOLUTION---
		A. THE ONBOARD SOLUTION OF CSI WILL NOT BE USED IF DIFFERENT FROM THE CSM SOLUTION GREATER THAN <u>2</u> FPS. THE CSM SOLUTION WILL BE USED INSTEAD.
		B. THE ONBOARD SOLUTION OF CDH WILL NOT BE USED IF DIFFERENT FROM THE CSM SOLUTION BY GREATER THAN <u>2</u> FPS. THE CSM SOLUTION WILL BE USED INSTEAD.
	5-112	THE ORDER OF PRIORITY FOR THE TPI SOLUTION IS PGNCIS, LM ONBOARD CHARTS, CSM, AND GROUND. THE ONBOARD SOLUTION WILL NOT BE USED IF DIFFERENT FROM THE CSM BY GREATER THAN <u>TBD</u> FPS.
	5-113	RENDEZVOUS PLANS SHALL, WHERE POSSIBLE, SATISFY THE FOLLOWING CONSTRAINTS---
		A. RENDEZVOUS MANEUVERS MUST BE <u>25</u> MIN APART.
		B. THE ALLOWABLE SLIP TIME FOR TPI IS +/- <u>15</u> MIN FROM MPD.
		C. THE DELTA H FOR TPI WILL BE 15 +/- NM.
	5-114	THE GROUND WILL BE RESPONSIBLE FOR ANY MANEUVERS PRIOR TO CSI.
		NOTE
		GROUND WILL COMPUTE CSI, CDH, AND TPI BUT WILL NOT PASS THESE MANEUVERS UNLESS REQUESTED.
	5-115	ALL MANEUVERS WILL BE NULLED ALONG THE X-AXIS. Y AND Z RESIDUALS WILL NOT BE TRIMMED.
		NOTE
		THIS INCLUDES NOMINAL AND/OR RESCUE MANEUVERS.
		RULES 5-116 THROUGH 5-120 ARE RESERVED.

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MISSION RULES

SECTION 5 TRAJECTORY AND GUIDANCE

REV ITEM

REV	ITEM	MISSION	REV	DATE	SECTION	GROUP	PAGE	
	5-121	TRANSEARTH MCC WILL BE TARGETED TO ACHIEVE ENTRY CONDITIONS AS FOLLOWS---						
		A. IF VEI GREATER THAN 30000 FPS USE STEEP TARGET LINE.						
		B. IF VEI LESS THAN 30000 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 (EXCEPTION---MCC5 ONLY).						
		C. THE LAST MCC WILL BE SCHEDULED NO LATER THAN EI-3 HOURS.						
		D. THE G&N WILL BE THE PRIMARY MODE OF EXECUTION FOR ALL TEC MCC.						
		E. MCC GREATER THAN <u>10</u> FPS WILL USE THE SPS IF PRACTICAL.						
		F. THE RESIDUALS FOR MCC'S WILL BE TRIMMED TO WITHIN 0.2 FPS IN EACH AXIS.						
	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 ANY PART OF THE OPERATIONAL FOOTPRINT IS ON LAND.						
		J. AFTER EI-24 HRS---WILL NOT BE EXECUTED.						
	5-124	ENTRY CONDITIONS WILL BE CONTROLLED TO AVOID HEAT SHIELD LIMITATIONS.						
	5-125	BACKUP ENTRY IS CONSTRAINED AS FOLLOWS---						
		A. THE CONSTANT G ENTRY MUST FALL BETWEEN <u>3</u> 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.						
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MISSION RULES

SECTION 5 TRAJECTORY AND GUIDANCE

R	ITEM
5-127	<p>PREDICTED ENTRY CORRIDOR VIOLATION AFTER THE LAST MCC OPPORTUNITY---</p> <p>A. UNDERSHOOT LINE EXCEEDED--- GROUND ADVISE CREW TO FLY FULL LIFT UNTIL PEAK G IS PASSED, THEN FLY G&N.</p> <p>B. OVERSHOOT LINE EXCEEDED---GROUND ADVISE CREW TO FLY NEGATIVE LIFT TO 2 G'S FOLLOWED BY 4 G CONSTANT ENTRY.</p>
5-128	<p>IF THE EMS INDICATES A SKIP CONDITION, NEGATIVE LIFT SHOULD BE ACHIEVED PRIOR TO VERIFYING THE EMS WITH CROSS CHECKS.</p>
5-129	<p>IF THE EMS INDICATES AN UNDERSHOOT CONDITION EXISTS, FULL LIFT SHOULD BE ACHIEVED PRIOR TO VERIFYING THE EMS WITH CROSS CHECKS.</p>
5-130	<p>THE G&N IS NO-GO DURING ENTRY IF---</p> <p>A. P65 VALUE OF VL DIFFERS FROM THE GROUND VALUE BY GREATER THAN +/- <u>800</u> FPS.</p> <p>B. P65 VALUE OF DL DIFFERS FROM THE GROUND BY GREATER THAN +/- <u>0.6</u> G'S.</p> <p>C. CAUSES TRAJECTORY TO VIOLATE THE OFFSET LIMITS (SKIP) ON EMS SCROLL.</p> <p>D. CAUSES TRAJECTORY TO VIOLATE THE ONSET LIMITS (G) ON EMS SCROLL.</p> <p>E. IF THE G&N TRIM ATTITUDES AT CM/SM SEP DIFFER FROM THE HORIZON MONITOR ATTITUDE BY GREATER THAN <u>5</u> DEG.</p> <p>F. IF THE G&N TRIM ATTITUDES AT .05 G DIFFERS FROM THE GROUND VALUES BY GREATER THAN <u>5</u> DEG.</p> <p>G. IF THE CVC FAILS TO SEQUENCE FROM P63 TO P64 AT RET .05 G +/- <u>5</u> SEC.</p>

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6 SLV - TB1 THROUGH
TB4/TB4A (LAUNCH)

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5

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MISSION RULES

SECTION 5 - SLV - TB1 THROUGH TB4/TB4A

REV ITEM

REV	ITEM													
		<p>----- ' BSE GENERAL RULES ' -----</p>												
		<p>A. BSE GENERALIZED SWITCH SELECTOR COMMAND CAPABILITY EXISTS---</p> <ol style="list-style-type: none"> 1. WHEN CREW ENABLES IU COMMAND SYSTEM (EXCEPT AS NOTED BELOW IN ITEM D) 2. AFTER TB7 + 20 MIN. <p>B. BSE MANEUVER UPDATE AND INHIBIT CAPABILITY FOR TB7 MANEUVERS ONLY.</p> <p>C. BSE HAS NAVIGATION UPDATE CAPABILITY.</p> <p>D. BSE HAS NO COMMAND CAPABILITY DURING POWERED BURN PHASES.</p> <p>E. A SAFE DISTANCE BETWEEN THE SPACECRAFT AND S-IVB/IU IS DEFINED AS 7000 FT.</p> <p>F. BSE WILL RECOMMEND NO S-IVB RESTART FOR ANY CONFIRMED MALFUNCTION IN THE LAUNCH VEHICLE WHICH RESULTS IN---</p> <ol style="list-style-type: none"> 1. A CATASTROPHIC HAZARD 2. INSUFFICIENT CONSUMABLES TO ASSURE A 1 SIGMA PROBABILITY OF GUIDANCE CUTOFF, OR 3. ANY CONDITION/MALFUNCTION(S) FOR WHICH A NOMINAL TLI CUTOFF WILL DEFINITELY NOT BE ACHIEVED. CONDITIONS LEADING ONLY TO A FAILURE TO RESTART WILL NOT BE CONSIDERED. <p>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 LM2 AND LOA 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.</p> <p>H. ABORT DURING LAUNCH PHASE WILL BE RECOMMENDED FOR THE FOLLOWING---</p> <ol style="list-style-type: none"> 6-1 S-IC LOSS OF THRUST 6-7 S-II LOSS OF THRUST 6-8 S-II GIMBAL SYSTEM FAILURE ANY SINGLE ACTUATOR HARDOVER (INBOARD) 6-9 S-II SECOND PLANE SEPARATION FAILS TO OCCUR AT TB3 + 31 SEC 6-10 S-IVB LOSS OF ENGINE HYDRAULIC FLUID PRIOR TO FIRST S-IVB BURN 6-11 S-IVB STAGE LOSS OF THRUST <p>I. SPACECRAFT GUIDANCE TAKEOVER WILL BE RECOMMENDED FOR THE FOLLOWING---</p> <ol style="list-style-type: none"> 6-4 LAUNCH VEHICLE INERTIAL PLATFORM FAILURE-ATTITUDE REFERENCE 7-8 LOSS OF ATTITUDE CONTROL (DURING COAST PERIOD) TB5, TB7 <p>J. S-II/S-IVB EARLY STAGING WILL BE RECOMMENDED FOR THE FOLLOWING---</p> <ol style="list-style-type: none"> 6-7 S-II LOSS OF THRUST 												
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MISSION RULES

SECTION 6 - SLV - TBI THROUGH TB4/TB4A

REV. ITEM

R	ITEM						
		<p>K. TLI INHIBIT OR SPACECRAFT SEPARATION WILL BE RECOMMENDED FOR THE FOLLOWING---</p> <ul style="list-style-type: none"> 7-1 INSUFFICIENT PROPELLANTS REMAIN FOR ACHIEVEMENT OF TLI GUIDANCE CUTOFF 7-5 FAILURE OF RANGE SAFETY SYSTEM AFTER INSERTION 7-8 LOSS OF ATTITUDE CONTROL •7-11 TIME BASE 5 OR TIME BASE 7 FAILS TO INITIATE AT S-IVB CUTOFF 7-16 S-IVB ENGINE CONTROL BOTTLE PRESSURE LESS THAN <u>400</u> PSIA 7-22 S-IVB LOSS OF ENGINE HYDRAULIC FLUID 8-1 INERTIAL PLATFORM FAILURE - ACCELEROMETER 8-5 S-IVB LH2 TANK ULLAGE PRESSURE LOW PRIOR TO SECOND BURN 8-6 S-IVB ACTUATOR CONFIRMED HARDOVER PRIOR TO TB6 + 9 MIN 20 SEC 8-8 LOSS OF ATTITUDE CONTROL DURING S-IVB SECOND BURN •EMERGENCY SEPARATION REQUIRED <p>L. SPACECRAFT SEPARATION OR TLI INHIBIT WILL BE RECOMMENDED UNLESS COMMAND ACTION IS SUCCESSFUL FOR THE FOLLOWING---</p> <ul style="list-style-type: none"> 7-4 J-2 ENGINE MAIN OXIDIZER VALVE FAILS TO CLOSE AT S-IVB CUTOFF •7-6 S-IVB COLD HELIUM SHUTOFF VALVES FAIL TO CLOSE 7-9 CONTINUOUS VENT SYSTEM (CVS) REGULATOR FAILS TO OPEN IN TB5 •7-14 S-IVB STAGE COMMON BULK-HEAD DELTA PRESSURE REACHES OR EXCEEDS +36 OR -26 PSID 7-18 LOW COLD HELIUM SPHERE PRESSURE 7-19 LOW LOX TANK ULLAGE PRESSURE 7-20 J-2 ENGINE START BOTTLE PRESSURE OUTSIDE RESTART LIMITS 8-7 S-IVB CONTINUOUS VENT SYSTEM (CVS) REGULATOR FAILS TO CLOSE DURING RESTART SEQUENCE • EMERGENCY SEPARATION REQUIRED <p>M. FOR EARLY SPACECRAFT SEPARATION THE CREW SHOULD ENABLE THE IC COMMAND SYSTEM AND THE BSE SHOULD GROUND COMMAND TO LOCK OPEN THE IC COMMAND SYSTEM, PRIOR TO SPACECRAFT SEPARATION IF AT ALL POSSIBLE.</p>					
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MISSION RULES

SECTION 6 - SLV - TBI THROUGH TB4/TB4A

REV ITEM

REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS				
	6-1	S-IC STAGE LOSS OF THRUST A. ANY SINGLE ENGINE PRIOR TO TB3 B. ANY TWO OR MORE ENGINES 1. PRIOR TO DEACTIVATION OF TWO ENGINES AUTO ABORT 2. AFTER DEACTIVATION OF TWO ENGINES AUTO ABORT C. 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) 1. VOICE COMM WITH RSO 2. NO VOICE COMM WITH RSO	LAUNCH	A. CONTINUE MISSION BSE INFORM FLIGHT AND FIDO. B. CONTINUE MISSION BSE INFORM FLIGHT. 1. ABORT BSE INFORM FLIGHT AND TRANSMIT ABORT REQUEST. 2. CONTINUE MISSION BSE INFORM FLIGHT AND FIDO. CAPCOM ADVISE CREW OF POTENTIAL OVERRATE CONDITION. C. CONTINUE MISSION BSE INFORM FLIGHT AND FIDO. FLIGHT INFORM RSO. 1. (A) FLIGHT CONFIRM ENGINE 3 OR 4 OUT VIA RSO PRIVATE LINE. (B) FLIGHT CONFIRM NO OTHER KNOWN ANOMALIES BY LITE ACTIVATION AND VOICE REPORT. 2. FLIGHT CONFIRM ENGINE 3 OR 4 OUT AND NO OTHER KNOWN ANOMALIES BY LITE ACTIVATION.	A6B. CUES--- 1. THRUST OK SWITCHES - OFF (K33-115 THROUGH K47-115) 2. THRUST CHAMBER PRESSURE LESS THAN 500 PSIA (D8-101 THROUGH D8-105). 3. LONGITUDINAL ACCELERATION - ZERO (A2-603). 4. FINAL THRUST OK CUTOFF - ON (K52-115 THROUGH K56-115). A6B. NOTE--- CREW MAY DEACTIVATE AUTOMATIC ABORT AFTER TBI + 120 SEC. C. CUES--- 1. THRUST CHAMBER PRESSURE LESS THAN 500 PSIA (D8-103, D8-104). 2. ENGINE 3 OR ENGINE 4 THRUST OK SWITCHES OFF (K39-115 THROUGH K44-115). 3. ENGINE 3 OR 4 FINAL THRUST OK CUTOFF (K54-115, K55-115). C. NOTES--- 1. RSO LOOP 111 OR FD LOOP BACKUP TO PL. 2. CONFIRMATION OF NO OTHER KNOWN ANOMALIES WILL BE BASED ON ENGINE CHAMBER PRESSURE ABOVE 500 PSIA AND HOLDING				
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MISSION RULES

SECTION 6 - SLV - TB1 THROUGH TB4/TB4A

REV ITEM

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS												
	6-2	LOSS OF ATTITUDE CONTROL A. S-IC BURN	LAUNCH	A. LAUNCH VEHICLE ABORT BSE INFORM FLIGHT AND FIDO, CAPCOM INFORM CREW OF LOSS OF ATTITUDE CONTROL. CREW WILL ABORT ON LIMITS (NOTE A. 1).	A. CUES--- 1. ANGULAR RATES - PITCH (R4-602, R13-602) OR YAW (R5-602, R8-602) GREATER THAN 2 DEG/SEC AND NOT DECREASING. ROLL (R6-602, R12-602) GREATER THAN 3 DEG/SEC AND NOT DECREASING. 2. PLATFORM GIMBAL ANGLES - PITCH, YAW, OR ROLL (R60-603) CHANGING AT THE RATES GIVEN IN CUE A.1. 3. LOSS OF ATTITUDE CONTROL ALERT (SEE NOTE A.2). A. NOTES--- 1. CREW ABORT LIMITS--- (A) PITCH AND YAW RATE PLUS OR MINUS 4 DEG/SEC (B) ROLL RATE PLUS OR MINUS 20 DEG/SEC (C) PITCH, YAW, OR ROLL ERROR PLUS OR MINUS 5 DEG AND GIMBAL DELTA P PLUS OR MINUS 3.2 PSID 2. LOSS OF ATTITUDE CONTROL ALERT WILL BE GIVEN FOR THE FOLLOWING CONDITIONS--- (A) LVDC/LVDA COMPUTATIONAL FAILURE (B) ATTITUDE ERROR SIGNALS GREATER THAN PLUS OR MINUS 5 DEG. (C) FAILURE TO INITIATE PROPER GUIDANCE SEQUENCE (D) S-IC ENGINE ACTUATOR HARD-OVER GREATER THAN PLUS OR MINUS 5 DEG.												
<table border="1"> <tr> <td>MISSION</td> <td>REV</td> <td>DATE</td> <td>SECTION</td> <td>GROUP</td> <td>PAGE</td> </tr> <tr> <td>APOLLO 11</td> <td></td> <td>4/16/69</td> <td>SLV - TB1 THROUGH TB4/TB4A</td> <td></td> <td>6-5</td> </tr> </table>						MISSION	REV	DATE	SECTION	GROUP	PAGE	APOLLO 11		4/16/69	SLV - TB1 THROUGH TB4/TB4A		6-5
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MISSION RULES

SECTION 6 - SLV - T81 THROUGH T84/T84A

REV ITEM

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS		
6-2	(CONT)	B. S-II BURN	LAUNCH	B. LAUNCH VEHICLE ABORT BSE INFORM FLIGHT AND FIDO. CAPCOM INFORM CREW OF LOSS OF ATTITUDE CONTROL. CREW WILL ABORT ON LIMITS (NOTE B.1).	B. CUES--- 1. ANGULAR RATES - PITCH (R4-602, R13-602), YAW (R5-602, R8-602), OR ROLL (R6-602, R12-602) GREATER THAN 5 DEG/SEC AND NOT DECREASING. 2. PLATFORM GIMBAL ANGLES - PITCH, YAW OR ROLL (R9-603) CHANGING AT THE RATES GIVEN IN NOTE B.1. 3. LOSS OF ATTITUDE CONTROL ALERT (SEE NOTE B.2). B. NOTES--- 1. CREW ABORT LIMITS--- (A) PITCH AND YAW RATE PLUS OR MINUS 10 DEG/SEC (B) ROLL RATE PLUS OR MINUS 20 DEG/SEC 2. LOSS OF ATTITUDE CONTROL ALERT WILL BE GIVEN FOR THE FOLLOWING CONDITIONS--- (A) LVDC/LVDA COMPUTATIONAL FAILURE (B) ATTITUDE ERROR SIGNALS GREATER THAN PLUS OR MINUS 5 DEG (C) FAILURE TO INITIATE PROPER GUIDANCE SEQUENCE (D) S-IVB ENGINE ACTUATOR HARDOVER GREATER THAN PLUS OR MINUS 5 DEG		
		C. S-IVB BURN	LAUNCH	C. LAUNCH VEHICLE ABORT BSE INFORM FLIGHT AND FIDO. CAPCOM INFORM CREW OF LOSS OF ATTITUDE CONTROL. CREW WILL ABORT ON LIMITS (NOTE C.1).	C. CUES--- 1. ANGULAR RATES - PITCH (R4-602, R13-602), YAW (R5-602, R8-602), OR ROLL (R6-602, R12-602) GREATER THAN 5 DEG/SEC AND NOT DECREASING. 2. PLATFORM GIMBAL ANGLES - PITCH, YAW OR ROLL (R9-603) CHANGING AT THE RATES GIVEN IN NOTE C.1. 3. LOSS OF ATTITUDE CONTROL ALERT (SEE NOTE C.2). C. NOTES--- 1. CREW ABORT LIMITS--- A PITCH AND YAW RATE PLUS OR MINUS 10 DEG/SEC (B) ROLL RATE PLUS OR MINUS 20 DEG/SEC 2. LOSS OF ATTITUDE CONTROL ALERT WILL BE GIVEN FOR THE FOLLOWING CONDITIONS---		
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MISSION RULES

SECTION 6 - SLV - TBI THROUGH TB4/TB4A

REV ITEM

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS			
					<p>(A) LVDC/LVDA COMPUTATIONAL FAILURE</p> <p>(B) ATTITUDE ERROR SIGNALS ROLL GREATER THAN PLUS OR MINUS 3.5 DEG, PITCH AND YAW GREATER THAN PLUS OR MINUS 5 DEG.</p> <p>(C) FAILURE TO INITIATE PROPER GUIDANCE SEQUENCE</p>			
6-3		INERTIAL PLATFORM FAILURE - ACCELEROMETER	LAUNCH	CONTINUE MISSION BSE INFORM FLIGHT AND FIDO. CAPCOM ADVISE CREW OF PROBABLE DEGRADED ORBIT.	<p>CUES---</p> <p>1. GUIDANCE STATUS WORD MODE CODE 24) (H60-503)</p> <p>BITS D26 AND D25 FOR Z ACCEL SET TO 'ONE'</p> <p>BITS D24 AND D23 FOR X ACCEL SET TO 'ONE'</p> <p>BITS D22 AND D21 FOR Y ACCEL SET TO 'ONE'</p> <p>2. ACCELEROMETER PICKOFFS (X, Y, OR Z) INDICATE IN EXCESS OF 3 DEG AND NOT DECREASING. (H10-603, H11-603, H12-603)</p> <p>NOTES---</p> <p>1. NO EFFECT ON VEHICLE TRAJECTORY DURING S-IC STAGE BURN.</p> <p>2. LVDC SWITCHED TO A BACKUP MODE AND UTILIZES A PRECOMPUTED PFM PROFILE FOR FAILED AXES DURING THE S-IC, S-II, AND S-IVB BURNS.</p>			
6-4		LAUNCH VEHICLE INERTIAL PLATFORM FAILURE - ATTITUDE REFERENCE	LAUNCH	CONTINUE MISSION BSE INFORM FLIGHT AND RECOMMEND SPACECRAFT GUIDANCE TAKEOVER.	<p>CUES---</p> <p>1. GUIDANCE REFERENCE FAILURE (U OR D 6) MODE CODE 26 BIT D8 SET TO 'ONE' (H60-603)</p> <p>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'</p> <p>3. LADDER OUTPUTS CONSTANT FOR FAILED AXES (H54-603, H55-603, H56-603)</p> <p>4. ATTITUDE ERROR CONSTANT FOR FAILED AXES (H69-602, H70-602, H71-602)</p> <p>NOTES---</p> <p>1. CUE 1 AND ANY OTHER CUE ARE NECESSARY TO CALL PLATFORM FAILURE.</p>			
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MISSION RULES

SECTION 6 - SLV - T81 THROUGH T84/T84A

REV ITEM

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS			
		RULE NUMBERS 6-5 THROUGH 6-6 ARE RESERVED.						
6-7	S-II LOSS OF THRUST	LAUNCH						
	A. ANY SINGLE ENGINE FAILURE TO ATTAIN THRUST OR LOSS OF THRUST PRIOR TO NOMINAL S-II CUTOFF			A. CONTINUE MISSION BSE INFORM FLIGHT AND FIDO.	A. CUES--- 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/ABORT	B. CUES---			
	1. VEHICLE CONTROLLING			1. CONTINUE MISSION BSE INFORM FLIGHT AND FIDO.	1. TWO ENGINES OUT (CUES A.1, A.2, A.3)			
	2. IF THE DIFFERENCE IN COMMANDED ANGLES AND GIMBAL ANGLES EXCEEDS 40 DEG IN PITCH OR YAW			2. ABORT BSE INFORM FLIGHT AND FIDO AND TRANSMIT ABORT REQUEST	2. COMMANDED ANGLES AND GIMBAL ANGLES (H60-603)			
	C. THREE OR MORE ENGINES OUT			C. ABORT/EARLY STAGE/ CONTINUE MISSION	C. CUES---			
	1. PRIOR TO S-IVB TO ORBIT CAPABILITY			1. ABORT BSE INFORM FLIGHT AND TRANSMIT ABORT REQUEST.	1. THREE OR MORE ENGINES OUT (CUES A.1, A.2, A.3)			
	2. AFTER S-IVB TO ORBIT 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. CONTINUE MISSION. BSE INFORM FLIGHT AND FIDO				
	(A) 3 OR 4 ENGINES OUT			(A) EARLY STAGE BSE INFORM FLIGHT AND RECOMMEND EARLY STAGE.				
	(B) ALL ENGINES OUT			(B) CONTINUE MISSION BSE INFORM FLIGHT				
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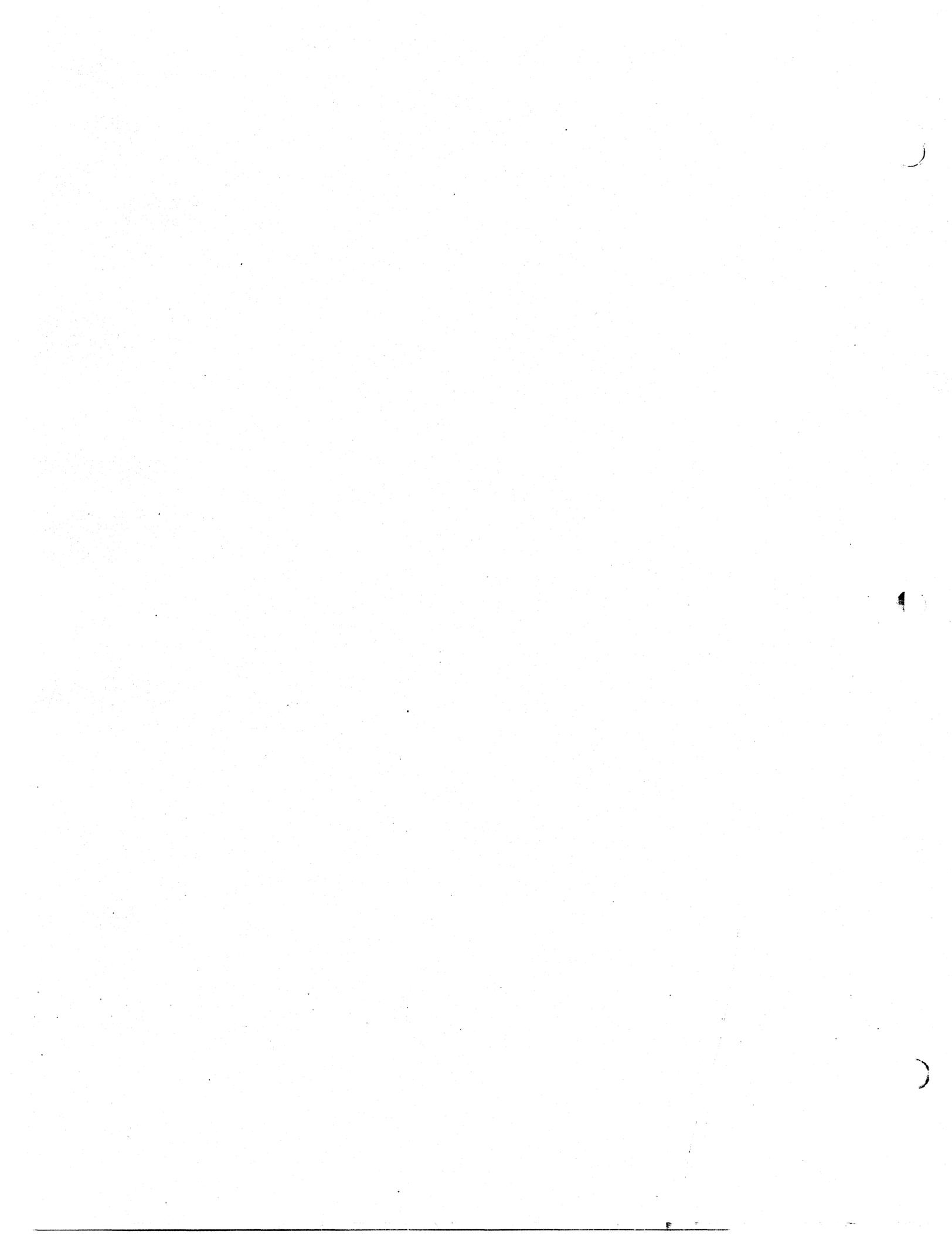
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MISSION RULES

SECTION 6 - SLV - T81 THROUGH T84/T84A

REV	ITEM	R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS	
			6-8	S-II STAGE GIMBAL SYSTEM FAILURE ANY SINGLE ACTUATOR HARDOVER (INBOARD)	LAUNCH	ABORT BSE INFORM FLIGHT AND TRANSMIT ABORT REQUEST.	<p>CUES---</p> <ol style="list-style-type: none"> 1. YAW ACTUATOR POSITION EXCEEDS + 6 DEG (G8-201 THROUGH 204). 2. PITCH ACTUATOR POSITION EXCEEDS + 6 DEG (G9-201 THROUGH 204). 3. ADJACENT CONTROL ENGINE ACTUATOR IN SAME PLANE MOVES +4-172 DEG INBOARD (SAME MEASUREMENTS AS CUES 1 AND 2) <p>NOTE---</p> <p>CREW SHOULD ABORT AS SOON AS POSSIBLE AFTER MALFUNCTION OCCURS TO PRECLUDE EXCESSIVE THERMAL PROBLEMS IN THE AFT INTERSTAGE.</p>	
			6-9	S-II SECOND PLANE SEPARATION FAILS TO OCCUR AT T83 + 31 SEC	LAUNCH	ABORT BSE INFORM FLIGHT AND TRANSMIT ABORT REQUEST. CREW ABORT PRIOR TO T83 + 52 SEC.	<p>CUES---</p> <ol style="list-style-type: none"> 1. SECOND PLANE SEPARATION INDICATION SHOWS NO SEPARATION (M86-206, M87-206) 2. GUIDANCE MODE WORD 2 MODE CODE 25 BIT 015 REMAINS <u>ZERO</u> (M60-603). 3. IGNITION BUS VOLTAGE REMAINS AT APPROXIMATELY <u>25</u> VOLTS (M125-207). <p>NOTES--- THE CREW SHOULD ABORT AS SOON AS POSSIBLE AFTER MALFUNCTION OCCURS TO PRECLUDE EXCESSIVE THERMAL PROBLEMS IN AFT INTERSTAGE.</p>	
			6-10	S-IVB LOSS OF ENGINE HYDRAULIC FLUID PRIOR TO S-IVB BURN	LAUNCH	SPACECRAFT SEPARATION BSE INFORM FLIGHT AND FIDO AND RECOMMEND NO S-IVB START. FIDO WILL ADVISE CREW OF COI CAPABILITY	<p>CUES---</p> <ol style="list-style-type: none"> 1. HYDRAULIC RESERVOIR OIL LEVEL APPROX <u>ZERO</u> PERCENT (L7-403). 2. HYDRAULIC SYSTEM PRESSURE LESS THAN <u>1700</u> PSIA (D41-403). 3. HYDRAULIC RESERVOIR PRESSURE APPROX <u>ZERO</u> PSIA (D42-403). <p>NOTE---</p> <p>1. L7-403 PLUS ONE OF THE OTHER CUES ARE REQUIRED FOR IMPLEMENTATION OF THIS RULE.</p>	
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7 BLV - TB5 AND
TB7 (COAST)



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MISSION RULES

SECTION 7 - SLV - TBS AND TBT

REV ITEM

REV	ITEM	SUMMARY OF COAST PHASE RULES					
		7-1	INSUFFICIENT PROPELLANT				
		7-2	RESERVED				
		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	TBS OR TBT FAILS TO INITIATE				
		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	LOSS OF ENGINE CONTROL BOTTLE PRESSURE				
		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-- NONE					
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MISSION RULES

SECTION 7 - SLV - TBS AND TB7

REV ITEM

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS		
7-1		PRIOR TO RESTART, INSUFFICIENT PROPELLANT REMAINS FOR ACHIEVEMENT OF TLI GUIDANCE CUTOFF	EARTH ORBIT	NO S-IVB RESTART BSE INFORM FLIGHT AND RECOMMEND NO S-IVB RESTART.	CUE--- PROPELLANT REMAINING AS ASCERTAINED DURING REAL-TIME MONITORING EVALUATIONS.		
		RULE NUMBER 7-2 IS RESERVED.					
7-3		J-2 ENGINE MAIN FUEL VALVE (MFV) FAILS TO CLOSE AT---			CUES---		
	A.	FIRST S-IVB CUTOFF	EARTH ORBIT	A. CONTINUE MISSION BSE INFORM FLIGHT AND COMMAND (ASAP)--- 1. PREVALVES AND RECIRC SHUTOFF VALVES CLOSED (SEE NOTE1) 2. ATTEMPT TO CLOSE MFV IF SUCCESSFUL, BSE COMMAND--- 3. PREVALVE AND RECIRC SHUTOFF VALVES OPEN	1. MAIN FUEL VALVE POSITION (G4-401). 2. MAIN FUEL VALVE OPEN (K118-401). 3. FUEL FLOWMETER FLOWRATE (F2-401). 4. FUEL RECIRC FLOWRATE (F5-401). NOTES--- 1. IF THE MFV IS OPEN, THE LH2 PUMP INLET PRESSURE WILL GO TO ZERO PSIA 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).		
	B.	SECOND S-IVB CUTOFF	TLC	B. CONTINUE MISSION BSE INFORM FLIGHT AND COMMAND--- 1. PREVALVES AND RECIRC SHUTOFF VALVES CLOSE 2. ATTEMPT TO CLOSE MFV WHEN S-IVB IS AT PROPER DUMP ATTITUDE, BSE COMMAND--- 3. PREVALVES AND RECIRC SHUTOFF VALVES OPEN			
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SECTION 7 - SLV - T85 AND T87

REV ITEM

REV	ITEM	R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	7-7		S-IVB AUXILIARY HYDRAULIC PUMP FAILS				
		A.	TO TURN OFF AS SEQUENCED		EARTH ORBIT	<p>A. CONTINUE MISSION</p> <p>BSE INFORM FLIGHT AND</p> <p>1. ATTEMPT TO TURN OFF AUXILIARY HYDRAULIC PUMP AS SOON AS POSSIBLE</p>	<p>CUES---</p> <p>A.1. SYSTEM PRESSURE ABOVE <u>1720</u> PSIA (D41-403).</p> <p>2. RESERVOIR LEVEL BELOW <u>50</u> PERCENT (L7-403).</p> <p>3. AFT BUS NO. 2 CURRENT ABOVE <u>20</u> AMPS (M22-404).</p> <p>4. HYDRAULIC RESERVOIR OIL PRESSURE GREATER THAN <u>137</u> PSIA (D42-403).</p> <p>NOTES---</p> <p>FAILURE TO TURN OFF HYDRAULIC PUMP DEPLETES AFT NO. 2 BATTERY IN APPROXIMATELY <u>90</u> MIN AND OVERHEATS HYDRAULIC SYSTEM IN APPROXIMATELY <u>70</u> MIN</p>
		B.	TO TURN ON			<p>B. CONTINUE MISSION</p> <p>1. BSE INFORM FLIGHT AND ATTEMPT TO TURN ON AUXILIARY HYDRAULIC PUMP</p> <p>2. BSE INFORM FLIGHT AND ATTEMPT TO TURN OFF AUXILIARY HYDRAULIC PUMP</p>	<p>CUES---</p> <p>B.1. SYSTEM PRESSURE BELOW <u>1700</u> PSIA (D41-403).</p> <p>2. RESERVOIR OIL LEVEL ABOVE <u>50</u> PERCENT (L7-403).</p> <p>3. AFTER BUS NO. 2 CURRENT AT ZERO AMPS (M22-404).</p> <p>4. RESERVOIR PRESSURE LESS THAN <u>89</u> PSI (D42-403).</p> <p>5. HYDRAULIC PUMP INLET OIL TEMP (C50-401).</p> <p>6. RESERVOIR OIL TEMP (C51-403).</p>
			1. AS SEQUENCED AND THE HYDRAULIC FLUID TEMP IS BELOW OR PREDICTED TO DROP BELOW 10 DEG F BEFORE NEXT STATION AOS				
		2.	AT T86 + 3 MIN 39 SEC		TLC		

MISSION

REV

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REV ITEM:

SECTION 7 - SLV - TB5 AND TB7

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	7-6	LOSS OF ATTITUDE CONTROL DURING			
	A.	TB5 AND TB7 TO TB7 + 15 MIN	EARTH ORBIT/ TLC	A. SPACECRAFT GUIDANCE TAKEOVER BSE INFORM FLIGHT AND RECOMMEND SPACECRAFT GUIDANCE TAKEOVER IF UNSUCCESSFUL, BSE RECOMMEND SPACECRAFT SEPARATION	CUES--- A. 1. ANGULAR RATES - PITCH (R4-602, R13-602) OR YAW (R5- 602, R8-602); GREATER THAN 0.3 DEG/SEC AND NOT DECREASING, AND ROLL (R6-602, R12-602); GREATER THAN 0.5 DEG/SEC AND NOT DECREASING 2. PLATFORM GIMBAL ANGLES - PITCH, YAW, OR ROLL (H60-603) CHANGING AT RATES CORRESPONDING TO THOSE IN CUE 1 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. ANGULAR RATES - PITCH (R4-602, R13-602) OR YAW (R5- 602, R8-602) GREATER THAN 0.5 DEG/SEC AND NOT DECREASING, AND ROLL (R6-602, R12-602) GREATER THAN 0.3 DEG/SEC AND NOT DECREASING 2. SAME AS CUE A.2 3. SAME AS CUE A.3
	C.	AFTER TB7 + 15	TLC	C. CREW DISCRETION BSE INFORM FLIGHT AND FIDO	C. 1. ANGULAR RATES PITCH (R4-602, R13-602); YAW (R5-602, R8-602); AND ROLL (R6-602, R12-602) GREATER THAN 1.0 DEG/SEC AND NOT DECREASING 2. SAME AS CUE A.2 3. SAME AS CUE A.1
	D.	AFTER TB8 INITIATE	TLC	D. CONTINUE MISSION BSE INFORM FLIGHT AND FIDO AND TERMINATE--- 1. PROPELLANT DUMP 2. ULLAGE ENGINE BURNS	D. SAME AS CUES C.1, C.2, AND C.3
NOTES---					
1. AFTER S-IVB CUTOFF AND 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					
(D) ATTITUDE REFERENCE FAILURE					
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MISSION RULES

SECTION 7 - SLV - T85 AND T87

REV ITEM

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS				
	7-9	CONTINUOUS VENT SYSTEM (CVS) REGULATOR FAILS TO OPEN IN T85 (T85 + 59 SEC)	EARTH ORBIT	CONTINUE MISSION/NO S-IVB RESTART BSE INFORM FLIGHT AND 1. ATTEMPT TO OPEN CVS RELIEF OVERRIDE SHUTOFF VALVE IF UNSUCCESSFUL, BSE--- 2. VENT THE LM2 TANK PRIOR TO T86 TO A VALUE BELOW THE PRESSURE REQUIRED FOR T86 INITIATE IF THE LM2 BLOWDOWN IS COMPLETED WITHIN 30 MINUTES PRIOR TO T86 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. EARTH ORBIT IF NEITHER COMMAND ACTION(S) 1 NOR 2 IS SUCCESSFUL, BSE RECOMMEND NO S-IVB RESTART.	CUES--- 1. CVS NOZZLE PRESSURE (D181-409, D182-409). 2. CVS REGULATOR CLOSED (K154-411). 3. LM2 ULLAGE PRESSURE (D177-408, D178-408). NOTES--- 1. IF THE CVS REGULATOR FAILS TO OPEN, THE LM2 SATURATION TEMPERATURE WILL INCREASE ABOVE RESTART LIMITS. 2. COMMAND ACTION WILL REQUIRE EVALUATION OF LM2 RESIDUALS TO DETERMINE ADEQUACY FOR TLI VELOCITY CUTOFF. APPROXIMATELY 150 POUNDS OF LM2 WILL BE LOST FOR EACH PSI THE LM2 TANK IS VENTED BELOW 19.5 PSIA.				
	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.	CUES--- 1. ULLAGE ENGINE THRUST CHAMBER PRESSURE GREATER THAN 90 PSIA (D220-414, D221-415). 2. APS HELIUM SPHERE PRESSURE DECREASING (D35-414, D36-415, D25-414, D251-415).				
	7-11	TIME BASE 5 OR TIME BASE 7 FAILS TO INITIATE AT S-IVB CUTOFF	EARTH ORBIT/ TLC	SPACECRAFT SEPARATION BSE INFORM FLIGHT AND RECOMMEND IMMEDIATE SEPARATION TO A SAFE DISTANCE	CUES--- LVDC FAILURE NOTE--- THIS CONDITION WILL RESULT IN LOSS OF SEQUENCING AND PITCH AND YAW ATTITUDE CONTROL.				
		RULE NUMBER 7-12 IS RESERVED.							
			MISSION	REV	DATE	SECTION	GROUP	PAGE	
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MISSION RULES

REV ITEM

SECTION 7 - SLV - TBS AND TB7

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS												
	7-13	<p>IU ECS WATER VALVE FAILS TO CYCLE OPEN AND CLOSED</p> <p>A. WATER VALVE CLOSED AND COOLANT INLET CONTROL TEMPERATURE IS 64 DEG. F OR HIGHER, AND THE INERTIAL GIMBAL TEMPERATURE IS PREDICTED TO BE EQUAL TO OR GREATER THAN 115 DEG.F BEFORE THE NEXT SITE AOS OR, THE LVDC MEMORY TEMPERATURE IS PREDICTED TO BE EQUAL TO OR GREATER THAN 124 DEG.F BEFORE THE NEXT SITE AOS</p> <p>B. WATER VALVE OPEN AND COOLANT INLET CONTROL TEMP IS 55 DEG.F OR LESS, AND THE INERTIAL GIMBAL TEMPERATURE IS PREDICTED TO BE 104 DEG.F OR LESS BEFORE THE NEXT SITE AOS OR, THE LVDC MEMORY TEMPERATURE IS PREDICTED TO BE 32 DEG.F OR LESS BEFORE THE NEXT SITE AOS.</p>	ALL	<p>A. CONTINUE MISSION</p> <p>BSE INFORM FLIGHT AND SEND---</p> <p>1. ECS LOGIC INHIBIT COMMAND</p> <p>2. WATER VALVE OPEN</p> <p>B. CONTINUE MISSION</p> <p>BSE INFORM FLIGHT AND SEND---</p> <p>1. ECS LOGIC INHIBIT COMMAND</p> <p>2. WATER VALVE CLOSED</p>	<p>CUES---</p> <p>1. WATER VALVE CLOSED/OPEN (G9-601, G6-601).</p> <p>2. ME/H2O TEMP (C15-601).</p> <p>3. GMW MODE CODE 27 BIT D8 SET TO ZERO (H60-603).</p> <p>4. ST-124 INERTIAL GIMBAL TEMP (C34-603).</p> <p>5. SUBLIMATOR INLET TEMP (C11-601).</p> <p>6. LVDC MEMORY TEMP (C54-603).</p> <p>7. LVDA TEMP NO. 1 (C35-603).</p> <p>8. LVDA TEMP NO. 2 (C36-603).</p>												
<table border="1"> <thead> <tr> <th>MISSION</th> <th>REV</th> <th>DATE</th> <th>SECTION</th> <th>GROUP</th> <th>PAGE</th> </tr> </thead> <tbody> <tr> <td>APOLLO 11</td> <td></td> <td>4/16/69</td> <td>SLV - TBS AND TB7</td> <td></td> <td>7-8</td> </tr> </tbody> </table>						MISSION	REV	DATE	SECTION	GROUP	PAGE	APOLLO 11		4/16/69	SLV - TBS AND TB7		7-8
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REV ITEM

SECTION 7 - SLV - T85 AND T87

REV	ITEM	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). 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.			
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SECTION 7 - SLV - T85 AND T87

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS			
	7-15	LOSS OR IMPENDING LOSS OF S-IVB STAGE PNEUMATICS PRESSURE A. ENGINE PUMP PURGE FAILS ON (T85 + 1 MIN 3 SEC) B. STAGE PNEUMATIC PRESSURE LEAKING AT GREATER THAN 6 PSI/MIN IN T85 OR EXCESSIVE LEAKAGE DURING T87	EARTH ORBIT	A. CONTINUE MISSION B5E INFORM FLIGHT AND 1. ATTEMPT TO TERMINATE PURGE IF UNSUCCESSFUL, COMMAND--- 2. AMBIENT HELIUM SUPPLY SHUTOFF VALVE CLOSED 3. REOPEN AMBIENT HELIUM SUPPLY SHUTOFF VALVE AS REQUIRED B. CONTINUE MISSION B5E INFORM FLIGHT AND COMMAND--- 1. AMBIENT HELIUM SHUTOFF VALVE CLOSED 2. REOPEN AMBIENT HELIUM SHUTOFF VALVE AS REQUIRED	CUES--- A.1. ENGINE PUMP PURGE REGULATOR PRESSURE (D50-403) FAILS TO DECREASE FROM ABOUT 100 PSIA TO ABOUT 10 PSIA. 2. AMBIENT HELIUM PNEUMATIC SPHERE PRESSURE (D235-403, D255-403) DECREASING AT 8 PSI/MIN. 3. LOX REPRESS SUPPLY PRESSURE (D88-403, D254-403) B.1. STAGE PNEUMATIC SUPPLY PRESSURE (D236-403, D256-403) 2. LOX REPRESS SUPPLY PRESSURE (D88-403, D254-403)			
			MISSION	REV	DATE	SECTION	GROUP	PAGE
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MISSION RULES

SECTION 7 - SLV - TB5 AND TB7

ITEM		SECTION 7 - SLV - TB5 AND TB7					
R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS		
	7-16	S-IVB ENGINE CONTROL BOTTLE PRESSURE LESS THAN 400 PSIA	EARTH ORBIT/ TLI	NO S-IVB RESTART (TB5)/TLI INHIBIT (TB6) BSE INFORM FLIGHT AND RECOMMEND NO S-IVB RESTART	CUES--- 1. ENGINE CONTROL BOTTLE PRESSURE (D19-401, D242-401). 2. REPRESSURIZATION BOTTLE PRESSURE (D20-403, D88-403, D249-403, D254-403).		
	7-17	LH2 TANK VENT FAILURE OR LEAK DURING ORBITAL COAST	EARTH ORBIT	CONTINUE MISSION IF LH2 ULLAGE PRESSURE DROPS BELOW 17 PSIA, BSE COMMAND--- 1. BOOST LH2 VENT VALVES CLOSED AND CVS REGULATOR CLOSED (ORIFICE OPEN) IF THE SITUATION CANNOT BE CORRECTED, AFTER INITIATION OF BURNER REPRESS, BSE COMMAND--- 2. SECOND BURN RELAY OFF	CUES--- 1. LH2 ULLAGE PRESSURE (D177-408, D178-408). 2. LH2 PUMP INLET PRESSURE (D2-403). 3. LH2VENT CLOSED DISCRETES (K1-410, D210-410). 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. EXISTENCE OF A SERIOUS LEAK WILL BE VERIFIED BY LITTLE OR NO PRESSURE RISE DURING BURNER REPRESS. 3. REPRESS REQUIREMENTS ARE BASED ON LH2 TANK ULLAGE PRESSURE OF 21 PSIA AT INITIATION OF RESTART SEQUENCE. 4. 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 TLI GUIDANCE CUTOFF PER FMR 7-1.		
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SECTION 7 - SLV - TB5 AND TB7

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS		
7-18	LOW COLD HELIUM SUPPLY PRESSURE	A. LESS THAN 1000 PSIA DURING TB5	EARTH ORBIT	A. CONTINUE MISSION BSE INFORM FLIGHT AND COMMAND FROM LAST STATION PRIOR TO TB6-- BURNER LOX SHUTDOWN VALVE CLOSE ON	CUE--- COLD HELIUM SPHERE PRESSURE (D261-403, D263-403).		
		B. LESS THAN 450 PSIA DURING BURNER REPRESSURIZATION	TLI	B. CONTINUE MISSION BSE INFORM FLIGHT AND COMMAND--- 1. BURNER LOX SHUTDOWN VALVE CLOSE ON 2. BURNER LOX SHUTDOWN VALVE CLOSE OFF			
		C. LESS THAN 350 PSIA PRIOR TO RESTART	EARTH ORBIT/ TLI	C. NO S-IVB RESTART (TB5)/TLI INHIBIT (TB6) BSE INFORM FLIGHT AND RECOMMEND NO S-IVB RESTART.			
7-19	LOW LOX TANK ULLAGE PRESSURE	A. LOX ULLAGE PRESSURE LESS THAN 31 PSIA IN TB5	EARTH ORBIT	A. CONTINUE MISSION BSE INFORM FLIGHT AND COMMAND--- 1. BURNER LOX SHUTDOWN VALVE CLOSE 2. LOX VENT VALVES BOOST CLOSE AS CLOSE AS POSSIBLE TO TB6 + 7 MIN 30 SEC, BSE COMMAND--- 3. LOX REPRESS ON	CUES--- 1. LOX ULLAGE PRESSURES (D179-406, D180-406). 2. LOX PUMP INLET PRESSURE (D3-403).		
		B. THE AMBIENT REPRESS SYSTEM DOES NOT INCREASE THE ULLAGE PRESSURE TO AT LEAST 20 PSIA FOR FIRST OPPORTUNITY RESTART OR 23 PSIA FOR SECOND OPPORTUNITY RESTART BY TB6 + 9 MIN 10 SEC		B. TLI INHIBIT BSE INFORM FLIGHT AND RECOMMEND TLI INHIBIT			
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SECTION 7 - SLV - TB5 AND TB7

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS		
7-20	J-2 ENGINE START BOTTLE PRESSURE OUTSIDE RESTART LIMITS A. ABOVE 1400 PSIA DURING ORBITAL COAST FOR FIRST OPPORTUNITY RESTART OR ABOVE 1500 PSIA FOR SECOND OPPORTUNITY RESTART B. ABOVE 1800 PSIA PRIOR TO RESTART	EARTH ORBIT		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. SPACECRAFT SEPARATION BSE INFORM FLIGHT AND FIDO AND RECOMMEND SPACECRAFT SEPARATION	CUES--- 1. START BOTTLE PRESSURE (D17-401, D241-401)		
7-21	PU VALVE FAILS TO A MIXTURE RATIO GREATER THAN 5.0 TO 1 ANY TIME PRIOR TO RESTART	EARTH ORBIT/ TLI		CONTINUE MISSION BSE INFORM FLIGHT AND COMMAND--- 1. PU VALVE HARDOVER POSITION ON (LOW EMR 4.5 TO 1) (SEE NOTE 1) IF 1 IS UNSUCCESSFUL, BSE INFORM FLIGHT AND--- 2. VENT START BOTTLE TO ACCEPTABLE LIMITS	CUES--- 1. PU VALVE POSITION (G10-401). 2. PU FEEDBACK VOLTAGE (M61-411) NOTES--- 1. THIS FAILURE WILL REQUIRE EVALUATION OF RESIDUALS TO DETERMINE ADEQUACY FOR TLI VELOCITY CUTOFF (REF FMR 7-1). 2. PU FEEDBACK VOLTAGE M61. IS ONLY VALID WHEN PU SYSTEM POWER IS ON		
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SECTION 7 - SLV - TB5 AND TB7

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS		
	7-22	S-IVB LOSS OF ENGINE HYDRAULIC FLUID	EARTH ORBIT/ TLI	NO S-IVB RESTART (TB5)/TLI INHIBIT (TB6) BSE INFORM FLIGHT AND RECOMMEND NO S-IVB RESTART	<p>CUES---</p> <ol style="list-style-type: none"> 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). <p>NOTES---</p> <p>L7-403 PLUS ONE OF THE OTHER CUES ARE REQUIRED FOR IMPLEMENTATION OF THIS RULE.</p>		
		RULE NUMBERS 7-23 AND 7-24 ARE RESERVED.					
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REV ITEM

SECTION 7 - SLV - TB5 AND TB7

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS			
7-25	S-IVB STAGE LOX NONPROPULSIVE VENT (NPV) FAILS TO OPEN AT---				CUES--- 1. LOX NPV NOZZLE PRESSURES (D243-404, D244-404). 2. LOX TANK ULLAGE PRESSURE (D179-406, D180-406). 3. LOX NPV OPEN DISCRETE (K198-424, K199-424).			
	A. TB7 + 0.7 SEC	TLC	A. CONTINUE MISSION BSE INFORM FLIGHT AND 1. ATTEMPT TO OPEN THE LOX NPV VALVE IF SUCCESSFUL 2. VENT THE LOX TANK FOR <u>2 MIN 30 SEC</u> THROUGH THE NPV IF UNSUCCESSFUL, BSE COMMAND---					
	B. TO LATCH OPEN AT TB8 + <u>17 MIN 3</u> SEC	TLC	B. CONTINUE MISSION BSE INFORM FLIGHT AND 1. ATTEMPT TO LATCH OPEN THE LOX LATCHING VENT VALVE IF UNSUCCESSFUL, BSE COMMAND---					
				2. LOX NPV VALVE CLOSE 4. LOX VENT VALVE OPEN FOR <u>40 SEC</u> 2. LOX NPV OPEN IF B2 UNSUCCESSFUL, BSE COMMAND---				
7-26	LH2 LATCHING VENT VALVE FAILS TO LATCH OPEN AS PROGRAMMED	TLC	CONTINUE MISSION BSE INFORM FLIGHT AND 1. ATTEMPT TO LATCH OPEN THE LH2 VENT IF UNSUCCESSFUL, BSE COMMAND---		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).			
			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					
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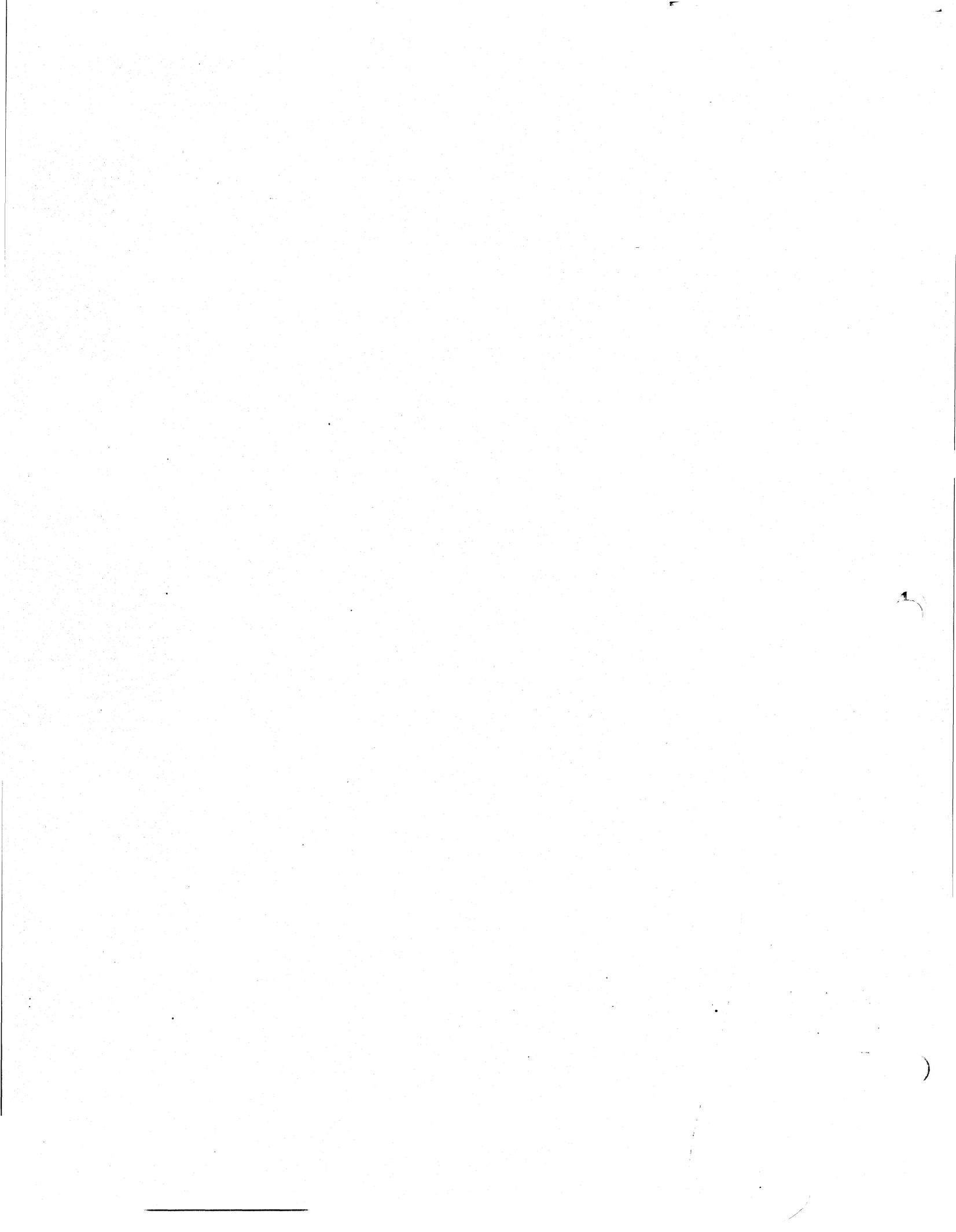
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SECTION 7 - SLV - T85 AND T87

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 (017-401, 0241-401).
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 THE BURNER. IF UNSUCCESSFUL, BSE INFORM FLIGHT AND AT T85 + 17 MIN 30 SEC SEND--- 2. LOX PRESSURIZATION SHUTOFF VALVES OPEN	CUES--- 1. COLD HELIUM BOTTLE PRESSURE (0261-403, 0263-403).

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MISSION RULES

SECTION 8 - SLV - T86

SLV ITEM

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS			
9-1		INERTIAL PLATFORM FAILURE-ACCELEROMETER A. AFTER T86 INITIATED BUT PRIOR TO T86 + 9 MIN 10 SEC B. AFTER T86 + 9 MIN 10 SEC	TLI	A. TLI INHIBIT BSE INFORM FLIGHT AND FIDO AND RECOMMEND TLI INHIBIT PRIOR TO T86 + 9 MIN 10 SEC. B. CONTINUE MISSION BSE INFORM FLIGHT AND FIDO.	CUES--- 1. GUIDANCE STATUS WORD (MODE CODE 24) (M60-603) 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 0.5 DEG AND NOT DECREASING (M10-603, M11-603, M12-603). NOTES--- 1. LVDC SWITCHES TO A BACKUP MODE AND UTILIZES A PRECOMPUTED F/Y PROFILE FOR FAILED AXIS DURING S-IVB BURN. 2. ACCELEROMETER FAILURE OCCURRING DURING T85 MAY NOT BE RECOGNIZED UNTIL SECOND BURST IGNITION.			
9-2		S-IVB STAGE O2/H2 BURNER FUEL PROPELLANT VALVE FAILS CLOSED	TLI	CONTINUE MISSION BSE INFORM FLIGHT AND COMMAND--- 1. BURNER SHUTDOWN 2. CONTINUOUS VENT SYSTEM ORIFICE OPEN 3. REPRESSURIZATION OFF	CUES--- 1. BURNER CHAMBER GUME TEMPERATURE INDICATES 450 DEG. + LESS (C2034-403). 2. BURNER PROPELLANT VALVE POSITIONS (K180-404, K192-403). 3. AMBIENT REPRESSURIZATION MODE SELECT (K175-404). NOTE--- THE O2/H2 BURNER VOTING CIRCUIT WILL NOT DETECT FAILURE OF THE BURNER TO IGNITE OR BURNER FLAME-OUT IN THE EVENT THE FUEL PROPELLANT VALVE FAILS CLOSED.			
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MISSION RULES
SECTION 8 - SLV - TB6

REV ITEM

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS				
	8-3	LH2 CHILDDOWN SYSTEM FAILS DURING RESTART PREPARATIONS	TLI	CONTINUE MISSION A. BSE INFORM FLIGHT AND--- 1. ATTEMPT TO CORRECT SITUATION SPECIFIED IN NOTE 1.A, 1.B, 1.D IF UNSUCCESSFUL, BSE INFORM FLIGHT AND AT TB 6 + 8 MIN 45 SEC COMMAND--- 2. FUEL LEAD	CUES--- 1. LH2 PUMP INLET TEMP (C3-403) 2. LH2 RECIRC FLOW (F5-404) 3. LH2 PUMP INLET PRESS (D2-403) 4. LH2 PREVALVE OPEN (K111-404) 5. LH2 BLEED VALVE CLOSE (K127-401) 6. LH2 RECIRC VALVE CLOSE (K136-409) 7. LH2 ULLAGE PRESS (D177-408, D178-408). NOTES--- 1. LH2 CHILDDOWN WILL NOT BE SATISFACTORY IF--- (A) PREVALVE IS OPEN (B) RECIRCULATION VALVE IS CLOSED (C) BLEED VALVE IS CLOSED (D) CHILDDOWN PUMP IS NOT ON 2. THIS FAILURE AND THE FUEL LEAD WILL REQUIRE EVALUATION OF LH2 RESIDUALS TO DETERMINE ADEQUACY FOR TLI VELOCITY CUTOFF (REF FNR 7-1).				
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MISSION RULES

SECTION 8 - SLV - T86

SLV ITEM

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS												
8-4	S-IVB STAGE LOX CHILLDOWN SYSTEM FAILS DURING RESTART PREPARATIONS	TLI	CONTINUE MISSION	<p>BSE INFORM FLIGHT AND---</p> <p>1. ATTEMPT TO CORRECT SITUATION SPECIFIED IN NOTE 1.A, 1.B, IN 1.D</p>	<p>CUES---</p> <p>1. LOX PUMP INLET TEMPERATURE (C4-403)</p> <p>2. LOX CHILLDOWN FLOW RATE (F4-424).</p> <p>3. LOX PUMP INLET PRESSURE (D3-403) AND LOX TANK ULLAGE PRESSURE (D179-406, D180-406)</p> <p>4. LOX PREVALVE DISCRETES (K109-403, K110-403)</p> <p>5. LOX BLEED VALVE CLOSED (K126-401)</p> <p>6. LOX RECIRCULATION VALVE CLOSED (K139-424)</p> <p>NOTES---</p> <p>1. LOX CHILLDOWN WILL NOT BE SATISFACTORY IF---</p> <p>(A) PREVALVE IS OPEN</p> <p>(B) RECIRCULATION VALVE IS CLOSED</p> <p>(C) BLEED VALVE IS CLOSED</p> <p>(D) CHILLDOWN PUMP IS NOT ON</p>												
8-5	LOW LH2 TANK ULLAGE PRESSURE AT T86 + 9 MIN 10 SEC	TLI	TLI INHIBIT	<p>BSE INFORM FLIGHT AND RECOMMEND TLI INHIBIT.</p>	<p>CUES---</p> <p>1. LH2 TANK ULLAGE PRESSURE (D177-408, D178-408).</p> <p>2. LH2 PUMP INLET PRESSURE (D2-403).</p> <p>NOTE---</p> <p>AT T86 + 9 MIN 10 SEC, THE LH2 TANK ULLAGE PRESSURE SHOULD BE 4 PSIA HIGHER THAN ULLAGE PRESSURE DURING ORBITAL COAST TO MEET RESTART REQUIREMENTS.</p>												
8-6	S-IVB ACTUATOR CONFIRMED HARDOVER (GREATER THAN OR EQUAL TO +/- 5 DEG.) PRIOR TO T86 + 9 MIN 10 SEC	TLI	TLI INHIBIT	<p>BSE INFORM FLIGHT AND RECOMMEND TLI INHIBIT</p>	<p>CUE---</p> <p>1. ACTUATOR POSITIONS +/- 5 DEG OR GREATER (G1-400, G1-403, G2-400, G2-403).</p> <p>NOTE---</p> <p>BOTH INDIVIDUAL ACTUATOR POSITIONS MUST CONFIRM MALFUNCTION PRIOR TO RECOMMENDING TLI INHIBIT.</p>												
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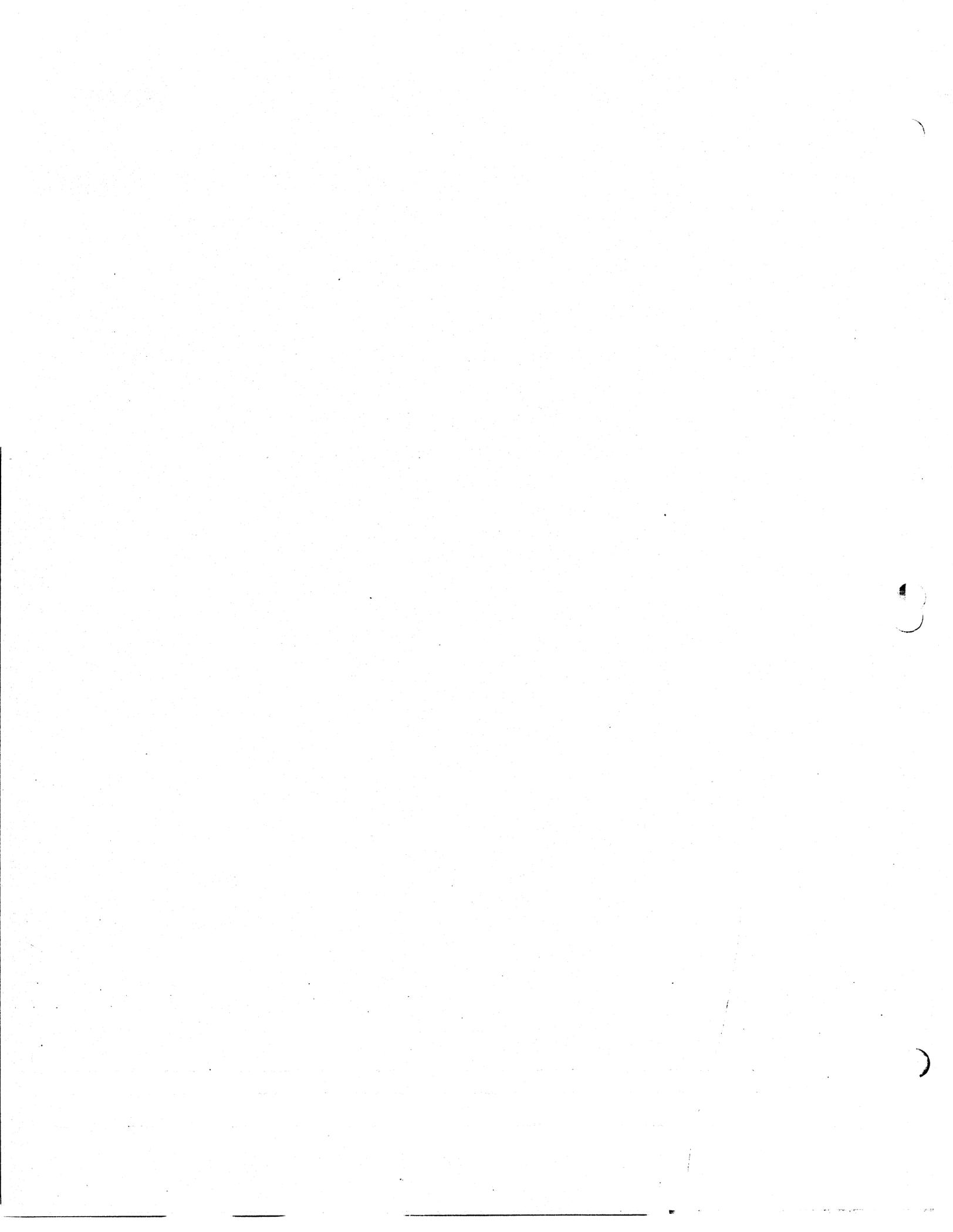
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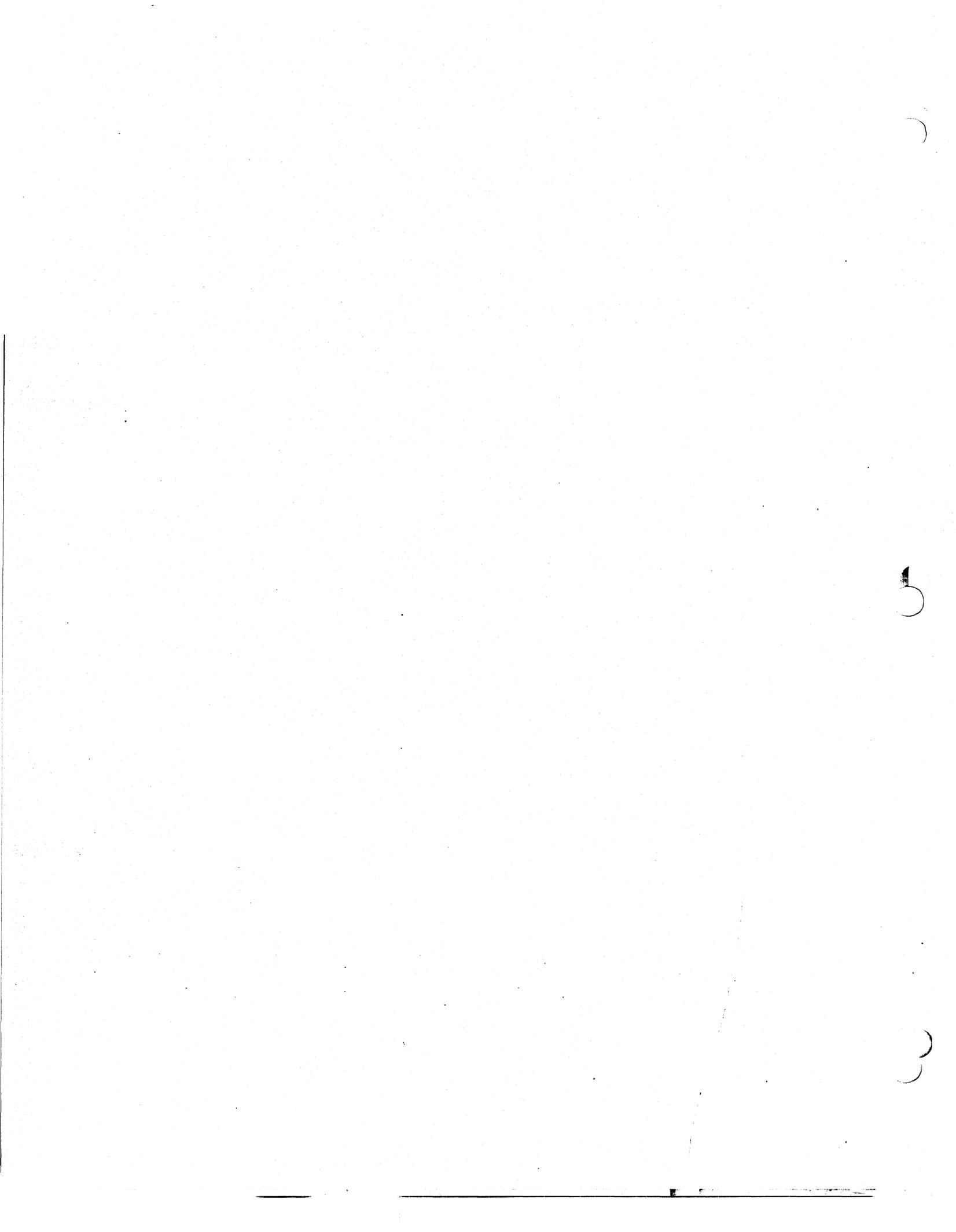
SECTION 8 - SLV - T86

SLV ITEM

Q	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS			
9-7	S-IVB STAGE CONTINUOUS VENT SYSTEM (CVS) REGULATOR FAILS TO CLOSE DURING RESTART SEQUENCE	TLI	CONTINUE MISSION/TLI INHIBIT BSE INFORM FLIGHT AND COMMAND--- 1. SECOND BURN RELAY OFF 2. ATTEMPT TO CLOSE THE CVS REGULATOR IF NEITHER 1 NOR 2 IS SUCCESSFUL, BSE INFORM FLIGHT AND RECOMMEND TLI INHIBIT.	CUES--- 1. CVS NOZZLE PRESSURE REMAINS GREATER THAN 3 PSIA (D181-409, D182-409). 2. CVS REGULATOR CLOSED (K154-411). 3. LH2 TANK ULLAGE PRESSURE (D177-408, D178-408).				
9-8	LOSS OF ATTITUDE CONTROL DURING S-IVB SECOND BURN	TLI	SPACECRAFT SEPARATION BSE INFORM FLIGHT AND FIDO. CARCOM INFORM CREW OF LOSS OF ATTITUDE CONTROL. CREW WILL ABORT ON LIMITS	CUES--- 1. ANGULAR RATES - PITCH (R4-602, R13-602), YAW (R5-602, R8-602), OR ROLL (R6-602, R12-602) GREATER THAN 5 DEG/SEC AND NOT DECREASING. 2. PLATFORM GIMBAL ANGLES PITCH, YAW, OR ROLL (M60-603) CHANGING AT RATES GIVEN IN CUE 1. 3. LOSS OF ATTITUDE CONTROL ALERT (SEE NOTE2). NOTES--- 1. THE SLV YAW GIMBAL (Z-AXIS) IS CRITICAL BEYOND +/- 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 +/- 3 DEG. (C) FAILURE TO INITIATE PROPER GUIDANCE SEQUENCE. (D) FAILURE OF S-IVB ENGINE HYDRAULICS. (E) ATTITUDE REFERENCE FAILURE				
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9 SLV - TOP (SAFING
AND SLINGSHOT)



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MISSION RULES

SECTION 9 - SLV T88

REV ITEM

REV	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		LH2 DUMP FAILS					
9-5		LOSS OF APS FOR DUMP					
		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 TB8 + 5 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					
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SECTION 9 - SLV T88

REV.	ITEM							
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).			
	9-2	S-IVB LOX DUMP FAILS TO INITIATE AT T88 + 12 MIN 0.2 SEC	TLC	CONTINUE MISSION BSE INFORM FLIGHT AND 1. ATTEMPT TO INITIATE LOX DUMP BY OPENING THE MAIN OXIDIZER VALVE	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).			
	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 RES. PRESS (D18-401). 2. ENGINE CONTROL HELIUM SPHERE PRESSURE (D19-401, D242-401).			
	9-4	LH2 DUMP FAILS TO INITIATE AT T88 - 17 MIN 9.4 SEC	TLC	CONTINUE MISSION BSE INFORM FLIGHT AND 1. ATTEMPT TO INITIATE LH2 DUMP BY OPENING THE MAIN FUEL VALVE	CUES--- 1. MAIN FUEL VALVE POSITION (G4-401). 2. MAIN FUEL VALVE OPEN DISCRETE (K118-401). 3. FUEL FLOW RATE (F2-401).			
	9-5	LOSS OF EITHER OR BOTH APS MODULES PRIOR TO OR DURING PROPELLANT DUMP	TLC	CONTINUE MISSION BSE INFORM FLIGHT AND COMMAND--- 1. S-IVB BURN MODE ON	CUES--- 1. MANIFOLD PRESSURE MOD 1 LESS THAN 160 PSIA (OXID FUEL) : D70-414, D71-414. 2. MANIFOLD PRESSURE MOD 2 LESS THAN 160 PSIA (OXID-FUEL) : D72-415, D73-415. 3. HELIUM SUPPLY PRESSURE MODE 1 APPROXIMATELY 1100 PSIA (D35-414, D250-414). 4. HELIUM SUPPLY PRESSURE MODE 2 APPROXIMATELY 1100 PSIA (D36-415, D251-415).			
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MISSION RULES

SECTION 9 - SLV - T88 - CONTINUED

REV ITEM

REV	ITEM	MEAS NUMBER ONBOARD	TRANS- DUCERS	CATEGORY	EFFECTIVE- TIVITY	MISSION RULE REF
----- PRELAUNCH INSTRUMENTATION -----						
MEASUREMENT DESCRIPTION						
STAGE COMMUNICATIONS SYSTEM AND FLIGHT CONTROL MEASUREMENT CATEGORIZATION						
STAGE COMMUNICATIONS SYSTEM						
S-IVB STAGE						
	MUX DP180 (VIA IU)				M	
INSTRUMENT UNIT						
	LINK DP18				M	
	EMERGENCY DETECTION SYSTEM (EDS)				M	
	COMMAND COMMUNICATIONS SYSTEM (CCS) UPLINK				M	
FLIGHT CONTROL MEASUREMENTS						
S-II STAGE						
	POSITION YAW ACTUATOR	G8-201			HD	6-8, 8-5
	POSITION YAW ACTUATOR	G8-202			HD	6-8
	POSITION YAW ACTUATOR	G8-203			HD	6-8
	POSITION YAW ACTUATOR	G8-204			HD	6-8
	POSITION PITCH ACTUATOR	G9-201			HD	6-8, 8-5
	POSITION PITCH ACTUATOR	G9-202			HD	6-8
	POSITION PITCH ACTUATOR	G9-203			HD	6-8
	POSITION PITCH ACTUATOR	G9-204			HD	6-8
	E1 YAW ACTUATOR PIST POS	G30-201			HD	6-8
	E2 YAW ACTUATOR PIST POS	G30-202			HD	6-8
	E3 YAW ACTUATOR PIST POS	G30-203			HD	6-8
	E4 YAW ACTUATOR PIST POS	G30-204			HD	6-8
	E1 PITCH ACTUATOR PIST POS	G31-201			HD	6-8
	E2 PITCH ACTUATOR PIST POS	G31-202			HD	6-8
	E3 PITCH ACTUATOR PIST POS	G31-203			HD	6-8
	E4 PITCH ACTUATOR PIST POS	G31-204			HD	6-8
	VOLT, IGNITION DC BUS	M125-207			HD	6-8
S-IVB STAGE						
	PRESS, FUEL PUMP INLET	D2-403				7-14
	PRESS, FUEL TANK ULLAGE EDS 1	D177-410	METER * COMMON		2 OF 3	7-14
	PRESS, FUEL TANK ULLAGE EDS 2	D178-410	METER * COMMON		M	7-14
	PRESS, OXID PUMP INLET	D3-403				7-14, 19
	PRESS, OXID TANK ULLAGE EDS 1	D179-406	METER * COMMON		2 OF 3	7-14, 19, 3-5
	PRESS, OXID TANK ULLAGE EDS 2	D180-406	METER * COMMON		M	7-14, 19, 3-5
	PRESS, COLD HELIUM SPHERE	D16-425			HD	7-13
	PRESS, GH2 START BOTTLE	D17-401			HD	7-20
	PRESS, ENG CONTROL HE SPHERE	D19-401			HD	7-16
	PRESS, HYDRAULIC SYSTEM	D41-403			HD	6-10, 7-22
	PRESS, RESERVOIR OIL	D42-403			HD	6-10, 7-22
	PRESS, AMBIENT HE PNEU SPHERE	D236-403			HD	7-15
	PRESS, GH2 START BOTTLE BKUP MEAS	D241-401			HD	7-20
	PRESS, ENG CONT HE SPHERE BKUP MEAS	D242-401			HD	7-16
	PRESS, AMB HE PNEU SPHERE	D256-403			HD	7-15
	PRESS, COLD HE SPHERE	D263-403			HD	7-18
	FLOWMETER, OXIDIZER	F1-401			HD	7-4
	POSITION, PITCH ACTUATOR	G1-403			HD	8-6
	POSITION, YAW ACTUATOR	G2-403			HD	8-6
	POSITION, MAIN OXIDIZER VALVE	G3-401			HD	7-4
	POSITION, PU SYSTEM RATIO VALVE	G10-401			HD	7-21
	VOLT, F/U 1 EBW RANGE SAFETY	M30-411			HD	7-5
	VOLT, F/U 2 EBW RANGE SAFETY	M31-411			HD	7-5
	VOLT, PU VALVE POSITION FEEDBACK	M61-411			HD	7-21
	NETWORK					
*ONBOARD DIS- PLAY MANDATORY						
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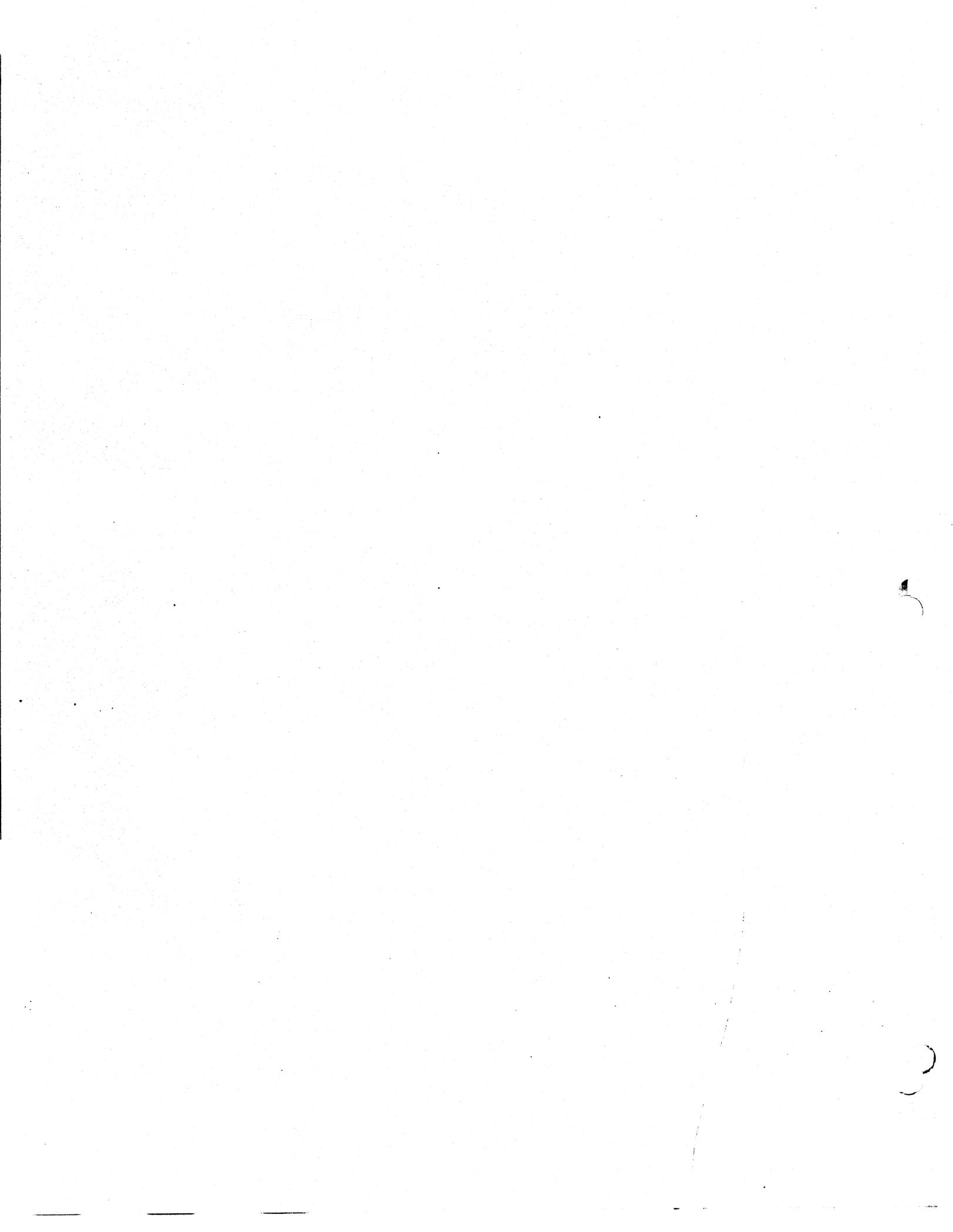
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MISSION RULES

SECTION 9 - SLV - T88 - CONTINUED

REV	ITEM	MEAS NUMBER	ONBOARD TRANSDUCERS	EFFECT- CATEGORY	MISSION RULE REF												
	MEASUREMENT DESCRIPTION																
	MISC. SEC R/S RCVR 1 L/L SIG STR	N57-411		HD	7-5												
	MISC. SEC R/S RCVR 2 L/L SIG STR	N62-411		HD	7-5												
	LEVEL, RESERVOIR OIL	L7-403		HD	6-10,7-22												
	INSTRUMENT UNIT																
	GUIDANCE COMPUTER OPERATION	H60-603		M	6-1/4/7/9, 7-8/11,8-1/a												
	COMPUTER RESET PULSE NO. 1-GUIDANCE DECODER	J71-603	}	1 OF 2 M	} REQUIRED TO COMPLETE MULTIPLE WORD GROUND COMMANDS												
	COMPUTER RESET PULSE NO. 2-GUIDANCE DECODER	J72-603															
	ANG VEL PITCH CONTROL	R4-602		HD	6-1/7,7-8,8-9												
	ANG VEL YAW CONTROL	R5-602		HD	6-1/7,7-8,8-8												
	ANG VEL ROLL CONTROL	R6-602		HD	6-1/7,7-8,8-8												
	ANG VEL YAW EDS GROUP 1 (REF)	R8-602		HD	6-1/7,7-8,8-8												
	ANG VEL ROLL EDS GROUP 2 (REF)	R12-602		HD	6-1/7,7-8,8-8												
	ANG VEL PITCH EDS GROUP 3 (REF)	R13-602		HD	6-1/7,7-8,8-8												
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10 CSM ENVIRONMENTAL
CONTROL



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MISSION RULES

SECTION 10 - CSM ENVIRONMENTAL CONTROL SYSTEM

REV	ITEM													
		<p>----- GENERAL -----</p>												
	10-1	<p>LAUNCH</p> <p>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.</p> <p>TLC & TEC</p> <p>WATER EVAPORATION WILL BE LIMITED TO COMPONENT TESTING.</p> <p>ALL PHASES</p> <p>A. BACKUP SYSTEMS AND BACKUP COMPONENTS WILL NORMALLY BE USED FOR THE MOST RAPID PRACTICAL RETURN TO EARTH, NOT FOR MISSION CONTINUATION.</p> <p>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.</p> <p>C. TO CONTINUE, WATER QUANTITY PREDICTIONS MUST REFLECT ADEQUATE QUANTITIES TO MEET NORMAL MISSION REQUIREMENTS.</p>												
	10-2	<p>DEFINITIONS</p> <p>LOSS OF CABIN INTEGRITY---</p> <p>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).</p> <p>LOSS OF SUIT INTEGRITY---</p> <p>TOTAL PGA AND SUIT LOOP LEAKAGE IS GREATER THAN 0.5 PSI/MIN (1.5 LB/HR) DURING PGA SUIT LOOP PRESSURE CHECK.</p> <p>LOSS OF SUIT CIRCUIT---</p> <p>INABILITY OF THE SUIT CIRCUIT TO MAINTAIN ADEQUATE CREW COMFORT AND/OR COMFORT AND/OR CO2 REMOVAL WITHOUT USING DIRECT O2.</p> <p>LOSS OF O2 MANIFOLD---</p> <p>AN O2 MANIFOLD OR REGULATOR FAILURE WITH WHICH THE SUIT CIRCUIT O2 DEMANDS CANNOT BE SUPPLIED FOR ENTRY.</p> <p>LOSS OF PRIMARY LOOP COOLING---</p> <p>LOSS OF ALL FLOW, A LEAK WHICH CANNOT BE ISOLATED, OR COMBINED FAILURES SUCH THAT RADIATORS AND EVAPORATOR PROVIDE NO COOLING.</p> <p>LOSS OF SECONDARY LOOP COOLING---</p> <p>LOSS OF ALL FLOW, A LEAK WHICH CANNOT BE ISOLATED, OR COMBINED FAILURES SUCH THAT RADIATORS AND EVAPORATOR PROVIDE NO COOLING.</p> <p>LOSS OF COOLANT LOOP RADIATORS---</p> <p>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.</p> <p>LOSS OF ALL COOLING---</p> <p>LOSS OF PRIMARY AND SECONDARY LOOP COOLING.</p> <p>LOSS OF SURGE TANK AND/OR REPRESS PACK---</p> <p>SURGE TANK, REPRESS PACK, OR ASSOCIATED ISOLATABLE PLUMBING FAILURES WHICH REQUIRE ISOLATION OF THE SURGE TANK AND/OR REPRESS PACK.</p> <p>RULE NUMBERS 10-3 THROUGH 10-9 ARE RESERVED.</p>												
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SECTION 10 - CSM ENVIRONMENTAL CONTROL SYSTEM

R	ITEM						
		<p>WATER SYSTEM</p> <p>A. WASTE WATER WILL BE 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.</p> <p>B. WATER DUMPS WILL BE MANAGED SO THAT---</p> <p>1. AT LOI, THE WASTE TANK WILL CONTAIN GREATER THAN 75 PERCENT</p> <p>2. AT CM-SM SEPARATION, THE POTABLE TANK WILL BE FULL AND THE WASTE TANK WILL BE 90 PERCENT FULL.</p> <p>C. GENERAL DUMPING CONSIDERATIONS TO REDUCE TRAJECTORY CALCULATION PERTURBATIONS---</p> <p>1. DUMPS WILL BE PERFORMED (IF REQUIRED) WITHIN 2 HOURS PRECEDING MCC MANEUVERS.</p> <p>2. IF DUMPS ARE REQUIRED IN LUNAR ORBIT THE OPTIMUM DUMP TIME IS IMMEDIATELY PRECEDING SLEEP PERIODS.</p> <p>SYSTEM BACKUP</p> <p>LM SYSTEMS WILL BE USED AS REQUIRED FOR CSM SYSTEMS BACKUP. DESCENT STAGE WILL BE RETAINED IF POSSIBLE.</p> <p>RULE NUMBERS 10-11 THROUGH 10-19 ARE RESERVED.</p>					
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SECTION 10 - CSM ENVIRONMENTAL CONTROL SYSTEM

REV ITEM

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS		
		RULE NUMBERS 7-29		----- SPECIFIC -----			
10-20		AND 7-30 ARE RESERVED. CABIN PRESSURE	LAUNCH	CONTINUE MISSION	NORMAL RELIEF STARTS AT 30 SECONDS		
10-21		CANNOT BE RELIEVED CABIN PRESSURE DECREASING AND/OR LESS THAN 4.5 PSIA AND---			3.5 PSIA CREW OPTION TO USE LM ENVIRONMENT FOR EARTH RETURN IN LIEU OF SUITED RETURN.		
		A. SUIT PRESSURE GREATER THAN	LAUNCH ALL	A.1. CONTINUE MISSION 2. ENTER NEXT BEST PTP IF CABIN PRESS NOT RESTORED GREATER THAN 4.5 PSIA.			
		B. SUIT PRESSURE LESS THAN 3.5 PSIA	LAUNCH ALL	B.1. ABORT ASAP 2. ENTER ASAP			
		C. LOSS OF SUIT CIRCULATION	LAUNCH ALL	C.1. ABORT ASAP OPEN DIRECT O2 45 DEG FROM LAUNCH SETTING. 2. ENTER ASAP	C.1. CORRESPONDS TO 12.6 LB/HR (APPROX 3 CFM/CREWMAN)		
10-22		LOSS OF SUIT CIRCULATION CABIN STABLE, AND GREATER THAN 4.5 PSIA	LAUNCH EO ALL	A. CONTINUE MISSION OPEN DIRECT O2 VALVE 45 DEG FROM LAUNCH SETTING. B. ENTER NEXT BEST PTP 1. DOFF SUITS. 2. OPEN WASTE OVERBOARD DRAIN VALVE TO OBTAIN CABIN BLEED FLOW. 3. DON FACE MASKS AFTER 1 HOUR C. ENTER NEXT BEST PTP	LM SYSTEMS (IF AVAILABLE) WILL BE USED FOR CO2 AND H2O REMOVAL. A. CORRESPONDS TO 12.6 LB/HR (APPROX 3 CFM/CREWMAN) B.2. WASTE OVERBOARD BLEED = 0.67 LB O2/HR 3. TIME REQUIRED FOR CM CO2 PARTIAL PRESSURE TO INCREASE TO 7.6 MM HG 1 CREWMAN --- 4 HR. 3 CREWMAN --- 80 MIN.		
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SECTION 10 - CSM ENVIRONMENTAL CONTROL SYSTEM

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS												
10-23	LOSS OF SURGE TANK OR REPRESS PACK		LAUNCH ALL	A. CONTINUE MISSION B. CONTINUE MISSION	FOR LEAK IN SURGE TANK, ISOLATE SURGE TANK AND PLACE RLSS VALVE TO FILL.												
10-24	LOSS OF SURGE TANK AND REPRESS PACK		LAUNCH ALL TEC	A. CONTINUE MISSION B. CONTINUE MISSION C. CONTINUE MISSION DOFF SUITS FOR ENTRY.	B. OPS 02 QTY 2 TANKS -2 LB/TANK PLAN TO RESTORE ENTRY O2 BY STORING OPS IN CM AT FINAL LM EGRESS.												
10-25	FIRE OR SMOKE IN COMMAND MODULE		LAUNCH ALL	A. ABORT 1. DECOMPRESS CABIN 2. TROUBLESHOOT ELECTRICAL SYSTEM PER FLIGHT CREW CHECKLIST BOOST FIRE PROCEDURES. B.1. TROUBLESHOOT/COMBAT FIRE PER FLIGHT CREW CHECKLIST EMERGENCY PROCEDURES. 2. ASSESS DAMAGE AND REMOVE POWER FROM AFFECTED SYSTEMS 3. ENTER NEXT BEST PTP													
<table border="1"> <thead> <tr> <th>MISSION</th> <th>REV</th> <th>DATE</th> <th>SECTION</th> <th>GROUP</th> <th>PAGE</th> </tr> </thead> <tbody> <tr> <td>APOLLO 11</td> <td></td> <td>4/16/69</td> <td>CSM ENVIRONMENT CONTROL SYSTEM</td> <td>SUIT/CABIN</td> <td>10-5</td> </tr> </tbody> </table>						MISSION	REV	DATE	SECTION	GROUP	PAGE	APOLLO 11		4/16/69	CSM ENVIRONMENT CONTROL SYSTEM	SUIT/CABIN	10-5
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MISSION RULES

REV ITEM

SECTION 10 - CSM ENVIRONMENTAL CONTROL SYSTEM

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 EO TLC TD&E ALL	A. CONTINUE MISSION B. CONTINUE MISSION C. INHIBIT TD&E D. TERMINATE PHASE CONTINUE LM EJECTION IF LM IS PRESSURIZED AND TUNNEL WORK IS COMPLETE. E. CONTINUE MISSION NO-GO FOR UNDOCK	CONTINUE MISSION EXCEPT FOR MAJOR CSM PRESSURE VESSEL CONFIGURATION CHANGES
10-28		LOSS OF O2 MANIFOLD A. O2 MANIFOLD LEAKS GREATER THAN 4 LB/HR AND CABIN PRESSURE GREATER THAN 4.5 PSIA	LAUNCH ALL	A.1. CONTINUE MISSION 2. ENTER NEXT BEST PTP (A) VERIFY SURGE TANK AND REPRESS PACK ISOLATED UNTIL ENTRY. (B) RETRIEVE OPS FROM LM.	A.2. APPROXIMATELY 5 HOURS ARE REQUIRED TO DEplete CABIN O2 FROM 4.8 TO 3.5 PSIA, WITH 0.56 LB/HR USAGE RATE (CREW + CABIN LEAK + TANK PRESS BLEED)
		B. O2 MANIFOLD LEAKS GREATER THAN 4 LB/HR AND CABIN PRESSURE LESS THAN 4.5 PSIA	LAUNCH ALL	B.1. ABORT ASAP 2. ENTER ASAP USE OPS IN SUITED MODE FOR ENTRY	A.2.(B) CREW OPTION TO USE LM ENVIRONMENT FOR EARTH RETURN IN CASE OF MANUAL CABIN PRESSURE REGULATION. LM O2 (IF AVAILABLE) MAY BE USED TO SUPPLEMENT CSM SUPPLY.
10-29		LOSS OF ONE MAIN REGULATOR	LAUNCH EO TLC ALL	A. CONTINUE MISSION B. NO-GO FOR TLI C. ENTER NEXT BEST PTP D. CONTINUE MISSION CONSIDER TEI AT NEXT BEST OPPORTUNITY AFTER RNOZ	

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SECTION 10 - CSM ENVIRONMENTAL CONTROL SYSTEM

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS		
	10-30	BOTH MAIN REGULATORS FAILED CLOSED	LAUNCH ALL	A. CONTINUE MISSION B. ENTER NEXT BEST PTP	LM SYSTEMS (IF AVAILABLE) MAY BE USED IN LIEU OF CSM SYSTEMS		
	10-31	LOSS OF ONE SUIT COMPRESSOR	LAUNCH EO ALL	A. CONTINUE MISSION B. NO-GO FOR TLI C. CONTINUE MISSION PERFORM ASCENT AT NEXT BEST OPPORTUNITY AFTER EVA.			
		RULE NUMBERS 10-32 THROUGH 10-39 ARE RESERVED.					
		MISSION	REV	DATE	SECTION	GROUP	PAGE
		APOLLO 11		4/16/69	CSM ENVIRONMENT CONTROL SYSTEM	SUIT/CABIN	10-7

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MISSION RULES

REV ITEM

SECTION 10 - CSM ENVIRONMENTAL CONTROL SYSTEM

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS												
10-40	PRIMARY COOLANT LOOP MALFUNCTIONS																
	A. LOSS OF EVAPORATOR		LAUNCH	A.1. CONTINUE MISSION	A.1. REF MALF PROC---												
			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	2. (A) MAINTAIN PRI RAD OUT TEMP GREATER THAN -20 DEG. F. (B) WATER MANAGEMENT MAY DICTATE ACTIVATION AND DEACTIVATION OF SECONDARY LOOP TO MAINTAIN PRI RAD OUT TEMP BETWEEN 45 AND 80 DEGREES F.												
	B. LOSS OF RADIATORS		LAUNCH	B.1. CONTINUE MISSION	B.1. REF MALF PROC---												
			EO	2. NO-GO FOR TLI (A) ACTIVATE SECONDARY LOOP (B) USE PRIMARY LOOP IN ADDITION TO SECONDARY LOOP FOR G&N OPERATIONS.	2. ALTERNATE MISSION MAY BE PERFORMED												
			TLC	3. ENTER NEXT BEST PTP NO-GO FOR LOI													
			LUNAR ORBIT/ LUNAR STAY	4. BASED ON WATER AVAILABLE FOR EVAPORATIVE COOLING CONSIDERATION WILL BE GIVEN TO CONTINUING MISSION													
	C. TOTAL LOSS OF LOOP		LAUNCH	C.1. CONTINUE MISSION ACTIVATE SECONDARY LOOP													
			EO	2. NO-GO FOR TLI ACTIVATE SECONDARY LOOP	C.2. ALTERNATE MISSION MAY BE PERFORMED.												
			ALL	3. ENTER NEXT BEST PTP ACTIVATE SECONDARY LOOP													
<table border="1"> <thead> <tr> <th>MISSION</th> <th>REV</th> <th>DATE</th> <th>SECTION</th> <th>GROUP</th> <th>PAGE</th> </tr> </thead> <tbody> <tr> <td>APOLLO 11</td> <td></td> <td>4/16/69</td> <td>CSM ENVIRONMENT CONTROL SYSTEM</td> <td>COOLANT</td> <td>10-8</td> </tr> </tbody> </table>						MISSION	REV	DATE	SECTION	GROUP	PAGE	APOLLO 11		4/16/69	CSM ENVIRONMENT CONTROL SYSTEM	COOLANT	10-8
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SECTION 10 - CSM ENVIRONMENTAL CONTROL SYSTEM

REV ITEM

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS			
10-41	SECONDARY LOOP MALFUNCTIONS							
	A. LOSS OF EVAPORATOR	ALL		A. CONTINUE MISSION	A. MALF ECS _____			
	B. LOSS OF RADIATORS	EO		B.1. NO-GO FOR TLI LOOP IS STILL OPERATIONAL IN EVAPORATIVE MODE.	B.1. MALF ECS _____			
		TLC		2. ENTER NEXT BEST PTP				
		LUNAR ORBIT		3. CONTINUE MISSION				
		LUNAR STAY		4. CONTINUE MISSION PERFORM ASCENT AT NEXT BEST OPPORTUNITY AFTER EVA				
	C. TOTAL LOSS OF LOOP	EO		C.1. NO-GO FOR TLI	C.1. MALF ECS _____			
		TLC		2. ENTER NEXT BEST PTP				
		LUNAR ORBIT		3. CONTINUE MISSION				
		LUNAR STAY		4. CONTINUE MISSION PERFORM ASCENT AT NEXT BEST OPPORTUNITY AFTER EVA				
10-42	LOSS OF PRIMARY AND SECONDARY EVAPORATORS	EO		A. CONTINUE MISSION NO-GO FOR TLI				
		TLC		B. CONTINUE MISSION NO-GO FOR LOI				
		ALL		C. ENTER NEXT BEST PTP				
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.				
		ALL		C. ENTER ASAP				
		MISSION	REV	DATE	SECTION	GROUP	PAGE	
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MISSION RULES

SECTION 10 - CSM ENVIRONMENTAL CONTROL SYSTEM

REV ITEM

R	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.	
			ALL	3. ENTER NEXT BEST PTP	
	B.	IN SUIT CIRCUIT	LAUNCH	B.1. CONTINUE MISSION	
			EO	2. ENTER NEXT BEST PTP DOFF SUITS AND USE FACE MASKS IF REQUIRED.	
			ALL	3. ENTER NEXT BEST PTP	
		RULE NUMBERS 10-45 THROUGH 10-49 ARE RESERVED.			

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SECTION 10 - CSM ENVIRONMENTAL CONTROL SYSTEM

REV ITEM

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS		
	10-50	LOSS OF OVERBOARD DUMPS					
		A. NORMAL OVERBOARD DUMPS FROZEN OR BLOCKED	ALL	A. CONTINUE MISSION	A.1. UTILIZE AUXILIARY DUMP FOR URINE AND WASTE WATER DISPOSAL. 2. BLEED O2 FROM WATER TANK THROUGH WASTE MANAGEMENT OVERBOARD DRAIN VALVE INTO CABIN.		
		B. LOSS OF ALL OVERBOARD DUMP CAPABILITY	EO TLC LUNAR ORBIT LUNAR STAY	B.1. ENTER NEXT BEST PTP 2. CONTINUE MISSION PERFORM ASCENT AT NEXT BEST OPPORTUNITY AFTER EVA	B.1. 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. 2. LM URINE STORAGE BAGS (IF AVAILABLE) WILL BE USED.		
	10-51	FAILURE OF BOTH WATER ACCUMULATORS OR UNCONTROLLABLE HIGH HUMIDITY			LM SYSTEMS MAY BE USED FOR HUMIDITY CONTROL.		
			LAUNCH	A. CONTINUE MISSION			
			ALL	B. 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		
			LAUNCH	A. CONTINUE MISSION			
			EO	B. CONTINUE MISSION NO-GO FOR TLI			
			ALL	C. ENTER NEXT BEST PTP			
		MISSION	REV	DATE	SECTION	GROUP	PAGE
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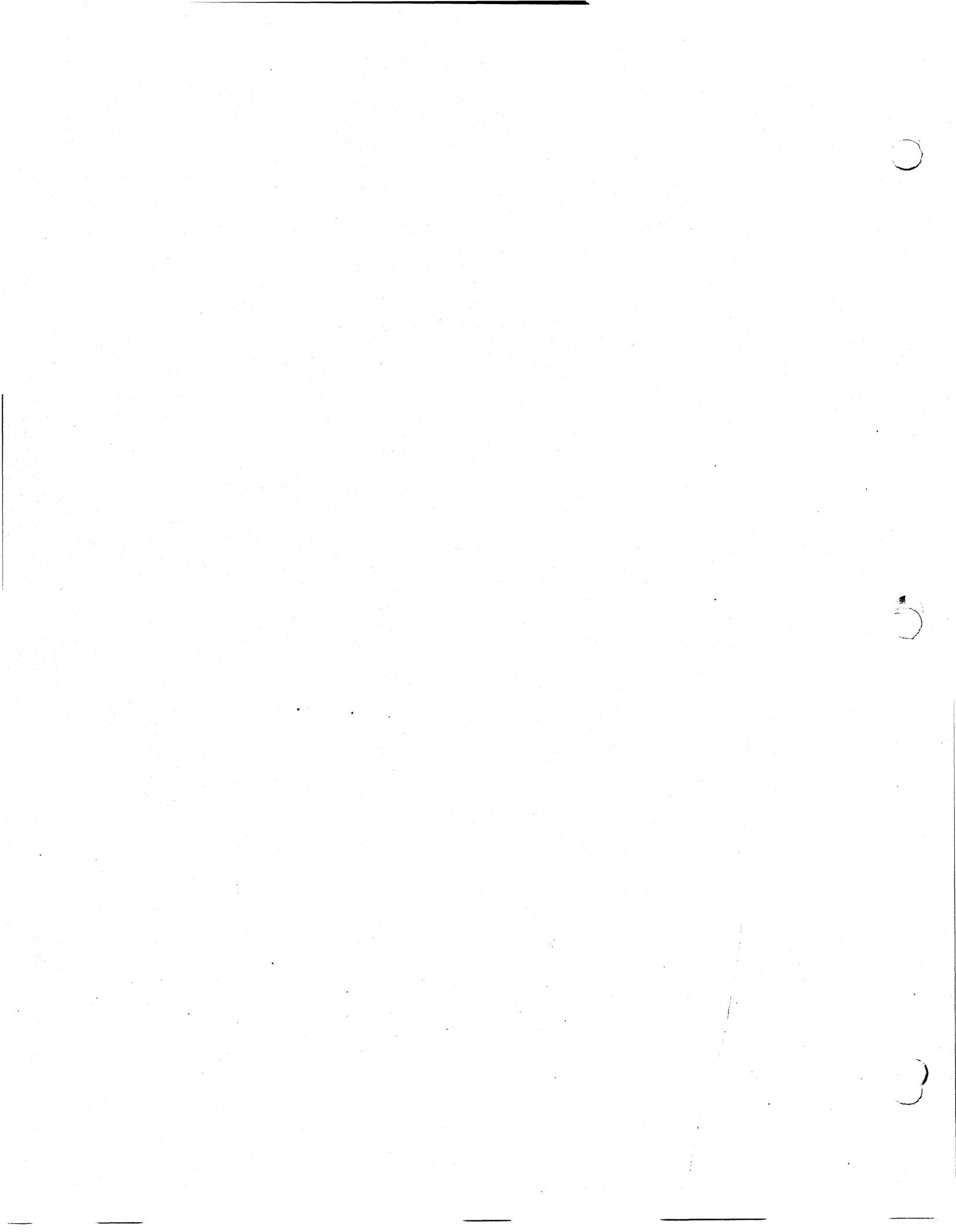
MISSION RULES

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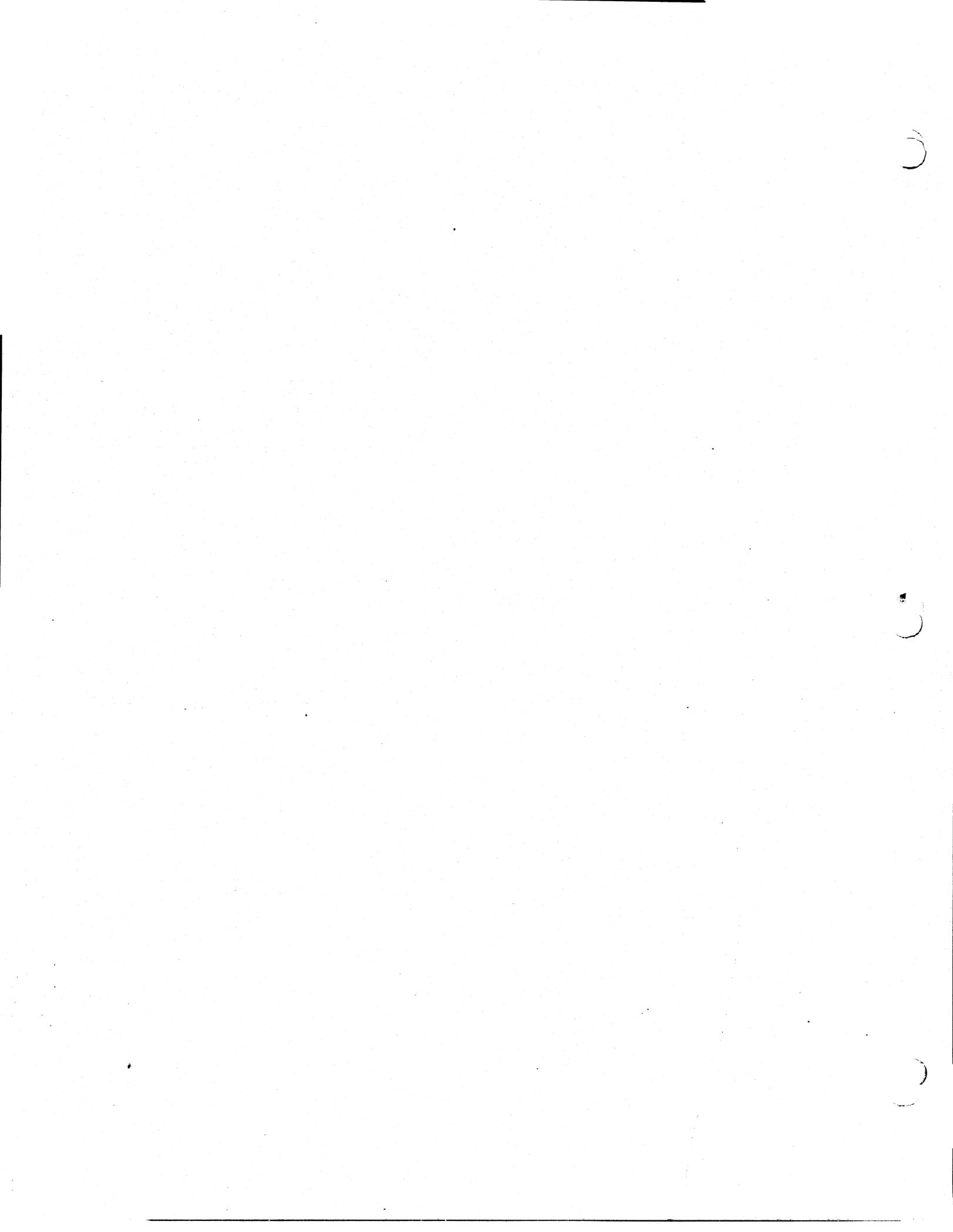
REV ITEM

R	ITEM	INSTRUMENTATION REQUIREMENTS					CATEGORY	REFERENCE
		MEAS DESCRIPTION	PCM	ONBOARD	TRANSDUCER			
	10-60	CABIN PRES	CF0001P	METER	COMMON	}	1 OF	10-20
		SUIT PRES	CF0012P	METER	COMMON		3 M	
		TANK BLADDER PRES	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	
		POTABLE H2O QTY	CF0010Q	METER	COMMON	}	1 OF	10-53
		WASTE H2O QTY	CF0009Q	METER	COMMON		2 M	
		SEC STEAM PRESS	CF0073P	METER	COMMON	}	1 OF	10-41
		SEC EVAP OUT TEMP	CF0071T	METER	COMMON		2 M	
		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 RAT OUT TEMP	SF0236T	METER	-----		HD	

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11 CSM CRYOGENICS



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MISSION RULES

SECTION 11 - CSM CRYOGENICS

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS		
				SPECIFIC MISSION RULES			
	11-20	LOSS OF ONE O2 AND/OR H2 CRYO TANK (TANK PRESSURE LESS THAN 150 O2, LESS THAN 100 H2, RESPECTIVELY).	LAUNCH EO TD&E ALL	A. CONTINUE MISSION B. CONTINUE MISSION NO-GO FOR TLI C. CONTINUE MISSION D. ENTER NEXT BEST PTP	LM, PLSS, AND OPS O2 WILL BE USED AS REQUIRED TO SUPPLEMENT CSM O2.		
	11-21	LOSS OF BOTH O2 AND/OR H2 CRYO TANK (TANK PRESSURE LESS THAN 150 O2, LESS THAN 100 H2, RESPECTIVELY)	LAUNCH EO	A. CONTINUE MISSION ISOLATE SURGE TANK PRIOR TO 800 PSIA. B. ENTER NEXT BEST ATP OR PTP MAXIMUM ORBIT TIME IS 4.75 HOURS FOR LOSS OF THREE FUEL CELLS.	B. IF THREE FUEL CELLS ARE LOST PRIOR TO CM/SM SEP, SMJC'S WILL BE INOPERATIVE.		
		RULE NUMBERS 11-22 THROUGH 11-49 ARE RESERVED.					
		MISSION	REV	DATE	SECTION	GROUP	PAGE
		APOLLO 11		4/16/69	CSM CRYOGENICS	SPECIFIC	11-3

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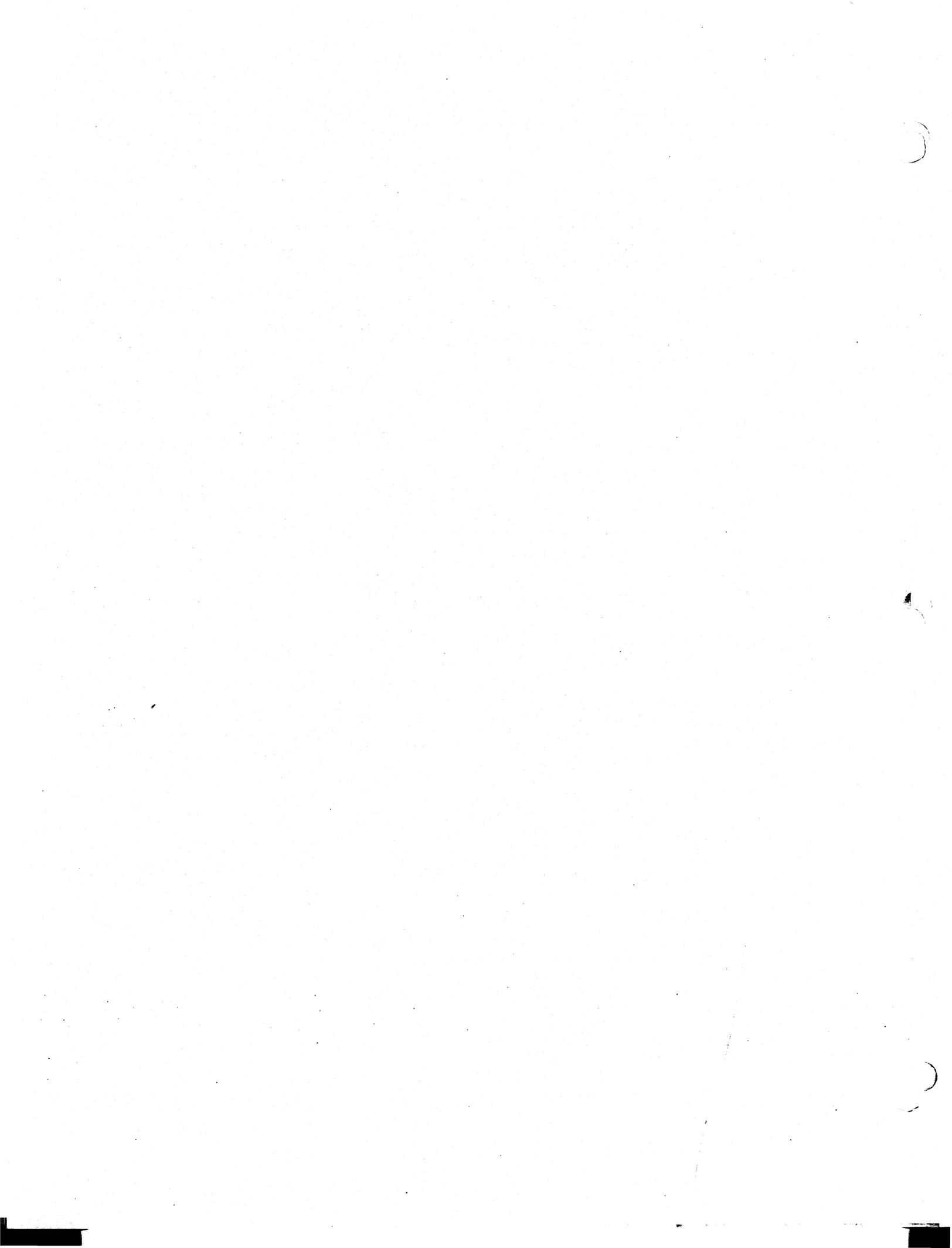
MISSION RULES

SECTION 11 - CSM CRYOGENICS - CONCLUDED

R		ITEM	----- INSTRUMENTATION REQUIREMENTS -----				MISSION RULE REFERENCE
		MEAS DESCRIPTION	PCM	ONBOARD	TRANSDUCERS	CATEGORY	
11-50		O2 TANK 1 QTY	SC0032Q	METER	COMMON	1 OF 2 MANDATORY	11-20
		O2 TANK 2 QTY	SC0033Q	METER	COMMON		
		O2 TANK 1 TEMP	SC0041T	-----	-----	HIGHLY DESIRABLE	11-20
		O2 TANK 2 TEMP	SC0042T	-----	-----		
		H2 TANK 1 QTY	SC0030Q	METER	COMMON	1 OF 2 MANDATORY	11-20
		H2 TANK 2 QTY	SC0031Q	METER	COMMON		
		H2 TANK 1 TEMP	SC0043T	-----	-----	HIGHLY DESIRABLE	11-20
		H2 TANK 2 TEMP	SC0044T	-----	-----		
		O2 TANK 1 PRESS	SC0037P	METER	COMMON	1 OF 2 MANDATORY	11-20
		O2 TANK 2 PRESS	SC0038P	METER	COMMON		
		H2 TANK 1 PRESS	SC0039P	METER	COMMON	1 OF 2 MANDATORY	11-20
		H2 TANK 2 PRESS	SC0040P	METER	COMMON		

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12 CSM ELECTRICAL
POWER SYSTEM



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MISSION RULES

SECTION 12 - CSM ELECTRICAL POWER SYSTEM

R	ITEM
	<p>----- ! GENERAL ! -----</p>
12-1	<p>LAUNCH</p> <p>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 OPERATIONAL TO CONTINUE.</p>
12-2	<p>THERE ARE NO FUEL CELL FAILURES FOR WHICH THE LAUNCH PHASE WILL BE TERMINATED AS LONG AS THREE ENTRY BATTERIES ARE REMAINING TO SUPPLY MAIN BUS LOADS.</p>
12-3	<p>ALL PHASES</p> <p>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.</p>
12-4	<p>BATTERY IS CONSIDERED FAILED IF---</p> <p>A. 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).</p> <p>B. SUSTAINED BATTERY CHARGER OUTPUT IS GREATER THAN 2.0 AMPS AND ALL LOADS REMOVED.</p>
12-5	<p>AN AC BUS IS CONSIDERED FAILED IF ANY TWO PHASES CANNOT BE MAINTAINED GREATER THAN 95 VOLTS.</p>
12-6	<p>AN INVERTER IS CONSIDERED FAILED IF---</p> <p>A. OUTPUT VOLTAGE ON ANY PHASE IS GREATER THAN 130 VAC.</p> <p>B. OUTPUT VOLTAGE ON ANY TWO PHASES IS LESS THAN 95 VAC.</p>
12-7	<p>FUEL CELL IS CONSIDERED FAILED FOR MISSION PLANNING IF---</p> <p>A. FUEL CELL CANNOT SUPPLY SUFFICIENT POWER TO MEET ITS OWN PARASITIC LOADS (5 AMPS PLUS INLINE HEATER POWER AS REQUIRED).</p> <p>B. FUEL CELL H2 LOOP IS CONTAMINATED WITH KOM.</p> <p>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).</p>
12-8	<p>TLI MINIMUM PURGE CAPABILITY IS BOTH OXYGEN AND HYDROGEN ON ONE FUEL CELL AND AT LEAST OXYGEN ON ONE OTHER FUEL CELL.</p> <p>RULE NUMBERS 12-9 THROUGH 12-19 ARE RESERVED.</p>

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MISSION RULES

SECTION 12 - CSM ELECTRICAL POWER SYSTEM

REV ITEM

R	ITEM						
		----- SYSTEMS MANAGEMENT -----					
12-20	BUS MANAGEMENT	<p>A. ONE AND ONLY ONE FUEL CELL WILL BE TIED TO BOTH MAIN BUSES.</p> <p>B. INVERTERS WILL BE CONFIGURED SUCH THAT MAIN BUS A WILL SUPPLY AC BUS 1 AND MAIN BUS B WILL SUPPLY AC BUS 2.</p> <p>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.</p> <p>D. THE BATTERY CHARGE WILL BE USED TO CHECK OUT A SUSPECTED SHORTED BUS (EXCEPT MAIN BUSES) AFTER ALL EQUIPMENT AND POWER SOURCES HAVE BEEN REMOVED FROM BUS.</p> <p>E. MINIMUM MAIN BUS VOLTAGE WILL BE MAINTAINED TO BE COMPATIBLE WITH ONLINE OPERATION EQUIPMENT.</p>					
		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	<p>A. BATTERIES A AND B WILL BE USED TO SUPPLEMENT MAIN BUS LOADS FROM T-75 SECONDS TO INSERTION.</p> <p>B. BATTERIES A AND B WILL BE USED TO SUPPLEMENT MAIN BUS LOADS FOR SPS MANEUVERS. BATTERY C WILL BE ROTATED IN THE EVENT THE BATTERY CHARGER FAILS TO MAINTAIN BATTERY BALANCE.</p> <p>C. BATTERY CHARGING WILL BE TERMINATED FOR ONE OF THE FOLLOWING, WHICHEVER OCCURS FIRST---</p>					
		1. INTEGRATED AMP-HOURS INTO BATTERY BY CHARGER EQUALS INTEGRATED AMP-HOURS OUT OF BATTERY BY LOADS.					
		2. WHEN BATTERY CHARGER CURRENT DROPS TO 0.4 AMPS.					
		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.					

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REV ITEM

R	ITEM						
12-22	FUEL CELL MANAGEMENT	<p>A. FUEL CELL WILL BE 'SHUTDOWN' FOR THE FOLLOWING---</p> <ol style="list-style-type: none"> 1. SUSTAINED CURRENT OUTPUT LESS THAN 5 AMPS. 2. FUEL CELL H2 LOOP IS CONTAMINATED WITH KOH. 3. REACTANT LEAKAGE JEOPARDIZING MISSION DURATION. <p>B. FUEL CELL MAY BE 'OPEN CIRCUITED' FOR THE FOLLOWING---</p> <ol style="list-style-type: none"> 1. SKIN TEMP GREATER THAN <u>475</u> DEG. F. 2. TCE TEMP GREATER THAN <u>200</u> 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. <p>C. FUEL CELL O2 PURGES WILL BE DONE AT 12 HOUR INTERVALS. FUEL CELL H2 PURGES WILL BE DONE AT 48 HOUR INTERVALS.</p> <p>D. ADDITIONAL PURGES WILL BE INITIATED AS OPERATIONAL CONDITIONS DICTATE.</p> <p>E. FUEL CELLS WILL NOT BE PURGED FOR CONFIRMED HIGH PH INDICATION.</p> <p>F. EACH H2 PURGE WILL NORMALLY BE PRECEDED BY 20 MINUTES OF H2 VENT HEATER OPERATION.</p> <p>G. FC INLINE HEATERS WILL NORMALLY OPERATE IN 'AUTO' CONTINUOUSLY.</p> <p>H. REACTANT VALVES MUST REMAIN OPEN AT ALL TIMES UNLESS THE FUEL CELL IS DECLARED FAILED.</p> <p>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.</p> <p>J. FUEL CELLS MAY BE PURGED TO PRECLUDE VENTING OF CRYO TANKS OR FOR CRYO PRESSURE MANAGEMENT.</p>					
12-23	INVERTER MANAGEMENT	<p>INVERTERS MAY BE REMOVED FROM LINE FOR ANY OF THE FOLLOWING REASONS---</p> <p>A. INVERTER TEMP GREATER THAN <u>190</u> DEG. F.</p> <p>B. SPACECRAFT LOAD MANAGEMENT</p>					
<p>RULE NUMBERS 12-24 THROUGH 12-29 ARE RESERVED</p>							
	MISSION	REV	DATE	SECTION	GROUP	PAGE	
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MISSION RULES

SECTION 12 - CSM ELECTRICAL POWER SYSTEM

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS												
				SPECIFIC MISSION RULES													
	12-30	LOSS OF ONE FUEL CELL (OUTPUT LESS THAN 5 AMPS)	LAUNCH EO TLC LUNAR ORBIT LUNAR STAY ALL	A. CONTINUE MISSION B. NO-GO FOR TLI 1. OPEN CIRCUIT FUEL CELL. 2. RECONFIGURE REMAINING TWO FUEL CELLS TO ONE FUEL CELL PER MAIN BUS ONLY. 3. IF FUEL CELL CANNOT BE RESTORED, PERFORM SHUTDOWN. C. BASED ON THE FAILURE MODE, CONSIDERATION WILL BE GIVEN TO CONTINUING WITH NOMINAL MISSION D. CONTINUE MISSION	B.1. REF MALF PROC EPS 5.												
	12-31	LOSS OF TWO FUEL CELLS (OUTPUT LESS THAN 5 AMPS EACH)	LAUNCH ALL	A. CONTINUE MISSION AFTER 2 + 00 GET PERFORM--- 1. EDS AUTO/OFF TO OFF. 2. IF LOSS OF FC 1 AND 2. TIE BAT C TO MAIN A. 3. IF LOSS OF FC 2 AND 3. TIE BAT C TO MAIN B. 4. IF LOSS OF FC 1 AND 3. TIE BAT C TO BOTH MAIN BUSES. B. ENTER NEXT BEST PTP 1. CONNECT REMAINING FUEL CELL TO BOTH MAIN BUSES. 2. PERFORM "LOSS OF TWO FC POWER DOWN."	* LM SYSTEMS MAY BE USED TO SUPPLEMENT CSM POWER. B. ONE ENTRY BATTERY MAY BE USED TO SUPPLEMENT REMAINING FC FOR GGN ALIGNMENT PRIOR TO DEORBIT.												
<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 30%;">MISSION</td> <td style="width: 5%;">REV</td> <td style="width: 10%;">DATE</td> <td style="width: 20%;">SECTION</td> <td style="width: 15%;">GROUP</td> <td style="width: 15%;">PAGE</td> </tr> <tr> <td>APOLLO 11</td> <td></td> <td>4/16/69</td> <td>CSM ELECTRICAL POWER SYSTEM</td> <td>FUEL CELLS</td> <td>12-4</td> </tr> </table>						MISSION	REV	DATE	SECTION	GROUP	PAGE	APOLLO 11		4/16/69	CSM ELECTRICAL POWER SYSTEM	FUEL CELLS	12-4
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MISSION RULES

SECTION 12 - CSM ELECTRICAL POWER SYSTEM

R	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.1. CONTINUE MISSION (A) AFTER 2 + 00 EDS AUTO/OFF TO OFF. (B) TIE BAT C TO BOTH MAIN BUSES. (C) POWER DOWN AT INSERTION ENTER 2-1 IF FUEL CELLS CANNOT BE RESTORED.	A.1.(A) IF TOTAL OUTPUT CAPABILITY LESS THAN 8 AMPS AT 22 VDC, SMJC WILL BE INOPERATIVE FOR CM/SM SEP. A.1.(C) 4.75 HOURS LEFT IN ORBIT BEFORE DEORBIT MANEUVER.		
			ALL	2. ENTER NEXT BEST PTP			
		B. TOTAL OUTPUT CAPABILITY INSUFFICIENT TO SUPPORT DRIFTING FLIGHT LOADS	ALL	B.1. ENTER NEXT BEST PTP MANIPULATION OF CYCLIC LOADS WILL BE ATTEMPTED TO MAINTAIN VM GREATER THAN 26.5 VDC	B.1. 95 AMPS REPRESENTS MAXIMUM DRIFTING FLIGHT REQUIREMENTS (66 AMPS AVERAGE).		
			LAUNCH	2. NOT APPLICABLE			
		C. TOTAL OUTPUT CAPABILITY LESS THAN 36 AMPS AT MAIN BUS VOLTAGE OF 26.5 VDC	ALL	C.1. ENTER NEXT BEST ATP OR PTP	C.1. 36 AMPS REPRESENTS MINIMUM POWER TO SUPPORT S/C SYSTEMS IN ORBIT.		
			LAUNCH	2. NOT APPLICABLE			
	12-33	LOSS OF THREE FUEL CELLS PLUS ONE BATTERY CURRENT LESS THAN 50 PERCENT OF LOAD ON EITHER REMAINING BATTERY			USE LM SYSTEMS (IF AVAILABLE). RESERVE ENTRY BATTERIES FOR ENTRY.		
			LAUNCH	A. ABORT	A. ASSUMES ALL THREE FUEL CELL CURRENTS LESS THAN OR EQUAL TO 5 AMPS AND BATTERY C TIED TO BOTH MAINS.		
			EO	B. ENTER NEXT BEST ATP OR PTP PERFORM EMERGENCY POWER DOWN	B. 2.4 HOURS LEFT IN ORBIT BEFORE SPS IGNITION		
			ALL	C. ENTER NEXT BEST PTP PERFORM EMERGENCY POWER DOWN			
		RULE NUMBERS 12-34 THROUGH 12-39 ARE RESERVED.					
		MISSION	REV	DATE	SECTION	GROUP	PAGE
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MISSION RULES

SECTION 12 - CSM ELECTRICAL POWER SYSTEM

REV ITEM

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 EO ALL	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. B. NO-GO FOR TLI C. 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 ALL	A. CONTINUE MISSION 1. EDS AUTO/OFF TO OFF. 2. ENTER 2-1 POWERED DOWN. B. ENTER NEXT BEST PTP USE ONE BATTERY ENTRY PROCEDURE.	B. IF LOSS DURING SPS MANEUVER, ATTEMPT TO TIE BATTERY C TO BOTH MAINS.
	12-42	LOSS OF BATTERY CHARGER	EO TLC LO LUNAR STAY	A. CONTINUE MISSION ROTATE BATTERY C FOR BURNS TO MAINTAIN BALANCED BATTERIES B. NO-GO FOR LOI IF SUM OF TWO LOWEST ENTRY BATTERIES LESS THAN ___AMP-HR. C. NO-GO FOR UNDOCK IF SUM OF TWO LOWEST ENTRY BATTERIES LESS THAN ___AMP-HR. D. PERFORM ASCENT AT NEXT BEST OPPORTUNITY IF SUM OF TWO LOWEST ENTRY BATTERIES LESS THAN ___AMPS.	REF MALF PROC EPS-5
	RULE NUMBERS 12-43 THROUGH 12-49 ARE RESERVED.				

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SECTION 12 - CSM ELECTRICAL POWER SYSTEM

REV ITEM

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS		
	12-90	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 BATTERY 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.		
		MISSION	REV	DATE	SECTION	GROUP	PAGE
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MISSION RULES

SECTION 12 - CSM ELECTRICAL POWER SYSTEM

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS												
	12-51	MAIN BUS SHORTED CAUSING FUEL CELL REVERSE CURRENT DISCONNECT															
	A.	FUEL CELL 2 DISCONNECTS FROM MAIN A	LAUNCH	A.1. CONTINUE MISSION (A) PLACE EDS AUTO/OFF TO OFF. (B) F/C 2 TO BUS A ONLY. (C) TIE BAT C TO MAIN A. (D) INVERTER 3 TO AC BUS 2. MAIN A. (E) POWER DOWN MAIN BUS B.	A.1. GREATER THAN 85 AMPS SHORT ON MAIN B WILL CAUSE REVERSE DISCONNECT DURING LAUNCH MALF EPS-3.												
			ALL	A.2. ENTER NEXT BEST PTP IF BUS NOT RESTORED POWER DOWN MAIN BUS B.	A.2. REF MALF PROC EPS 55R-1												
	B.	FUEL CELL 2 DISCONNECTS FROM MAIN B	LAUNCH	B.1. CONTINUE MISSION (A) PLACE EDS AUTO/OFF TO OFF. (B) FC 2 TO BUS B ONLY. (C) TIE BAT C TO MAIN BUS B. (D) INVERTER 3 TO AC BUS 1. MAIN B. (E) POWER DOWN MAIN BUS A. (F) TVC GIMBAL DRIVE (P,Y)-2. (G) GIMBAL MOTOR CONTROL (YAW 2. PITCH 2) BAT B OPEN FOLLOWING GIMBAL MOTOR TURN ON.	B.1. GREATER THAN 79 AMPS SHORT ON MAIN A WILL CAUSE REVERSE DISCONNECT DURING LAUNCH												
			ALL	B.2. ENTER NEXT BEST PTP IF BUS NOT RESTORED. POWER DOWN MAIN BUS A													
	C.	MAIN BUS SHORTED GREATER THAN 25 AMPS AND FUEL CELLS 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.												
			ALL	2. ENTER NEXT BEST PTP IF MAIN BUS NOT RESTORED.	2. IF FUEL CELL FEED CIRCUITRY SHORTED, CLOSE FC REACTANT VALVES.												
<table border="1"> <tr> <td>MISSION</td> <td>REV</td> <td>DATE</td> <td>SECTION</td> <td>GROUP</td> <td>PAGE</td> </tr> <tr> <td>APOLLO 11</td> <td></td> <td>4/16/69</td> <td>CSM ELECTRICAL POWER SYSTEM</td> <td>DC DISTRIBUTION</td> <td>12-8</td> </tr> </table>						MISSION	REV	DATE	SECTION	GROUP	PAGE	APOLLO 11		4/16/69	CSM ELECTRICAL POWER SYSTEM	DC DISTRIBUTION	12-8
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REV ITEM

SECTION 12 - CSM ELECTRICAL POWER SYSTEM

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS		
12-52	A. BATTERY BUS SHORTED IS 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 22 AMPS WILL CAUSE BATTERY BUS VOLTAGE TO BE GREATER THAN OR EQUAL TO MAIN BUS VOLTAGE.		
			ALL	2. ENTER NEXT BEST PTP IF BUS NOT RESTORED	A.2. 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		LAUNCH	A.1. CONTINUE MISSION			
	A. SHORT GREATER THAN 2.0 AMPS		ALL	2. ENTER NEXT BEST PTP OPEN BATTERY BUS TO BATTERY RELAY BUS CB'S.	A.2. REF MALF PROC EPS-SSR-2		
			LUNAR ORBIT LUNAR STAY	3. CONTINUE MISSION PERFORM ASCENT AT NEXT BEST OPPORTUNITY AFTER EVA.			
	B. SHORT LESS THAN 2.0 AMPS		ALL	B. CONTINUE MISSION	B. PLACE BATTERY A ONLY TO BAT RELAY BUS AND CHARGE BAT B CONTINUOUSLY WITH BAT B POWER ENTRY AND POST LANDING CB OPEN. CONSIDER BATTERY CHARGER LOST FOR MISSION PLANNING. MALF EPS SSR-2		
12-54	A. LOSS OF ONE BATTERY BUS, MAIN BUS, (UNABLE TO POWER BUS)		LAUNCH	A.1. CONTINUE MISSION			
			ALL	2. ENTER NEXT BEST PTP			
	B. LOSS OF BATTERY RELAY BUS (UNABLE TO POWER BUS)		LAUNCH	B.1. CONTINUE MISSION			
			EO TLC	2. ENTER NEXT BEST PTP			
			LUNAR ORBIT LUNAR STAY	3. CONTINUE MISSION PERFORM ASCENT AT NEXT BEST OPPORTUNITY AFTER EVA			
	RULE NUMBERS 12-55 THROUGH 12-59 ARE RESERVED.						
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SECTION 12 - CSM ELECTRICAL POWER SYSTEM

REV ITEM

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS		
	12-60	LOSS OF TWO INVERTERS	LAUNCH ALL	A. CONTINUE MISSION B. ENTER NEXT BEST PTP	A. REF MALF PROC _____ PLACE REMAINING INVERTER ON BOTH AC BUSES. B. CONSIDERATION WILL BE GIVEN TO RETAINING LM FOR SYSTEM BACKUP.		
	12-61	LOSS OF ONE AC BUS (TWO PHASES CANNOT BE MAINTAINED GREATER THAN 95 VAC)	LAUNCH ALL	A. CONTINUE MISSION B. ENTER NEXT BEST PTP	B. REF MALF PROC EPS-1		
	12-62	LOSS OF BOTH AC BUSES	LAUNCH ALL	A. ABORT MODE I OR MODE II 1. OPEN DIRECT O2 FOR SUIT VENTILATION. 2. IF AFTER MODE II, ENTER PTP 2-1. B. ENTER NEXT BEST PTP OR ATP IF SUITED, REMOVE HELMET AND GLOVES. IF TIME PERMITS, REMOVE SUITS. IF CABIN DEPRESSURIZED, USE DIRECT O2 UNTIL CABIN IS REPRESSURIZED.	A. REF MR _____ A.2. INITIATE CONTINUOUS FC H2 PURGE FOR COOLING. B.1. USE LM SYSTEMS (IF AVAILABLE) FOR AC POWERED FUNCTIONS TO ENTRY. 2. FOR CSM ONLY, ENTER WITHIN 1-1/2 HOURS, INITIATE CONTINUOUS F H2 PURGE FOR COOLING.		
		RULE NUMBERS 12-63 THROUGH 12-69 ARE RESERVED.					
		MISSION	REV	DATE	SECTION	GROUP	PAGE
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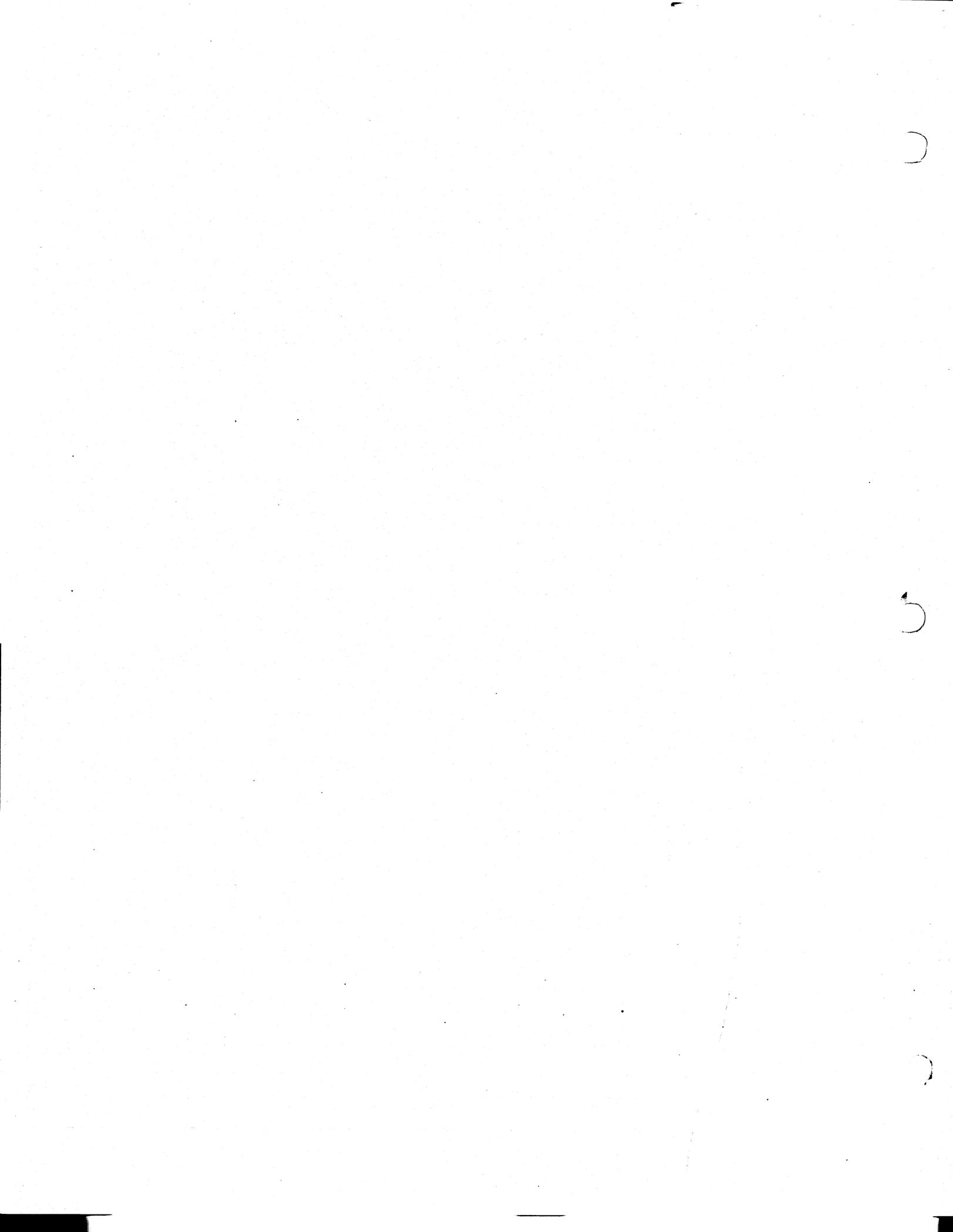
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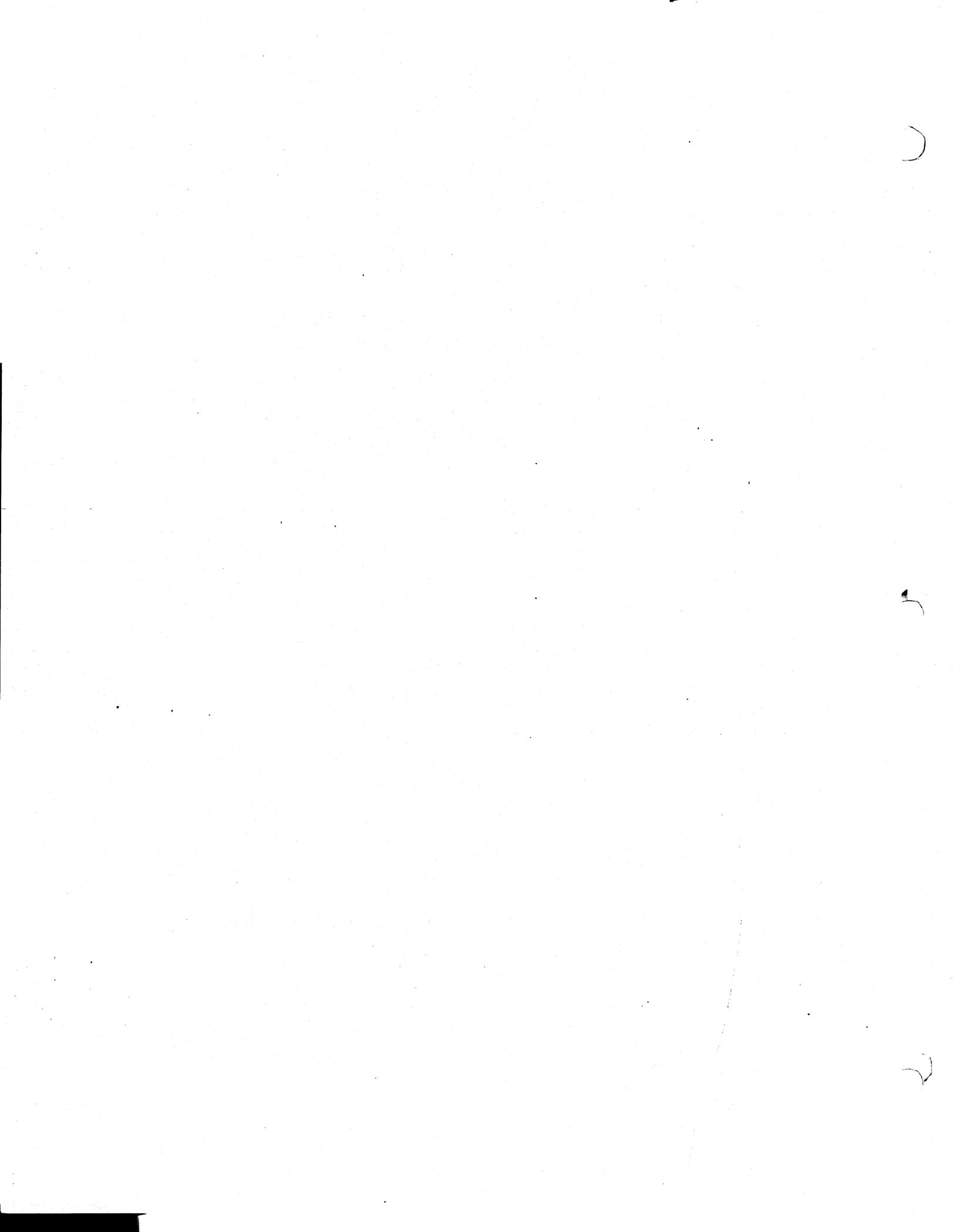
SECTION 12 - CSM ELECTRICAL POWER SYSTEM - CONCLUDED

REV ITEM

R	ITEM	----- INSTRUMENTATION REQUIREMENTS -----					MISSION RULE REFERENCE
	12-70	MEAS DESCRIPTION	PCM	ONBOARD	TRANSDUCERS	CATEGORY	
		AC BUS 1 PHASE A VAC	CC0200V	METER	SEPARATE	HIGHLY DESIRABLE	12-5.6.61
		AC BUS 1 PHASE B VAC	-----	METER	-----	HIGHLY DESIRABLE	
		AC BUS 1 PHASE C VAC	-----	METER	-----	HIGHLY DESIRABLE	
				COMMON METER			
		AC BUS 2 PHASE A VAC	CC0203V	METER	SEPARATE	HIGHLY DESIRABLE	12-5.6.61
		AC BUS 2 PHASE B VAC	-----	METER	-----	HIGHLY DESIRABLE	
		AC BUS 2 PHASE C VAC	-----	METER	-----	HIGHLY DESIRABLE	
		MAIN BUS A VDC	CC0206V	METER	SEPARATE		12-32.52.20C
		MAIN BUS B VDC	CC0207V	METER	SEPARATE	1 OF 2 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	2 OF 3 MANDATORY	12-4.33.40.41
		BAT B CURRENT	CC0223C	METER	COMMON		
		BAT C CURRENT	CC0224C	METER	COMMON		
		FC 1 CURRENT	SC2113C	METER	COMMON	1 OF 3 MANDATORY	12-7.31.32.33.22A
		FC 1 O2 FLO	SC2141R	METER	COMMON		
		FC 1 H2 FLO	SC2139R	METER	COMMON		
		FC 2 CURRENT	SC2114C	METER	COMMON	1 OF 3 MANDATORY	12-7.31.32.33.22A
		FC 2 O2 FLO	SC2142R	METER	COMMON		
		FC 2 H2 FLO	SC2140R	METER	COMMON		
		FC 3 CURRENT	SC2115C	METER	COMMON	1 OF 3 MANDATORY	12-7.31.32.33.22A
		FC 3 O2 FLO	SC2144R	METER	COMMON		
		FC 3 H2 FLO	SC2141R	METER	COMMON		
		BAT CHARGER CURRENT	SC0215C	METER	COMMON	HIGHLY DESIRABLE	
		FC 1 SKIN TEMP	SC2084T	METER	COMMON	HIGHLY DESIRABLE	12-22B
		FC 2 SKIN TEMP	SC2085T	METER	COMMON	HIGHLY DESIRABLE	
		FC 3 SKIN TEMP	SC2086T	METER	COMMON	HIGHLY DESIRABLE	
		FC 1 COND TEMP	SC2081T	METER	COMMON	HIGHLY DESIRABLE	12-22B
		FC 2 COND TEMP	SC2082T	METER	COMMON	HIGHLY DESIRABLE	
		FC 3 COND TEMP	SC2083T	METER	COMMON	HIGHLY DESIRABLE	
		FC 1 RAD OUT TEMP	SC2087T	METER	COMMON	HIGHLY DESIRABLE	12-221
		FC 2 RAD OUT TEMP	SC2088T	METER	COMMON	HIGHLY DESIRABLE	
		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	12-22E
		FC 2 PH	SC2161X	TALKBACK	COMMON	HIGHLY DESIRABLE	
		FC 3 PH	SC2162X	TALKBACK	COMMON	HIGHLY DESIRABLE	
		NOTE--- USE BAT C IN LIEU OF BATTERY WITH LOST INST					
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13 DOCKING AND
UMBILICAL



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MISSION RULES

SECTION 13 - DOCKING AND UMBILICAL

REV ITEM

R	ITEM						
		<u>GENERAL</u>					
13-1	THREE GOOD DOCKING RING LATCHES 120 DEG. APART ARE REQUIRED FOR AN IVT.						
13-2	THREE GOOD DOCKING RING LATCHES 120 DEG. APART ARE REQUIRED FOR A DOCKED RCS MANEUVER.						
13-3	DOCKED SPS OR DPS BURNS REQUIRE AT LEAST NINE DOCKING RING LATCHES.						
13-4	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.						
13-5	WITH FAILURE OF THE CSM FOWARD HATCH PRIMARY LOCK/UNLOCKED MECHANISM, THE NOMINAL MISSION WILL BE PERFORMED USING THE SECONDARY LOCK/UNLOCK MECHANISM.						
13-6	LOSS OF VISUAL DOCKING AIDS (COAS AND TARGETS) WILL NOT INHIBIT DOCKING AND UNDOCKING.						
13-7	IF THE DOCKING PROBE FAILS TO INDICATE EXTENSION OR IF BOTH TALK BACK INDICATORS* ARE BARBER POLE, TDGE WILL BE ATTEMPTED.						
		*NOTE---THE ONLY DOCKING PROBE INSTRUMENTATION CONSISTS OF TWO TALK BACK INDICATORS IN THE CSM.					
		RULE NUMBERS 13-8 THROUGH 13-10 ARE RESERVED					
		MISSION	REV	DATE	SECTION	GROUP	PAGE
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MISSION RULES

SECTION 13 - DOCKING AND UMBILICAL

REV ITEM

R	ITEM						
		<p>----- ' MANAGEMENT ' -----</p>					
13-11		TWO NITROGEN BOTTLES ARE REQUIRED FOR UNDOCKING. FOR SYSTEM RETRACT FAILURE, USE THE SECOND BOTTLE IN THE SAME SYSTEM BEFORE UTILIZING BOTTLES IN THE REDUNDANT SYSTEM					
13-12		THE CM FORWARD AND LM UPPER MATCH NORMALLY WILL BE INSTALLED FOR ANY TYPE OF MANEUVER OR DOCKING.					
		RULE NUMBERS 13-13 THROUGH 13-19 ARE RESERVED.					
		MISSION	REV	DATE	SECTION	GROUP	PAGE
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SECTION 13 - DOCKING AND UMBILICAL

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS		
<p>SIX ITEM</p> <p>SPECIFIC MISSION RULES</p>							
13-20	FAILURE TO MAINTAIN POWER TO X-LUNAR BUS OR TO MAINTAIN X-LUNAR BUS LOADS FROM CSM	DOCKED		CONTINUE MISSION RETURN LM TO DESCENT BATTERY POWER	MAXIMUM LIFETIME OF DESCENT ECA'S WITH DESCENT BATTERIES SUPPLYING LM POWER IS 30 HOURS.		
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.	LM MASS MAY HAVE TO BE MODIFIED FOR APS BURN		
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.			
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		
		MISSION	REV	DATE	SECTION	GROUP	PAGE
		APOLLO 11		4/16/69	DOCKING AND UMBILICAL	SPECIFIC	13-3

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MISSION RULES

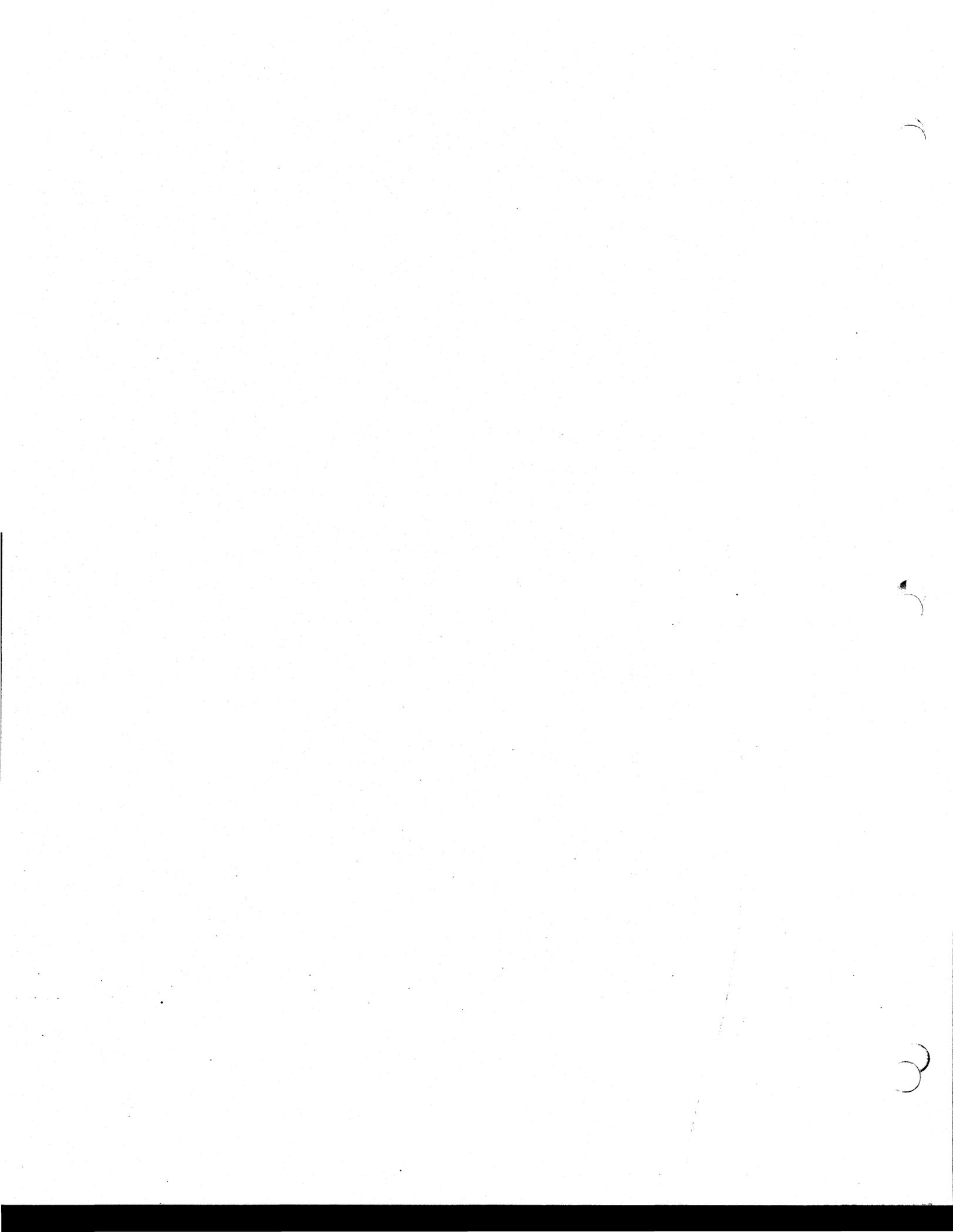
SECTION 13 - DOCKING AND UMBILICAL

REV ITEM

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	13-26	FAILURE TO RELEASE CAPTURE LATCHES	DOCKED	REDOCK PERFORM RETRACTION	
	13-27	PRIMARY FORWARD HATCH LOCK/UNLOCK MECHANISM INOPERATIVE	ALL	CONTINUE MISSION	
	13-28	FAILURE TO REINSTALL CSM FORWARD HATCH	TD&E DOCKED	CONTINUE MISSION 1. ATTEMPT TO SEAL HATCH WITH 4 PSID. 2. JUST PRIOR TO ENTRY, PRESS CABIN TO 15 PSI. AT DROGUE DEPLOY, OPEN RAPID REPRESS. 3. ENTER IN SUITS	
	13-29	FAILURE TO REINSTALL PROBE AND/OR DROGUE OR FAILURE TO CLOSE LM UPPER HATCH	DOCKED	NO DOCKING	RETAIN DESCENT STAGE FOR TEI

	MISSION	REV	DATE	SECTION	GROUP	PAGE
	APOLLO 11		4/16/69	DOCKING AND UMBILICAL	SPECIFIC	13-4

14 CSM SEQUENTIAL



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MISSION RULES

SECTION 14 - CSM SEQUENTIAL

REV ITEM

R	ITEM	MISSION	REV	DATE	SECTION	GROUP	PAGE
		APOLLO 11		4/16/69	CSM SEQUENTIAL	GENERAL	14-1
		<p>----- GENERAL -----</p>					
14-1	<p>LAUNCH</p> <p>THERE ARE NO SEQUENTIAL MALFUNCTIONS FOR WHICH LAUNCH WILL BE TERMINATED.</p>						
14-2	<p>IF AN ENTRY BATTERY IS LOST, THE EDS WILL BE FLOWN OPEN LOOP.</p>						
14-3	<p>ALL MISSION PHASES</p> <p>TO CONTINUE THE MISSION, BOTH PYRO BUSES AND BOTH LOGIC BUSES ARE REQUIRED.</p>						
14-4	<p>SEQUENTIAL LOGIC BUS IS CONSIDERED FAILED IF---</p> <p>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).</p> <p>B. LOGIC BUS SHOURTED GREATER THAN 10 AMPS.</p>						
14-5	<p>PYRO BUS IS CONSIDERED FAILED IF---</p> <p>A. SHORTED GREATER THAN 10 AMPS.</p> <p>B. FAILURE TO PERFORM ANY SEQUENTIAL FUNCTION WITH SUSPECTED FAILED PYRO SYSTEM.</p>						
	<p>RULE NUMBERS 14-6 THROUGH 14-9 ARE RESERVED</p>						

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MISSION RULES

SECTION 14 - CSM SEQUENTIAL

REV ITEM

R	ITEM						
		<p>----- ' MANAGEMENT ' -----</p>					
	14-10	<p>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.</p>					
		<p>RULE NUMBERS 14-11 THROUGH 14-19 ARE RESERVED</p>					
		MISSION	REV	DATE	SECTION	GROUP	PAGE
		APOLLO 11		4/16/69	CSM SEQUENTIAL	MANAGEMENT	14-2

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MISSION RULES

SECTION 14 - CSM SEQUENTIAL

REV ITEM

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS																
<p>-----</p> <p>SPECIFIC MISSION RULES</p> <p>-----</p>																					
14-20		SEQUENTIAL LOGIC BUS A OR B LESS THAN OR EQUAL TO 22 VDC AND UNABLE TO ACTIVATE RCS ENABLE AND/OR SLA SEP RELAYS	LAUNCH EO TLC LUNAR ORBIT/ LUNAR STAY	A. CONTINUE MISSION ENTER 3-1 IF BUS NOT RESTORED B. TERMINATE OPERATIONS ENTER NEXT BEST PTP IF BUS NOT RESTORED C. CONTINUE MISSION	CD0170X AND/OR CD0123X SYSTEM A CD0171X AND/OR CD0124X SYSTEM B																
14-21		PYRO BUS A OR B LESS THAN OR EQUAL TO 35 VDC	LAUNCH EO TLC LUNAR ORBIT/ LUNAR STAY	A.1. CONTINUE MISSION 2. TERMINATE OPERATIONS ENTER NEXT BEST PTP 3. CONTINUE MISSION	A.2. USE BATTERY TIE FOR PYRO POWER TO AFFECTED BUS B. USE BATTERY TIE FOR PYRO POWER TO AFFECTED BUS																
		A. SHORTED GREATER THAN 10 AMPS	LAUNCH EO TLC LUNAR ORBIT/ LUNAR STAY	A.1. CONTINUE MISSION 2. TERMINATE OPERATIONS ENTER NEXT BEST PTP 3. CONTINUE MISSION	A.2. USE BATTERY TIE FOR PYRO POWER TO AFFECTED BUS 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 ALL	C.1. CONTINUE MISSION 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.																
<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 25%;"></td> <td style="width: 10%;">MISSION</td> <td style="width: 5%;">REV</td> <td style="width: 10%;">DATE</td> <td style="width: 15%;">SECTION</td> <td style="width: 15%;">GROUP</td> <td style="width: 10%;">PAGE</td> <td style="width: 10%;"></td> </tr> <tr> <td></td> <td>APOLLO 11</td> <td></td> <td>4/16/69</td> <td>CSM SEQUENTIAL</td> <td>SPECIFIC</td> <td>14-3</td> <td></td> </tr> </table>							MISSION	REV	DATE	SECTION	GROUP	PAGE			APOLLO 11		4/16/69	CSM SEQUENTIAL	SPECIFIC	14-3	
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MISSION RULES

SECTION 14 - CSM SEQUENTIAL

REV ITEM

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
14-22	TELEMETRY INDICATES AN EDS VOTE INPUT 1, 2, OR 3	LAUNCH	CONTINUE MISSION	<p>A. IF ANY ENTRY BATTERY LESS THAN 22 VDC, EDS AUTO/OFF SWITCH TO OFF</p> <p>B. ALL ENTRY BATTERIES GREATER THAN 22 VDC— CHECK CORRESPONDING EDS CB'S 1, 2, OR 3 CLOSED</p>	<p>PARAMETERS ARE CD0132X, CD0135X, AND CD0134X RESPECTIVELY.</p> <p>A. BAT C VOLTAGE CAN ONLY BE MONITORED ONBOARD</p>
14-23	LET JETTISON MOTOR DOES NOT FIRE	LAUNCH	CONTINUE MISSION ATTEMPT JETTISON PER CREW CHECKLIST EMERGENCY PROCEDURE		
14-24	SMJC ACTIVATES PREMATURELY	ALL	ENTER NEXT BEST PTP	<p>A. TERMINATE OPERATIONS AND POWER DOWN AFFECTED MAIN BUS. DO NOT ARM AFFECTED PYRO BUS</p> <p>B. IF UNDOCKED, RETURN TO CSM AND PERFORM CSM/LM FINAL SEP</p> <p>C. REPOWER AFFECTED MAIN BUS AFTER CM/SM SEP</p>	<p>A. USE GOOD SEQUENTIAL SYSTEM IF IN CONTACT WITH MSFN. ARMING OF LOGIC BUSES WILL INDICATE WHICH MAIN BUS MUST BE POWERED DOWN. MAIN A IF SYSTEM A CM/SM SEP. MAIN B IF SYSTEM B CM/SM SEP EVENT IS ACTIVATED.</p> <p>B. USE GOOD SEQUENTIAL SYSTEM</p>
14-25	ACTIVATED CM RCS PRESS LOGIC RELAYS.	ALL	CONTINUE MISSION	<p>A. PRIOR TO CM RCS PRESS—DO NOT ARM RESPECTIVE PYRO BUS</p> <p>(FOR BOTH INDICATIONS PERFORM SLA SEP WITH SECS ARM CB'S OPEN.)</p> <p>B. AT CM RCS PRESS—ARM RESPECTIVE PYRO BUS</p>	CD0173X AND/OR CD0174X
14-26	ACTIVATED SLA DEPLOY LOGIC RELAYS	ALL	CONTINUE MISSION	<p>A. PRIOR TO SLA SEP—DO NOT ARM RESPECTIVE PYRO BUS</p> <p>B. FOR SLA SEP—ARM RESPECTIVE PYRO BUS FIRST</p>	CD0123X AND/OR CD0124X

MISSION	REV	DATE	SECTION	GROUP	PAGE
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MISSION RULES

SECTION 14 - CSM SEQUENTIAL

REV	ITEM	R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
			14-27	UNABLE TO PERFORM SLA SEPARATION	TLC	ENTER NEXT BEST PTP	REF MR _____
			14-28	LOST GROUND TO REGISTER NETWORK FOR LOGIC OR PYRO BUS VOLTS MEASUREMENTS RULE NUMBERS 14-29 THROUGH 14-39 ARE RESERVED.	ALL ALL	CONTINUE MISSION DO NOT ARM AFFECTED SYSTEM UNTIL SEQ GO/NO-GO B. ENTER NEXT BEST PTP PRIOR TO ENTRY UNLESS OTHER PYRO SYSTEM FAILS.	ARMING SYSTEM WITH VOLTAGE GREATER THAN 18 VDC MAY RESULT IN PERMANENT LOSS OF THAT PAM TRAIN.
			14-40	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 (CDU230X AND CDU23X)
			14-41	ACTIVATED DROGUE CHUTE DEPLOY LOGIC RELAYS	LUNAR ORBIT/ LUNAR STAY	A. CONTINUE MISSION DO NOT ARM PYRO BUSES UNTIL MALFUNCTION HAS BEEN ISOLATED DO NOT ARM PYRO BUSES UNTIL MALFUNCTION HAS BEEN ISOLATED.	MAY BE DETECTED AT ANY TIME (CE0001X AND/OR CE0002X)
			14-42	ACTIVATED PILOT CHUTE DEPLOY LOGIC RELAYS RULE NUMBERS 14-43 THROUGH 14-49 ARE RESERVED.	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 PRIOR TO ENTRY (CE0003X AND/OR CE0004X) WITH ELS BAT A(B) CB CLOSED
		MISSION	REV	DATE	SECTION	GROUP	PAGE
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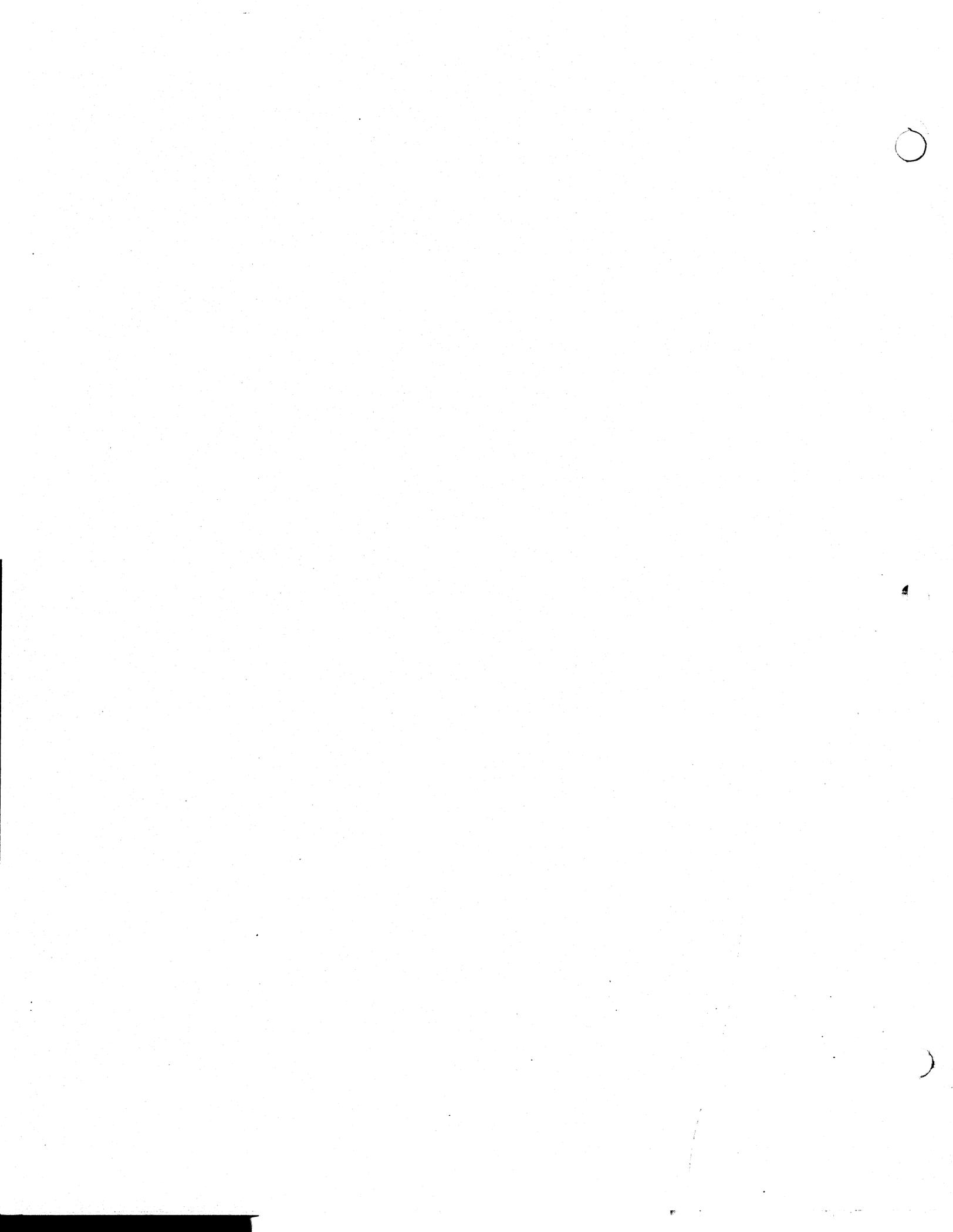
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MISSION RULES

SECTION 14 - CSM SEQUENTIAL - CONCLUDED

REV ITEM		INSTRUMENTATION REQUIREMENTS					
R	ITEM	MEAS DESCRIPTION	PCM	ONBOARD	TRANSDUCERS	CATEGORY	MISSION RUL REFERENCE
14-50		PYRO BUS A VOLTS	CD0005V	----	-----	1 OF	14-21
		PYRO BUS B VOLTS	CD0006V	----	-----	2 M	14-21
		SEQ LOGIC BUS A VOLTS	CD0200V	----	-----	MD	14-20
		SEQ LOGIC BUS B VOLTS	CD0201V	----	-----	MD	14-20
		APEX JET A	CD0230X	----	-----	MD	14-40
		APEX JET B	CD0231X	----	-----	MD	14-40
		DROGUE DEPLOY A	CE0001X	----	-----	MD	14-41
		DROGUE DEPLOY B	CE0002X	----	-----	MD	14-41
		PILOT CHUTE DEPLOY A	CE0003X	----	-----	MD	14-42
		PILOT CHUTE DEPLOY B	CE0004X	----	-----	MD	14-42
		SLA SEP RELAY A	CD0123X	----	-----	MD	14-26
		RCS/SCS ACTIVATE A	CD0170X	----	-----	MD	-----
		SLA SEP RELAY B	CD0124X	----	-----	MD	14-26
		RCS/SCS ACTIVATE B	CD0171X	----	-----	MD	-----
		CM RCS PRESS SIG A	CD0173X	----	-----	MD	14-25
		CM RCS PRESS SIG B	CD0174X	----	-----	MD	14-25
		CM-SM SEP RELAY A	CD0023X	----	-----	MD	-----
		CM-SM SEP RELAY B	CD0024X	----	-----	MD	-----
		CREW ABORT A	CD0130X	----	-----	MD	-----
		CREW ABORT B	CD0131X	----	-----	MD	-----
		EDS ABORT VOTE 1	CD0132X	----	-----	MD	14-22
		EDS ABORT VOTE 2	CD0133X	----	-----	MD	14-22
		EDS ABORT VOTE 3	CD0134X	----	-----	MD	14-22
		EDS ABORT A	CD0135X	----	-----	MD	-----
		EDS ABORT B	CD0136X	----	-----	MD	-----
		MAIN CHUTE DISC A	CE0321X	----	-----	MD	-----
		MAIN CHUTE DISC B	CD0322X	----	-----	MD	-----
		EDS ABORT REQ A	B50080X	----	-----	MD	-----
		EDS ABORT REQ B	B50081X	----	-----	MD	-----
		DOCKING PROBE TEMP	CS0220T	----	-----	MD	-----
		CSM-LM LOCK RING	CD1154X	----	-----	MD	19-23
		SEP RELAY A		----	-----	MD	19-23
		SEP RELAY B		----	-----	MD	19-23
		CSM-LM LOCK RING	CD115X			MD	-----
		LM CURRENT	SC2962C	METER	COMMON	MD	-----

15 CSM GUIDANCE
AND CONTROL



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MISSION RULES

SECTION 15 - GUIDANCE AND CONTROL

REV ITEM:

R	ITEM						
		<p>----- ' SYSTEMS MANAGEMENT ' -----</p>					
15-10		<p>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 DOCKIN ACTIVITIES AFTER OPENING THE APS INTERCONNECT (BOTH VEHICLES IN ACTIVE RCS CONTROL), THE CSM MUST BE IN A TIGHTER DEADBAND THAN THE LM.</p>					
15-11		<p>PIPA AND IRIG BIAS WILL BE UPDATED WHEN ACTUAL BIASES DIFFER FROM VALUES IN CMC ERASABLE BY 0.007 FT/SEC2 AND 0.075 DEG/HR RESPECTIVELY.</p>					
15-12		<p>DELTA V COUNTER DRIFT</p> <p>SHOULD THE DELTA V COUNTER DRIFT BE GREATER THAN 0.01 FT/SEC2 FOR AN RCS MANEUVER, THE VC SETTING WILL BE APPROPRIATELY BIASED. SHOULD THE DRIFT BE GREATER THAN 0.1 FT/SEC2, THE EMS WILL BE CONSIDERED FAILED.</p>					
15-13		<p>DAP INITIALIZATION</p> <p>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 G6N 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.</p> <p>CSM, LM WEIGHT--- WILL 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.</p> <p>RULE NUMBERS 15-14 THROUGH 15-19 RESERVED.</p>					
		MISSION	REV	DATE	SECTION	GROUP	PAGE
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MISSION RULES

SECTION 15 - GUIDANCE AND CONTROL

REV	ITEM	SECTION 15 - GUIDANCE AND CONTROL					
R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS		
				<p style="border: 1px dashed black; padding: 2px;">SPECIFIC MISSION RULES</p>			
	15-20	LOSS OF EITHER BMAG 1 OR 2 IN EITHER PITCH OR YAW CHANNEL	ALL	CONTINUE MISSION	<p>A. REF MALF PROC---</p> <p>G6C-1,3,4+8</p> <p>SCS-1,3,3A,+6</p> <p>B. NO SCS AUTO TVC</p> <p>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.</p>		
	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			
			DESCENT	C. CONTINUE MISSION			
			ALL OTHERS	D. TERMINATE PHASE AND ENTER NEXT BEST PTP	<p>D.1. IN LUNAR ORBIT DO DPS TEI.</p> <p>2. IF STAGED, RETAIN LM ASCENT STAGE FOR TEI.</p> <p>3. IN EARTH ORBIT, LOSS OF PITCH CHANNEL RESULTS IN ALL THREE DEORBIT METHODS BEING SUBJECTED TO SINGLE FAILURES IN THE G6N SYSTEM. THE YAW LOSS PRECLUDES HYBRID DEORBIT AND SUBJECTS BOTH REMAINING DEORBIT METHODS TO SINGLE FAILURES IN THE G6N SYSTEM</p>		
			ENTRY	E. CONTINUE MISSION	E. RSI AND SCS FDAI ROLL UNUSABLE WITH YAW CHANNEL FAILURES.		
	15-22	LOSS OF ROLL BMAG					
		A. NUMBER ONE	ALL	A. CONTINUE MISSION	<p>A.1. MANUAL ROLL ATTITUDE CONTROL REQUIRED IN ALL SCS MODES.</p> <p>2. NO SCS FDAI ROLL. RSI VALID.</p>		
		B. NUMBER TWO	ALL	B. CONTINUE MISSION	<p>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.</p> <p>2. SELECTION OF RATE 1 WILL PROVIDE BOTH RSI AND SCS FDAI ROLL FOR ENTRY. RSI MUST BE REALIGNED FOR ROLL FAILURE AFTER .05G.</p>		
		MISSION	REV	DATE	SECTION	GROUP	PAGE
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MISSION RULES

SECTION 15 - GUIDANCE AND CONTROL

REV ITEM

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS												
	15-23	LOSS OF BOTH ROLL BMAG'S	LAUNCH EO TLC ALL OTHERS	A. CONTINUE MISSION B. ENTER NEXT BEST PTP B.1. NO GO FOR TLI 2. ENTER NEXT BEST PTP IF SM DEORBIT NOT AVAILABLE C. NO-GO FOR LOI D. CONTINUE MISSION	C. NO SCS FDAI ROLL OR RSI AVAILABLE FOR ENTRY.												
	15-24	LOSS OF EITHER TVC SERVO LOOP IN EITHER PITCH OR YAW AXIS	LAUNCH/ EO TLC DESCENT ALL OTHERS	A. CONTINUE ALTERNATE EO MISSION SELECT 1 OR 2 ON TVC GIMBAL DRIVE SWITCH IN APPROPRIATE AXIS B. NO-GO FOR LOI C. CONTINUE MISSION D. TERMINATE PHASE AND ENTER NEXT BEST PTP	- MAINTAIN 20 LBS/QUAD/AXIS FOR HARDOVER RECOVERY FOR UNDOCKED AND --- LBS/QUAD/ AXIS FOR HARDOVER RECOVERY FOR DOCKED SPS MANEUVERS. D. IN LUNAR ORBIT DO DPS TEI.												
	15-25	LOSS OF BOTH TVC SERVO LOOPS	LAUNCH EO TLC DESCENT ALL OTHERS	A. CONTINUE MISSION B. ENTER NEXT BEST PTP RCS DEORBIT C. NO-GO FOR LOI D. CONTINUE MISSION E. TERMINATE PHASE AND ENTER NEXT BEST PTP	A.1. REF MALF PROC G&C-1, G&N-4, SCS-A1 2. NO MODE III OR IV CAPABILITY. LIMITED LANDING POINT CONTROL IN MODE III OR IV WITH SM-RCS. E. IN LUNAR ORBIT DO DPS TEI.												
	15-26	LOSS OF PROPORTIONAL CONTROL FROM— A. EITHER RHC B. BOTH RHC'S	ALL ALL	A. CONTINUE MISSION USE REMAINING RHC B. CONTINUE MISSION USE DIRECT RCS OR ACCEL CMD FOR MANUAL MANEUVERS	B. NO MTVC RATE OR MTVC ACCEL CMD CAPABILITY												
<table border="1"> <tr> <td>MISSION</td> <td>REV</td> <td>DATE</td> <td>SECTION</td> <td>GROUP</td> <td>PAGE</td> </tr> <tr> <td>APOLLO 11</td> <td></td> <td>4/16/69</td> <td>GUIDANCE AND CONTROL</td> <td>SCS</td> <td>15-5</td> </tr> </table>						MISSION	REV	DATE	SECTION	GROUP	PAGE	APOLLO 11		4/16/69	GUIDANCE AND CONTROL	SCS	15-5
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SECTION 15 - GUIDANCE AND CONTROL

REV ITEM

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	ALL	A. CONTINUE MISSION	
		B. BOTH RHC'S	LAUNCH	B.1. CONTINUE MISSION	
			DESCENT	2. CONTINUE MISSION	
			ALL OTHERS	3. TERMINATE PHASE AND ENTER NEXT BEST PTP	B.3. FAILURE VIOLATES DIRECT RCS REQUIREMENT.
	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	
			ALL OTHERS	2. TERMINATE PHASE AND ENTER NEXT BEST PTP USE DIRECT ULLAGE AND DIRECT RCS.	C.2. FAILURE VIOLATES RATE DAMPING REQUIREMENTS.
	15-29	LOSS OF FLIGHT DIRECTOR ATTITUDE INDICATORS			• REF MALF PROC G6C-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	
			DESCNT	3. CONTINUE MISSION	
			ALL OTHERS	C. TERMINATE PHASE AND ENTER NEXT BEST PTP	C. IN LUNAR ORBIT, DO DPS TEI. DO NOT STAGE LM IF STAGED, RETAIN LM ASCENT STAGE FOR TEI USE WINDOW REF.

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SECTION 15 - GUIDANCE AND CONTROL

REV ITEM

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	15-30	LOSS OF AC1 PHASE A			<p>- LOSS OF AC1 PHASE A RESULTS IN THE LOSS OF---</p> <p>A. REDUNDANT SERVO LOOP POWER. BOTH SERVO LOOPS MUST BE POWERED BY THE SAME BUS.</p> <p>B. PROPORTIONAL ATTITUDE CONTROL FROM BOTH RHC'S. ALL PROPORTIONAL CONTROL FROM RHC NO. 1.</p> <p>C. FDAI NO. 1</p> <p>D. GYRO ASSEMBLY NO. 1</p> <p>E. SCS TOTAL ATTITUDE ERROR</p> <p>F. SCS TOTAL ATTITUDE</p> <p>G. SCS AUTO TVC CAPABILITY</p> <p>H. SCS MINIMUM IMPULSE CAPABILITY</p> <p>I. SCS ATTITUDE CONTROL RATE DAMPING</p> <p>J. GPI P6Y DRIVE NO. 1.</p> <p>* IN EARTH ORBIT, LOSS OF AC1 PRECLUDES HYBRID DEORBIT AND SUBJECTS BOTH REMAINING DEORBIT METHODS TO A SINGLE FAILURE (AC2 PHASE A)</p>
			LAUNCH	A. CONTINUE MISSION	
			TLC	B. NO-GO FOR LOI	
			DESCENT	C. CONTINUE MISSION	
			ALL OTHERS	D. TERMINATE PHASE AND ENTER NEXT BEST PTP	D. IN LUNAR ORBIT DO OPS TEL.

MISSION	REV	DATE	SECTION	GROUP	PAGE
APOLLO 11		4/16/69	GUIDANCE AND CONTROL	SCS	15-7

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MISSION RULES

SECTION 15 - GUIDANCE AND CONTROL

REV ITEM

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	15-31	LOSS OF AC2 PHASE A			<p>- LOSS OF AC2 PHASE A RESULTS IN THE LOSS OF---</p> <p>A. REDUNDANT SERVO LOOP POWER</p> <p>B. ALL PROPORTIONAL CONTROL</p> <p>C. FDAI NO. 2</p> <p>D. GYRO ASSEMBLY NO. 2</p> <p>E. SCS PITCH AND YAW TOTAL ATTITUDE</p> <p>F. ALL SCS TVC CAPABILITY (AUTO. RATE AND ACCEL CMD)</p> <p>G. RSI</p> <p>H. GPI P&Y DRIVE NO. 2</p> <p>* IN EARTH ORBIT, LOSS OF AC2 RESULTS IN ALL THREE DEORBIT METHODS BEING SUBJECTED TO A SINGLE FAILURE (AC1 PHASE A).</p>
			LAUNCH	A. CONTINUE MISSION	
			TLC	B. NO-GO FOR LOI	
			DESCENT	C. CONTINUE MISSION	
			ALL OTHERS	D. TERMINATE PHASE AND ENTER NEXT BEST PTP	D. IN LUNAR ORBIT DO DPS TE1.
	15-32	LOSS OF ORBIT RATE DISPLAY (ORDEAL) EARTH AND LUNAR	ALL	CONTINUE MISSION	REF MALF PROC G6C-++5
	15-33	LOSS OF ENTRY MONITOR SYSTEM	ALL	CONTINUE MISSION	-EF MALF PROC EMS-1

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MISSION RULES

SECTION 19 - GUIDANCE AND CONTROL

REV: ITEM

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS		
15-34		GROUND AT EITHER EITHER SPS SOL DRIVER OUTPUT AND UNABLE TO REMOVE	LAUNCH EARTH ORBIT TLC ALL OTHERS	A. CONTINUE MISSION B. CONTINUE ALTERNATE EO MISSION. USE OTHER SPS BANK FOR ENGINE OPERATION C. NO-GO FOR LOI D. CONTINUE MISSION	REF MALF PROC G6C-1		
15-35		LOSS OF TRANSLATION HAND CONTROLLER	LAUNCH EARTH ORBIT TLC LO UNDOCKED ALL OTHERS	A. CONTINUE MISSION B. ENTER NEXT BEST PTP C. CONTINUE MISSION D. NO-GO FOR UNDOCKING E. DOCK F. CONTINUE MISSION	B. VIOLATES BOTH SM AND HYBRID DEORBIT MINIMUM REQUIREMENTS. D. VIOLATES LM RESCUE MINIMUM REQUIREMENTS.		
		RULE NUMBERS 15-36 THROUGH 15-49 ARE RESERVED.					
		MISSION	REV	DATE	SECTION	GROUP	PAGE
		APOLLO 11		4/16/69	GUIDANCE AND CONTROL	SCS	19-9

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MISSION RULES

SECTION 13 - GUIDANCE AND CONTROL

R	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS		
15-50		LOSS OF COMMAND MODULE COMPUTER	LAUNCH	A. CONTINUE MISSION	• REF MALF PROC G6N-5		
			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			
			UNDOCKED	E. DOCK	E. VIOLATES LM RESCUE REQUIREMENTS		
			DESCENT	F. CONTINUE MISSION			
			ENTRY	G. PERFORM BACKUP ENTRY			
			ALL OTHERS	H. TERMINATE PHASE AND ENTER NEXT BEST PTP	H. IN LUNAR ORBIT DO DPS TEI.		
15-51		LOSS OF DSKY			• REF MALF PROC G6C 5		
		A. EITHER MDC OR LEB DSKY	ALL	A. CONTINUE MISSION			
		B. BOTH MDC AND LEB DSKY	EO	B.1. CONTINUE ALTERNATE EO MISSION IF BOTH SPS AND SM DEORBIT CAPABILITY AVAILABLE	B.1. VIOLATES HYBRID DEORBIT MINIMUM REQUIREMENTS		
			TLC	2. NO-GO FOR LOI			
			LO	3. ENTER NEXT BEST PTP			
			UNDOCKED	4. DOCK	4. VIOLATES LM RESCUE MINIMUM REQUIREMENTS		
			DESCENT	5. CONTINUE MISSION			
			ENTRY	6. PERFORM BACKUP ENTRY			
			ALL OTHERS	7. TERMINATE PHASE AND ENTER NEXT BEST PTP	7. IN LUNAR ORBIT DO DPS TEI.		
		MISSION	REV	DATE	SECTION	GROUP	PAGE
		APOLLO 11		4/14/69	GUIDANCE AND CONTROL	G6N	13-10

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MISSION RULES

SECTION 15 - GUIDANCE AND CONTROL

REV ITEM

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS		
	15-54	LOSS OF OPTICS SYBSYSTEM COUPLING DATA UNIT DIGITAL TO ANALOG CONVERTER	LAUNCH EO TLC LO UNDOCKED DESCENT ALL OTHERS	A. CONTINUE MISSION B. CONTINUE ALTERNATE EO MISSION IF BOTH SPS AND SM DEORBIT CAPABILITY AVAILABLE C. NO-GO FOR LOI D. ENTER NEXT BEST PTP E. DOCK F. CONTINUE MISSION G. TERMINATE PHASE AND NEXT BEST PTP	REF MALF PROC G6C-1 CONSTITUTES LOSS OF TVC DAP D. DO DPS TEI		
		RULE NUMBERS 15-55 THROUGH 15-59 ARE RESERVED.					
		MISSION	REV	DATE	SECTION	GROUP	PAGE
		APOLLO 11		4/14/69	GUIDANCE AND CONTROL	G6N	15-12

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MISSION RULES

SECTION 15 - GUIDANCE AND CONTROL - CONCLUDED

REV ITEM

R	ITEM	INSTRUMENTATION REQUIREMENTS					
15-60	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	

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16 CSM SERVICE
PROPULSION
SYSTEM

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MISSION RULES

SECTION 16 - CSM SPS

REV ITEM

REV	ITEM	MISSION	REV	DATE	SECTION	GROUP	PAGE
		APOLLO 11		4/16/69	CSM SPS	GENERAL	16-1
		----- GENERAL -----					
16-1	LAUNCH PHASE THERE ARE NO SPS FAILURES THAT ARE CONSIDERED CAUSE FOR ABORT DURING THE LAUNCH PHASE.						
16-2	REMAINING MISSION PHASES A. FAILURES AFFECTING THE SPS FALL INTO ONE OF THREE CATEGORIES--- 1. FAILURES WHICH CAUSE THE SPS TO BE UNSAFE. FAILURES IN THIS CATEGORY CAUSE THE MISSION TO BE TERMINATED BY ENTRY INTO THE NEXT BEST PTP. 2. FAILURES WHICH CAUSE THE SPS TO BE INOPERABLE OR UNSAFE TO OPERATE. FAILURES IN THIS CATEGORY CAUSE THE MISSION TO BE TERMINATED OR ALTERED SUCH THAT SUBSEQUENT SPS MANEUVERS ARE NOT NECESSARY. 3. FAILURES WHICH DEGRADE THE CAPABILITY OF THE SPS TO A DEGREE THAT REQUIRES THAT ALL PLANNED BURNS EXCEPT CRITICAL BURNS BE INHIBITED. FAILURES IN THIS CATEGORY CAUSE THE MISSION TO BE ALTERED SUCH THAT SUBSEQUENT SPS MANEUVERS ARE NOT NECESSARY, IF POSSIBLE. B. WITH STORAGE TANKS EMPTY, EITHER A TWO-JET OR FOUR-JET ULLAGE MANEUVER IS REQUIRED PRIOR TO ALL NON-CRITICAL BURNS. LACK OF CAPABILITY TO PERFORM AN ULLAGE MANEUVER WILL NOT BE CAUSE FOR INHIBITING A CRITICAL BURN. C. SPS ANOMALIES OR DEGRADATIONS ARE NOT CAUSE FOR TERMINATING A CRITICAL BURN. NO CRITICAL BURNS WILL BE TERMINATED FOR SPS ANOMALIES OR DEGRADATIONS WHICH CAUSE OR COULD LEAD TO UNSAFE CONDITIONS.						
16-3	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.						
16-4	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.						

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MISSION RULES

SECTION 16 - CSM SPS

RIV ITEM

R	ITEM							
	16-5	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.						
	16-6	DESCENT PHASE						
		THE LM POWERED DESCENT WILL BE ABORTED FOR SPS PROPELLANT LEAKS BECAUSE THE CAPABILITY TO PERFORM TEI IS DECREASING WITH TIME.						
	16-7	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. IN ADDITION, THE LUNAR STAY PHASE WILL BE TERMINATED FOR LOSS OF LM RESCUE CAPABILITY.						
	16-8	ASCENT PHASE						
		LM RESCUE IS THE ONLY BURN REQUIRED IN THIS PHASE AND ARE CRITICAL.						
	16-9	TRANSEARTH COAST PHASE						
		CRITICAL BURNS IN THIS PHASE ARE MIDCOURSE CORRECTIONS TO ATTAIN THE PROPER ENTRY CORRIDOR WHICH ARE OUTSIDE SM-RCS CAPABILITY. HOWEVER, ONCE INITIATED, THESE BURNS ARE CONSIDERED NON-CRITICAL BECAUSE SUFFICIENT TIME IS THEN AVAILABLE FOR ANALYSIS AND POSSIBLE CORRECTIVE ACTION.						
			MISSION	REV	DATE	SECTION	GROUP	PAGE
			APOLLO 11		4/16/69	CSM SPS	GENERAL	16-2

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MISSION RULES

SECTION 16 - CSM SPS

REV ITEM

R	ITEM						
		<p>----- ' SYSTEMS MANAGEMENT ' -----</p>					
16-10	PROPELLANT GAGING	<p>A. PRIME METHOD---ONBOARD GAGING SYSTEM(1 PERCENT). B. BACKUP METHOD---FLOW RATE X BURN TIME (3 PERCENT).</p>					
16-11	PROPELLANT UTILIZATION VALVE	<p>THE PU VALVE WILL BE USED TO CONTROL THE O/F MIXTURE RATIO TO MAINTAIN OXIDIZER IMBALANCE WITHIN +- 100 POUNDS.</p>					
16-12	DUAL BANK VS SINGLE BANK OPERATION	<p>THE SPS WILL ALWAYS BE STARTED USING A SINGLE BANK. HOWEVER, THE OTHER BANK WILL BE CLOSED 2 TO 5 SECONDS AFTER IGNITION FOR LOI AND TEI. BANK A WILL BE USED FOR THE FIRST ENGINE IGNITION.</p>					
16-13	PROPELLANT MANAGEMENT	<p>A. THE SPS PROPELLANT REDLINE PRE LOI TO PROVIDE CAPABILITY FOR LOI, CIRCULARIZATION, LOPC TEI AND TEMC FOR THE NOMINAL MISSION IS _____PERCENT INDICATED PROPELLANT REMAINING. B. THE SPS PROPELLANT REDLINE PREUNDOCKING TO PROVIDE CAPABILITY FOR LM RESCUE, TEI AND TEMC FOR THE NOMINAL MISSION IS _____PERCENT INDICATED PROPELLANT REMAINING.</p>					
16-14	PROPELLANT FEEDLINE TEMPERATURE MANAGEMENT	<p>SPS LINE HEATERS WILL BE MANUALLY CYCLED TO MAINTAIN FEEDLINE TEMPERATURES BETWEEN 45 DEG. F AND 75 DEG. F. AND ENGINE VALVE TEMPERA URE ABOVE 45 DEG. F.</p>					
16-15	ULLAGE MANAGEMENT	<p>IN GENERAL, DCKED SPS BURNS REQUIRING ULLAGE WILL BE PRECEDED BY A FOUR-JET ULLAGE - UNDOCKED SPS BURNS BY A TWO-JET ULLAGE. TWO-JET ULLAGE WILL BE USED WHENEVER NECESSARY TO IMPROVE SM RCS PROPELLANT CAPABILITY.</p> <p>RULE NUMBERS 16-16 THROUGH 16-19 ARE RESERVED.</p>					
		MISSION	REV	DATE	SECTION	GROUP	PAGE
		APOLLO 11		4/16/69	CSM SPS	MANAGEMENT	16-3

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MISSION RULES

SECTION 16 - CSM SPS

REV ITEM

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS		
				<div style="border: 1px dashed black; padding: 5px;"> SPECIFIC MISSION RULES </div>			
16-20		SUSTAINED PRESSURE DECAY IN EITHER THE FUEL OR OXIDIZER TANK (COULD BE HELIUM OR FUEL OR OXIDIZER)	LAUNCH	CONTINUE MISSION	<ul style="list-style-type: none"> • MALF PROC--- SPS 18 • MANUAL PRESSURIZATION OF THE TANKS SHOULD BE CONSIDERED PRIOR TO ANY REQUIRED SPS BURN. 		
			EO	ENTER NEXT BEST PTP RCS DEORBIT			
			TLC	NO-GO FOR LOI INHIBIT NON-CRITICAL SPS BURNS			
			LO	PLAN TEI ASAP USE LM DPS IF CAPABILITY EXISTS			
			UNDOCKED	DOCK ASAP	DO NOT STAGE LM		
			DESCENT	ABORT, RETURN TO CSM			
			LUNAR STAY	RETURN TO CSM ASAP			
			TEC	CONTINUE MISSION INHIBIT NON-CRITICAL BURNS			
		A. DURING NON-CRITICAL BURN	ALL	A. TERMINATE BURN			
		B. DURING CRITICAL BURN	ALL	B. CONTINUE BURN			
16-21		LOSS OF ONE GN2 TANK PRESSURE (LESS THAN 400 PSIA)	UNDOCKED LUNAR STAY ALL OTHERS	A.1. REDOCK 2. PERFORM MANEUVER ON SUSPECTED SYSTEM. REF FMR 16-22 B. CONTINUE MISSION	<ul style="list-style-type: none"> • MALF PROC--- SPS 9 • TRANSDUCER INDICATION CANNOT BE VERIFIED WITHOUT ENGINE OPERATION. 		
		MISSION	REV	DATE	SECTION	GROUP	PAGE
		APOLLO 11		4/16/69	CSM SPS	SPECIFIC	16-4

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MISSION RULES

SECTION 16 - CSM SPS

REV ITEM

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS												
	16-22	LOSS OF ONE BANK OF BALL VALVES	LAUNCH/ EO TLC LO UNDOCKED/ DESCENT LUNAR STAY	A. N/A B. NO-GO FOR LOI C. ENTER NEXT BEST PTP USE LM DPS IF AVAILABLE D. N/A E. ENTER NEXT BEST PTP	MALF PROC SPS-9												
	16-23	LOSS OF BOTH GN2 TANK PRESSURES (LESS THAN 400 PSIA)	LAUNCH EO TLC LO UNDOCKED DESCENT LUNAR STAY TEC	A. CONTINUE MISSION B. ENTER NEXT BEST PTP RCS DEORBIT C. NO-GO FOR LOI D. PLAN TEI ASAP WITH LM DPS E. DOCK ASAP F. CONTINUE MISSION G. RETURN TO CSM ASAP H. CONTINUE MISSION	• MALF PROC--- SPS 9 • TRANSDUCER INDICATION CANNOT BE VERIFIED WITHOUT ENGINE OPERATION. E. DO NOT STAGE LM												
A	16-24	FUEL FEEDLINE AND/OR OXIDIZER FEEDLINE TEMP LESS THAN 27 DEG F. AND UNABLE TO INCREASE.	LAUNCH EO TLC LO UNDOCKED	A. CONTINUE MISSION B. ENTER NEXT BEST PTP RCS DEORBIT C. NO-GO FOR LOI D. PLAN TEI ASAP WITH LM DPS E. DOCK ASAP	• MALF PROC--- SPS 11 E. DO NOT STAGE LM												
<table border="1"> <tr> <td>MISSION</td> <td>REV</td> <td>DATE</td> <td>SECTION</td> <td>GROUP</td> <td>PAGE</td> </tr> <tr> <td>APOLLO 11</td> <td></td> <td>4/16/69</td> <td>CSM SPS</td> <td>SPECIFIC</td> <td>16-5</td> </tr> </table>						MISSION	REV	DATE	SECTION	GROUP	PAGE	APOLLO 11		4/16/69	CSM SPS	SPECIFIC	16-5
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MISSION RULES

SECTION 16 - CSM SPS

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS			
16-25		ENGINE FLANGE TEMP GOES HIGHER THAN 480 DEG F DURING AN SPS BURN.	DESCENT LUNAR STAY TEC	F. CONTINUE MISSION G. RETURN TO CSM ASAP H. CONTINUE MISSION	MALF PROC--- SPS 5			
			LAUNCH	NOT APPLICABLE				
			EO	ENTER NEXT BEST PTP				
				RCS DEORBIT				
			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	NOT APPLICABLE				
			EO	ENTER NEXT BEST PTP RCS DEORBIT				
			LC	ENTER NEXT BEST PTP, USE LM DPS IF AVAILABLE				
		A. DURING NON-CRITICAL BURN		A. TERMINATE BURN INHIBIT FURTHER NON-CRITICAL BURNS				
		B. DURING CRITICAL BURN		B. CONTINUE BURN INHIBIT FURTHER NON-CRITICAL BURNS				
16-27		LACK OF ULLAGE CAPABILITY	LAUNCH	A. NOT APPLICABLE	MALF PROC--- SM RCS ---			
			EO	B. NO-GO FOR TLI CONTINUE MISSION IN EO WITH SUITABLE ALTERNATE				
			TLC	C. NO-GO FOR LOI				
			LO	D. ENTER NEXT BEST PTP	PRELUDES LM RESCUE			
			UNDOCKED	E. REDOCK				
		MISSION	REV	DATE	SECTION	GROUP	PAGE	
		APOLLO 11		4/16/69	CSM SPS	SPECIFIC	16-6	

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MISSION RULES

SECTION 16 - CSM SPS

REV	ITEM	R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS	
					ALL OTHERS	F. CONTINUE MISSION INHIBIT NON-CRITICAL BURNS IF POSSIBLE		
		16-28		DELTA P BETWEEN FUEL AND TANK PRESSURES GREATER THAN 20 PSI AND UNABLE TO DECREASE	LAUNCH	CONTINUE MISSION	MALF PROC-- SPS 1C	
					EO	ENTER NEXT BEST PTP RCS DEORBIT		
					TLC	NO-GO FOR LOI		
					LO	PLAN TEI ASAP WITH LM DPS		
					UNDOCKED	DO NOT STAGE LM DOCK ASAP		
					ALL	RETURN TO CSM OR ATTEMPT CSM RESCUE CONTINUE MISSION		
			A. DURING NON-CRITICAL BURN		OTHERS	A. TERMINATE BURN INHIBIT FURTHER NON-CRITICAL BURNS		
			B. DURING CRITICAL BURN			B. CONTINUE BURN INHIBIT FURTHER NON-CRITICAL BURNS		
		16-29		LEAK OR COMPLETE LOSS OF HELIUM SUPPLY PRESSURE OR BOTH HELIUM VALVES FAIL CLOSED.	LAUNCH	A. CONTINUE MISSION	* BLOWDOWN DELTA V REMAINING IS A FUNCTION OF ULLAGE VOLUME AT TIME OF FAILURE. MALF PROC-- SPS 768	
					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		
					UNDOCKED	E. DOCK ASAP	E. NORMAL MISSION PRECLUDES LM RESCUE	
					ALL OTHERS	F. CONTINUE MISSION		
				RULE NUMBERS 16-30 THROUGH 16-49 ARE RESERVED.				
		MISSION	REV	DATE	SECTION	GROUP	PAGE	
		APOLLO 11		4/16/69	CSM SPS	SPECIFIC	16-7	

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MISSION RULES

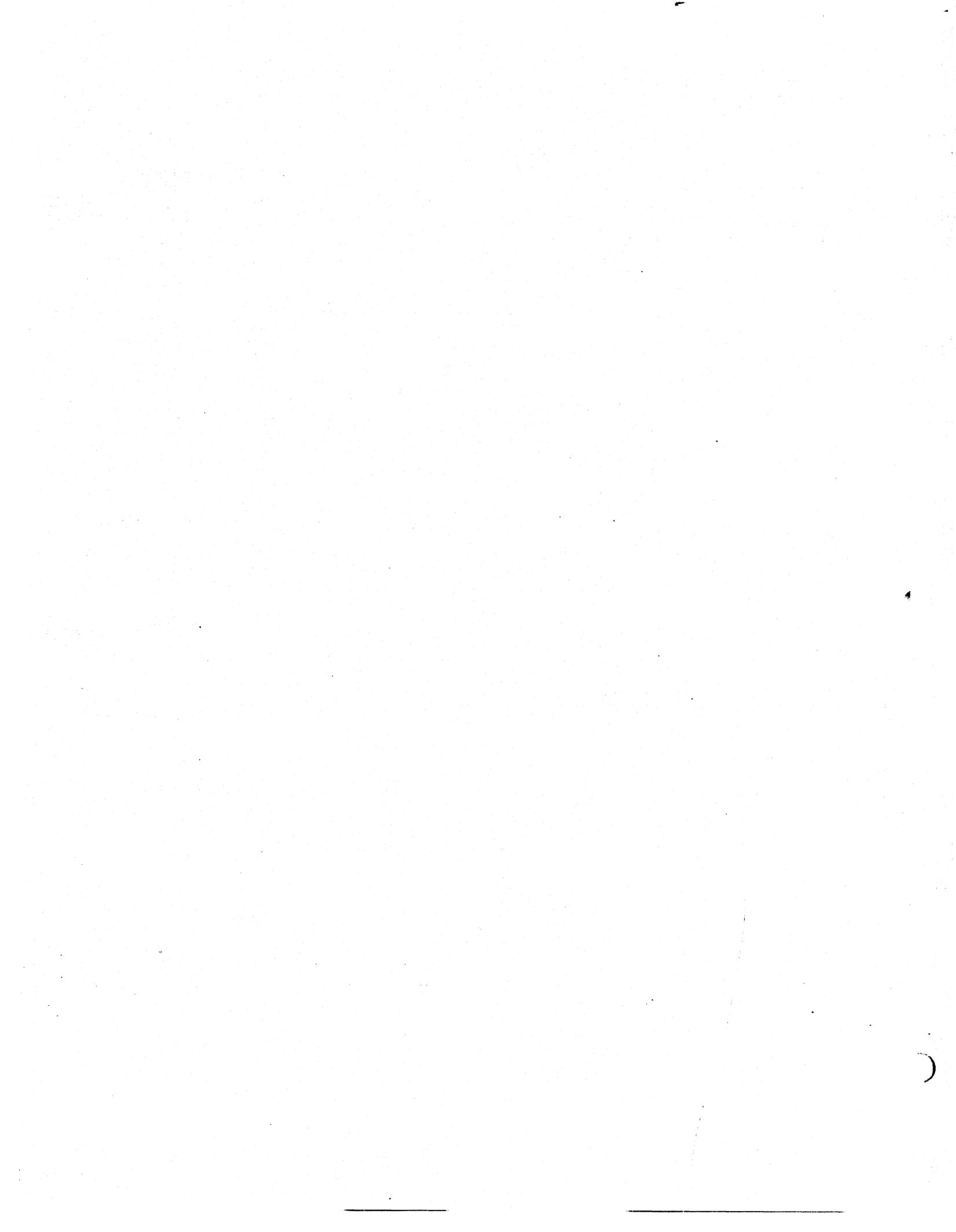
SECTION 16 - CSM SPS - CONCLUDED

REF. ITEM

R	ITEM	INSTRUMENTATION REQUIREMENTS					
	16-50	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	-1 OF 2 M O/B	16-21, 22
		SPS VLV ACT PRESS-SEC	SP0601P	METER	COMMON		16-21, 22
		SPS FU FEEDLINE TEMP	SP0048T	METER	COMMON	-1 OF 2 M	16-24
		SPS OX FEEDLINE TEMP	SP0049T	SYS TEST	COMMON		16-24
		SPS INJ FLANGE TEMP 1	SP0061T	C&W	COMMON	-1 OF 2 M O/B	16-25
		SPS INJ FLANGE TEMP 2	SP0062T	C&W	COMMON		16-25
		ENG CHAMBER PRESS	SP0661P	METER	COMMON	M O/B	16-26
		HE TK PRESS	SP0001P	METER	SEPARATE	HD	16-29
		FU/OX VLV 1 POS	SP0022H	DISPLAY	SEPARATE M	1 OF 2 O/B	16-21, 26
		FU/OX VLV 2 POS	SP0023H	DISPLAY	SEPARATE M		16-21, 26
		FU/OX VLV 3 POS	SP0024H	DISPLAY	SEPARATE M		16-21, 26
		FU/OX VLV 4 POS	SP0025H	DISPLAY	SEPARATE M		16-21, 26
		OX TK 1 QTY - TOTAL AUX	SP0655C	DISPLAY	COMMON	HD	16-10, 11, 13
		OX TK 2 QTY	SP0656C	DISPLAY	COMMON	HD	16-10, 11, 13
		FU TK 1 QTY - TOTAL AUX	SP0657C	DISPLAY	COMMON	HD	16-10, 11, 13
		FU TK 2 QTY	SP0658C	DISPLAY	COMMON	HD	16-10, 11, 13

MISSION	REV	DATE	SECTION	GROUP	PAGE
APOLLO 11		4/16/69	CSM SPS	INSTR REQ	16-8

17 CSM SM-RCS



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MISSION RULES

SECTION 17 - CSM SM-RCS

REV ITEM

R	ITEM						
		<u>GENERAL</u>					
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	<p>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 TL; BE INHIBITED AND MAY LEAD TO EARLY MISSION TERMINATION SINCE THE CAPABILITY TO PERFORM SM OR HYBRID DEORBIT WILL BE AFFECTED.</p> <p>B. LOSS OF TWO OR MORE QUADS IS CAUSE FOR ENTRY INTO THE NEXT BEST PTP.</p> <p>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.</p> <p>2. LOSS OF TWO OPPOSITE QUADS WILL DESTROY THE CAPABILITY TO PERFORM PRECISE 3-AXIS ATTITUDE CONTROL AND PRECLUDES SM OR HYBRID DEORBIT.</p>					
17-3	TRANSLUNAR COAST	LOSS OF ONE QUAD IS NOT, IN ITSELF, CAUSE FOR TERMINATION OF THE MISSION. HOWEVER, CONSIDERING THE EFFECTS OF POSSIBLE SUBSEQUENT QUAD OR JET FAILURES AND LM RCS CAPABILITY, THE TRANSLUNAR COAST PHASE MAY BE TERMINATED BY ENTRY INTO THE NEXT BEST PTP. LOSS OF ONE QUAD IS CAUSE FOR INHIBITING LOI, BECAUSE SUBSEQUENT FAILURE OF QUADS OR JETS IMPAIR ATTITUDE CONTROL OR ULLAGE.					
17-4	LUNAR ORBIT	LOSS OF ONE QUAD IS CAUSE FOR EARLY TERMINATION OF LUNAR ORBIT AND LUNAR STAY PHASES, AND FOR INHIBITING LOI2 AND UNDOCKING, BECAUSE SUBSEQUENT FAILURE OF QUADS OR JETS IMPAIR ATTITUDE CONTROL OR ULLAGE. UNDOCKING WILL BE NO-GO BECAUSE LOSS OF ONE QUAD PRECLUDES CSM ACTIVE DOCKING. LOSS OF TWO QUADS IS CAUSE FOR RETAINING THE LM ASCENT STAGE THROUGH TE; FOR TEMC AND PTC.					
		RULE NUMBERS 17-5 THROUGH 17-14 ARE RESERVED.					
		MISSION	REV	DATE	SECTION	GROUP	PAGE
		APOLLO 11		4/16/69	CSM SM-RCS	GENERAL	17-1

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MISSION RULES

SECTION 17 - CSM SM-RCS

REV ITEM

R	ITEM	MISSION	REV	DATE	SECTION	GROUP	PAGE
		APOLLO 11		4/16/69	CSM SM-RCS	MANAGEMENT	17-2
		<p>----- ' SYSTEMS MANAGEMENT ' -----</p>					
17-15	<p>PROPELLANT GAGING</p> <p>A. PRIME METHOD---RTCC EQUATION (6 PERCENT).</p> <p>B. BACKUP METHOD---HELIUM PRESSURE/TEMPERATURE (11 PERCENT) (ONBOARD)</p>						
17-16	<p>QUAD PROPELLANT BALANCE</p> <p>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.</p>						
17-17	<p>SECONDARY PROPELLANT FUEL PRESSURE VALVE</p> <p>THE RCS SECONDARY FUEL PRESSURIZATION VALVE WILL BE OPENED WHEN THE PRIMARY FUEL MANIFOLD PRESSURE REACHES 190 PSIA.</p> <p>RULE NUMBERS 17-18 THROUGH 17-19 ARE RESERVED.</p>						

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MISSION RULES

SECTION 17 - CSM SM-RCS

REV ITEM

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS	
SPECIFIC MISSION RULES						
17-20	SUSTAINED LEAK IN HELIUM TANK				<ul style="list-style-type: none"> MALF PROC --- RCS --- QUAD WILL REMAIN USABLE UNTIL THE 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) CONTINUE MISSION IF SUFFICIENT BLOWDOWN CAPABILITY EXISTS		
		LO		3. PLAN TEI FOR NEXT OPPORTUNITY		
		UNDOCKED		4. DOCK ASAP		
		DESCENT		5. CONTINUE MISSION		
		LUNAR STAY		6. CONTINUE MISSION WITHIN BLOWDOWN CAPABILITY		
	C. MORE THAN ONE QUAD	EO		C.1. CONTINUE MISSION ENTER PRIOR TO LOSS OF HYBRID DEORBIT CAPABILITY		
		ALL OTHER		2. REF RULING B	C.2. RETAIN LM ASCENT STAGE FOR TEI DEPENDING UPON LM APS/ RCS PROPELLANT REMAINING.	
17-21	SUSTAINED LEAK BELOW THE ISOLATION VALVE (COULD BE HELIUM OR FUEL OR OXIDIZER)				<ul style="list-style-type: none"> MALF PROC --- RCS --- QUAD WILL REMAIN USABLE UNTIL THE 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. ENTER NEXT BEST PTP		
		LO		3. PLAN TEI FOR NEXT OPPORTUNITY		
		UNDOCKED		4. DOCK ASAP		
		DESCENT		5. CONTINUE MISSION		
		LUNAR STAY		6. ENTER NEXT BEST PTP		
	C. MORE THAN ONE	EO		C.1. ENTER NEXT BEST PTP		
		ALL OTHER		2. REF RULING B	C.2. RETAIN LM ASCENT STAGE FOR TEI DEPENDING UPON LM APS/ RCS PROPELLANT REMAINING.	
	MISSION	REV	DATE	SECTION	GROUP	PAGE
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MISSION RULES

SECTION 17 - CSM SM-RCS

REV ITEM

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
17-22		PACKAGE TEMP LESS THAN 55 DEG F. AND UNABLE TO INCREASE	LAUNCH	NOT APPLICABLE	• MALF PROC--- RCS _____
	A. ONE QUAD (ALL OTHER QUADS NORMAL)		EO	A.1. NO-GO FOR TLI	
			TLC	2. ENTER NEXT BEST PTP	
			LO	3. PLAN TEI FOR NEXT OPPORTUNITY	
			UNDOCKED	4. DOCK ASAP	
			DESCENT	5. CONTINUE MISSION	
			LUNAR STAY	6. ENTER NEXT BEST PTP	
	B. MORE THAN ONE QUAD		EO	B.1. ENTER NEXT BEST PTP	
			ALL OTHER	2. REF RULING A	B.2. RETAIN LM ASCENT STAGE FOR TEI DEPENDING UPON LM APS/ RCS PROPELLANT.

MISSION	REV	DATE	SECTION	GROUP	PAGE
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MISSION RULES

REV ITEM: SECTION 17 - CSM SM-RCS

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	LO UNDOCKED ALL OTHERS	A.1. NO-GO FOR UNDOCKING 2. DOCK ASAP 3. CONTINUE MISSION			
	B.	LOSS OF FOLLOWING THRUSTER COMBINATIONS— TWO PITCH OR TWO YAW. ONE PITCH AND ONE YAW. PITCH AND TWO ROLL IN SAME DIRECTION. ONE YAW AND TWO ROLL IN SAME THREE ROLL IN SAME DIRECTION	EO TLC UNDOCKED DESCENT LUNAR STAY	B.1. CONTINUE ALTERNATE EO MISSION IF BOTH SPS AND SM RCS DEORBIT CAPABILITY AND ALL AXIS ATTITUDE CONTROL AVAILABLE 2. NO-GO FOR LOI OPPORTUNITY 4. DOCK ASAP 5. CONTINUE MISSION 6. ENTER NEXT BEST PTP	B.5. RETAIN LM ASCENT STAGE FOR TEI IF LOSS OF ALL THRUSTERS IN ONE DIRECTION IN SAME AXIS		
	C.	LOSS OF 2X THRUSTERS ON ADJACENT QUADS.	ALL	C. INHIBIT NON-CRITICAL SPS BURNS	C. REF SPS RULE 16-27; LACK OF ULLAGE CAPABILITY		
		RULE 17-24 THROUGH 17-49 ARE RESERVED.					
		MISSION	REV	DATE	SECTION	GROUP	PAGE
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MISSION RULES

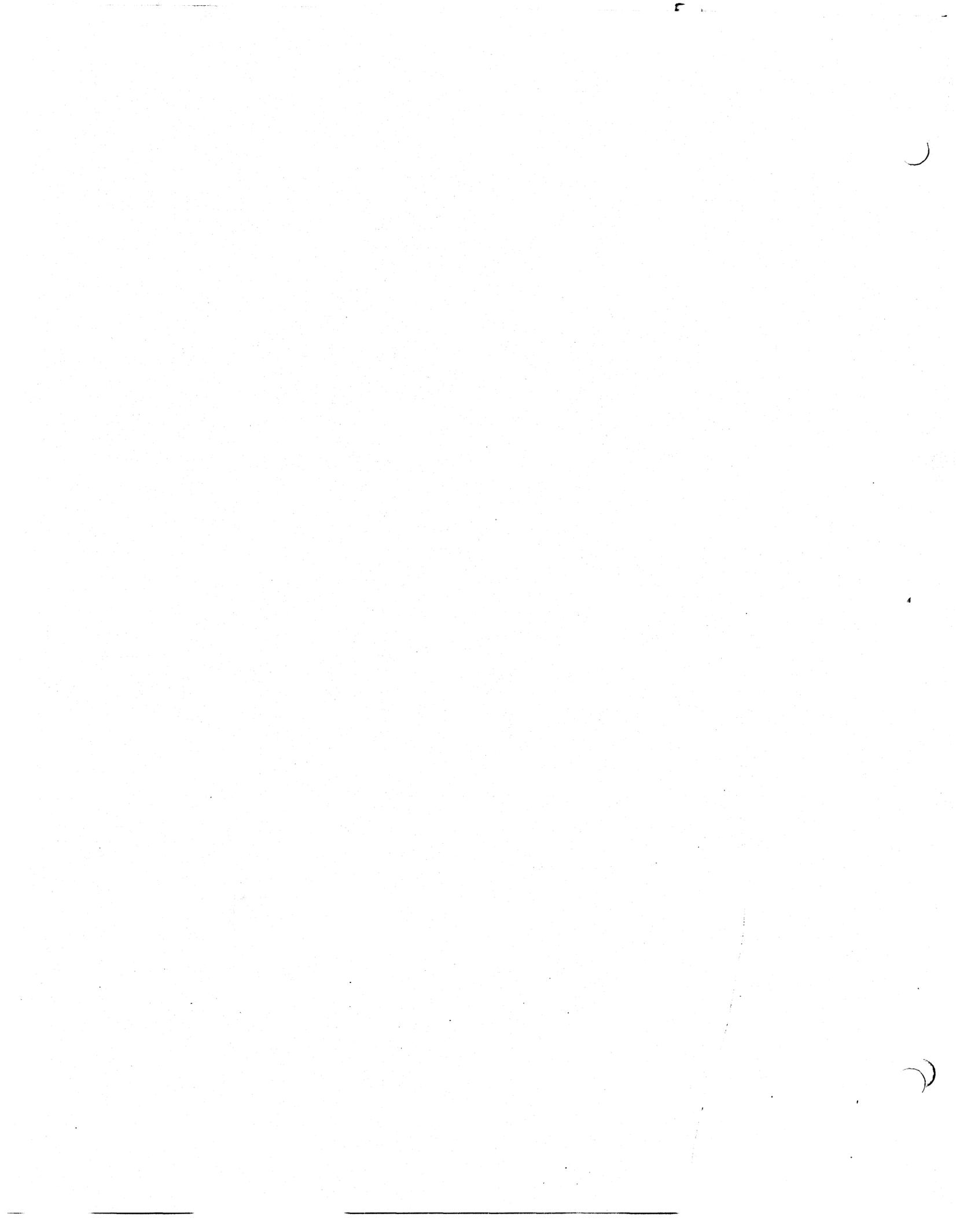
SECTION 17 - CSM SM-RCS - CONCLUDED

REV ITEM

R	ITEM	INSTRUMENTATION REQUIREMENTS					
	17-50	MEAS DESCRIPTION	PCM	ONBOARD	TRANSDUCERS	CATEGORY	MISSION RULE REFERENCE
		SM HE TK A PRESS	SR5001P	METER	COMMON	} -1 OF 2 M	17-20, 21
		QTY SM-RCS PROP SYS A	SR5025Q	METER	COMMON		17-20, 21
		SM HE TK B PRESS	SR5002P	METER	COMMON	} -1 OF 2 M	17-20, 21
		QTY SM-RCS PROP SYS B	SR5026Q	METER	COMMON		17-20, 21
		SM HE TK C PRESS	SR5003P	METER	COMMON	} -1 OF 2 M	17-20, 21
		QTY SM-RCS PROP SYS C	SR5027Q	METER	COMMON		17-20, 21
		SM HE TK D PRESS	SR5004P	METER	COMMON	} -1 OF 2 M	17-20, 21
		QTY SM-RCS PROP SYS D	SR5028Q	METER	COMMON		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

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18 CSM CM-RCS



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MISSION RULES

SECTION 18 - CSM CM-RCS

REV ITEM

R	ITEM													
		<p>----- GENERAL -----</p>												
18-1	LAUNCH	<p>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 PTP 6-4 SINCE SYSTEMS ARE NO LONGER REDUNDANT.</p> <p>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.</p>												
18-2	LUNAR ORBIT, LUNAR STAY PHASES	<p>A. LUNAR ORBIT ACTIVITIES WILL BE CONTINUED FOR LOSS OR IMPENDING LOSS OF ONE CM RCS SYSTEM.</p> <p>B. THESE PHASES WILL ALSO BE CONTINUED IF THE CM-RCS IS ARMED.</p> <p>C. LOSS OF ONE SYSTEM AND ANY DEGRADATION IN THE REMAINING SYSTEM IS CAUSE FOR ENTRY INTO THE NEXT BEST PTP.</p>												
18-3	LM DESCENT PHASE	<p>THERE ARE NO CSM RCS FAILURES THAT ARE CAUSE FOR TERMINATING THE DESCENT PHASE.</p>												
18-4	ALL OTHER PHASES	<p>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.</p> <p>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.</p> <p>RULE NUMBERS 18-5 THROUGH 18-9 ARE RESERVED.</p>												
		<table border="1"> <thead> <tr> <th>MISSION</th> <th>REV</th> <th>DATE</th> <th>SECTION</th> <th>GROUP</th> <th>PAGE</th> </tr> </thead> <tbody> <tr> <td>APOLLO 11</td> <td></td> <td>4/16/69</td> <td>CSM CM-RCS</td> <td>GENERAL</td> <td>18-1</td> </tr> </tbody> </table>	MISSION	REV	DATE	SECTION	GROUP	PAGE	APOLLO 11		4/16/69	CSM CM-RCS	GENERAL	18-1
MISSION	REV	DATE	SECTION	GROUP	PAGE									
APOLLO 11		4/16/69	CSM CM-RCS	GENERAL	18-1									

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MISSION RULES

SECTION 18 - CSM CM-RCS

REV ITEM

R	ITEM						
		----- ' SYSTEMS MANAGEMENT ' -----					
18-10	THRUSTER TEMP CONTROL	<p>CM RCS THRUSTERS WILL 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.</p> <p>HALF PROC RCS ____.</p>					
18-11	HELIUM INTERCONNECT	<p>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. HALF PROC RCS ____.</p> <p>RULE NUMBERS 18-12 THROUGH 18-19 ARE RESERVED.</p>					
		MISSION	REV	DATE	SECTION	GROUP	PAGE
		APOLLO 11		4/16/69	CSM CM-RCS	MANAGEMENT	18-2

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MISSION RULES

SECTION 18 - CSM CM-RCS

REV	ITEM	SECTION 18 - CSM CM-RCS					
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 PTP 6-4			
			LO/DESCENT/LUNAR STAY	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 PTP 2-1. 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 <u>TSD</u> 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 PTP 6-4			
			LO/DESCENT/LUNAR STAY	2. CONTINUE MISSION			
			ALL OTHERS	3. TERMINATE PHASE AND ENTER NEXT BEST PTP			
	B. BOTH RINGS		LAUNCH	B.1. CONTINUE MISSION AND ENTER PTP 2-1. 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 <u>TSD</u> FOR LUNAR RETURN ENTRY.		
		MISSION	REV	DATE	SECTION	GROUP	PAGE
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MISSION RULES

SECTION 18 - CSM CM-RCS

REV ITEM

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS		
	18-22	CM RCS IS ARMED FOR ANY REASON	LO/ DESCENT/ LUNAR STAY ALL OTHERS	CONTINUE MISSION TERMINATE PHASE AND ENTER NEXT BEST PTP			
		RULE NUMBERS 18-23 THROUGH 18-49 ARE RESERVED.					
		MISSION	REV	DATE	SECTION	GROUP	PAGE
		APOLLO 11		4/16/69	CSM CM-RCS	SPECIFIC	18-4

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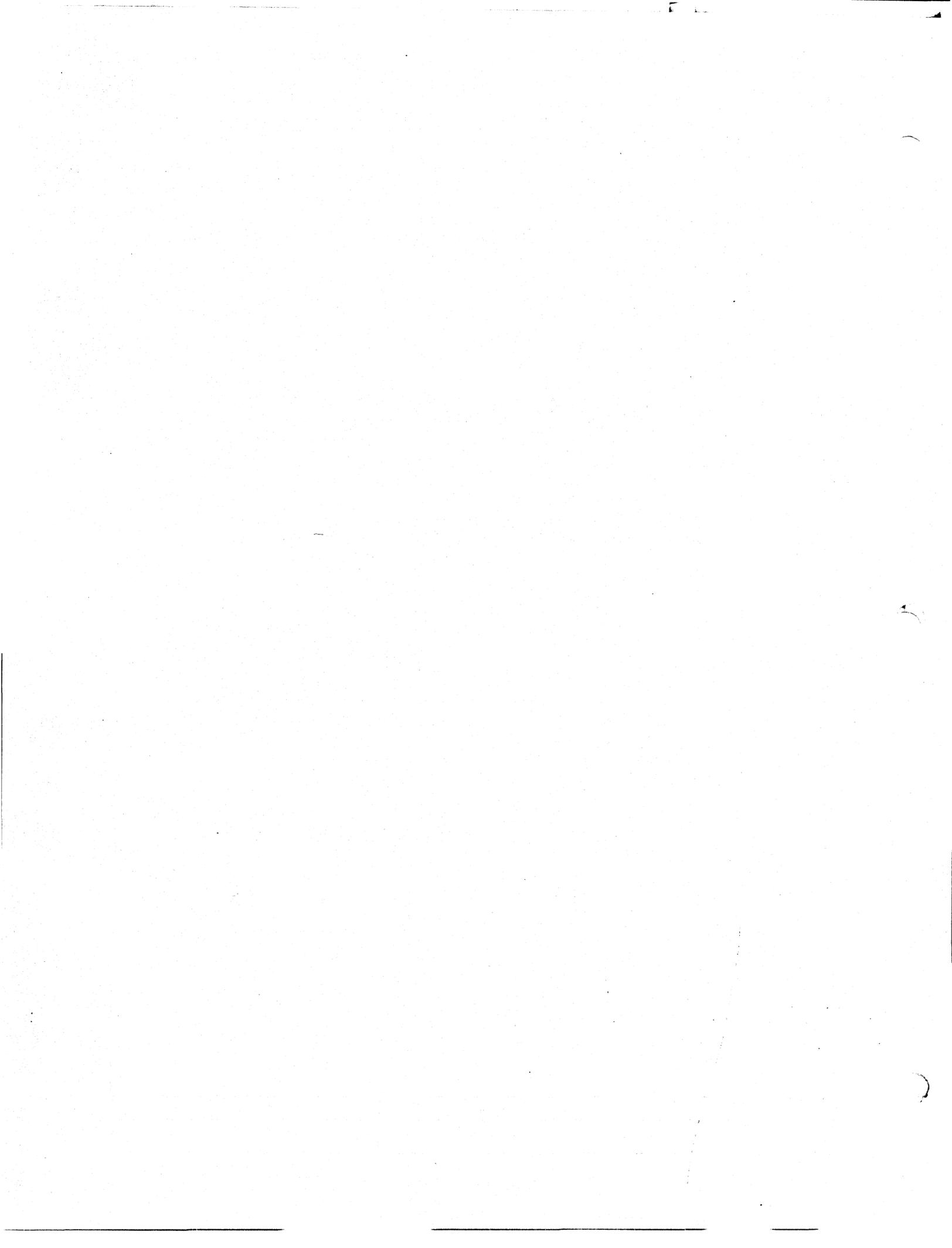
MISSION RULES

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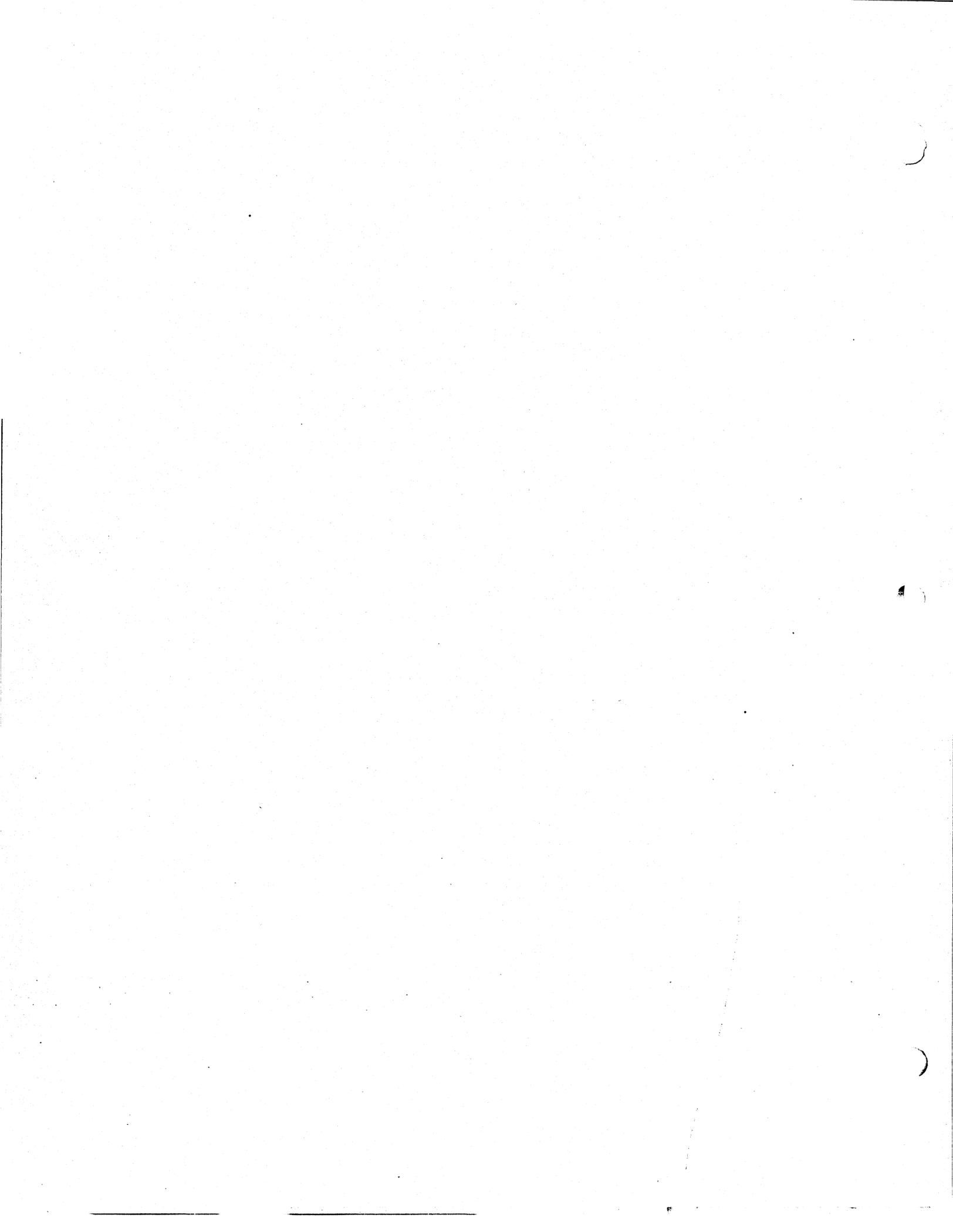
REV ITEM

R	ITEM	----- ' INSTRUMENTATION REQUIREMENTS ' -----					MISSION RULE REFERENCE
	18-50	MEAS DESCRIPTION	PCM	ONBOARD	TRANSDUCERS CATEGORY		
		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	METER/C&W	SEPARATE	M	18-21
		CM HE MNFLD B PRESS	CR0036P	METER/C&W	SEPARATE	M	18-21

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19 EMU/EVA



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MISSION RULES

SECTION 19 - EMU/EVA -

REV ITEM

R	ITEM															
		<p>=====</p> <p>GENERAL</p> <p>=====</p>														
19-1		<p>TO INITIATE AND CONTINUE THE FOLLOWING MISSION PHASES, THE EXTRAVEHICULAR MOBILITY UNIT (EMU) MUST PROVIDE THE FOLLOWING MINIMUM CAPABILITIES---</p> <p>A. DOCKED (TUNNEL HARDWARE INSTALLED)/UNDOCKED/RNDZ</p> <p>TWO LIFE SUPPORT UNITS (PLSS AND OPS OR TWO OPS) PROVIDING SUFFICIENT CONSUMABLES TO SUPPORT A 30-MINUTE CONTINGENCY TRANSFER.</p> <p>B. EVA</p> <p>1. NOMINAL (TWO MAN)</p> <p>TWO EXTRAVEHICULAR MOBILITY UNITS (EMU) WITH SUFFICIENT CONSUMABLES TO SUPPORT CHECKOUT AND THE PLANNED EVA.</p> <p>2. ALTERNATE</p> <p>AN EXTRAVEHICULAR MOBILITY UNIT (EMU) WITH SUFFICIENT CONSUMABLES TO SUPPORT CHECKOUT AND THE ALTERNATE EVA.</p>														
		<p>=====</p> <p>MANAGEMENT</p> <p>=====</p>														
19-2		<p>THE PLSS BATTERY IS CONSIDERED TO HAVE A MINIMUM OF <u>14.3</u> AMP-HR CAPABILITY. THIS CONSUMABLE IS GAGED BY MONITORING GT8140C/GT8240C AND PROCESSING IN THE RTCC TO OBTAIN AMP-HRS.</p>														
19-3		<p>THE PLSS PRIMARY OXYGEN SUBSYSTEM (POS) IS CONSIDERED TO HAVE A MINIMUM SOURCE PRESSURE OF <u>1060</u> PSIA TO SATISFY THE PLANNED EVA. THIS CONSUMABLE IS GAGED BY MONITORING GT8182P/GT8282P AND PROCESSING IN THE RTCC TO OBTAIN LBS MASS.</p>														
19-4		<p>THE PLSS FEEDWATER RESERVOIR IS CONSIDERED TO HAVE A NOMINAL LOADING OF <u>8.5</u> LBS. THIS CONSUMABLE IS GAGED BY MONITORING GT8154T/GT8254T, GT8196T/GT8296T, GT8182P/GT8282P, GT8110P/GT8210P AND PROCESSING IN THE RTCC AND HAND CALCULATIONS TO OBTAIN LBS REMAINING.</p>														
19-5		<p>THE CONTAMINANT CONTROL ASSEMBLY IS CONSIDERED TO HAVE A 4800 BTU TOTAL METABOLIC CAPABILITY. THIS CONSUMABLE (L10H) IS GAGED BY MONITORING POS CONSUMPTION.</p>														
		<p>RULES 19-6 THROUGH 19-19 ARE RESERVED.</p>														
<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 25%;">MISSION</th> <th style="width: 5%;">REV</th> <th style="width: 10%;">DATE</th> <th style="width: 20%;">SECTION</th> <th style="width: 15%;">GROUP</th> <th style="width: 10%;">PAGE</th> <th style="width: 15%;"></th> </tr> </thead> <tbody> <tr> <td>APOLLO 11</td> <td></td> <td>4/16/69</td> <td>EMU/EVA</td> <td>GENERAL/ MANAGEMENT</td> <td>19-1</td> <td></td> </tr> </tbody> </table>			MISSION	REV	DATE	SECTION	GROUP	PAGE		APOLLO 11		4/16/69	EMU/EVA	GENERAL/ MANAGEMENT	19-1	
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MISSION RULES

SECTION 19 - EMU/EVA -

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS		
				----- SPECIFIC -----			
19-20		LOSS OF PRESSURE INTEGRITY	EVA		REF MALF EMU		
	A.	PGA PRESS LESS THAN 3.75 PSIA (TM) AND DECREASING OR PGA PRESS GAGE OF LESS THAN 3.7 PSIA AND DECREASING		A. TERMINATE EVA 1. ACTIVATE OPS 2. INGRESS LM	A. GT8168P/GT8268P PGA PRESS PGA PRESS GAGE LOW PGA PRESS FLAG ANNUNCIATOR HIGH O2 FLOW FLAG ANNUNCIATOR		
	B.	PGA PRESS GREATER THAN 4.05 PSIA (TM) AND INCREASING OR PGA PRESS GAGE OF GREATER THAN 4.0 PSIA AND INCREASING		B. TERMINATE EVA 1. ACTIVATE OPS 2. CLOSE POS SHUTOFF VALVE 3. INGRESS LM	REF MALF EMU B. GT8168P/GT8268P PGA PRESS PGA PRESS GAGE CREW SENSIBLE DETECTION HIGH O2 FLOW FLAG ANNUNCIATOR		
		MISSION	REV	DATE	SECTION	GROUP	PAGE
		APOLLO 11		4/16/69	CEVT	SPECIFIC	19-2

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MISSION RULES

SECTION 19 - EMU/EVA -

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS		
19-21	LOSS OF OXYGEN VENTILATION				REF MALF EMU		
	A. FAN FAILURE	EVA	A. TERMINATE EVA	1. ACTIVATE OPS 2. OPEN PGA PURGE VALVE 3. INGRESS LM ASAP	A. GT8140C/GT8240C PLSS BAT CUR GT8141V/GT8241V PLSS BAT VOLT GT8170T/GT8270T SUBL O2 OUT TEMP LOW VENT FLOW FLAG ANNUNCIATOR		
	B. NOXIOUS ODOR	EVA	B. TERMINATE EVA	1. ACTIVATE OPS 2. OPEN PGA PURGE VALVE 3. INGRESS LM ASAP	B. CREW SENSIBLE DETECTION GT8175P/GT8275P PLSS CO2 PP HIGH CO2 PP FLAG ANNUNCIATOR		
19-22	HUMIDITY CONTROL MALFUNCTION				REF MALF EMU		
	A. DEGRADED OPERATION OF WATER SEPARATOR	EVA	A. CONTINUE MISSION REDUCE WORK PROFILE TO COMPENSATE FOR INCREASED HUMIDITY		A. CREW SENSIBLE DETECTION		
	B. TOTAL LOSS OF WATER SEPARATOR	EVA	B. TERMINATE EVA	1. IF DEMUMIDIFICATION IS REQUIRED, ACTIVATE OPS IN PURGE MODE 2. INGRESS LM ASAP	B. CREW SENSIBLE DETECTION GT8110P/GT8210P FEED H2O PRESS GT8140C/GT8240C PLSS BAT CUR LOW FEED H2O PRESS FLAG ANNUNCIATOR		
RULES 19-23 THRU 19-29 ARE RESERVED.							
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MISSION RULES

SECTION 19 - EMU/EVA -

REV ITEM

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS			
19-30	LOSS OF LIQUID TRANSPORT LOOP THERMAL CONTROL				REF MALF EMU			
	A. DEGRADED CIRCULATION (LESS THAN 3.5 LBS/MIN)	EVA	A. CONTINUE MISSION ADJUST WORK PROFILE TO COMPENSATE FOR DEGRADED COOLING	A. GT8154T/GT8254T LCG H2O TEMP GT8196T/GT8296T LCG H2O AT GT8140C/GT8240C PLSS BAT CUR GT8141V/GT8241V PLSS BAT VOLT GT8110P/GT8210P FEED H2O PRESS CREW SENSIBLE DETECTION REF MALF EMU				
	B. LOSS OF CIRCULATION	EVA	B. TERMINATE EVA 1. IF ADDITIONAL COOLING IS REQUIRED, ACTIVATE OPS IN PURGE MODE 2. INGRESS LM ASAP	B. GT8140C/GT8240C PLSS BAT CUR GT8141V/GT8241V PLSS BAT VOLT GT8154T/GT8254T LCG H2O TEMP GT8196T/GT8296T LCG H2O DELTA T GT8110P/GT8210P FEED H2O PRESS CREW SENSIBLE DETECTION REF MALF EMU				
	C. DEGRADED SUBLIMATOR (LIQUID TRANSPORT LOOP HEAT REJECTION LESS THAN 1250 BTU/HR IN MAX H2O DIVERTER VALVE POSITION)	EVA	C. CONTINUE MISSION 1. ADJUST WORK PROFILE TO COMPENSATE FOR DEGRADED COOLING 2. IF COOLING IS INADEQUATE, CREWMAN MAY ATTEMPT A WET SUBLIMATOR RESTART	C. GT8154T/GT8254T LCG H2O TEMP GT8196T/GT8296T LCG H2O DELTA T GT8110P/GT8210P FEED H2O PRESS GT8170T/GT8270T SUBL O2 OUT TEMP CREW SENSIBLE DETECTION LOW FEED H2O PRESS FLAG ANNUNCIATOR REF MALF EMU				
	D. SUBLIMATOR FAILURE	EVA	D. TERMINATE EVA 1. IF ADDITIONAL COOLING IS REQUIRED, ACTIVATE OPS IN PURGE MODE 2. INGRESS LM ASAP	D. GT8154T/GT8254T LCG H2O TEMP GT8196T/GT8296T LCG H2O DELTA T GT8170T/GT8270T SUBL O2 OUT TEMP				
19-31	FEED H2O PRESSURE DECAY FEED H2O PRESSURE LESS THAN 2.5 PSIA AND DECREASING	EVA	TERMINATE EVA 1. IF ADDITIONAL COOLING IS REQUIRED, ACTIVATE OPS IN PURGE MODE 2. INGRESS LM ASAP	REF MALF EMU GT8110P/GT8210P FEED H2O PRESS GT8154T/GT8254T LCG H2O TEMP GT8170T/GT8270T SUBL O2 OUT TEMP GT8196T/GT8296T LCG H2O DELTA T LOW FEED H2O PRESS FLAG ANNUNCIATOR CREW SENSIBLE DETECTION				
		MISSION	REV	DATE	SECTION	GROUP	PAGE	
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MISSION RULES

SECTION 19 - EMU/EVA -

RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS			
19-32	DEPLETION OF POS POS PRESS LESS THAN <u>152</u> PSIA	EVA	TERMINATE EVA 1. ACTIVATE OPS 2. INGRESS LM	REF MALF EMU GT8182P/GT8282P PLSS O2 PRESS GT8168P/GT8268P PGA PRESS PGA PRESS GAGE LOW PGA PRESS FLAG ANNUNCIATOR PLSS O2 QTY IND			
19-33	LOSS OF MAIN POWER SUPPLY A. PLSS BAT VOLT LESS THAN 16.0 VDC AND DECREASING B. TOTAL AMP-HRS REMAINING LESSER THAN <u>6.0</u> AMP-HRS	EVA EVA	A. TERMINATE EVA 1. ACTIVATE OPS IN A PURGE MODE 2. INGRESS LM ASAP B. TERMINATE EVA	REF MALF EMU A. GT8140C/GT8240C PLSS BAT CUR GT8141V/GT8241V PLSS BAT VOLT CREW SENSIBLE DETECTION LOW VENT FLOW FLAG ANNUNCIATOR B. GT8140C/GT8240C PLSS BAT CUR			
19-34	DEGRADED POWER PROFILE CUR LESS THAN <u>2.0</u> AMP OR CUR GREATER THAN <u>2.0</u> AMP	EVA	CONTINUE MISSION VERIFY PERFORMANCE OF FAN PUMP, AND EVC	REF MALF EMU GT8140C/GT8240C PLSS BAT CUR LOW VENT FLOW FLAG ANNUNCIATOR			
19-35	CO2 PP GREATER THAN <u>10.0</u> MM HG AND INCREASING	EVA	TERMINATE EVA ACTIVATE OPS IN A PURGE MODE INGRESS LM ASAP	GT8175P/GT8275P PLSS CO2 PP HIGH CO2 PP FLAG ANNUNCIATOR			
19-36	LOSS OF TM	EVA	CONTINUE MISSION				
19-37	LOSS OF CRITICAL INSTRUMENTATION	EVA	TERMINATE EVA	REF MR 20-62			
NOTE --- REF SECTION 20 FOR EVA COMMUNICATIONS RULES							
RULES 19-38 THRU 19-40 ARE RESERVED.							
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MISSION RULES

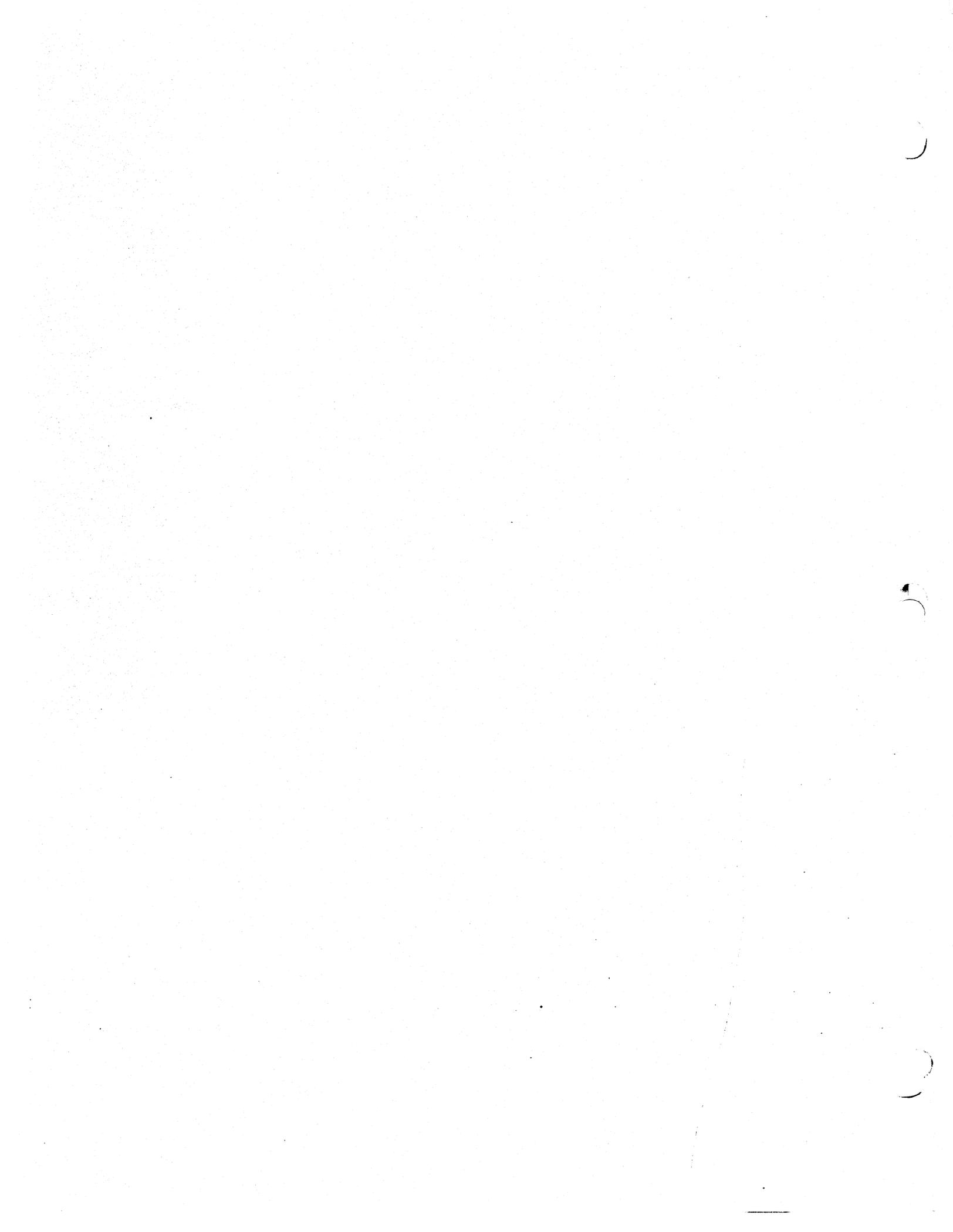
SECTION 19 - EMU/EVA - CONCLUDED

REV ITEM

R	ITEM						
----- INSTRUMENTATION REQUIREMENTS -----							
19-41	MEAS DESCRIPTION	PAM FM/FM	ONBOARD	TRANSDUCERS	CATEGORY	MISSION RULE REFERENCE	
	FEED H2O PRESS	GT8110P/GT8210P		} COMMON	HD		
	LOW FEED H2O PRESS		FLAG ANNUNCIATOR		M		
	PLSS EKG	GT8124J/GT8224J			•		
	PLSS BAT CUR	GT8140C/GT8240C			HD		
	PLSS BAT VOLT	GT8141V/GT8241V			HD		
	LCG H2O TEMP	GT8154T/GT8254T			HD		
	PGA PRESS	GT8168P/GT8268P			HD		
	PGA PRESS GAGE		METER		M		
	LOW PGA PRESS		FLAG ANNUNCIATOR		M		
	SUBL O2 OUT TEMP	GT8170T/GT8270T			HD		
	PLSS CO2 PP	GT8175P/GT8275P			HD		
	HIGH CO2 PP		FLAG ANNUNCIATOR		M		
	PLSS O2 PRESS	GT8182P/GT8282P		} COMMON	HD		
	PLSS O2 QTY IND		METER		M		
	HIGH O2 FLOW		FLAG ANNUNCIATOR		M		
	LOW VENT FLOW		FLAG ANNUNCIATOR		M		
	LCG H2O DELTA T	GT8196T/GT8296T			HD		
	OPS PRESS GAGE		METER		M		
	OPS REG PRESS GAGE		METER		••M		
	HEATER STATUS CHECK		GREEN LIGHTS		1 OF 2M		
	* AEROMEDICAL PARAMETER REFERENCE SECTION 31.						
	**1 OF 2 OPS REG PRESS GAGES IS MANDATORY.						
19-42	CRITICAL INSTRUMENTATION						
	MEAS DESCRIPTION	PAM FM/FM	ONBOARD	TRANSDUCER			
	PLSS O2 PRESS/PLSSO2 QTY IND	GT8182P/ GT8282P	METER	COMMON			
	PGA PRESS GAGE/LOW PGA PRESS FLAG ANNUNCIATOR/PGA PRESS	GT8168P/ GT8268P	METER/TONE- FLAG				
	PLSS CO2 PP/HIGH CO2 PP FLAG ANNUNCIATOR	GT8175P/ GT8275P	METER/TONE- FLAG	} COMMON			
	LOW VENT FLOW FLAG ANNUNCIATOR		TONE-FLAG				

MISSION	REV	DATE	SECTION	GROUP	PAGE	
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20 COMMUNICATIONS/
INSTRUMENTATION



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MISSION RULES

SECTION 20 - COMMUNICATIONS AND INSTRUMENTATION

R	ITEM						
20-1		<p>TO INITIATE THE FOLLOWING MISSION PHASES, THE CSM, LM, AND EVA COMMUNICATIONS AND INSTRUMENTATION SYSTEMS MUST PROVIDE THE FOLLOWING MINIMUM CAPABILITIES---</p> <p style="text-align: center;">NOTE LM-ACTIVE RENDEZVOUS/CONTINGENCY RETURN ASSUMED.</p> <p>A. LAUNCH</p> <p>THERE ARE NO COMMUNICATIONS/INSTRUMENTATION FAILURES FOR WHICH THE LAUNCH/INSERTION PHASE WILL BE TERMINATED.</p> <p>B. ALL PHASES EXCEPT LAUNCH BASELINE REQUIREMENTS</p> <ol style="list-style-type: none"> 1. CRITICAL INSTRUMENTATION (CRITICAL INSTRUMENTATION IS THAT INSTRUMENTATION, ONBOARD OR TM DURING MSFN AOS, OR ONBOARD ONLY DURING MSFN LOS REQUIRED TO VERIFY MISSION GO/NO-GO CRITERIA) 2. TWO-WAY VOICE COMM BETWEEN SPACECRAFT. <p style="text-align: center;">NOTE THIS MAY BE SATISFIED BY UMBILICAL INTERCOM DURING DOCKED PHASES.</p> <ol style="list-style-type: none"> 3. TWO-WAY VOICE COMM BETWEEN CSM OR LM AND MSFN DURING ALL DOCKED ACTIVITIES AND BETWEEN BOTH SPACECRAFT AND MSFN DURING UNDOCKED ACTIVITIES. <p>C. POWERED DESCENT ADDITIONAL REQUIREMENTS</p> <p>LM HBR AND CSM OPERATIONAL TELEMETRY.</p> <p style="text-align: center;">NOTE NO REQUIREMENT FOR ANY VOICE COMM AFTER POI.</p> <p>D. LUNAR STAY ADDITIONAL REQUIREMENTS</p> <ol style="list-style-type: none"> 1. FOR TWO-MAN EVA---VOICE COMM BETWEEN MSFN AND ONE EVA. 2. FOR ONE-MAN EVA---VOICE COMM BETWEEN MSFN AND LM OR EVA. 3. DUPLEX VOICE COMM BETWEEN BOTH EVA CREWMEN. 4. LM LBR TM. <p>E. RENDEZVOUS ADDITIONAL REQUIREMENTS</p> <p>CSM OPERATIONAL TELEMETRY.</p>					
20-2		<p>THE MISSION WILL BE CONTINUED WITH THE LOSS OF---</p> <ol style="list-style-type: none"> A. EITHER OR BOTH THE CSM AND THE LM UPDATA LINKS B. EITHER OR BOTH THE CSM AND THE LM CAUTION AND WARNING SYSTEMS C. EITHER OR BOTH THE CSM DSE AND THE LM DSEA D. THE CSM HIGH GAIN ANTENNA E. EVA TELEMETRY F. EITHER OR BOTH LM AND CSM FM DOWNLINKS G. EITHER OR BOTH LM AND CSM USB RANGING H. V-F RANGING 					
	MISSION	REV	DATE	SECTION	GROUP	PAGE	
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MISSION RULES

SECTION 20 - COMMUNICATIONS AND INSTRUMENTATION

R	ITEM
20-3	<p>VHF EVA COMMUNICATIONS PRIORITIES ARE---</p> <p>A. TWO-MAN EVA</p> <ol style="list-style-type: none"> PRIME---EVA-1 A/EVA-2 A (TRANSMIT TO LM ON 259.7 MHZ, RECEIVE FROM LM 296.8 MHZ) BACKUP---EVA-1 A/EVA-2 B OR EVA-1 B/EVA-2 A (TRANSMIT TO LM ON 259.7 MHZ AND 296.8 MHZ, RECEIVE FROM LM ON 296.8 MHZ) <p>B. ONE-MAN EVA</p> <ol style="list-style-type: none"> PRIME---EVA-1 OR EVA-2 A (TRANSMIT TO LM 259.7 MHZ, RECEIVE FROM LM 296.8 MHZ) BACKUP---EVA-1 OR EVA-2 B (TRANSMIT TO LM 296.8 MHZ, RECEIVE FROM LM 259.7 MHZ)
20--	<p>VOICE CONFIGURATION</p> <p>A. LM/CSM/MSFN</p> <ol style="list-style-type: none"> VHF DUPLEX B AND USB WILL BE TRANSMITTED/RECEIVED SIMULTANEOUSLY FOR LAUNCH AND EARTH ORBIT. (THE BEST QUALITY DOWNLINK WILL BE REMOTED TO HOUSTON). 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. VHF B SIMPLEX 259.7 MHZ IS BACKUP TO VHF A SIMPLEX 296.8 MHZ, BUT WILL BE USED ONLY IF REQUIRED. USB IS PRIME VOICE COMM BETWEEN MSFN AND CSM OR LM USB/VHF RELAY IS VOICE COMM BACKUP TO USB BETWEEN MSFN AND MALFUNCTIONED SFC. NORMAL VOICE COMM WILL USE SIMULTANEOUS MSFN UPLINK TO BOTH VEHICLES; HOWEVER, IF REQUIREMENT SHOULD EXIST, SIMULTANEOUS INDEPENDENT MSFN/CSM AND MSFN/LM COMM MODES WILL BE INITIATED. CSM AND LM WILL TRANSMIT SIMULTANEOUSLY ON VHF AND USB. PRIME MODE FOR VEHICLE-TO-VEHICLE COMM DURING LUNAR STAY IS VIA MSFN RELAY. 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. <p>B. LM/CSM/EVA/MSFN</p> <ol style="list-style-type: none"> LM TWO-WAY RELAY WITH TWO-MAN EVA PRIME MODE IS PLANNED FOR EVA OPERATION. CSM---USB TRANSMIT/RECEIVE ONLY--LM---TRANSMIT VHF A, RECEIVE VHF A AND B; MSFN CONFIGURED FOR USB RELAY. LM TWO-WAY RELAY WITH TWO-MAN EVA BACKUP MODE IS BACKUP FOR EVA OPERATIONS. CSM---USB TRANSMIT/RECEIVE ONLY, LM ---TRANSMIT VHF A, RECEIVE VHF A AND B; MSFN CONFIGURED FOR USB RELAY. LM TWO-WAY RELAY WITH ONE-MAN EVA PRIME OR BACKUP MODE WILL BE USED IF NECESSARY. CSM---USB TRANSMIT/RECEIVE ONLY, LM---TRANSMIT A, RECEIVE VHF A AND B; MSFN CONFIGURED FOR USB RELAY. <p>RULE NUMBERS 20-5 THROUGH 20-9 ARE RESERVED.</p>

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MISSION RULES

SECTION 20 - COMMUNICATIONS AND INSTRUMENTATION

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS		
				----- ' SPECIFIC ' -----			
20-23	LOSS OF LM TM						
	A. LOSS OF LBR ONLY		ALL	A. CONTINUE MISSION	• REF MAL PROC COMM---		
	B. LOSS OF HBR ONLY		ALL	B.1. CONTINUE MISSION	6 MSFN REPORTS LOSS OF PCM		
			DESCENT ORBIT	2. RETURN TO VICINITY OF CSM ASAP NO GO FOR PDI			
	C. LOSS OF ALL TM		DOCKED	C.1. CONTINUE MISSION			
			UNDOCKED	2. RETURN TO VICINITY OF CSM ASAP NO GO FOR DOI			
			DESCENT ORBIT	3. RETURN TO VICINITY OF CSM ASAP NO GO FOR PDI			
			POWERED DESCENT	4. CONTINUE MISSION NO GO FOR LUNAR STAY			
			LUNAR STAY	5. LM LIFTOFF ASAP			
20-24	LOSS OF CRITICAL INSTRUMENTATION		LAUNCH	CONTINUE MISSION			
			EO	NO GO FOR TLI			
			TLC	CONTINUE MISSION			
				NO GO LOI			
			LUNAR ORBIT	NO GO FOR UNDOCKED ACTIVITIES			
			DOCKED	DO NOT UNDOCK			
			UNDOCKED	DOCK ASAP			
20-25	LOSS OF ONE CSM PMP POWER SUPPLY		ALL	CONTINUE MISSION			
20-26	LOSS OF BOTH CSM POWER AMPLIFIERS		EPO	NO GO FOR TLI			
			ALL	CONTINUE MISSION			
		MISSION	REV	DATE	SECTION	GROUP	PAGE
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SECTION 20 - COMMUNICATIONS AND INSTRUMENTATION

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS												
20-27	LOSS OF THE SCE	EPO TLC LUNAR ORBIT LUNAR STAY	EPO TLC LUNAR ORBIT LUNAR STAY	'NO GO FOR TLI 'CONTINUE MISSION 'NO GO FOR LOI 'CONTINUE MISSION 'CONTINUE MISSION													
20-28	LOSS OF TWO CSM AUDIO CENTERS	EPO ALL	EPO ALL	'NO GO FOR TLI 'CONTINUE MISSION													
20-29	LOSS OF VOICE FROM EVA-2 TO EVA-1	DUAL EVA	DUAL EVA	'CONTINUE MISSION 'EVA-2 GO POSITION 'B''	EVA-1 HAS EVC-1 EVA-2 HAS EVC-2												
20-30	LOSS OF VOICE FROM EVA-1 TO EVA-2	DUAL EVA	DUAL EVA	'CONTINUE MISSION 1. EVA-2 GO TO POSITION 'A' 2. EVA-1 GO TO POSITION 'B''													
20-31	LOSS OF DUPLEX VOICE BETWEEN EVA-1 AND EVA-2	DUAL EVA	DUAL EVA	'TERMINATE EVA													
20-32	LOSS OF TWO-WAY VOICE BETWEEN MSFN AND EVA	DUAL EVA	DUAL EVA	'CONTINUE MISSION 1. EVA-2 GO TO POSITION 'A' EVA-2 GO TO POSITION 'B'' 2. IF UNABLE TO RE-ESTABLISH COMM EVA-2 MAY ELECT TO RETURN TO LM AND RECONFIGURE COMM 3. IF UNABLE TO RE-ESTABLISH COMM, TERMINATE EVA.													
<table border="1"> <thead> <tr> <th>MISSION</th> <th>REV</th> <th>DATE</th> <th>SECTION</th> <th>GROUP</th> <th>PAGE</th> </tr> </thead> <tbody> <tr> <td>APOLLO 11</td> <td></td> <td>4/16/69</td> <td>COMMUNICATIONS AND INSTR</td> <td>SPECIFIC</td> <td>20-6</td> </tr> </tbody> </table>						MISSION	REV	DATE	SECTION	GROUP	PAGE	APOLLO 11		4/16/69	COMMUNICATIONS AND INSTR	SPECIFIC	20-6
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MISSION RULES

REV ITEM

SECTION 20 - COMMUNICATIONS AND INSTRUMENTATION

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS		
	20-33	LOSS OF TWO-WAY VOICE BETWEEN MSFN AND BOTH LM AND EVA	ALT EVA (ONE-MAN)	CONTINUE MISSION 1. RECONFIGURE LM TO RE-ESTABLISH COMM 2. IF UNABLE TO RE-ESTABLISH COMM, TERMINATE EVA.			
	20-34	LOSS OF DUPLEX VOICE BETWEEN LM AND EVA	ALT EVA (ONE-MAN)	CONTINUE MISSION 1. RECONFIGURE LM AND EVA TO VHF BACKUP MODE 2. IF UNABLE TO RE-ESTABLISH COMM, TERMINATE EVA			
		RULES 20-35 THROUGH 20-39 ARE RESERVED.					
		MISSION	REV	DATE	SECTION	GROUP	PAGE
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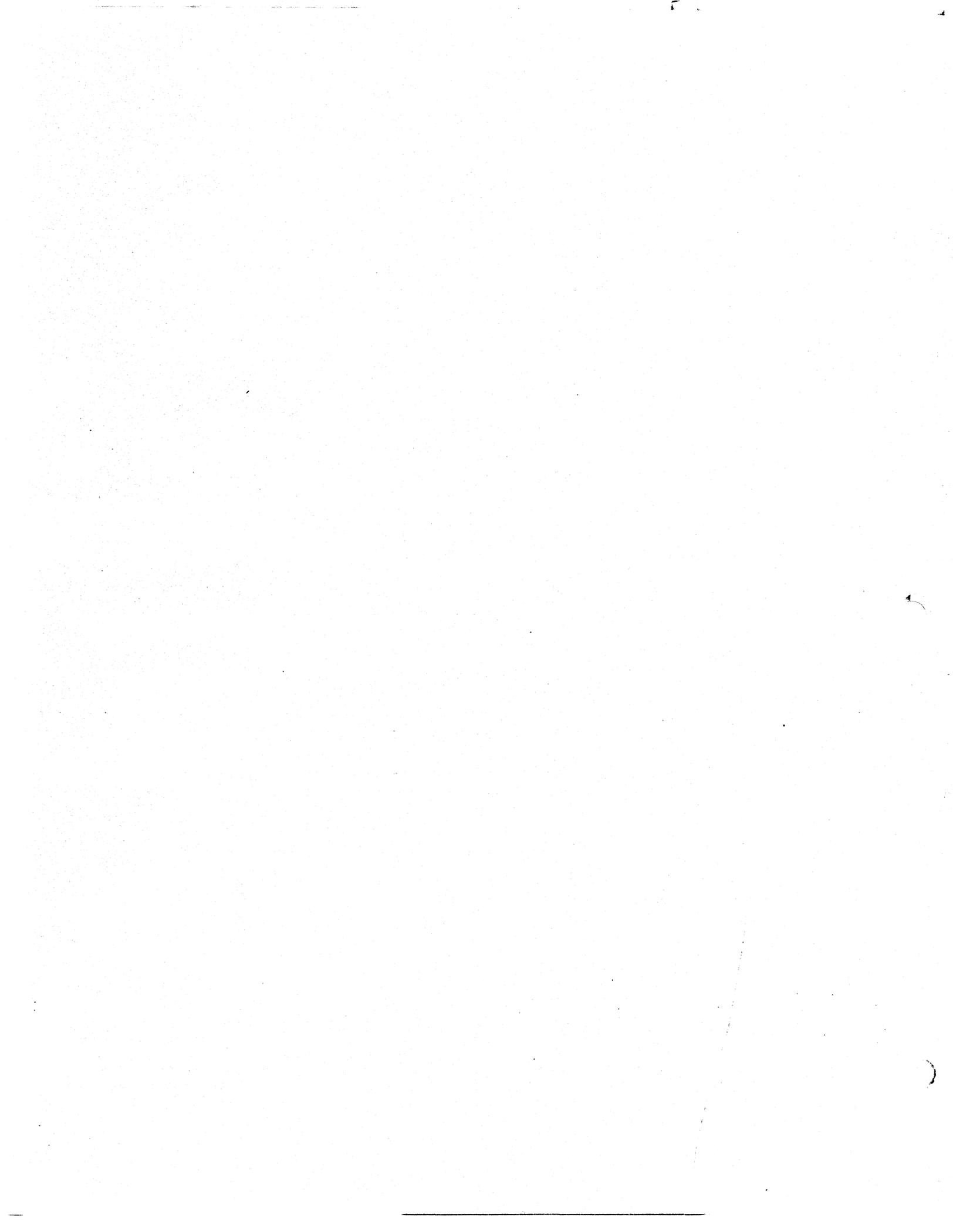
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MISSION RULES

SECTION 20 - COMMUNICATIONS AND INSTRUMENTATION CONCLUDED

MI	ITEM	CSM- INSTRUMENTATION REQUIREMENTS					
20-40	MEAS DESCRIPTION	PCM	ONBOARD	TRANSDUCERS	CATEGORY	MISSION RULE REF	
	LDL VALIDITY SIGNAL	CT0262V	-	-	HD	13-108+108+111	
	USB RECEIVER AGC	CT0620E	METER	COMMON	HD	13-108	
	USB RECEIVER AGC	METER	-	-	HD	13-108	
	USB RECEIVER ERROR	CT0604F	-	-	HD		
	DSE TAPE MOTION	CT0012X	TE	-	HD	13-11	
	CTE TIME	CT0145F	-	-	HD	13-11	
	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	CT0125V	-	-	HD		
LM- INSTRUMENTATION REQUIREMENTS							
20-41	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	GL0501X	-	-	HD		
	CGW PWR FAIL	GL4054X	CAUTION	-	HD	20-24	
	MASTER ALARM	GL4069X	MASTER ALARM	-	HD	20-24	
	DUA STATUS	GT0441X	-	-	HD		
	S-BND ST PH ERR	GT0992B	-	-	HD	20-11	
	S-BND RCVR SIG	GT0994V	METER	-	HD	20-11	
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	APOLLO 11		4/16/69	COMMUNICATIONS AND INSTR	CSM/LM INSTR REQ TS	20-8	

21 LM SEQUENTIAL
AND PYROTECHNIC



NASA - Manned Spacecraft Center

MISSION RULES

SECTION 21 - LM SEQUENTIAL AND PYROTECHNIC

REV ITEM

R	ITEM						
		<p>----- GENERAL -----</p>					
21-1		<p>TO INITIATE THE FOLLOWING MISSION PHASES, THE PYROTECHNIC SYSTEM MUST PROVIDE THE FOLLOWING MINIMUM CAPABILITIES---</p> <p style="text-align: center;">NOTE LM-ACTIVE RENDEZVOUS/CONTINGENCY RETURN ASSUMED</p> <p>A. DOCKED OPERATIONS, UNDOCKING ONE OPERATIONAL PYRO SYSTEM</p> <p>B. DESCENT ORBIT, POWERED DESCENT, LUNAR STAY TWO OPERATIONAL PYRO SYSTEMS</p>					
21-2		<p>DEFINITIONS---</p> <p>LOSS OF PYRO SYSTEM</p> <p>A. PYRO BATTERY OPEN CIRCUIT VOLTAGE LESS THAN 35 VDC</p> <p>B. UNABLE TO ARM SYSTEM</p>					
21-3		<p>A PYRO SYSTEM WILL BE DISABLED IF---</p> <p>A. ANY RELAY K2 THROUGH K6 INADVERTENTLY CLOSES (REF MR 21-13)</p> <p>B. ANY RELAY K7 THROUGH K19 INADVERTENTLY CLOSES. SYSTEM WILL BE USED FOR APS PRESSURIZATION, DPS VENTING AND STAGING</p> <p>A PYRO SYSTEM IS DISABLED BY OPENING THE APPROPRIATE "LOGIC POWER" CIRCUIT BREAKER</p>					
21-4		<p>THE ASCENT AND DESCENT STAGES ARE CONSIDERED NON-RIGIDLY ATTACHED IF THE GUILLOTINE FAILS TO SEVER THE INTERSTAGE UMBILICALS AND ALL OTHER INTERSTAGE ATTACHMENT POINTS HAVE RELEASED.</p> <p>RULE NUMBERS 21-5 THROUGH 21-9 ARE RESERVED.</p>					
		MISSION	REV	DATE	SECTION	GROUP	PAGE
		APOLLO 11		4/16/69	LM SEQUENTIAL AND PYROTECHNIC	GENERAL MANAGEMENT	21-1

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MISSION RULES

SECTION 21 - LM SEQUENTIAL AND PYROTECHNIC

REV ITEM

R	ITEM							
		<p>----- MANAGEMENT -----</p>						
	21-10	<p>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.</p>						
	21-11	<p>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.</p>						
	21-12	<p>UNDOCKED STAGING WITH ONE PYRO SYSTEM WILL BE PERFORMED ONLY IF ABSOLUTELY NECESSARY TO MAINTAIN CREW SAFETY.</p>						
	21-13	<p>FOR A K1 THROUGH K6 FAILURE, THE GOOD SYSTEM WILL BE DISABLED AND A PYRO FUNCTION, OTHER THAN STAGING, ATTEMPTED TO DETERMINE IF K1 HAS FAILED CLOSED. IF BOTH SYSTEMS ARE FAILED IN THIS MODE, THEY MUST BOTH BE TESTED FOR A K1 FAILURE INDEPENDENTLY. A PYRO SYSTEM CANNOT BE DISABLED FOR A K1 FAILURE.</p>						
	21-14	<p>AN ARMED PYRO SYSTEM(S) THAT CANNOT BE DEARMED IS CONSIDERED UNSAFE FOR THE VIBRATION/SHOCK ENVIRONMENT ASSOCIATED WITH LUNAR TOUCHDOWN.</p>						
		<p>RULE NUMBERS 21-15 THROUGH 21-19 ARE RESERVED.</p>						
		MISSION	REV	DATE	SECTION	GROUP	PAGE	
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MISSION RULES

SECTION 21 - LM SEQUENTIAL AND PYROTECHNIC

REV ITEM

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS												
21-22	A RELAY K7 THROUGH K15 INADVERTENTLY CLOSES	ALL			<p>RELAYS</p> <p>K7 EQUALS RCS PRESS</p> <p>K8 EQUALS LAND GEAR DEPLOY</p> <p>K8A EQUALS LAND GEAR DEPLOY</p> <p>K9 EQUALS DPS CRYO HE PRESS</p> <p>K10 EQUALS ASC HE TANK 1</p> <p>K11 EQUALS ASC HE TANK 2</p> <p>K12 EQUALS ASC FUEL AND OX COMP VALVE</p> <p>K12A EQUALS ASC FUEL AND OX COMP VALVES (SYSTEM A ONLY)</p> <p>K13 EQUALS DPS FUEL AND OX VENT</p> <p>K14 EQUALS DPS AMBIENT HE</p> <p>K15 EQUALS DPS FUEL AND OX COMP VALVES</p>												
	A. SYSTEM A			<p>A. CONTINUE MISSION</p> <p>OPEN LOGIC POWER</p> <p>A C/B UNTIL DPS CRYO HE PRESSURIZATION ACCOMPLISHED</p>	<p>A AND B - PRIOR TO DPS CRYO HE PRESS, THE FAILED SYSTEM WILL BE DISABLED FOR ALL PYRO FUNCTIONS. SUBSEQUENTLY, REMAINING PYRO FUNCTIONS WILL BE ACCOMPLISHED USING SYSTEMS A AND B.</p>												
	B. SYSTEM B		<p>B. CONTINUE MISSION</p> <p>OPEN LOGIC POWER</p> <p>B C/B UNTIL DPS CRYO HE PRESSURIZATION ACCOMPLISHED.</p>														
	C. BOTH SYSTEMS		<p>C. 1. CONTINUE MISSION</p> <p>2. PRIOR TO POSITIONING MASTER ARM SW TO ON--- CLOSE DES HE REG 1 AND 2</p> <p>3. OPEN DES HE REG 1 AT TIG OF DPS 1 BURN</p>														
<table border="1"> <thead> <tr> <th>MISSION</th> <th>REV</th> <th>DATE</th> <th>SECTION</th> <th>GROUP</th> <th>PAGE</th> </tr> </thead> <tbody> <tr> <td>APOLLO 11</td> <td></td> <td>4/16/69</td> <td>LM SEQUENTIAL AND PYROTECHNIC</td> <td>SPECIFIC MANAGEMENT</td> <td>21-4</td> </tr> </tbody> </table>						MISSION	REV	DATE	SECTION	GROUP	PAGE	APOLLO 11		4/16/69	LM SEQUENTIAL AND PYROTECHNIC	SPECIFIC MANAGEMENT	21-4
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MISSION RULES

SECTION 21 - LM SEQUENTIAL AND PYROTECHNIC

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	QUES/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		
		E. 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.		
		RULE NUMBERS 21-24 THROUGH 21-49 ARE RESERVED					
		MISSION	REV	DATE	SECTION	GROUP	PAGE
		APOLLO 11		4/16/69	LM SEQUENTIAL AND PYROTECHNIC	SPECIFIC MANAGEMENT	21-5

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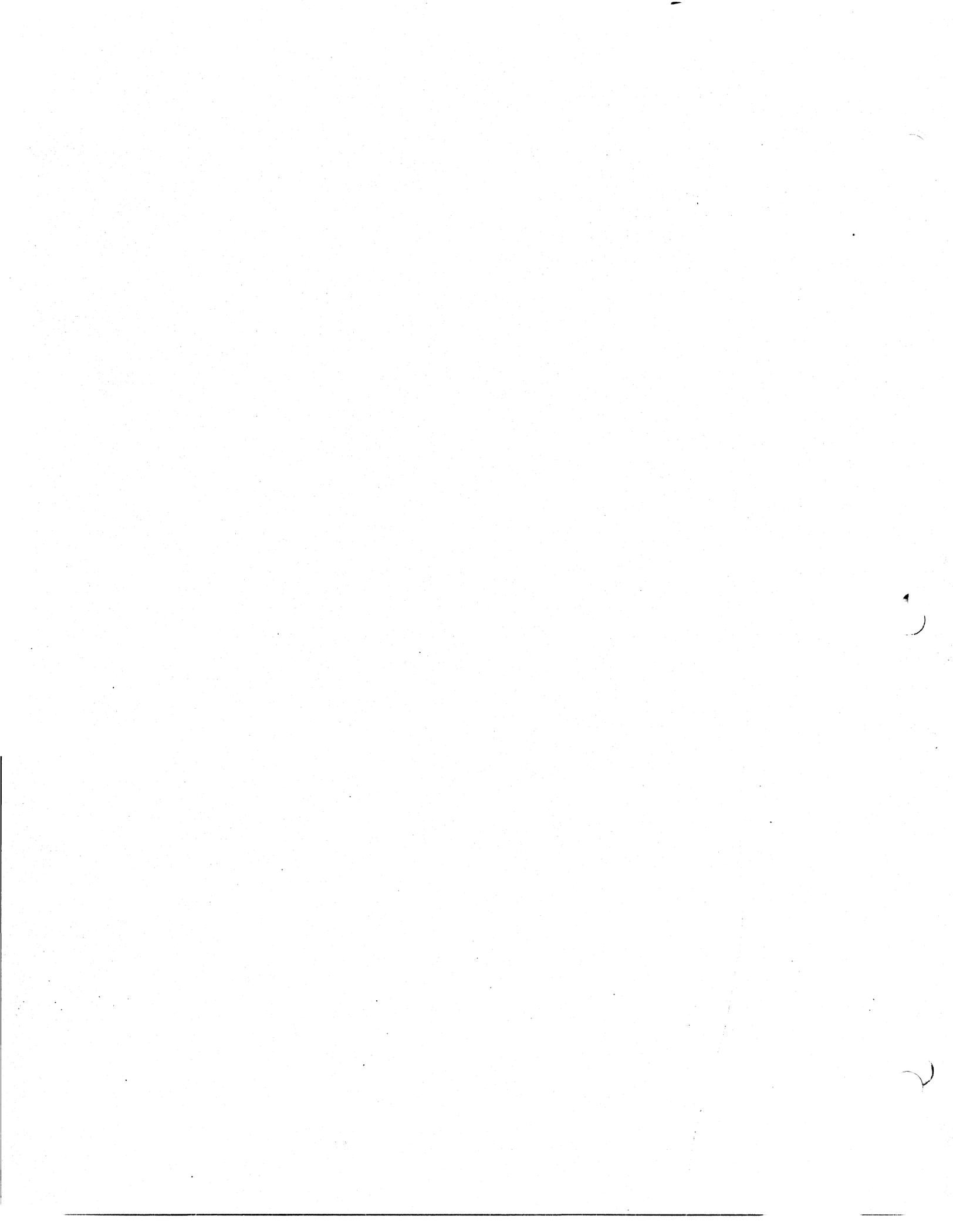
MISSION RULES

SECTION 21 - LM SEQUENTIAL AND PYROTECHNIC - CONCLUDED

R	ITEM	PRELAUNCH INSTRUMENTATION					CATEGORY	MISSION RULE REFERENCE
21-50	MEAS DESCRIPTION	PCM	ONBOARD	COMMON CAUTION LIGHT	M	21-1, 2, 3, 13, 20, 21		
	ED RLY A K1-K6	GY0201X	SYS A STAGING LIGHT	}	HD			
	ED RLY B K1-K6	GY0202X	SYS B STAGING LIGHT		M	21-1, 2, 3, 13, 20, 21		
	ED RLY A K7-K15	GY0231X	-----		M	21-1, 3, 22		
	ED RLY B K7-K15	GY0232X	-----		M	21-1, 3, 22		
	SELECTED ED BAT VOLT	-----	METER		M	21-1, 2, 20		

MISSION	REV	DATE	SECTION	GROUP	PAGE
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22 LM ELECTRICAL
POWER



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MISSION RULES

SECTION 22 - LM ELECTRICAL POWER

R	ITEM							
	22-2	<p>DEFINITIONS---</p> <p>LOSS OF CDR OR LMP BUS</p> <ul style="list-style-type: none"> A. INABILITY TO MAINTAIN BUS VOLTAGE GREATER THAN 26.5 VDC B. A BUS CURRENT GREATER THAN OR EQUAL TO 90 AMPS <p>LOSS OF AN EPS BATTERY</p> <ul style="list-style-type: none"> A. BATTERY OUTPUT LESS THAN 2 AMPS WHEN CONNECTED TO A BUS B. TEMPERATURE GREATER THAN OR EQUAL TO 145 DEG F 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 <p>LOSS OF A DC BUS FEEDER</p> <p style="padding-left: 40px;">CANNOT BE USED AS A POWER PATH</p> <p>LOSS OF OVERCURRENT PROTECTION</p> <ul style="list-style-type: none"> A. DEFINITE LOSS IF--- <ul style="list-style-type: none"> (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 PATH B. PROBABLE LOSS IF--- <ul style="list-style-type: none"> (1) UNABLE TO MEASURE A BATTERY CURRENT BOTH ONBOARD AND ON TELEMETRY (2) UNABLE TO TAKE THE BATTERY OFF LINE <p>LOSS OF AN INVERTER AND/OR ASSOCIATED AC DISTRIBUTION</p> <ul style="list-style-type: none"> 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 <p>RULE NUMBERS 22-3 THROUGH 22-9 ARE RESERVED.</p>						
		MISSION	REV	DATE	SECTION	GROUP	PAGE	
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MISSION RULES

SECTION 22 - LM ELECTRICAL POWER

R	ITEM						
		<p>----- ' MANAGEMENT ' -----</p>					
22-10		<p>THE MISSION WILL BE CONTINUED WITH THE LOSS OF OVERCURRENT PROTECTION-- IF THIS PROTECTION IS LOST PRIOR TO LIFTOFF, A HOLD WILL BE CALLED.</p> <p>A. IF OVERCURRENT PROTECTION IS LOST ON AN INDIVIDUAL DESCENT BATTERY, THE BATTERY WILL BE LEFT ON LINE IF REQUIRED.</p> <p>B. IF ALL DESCENT OVERCURRENT PROTECTION IS LOST, BOTH ASCENT BATTERIES WILL BE PARALLELED WITH THE DESCENT BATTERIES ON LINE.</p> <p>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.</p>					
22-11		<p>FOR NIMINAL STAGING, THE ASCENT BATTERIES WILL BE PRECONDITIONED FOR ONE ASCENT BATTERY OPERATION BY REMOVING 20 AMP-HRS FROM EACH BATTERY IMMEDIATELY PRIOR TO THE EVENT.</p>					
22-12		<p>FOR CONTINGENCY STAGING, THE ASCENT BATTERIES WILL BE PRECONDITIONED FOR TWO ASCENT BATTERY OPERATION BY REMOVING 5 AMP-HRS FROM EACH BATTERY IMMEDIATELY PRIOR TO THE EVENT. THIS IS PRESENTLY PLANNED TO BE ACCOMPLISHED ONLY FOR POWERED DESCENT OR IMMEDIATE LIFTOFF ANOMALIES. IN THE EVENT THAT A BATTERY IS LOST AT, OR SUBSEQUENT TO, STAGING, SINGLE BUS OPERATION WILL BE CONTINUED UNTIL 20 AMP-HOURS HAVE BEEN REMOVED FROM THE REMAINING ASCENT BATTERY.</p>					
22-13		<p>THE BAL LOAD CROSSTIES (30A) WILL BE OPEN FOR MAIN PROPULSION BURNS, STAGING, AND WHENEVER AGS IS IN THE OPERATE MODE. THE BUS CROSSTIES (100A) WILL NOMINALLY NEVER BE CLOSED.</p>					
22-14		<p>FOR TIME CRITICAL SITUATIONS WHERE A REQUIREMENT EXISTS TO DETERMINE THE LOCATION OF A SHORT (BUS OR ASCENT/DESCENT FEEDER), PROCEDURES WILL ALLOW TAKING THE RISK OF INTENTIONALLY FEEDING THE SHORT. IF TIME PERMITS, STANDARD MALFUNCTION PROCEDURES WILL BE FOLLOWED. THE BUSES WILL NEVER BE CROSSTIED TO DETECT THE LOCATION OF A SHORT.</p>					
22-15		<p>THE INVERTERS WILL BE SWITCHED FOR A VOLTAGE LESS THAN OR EQUAL TO 112 VAC OR A FREQUENCY 402 LESS THAN OR EQUAL TO F LESS THAN OR EQUAL TO 398 HZ.</p>					
22-16		<p>BATTERIES WILL BE MANAGED DURING LUNAR STAY TO MAINTAIN EQUAL DISSIPATION OF AVAILABLE ENERGY WITHIN <u>180</u> AMP-HOURS BETWEEN ALL BATTERIES ON LINE.</p>					
		<p>RULE NUMBERS 22-17 THROUGH 22-19 ARE RESERVED.</p>					
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MISSION RULES

SECTION 22 - LM ELECTRICAL POWER

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS		
		(A) IN BOTH ASCENT AND DESCENT BATTERIES TO COMPLETE THE		SPECIFIC			
22-20	LOSS OF EITHER DC BUS	DOCKED ALL	A. TERMINATE LM ACTIVITIES B. DOCK ASAP	REF HALF PROC EPS---	1 UNSTAGED DC BUS 2 STAGED DC BUS 3 UNSTAGED DC BUS W/BUS FAULT 4 STAGED DC BUS W/BUS FAULT 5 UNSTAGED DC BUS W/BAT FAULT 6 STAGED DC BUS W/BAT FAULT 7 UNSTAGED C AND W PWR 8 STAGED C AND W PWR 9 BATTERY LOSS OF DC BUS RESULTS IN LOSS OF ONE PYRO SYSTEM		
22-21	SHORTED DC BUS FEEDER			REF HALF PROC EPS---	5 UNSTAGED DC BUS W/BAT FAULT 6 STAGED DC BUS W/BAT FAULT 7 UNSTAGED C AND W PWR 8 STAGED C AND W PWR		
	A. DESCENT	ALL	A. RETURN TO VICINITY OF CSM CONFIGURE WITH BOTH ASCENT BATTERIES ON NORMAL FEED WITH THE SHORT ISOLATED VIA THE DEADFACE RELAY	A. RESULTS IN LOSS OF ALL DESCENT BATTERIES			
	B. ASCENT	DOCKED ALL	B. 1. TERMINATE LM ACTIVITIES 2. DOCK ASAP				
		MISSION	REV	DATE	SECTION	GROUP	PAGE
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MISSION RULES

SECTION 22 - LM ELECTRICAL POWER

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS												
22-22	LOSS OF ASCENT BATTERY(S) A. LOSS OF ONE ASCENT BATTERY	DOCKED UNDOCKED DESCENT ORBIT POWERED DESCENT	LUNAR STAY	A. 1. CONTINUE MISSION 2. RETURN TO VICINITY OF CSM ASAP. NO GO PDI 3. (A) PDI TO LO GATE - ABORT DELAY STAGING ALAP (B) LO GATE TO TD - CONTINUE MISSION 4. LIFTOFF AT NEXT BEST OPPORTUNITY	REF MALF PROC EPS--- 2 STAGED DC BUS 4 STAGED DC BUS W/BUS FAULT 6 STAGED DC BUS W/BAT FAULT 8 STAGED C AND W POWER 9 BATTERY												
	B. LOSS OF TWO ASCENT BATTERIES	ALL DOCKED POWERED DESCENT		B. 1. DO NOT STAGE - DOCK ASAP 2. DO NOT UNDOCK 3. ABORT													
22-23	LOSS OF DESCENT BATTERIES A. LOSS OF ONE OR TWO DESCENT BATTERIES B. LOSS OF THREE OR MORE DESCENT BATTERIES	ALL DOCKED UNDOCKED DESCENT ORBIT POWERED DESCENT	LUNAR	A. CONTINUE MISSION B. 1. DO NOT UNDOCK 2. RETURN TO VICINITY OF CSM ASAP 3. (A) PDI TO LO GATE - RETURN TO VICINITY OF CSM ASAP (B) LO GATE TO TD - CONTINUE MISSION 4. LIFT OFF AT NEXT BEST OPPORTUNITY	REF MALF PROC EPS--- 1 UNSTAGED DC BUS 3 UNSTAGED DC BUS W/BUS FAULT 5 UNSTAGED DC BUS W/BAT FAULT 7 UNSTAGED C AND W POWER 9 BATTERY												
<table border="1"> <tr> <td>MISSION</td> <td>REV</td> <td>DATE</td> <td>SECTION</td> <td>GROUP</td> <td>PAGE</td> </tr> <tr> <td>APOLLO 11</td> <td></td> <td>4/16/69</td> <td>LM ELECTRICAL POWER</td> <td>SPECIFIC</td> <td>22-6</td> </tr> </table>						MISSION	REV	DATE	SECTION	GROUP	PAGE	APOLLO 11		4/16/69	LM ELECTRICAL POWER	SPECIFIC	22-6
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MISSION RULES

SECTION 22 - LM ELECTRICAL POWER

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS		
	22-24	LOSS OF ONE INVERTER			REF HALF PROC EPS---		
	A.	LOSS OF ONE INVERTER	ALL	1. CONTINUE MISSION	10 INVERTER		
			DESCENT ORBIT	2. DO NOT PERFORM PDI			
	B.	LOSS OF BOTH INVERTERS	DOCKED/ UNDOCKED	1. CONTINUE MISSION NO GO DOI			
			DESCENT ORBIT	2. DO NOT PERFORM PDI			
			POWERED DESCENT	3. (A) PDI TO LO GATE - ABORT (B) LO GATE TO TD - CONTINUE MISSION			
			LUNAR STAY	4. CONTINUE MISSION			
	22-25	LOSS OF AC BUSES			REF HALF PROC EPS---		
	A.	LOSS OF BUS A	DOCKED UNDOCKED	1. CONTINUE MISSION NO GO DOI	10 INVERTER		
			DESCENT ORBIT	2. DO NOT PERFORM PDI	LOSS OF AC BUS A RESULTS IN LOSS OF DPS GIMBAL CONTROL AND THE RENDEZ RADAR		
			POWERED DESCENT	3. (A) PDI TO LO GATE - ABORT (B) LO GATE TO TD - CONTINUE MISSION	LOSS OF AC BUS B RESULTS IN LOSS OF S-BAND STEERABLE ANTENNA (HBR TM)		
			LUNAR STAY	4. CONTINUE MISSION	LOSS OF BOTH AC BUSES RESULTS IN THE ABOVE PLUS LOSS OF BOTH FDAI SPHERES.		
	B.	LOSS OF BUS B	ALL	1. CONTINUE MISSION			
			DESCENT ORBIT	2. DO NOT PERFORM PDI			
	C.	LOSS OF BOTH AC BUSES	DOCKED UNDOCKED	1. CONTINUE MISSION			
			DESCENT ORBIT	2. DO NOT PERFORM DOI			
			POWERED DESCENT	3. DO NOT PERFORM PDI			
			LUNAR STAY	4. (A) PDI TO LO GATE - ABORT (B) LO GATE TO TD - CONTINUE MISSION			
			LUNAR STAY	5. CONTINUE MISSION			
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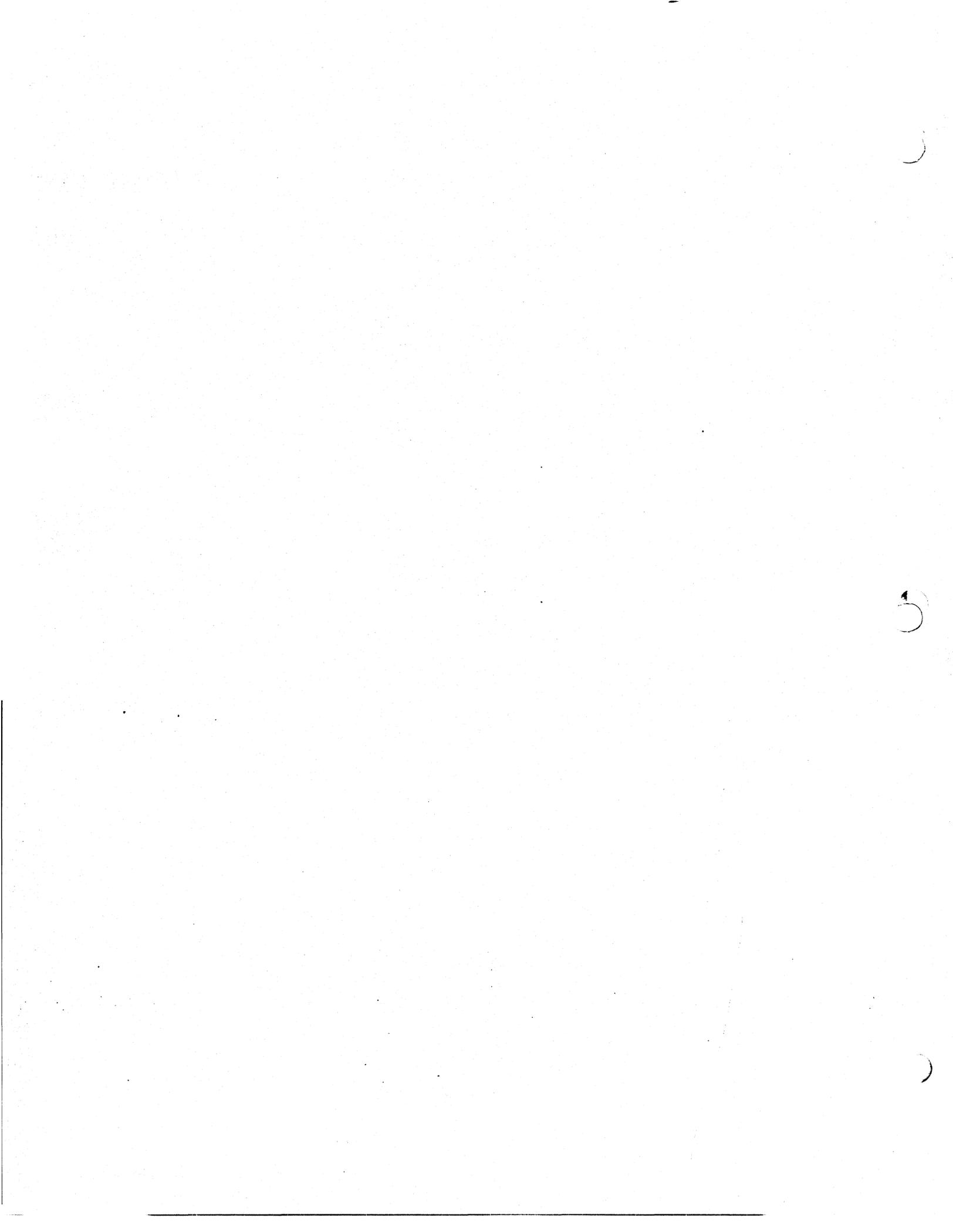
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MISSION RULES

SECTION 22 - LM ELECTRICAL POWER - CONCLUDED

REV	ITEM	SECTION 22 - LM ELECTRICAL POWER - CONCLUDED					
R	ITEM	INSTRUMENTATION REQUIREMENTS					
22-50	MEAS DESCRIPTION	PCM	ONBOARD	CATEGORY	MISSION RULE REFERENCE		
	AC BUS FREQ	GC0155F	CAUTION	(COMMON	M	} 22-2.5,24,25	
	AC BUS VOLTS	GC0071V	METER/CAUTION	LIGHT	M		
	BAT 1 VOLTS	GC0201V	METER	} COMMON METER	HD	} 22-2.10,14 20,21,24	
	BAT 2 VOLTS	GC0202V	METER		HD		
	BAT 3 VOLTS	GC0203V	METER		HD		
	BAT 4 VOLTS	GC0204V	METER		HD		
	BAT 5 VOLTS	GC0205V	METER		M		
	BAT 6 VOLTS	GC0206V	METER		M		
	CDR BUS VOLTS	GC0301V	METER/WARNING	(COMMON	M	} 22-2.10,14 21,22,23	
	LMP BUS VOLTS	GC0302V	METER/WARNING	LIGHT	M		
	BAT 1 CUR	GC1201C	METER	} COMMON METER	M PCM	} 22-2.10,14 20,21,22,23	
	BAT 2 CUR	GC1202C	METER		M PCM		
	BAT 3 CUR	GC1203C	METER		M PCM		
	BAT 4 CUR	GC1204C	METER		M PCM		
	BAT 5 CUR	GC1205C	METER		M PCM		
	BAT 6 CUR	GC1206C	METER		M PCM		
	BAT 1 MAL	GC9961U	CAUTION/COMP	} COMMON LIGHTS	M ONBOARD	} 22-2.10,14,20,21,23	
	BAT 2 MAL	GC9962U	CAUTION/COMP		M ONBOARD		
	BAT 3 MAL	GC9963U	CAUTION/COMP		M ONBOARD		
	BAT 4 MAL	GC9964U	CAUTION/COMP		M ONBOARD		
	BAT 5 MAL	GC9965U	CAUTION/COMP		M ONBOARD		
	BAT 6 MAL	GC9966U	CAUTION/COMP		M ONBOARD		
	BATTERY MAL	GC4047X			HD	22-2.10,20,21,22,23	
	BAT 1 LOW TAP	GC4362X	FLAG		HD	} 22-2.10,20,21,23	
	BAT 2 LOW TAP	GC4364X	FLAG		HD		
	BAT 3 LOW TAP	GC4366X	FLAG		HD		
	BAT 4 LOW TAP	GC4368X	FLAG		HD		
	BAT 5 B/U CDR	GC4369X	FLAG		HD	} 22-2.10,17,20 21,22	
	BAT 6 NORM CDR	GC4370X	FLAG		HD		
	BAT 5 NORM LMP	GC4371X	FLAG		HD		
	BAT 6 B/U LMP	GC4372X	FLAG		HD		

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SECTION 23 - LM ENVIRONMENTAL CONTROL

REV ITEM

R	ITEM						
	23-1	<p>----- ' GENERAL ' -----</p> <p>TO INITIATE THE FOLLOWING MISSION PHASES THE ENVIRONMENTAL CONTROL SYSTEM MUST PROVIDE THE FOLLOWING MINIMUM CAPABILITIES---</p> <p style="text-align: center;">NOTE LM ACTIVE RENDEZVOUS/CONTINGENCY RETURN IS ASSUMED</p> <p>A. DOCKED WITH HATCH OPEN AND TUNNEL CLEAR</p> <ol style="list-style-type: none"> 1. COMBINED VEHICLE PRESSURE INTEGRITY 2. ONE LM COOLANT LOOP <p>B. DOCKED WITH HATCH CLOSED</p> <ol style="list-style-type: none"> 1. CABIN PRESSURE INTEGRITY 2. SUIT CIRCUIT INTEGRITY 3. ONE SUIT FAN 4. ONE DEMAND REGULATOR 5. ONE COOLANT LOOP 6. SUFFICIENT O₂, H₂O, AND LIQH CONSUMABLES TO COMPLETE THE PLANNED ACTIVITY PERIOD PLUS A RESERVE OF 1 HOUR <p>C. UNDOCKED/SEPARATION</p> <ol style="list-style-type: none"> 1. CABIN PRESSURE INTEGRITY 2. SUIT CIRCUIT INTEGRITY 3. ONE SUIT FAN 4. ONE DEMAND REGULATOR 5. ONE COOLANT LOOP 6. BOTH H₂O SEPARATORS OR 1 OF 2 H₂O SEPARATORS PLUS THE LCG LOOP 7. SUFFICIENT O₂, H₂O AND LIQH <ol style="list-style-type: none"> (A) TO COMPLETE THE PLANNED ACTIVITY PLUS A RESERVE OF 2 HOURS (B) IN EACH ASCENT H₂O TANK TO PROVIDE A 2-HOUR CONTINGENCY RETURN CAPABILITY (C) IN BOTH ASCENT O₂ TANKS TO PROVIDE A 2-HOUR CONTINGENCY RETURN CAPABILITY <p style="text-align: center;">NOTE TO CONTINUE LANDING MISSION, SEE POWERED DESCENT CONSUMABLES REQUIREMENTS.</p>					
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SECTION 23 - LM ENVIRONMENTAL CONTROL

R	ITEM						
		<p>D. DESCENT ORBIT</p> <ol style="list-style-type: none"> 1. CABIN PRESSURE INTEGRITY 2. SUIT LOOP INTEGRITY 3. ONE SUIT FAN 4. ONE DEMAND REGULATOR 5. BOTH COOLANT LOOP 6. PRIMARY H2O FEEDPATH CAPABILITY 7. BOTH H2O SEPARATORS OR 1 OF 2 H2O SEPARATORS PLUS THE LGC LOOP 8. SUFFICIENT O2, H2O, AND LIQH <ul style="list-style-type: none"> (A) TO COMPLETE THE PLANNED ACTIVITY PLUS A RESERVE OF 2 HOURS. (B) IN EACH ASCENT H2O TANK TO PROVIDE A 5-HOUR CONTINGENCY RETURN CAPABILITY (C) IN BOTH ASCENT O2 TANKS TO PROVIDE A 5-HOUR CONTINGENCY RETURN CAPABILITY <p style="text-align: center;">NOTE</p> <p style="text-align: center;">TO CONTINUE MISSION, SEE POWERED DESCENT CONSUMABLE REQUIREMENTS.</p> <p>E. POWERED DESCENT</p> <ol style="list-style-type: none"> 1. CABIN PRESSURE INTEGRITY 2. SUIT LOOP INTEGRITY 3. BOTH SUIT FANS 4. ONE DEMAND REGULATOR 5. BOTH COOLANT LOOPS 6. PRIMARY H2O FEEDPATH CAPABILITY 7. BOTH H2O SEPARATORS OR 1 OF 2 H2O SEPARATORS PLUS THE LGC LOOP 8. SUFFICIENT O2, H2O, AND LIQH--- <ul style="list-style-type: none"> (A) CARTRIDGES TO COMPLETE A NOMINAL LUNAR LANDING, A 4-HOUR LUNAR STAY, PLUS A LUNAR STAY RESERVE OF 2 HOURS (B) IN EACH ASCENT H2O TANK TO ACCOMPLISH LIFTOFF RENDEZVOUS/DOCKING /CREW TRANSFER AND COMBINED IN BOTH TANKS TO ACCOMPLISH A 2-HOUR LUNAR STAY (IN-PHASE LIFTOFF), RENDEZVOUS DOCKING/ CREW TRANSFER, PLUS AN ORBITAL RESERVE OF 2 HOURS (C) IN EITHER ASCENT O2 TANK TO ACCOMPLISH LIFTOFF RENDEZVOUS/DOCKING/CREW TRANSFER OPERATION IN AN OPEN SUIT LOOP MODE AND IN BOTH ASCENT O2 TANKS TO ACCOMPLISH A 2-HOUR LUNAR STAY (IN-PHASE LIFTOFF), RENDEZVOUS/DOCKING/CREW TRANSFER, PLUS AN ORBITAL RESERVE OF 2 HOURS OPERATING IN A CLOSED SUIT LOOP MODE 					
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SECTION 23 - LM ENVIRONMENTAL CONTROL

PL. ITEM

R	ITEM						
		<p>F. LUNAR STAY</p> <ol style="list-style-type: none"> 1. CABIN PRESSURE INTEGRITY 2. SUIT LOOP INTEGRITY 3. BOTH SUIT FANS 4. BOTH COOLANT LOOPS 5. PRIMARY H2O FEEDPATH 6. BOTH H2O SEPARATORS OR 1 OF 2 H2O SEPARATORS PLUS THE LCG LOOP 7. SUFFICIENT AVAILABLE O2 AND H2O <ul style="list-style-type: none"> (A) IN THE DESCENT TANK TO ACCOMPLISH A NOMINAL 22-HOUR LUNAR STAY PLUS A LUNAR STAY RESERVE OF 2 HOURS (B) IN EACH ASCENT H2O TANK TO ACCOMPLISH LIFTOFF/ RENDEZVOUS/DOCKING/CREW TRANSFER AND IN BOTH TANKS TO ACCOMPLISH A 2-HOUR LUNAR STAY (IN-PHASE LIFTOFF); RENDEZVOUS/DOCKING/CREW TRANSFER PLUS AN ORBITAL RESERVE OF 2 HOURS (C) IN EITHER ASCENT O2 TANK TO ACCOMPLISH LIFTOFF/ RENDEZVOUS TRANSFER OPERATING IN AN OPEN SUIT LOOP MODE AND IN BOTH ASCENT O2 TANKS TO ACCOMPLISH A 2 HOURS LUNAR STAY (IN-PHASE LIFTOFF), RENDEZVOUS/DOCKING/CREW TRANSFER PLUS AN ORBITAL RESERVE OF 2 HOURS OPERATING IN A CLOSED SUIT LOOP MODE 8. SUFFICIENT LIQH FOR A 22-HOUR LUNAR STAY, LIFTOFF/ RENDEZVOUS/ DOCKING/CREW TRANSFER, PLUS A RESERVE OF 4 HOURS <p>G. LM-ACTIVE RENDEZVOUS/DOCKING</p> <ol style="list-style-type: none"> 1. ONE COOLANT LOOP 2. ONE H2O FEEDPATH 3. ONE H2O SEPARATOR OR THE LCG LOOP 4. ONE ASCENT H2O TANK 5. SUFFICIENT H2O TO ACCOMPLISH RENDEZVOUS/DOCKING 					
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SECTION 23 - LM ENVIRONMENTAL CONTROL

RULE ITEM

R	ITEM						
23-2		<p>DEFINITIONS---</p> <p>LOSS OF CABIN INTEGRITY</p> <p>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 0.6 LBS/HR. FOR DOCKING ACTIVITIES. THIS WILL BE RELAXED TO A FLOW RATE OF 6 LBS/HR.</p> <p>LOSS OF SUIT INTEGRITY</p> <p>TOTAL PGA/SUIT LOOP LEAKAGE GREATER THAN OR EQUAL TO 0.3 PSI/MIN (0.6 LBS/HR) DURING SUIT LOOP PRESSURE CHECK OR A VISIBLE TEAR IN THE PGA.</p> <p>LOSS OF COOLANT LOOP</p> <p>A. SUSTAINED GLYCOL TEMPERATURE GREATER THAN OR EQUAL TO 50 DEGREE F AND RISING EXCEPT DURING COOLANT LOOP STARTUP AND DRYOUT (SUBLIMATOR LOST)</p> <p>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).</p> <p>GLYCOL COOLANT LEAK</p> <p>OBSERVED FLUID IN CABIN CONFIRMED BY TASTE OR PRESENCE OF GLYCOL LOW INDICATION CONFIRMED BY STATIC PRESSURE DROP.</p> <p>LOSS OF DESCENT O2 TANK</p> <p>INABILITY TO TRANSFER O2 FROM DESCENT TANK OR MSFN CONFIRMATION OF INADEQUATE DESCENT TANK PRESSURE WITH O2 MANIFOLD PRESSURE.</p> <p>LOSS OF ASCENT O2 TANK</p> <p>A. MSFN CONFIRMATION OF LOSS OF ASCENT TANK PRESSURE WITH O2 MANIFOLD PRESSURE-- OR</p> <p>B. IF UNSTAGED AND DESCENT TANK GREATER THAN 35 PERCENT, CREW CONFIRM LOSS BY BALANCING ONE TANK AGAINST THE OTHER-- OR</p> <p>C. IF STAGED OR IF DESCENT O2 LESS THAN 35 PERCENT, LOSS OF ONBOARD AND MSFN READOUT.</p> <p>LOSS OF DESCENT H2O TANK</p> <p>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).</p> <p>LOSS OF ASCENT H2O TANK</p> <p>A. LOSS OF MEASUREMENT AND REMAINING TANK FEEDING AT TWICE NORMAL RATE</p> <p>B. ONE TANK FEEDING TWICE NORMAL RATE AND NO CHANGE IN MEASUREMENT ON OTHER TANK.</p>					
23-3		<p>IF A SUBLIMATOR IS LOST DUE TO BREAKTHROUGH, NO RESTART ATTEMPT WILL BE MADE.</p>					
23-4		<p>OXYGEN PURGE SYSTEM AND PLSS CONSUMABLES WILL BE RESERVED FOR POSSIBLE EVT AND WILL NOT BE CONSIDERED FOR NOMINAL REDLINE USAGE.</p>					
23-5		<p>OXYGEN CONTAINED IN THE LM CABIN WILL BE CONSIDERED UNAVAILABLE FOR A USE IN CALCULATING CONSUMABLE GO/NO-GO'S OR REDLINES. THE CABIN CAN BE CONSIDERED, WHEN DISCUSSING FUNCTIONAL PRESSURE VESSEL REQUIREMENTS, AS A THIRD ORDER BACKUP TO THE ASCENT O2 TANKS.</p>					
		<p>RULE NUMBERS 23-6 THROUGH 23-9 ARE RESERVED.</p>					
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SECTION 23 - LM ENVIRONMENTAL CONTROL

REV ITEM

R	ITEM						
		<p>----- ' SYSTEMS MANAGEMENT ' -----</p>					
23-10	PRIMARY GLYCOL LOOP CIRCULATION WILL BE DISCONTINUED DURING STARTUP OF THE SECONDARY LOOP BUT MAY BE REINITIATED FOLLOWING SEC LOOP STABILIZATION IF DEEMED NECESSARY.						
23-11	IF EITHER ASCENT O2 TANK IS LESS THAN OR EQUAL TO 95 PERCENT, IT WILL BE REPLENISHED FROM THE DESCENT O2 WHEN THE DESCENT TANK QUANTITY IS GREATER THAN OR EQUAL TO 35 PERCENT AND AS CLOSE TO STAGING AS POSSIBLE.						
23-12	THE PLSS FILL VALVE WILL BE CLOSED, EXCEPT FOR REPRESSURIZING THE PLSS AND FOR MSFN REQUESTED READOUTS OF O2 MANIFOLD PRESSURE.						
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.						
		<p>RULE NUMBERS 23-14 THROUGH 23-19 ARE RESERVED.</p>					
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REV ITEM

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	23-21	LOSS OF SUIT LOOP INTEGRITY	DOCKED	CONTINUE MISSION	• REF MALF ECS---
				1. PERFORM SYSTEMS EVALUATION WITHIN CONSUMABLES LIFETIME CONSTRAINTS WITH ONE CREWMAN ON BOTH THE CSM AND LM UMBILICALS	3A SUIT FAN
				2. NO-GO FOR UNDOCKING	
			UNDOCKED	DOCK ASAP	
				DO NOT STAGE WHILE UNDOCKED	
				NO-GO FOR DOI	
			DESCENT ORBIT	DOCK ASAP	
				DO NOT STAGE WHILE UNDOCKED	
			POWERED DESCENT	1. PDI TO PDI +5 - ABORT	
				DOCK ASAP	
				DO NOT STAGE WHILE UNDOCKED	
				2. PDI +5 TO TD - ABORT	
				DOCK ASAP	
			LUNAR STAY	LIFTOFF AT NEXT BEST OPPORTUNIGY	
			RNDZ	CONTINUE MISSION DOCK ASAP	

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REV ITEM

SECTION 23 - LM ENVIRONMENTAL CONTROL

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS												
	23-23	LOSS OF H2O SEPARATOR(S) AND/OR LCG LOOP			REF MALF PROC ECS--- 7B ECS												
		A. ONE H2O SEPARATOR (LCG LOOP OPERABLE)	ALL	A. CONTINUE MISSION													
		B. TWO H2O SEPARATORS (LCG LOOP OPERABLE) OR ONE H2O SEPARATOR AND LCG LOOP	DOCKED	B.1. CONTINUE MISSION													
			UNDOCKED DESCENT ORBIT	2. DOCK ASAP DO NOT STAGE WHILE UNDOCKED													
			POWERED DESCENT	3.(A) PDI TO PDI +5 ABORT DELAY STAGING ALAP (B) PDI +5 TO TD CONTINUE MISSION													
			LUNAR STAY	4. LIFTOFF NEXT BEST OPPORTUNITY													
			RNDZ	5. CONTINUE MISSION AND DOCK ASAP													
		C. TWO H2O SEPARATORS AND LCG LOOP	DOCKED	C.1. CONTINUE MISSION													
			UNDOCKED DESCENT ORBIT	2. DOCK ASAP DO NOT STAGE WHILE UNDOCKED													
			POWERED DESCENT	3.(A) PDI TO PDI +5 ABORT DELAY STAGING ALAP (B) PDI +5 TO TD CONTINUE MISSION													
			LUNAR STAY	4. LIFTOFF NEXT BEST OPPORTUNITY													
			RNDZ	5. INITIATE CSM RESCUE													
<table border="1"> <tr> <td>MISSION</td> <td>REV</td> <td>DATE</td> <td>SECTION</td> <td>GROUP</td> <td>PAGE</td> </tr> <tr> <td>APOLLO 11</td> <td></td> <td>4/16/69</td> <td>LM ENVIRONMENTAL CONTROL</td> <td>SPECIFIC</td> <td>23-9</td> </tr> </table>						MISSION	REV	DATE	SECTION	GROUP	PAGE	APOLLO 11		4/16/69	LM ENVIRONMENTAL CONTROL	SPECIFIC	23-9
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MISSION RULES

ENVIRONMENT

SECTION 23 - LM ENVIRONMENTAL CONTROL

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
23-24	DEMAND REGULATOR(S) FAIL OPEN OR CLOSED				
	A. ONE REGULATOR	ALL		1. CONTINUE MISSION	REF MALF PROC ECS---
	B. TWO REGULATORS	DOCKED		1. DO NOT UNDOCK	2. CABIN PRESS IND HI
		UNDOCKED		2. DOCK ASAP	6 OZ QTY
		DESCENT ORBIT		3. DELAY STAGING ALAP	
		POWERED DESCENT		4. CONTINUE MISSION	
		LUNAR STAY		5. CONTINUE MISSION	
		RNDZ		6. CONTINUE MISSION	
23-25	LOSS OF COOLANT LOOP(S)				REF MALF PROC ECS---
	A. PRIMARY OR SECONDARY LOOP	DOCKED		1. CONTINUE MISSION ON SECONDARY LOOP	7E ECS
		UNDOCKED		2. DO NOT UNDOCK	3. GLYCOL
		DESCENT ORBIT		3. RETURN TO VICINITY OF T8	
		POWERED DESCENT		4. (A) PDI TO L2 GATE - ABORT	
				(B) L2 GATE TO T8 - CONTINUE MISSION	
		LUNAR STAY		5. LIFTOFF NEXT BEST OPPORTUNITY	
		RNDZ		6. CONTINUE MISSION	
	B. BOTH LOOPS (ANY COMBINATION OF LOSS OF CIRCULATION, SUBLIMATION CAPABILITY, OR H2O FEED FOR BOTH LOOPS)	DOCKED		1. INGRESS CSM ASAP	
				2. DO NOT UNDOCKING	
		UNDOCKED		3. DOCK ASAP	
		DESCENT ORBIT		4. DELAY STAGE	
		POWERED DESCENT		5. (A) PDI TO L2 PLUS 5 - ABORT, DOCK ASAP	
				DO NOT STAGE	
				(B) PDI PLUS 5 TO T8 - ABORT, DOCK ASAP	
		LUNAR STAY		6. LIFTOFF ASAP	
		RNDZ		7. INITIATE CSM RESCUE	

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SECTION 23 - LM ENVIRONMENTAL CONTROL

RLV ITEM

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
23-26	LOSS OF PRIMARY H2O FEEDPATH	DOCKED UNDOCKED DESCENT ORBIT POWERED DESCENT LUNAR STAY RNDZ	CONTINUE MISSION NO-GO FOR UNDOCKING RETURN TO VICINITY OF CSM 1. PDI TO LO GATE - ABORT 2. LO GATE TO TD - CONTINUE MISSION LIFTOFF NEXT BEST OPPORTUNITY CONTINUE MISSION	REF MALF PROC ECS--- B GLYCOL	
23-27	FIRE OR SMOKE IN CABIN OR SUIT	ALL	TROUBLESHOOT/COMBAT FIRE ASSESS DAMAGE AND TRANSFER TO CSM IF NECESSARY	REF AOM PROC 5.3.2	
23-28	CONTAMINATION IN CABIN	ALL	CREW MAY ELECT TO DECOMPRESS	IF UNABLE TO CLEAR CONTAMINATION MISSION MAY BE TERMINATED EARLY.	
23-29	GLYCOL COOLANT LEAK A. CABIN B. SUIT RULE NUMBERS 23-40 THROUGH 23-49 ARE RESERVED.	ALL ALL ALL	TRANSFER TO CSM A. PURGE SUIT WITH DIRECT O2 B. DISCONNECT FROM SUIT LOOP	REF MALF PROC ECS--- B GLYCOL	

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SECTION 23 - LM ENVIRONMENTAL CONTROL - CONCLUDED

#	ITEM	----- INSTRUMENTATION REQUIREMENTS -----			
23-50	MEAS DESCRIPTION	PCM	ONBOARD	CATEGORY	
	SUIT PRESS	GF1301P	METER	MANDATORY	
	CABIN PRESS	GF3571P	WARNING METER	MANDATORY	
	REPR ELEC OPEN	GF3572X	WARNING	HIGHLY DESIRABLE	
	COL PART PRESS	GF1521P	METER, CAUTION COMP	HIGHLY DESIRABLE	
	H2O SEP RATE	GF9999U	CAUTION, COMP	HIGHLY DESIRABLE	
	DES O2 PRESS	GF3584P	METER, CAUTION	MANDATORY	
	ASC 1 O2 PRESS	GF3582P	METER, CAUTION 1	1 OF 2 MANDATORY	
	ASC 2 O2 PRESS	GF3583P	METER, CAUTION 1	MANDATORY	
	O2 MANIFOLD PRESS	GF3589P	-----	MANDATORY	
	GLYCOL PUMP DELTA P	GF2021P	-----	MANDATORY	
	GLYCOL PUMP SW/C	GF2936X	COMP	HIGHLY DESIRABLE	
	SEC GLY PUMP PRESS	GF2921P	-----	MANDATORY	
	GLYCOL PUMP P	GF9997U	METER	MANDATORY	
	SEL, GLY LVL LOW	GF9986U	CAUTION	MANDATORY	
	GLYCOL TEMP	GF9998U	METER, CAUTION	MANDATORY PCM	
	DES H2O QTY	GF4581U	METER, CAUTION	MANDATORY	
	ASC 1 H2O QTY	GF4582Q	METER, CAUTION	PCM ONE TANK AND METER OTHER TANK OR PCM AND CAUTION BOTH TANKS	
	ASC 2 H2O QTY	GF4583Q	METER, CAUTION 1 OF 2 M		
	PRI H2O REG DELTA P	GF4101P	-----	MANDATORY	
	SUIT DIV EGRESS	GF1221X	-----	HIGHLY DESIRABLE	
	SUIT TEMP	GF1281T	METER	HIGHLY DESIRABLE	
	CABIN TEMP	GF1651T	METER	HIGHLY DESIRABLE	

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24 LM GUIDANCE
AND CONTROL

25 LM DPS

26 LM APS

27 LM REACTION
CONTROL SYSTEM

28 SPACE
ENVIRONMENT

29 RECOVERY

30 AEROMEDICAL

31 EASEP

APPENDICES

A ACRONYMS AND
SYMBOLS

B DISTRIBUTION
LIST

C CHANGE CONTROL

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MISSION RULES

SECTION 24 - LM GUIDANCE AND CONTROL

REV ITEM

R	ITEM						
		<p>----- ! GENERAL ! -----</p>					
	24-1	<p>TO INITIATE THE FOLLOWING PHASES, THE LM GUIDANCE SYSTEMS MUST PROVIDE THE FOLLOWING MINIMUM CAPABILITIES---</p> <p>A. DOCKED/UNDOCKED, DESCENT ORBIT</p> <ol style="list-style-type: none"> 1. OPERATIONAL PGNS, WHICH REQUIRES LGC, ISS, AND DSKY. 2. REDUNDANT 3-AXIS AUTO ATTITUDE CONTROL AND HOLD CAPABILITY, WHICH REQUIRES BOTH PGNS AND AGS 3-AXIS ATTITUDE HOLD AND CONTROL CAPABILITY. 3. REDUNDANT 3-AXIS CONTROL. 4. ONE HAND CONTROLLER (ACA). 5. 3-AXIS TRANSLATION CAPABILITY, WHICH REQUIRES--- <li style="margin-left: 20px;">(A) ONE TTCA <li style="margin-left: 20px;">(B) PGNS OR AGS 3-AXIS TRANSLATION CAPABILITY 6. ONE THRUST TRANSLATION CONTROLLER ASSEMBLY (TTCA) 7. ONE FDAI INCLUDING--- <li style="margin-left: 20px;">(A) ATTITUDE REFERENCE <li style="margin-left: 20px;">(B) RATE NEEDLES <li style="margin-left: 20px;">(C) ERROR NEEDLES 8. AN OPERATIONAL AOT <li style="margin-left: 20px;">NO AOT FAILURE THAT WOULD PREVENT ITS USE IN REALIGNING THE LM PLATFORM. <p style="text-align: center;">NOTE</p> <p>AFTER SUCCESSFUL PLATFORM FINE ALIGNMENT THE AOT IS NOT REQUIRED.</p> <ol style="list-style-type: none"> 9. OPERATIONAL RENDEZVOUS RADAR (RR) AND RR TRANSPONDER <li style="margin-left: 20px;">(A) PRIOR TO UNDOCKING IDENTIFIED BY ABILITY TO ACTIVATE, AND ANTENNA TEMPERATURE WITHIN LIMITS. <li style="margin-left: 20px;">(B) AFTER UNDOCKING REQUIRES ABILITY TO LOCK ON THE TRANSPONDER, LGC INTERFACE, AND ANTENNA TEMPERATURE WITHIN LIMITS. 10. OPERATIONAL LANDING RADAR (LR) <li style="margin-left: 20px;">DURING THIS PHASE MAY BE CONFIRMED ONLY BY THE ABILITY TO ACTIVATE AND THE ANTENNA TEMPERATURE WITHIN LIMITS. 11. REDUNDANT ASC ENGINE ON/OFF CAPABILITY <li style="margin-left: 20px;">BOTH AUTO AND MANUAL ASC ENGINE ON/OFF CAPABILITY. 12. OPERATIONAL PITCH AND ROLL GDA, WHICH REQUIRES--- <li style="margin-left: 20px;">(A) NO GDA FAILURE <li style="margin-left: 20px;">(B) NO CES DC POWER FAILURE <li style="margin-left: 20px;">(C) AC BUS A POWER 13. OPERATIONAL MANUAL THROTTLE CAPABILITY, WHICH REQUIRES ONE TTCA AND NO CES/DESCENT ENGINE FAILURES WHICH WOULD INHIBIT THROTTLE CONTROL. 14. OPERATIONAL AUTO THROTTLE CAPABILITY, WHICH REQUIRES NO CES/DESCENT ENGINE FAILURES WHICH WOULD INHIBIT THROTTLE CONTROL. 					
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SECTION 24 - LM GUIDANCE AND CONTROL

RIV I TLM

R	ITEM						
		<p>B. POWERED DESCENT</p> <ol style="list-style-type: none"> 1. REQUIREMENTS TO INITIATE PDI ARE IDENTICAL TO DESCENT ORBIT EXCEPT DELETE AOT AND RR WHICH ARE NOT REQUIRED. 2. PDI TO LOW GATE <ol style="list-style-type: none"> (A) OPERATIONAL PGNS (B) PGNS 3-AXIS AUTO ATTITUDE CONTROL AND HOLD CAPABILITY (C) 3-AXIS CONTROL (D) ONE ACA (E) ONE TTCA (F) ONE FDAI (G) OPERATIONAL LANDING RADAR <ol style="list-style-type: none"> (1) NOT REQUIRED AFTER ADEQUATE ALTITUDE UPDATING OF LM STATE VECTORS. (2) OPERATIONAL LR REQUIRES--- VALID ALTITUDE LOCK ON VALID ALTITUDE READOUT ANTENNA TEMPERATURE WITHIN LIMITS (H) OPERATIONAL PITCH AND ROLL GDA (I) OPERATIONAL AUTO AND MANUAL THROTTLE 3. LOW GATE TO TOUCHDOWN (TD) <ol style="list-style-type: none"> (A) ONE ACA (B) ONE TTCA (C) OPERATIONAL MANUAL THROTTLE <p>C. LUNAR STAY</p> <ol style="list-style-type: none"> 1. THE ASCENT MANEUVER TO LIFTOFF THE LUNAR SURFACE AT THE NEXT BEST OPPORTUNITY WILL BE PERFORMED IF ANY OF THE FOLLOWING G&C SYSTEM CAPABILITIES ARE LOST--- <ol style="list-style-type: none"> (A) OPERATIONAL AGS (B) REDUNDANT 3-AXIS AUTO ATTITUDE CONTROL AND HOLD CAPABILITY (C) REDUNDANT 3- AXIS CONTROL (D) REDUNDANT ASC ENGINE ON/OFF CAPABILITY 					
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REV. ITEM

R	ITEM							
		<p>D. RENDEZVOUS</p> <p>1. CSI AND CDH</p> <p>IN ORDER FOR THE LM TO BE ACTIVE VEHICLE IN PERFORMING THE INITIAL RENDEZVOUS MANEUVERS, THE G&C SYSTEMS MUST PROVIDE THE FOLLOWING MINIMUM CAPABILITIES---</p> <p>(A) OPERATIONAL PGNS OR AGS</p> <p>(B) 3-AXIS AUTO ATTITUDE CONTROL AND HOLD CAPABILITY</p> <p>(C) 3-AXIS CONTROL</p> <p>(D) 1-AXIS TRANSLATION CAPABILITY</p> <p>(E) AN OPERATIONAL RR AND RR TRANSPONDER</p> <p>2. TPI AND TPF</p> <p>IN ORDER FOR THE LM TO BE THE ACTIVE VEHICLE FOR THE TERMINAL RENDEZVOUS MANEUVERS, THE G&C SYSTEMS MUST PROVIDE THE FOLLOWING MINIMUM CAPABILITIES---</p> <p>(A) OPERATIONAL PGNS OR AGS</p> <p>(B) 3-AXIS AUTO ATTITUDE CONTROL AND HOLD CAPABILITY</p> <p>(C) 3-AXIS CONTROL</p> <p>(D) 3-AXIS TRANSLATION CAPABILITY</p> <p>(E) AN OPERATIONAL RR AND RR TRANSPONDER</p> <p>(F) ONE TTCA</p> <p>3. DOCKING</p> <p>IN ORDER FOR THE LM TO BE THE ACTIVE VEHICLE FOR DOCKING THE G&C SYSTEMS MUST PROVIDE THE FOLLOWING MINIMUM CAPABILITIES---</p> <p>(A) 3-AXIS CONTROL</p> <p>(B) ONE ACA</p> <p>(C) 3-AXIS TRANSLATION CAPABILITY</p> <p>(D) ONE TTCA</p>						
		MISSION	REV	DATE	SECTION	GROUP	PAGE	
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SECTION 24 - LM GUIDANCE AND CONTROL

REV	ITEM						
	24-2	<p>DEFINITIONS</p> <p>3-AXIS AUTO ATTITUDE CONTROL AND HOLD CAPABILITY</p> <p>3-AXIS AUTO ATTITUDE CONTROL AND HOLD CAPABILITY IS DEFINED AS THE LM'S ABILITY TO AUTOMATICALLY HOLD AND CONTROL ATTITUDE. IN ORDER TO HAVE THIS CAPABILITY THE LM REQUIRES EITHER AN OPERATIONAL PGNS OR AN OPERATIONAL AGS.</p> <p>3-AXIS CONTROL</p> <p>3-AXIS CONTROL IS DEFINE AS THE ABILITY TO CHANGE THE EXISTING VEHICLE ATTITUDE. TO HAVE THIS CAPABILITY THE LM REQUIRES AN OPERATIONAL MANUAL OR AUTOMATIC CONTROL SYSTEM.</p> <p>OPERATIONAL PGNS</p> <p>AN OPERATIONAL PGNS IS DEFINED AS NO LGC FAILURE, NO ISS FAILURE, AND NO DSKY FAILURES.</p> <p>A. ANY FAILURE OF THE LGC HARDWARE AND/OR THE ASSOCIATED INPUT/OUTPUT INTERFACES WHICH CANNOT BE REMEDIED BY CREW PROCEDURES IS CONSIDERED AN LGC FAILURE.</p> <p>B. ANY FAILURE WITHIN THE IMU, CDU, PTA, OR THE PSA WHICH WOULD CAUSE A PERMANENT LOSS OF THE INERTIAL ATTITUDE AND VELOCITY MEASUREMENT, IS CONSIDERED AN ISS FAILURE.</p> <p>C. ANY FAILURE OF THE DSKY HARDWARE AND/OR THE ASSOCIATED INPUT/OUTPUT INTERFACES WHICH CANNOT BE REMEDIED BY CREW PROCEDURES IS CONSIDERED A DSKY FAILURE.</p> <p>OPERATIONAL AGS</p> <p>AN OPERATIONAL AGS IS DEFINED AS NO AEA FAILURE, NO ASA FAILURE, NO DEDA FAILURE, AND NO CES FAILURE PREVENTING ATTITUDE CONTROL.</p> <p>A. ANY FAILURE OF THE AEA HARDWARE AN/OR THE ASSOCIATED INPUT/OUTPUT INTERFACES WHICH CANNOT BE REMEDIED BY CREW PROCEDURES IS CONSIDERED AN AEA FAILURE.</p> <p>B. ANY FAILURE OF THE ASA HARDWARE AND/OR THE ASSOCIATED INPUT/OUTPUT INTERFACES WHICH CAUSE LOSS OF THE VEHICLE ATTITUDE AND VELOCITY MEASUREMENTS IS CONSIDERED AN ASA FAILURE.</p> <p>C. ANY FAILURE OF THE DEDA HARDWARE AND/OR THE ASSOCIATED INPUT/OUTPUT INTERFACES WHICH CANNOT BE REMEDIED BY CREW PROCEDURES IS CONSIDERED A DEDA FAILURE.</p> <p>D. ANY FAILURE OF THE CES HARDWARE THAT PREVENTS ATTITUDE CONTROL WHILE IN AGS IS CONSIDERED A CES FAILURE.</p> <p>3-AXIS TRANSLATION</p> <p>3-AXIS TRANSLATION IS DEFINED AS THE ABILITY TO CHANGE THE VEHICLE VELOCITY, PLUS OR MINUS, ALONG EACH BODY AXIS. TO HAVE THIS CAPABILITY THE LM REQUIRES ONE TTCA AND AN OPERATIONAL PGNS OR OPERATIONAL CES CIRCUITRY.</p>					
		MISSION	REV	DATE	SECTION	GROUP	PAGE
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MISSION RULES

SECTION 24 - LM GUIDANCE AND CONTROL

REV	ITEM								
		----- ' MANAGEMENT ' -----							
	24-3	IMU	<p>A. THE IRIG BIAS WILL BE UPDATED WHENEVER THE GYRO DRIFT IS GREATER THAN OR EQUAL TO <u>± 0.09</u> DEG/HR (6 MERU).</p> <p>B. THE PGNS WILL BE CONSIDERED NO-GO WITH A GYRO DRIFT GREATER THAN OR EQUAL TO ± 1.5 DEG/HR (100 MERU). THE MAXIMUM ALLOWABLE VALUE WITHIN THE LGC IS ± 1.93 DEG/HR (128 MERU).</p> <p>C. THE PIPA BIAS WILL BE UPDATED WHENEVER THE DELTA BIAS (LGC VALUE OF BIAS - MEASURE BIAS) IS GREATER THAN OR EQUAL TO ± 200 CM/SEC² (.0066 FT/SEC²).</p> <p>D. THE PGNS WILL BE CONSIDERED NO-GO IF THE PIPA BIAS EXCEEDS <u>± 3.125</u> CM/SEC². THE MAXIMUM ALLOWABLE VALUE WITHIN THE LGC.</p>						
	24-4	LGC	<p>A. A MASS UPDATE IS REQUIRED IF A MASS DELTA OF ± 10 PERCENT (DIFFERENCE BETWEEN GROUND CALCULATION AND LGC VALUE) EXISTS WHEN IN THE DPS CONFIGURATION, OR ± 5 PERCENT IN APS CONFIGURATION.</p> <p>B. ALL DESCENT ENGINE STARTS MUST NOMINALLY BE PRECEDED BY A PROPELLANT SETTLING MANEUVER USING TWO SYSTEM B JETS IN CASE OF A CONTINGENCY.</p> <p>C. ULLAGE FOR ALL APS BURNS MAY BE 4 JET OR 2 JET SYSTEM A OR B.</p> <p>D. ALL $\pm(U-V)$ JETS WILL BE INHIBITED VIA V65 DURING DOCKED DPS BURNS.</p> <p>E. DURING DOCKED MANEUVERS, ALL DPS GIMBAL TRIMMING MUST BE DONE AT GREATER THAN 35 PERCENT THROTTLE IN THE AUTO THROTTLE MODE. THE RECOMMENDED SETTING IS 40 PERCENT THROTTLE.</p>						
	24-5	RENDEZVOUS RADAR	<p>A. THE RR MUST NOT BE OPERATED UNTIL THE ANTENNA TEMPERATURE (HPM) IS GREATER THAN OR EQUAL TO 15 DEG. F AND THE GYRO PACKAGE IS ESTIMATED TO BE GREATER THAN OR EQUAL TO 15 DEG F.</p> <p>B. THE RR SHOULD NOT BE OPERATED AT AN ANTENNA TEMPERATURE GREATER THAN OR EQUAL TO <u>145 DEG F</u> AND/OR A GYRO PACKAGE TEMP (ESTIMATED) OF GREATER THAN OR EQUAL TO 200 DEG F.</p> <p>C. IF IT IS ESTIMATED THAT THE RR GYRO PACKAGE WILL EXCEED 200 DEG F (HPM APPROX. <u>125 DEG F</u>) PRIOR TO COMPLETION OF THE BRAKING PHASE, THE RR SHOULD BE TURNED OFF UNTIL REQUIRED FOR TPI AND BRAKING.</p> <p>D. IF THE ESTIMAT GYRO PACKAGE TEMP SHOULD EXCEED 200 DEG F (HPM APPROX. <u>125 DEG F</u>) ANYTIME DURING THE RENDEZVOUS PHASE, THE AC POWER TO THE RR SHOULD NOT BE TURNED OFF.</p> <p>E. IF THE RR ANTENNA TEMP (HPM) EXCEEDS THE NOMINAL TEMP PROFILE BY <u>150</u> DEG F, THE RR SHOULD BE TURNED OFF IF IT IS NOT NEEDED.</p> <p>F. IF THE RR HEATERS ARE TURNED OFF (BOTH THE PGNS--- RNDZ RDR AND OPR OPEN) FOR <u>150</u> MIN. RR DATA MUST NOT BE USED UNTIL <u>17</u> MIN AFTER RE-ENERGIZING.</p>						
			MISSION	REV	DATE	SECTION	GROUP	PAGE	
			APOLLO 11		4/16/69	LM GUIDANCE AND CONTROL	MANAGEMENT	24-5	

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SECTION 24 - LM GUIDANCE AND CONTROL

REV ITEM

R	ITEM						
	24-6	<p>LANDING RADAR</p> <p>A. THE LR SHOULD NOT BE OPERATED AT AN ANTENNA TEMP LESS THAN <u>+50 DEG F.</u></p> <p>B. THE LR TEMP SHOULD NOT BE GREATER THAN <u>100 DEG F</u> AT PDI.</p>					
	24-7	<p>AGS</p> <p>A. THE AGS IS DECLARED NO-GO WITH AN ASA TEMPERATURE OF LESS THAN + 90 DEG F OR GREATER THAN + 150 DEG F.</p> <p>B. THE AGS IS DECLARED NO-GO DURING A GYRO AND ACCELEROMETER CALIBRATION IF THE GYRO DRIFT CHANGE IS GREATER THAN <u>2.50 DEG/HR</u> AND IF THE ACCELEROMETER BIAS CHANGE IS GREATER THAN <u>0.049 FT/SEC²</u> FROM THE VALUE AT THE START OF THE CALIBRATION.</p> <p>C. THE AGS MUST BE UPDATED WITHIN <u>7 MINUTES</u> OF A BURN.</p> <p>D. THE AGS CAN BE USED TO PERFORM DOCKED ATTITUDE HOLD CONTROL.</p> <p>E. THE AGS USING ONLY TTCA CONTROL CAN BE USED TO PERFORM A DOCKED DPS BURN.</p>					
		<p>RULE NUMBERS 24-8 THROUGH 24-19 ARE RESERVED.</p>					
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REV ITEM

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS		
				<div style="border: 1px dashed black; padding: 2px;"> SPECIFIC </div>			
	24-20	LOSS OF OPERATIONAL PGNS	DOCKED/ UNDOCKED	1. RETURN TO CSM ASAP 2. NO-GO FOR DOI	• REF MALF PROC PGNS--- 1 ISS WARN		
			DESCENT ORBIT	1. RETURN TO CSM ASAP 2. NO-GO FOR PDI	263 LGC WARN 9 TEMP CAUTION		
			POWERED DESCENT	1. PRIOR TO LOW GATE (A) NO-GO FOR LANDING (B) ABORT 2. AFTER LOW GATE (A) LAND MANUALLY (B) NO-GO FOR EXTENDED LUNAR STAY	15 ABNORMAL DSKY RESPONSE 16 MISSING NUMERICS ON DSKY 17 ABNORMAL DSKY PUSHBUTTON RESPONSE		
			LUNAR STAY	ASCENT AT NEXT BEST OPPORTUNITY			
			RNDZ	1. SWITCH TO AGS 2. CONTINUE MISSION			
	24-21	LOSS OF FDAI			• REF MALF PROC DISPLAY---		
		A. ONE	ALL	A. CONTINUE MISSION	1 FDAI ATT ERROR ABNORMAL		
		B. BOTH	DOCKED/ UNDOCKED	B.1.(A) RETURN TO CSM ASAP (B) NO-GO FOR DOI	2 FDAI TOTAL ATT ABNORMAL 3 FDAI RATE DISPLAY ABNORMAL		
			DESCENT ORBIT	2.(A) RETURN TO CSM ASAP (B) NO-GO FOR PDI			
			POWERED DESCENT	3.(A) PRIOR TO LOW GATE--- (1) NO-GO FOR LANDING (2) ABORT (B) AFTER LOW GATE--- CONTINUE MISSION			
			LUNAR STAY/RNDZ	4. CONTINUE MISSION			
		MISSION	REV	DATE	SECTION	GROUP	PAGE
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REV ITEM

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS		
	24-22	LOSS OF AOT	DOCKED/ UNDOCKED	PRIOR TO FINE ALIGNMENT 1. RETURN TO CSM ASAP 2. NO-GO FOR DOI AFTER FINE ALIGNMENT CONTINUE MISSION			
	24-23	LOSS OF RENDEZVOUS RADAR AND/OR TRANSPONDER	DOCKED/ UNDOCKED DESCENT ORBIT/ LUNAR STAY RNDZ	1. RETURN TO CSM ASAP 2. NO-GO FOR DOI 1. CONTINUE MISSION 2. NO-GO FOR LM ACTIVE RNDZ CSM ACTIVE FOR RNDZ PHASE	• REF MALF PROC PGNS--- 5 HEATER CAUTION 667 RNDZ RADAR CAUTION 9 NO TRACK		
	24-24	LOSS OF LANDING RADAR	DOCKED/ UNDOCKED DESCENT ORBIT POWERED DESCENT	1. RETURN TO CSM ASAP 2. NO-GO FOR DOI 1. RETURN TO CSM ASAP 2. NO-GO FOR PDI 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	• REF MALF PROC PGNS--- 8 LDG RADAR CAUTION 10 TRACKER CAUTION 1. GUIDO TO DECIDE WHEN ADEQUATE UPDATING OF LM STATE VECTORS HAS BEEN ACCOMPLISHED.		
	24-25	LOSS OF VHF RANGING		TBD			
	24-26	LOSS OF TRACKING LIGHT		TBD			
		MISSION	REV	DATE	SECTION	GROUP	PAGE
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REV ITEM

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS		
24-27	LOSS OF REDUNDANT AUTOMATIC 3-AXIS ATTITUDE CONTROL AND HOLD CAPABILITY---				<ul style="list-style-type: none"> • REF MALF PROC CES--- 1 ABNORMAL VEHICLE DYNAMICS 11 LM DRIFTS 		
	A. LOSS OF AGS		ALL	CONTINUE MISSION			
	B. LOSS OF PGNS CAPABILITY		DOCKED/ UNDOCKED DESCENT ORBIT POWERED DESCENT LUNAR STAY	B.1.(A) RETURN TO CSM (B) NO-GO FOR DOI 2.(2) STOP BURN. IF BURNING (B) NO-GO FOR PDI (C) RETURN TO CSM ASAP 3.(A) PRIOR TO LOW GATE ABORT (B) AFTER LOW GATE (1) LAND MANUALLY (2) NO-GO FOR EXTENDED LUNAR STAY 4. ASCENT AT THE NEXT BEST OPPORTUNITY			
24-28	LOSS OF 3-AXIS CONTROL A. REDUNDANT		DOCKED/ UNDOCKED DESCENT ORBIT POWERED DESCENT LUNAR STAY RNDZ	A.1.(A) RETURN TO CSM ASAP (B) NO-GO FOR DOI 2.(A) RETURN TO CSM ASAP (B) NO-GO FOR PDI 3. CONTINUE MISSION 4. ASCENT AT NEXT BEST OPPORTUNITY 5. CONTINUE MISSION			
	B. ANY AXIS		POWERED DESCENT RNDZ	B.1.(A) PDI TO LOW GATE ABORT (B) AFTER LOW GATE CONTINUE MISSION NO-GO FOR EXTENDED LUNAR STAY 2. NO-GO FOR LM ACTIVE RNDZ			
		MISSION	REV	DATE	SECTION	GROUP	PAGE
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R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
24-29	LOSS OF TRANSLATION CAPABILITY A. AUTOMATIC ULLAGE (+X)	DOCKED/ UNDOCKED DESCENT ORBIT		A.1. NOT APPLICABLE 2.(A) RETURN TO CSM ASAP (B) DOI INHIBITED (C) DO NOT BACK UP ULLAGE MANUALLY (D) NO-GO FOR PDI 3.(A) PRIOR TO PDI (1) RETURN TO CSM ASAP (2) PDI INHIBITED (3) DO NOT BACK UP ULLAGE MANUALLY (4) NO-GO FOR LANDING (B) AFTER PDI CONTINUE MISSION	A.1. CAN NOT DETECT FAILURE UNTIL LGC COMMANDS ULLAGE • REF MALF PROC CES--- 14 ABSENCE OF NORMAL RESPONSE VIA TTCA 1 ABNORMAL VEHICLE DYNAMICS
	B. EITHER +/-Y, +/-Z, +/-X TRANSLATION	DOCKED/ UNDOCKED DESCENT ORBIT		B.1.(A) RETURN TO CSM ASAP (B) NO-GO FOR DOI 2.(A) PRIOR TO DOI (1) RETURN TO CSM ASAP (2) DOI INHIBITED (3) NO-GO FOR PDI (B) AFTER DOI (1) CONTINUE MISSION (2) NO-GO FOR LM ACTIVE TPI AND TPF 3.(A) CONTINUE MISSION (B) NO-GO FOR LM ACTIVE TPI AND TPF	
		POWERED DESCENT			
		RNDZ		4.(A) CSI-CDH (1) CONTINUE MISSION (2) NO-GO FOR TPI-TPF (B) TPI-TPF (1) CSM ACTIVE RNDZ AND DOCKING	B.4(A) A MINIMUM OF ONE AXIS TRANSLATION IS REQUESTED DURING THIS PHASE

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REV	ITEM	SECTION 24 - LM GUIDANCE AND CONTROL			
R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	24-30	LOSS OF PITCH OR ROLL GDA	DOCKED/ UNDOCKED DESCENT ORBIT POWERED DESCENT	1. RETURN TO CSM ASAP 2. NO-GO FOR DOI 1. RETURN TO CSM ASAP 2. NO-GO FOR PDI CONTINUE MISSION UNLESS RCS IMPINGEMENT CONSTRAINTS ARE VIOLATED.	RCS IMPINGEMENT CONSTRAINTS MAY BE VIOLATED BECAUSE OF RCS OPPOSING THRUST VECTOR OFFSET. REF MALF PROC CES--- 5 GDA CAUTION LIGHT ON
	24-31	LOSS OF AUTO ENGINE ON/OFF CAPABILITY	DOCKED/ UNDOCKED DESCENT ORBIT POWERED DESCENT LUNAR STAY	1. RETURN TO CSM ASAP 2. NO-GO FOR DOI 1. RETURN TO CSM ASAP 2. DOI INHIBITED 3. NO-GO FOR PDI 1. BACKUP PDI WITH MANUAL START PB 2. CONTINUE MISSION 3. NO-GO FOR EXTENDED LUNAR STAY IF FAILURE AFFECTS ASCENT ENGINE. ASCENT AT NEXT BEST OPPORTUNITY VIA MANUAL START CAPABILITY	REF MALF PROC CES--- 7 MPS DOES NOT THRUST WHEN EVENT TIMER IND 00.00
	24-32	ENGINE DOES NOT IGNITE AFTER START PB DEPRESSION	POWERED DESCENT	1. INHIBIT PDI 2. RETURN TO CSM ASAP	STOP PB MUST BE SET TO RESET THE LATCHING RELAYS ENERGIZED BY START PB DEPRESSION. REF MALF PROC CES 7. MPS DOES NOT THRUST WHEN EVENT TIMER IND 00.00
	24-33	LOSS OF OPERATIONAL AGS	ALL	CONTINUE MISSION	REF MALF PROC AGS--- 1 AGS WARNING LIGHT 11 DEDA RESPONSE IS ABNORMAL

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RIV ITEM

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
24-34	LOSS OF AUTO THRUST CONTROL	DOCKED/ UNDOCKED	1. RETURN TO CSM ASAP 2. NO-GO FOR DOI	• REF MALF PROC CES--- 19 ENG THR AND CMD DO NOT AGREE DURING DPS BURN 20 CMD THR DOES NOT RESPOND TO TTCA OR DOES NOT FOLLOW TIMELINE	
		DESCENT ORBIT	1. RETURN TO CSM ASAP 2. IF BURNING, CONTINUE BURN 3. NO-GO FOR PDI		
		POWERED DESCENT	1. PRIOR TO LOW GATE ABORT USING DPS. ABORT STAGE 20 SEC AFTER LOW LEVEL 2. AFTER LOW GATE (A) SWITCH TO MANUAL THROTTLE (B) CONTINUE MISSION		
24-35	LOSS OF ALL MANUAL THRUST CONTROL	DOCKED/ UNDOCKED	1. RETURN TO CSM ASAP 2. NO-GO FOR DOI	NO LONGER THAN 100 SEC IN NON-THROTTLEABLE RANGE CAN BE ACCUMULATED. • REF MALF PROC CES--- 19 ENG THR AND CMD THR DO NOT AGREE DURING DPS BURN 20 CMD THR DOES NOT RESPOND TO TTCA OR DOES NOT FOLLOW TIMELINE	
		DESCENT ORBIT	1. RETURN TO CSM ASAP 2. IF BURNING, CONTINUE BURN 3. NO-GO FOR PDI		
		POWERED DESCENT	1. DO NOT SWITCH TO MANUAL THROTTLE 2. ABORT USING DPS. ABORT STAGE 20 SEC AFTER LOW LEVEL		
24-36	LOSS OF ACA			• REF MALF PROC CES--- 1 ABNORMAL VEHICLE DYNAMICS IN ACA JAMMED OUT OF DETENT. PROPORTIONAL SIGNALS ALWAYS PRESENT	
	A. ONE	ALL	A. CONTINUE MISSION		
	B. BOTH	DOCKED/ UNDOCKED	B.1. (A) RETURN TO CSM ASAP (B) NO-GO FOR DOI		
		DESCENT ORBIT	2. (A) RETURN TO CSM ASAP IF BURNING CONTINUE BURN (B) NO-GO FOR PDI		
		POWERED DESCENT	3. (A) ABORT USING DPS. ABORT STAGE 20 SEC AFTER LOW LEVEL		
		LUNAR STAY RNDZ	4. (A) CONTINUE MISSION (B) CSM ACTIVE VEHICLE FOR DOCKING		

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REV ITEM

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	24-37	LOSS OF TTCA A. ONE B. BOTH	ALL DOCKED/ UNDOCKED DESCENT ORBIT POWERED DESCENT LUNAR STAY RNDZ	A. CONTINUE MISSION B.1. (A) RETURN TO CSM ASAP (B) NO-GO FOR DOI 2. (A) RETURN TO CSM ASAP (B) NO-GO FOR PDI, CDM, CSI, DOCKING 3. (A) DO NOT SWITCH TO MANUAL THROTTLE (B) ABORT USING DPS. ABORT STAGE 20 SEC AFTER LOW LEVEL 4. CONTINUE MISSION 5. THE CSM MUST BE THE ACTIVE VEHICLE FOR TPI, TPF, AND DOCKING	REF MALF PROC CES--- 1 ABNORMAL VEHICLE DYNAMICS 14 ABSENCE OF NORMAL RESPONSE VIA TTCA
	24-38	LOSS OF LUNAR CONTACT LIGHTS RULE NUMBER 24-39 IS RESERVED.	POWERED DESCENT	CONTINUE MISSION	

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R	ITEM	PRELAUNCH INSTRUMENTATION					MISSION RULE REFERENCE
	24-40	MEAS DESCRIPTION	PCM	ONBOARD	TRANSDUCERS	CATEGORY	
		LGC DOWNLINK	GG0001U	-	-	M	24-20
		PLS TORO 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	M-PCM	24-20
		IG IX RXVR OUT COS	GG2113V	FDAI	COMMON	M-PCM	24-20
		MG SVO ERR IN PHASE	GG2137V	-	-	HD	24-20
		MG IX RSVR OUT SIN	GG2142V	FDAI	COMMON	M-PCM	24-20
		MG IX RSVR OUT COS	GG2143V	FDAI	COMMON	M-PCM	24-20
		OG SVO ERR IN PHASE	GG2167V	-	-	HD	24-20
		OG RSVR OUT SIN	GG2172V	FDAI	COMMON	M-PCM	24-20
		OG RSVR OUT COS	GG2173V	FDAI	COMMON	M-PCM	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	HC - PCM	24-20
		PIPA TEMP	GG2300T	C&W	SEPARATE	M-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&W	COMMON	HD - PCM	24-20
		ISS WARNING	GG9002X	C&W	COMMON	HC - PCM	24-20
		LR ANT TEMP	GN7563T	TEMP MONITOR	COMMON	HC - PCM	24-20
		RR NO TRACK	GN7621X	C&W	COMMON	HD - PCM	24-20
		RR ANT TEMP	GN7723T	TEMP MONITOR	COMMON	M-PCM	24-23
		YAW ERR CMD	GH1247V	-	-	M	24-33
		PITCH ERR CMD	GH1248V	-	-	M	24-33
		ROLL ERR CMD	GH1249V	-	-	M	24-33
		JD A4D OUTPUT	GH1419V	-	-	HD	24-27
		RCS TCP A4D	GR5032X	-	-	HD	24-27
		JD B3D OUTPUT	GH1423V	-	-	HD	24-27
		RCS TCP B3D	GR5036X	-	-	HD	24-27
		JD A2D OUTPUT	GH1427V	-	-	HD	24-27
		RCS TCP A2D	GR5040X	-	-	HD	24-27
		JD B1D OUTPUT	GH1431V	-	-	HD	24-27
		RCS TCP B1D	GR5044X	-	-	HD	24-27
		JD B4U OUTPUT	GH1418V	-	-	HD	24-27
		JD B4F OUTPUT	GH1420V	-	-	HD	24-27
		JD A4R OUTPUT	GH1421V	-	-	HD	24-27
		JD A3U OUTPUT	GH1422V	-	-	HD	24-27
		JD B3A OUTPUT	GH1424V	-	-	HD	24-27
		JD A3R OUTPUT	GH1425V	-	-	HD	24-27
		JD B2U OUTPUT	GH1426V	-	-	HD	24-27
		JD A2A OUTPUT	GH1428V	-	-	HD	24-27
		JD B2L OUTPUT	GH1429V	-	-	HD	24-27
		JD A1U OUTPUT	GH1430V	-	-	HD	24-27
		JD A1F OUTPUT	GH1432V	-	-	HD	24-27
		JD B1L OUTPUT	GH1433V	-	-	HD	24-27
		RCS TCP B4U	GR5031X	-	-	HD	24-27
		RCS TCP B4F	GR5033X	-	-	HD	24-27
		RCS TCP A4R	GR5034X	-	-	HD	24-27
		RCS TCP A3U	GR5035X	-	-	HD	24-27
		RCS TCP B3A	GR5037X	-	-	HD	24-27
		RCS TCP A3R	GR5038X	-	-	HD	24-27
		RCS TCP B2U	GR5039X	-	-	HD	24-27
		RCS TCP A2A	GR5041X	-	-	HD	24-27
		RCS TCP B2L	GR5042X	-	-	HD	24-27
		RCS TCP A1U	GR5043X	-	-	HD	24-27
		RCS TCP A1F	GR5045X	-	-	HD	24-27
		RCS TCP B1L	GR5046X	-	-	HD	24-27
		YAW ATT ERR	GH1455V	FDAI	COMMON	HD	24-33
		PITCH ATT ERR	GH1456V	FDAI	COMMON	HD	24-33

MISSION	REV	DATE	SECTION	GROUP	PAGE
APOLLO 11		4/16/69	LM GUIDANCE AND CONTROL	PRELAUNCH INSTR	24-14

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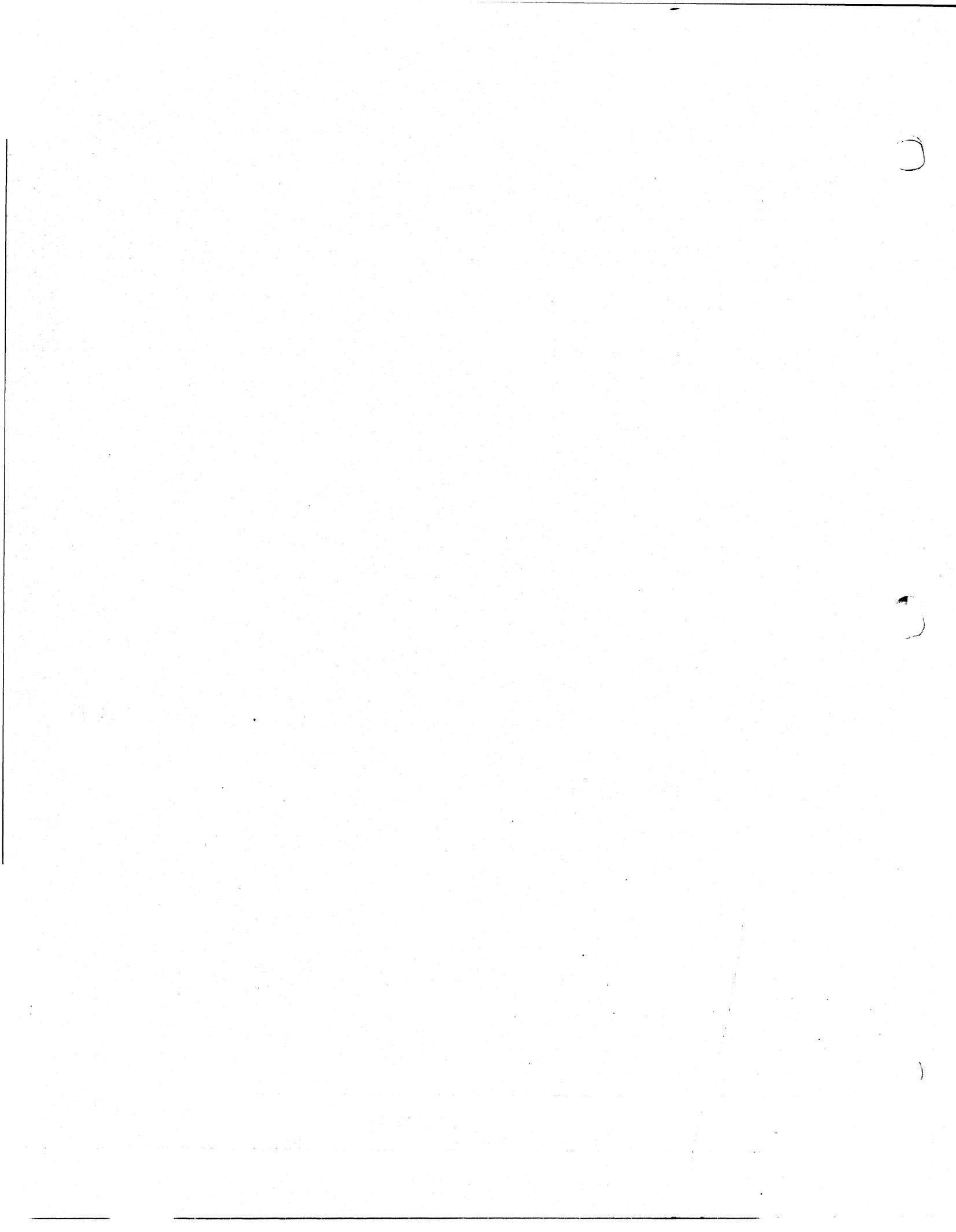
MISSION RULES

SECTION 24 - M GUIDANCE AND CONTROL - CONTINUED

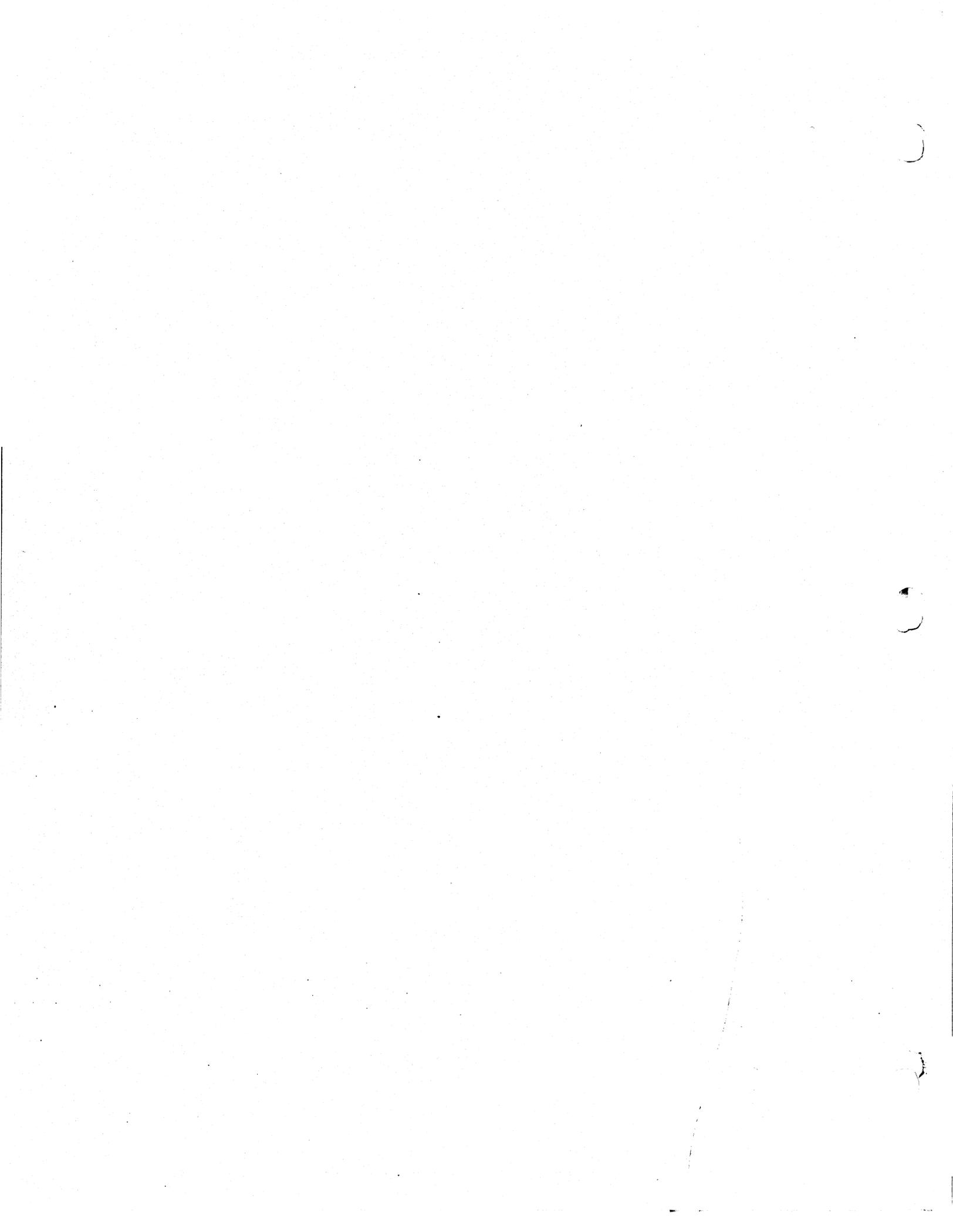
REV ITEM

R	ITEM	MEAS DESCRIPTION	PCM	ONBOARD	TRANSDUCERS	CATEGORY	MISSION RULE REFERENCE
	24-40	ROLL ATT ERR	GH1457V	FDAI	COMMON	HD	24-28
		RGA YAW RATE	GH1461V	FDAI	COMMON	M ON BOAR	24-33
		RGA PITCH RATE	GH1462V	FDAI	COMMON	M PCM/HD	24-33
		RGA ROLL RATE	GH1463V	FDAI	COMMON	M	24-33
		AGS SEL	GH1621X	-	-	HD	24-33
		ROLL PLSD/DIR	GH1628X	-	-	HD	24-33
		PITCH PLSD/DIR	GH1629X	-	-	HD	24-33
		YAW PLSD/DIR	GH1630X	-	-	HD	24-33
		AUTO ON	GH1214X	-	-	M	24-31
		APS ARM	GH1230X	-	-	M	24-31
		ENG FIRE OVRD	GH1286X	-	-	M	24-31
		MAN THRUST CMD	GH1311V	METER	SEPARATE	M	24-34,24-35
		PITCH GDA POS	GH1313V	-	-	M	24-30
		ROLL GDA POS	GH1314V	-	-	M	24-30
		P TRM FAIL	GH1323X	C&W	COMMON	M	24-30
		R TRM FAIL	GH1330X	C&W	COMMON	M	24-30
		AUTO THRUST CMD	GH1331V	METER	SEPARATE	HD	24-34
		DPS ARM	GH1348X	-	-	M	24-32,24-31
		VAR INJ ACT POS	GO6806H	-	-	M	24-34,24-35
		CES AC PWR FAIL	GL4026X	C&W	COMMON	M	24-30
		CES DC PWR FAIL	GL4027X	C&W	COMMON	M	24-30
		AGS DOWNLINK DATA	GI0001X	-	-	M	24-33
		ASA TEMP	GI3301T	-	-	HD	24-33
		ASA PWR/AEA FAIL	GL4028X	C&W	COMMON	HD	24-33
		AUTO OFF	GH1217X	-	-	HD	24-32,24-31
		AGS AUTO	GH1641X	-	-	HD	24-27
		AGS ATT HOLD	GH1642X	-	-	HD	24-27
		PGNS AUTO	GH1643X	-	-	HD	24-27
		PGNS ATT HOLD	GH1644X	-	-	HD	24-27
		LR RNG DATA NO GOOD	GN7521X	C&W	COMMON	HD	
		LR VEL DATA NO GOOD	GN7557X	C&W	COMMON	HD	

MISSION	REV	DATE	SECTION	GROUP	PAGE
APOLLO 11		4/16/69	LM GUIDANCE AND CONTROL	PRELAUNCH INSTR	24-15



25 LM DPS



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MISSION RULES

SECTION 25 - LM PROPULSION- DPS

REV ITEM

R	ITEM							
		<p>----- ' GENERAL ' -----</p>						
25-1		<p>IN ORDER TO INITIATE AND CONTINUE THE FOLLOWING MISSION PHASES THE DPS SUBSYSTEM MUST PROVIDE THE FOLLOWING MINIMUM CAPABILITIES.</p>						
		<p>A. DOCKED/UNDOCKED NO DPS PROPELLANT LEAKS</p> <p>B. DESCENT ORBIT, POWERED DESCENT</p> <ol style="list-style-type: none"> 1. NO DPS PROPELLANT LEAKS 2. AN OPERATIONAL DPS 3. NO EXCESSIVE PROPELLANT USAGE 4. GREATER THAN <u>TBD</u> PERCENT QUANTITY REMAINING AND NO LOW LEVEL WARNING ABOVE <u>800</u> FT ALT. 						
25-2		<p>DEFINITIONS</p>						
		<p>A. AN OPERATIONAL DPS IS DEFINED AS FOLLOWS---</p> <ol style="list-style-type: none"> 1. FUEL AND/OR OXID ENGINE INLET PRESSURE GREATER THAN 100 PSIA AT DOI INITIATION AND GREATER THAN <u>225</u> PSIA AT PDI. 2. FUEL AND/OR OXID ENGINE INLET PRESSURES GREATER THAN 120 PSIA DURING A BURN WITH THROTTLE LESSER THAN 65 PERCENT OR GREATER THAN 150 PSIA WITH THROTTLE GREATER THAN 65 PERCENT. 3. DPS PROPELLANT TEMPS LESS THAN <u>75</u> DEG F OR GREATER THAN 50 DEG F ONLY TO INITIATE A BURN. 4. DELTA TEMP BETWEEN FUEL AND OXID LESS THAN <u>25</u> DEG F ONLY TO INITIATE A BURN. 5. (A) DELTA PRESSURE BETWEEN FUEL AND OXID ENGINE INLET PRESSURES AT FTP LESS THAN <u>12</u> PSID (OXID HIGH) AND LESS THAN <u>25</u> PSID (FUEL HIGH) DURING DESCENT PRIOR TO LOW GATE. (B) DELTA PRESSURE FOR LOWER THROTTLE SETTINGS <u>TBD</u>. 6. SUPERCRITICAL HELIUM ADEQUATE TO COMPLETE MISSION. <p>B. THE LOW THROTTLE POINT IS DEFINED AS THE MINIMUM POSITION THAT THE THROTTLE ACTUATOR WILL ASSUME WITH MINIMUM MANUAL THROTTLE COMMAND VOLTAGE (10.9 FOR LM-5).</p>						
		<p>RULES 25-3 THROUGH 25-10 ARE RESERVED.</p>						
		MISSION	REV	DATE	SECTION	GROUP	PAGE	
		APOLLO 11		4/16/69	LM PROPULSION -DPS	GENERAL - DPS	25-1	

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MISSION RULES

SECTION 25 - LM PROPULSION- DPS

REV ITEM

R	ITEM																											
25-19	<p>DPS ENGINE RESTART CAN BE MADE WITH THE FOLLOWING CONSTRAINTS---</p> <table border="0"> <tr> <td>INITIAL BURN</td> <td>REQUIRED COAST TIME</td> <td>MAXIMUM RESTART BURN TIME</td> </tr> <tr> <td>A. UP TO TBD SEC</td> <td>2 SECONDS</td> <td>NO CONSTRAINT</td> </tr> <tr> <td>B. TBD TO 190 SEC</td> <td>2 SECONDS</td> <td>400 SECS</td> </tr> <tr> <td>C. 190 SECS TO 600 SECS</td> <td>REFERENCE (SEE FIGURE BELOW)</td> <td>100 SECS</td> </tr> <tr> <td>D. GREATER THAN 600 SECS</td> <td>NO RESTART</td> <td></td> </tr> </table> <p>THESE CONSTRAINTS ARE BASED ON ENGINE THRUST CHAMBER HEATING AND SOAK BACK LIMITS. TERMINATE THE BURN IF THE MAXIMUM RESTART BURN TIME IS EXCEEDED.</p> <p>THERE SHALL BE NO MORE THAN 5 RESTARTS AFTER THE INITIAL BURN.</p> <div> <table border="1"> <caption>Data points for Figure 25-1</caption> <thead> <tr> <th>Initial burn time, sec</th> <th>Required coast time, sec</th> </tr> </thead> <tbody> <tr><td>200</td><td>2000</td></tr> <tr><td>300</td><td>7000</td></tr> <tr><td>400</td><td>9500</td></tr> <tr><td>500</td><td>11000</td></tr> <tr><td>600</td><td>11500</td></tr> </tbody> </table> </div>	INITIAL BURN	REQUIRED COAST TIME	MAXIMUM RESTART BURN TIME	A. UP TO TBD SEC	2 SECONDS	NO CONSTRAINT	B. TBD TO 190 SEC	2 SECONDS	400 SECS	C. 190 SECS TO 600 SECS	REFERENCE (SEE FIGURE BELOW)	100 SECS	D. GREATER THAN 600 SECS	NO RESTART		Initial burn time, sec	Required coast time, sec	200	2000	300	7000	400	9500	500	11000	600	11500
INITIAL BURN	REQUIRED COAST TIME	MAXIMUM RESTART BURN TIME																										
A. UP TO TBD SEC	2 SECONDS	NO CONSTRAINT																										
B. TBD TO 190 SEC	2 SECONDS	400 SECS																										
C. 190 SECS TO 600 SECS	REFERENCE (SEE FIGURE BELOW)	100 SECS																										
D. GREATER THAN 600 SECS	NO RESTART																											
Initial burn time, sec	Required coast time, sec																											
200	2000																											
300	7000																											
400	9500																											
500	11000																											
600	11500																											

Figure 25-1.- LMDE required coast time vs initial burn time for engine chamber heating limitations.

MISSION	REV	DATE	SECTION	GROUP	PAGE
APOLLO 11		4/16/69	LM PROPULSION -DPS	MANAGEMENT	25-3

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MISSION RULES

SECTION 25 - LM PROPULSION - DPS

REV ITEM

R	ITEM						PAGE
25-20	ONLY PERMISSION APPROVED ALTERNATE DPS/MULTIBURN PROFILES WILL BE EXECUTED. SINCE NO DATA EXISTS TO ALLOW REAL-TIME SUPPORT FOR EXAMINING DPS FREEZING, CHARRING, BACKWALL TEMPERATURE CONSTRAINTS FOR MULTIBURN PROFILES.						
25-21	PROPELLANT GAGING						
	A. PRIME METHOD--- PGGS (TM, ONBOARD) (<u>1.3</u> PERCENT)						
	B. BACKUP METHOD--- GROUND MASS CALCULATION (<u>1.5</u> PERCENT)						
	RULE NUMBERS 25-22 THROUGH 25-29 ARE RESERVED.						
		MISSION	REV	DATE	SECTION	GROUP	PAGE
		APOLLO 11		4/16/69	LM PROPULSION -DPS	MANAGEMENT	25-6

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MISSION RULES

SECTION 25 - LM PROPULSION- DPS

RIV ITEM

R	RULE	CONDITION/MALFUNCTION	PHASE	ACTION	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 OR EQUAL TO 120 PSIA	DOCKED/ UNDOCKED DESCENT ORBIT POWERED DESCENT		A. INHIBIT DPS BURNS B. STOP DOI IF IN PROGRESS 1. INHIBIT PDI 2. RNDZ WITH APS C. ABORT STAGE	REF MAL PROC NO. _____			
25-31	START TANK LEAK PRIOR TO PRESSURIZATION A. FUEL AND/OR OXID ENGINE INLET P GREATER THAN 100 PSIA. B. FUEL AND/OR OXID ENGINE INLET P LESS THAN 100 PSIA.	ALL		A. CONTINUE MISSION INHIBIT FIRING DPS START TANK SQUIB B. CONTINUE MISSION 1. FIRE SQUIB TO START TANK 2. INHIBIT DPS BURNS IF INLET PRESSURES DO NOT COME UP GREATER THAN OR EQUAL TO 100 PSIA.	REF MAL PROC NO. _____ 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	DPS FAILS TO PRESSURIZE A. VIA START TANK 1. INLET PRESS GREATER THAN OR EQUAL TO 100 PSIA. 2. INLET PRESS LESS THAN 100 PSIA. B. VIA SUPERCRITICAL HELIUM	ALL DESCENT ORBIT		A. 1. CONTINUE MISSION 2. INHIBIT ALL DPS BURNS B. CUT OFF DOI ON INLET PRESSURES 1. NO-GO FOR PDI 2. RNDZ WITH APS	REF MAL PROC NO. _____			
		MISSION	REV	DATE	SECTION	GROUP	PAGE	
		APOLLO 11		4/16/69	LM PROPULSION -DPS	SPECIFIC-DPS	25-5	

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MISSION RULES

SECTION 25 - LM PROPULSION- DPS

REV ITEM

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS		
	25-35	LEAK BETWEEN SHE SQUIB AND DES HE REG 1 AND 2 SHUTOFF VALVES.	DOCKED/ UNDOCKED DESCENT ORBIT	A. PRIOR TO DOI DO NOT BLOW SHE SQUIB AT DOI 1. DO NOT ARM PYRO PRIOR TO DOI 2. ARM PYRO PRIOR TO PDI INHIBIT FURTHER DPS BURNS	REF MAL PROC DPS NO. _____		
	25-36	DPS PROPELLANT/VAPOR LEAK DOWNSTREAM OF QUAD CHECK VALVES	DOCKED/ UNDOCKED DESCENT ORBIT POWERED DESCENT	STAGE ASAP STAGE ASAP APS RNDZ A. PDI TO LOW GATE ABORT STAGE B. LOW GATE TO TD CONTINUE MISSION	REF MAL PROC DPS NO. _____		
	25-37	LOW LEVEL PRIOR TO 800 FEET ALTITUDE	POWERED DESCENT	A. ABORT B. ABORT STAGE 20 SECONDS AFTER LOW LEVEL	REF MAL PROC DPS NO. _____		
	25-38	PQGS READING 3 PERCENT (EITHER FUEL OR OXID) AND NO VALID TIME ESTIMATE FROM LOW LEVEL	POWERED DESCENT	ABORT ABORT STAGE AT DPS DEPLETION	REF MAL PROC DPS NO. _____		
	25-39	EXCESSIVE PROPELLANT USAGE (MARGIN AT TOUCHDOWN LESS THAN TBD PERCENT).	POWERED DESCENT	A. PRIOR TO THROTTLE DOWN - CONTINUE MISSION B. AFTER THROTTLE DOWN - 1. ABORT 2. ABORT STAGE 20 SECONDS AFTER LOW LEVEL.			
		MISSION	REV	DATE	SECTION	GROUP	PAGE
		APOLLO 11		4/16/69	LM PROPULSION -DPS	SPECIFIC-DPS	25-7

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MISSION RULES

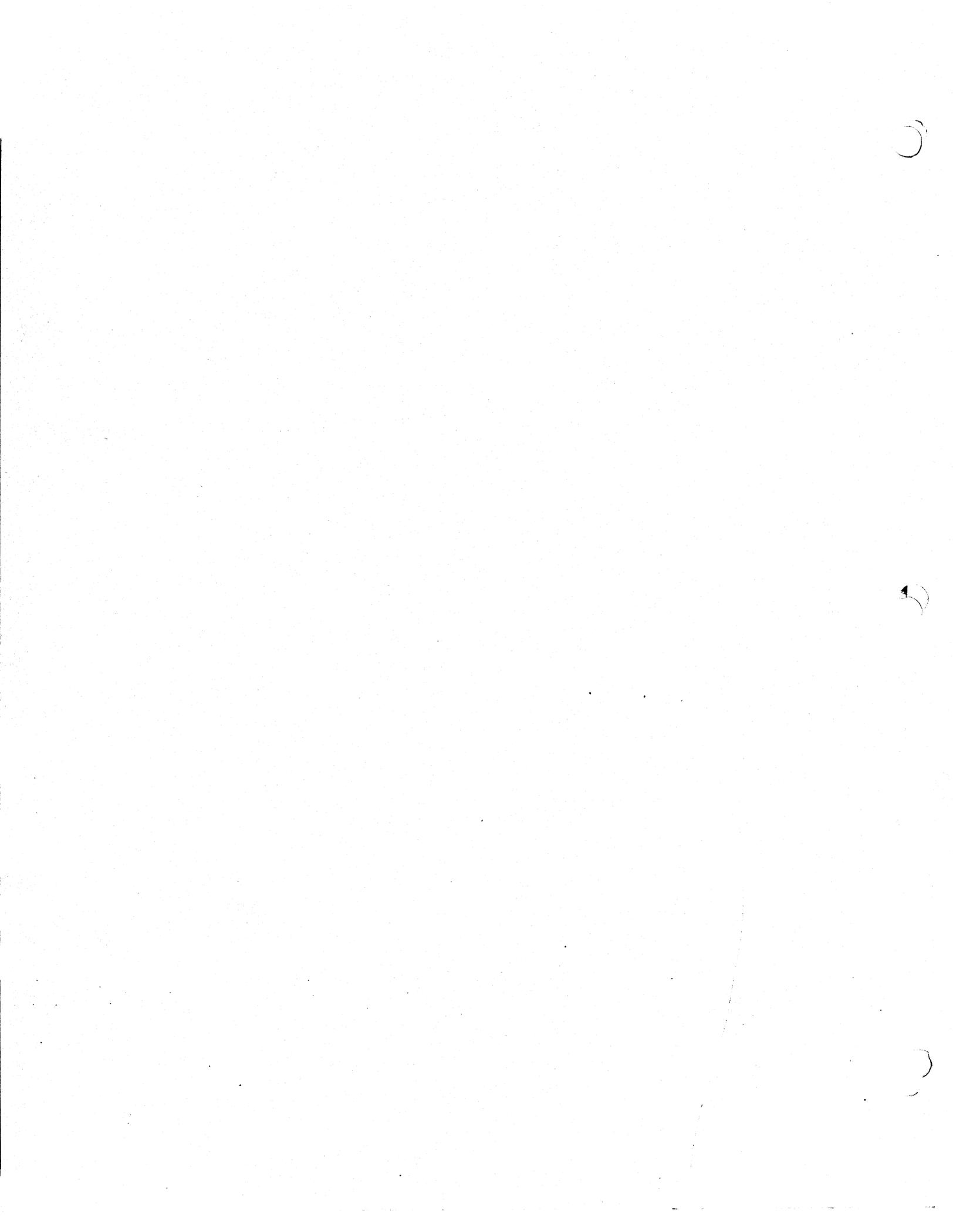
SECTION 25 - LM DPS - CONCLUDED

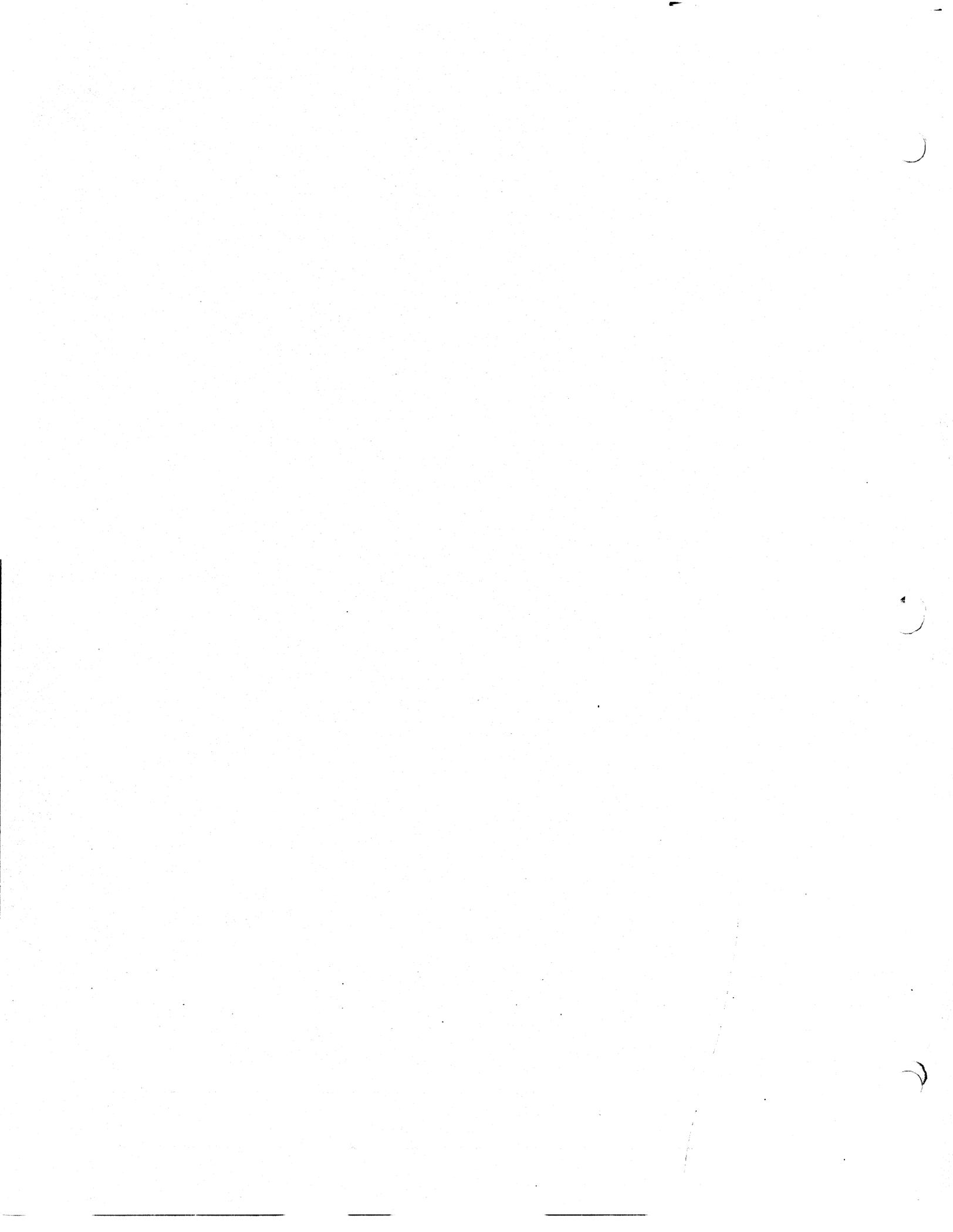
REV ITEM

R	ITEM						MISSION RULE REFERENCE
----- ' DPS - PRELAUNCH INSTRUMENTATION ' -----							
25-40	MEAS DESCRIPTION	PCM	ONBOARD	TRANSDUCER	CATEGORY		
	START TNK PRESS	GQ3015P	HE MON	COMMON	M	25-31:32:35	
	HE REG PRESS	GQ3018P	C&W	COMMON	HD 1 OF 2	25-34:30:35	
	HE REG PRESS	GQ3025P			M-PCM	25-34:30:35	
	HE PRESS	GQ3435P			HD 1 OF 2	25-33:30:32	
	HE PRESS	GQ3436P	PRESS		HD M	25-33:30:32	
	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	
	LOW LEVEL	GQ4455X	DPS LOW	COMMON	M	25-36	

MISSION	REV	DATE	SECTION	GROUP	PAGE
APOLLO 11		4/16/69	LM DPS	PRELAUNCH INSTR	25-8

26 LM APS





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MISSION RULES

SECTION 26 - LM PROPULSION - APS

REV ITEM

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS		
				----- SPECIFIC -----			
26-20	LOSS OF AN OPERATIONAL APS		DOCKED/ UNDOCKED DESCENT ORBIT POWERED DESCENT LUNAR STAY	A. RETURN TO CSM NO-GO FOR DOI B. RETURN TO CSM ASAP NO-GO FOR PDI C. ABORT USE DPS AS LONG AS POSSIBLE D. ASCEND ASAP	REF MAL PROC APS NO. ____		
26-21	APS HE SOURCE PRESSURE		DOCKED/ UNDOCKED DESCENT ORBIT POWERED DESCENT LUNAR STAY	A. 1. RETURN TO CSM NO-GO FOR DOI 2. RETURN TO CSM NO-GO FOR PDI 3. ABORT (A) USE DPS AS LONG AS POSSIBLE (B) SELECT ALTERNATE APS HELIUM TANK (C) AFTER APS GOES IN BLOWDOWN, SELECT LEAKING TANK IF PRESS GREATER THAN 200 PSIA 4. ASCEND ASAP (A) SELECT ALTERNATE APS HELIUM TANK (B) AFTER APS GOES IN BLOWDOWN, SELECT LEAKING TANK IF PRES IS GREATER THAN 200 PSIA.	REF MAL PROC APS NO. ____ NOTE ONE HELIUM BOTTLE CAN SUPPLY SUFFICIENT APS DELTA V CAPABILITY FOR NONLANDING ALTERNATE MISSIONS.		
	A. LEAK PRIOR TO PRESSURIZATION		LUNAR STAY	B. 1. ASCEND IMMEDIATELY 2. CONTINUE MISSION			
	B. LEAK AFTER PRESSURIZATION		LUNAR STAY RNDZ				
		MISSION	REV	DATE	SECTION	GROUP	PAGE
		APOLLO 11		4/16/69	LM PROPULSION - APS	SPECIFIC	26-3

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MISSION RULES

SECTION 26 - LM PROPULSION - APS

REV ITEM

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS			
26-22		APS HE LEAK BETWEEN QUAD CHECK VALVES AND ASC HE REG 1 AND 2 SHUTOFF VALVES	DOCKED/ UNDOCKED DESCENT ORBIT POWERED DESCENT LUNAR STAY RNDZ	A. RETURN TO CSM NO-GO FOR DOI B. RETURN TO CSM NO-GO FOR PDI C. ABORT USE DPS AS LONG AS POSSIBLE D. CONTINUE MISSION 1. PRESSURIZE WITH ONE BOTTLE IMMEDIATELY PRIOR TO IGNITION 2. USE SECOND BOTTLE WHEN APS GOES IN BLOWDOWN E. CONTINUE MISSION CLOSE HE SOV'S	REF MAL PROC APS NO. ____ NOTE SHORT APS BURNS MIGHT BE POSSIBLE.			
26-23		APS HELIUM/ PROPELLANT VAPOR LEAK DOWNSTREAM OF QUAD CHECK VALVES	DOCKED UNDOCKED DESCENT ORBIT/ RNDZ POWERED DESCENT LUNAR STAY	A. EGRESS TO CSM ASAP JETTISON LM B. DOCK ASAP 1. CSM ACTIVE DOCKING 2. JETTISON LM ASAP C. DOCK ASAP 1. CSM RESCUE 2. CSM ACTIVE DOCKING 3. JETTISON LM ASAP D. ABORT 1. USE DPS AS LONG AS POSSIBLE 2. CSM RESCUE 3. CSM ACTIVE DOCKING 4. JETTISON LM ASAP E. ASCEND IMMEDIATELY 1. CSM RESCUE 2. CSM ACTIVE DOCKING 3. JETTISON LM ASAP	REF MAL PROC APS NO. ____			
		MISSION	REV	DATE	SECTION	GROUP	PAGE	
		APOLLO 11		4/16/69	LM PROPULSION - APS	SPECIFIC	26-4	

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MISSION RULES

SECTION 26 - LM PROPULSION - APS

REV ITEM

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	26-24	APS PROP VALVE MISMATCH (DELTA POS)	ALL	CONTINUE MISSION IF BURNING OR HAVE HAD AT LEAST ONE APS BURN. INHIBIT SUBSEQUENT APS BURNS	THIS INDICATION PRIOR TO FIRST APS ENGINE ON WILL BE CONSIDERED A TM FAILURE
	26-25	APS FU AND/OR OXID LOW LEVEL	ASCENT	A. CONTINUE MISSION 1. OPEN RCS MAINS	2. CLOSE ASC FEED APS MAL PROC APS NO. _____
		RULES 26-26 THROUGH 26-29 ARE RESERVED.			

	MISSION	REV	DATE	SECTION	GROUP	PAGE
	APOLLO 11		4/16/69	LM PROPULSION - APS	SPECIFIC	26-5

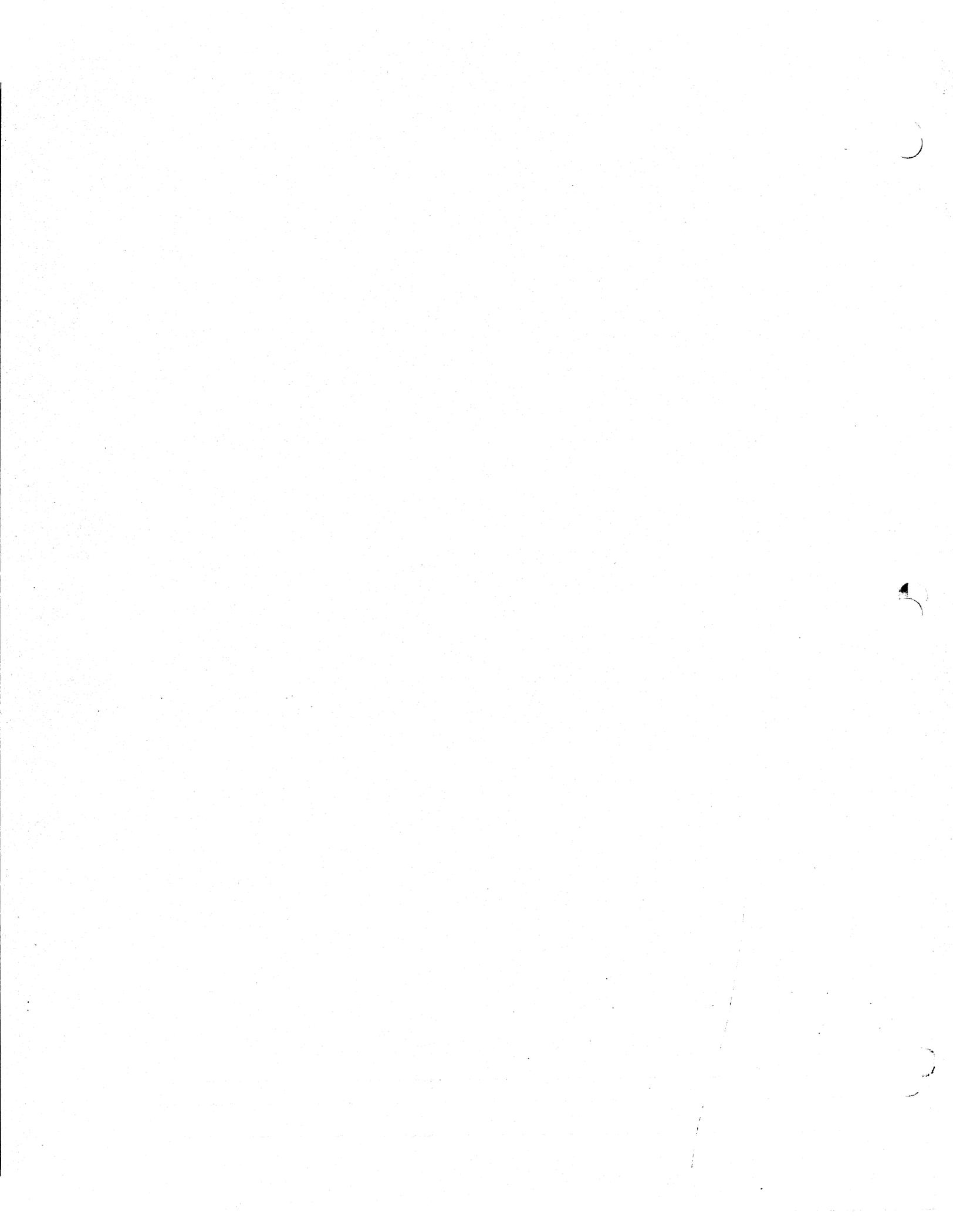
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MISSION RULES

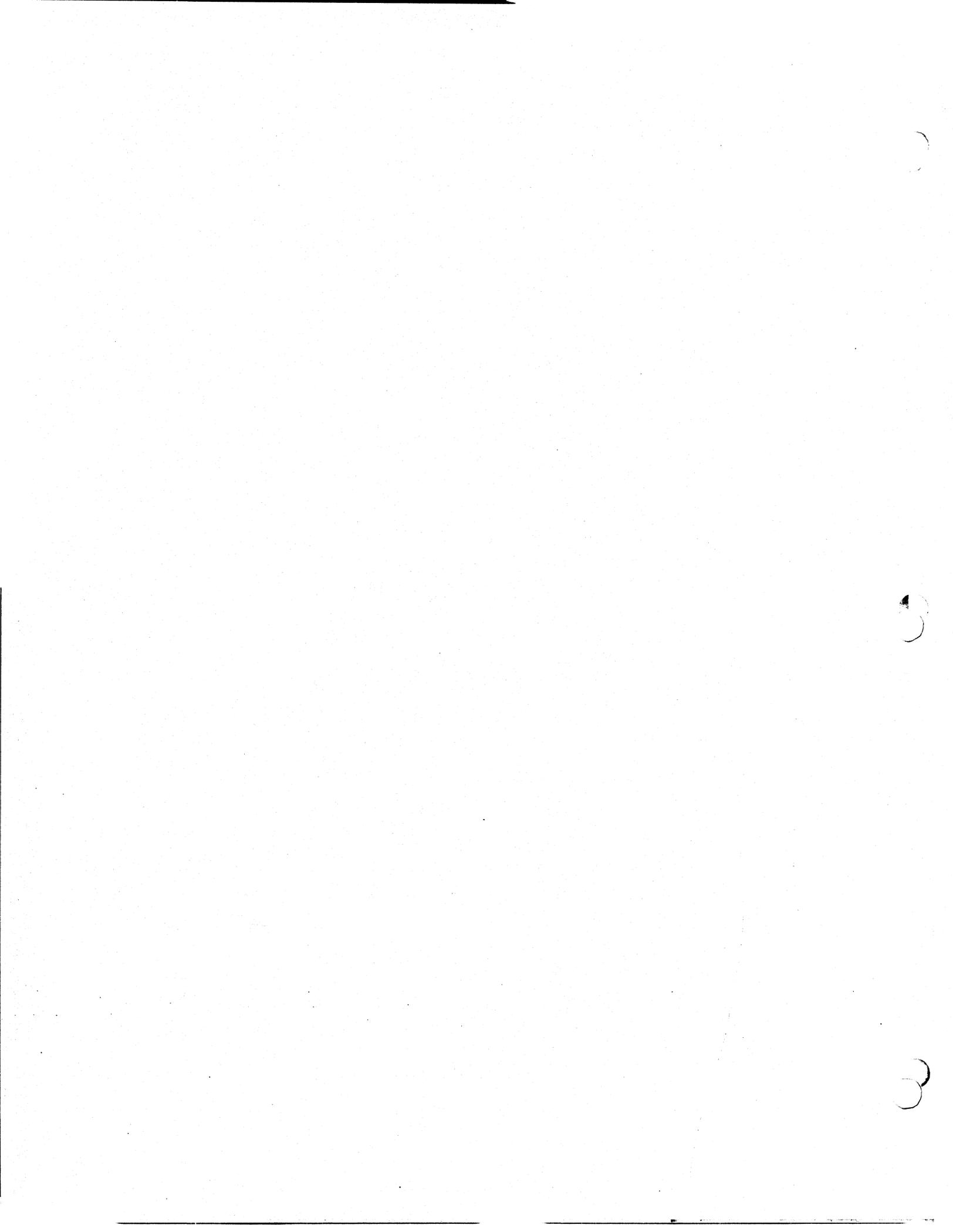
SECTION 26 - LM APS - CONCLUDED

REV ITEM

R	ITEM	INSTR 26-5					MISSION RULE REFERENCE
----- ' APS - PRELAUNCH INSTRUMENTATION ' -----							
26-30	MEAS DESCRIPTION	PCM	ONBOARD TRANSDUCER	CATEGORY			
	APS HE 1 PRESS	GP0001P	HEL MON C&W COMMON	M - PCM		26-20+21+22	
	APS HE 2 PRESS	GP0002P	HEL MON C&W COMMON	M - PCM		26-20+21+22	
	APS HE REG PRESS	GP0018P		HD } 1 OF 2		26-20+22	
	APS HE REG PRESS	GP0025P	C&W COMMON	HD } M - PCM		26-20+22	
	APS HE 1 TEMP	GP0201T	HEL MON COMMON	HD - PCM		26-21	
	APS HE 2 TEMP	GP0202T	HEL MON COMMON	HD - PCM		26-21	
	APS FUEL TEMP	GP0718T	TEMP COMMON	M - PCM		26-20	
	APS FUEL LOW	GP0908X	C&W COMMON	HD		26-25	
	APS OXID TEMP	GP1218T	TEMP COMMON	M - PCM		26-20	
	APS OXID LOW	GP1408X	C&W COMMON	HD		26-25	
	APS FUEL PRESS	GP1501P	C&W COMMON	M - PCM		26-20+21+22+23	
	APS OXID PRESS	GP1503P	C&W COMMON	M - PCM		26-20+21+22+23	
	VLVS A DELTA POS	GP2997U		HD		26-24	
	VLVS B DELTA POS	GP2998U		HD		26-25	
	APS TCP	GP2010P		HD			
		MISSION	REV	DATE	SECTION	GROUP	PAGE
		APOLLO 11		4/16/69	LM APS - APS	PRELAUNCH	26-6



27 LM REACTION
CONTROL SYSTEM



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MISSION RULES

SECTION 27 - LM REACTION CONTROL SYSTEM

PLV ITEM

R	ITEM						
		<p>----- ' GENERAL ' -----</p>					
	27-1	<p>IN ORDER TO INITIATE AND CONTINUE THE FOLLOWING MISSION PHASES, THE RCS SUBSYSTEM MUST PROVIDE THE FOLLOWING MINIMUM CAPABILITIES---</p> <p>A. DOCKED</p> <p>NO PROPELLANT LEAKS</p> <p>B. UNDOCKED, DESCENT ORBIT</p> <p>1. OPERATIONAL RCS SYSTEMS A AND B</p> <p>2. NO PROPELLANT LEAKS</p> <p>C. POWERED DESCENT</p> <p>1. TO INITIATE PDI</p> <p>(A) OPERATIONAL RCS SYSTEMS A AND B</p> <p>(B) NO PROPELLANT LEAKS</p> <p>2. TO CONTINUE POWERED DESCENT</p> <p>(A) OPERATIONAL RCS SYSTEM A OR B, OR A COMBINATION OF SYSTEMS A AND B WHICH WOULD PROVIDE 3-AXIS ATTITUDE CONTROL</p> <p>(B) NO PROPELLANT LEAKS</p> <p>D. LUNAR STAY</p> <p>1. OPERATIONAL RCS SYSTEMS A AND B</p> <p>2. NO PROPELLANT LEAKS</p> <p>E. RENDEZVOUS</p> <p>1. OPERATIONAL RCS SYSTEM A OR B, OR A COMBINATION OF A AND B WHICH WOULD PROVIDE 3-AXIS ATTITUDE CONTROL AND ONE AXIS TRANSLATION CAPABILITY PRIOR TO TPI AND 3-AXIS TRANSLATION CAPABILITY FROM TPI THROUGH DOCKING.</p> <p>2. NO PROPELLANT LEAKS.</p>					
	27-2	<p>DEFINITIONS</p> <p>A. RCS SYSTEM</p> <p>AN RCS SYSTEM CONTAINS EIGHT OPERATIONAL THRUSTERS SUPPLIED BY ITS OWN PRESSURIZATION AND PROPELLANT FEED SYSTEM INDEPENDENT OF ASCENT FEED AND CROSSFEED.*</p> <p>*INDIVIDUAL THRUSTERS REQUIRED FOR DIFFERENT MISSION PHASES WILL BE COVERED SEPARATELY.</p> <p>B. OPERATIONAL RCS SYSTEM</p> <p>1. FUEL AND/OR OXID MANIFOLD PRESSURES GREATER THAN OR EQUAL TO 100 PSI.</p> <p>2. DELTA PRESSURE BETWEEN FUEL AND OXID MANIFOLD LESS THAN OR EQUAL TO 80 PSID.</p> <p>3. FUEL TEMP GREATER THAN OR EQUAL TO 40 DEG F AND LESS THAN OR EQUAL TO 100 DEG F.</p> <p>RULE NUMBERS 27-3 THROUGH 27-9 ARE RESERVED.</p>					
		MISSION	REV	DATE	SECTION	GROUP	PAGE
		APOLLO 11		4/16/69	LM REACTION CONTROL SYSTEM	GENERAL - RCS	27-1

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MISSION RULES

SECTION 27 - LM REACTION CONTROL SYSTEM

RIV ITEM

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS														
				----- ' SPECIFIC MISSION RULES ' -----															
27-20	LOSS OF RCS SYSTEM A OR B	ALL		A. CLOSE MAINS OF AFFECTED SYSTEM IF LOSS OF SYSTEM RESULTED FROM ANYTHING OTHER THAN ISOLATION OF JETS B. CROSSFEED FROM GOOD SYSTEM DOCKED DO NOT UNDOCK UNDOCKED DOCK ASAP NO-GO FOR DOI DESCENT RETURN OF CSM ASAP ORBIT NO-GO FOR PDI POWERED CONTINUE MISSION DESCENT/ RNDZ LUNAR ASCENT ASAP STAY	REF MAL PROC RCS NO. ____														
<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 25%;">MISSION</td> <td style="width: 5%;">REV</td> <td style="width: 10%;">DATE</td> <td style="width: 20%;">SECTION</td> <td style="width: 15%;">GROUP</td> <td style="width: 10%;">PAGE</td> <td style="width: 15%;"></td> </tr> <tr> <td>APOLLO 11</td> <td></td> <td>4/16/69</td> <td>LM REACTION CONTROL SYSTEM</td> <td>SPECIFIC - RCS</td> <td>27-3</td> <td></td> </tr> </table>						MISSION	REV	DATE	SECTION	GROUP	PAGE		APOLLO 11		4/16/69	LM REACTION CONTROL SYSTEM	SPECIFIC - RCS	27-3	
MISSION	REV	DATE	SECTION	GROUP	PAGE														
APOLLO 11		4/16/69	LM REACTION CONTROL SYSTEM	SPECIFIC - RCS	27-3														

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MISSION RULES

SECTION 27 - LM REACTION CONTROL SYSTEM

REV ITEM

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS		
	27-21	RCS THRUSTER PAIR			REF MAL PROC RCS NO. _____		
		A. ONE PAIR ISOLATED	DOCKED	A. 1. DO NOT UNDOCK			
			UNDOCKED	2. DOCK ASAP NO-GO FOR DOI			
			DESCENT	3. RETURN TO CSM ASAP			
			ORBIT	NO-GO FOR PDI			
			POWERED DESCENT/RNDZ	4. CONTINUE MISSION			
			LUNAR STAY	5. ASCENT ASAP			
		B. COMBINATION ISOLATED RESULTING IN LOSS OF ATTITUDE CONTROL	DOCKED	B. 1. DO NOT UNDOCK			
			UNDOCKED	2. CSM ACTIVE DOCKING NO-GO FOR DOI			
			DESCENT	3. CSM RESCUE			
			ORBIT	NO-GO FOR PDI. CSM ACTIVE DOCKING			
			POWERED DESCENT	4. OPEN WHATEVER ISOLATION PAIRS REQUIRED TO MAINTAIN ATTITUDE CONTROL.			
				(A) PRIOR TO LOW GATE -			
				(1) ABORT			
				(2) ABORT STAGE AT DPS DEPLETION			
				(B) LOW GATE TO TOUCHDOWN CONTINUE MISSION			
			LUNAR STAY/RNDZ	5. OPEN WHATEVER ISOLATION PAIRS REQUIRED TO ACHIEVE SAFE ASCENT. CSM RESERVE AND ACTIVE DOCKING			
		MISSION	REV	DATE	SECTION	GROUP	PAGE
		APOLLO 11		4/16/69	LM REACTION CONTROL SYSTEM	SPECIFIC - RCS	27-4

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MISSION RULES

SECTION 27 - LM REACTION CONTROL SYSTEM

REV ITEM

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS												
	27-22	DECREASING OR LOSS OF RCS HE PRESSURE	ALL DOCKED UNDOCKED DESCENT ORBIT POWERED DESCENT/RNDZ LUNAR STAY	A. 1. CONTINUE USING BOTH SYSTEMS UNTIL MFLD PRESS IN BAD SYSTEM LESSER THAN 100 PSI THEN CLOSE MAINS OF BAD SYSTEM 2. CROSSFEED FROM GOOD SYSTEM B. DO NOT UNDOCK UNLESS SUFFICIENT PROPELLANT TO REDOCK EXISTS IN BLOWDOWN C. RETURN TO CSM AND DOCK ASAP GO-GO FOR DOI D. RETURN TO CSM AND DOCK ASAP NO-GO FOR PDI E. CONTINUE MISSION F. CONTINUE MISSION IF SUFFICIENT BLOWDOWN CAPABILITY EXISTS IN FAILED SYSTEM FOR 6 HOURS OF LINE OF SIGHT AND 5 MINUTES OF ATT HOLD IF THIS CAPABILITY DOES NOT EXIST, ASCEND ASAP	REF MAL PROC RCS NO. ____ WHEN MFLD PRESS DROPS BELOW 100 PSI, THE SYSTEM IS CONSIDERED NON-OPERATIONAL REF RULE 27-2												
	27-23	RCS PROPELLANT LEAK	DOCKED UNDOCKED DESCENT ORBIT/RNDZ POWERED DESCENT/LUNAR STAY	A. EGRESS TO CSM ASAP JETTISON LM B. CSM RESCUE NO-GO FOR DOI C. DOCK ASAP 1. NO-GO FOR PDI 2. CSM RESCUE 3. CSM ACTIVE DOCKING 4. JETTISON LM ASAP D. ASCEND IMMEDIATELY 1. CSM RESCUE 2. CSM ACTIVE DOCKING 3. JETTISON LM ASAP	REF MAL PROC RCS NO. ____ NOTE LM RCS ACTIVITY SHOULD BE KEPT AT AN ABSOLUTE MINIMUM												
<table border="1"> <thead> <tr> <th>MISSION</th> <th>REV</th> <th>DATE</th> <th>SECTION</th> <th>GROUP</th> <th>PAGE</th> </tr> </thead> <tbody> <tr> <td>APOLLO 11</td> <td></td> <td>4/16/69</td> <td>LM REACTION CONTROL SYSTEM</td> <td>SPECIFIC - RCS</td> <td>27-5</td> </tr> </tbody> </table>						MISSION	REV	DATE	SECTION	GROUP	PAGE	APOLLO 11		4/16/69	LM REACTION CONTROL SYSTEM	SPECIFIC - RCS	27-5
MISSION	REV	DATE	SECTION	GROUP	PAGE												
APOLLO 11		4/16/69	LM REACTION CONTROL SYSTEM	SPECIFIC - RCS	27-5												

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MISSION RULES

SECTION 27 - LM REACTION CONTROL SYSTEM

REV ITEM

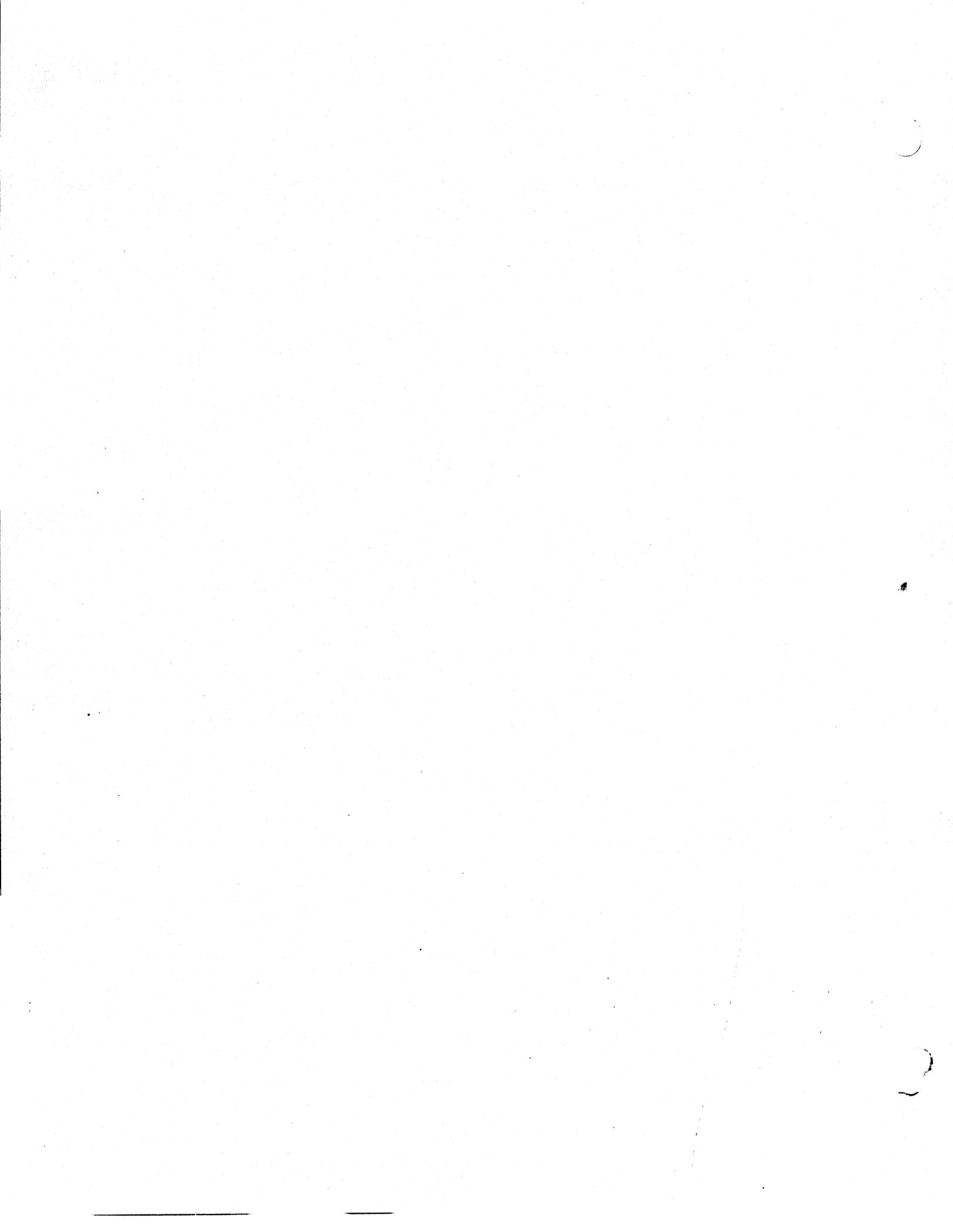
R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS		
	27-24	RCS QUAD TEMP LESSER THAN 119 DEG OR GREATER THAN 190 DEG F EXCEPT DURING PERIODS OF HEAVY DUTY CYCLE WITH EXPECTED RISES, SUCH AS DOCKING	ALL	ISOLATE BOTH THRUSTER PAIRS IN AFFECTED QUAD (REF RULE 27-21)	REF MAL PROC NO. --- QUAD TEMP LESS THAN 119 DEG INDICATES THE POSSIBILITY OF INCOMPLETE COMBUSTION, WHICH COULD CAUSE HARD STARTS AND POSSIBLE EXPLOSIONS. QUAD TEMPS GREATER THAN 190 DEG F INDICATES PREMATURE OXID VAPORIZATION AND ALSO POSSIBILITY OF VALVE SEAT DAMAGE.		
	27-25	IMPINGEMENT CONSTRAINTS VIOLATED	DOCKED/ UNDOCKED DESCENT ORBIT POWERED DESCENT LUNAR STAY/ RNDZ	A. DOCK ASAP CSM ACTIVE DOCKING B. CSM RESCUE CSM ACTIVE DOCKING C. 1. PDI TO LOW GATE ABORT STAGE 2. LOW GATE TO TD CONTINUE MISSION D. CONTINUE MISSION	REF MAL PROC RCS NO. ---		
	RULES 27-26 THROUGH 27-29 ARE RESERVED.						
		MISSION	REV	DATE	SECTION	GROUP	PAGE
		APOLLO 11		4/16/69	LM REACTION CONTROL SYSTEM	SPECIFIC - RCS	27-6

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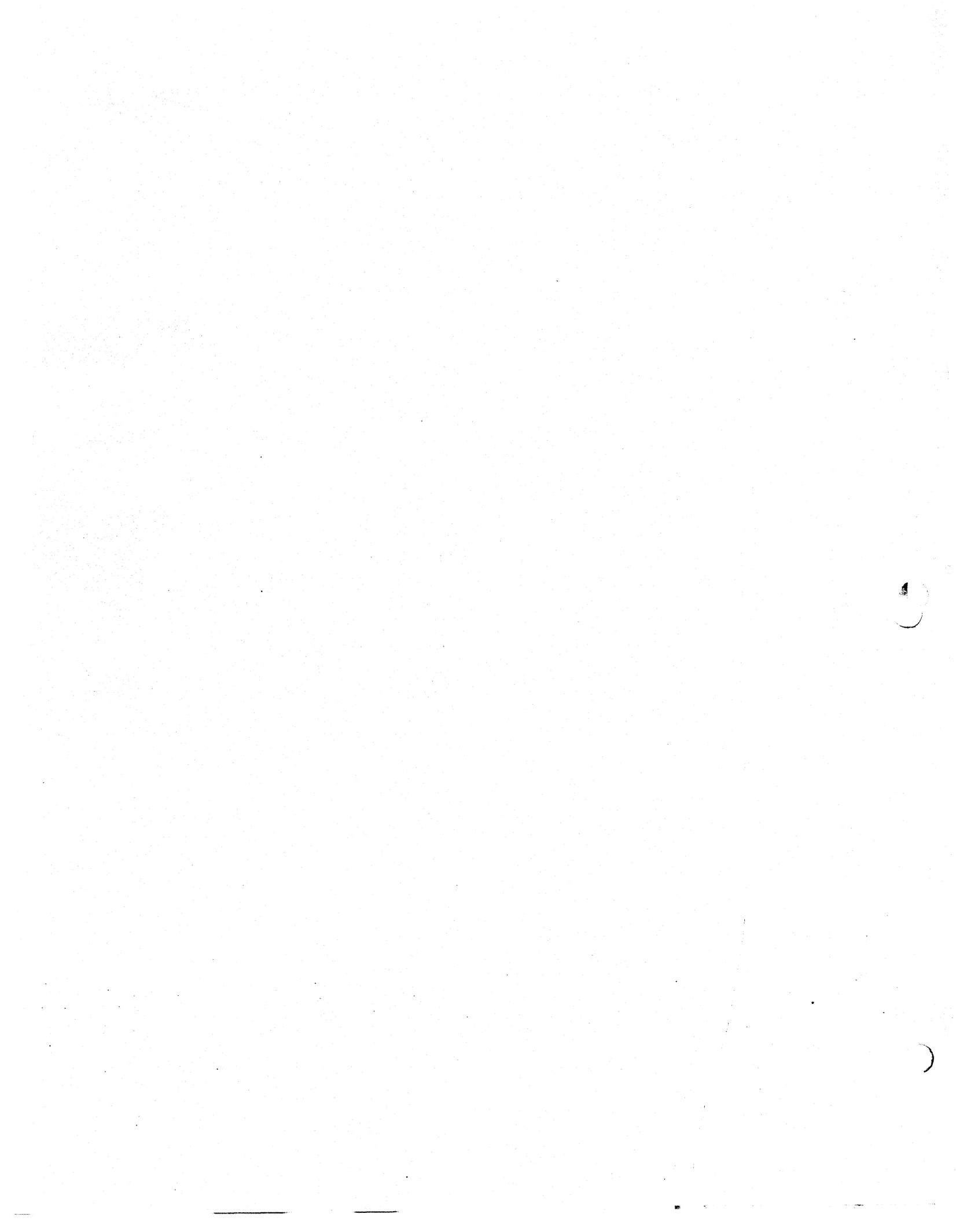
MISSION RULES

SECTION 27 - LM REACTION CONTROL - CONCLUDED

REV	ITEM						
R	ITEM						
----- PRELAUNCH INSTRUMENTATION -----							
27-30	MEAS DESCRIPTION	PCM	ONBOARD	TRANSDUCER	CATEGORY	MISSION RULE REFERENCE	
	RCS 'A' PROP QTY	GR1085Q	QUANTITY	COMMON	M	27-23,22,20	
	RCS 'B' PROP QTY	GR1095Q	QUANTITY	COMMON	M	27-23,22,20	
	RCS 'A' REG PRESS	GR1201P	PRESS MON C&W	COMMON	M-PCM	27-20,22,23	
	RCS 'B' REG PRESS	GR1202P	PRESS MON C&W	COMMON	M-PCM	27-20,22,23	
	RCS 'A' HE PRESS	GR1101P	PRESS MON C&W	COMMON	M-PCM	27-23,20	
	RCS 'B' HE PRESS	GR1102P	PRESS MON C&W	COMMON	M-PCM	27-23,20	
	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		
	RCS MAIN 'B' CLSD	GR9610U	MAIN SOV	COMMON	HD		
	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		
	QUAD 1 'A' TCA ISOL VLV	GR9667U	SYS A QUAD 1	COMMON	HD	27-21	
	QUAD 2 'A' TCA ISOL VLV	GR9665U	SYS A QUAD 2	COMMON	HD	27-21	
	QUAD 3 'A' TCA ISOL VLV	GR9663U	SYS A QUAD 3	COMMON	HD	27-21	
	QUAD 4 'A' TCA ISOL VLV	GR9661U	SYS A QUAD 4	COMMON	HD	27-21	
	QUAD 1 'B' TCA ISOL VLV	GR9668U	SYS B QUAD 1	COMMON	HD	27-21	
	QUAD 2 'B' TCA ISOL VLV	GR9666U	SYS B QUAD 2	COMMON	HD	27-21	
	QUAD 3 'B' TCA ISOL VLV	GR9664U	SYS B QUAD 3	COMMON	HD	27-21	
	QUAD 4 'B' TCA ISOL VLV	GR9662U	SYS B QUAD 4	COMMON	HD	27-21	
	QUAD 1 TEMP	GR6004T	TEMP MON C&W	COMMON	M	27-24	
	QUAD 2 TEMP	GR6003T	TEMP MON C&W	COMMON	M	27-24	
	QUAD 3 TEMP	GR6002T	TEMP MON C&W	COMMON	M	27-24	
	QUAD 4 TEMP	GR6001T	TEMP MON C&W	COMMON	M	27-24	
	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



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MISSION RULES

SECTION 28 - SPACE ENVIRONMENT

RLV ITEM

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 RELIABLE SOURCES.					
		H. A SIGNIFICANT INCREASE OF THE MOD IS DEFINED AS A PARTICLE EVENT THAT WILL PRODUCE A FLUX OF 10 TO THE 10TH POWER AND A SKIN DOSE OF 575 RADS AND/OR A DEPTH DOSE OF 140 RADS.					
		MISSION	REV	DATE	SECTION	GROUP	PAGE
		APOLLO 11		4/16/69	SPACE ENVIRONMENT	GENERAL	28-1

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MISSION RULES

SECTION 28 - SPACE ENVIRONMENT

REV ITEM

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS			
				----- SPECIFIC MISSION RULES -----				
28-10	ANY SOURCE REPORTS A POSSIBLE ARTIFICIAL EVENT		ALL	PROCEED UNTIL VERIFICATION FROM ALL OTHER SOURCES.				
28-11	DEFINITE ARTIFICIAL EVENT CONFIRMED BY REPORTING SOURCES		PRE-LAUNCH	A. HOLD IF INFORMATION FROM REPORTING SOURCES INDICATES A SEVERE INCREASE IN RADIATION ALONG THE S/C TRAJECTORY.				
			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.	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		PRE-LAUNCH AND LAUNCH	NOT APPLICABLE				
			ALL OTHERS	REENTER NEXT BEST PTP				
28-13	MAJOR SOLAR FLARE PREDICTED		ALL	CONTINUE MISSION				
		MISSION	REV	DATE	SECTION	GROUP	PAGE	
		APOLLO 11		4/16/69	SPACE ENVIRONMENT	SPECIFIC	28-3	

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MISSION RULES

SECTION 28 - SPACE ENVIRONMENT

REV ITEM

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/RTAC ANALYSIS INDICATE THE MOD WILL BE EXCEEDED DURING THE MISSION	PRE-LAUNCH	B.1. HOLD IF DATA ANALYSIS INDICATES THAT THE MOD WILL BE SIGNIFICANTLY EXCEEDED PRIOR TO MISSION COMPLETION.				
			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 NG-GC.				
			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 CONSIDERATIONS SHOULD BE GIVEN TO ENTER IN NEXT BEST PTP IF THE TOTAL DOSE CANNOT BE REDUCED SIGNIFICANTLY WITHOUT INCREASING THE TOTAL RISK TO THE CREW.	C.1. CREW SHOULD BEGIN PERSONAL DOSIMETER 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				
		MISSION	REV	DATE	SECTION	GROUP	PAGE	
		APOLLO 11		4/16/69	SPACE ENVIRONMENT	SPECIFIC	28-4	

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MISSION RULES

SECTION 28 - SPACE ENVIRONMENT - CONCLUDED

REV ITEM

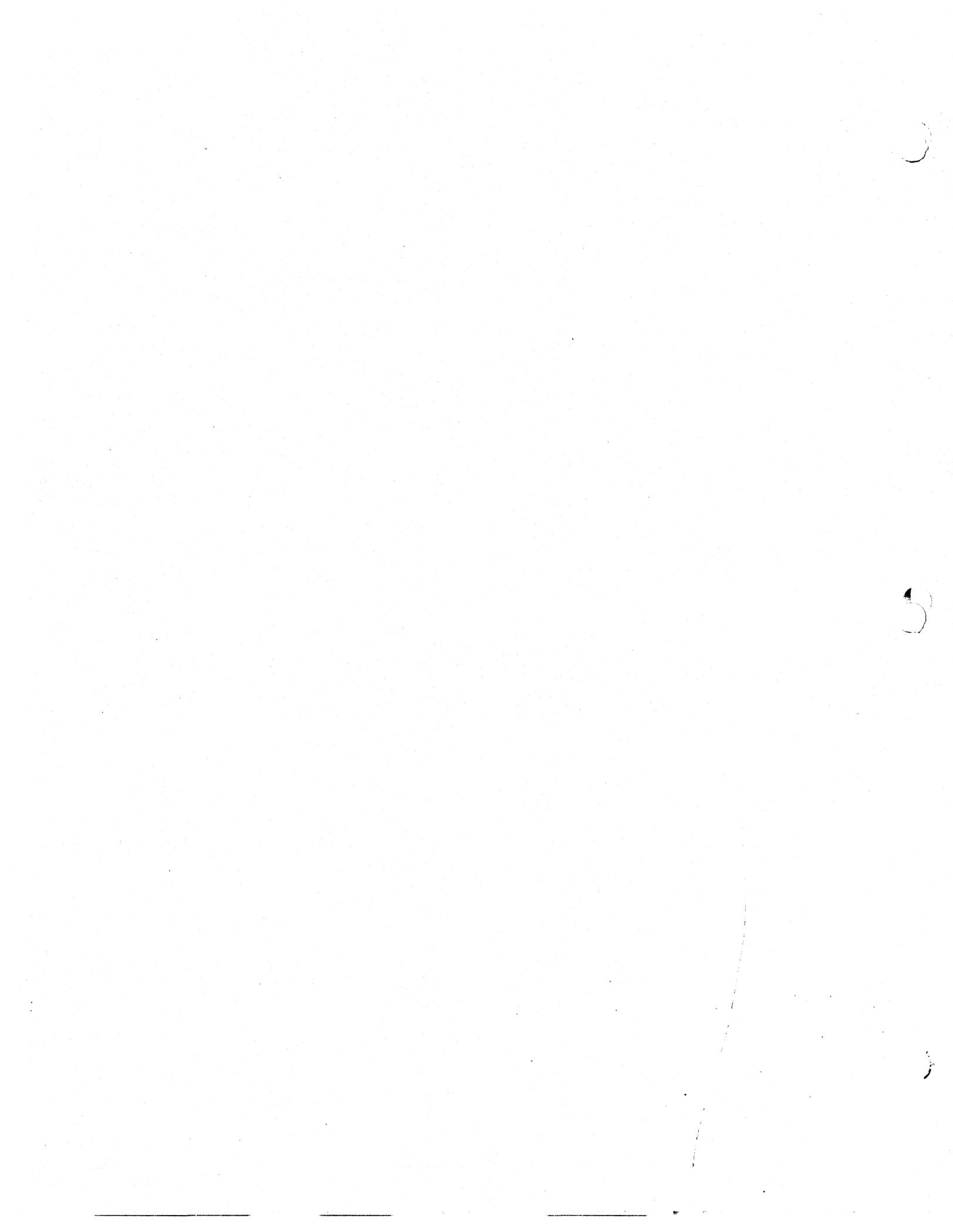
R	ITEM	----- INSTRUMENTATION REQUIREMENTS -----					
		MEAS DESCRIPTION	PCM	ONBOARD	TRANSDUCERS	CATEGORY	MISSION RULE REF
28-15		RADIATION DOSIMETER 1 (CM DEPTH DOSE RATE)	CK1051K	-	-	HD	28-12
			VABD				
		RADIATION DOSIMETER 2 (CM SKIN DOSE RATE) 2	CK1052K	-	-	HD	28-12
		DOSIMETER RATE CHANGE	CK1053R	-	-	HD	28-12
		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
			NPDS				
		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)	3 - ONBOARD	-	-	MANDATORY TO BE ONBOARD	28-14
		MISSION	REV	DATE	SECTION	GROUP	PAGE
		APOLLO 11		4/16/69	SPACE ENVIRONMENT	INSTR REQ	28-5

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3

29-45-0177



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MISSION RULES

SECTION 29 - RECOVERY

REV ITEM

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS								
				<div style="border: 1px dashed black; padding: 2px;"> SPECIFIC </div>									
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 65 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.								
<p>*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---</p> <table style="margin-left: auto; margin-right: auto;"> <tr> <td>SURFACE WINDS</td> <td>25 KNOTS</td> </tr> <tr> <td>CEILING</td> <td>1500 FT</td> </tr> <tr> <td>VISIBILITY</td> <td>3 NM</td> </tr> <tr> <td>WAVE HEIGHT</td> <td>8 FT</td> </tr> </table>						SURFACE WINDS	25 KNOTS	CEILING	1500 FT	VISIBILITY	3 NM	WAVE HEIGHT	8 FT
SURFACE WINDS	25 KNOTS												
CEILING	1500 FT												
VISIBILITY	3 NM												
WAVE HEIGHT	8 FT												
		MISSION	REV	DATE	SECTION	GROUP	PAGE						
		APOLLO 11		4/16/69	RECOVERY	SPECIFIC	29-1						

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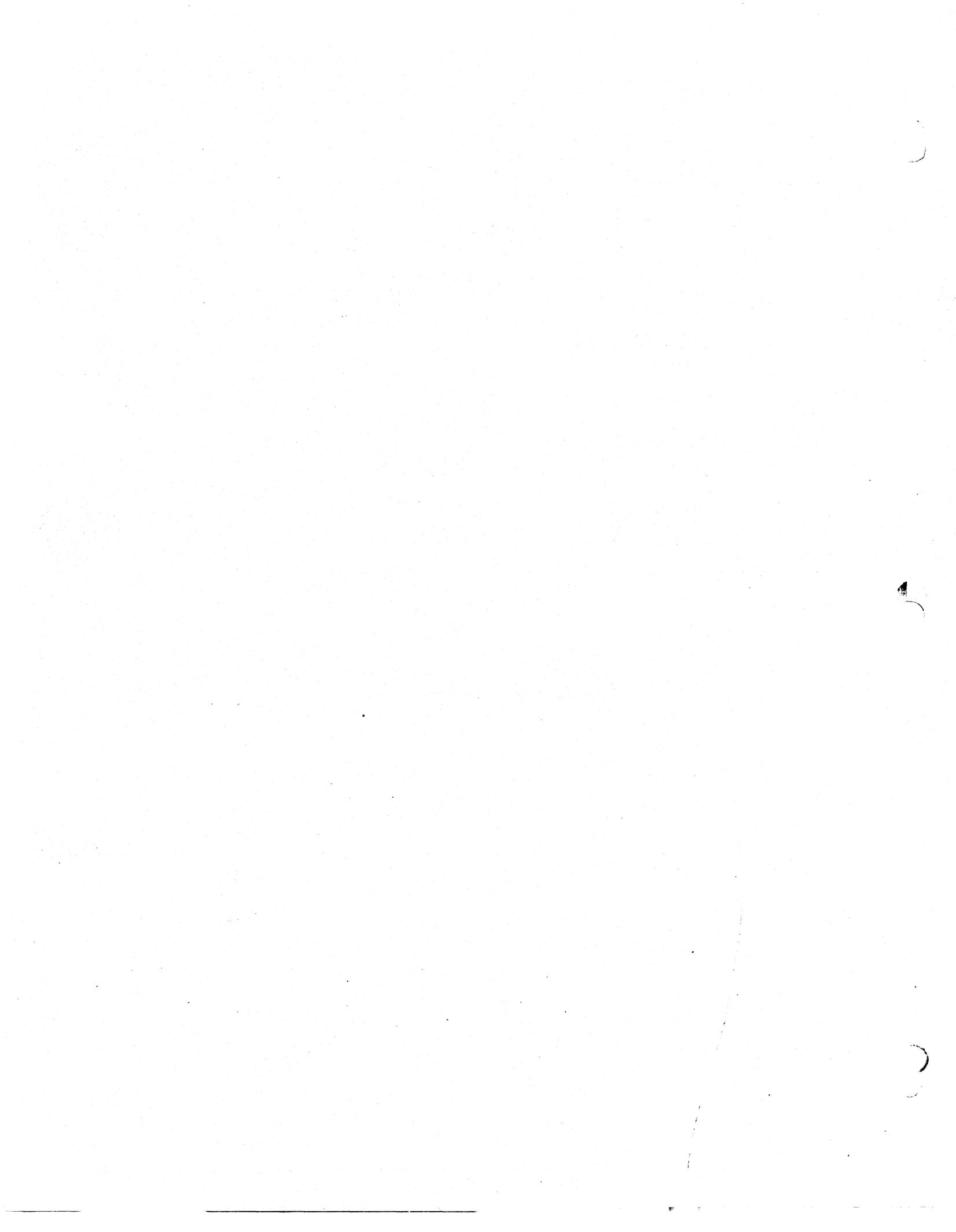
MISSION RULES

SECTION 29 - RECOVERY

RLV ITEM

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS		
	29-6	AN ELLIPSE <u>163</u> NM UPRANGE <u>152</u> NM DOWNRANGE AND <u>50</u> NM TO EITHER SIDE OF 55 DEG/55DEG TARGET POINT-- AND AN ELLIPSE <u>105</u> NM UPRANGE AND DOWNRANGE AND <u>40</u> 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 <u>109</u> NM UPRANGE AND DOWNRANGE AND <u>40</u> NM TO EITHER SIDE OF 90 DEG/90DEG TARGET POINT-- AND ELIPSE <u>105</u> NM UPRANGE AND DOWNRANGE AND <u>40</u> NM TO EITHER SIDE OF ROLL RIGHT 90 DEG TARGET POINT WILL BE CLEAR OF LARGE LAND MASSES.	EARTH ORBITAL	HIGHLY DESIRABLE			
	29-8	AN ELLIPSE <u>TBD</u> NM UPRANGE <u>TBD</u> NM DOWNRANGE AND <u>TBD</u> NM TO EITER SIDE OF THE GNCS TARGET POINT--AND AN ELLIPSE <u>TBD</u> NM UPRANGE <u>TBD</u> NM DOWNRANGE AND <u>TBD</u> NM TO EITHER SIDE OF THE EMS TARGET POINT WILL BE CLEAR OF ALL LAND	POST-TLI	MANDATORY			
	29-9	REMAINDER OF OPERATIONAL FOOTPRINT AND AN ELLIPSE <u>TBD</u> NM UPRANGE <u>TBD</u> NM DOWNRANGE AND <u>TBD</u> NM TO EITHER SIDE OF THE CONSTANT 'G' TARGET POINT WILL BE CLEAR OF LARGE LAND MASSES	POST-TLI	HIGHLY DESIRABLE			
		MISSION	REV	DATE	SECTION	GROUP	PAGE
		APOLLO 11		4/16/69	RECOVERY	SPECIFIC	29-2

WATERMEDICAL



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MISSION RULES

SECTION 30 - AEROMEDICAL

REV ITEM

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS		
				----- ' SPECIFIC MISSION RULES '			
30-15	LOSS OR UNREADABLE EKG		ALL PHASES	CONTINUE MISSION	ARTIFACTS ANTICIPATED DURING LAUNCH MCC SURGEON WILL EVALUATE THE PROBLEM AND MAY RECOMMEND EARLY MISSION TERMINATION IF CORRECTIVE ACTION IS NOT EFFECTIVE.		
30-16	ABNORMAL HEART RATE, RHYTHM OR EKG		LAUNCH EPO TLC LO TEC	A. CONTINUE MISSION B. NO-GO FOR TLI C. NO-GO FOR LOI D. ENTER NEXT BEST PTP E. ENTER NEXT BEST PTP	MCC SURGEON WILL EVALUATE THE PROBLEM AND MAY RECOMMEND EARLY MISSION TERMINATION IF CORRECTIVE ACTION IS NOT EFFECTIVE.		
30-17	ABNORMAL RESPIRATORY RATE		LAUNCH EPO TLC LO TEC	A. CONTINUE MISSION B. NO-GO FOR TLI C. NO-GO FOR LOI D. ENTER NEXT BEST PTP E. ENTER NEXT BEST PTP	THE ABNORMAL RATES WILL BE EVALUATED BY THE MCC SURGEON AND EARLY MISSION TERMINATION MAY BE RECOMMENDED IF CORRECTIVE ACTION IS NOT EFFECTIVE.		
30-18	ONSET OF SERIOUS MEDICAL PROBLEM		LAUNCH EPO TLC LO TEC	A. CONTINUE MISSION CREW MAY ELECT TO ABORT IF INTOLERABLE B. ENTER NEXT BEST PTP C. ENTER NEXT BEST PTP D. ENTER NEXT BEST PTP E. ENTER NEXT BEST PTP	MCC SURGEON WILL EVALUATE AND MAY RECOMMEND EARLY MISSION TERMINATION IF CORRECTIVE ACTION IS NOT EFFECTIVE.		
		MISSION	REV	DATE	SECTION	GROUP	PAGE
		APOLLO 11		4/16/69	AEROMEDICAL	SPECIFIC PHYSIOLOGICAL	30-2

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MISSION RULES

SECTION 30 - AEROMEDICAL

REV ITEM

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 9 PSIA IN 75 SEC). (D) SELECT SUIT DEMAND REG INLET SEL VALVE TO OFF WHEN SUIT PRESS REACHES 9.0 PSIA. (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			
		RULE NUMBERS 30-21 THROUGH 30-24 ARE RESERVED.					
		MISSION	REV	DATE	SECTION	GROUP	PAGE
		APOLLO 11		4/16/69	AEROMEDICAL	SPECIFIC PHYSIOLOGICAL	30-3

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MISSION RULES

SECTION 30 - AEROMEDICAL

REV ITEM

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 ALL	A.1. CONTINUE MISSION 2. CONTINUE MISSION CHANGE LIQH CANISTER	A. PCO2 SHOULD DECREASE BELOW 2 MM HG WITHIN 30 MINUTES.		
		B. GREATER THAN OR EQUAL TO 7.6 MM HG AND UNABLE TO DECREASE	LAUNCH ALL	B.1. CONTINUE MISSION 2. CONTINUE MISSION (A) OPEN SUITS AND BREATHE FROM CABIN (B) CHANGE SECOND LIQH CANISTER (C) TEST PCO2 SENSOR	B.2. LIQH CANISTERS WILL NOT BE CHANGED IN AN UNPRESSURIZED CABIN. B.2.(C) PCO2 SENSOR TEST--- <ul style="list-style-type: none"> • 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 PCO READING NEAR ZERO, THE PCO2 SENSOR IS OPERATING PROPERLY 		
		C. GREATER THAN OR EQUAL TO 10 MMHG	LAUNCH ALL	C.1. CONTINUE MISSION 2. TERMINATE PHASE ENTER NEXT BEST PTP			
30-26		PCO2 INSTRUMENTATION FAILURE	ALL	CONTINUE MISSION USE ONBOARD CO2 TAPES			
		RULE NUMBER 30-27 THROUGH 30-34 ARE RESERVED.					
		MISSION	REV	DATE	SECTION	GROUP	PAGE
		APOLLO 11		4/16/69	AEROMEDICAL	SPECIFIC EQUIPMENT	30-4

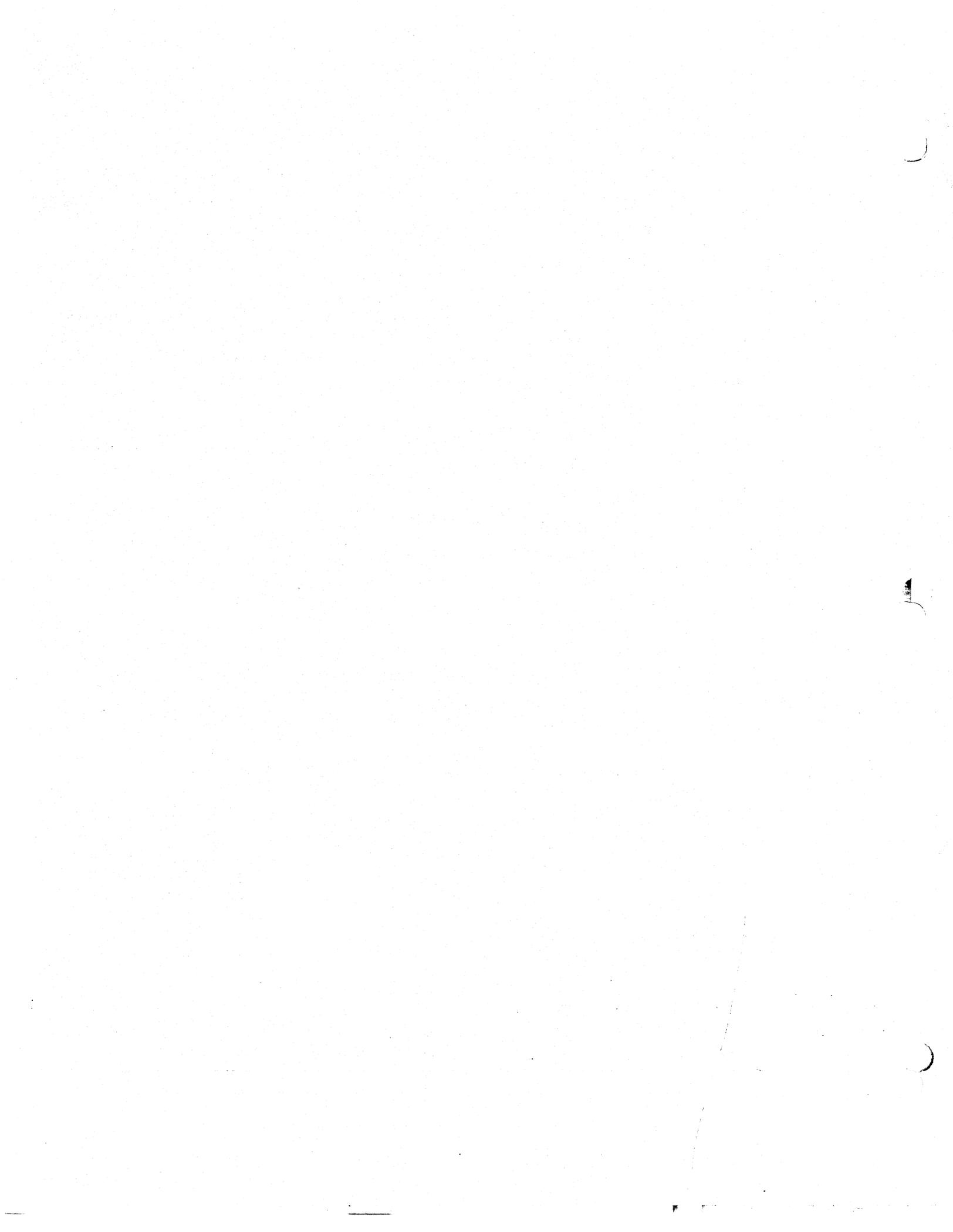
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MISSION RULES

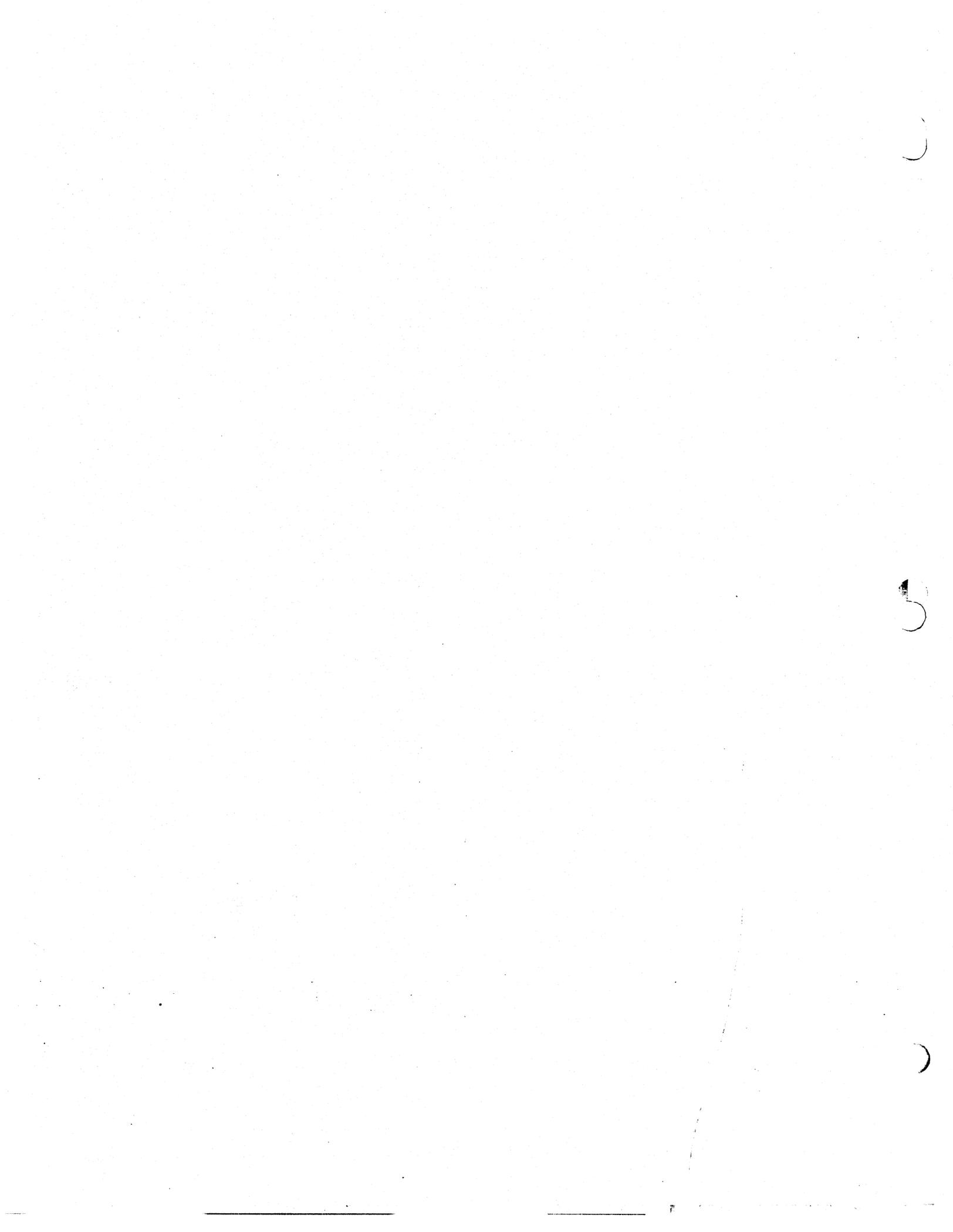
SECTION 30 - AEROMEDICAL - CONCLUDED

REV ITEM

R	ITEM						MISSION RULE REFERENCE
----- ' INSTRUMENTATION REQUIREMENTS ' -----							
CSM							
30-35	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	CJ0200R	NOT DISPLAYED		HD	30-17	
	PNEUMOGRAM	CJ0201R	NOT DISPLAYED		HD	30-17	
	PNEUMOGRAM	CJ0202R	NOT DISPLAYED		HD	30-17	
LM							
	CO2 PARTIAL PRESSURE	GF1521P	METER		HD		
	ELECTROCARDIOGRAM	GT9999	NOT DISPLAYED		HD	30-15/16	
	PNEUMOGRAM		NOT DISPLAYED		HD	30-17	
PLSS							
	PLSS ELECTROCARDIOGRAM	GT8124J			M	30-15/16	
*MANDATORY TO CABIN CLOSEOUT							
EVA RULES NOT INCLUDED							
		MISSION	REV	DATE	SECTION	GROUP	PAGE
		APOLLO 11		4/16/69	AEROMEDICAL	INSTR REQ	30-5



SECRET



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MISSION RULES

SECTION 31 - EASEP

REV ITEM

R	ITEM							
		<p>----- GENERAL -----</p>						
	31-1	<p>A. GENERAL</p> <ol style="list-style-type: none"> 1. THE GATHERING OF SCIENTIFIC DATA WILL NOT BE COMPROMISED FOR ENGINEERING OR TEST PURPOSES. 2. REDUNDANT OR BACKUP SYSTEMS WILL NOT BE SELECTED UNLESS A FAILURE WARRANTS SUCH ACTION. SWITCHING TO REDUNDANT SYSTEMS WILL NOT BE ACCOMPLISHED TO SATISFY ENGINEERING TESTS UNLESS ALL SCIENTIFIC MISSION OBJECTIVES HAVE BEEN COMPLETED AND THE PSEP HAS BEEN DEPLOYED ON THE MOON FOR ONE YEAR. 3. BIT RATES WILL NOT BE CHANGED ON THE PSEP UNLESS THIS ACTION WILL CORRECT CERTAIN SYNC PROBLEMS (FROM THAT OPERATIONAL MSFN SITE) OR UNLESS A CHANGE OF BIT RATE IS NECESSARY TO SATISFY CERTAIN SCIENTIFIC OBJECTIVES. IF THE BIT RATE IS CHANGED FROM THE NORM BECAUSE OF A MSFN PROBLEM, THE PSEP WILL BE CONFIGURED BACK TO NORMAL (1.06 KBPS) PRIOR TO TERMINATION OF SUPPORT OF THAT SITE. 4. BEFORE IMPLEMENTING ANY MISSION RULE ACTION BASED ON AN APPARENT PSEP MALFUNCTION, IT WILL BE ASCERTAINED THAT THERE ARE NO PROBLEMS WITH THE MSFN SUPPORTING SITE. 5. THE TIMER INHIBIT COMMAND WILL NOT BE SENT PRIOR TO ALL EXPERIMENTS BEING ON AND PROPERLY ADJUSTED FOR OPTIMUM SCIENTIFIC DATA RETURN. 6. THE TIMER WILL NEVER BE INHIBITED WHILE THE PSEP TRANSMITTER IS OFF, AND THE PSEP TRANSMITTER WILL NEVER BE COMMANDED OFF WHILE THE TIMER IS INHIBITED. 7. EITHER PSEP COMMAND DECODER MAY BE ADDRESSED DURING NORMAL GROUND COMMANDING OPERATIONS. 8. ANYTIME PCU NO. 2 IS SELECTED BY COMMAND OR BY AUTOMATIC SWITCHOVER FROM PCU NO. 1, SELECTION OF PCU NO. 1 WILL NOT BE ATTEMPTED UNLESS SCIENTIFIC DATA IS BEING LOST DUE TO IMMINENT TOTAL FAILURE OF PCU NO. 2. 9. NO FUNCTION CAN BE COMMANDED (OTHER THAN 'STANDBY OFF' OR 'OPERATE SELECT') IN AN EXPERIMENT, BY GROUND COMMAND OR BY UNBOARD TIMER, UNLESS THE EXPERIMENT IS IN THE 'OPERATE' MODE. 10. THE PSE WILL BE GOUND COMMANDED ON PRIOR TO THE CREW LEAVING THE IMMEDIATE CS AREA. 11. PDR NO. 1 (SW) WILL BE COMMANDED ON APPROXIMATELY ONE (1) HOUR BEFORE LUNAR SUNSET. 12. TRANSMITTER WILL BE COMMANDED OFF APPROXIMATELY ONE (1) HOUR BEFORE LUNAR SUNSET. 13. NO SEQUENCE OF COMMANDS WILL BE SENT WHICH WILL CAUSE UNLOADING OF THE 29V LINE. UNLOADING THE 29V LINE COULD CAUSE AN OUT OF REGULATION CONDITION, A BUILDUP OF SPIKES ON THE OUTPUT FILTER CAPACITORS, AND VOLTAGE UP TO 50 VOLTS WHICH WOULD DAMAGE CS COMPONENTS. 14. AT LUNAR SUNRISE, THERE MUST BE PROPER LOADING ON THE CS TO ASSURE REGULATION AND PREVENT OVER-VOLTAGE CONDITIONS ON CS COMPONENTS. 15. SUBSEQUENT TO DEPLOYMENT, ASTRONAUT WILL AVOID BLOCKING SOLAR PANEL FIELD OF VIEW ON SUNSIDE. 16. THE TRANSMITTER WILL NOT BE COMMANDED ON UNTIL APPROXIMATELY 20 HOURS AFTER LUNAR SUNRISE. <p>B. PSE</p> <ol style="list-style-type: none"> 1. THE PSE WILL BE UNCAGED AS SOON AS POSSIBLE AFTER THE PSE IS COMMANDED ON. THE TEMPERATURE OF THE PSE ELECTRONICS IN THE CENTRAL STATION, MONITORED ON AT-5 THERMAL PLATE 3 TEMP., MUST BE ABOVE 625 DEG F BEFORE THE PSE CAN BE UNCAGED- HOWEVER, PSE UNCAGING WILL BE ATTEMPTED AT ANY TEMP. 2. THE PSE LEVELING MOTORS WILL NOT BE ACTIVATED PRIOR TO UNCAGING OF THE PSE. 3. AFTER PSE LEVELING OF THE HORIZONTAL COMPONENTS (LPX AND LPY) HAS BEEN COMPLETED, THE COARSE LEVEL SENSORS WILL BE GROUND COMMANDED OUT (VIA CMD 102 LEVEL SENSOR IN/OUT). 						
		MISSION	REV	DATE	SECTION	GROUP	PAGE	
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SECTION 31 - EASEP

REV ITEM

R	ITEM
	<p>4. FOR PROPER OPERATION OF THE PSE, THE FEEDBACK FILTER MUST BE IN THE FOLLOWING MODES (THE FILTER IS GROUND COMMANDED IN AND OUT OF THE FEEDBACK LOOP BY CMD 101 PSE FILTER IN/OUT)---</p> <p>A. LEVELING MOTOR MODE OF ANY KIND - FILTER OUT</p> <p>B. LONG PERIOD CALIBRATION - FILTER IN</p> <p>C. NORMAL OPERATIONAL MODE - FILTER IN</p> <p>5. THE X-AXIS AND Y-AXIS MASSES OF THE PSE MUST BE LEVELED BEFORE THE Z-AXIS MASS.</p> <p>6. REFER TO STANDARD OPERATING PROCEDURE FOR PSE LEVELING PROCEDURES.</p> <p>7. THE PSE SENSOR HEATERS MUST BE OFF DURING OPERATION OF THE PSE LEVELING MOTORS.</p> <p>8. PSE WILL BE PLACED IN STBY=SELECT CONDITION, BY GROUND COMMAND, APPROXIMATELY ONE (1) HOUR BEFORE LUNAR SUNSET.</p> <p>RULES 31-2 THRU 31-9 ARE RESERVED</p>

MISSION	REV	DATE	SECTION	GROUP	PAGE
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MISSION RULES

SECTION 31 - EASEP

REV ITEM

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS		
	31-10	FAILURE OF PCU		<p>A. IF PCU 1 IS ACTIVE, SELECT PCU 2.</p> <p>B. IF PCU 2 IS ACTIVE---</p> <p>1. VERIFY THAT SCIENTIFIC DATA IS BEING LOST.</p> <p>2. VERIFY THAT TOTAL FAILURE OF PCU 2 IS INEVITABLE.</p> <p>3. IF ABOVE CONDITIONS ARE MET, SELECT PCU 1.</p>	<p>CUE--- PCU OUTPUT VOLTAGES ARE OFF NOMINAL AND SCIENTIFIC DATA IS BEING LOST.</p> <p>AUTOMATIC SWITCHOVER FROM PCU 1 TO PCU 2 SHOULD OCCUR WHEN THE +12 VDC BUS VARIES +1 VDC.</p> <p>CMD 062, PCU 2 SELECT.</p> <p>CMD 060, PCU 1 SELECT.</p>		
		<p>RULES 31-11 THRU 31-19 ARE RESERVED</p>					
		MISSION	REV	DATE	SECTION	GROUP	PAGE
		APOLLO 11		4/16/69	EASEP	ELECTRICAL	31-3

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MISSION RULES

SECTION 31 - EASEP

REV ITEM

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS		
	31-20	ANY THERMAL PLATE TEMP. EXCEEDS DEG F.		<p>REFER TO GRAPH OF CENTRAL STATION INTERNAL POWER DISSIPATION VS. SHUNT CURRENT TO DETERMINE THE PROPER COMBINATION OF THE FOLLOWING ALTERNATIVES TO BE EXERCISED---</p> <ol style="list-style-type: none"> 1. PDR NO. 1 ON OR OFF 2. PDR NO. 2 ON OR OFF 3. PSE OFF 4. TRANSMITTER OFF 	<p>SELECT THE ADJUSTMENT WHICH REDUCES HEAT GENERATION (E.G., BY REDUCING INTERNAL POWER DISSIPATION) AND MINIMIZES THE RISK OF EXCEEDING PCU HIGH AND LOW LOAD LIMITS (ALSO, SHUNT CURRENT HIGH AND LOW LIMITS). GRAPH OF INTERNAL POWER DISSIPATION VS. PCU LOAD COULD BE USED IF AVAILABLE. THERMAL PLATE TEMP. MEASUREMENTS ARE AT-3, AT-4, AT-5, AT-6, AND AT-7. PDR NO. 1 DISSIPATES 5 WATTS. PDR NO. 2 DISSIPATES 10 WATTS.</p>		
		RULES 31-21 THRU 31-29 ARE RESERVED.					
		MISSION	REV	DATE	SECTION	GROUP	PAGE
		APOLLO 11		4/16/69	EASEP	THERMAL	31-4

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SECTION 31 - EASEP

REV. ITEM

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS		
	31-30	EASEP FAILS TO RESPOND TO A CMD.		A. REINITIATE THE CMD. B. IF UNSECESSFUL, SELECT OTHER DECODER (ALSEP 2A OR 2B) AND REINITIATE THE CMD. C. IF UNSECESSFUL, SEND A 'SPARE' CMD. D. IF UNSECESSFUL, SWITCH TO OTHER DATA PROCESSOR.	CUE--- NO FUNCTIONAL VERIFICATION AND NO CMD VERIFICATION WORD (CVW) VERIFY THAT THE RECEIVER CB HAS NOT OPENED. 'SPARE' CMD SHOULD YIELD CVW BUT NO FUNCTION. CMD 150, 153, 154, AND 155 ARE SPARE CMDS. CMD 034 PROCESSOR 'X' SELECT. CMD 035 PROCESSOR 'Y' SELECT.		
		RULES 31-31 THRU 31-39 ARE RESERVED.					
		MISSION	REV	DATE	SECTION	GROUP	PAGE
		APOLLO 11		4/16/69	EASEP	UPLINK	31-5

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MISSION RULES

SECTION 31 - EASEP

RLV ITEM

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS		
	31-40	LOSS OF DOWNLINK CARRIER.		<p>A. SELECT OTHER TLM TRANSMITTER.</p> <p>B. IF NO EFFECT--- SEND TRANSMITTER ON CMD.</p>	<p>GROUND STATION VERIFIES THAT LOSS OF TLM CARRIER IS NOT FAILURE IN GROUND SYSTEMS. SELECTION OF ALTERNATE TRANSMITTER WILL RESET CIRCUIT BREAKERS TO THE TRANSMITTERS (CB-02, CB-03, CB-04, AND CB-05).</p> <p>CMD 012 TRANSMITTER 'A' SELECT.</p> <p>CMD 015 TRANSMITTER 'B' SELECT.</p> <p>CMD 013 TRANSMITTER ON.</p>		
	31-41	LOSS OF DOWNLINK MODULATION.		<p>A. SELECT OTHER DATA PROCESSOR.</p> <p>B. IF NO EFFECT--- SELECT OTHER TLM TRANSMITTER.</p>	<p>GROUND STATION VERIFIES LOSS OF MODULATION ON TLM CARRIER.</p> <p>CMD 034, PROCESSOR 'X' SELECT.</p> <p>CMD 035, PROCESSOR 'Y' SELECT.</p> <p>CMD 012, TRANSMITTER 'A' SELECT.</p> <p>CMD 015, TRANSMITTER 'B' SELECT.</p>		
	31-42	UNABLE TO RETAIN NORMAL BIT RATE.		<p>A. SEND NORMAL BIT RATE CMD.</p> <p>B. IF UNSUCCESSFUL, SEND NORMAL BIT RATE RESET CMD.</p> <p>C. IF UNSUCCESSFUL, SELECT OTHER DATA PROCESSOR.</p> <p>D. IF UNSUCCESSFUL, REPEAT STEP A AND/OR STEP B.</p>	<p>LSM DATA IS MEANINGLESS IN LOW BIT RATE.</p> <p>CMD 006, NORMAL BIT RATE</p> <p>CMD 011, NORMAL BIT RATE RESET</p> <p>CMD 034, PROCESSOR 'X' SELECT</p> <p>CMD 035, PROCESSOR 'Y' SELECT</p>		
	31-43	ONE OR MORE SYNC LOSSES EVERY TEN (10) SECONDS.		<p>A. SWITCH TO REDUNDANT TRANSMITTER.</p> <p>B. IF UNSUCCESSFUL--- SWITCH TO REDUNDANT DATA PROCESSOR.</p> <p>C. IF UNSUCCESSFUL--- SELECT LOW BIT RATE.</p>	<p>THIS RATE OF SYNC LOSSES EXCEEDS BIT ERROR RATE. INDICATION OF MALFUNCTION WILL BE EVENT LIGHT.</p> <p>THIS ACTION ASSUMES NO GROUND STATION MALFUNCTION.</p> <p>LOW BIT RATE IS 530 BPS RATE. NOTE THAT LSM DATA WILL BECOME MEANINGLESS.</p> <p>CMD 012, TRANSMITTER 'A' SELECT</p> <p>CMD 015, TRANSMITTER 'B' SELECT</p> <p>CMD 034, PROCESSOR 'X' SELECT</p> <p>CMD 035, PROCESSOR 'Y' SELECT</p> <p>CMD 007, LOW BIT RATE SELECT</p>		
		MISSION	REV	DATE	SECTION	GROUP	PAGE
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MISSION RULES

SECTION 31 - EASEP

REV ITEM

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS		
	31-44	DATA DEMAND SIGNAL FROM DATA PROCESSOR FAILS--HIGH		SWITCH TO REDUNDANT PROCESSOR, USING THE OTHER DECODER.	<p>CUES---</p> <p>COMMAND VERIFICATION WORD (CVW) IS STEADILY INDICATING AN ERRONEOUS PATTERN OTHER THAN ALL ZEROS (CVW LIGHT ON EVERY 0.6 SECONDS) AFTER A CMD HAS BEEN SENT.</p> <p>NOTE WHICH PROCESSOR WAS IN OPERATION FROM LOG DATA (NO TM POINT DISPLAYED).</p> <p>CMD 034. PROCESSOR 'X' SELECT</p> <p>CMD 035. PROCESSOR 'Y' SELECT</p>		
		RULES 31-45 THRU 31-49 ARE RESERVED.					
		MISSION	REV	DATE	SECTION	GROUP	PAGE
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MISSION RULES

SECTION 31 - EASEP

REV ITEM

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS		
	31-50	FAILURE OF AUTOMATIC PSE LEVELING MODE		REFERENCE PROCEDURE FOR MANUAL LEVELING OF THE PSE BY GROUND COMMANDS.	PSE ACTIVATION PRESETS LEVELING MODE TO AUTOMATIC. CMD 103 WILL SWITCH TO THE MANUAL MODE. CMD 103 IS A 2-STATE CMD. PSE LEVELING MODE AUTO/MANUAL.		
	31-51	PSE LEVELING MOTOR FAILS ON		ALTERNATELY GND CMD PSE TO STANDBY SELECT AND TO OPERATE SELECT.	UNABLE TO COMMAND PSE LEVELING MOTOR OFF. CUES— LEVELING MOTOR WILL DRAW 3 WATTS FROM RESERVE POWER. CMD 037, EXP 1 (PSE) STANDBY SELECT. CMD 036, EXP 1 (PSE) OPERATE SELECT.		
	31-52	FAILURE OF PSE LEVELING MOTOR - OFF		NO ACTION CAN BE TAKEN.	CUES— NO DROP IN RESERVE POWER (NORMALLY 3 WATTS) WHEN ATTEMPT IS MADE TO TURN MOTOR ON, AND NO ACTIVITY ON SHORT PERIOD Z-DATA CHANNEL.		
	31-53	FAILURE OF MECHANICAL LEVEL DRIVE		SELECT LOW SPEED AND HIGH SPEED AND DIRECTION REVERSALS ALTERNATELY.	CUES— NO MOTION OF THE PLATFORM CAN BE DETECTED ON THE OTHER LP HORIZONTAL OR LPZ COMPONENT TIDAL OUTPUT. X-MOTOR ON/OFF - CMD 070 Y-MOTOR ON/OFF - CMD 071 Z-MOTOR ON/OFF - CMD 072 DIRECTION PLUS/MINUS - CMD 074 SPEED LOW/HIGH - CMD 075		
	31-54	MISALIGNED COARSE SENSOR		A. COMMAND COARSE SENSOR OUT WHEN CORRESPONDING MOTOR IS IN LEVELING OPERATION. B. REFERENCE PROCEDURE FOR MANUAL LEVELING OF THE PSE BY GROUND COMMANDS.	WHILE IN FINAL LEVELING PHASE (LOW STEPPING RATE), THE MOTOR REVERTS TO A HIGH STEPPING RATE REPEATEDLY WITHOUT ACHIEVING CENTERING. COARSE LEVEL SENSOR AND GIMBAL WILL NEVER ALIGN, AND THE MOTOR WILL CONTINUE TO DRIVE BEYOND LEVEL. CMD 102, COARSE SENSOR OUT.		
		MISSION	REV	DATE	SECTION	GROUP	PAGE
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MISSION RULES

SECTION 31 - EASEP

REV	ITEM	R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS	
			31-55	FAILURE OF COARSE LEVEL SENSOR		A. SELECT MANUAL PSE LEVELING MODE. B. GROUND COMMAND COARSE LEVEL SENSOR OUT. C. PROCEED WITH MANUAL LEVELING FOR COARSE LEVELING. PROCEDURE D. USE AUTO MODE FOR FINE LEVELING. PROCEDURE	CUES--- NO HIGH SPEED MOTOR OPERATION IS MOTICED DURING INITIAL LEVELING PHASE AND COMPONENT DOES NOT CENTER WITHIN EXPECTED TIME. (40 MINUTES MAXIMUM IN AUTO MODE.) USE HIGH SPEED MANUAL LEVELING FOR COARSE LEVELING. CMD 103. PSE LEVELING MODE AUTO/MANUAL. CMD 102. COARSE LEVEL SENSOR OUT.	
			31-56	LONG PERIOD COMPONENTS STICK		A. USE HIGH SPEED, MANUAL LEVELING IN DIRECTION WHICH PULLS MASS AWAY FROM STOP. B. IF UNSUCCESSFUL, SELECT LOW SPEED AND HIGH SPEED AND DIRECTION REVERSALS ALTERNATELY.	CUE--- FAILURE TO CENTER WITHIN EXPECTED TIME (40 MINUTES MAXIMUM IN AUTO MODE). IF STEPS A AND B FAIL, LP COMPONENT IS DEFECTIVE. NOTE--- DO NOT EXCEED LEVELING LIMITS. X-MOTOR ON/OFF - CMD 070 Y-MOTOR ON/OFF - CMD 071 Z-MOTOR ON/OFF - CMD 072 DIRECTION PLUS/MINUS - CMD 074 SPEED LOW/HIGH - CMD 075	
			31-57	ELECTRICAL FAILURE OF LONG PERIOD COMPONENT		TERMINATE LEVELING OF THE AFFECTED AXIS AFTER COARSE SENSOR PHASE IS COMPLETED.	CUE--- TIDAL OUTPUT IS WITHIN RANGE, BUT IS NOT AFFECTED BY LEVELING OR CENTERING DRIVE.	
			MISSION	REV	DATE	SECTION	GROUP	PAGE
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MISSION RULES

SECTION 31 - EASEP

RIV ITEM

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS		
	31-58	FAILURE TO UNCAGE PSE		<p>A. TO UNCAGE ARM---</p> <ol style="list-style-type: none"> 1. SEND UNCAGE ARM/FIRE. 2. IF UNSUCCESSFUL, FIRST 12-HOUR TIMER PULSE WILL ARM ACTUATOR. 3. IF UNSUCCESSFUL, 96 HOURS +2 MINUTES PULSE FROM DELAYED CMD SEQUENCER WILL ARM ACTUATOR. <p>B. TO UNCAGE FIRE (AFTER THE ACTUATOR HAS BEEN ARMED)---</p> <ol style="list-style-type: none"> 1. SEND UNCAGE ARM/FIRE. 2. IF UNSUCCESSFUL, NEXT 12-HOUR TIMER PULSE WILL FIRE THE ACTUATOR. 3. IF UNSUCCESSFUL, SEND CMD 037 EXPR 1 (PSE) STANDBY SELECT. 	<p>NORMAL UNCAGING OF PSE ACCOMPLISHED BY SENDING CMD 073 UNCAGE ARM/FIRE TWICE, ONCE TO ARM AND ONCE TO FIRE THE ACTUATOR CIRCUIT WHICH UNCAGES ALL SPRING MASSES.</p> <p>NOTE--- AT05 THERMAL PLATE 3 TEMP, PSE ELECTRONICS IN CENTRAL STATION MUST BE ABOVE +25 DEG F BEFORE UNCAGING IS POSSIBLE.</p>		
	31-59	AUTOMATIC SWITCHOVER OF PSE TO STANDBY		<p>IF PSE HAS NOT BEEN RIPPLED OFF, COMMAND EXPR. 1 (PSE) TO OPERATE SELECT.</p>	<p>IF CIRCUIT BREAKER CB-06 HAS OPENED FROM OVERCURRENT (500 MA +/- 10 PERCENT), STANDBY MODE WILL BE SELECTED AND THE CIRCUIT BREAKER WILL BE RESET AUTOMATICALLY.</p> <p>CMD 036, EXPR. 1 OPERATE SELECT.</p>		
	31-60	PSE GOES OFF WHILE IN STANDBY MODE		<p>COMMAND EXPR. 1 (PSE) TO OPERATE SELECT.</p>	<p>CUE--- EXP. 1 STDBY DISCRETE EXTINGUISHES, AND RESERVE POWER INCREASES SINCE POWER IS REMOVED FROM THE HEATERS. FUSE (F-03) HAS PROBABLY BEEN BLOWN BY OVERCURRENT (500 MA). CAPABILITY TO SELECT PSE STANDBY MODE IS LOST.</p> <p>CMD 036, EXPR. 1 OPERATE SELECT.</p>		
		MISSION	REV	DATE	SECTION	GROUP	PAGE
		APOLLO 11		4/16/69	EASEP	PSE	31-10

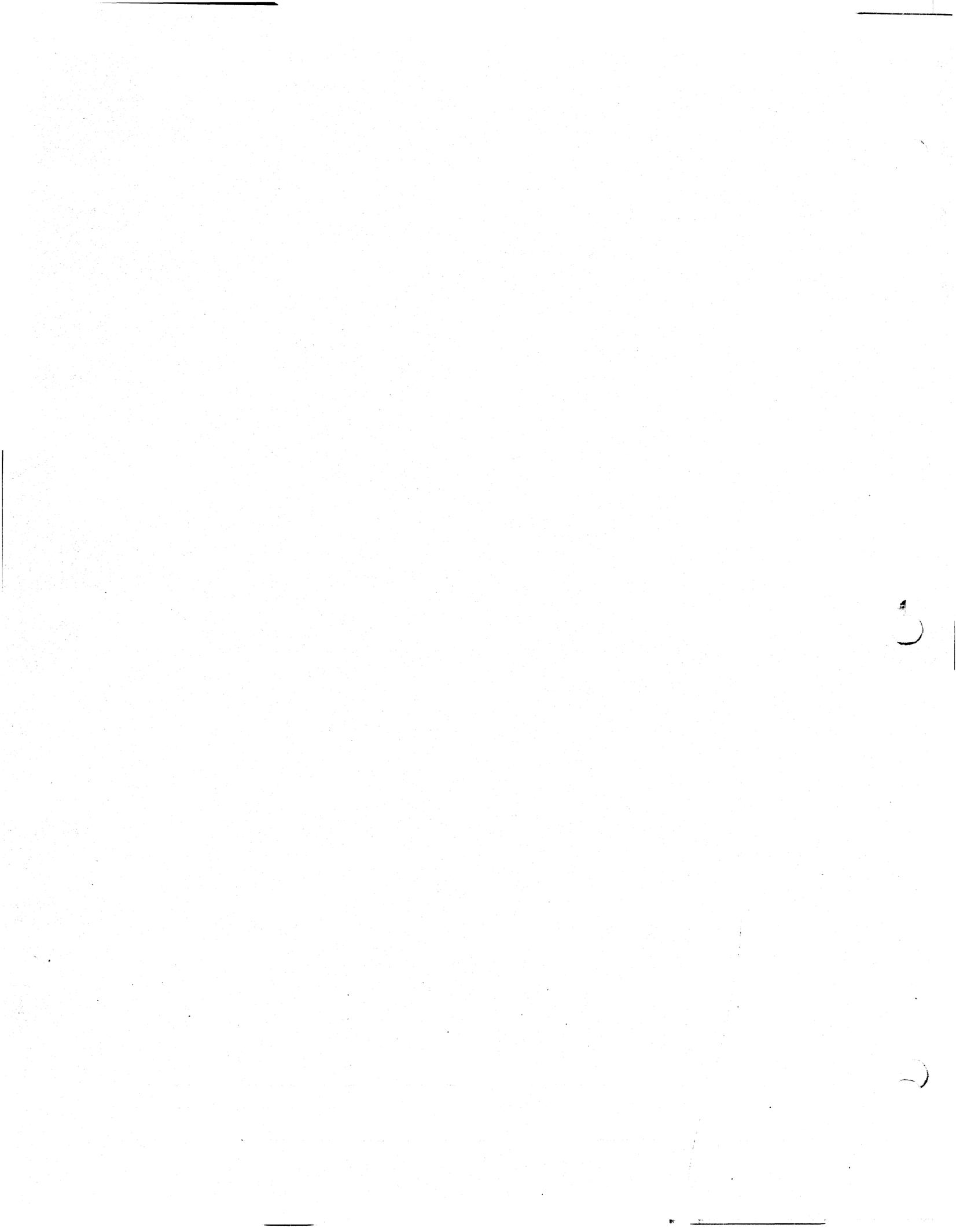
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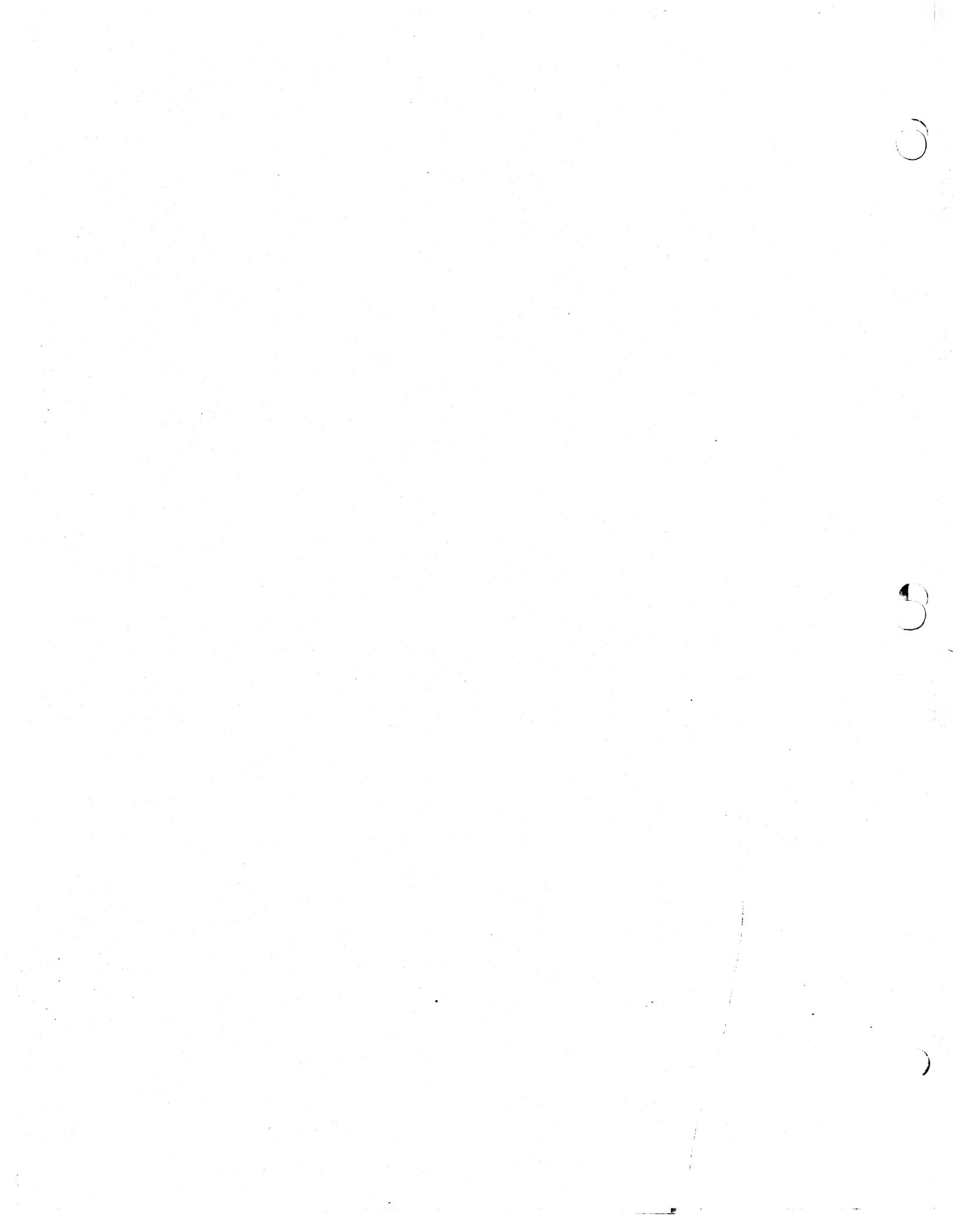
SECTION 31 - EASEP

REV ITEM

R	RULE	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS		
	31-61	PSE INSTRUMENT TEMP BELOW 123 DEG F		COMMAND HEATER TO MANUAL ON.	ASSUME AUTOMATIC THERMOSTAT CONTROL FAILED. CMD 076 IS A 4-STATE CMD, WHICH CAN SEQUENTIALLY STEP THROUGH THE FOLLOWING MODES TO CONTROL THE PSE SENSOR HEATER--- 1. OFF 2. MANUAL HEATER ON 3. OFF 4. AUTOMATIC THERMOSTAT CONTROL ENABLED. DL-07 PSE INSTRUMENT TEMP.		
	31-62	PSE INSTRUMENT TEMP EXCEEDS 127 DEG F		A. COMMAND HEATER OFF. B. IF UNSUCCESSFUL, COMMAND PSE TO STANDBY, THEN TO OPERATE.	A. CMD 076 IS A 4-STATE CMD WHICH CAN SEQUENTIALLY STEP THROUGH THE FOLLOWING MODES TO CONTROL THE PSE SENSOR HEATER--- 1. OFF 2. MANUAL HEATER ON 3. OFF 4. AUTOMATIC THERMOSTAT CONTROL ENABLED. DL-07 PSE INSTRUMENT TEMP. B. SELECTING PSE TO STANDBY WILL REINITIALIZE TO AUTOMATIC THERMOSTAT CONTROL.		
		MISSION	REV	DATE	SECTION	GROUP	PAGE
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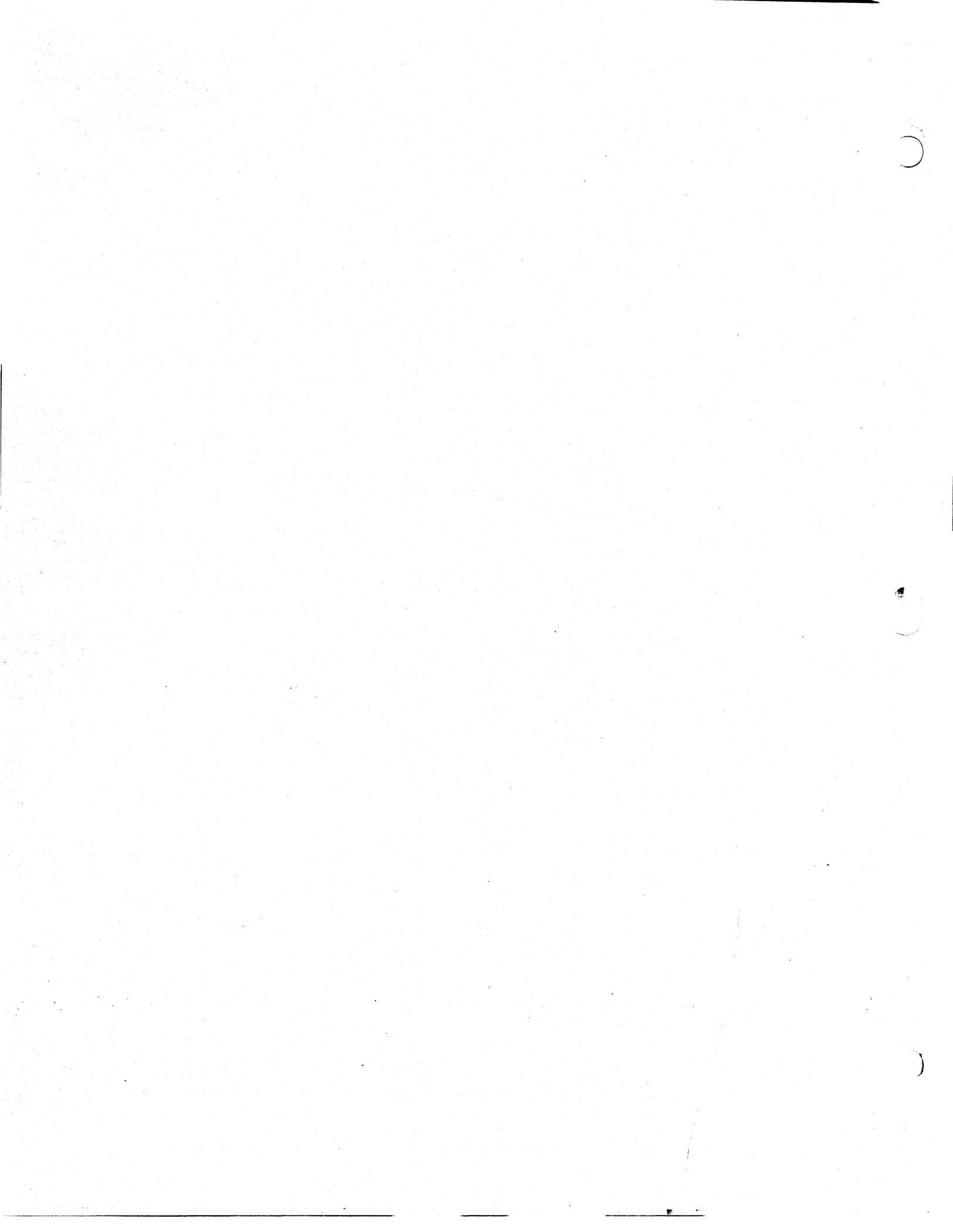
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APPENDIX A - ACRONYMS AND SYMBOLS

RLV ITEM

R	ITEM		
	AC	ALTERNATING CURRENT	CONF
	ACA	ATTITUDE CONTROLLER ASSEMBLY	CONTROL
	ACCEL	ACCELEROMETER	CP
	ACCUM	ACCUMULATOR	CRO
	ACS	ATTITUDE CONTROL AND STABILIZATION SYSTEM	CRYO
	ACT	ACTUATOR	CSI
	ADEG	AUXILIARY DISPLAY EQUIPMENT GROU	CSM
	AEA	ABORT ELECTRONICS ASSEMBLY	CTE
	AELD	ASCENT ENGINE LATCHING DEVICE	CVS
	AFD	ASSISTANT FLIGHT DIRECTOR	CVTS
	AFETR	AIR FORCE EASTERN TEST RANGE	CW
	A/G	AIR-TO-GROUND	C&W
	AGS	ABORT GUIDANCE SYSTEM	CYI
	ALDS	APOLLO LAUNCH DATA SYSTEM	
	ALT	ALTERNATE	
	AM	AMPLITUDE MODULATION	
	AMP	AMPERE(S)	DAP
	ANT	ANTENNA	DB
	AOA	ANGLE OF ATTACK	DC
	AOM	APOLLO OPERATIONS HANDBOOK	DCA
	AOT	ALIGNMENT OPTICAL TELESCOPE	DCS
	APS	ASCENT PROPULSION SYSTEM	DDD
	APS	AUXILIARY PROPULSION SYSTEM	DECA
	ARIA	APOLLO RANGE INSTRUMENTATION AIRCRAFT	DEDA
	ASA	ABORT SENSOR ASSEMBLY	DEG
	ASAP	AS SOON AS PRACTICAL	DESC
	ASC	ASCENT	DFI
	ATCA	ATTITUDE TRANSLATION CONTROLLER ASSEMBLY	DK
	ATP	ALTERNATE TARGET POINT	DKD
	ATT	ATTITUDE	DOD
	AUX	AUXILIARY	DPS
	AZUSA	ELECTRONIC TRACKING AND VECTORING SYSTEM ETR	DRA
			DRS
			DSC
			DSE
			DSKY
			DTO
			D/TV
	BA	BANK ANGLE	ECS
	BAP	BEST ADOPTIVE PATH	EDS
	BAT	BATTERY	EECOM
	BDA	BERMUDA MSFN REMOTED SITE	EKG
	B/H	BLOCK HOUSE	EMR
	BMAG	BODY MOUNTED ATTITUDE GYRO	EMS
	BRSO	BERMUDA RANGE SAFETY OFFICER	EMU
	BSE	BOOSTER SYSTEMS ENGINEER	ENG
	BTU	BRITISH THERMAL UNIT	EPS
			ERR
	CAL	CALIBRATE	ESE
	CASTS	COUNTDOWN AND STATUS TRANSMISSION SYSTEM	ETDM
	CB	CIRCUIT-BREAKER	ETR
	CCATS	COMMAND, COMMUNICATIONS, AND TELEMETRY SYSTEM	EVA
			EVAP
	CCW	COUNTERCLOCKWISE	EVT
	CDH	CONSTANT DELTA HEIGHT	EVVA
	CDP	COMMAND DATA PROCESSOR	
	CDR	COMMANDER	F/A
	CDU	COUPLING DATA UNIT	FC
	CES	CONTROL ELECTRONICS SYSTEM	FCSM
	CEVT	CONTINGENCY EXTRA VEHICULAR TRANSFER	
	CFM	CUBIC FEET PER MINUTE	FD
	CIF	CENTRAL INSTRUMENTATION FACILITY	FDAI
	CIM	COMPUTER INPUT MATRIX	
	CKT	CIRCUIT	FDO
	CLTC	CHIEF LAUNCH VEHICLE TEST CONDUCTOR	FIDO
	CM	COMMAND MODULE	FIG
	CMC	COMMAND MODULE COMPUTER	FIM
	CMD	COMMAND	
	CMP	COMMAND MODULE PILOT	
	C/O	CUTOFF	
	CO2	CARBON DIOXIDE	
	COAS	CREW OPTICAL ALIGNMENT SIGHT	
	COI	CONTINGENCY ORBIT INSERTION	
	COMM	COMMUNICATION	
			CONFERENCE
			LM GNC SYSTEMS ENGINEER
			COMMUNICATIONS PROCESSOR
			CARNARVON MSFN REMOTED SITE
			CRYOGENICS
			CONCENTRIC SEQUENCE INITIATE
			COMMAND SERVICE MODULE
			CENTRAL TIMING EQUIPMENT
			CONTINUOUS VENT SYSTEM
			CHIEF VEHICLE TEST SUPVISOR
			CLOCKWISE
			CAUTION AND WARNING
			CANARY ISLAND
			DIGITAL AUTO PILOT
			DEADBAND
			DIRECT CURRENT
			DIGITAL COMMAND ASSEMBLY
			DIGITAL COMMAND SYSTEM
			DIGITAL DISPLAY DRIVER
			DESCENT ENGINE CONTROL ASSEMBLY
			DATA ENTRY AND DISPLAY ASSEMBLY
			DEGREE
			DESCENT
			DEVELOPMENT FLIGHT INSTRUMENTATION
			DOCK
			DOCKED
			DEPARTMENT OF DEFENSE
			DESCENT PROPULSION SYSTEM
			DISCRETE RECOVERY AREA
			DATA RECEIVING STATION
			DYNAMIC STANDBY COMPUTER
			DATA STORAGE EQUIPMENT
			DISPLAY KEYBOARD
			DETAILED TEST OBJECTIVE
			DIGITAL TO TELEVISION
			ENVIRONMENTAL CONTROL SYSTEM
			EMERGENCY DETECTION SYSTEM
			ELECTRICAL, ENVIRONMENTAL, AND COMMUNICATIONS
			ELECTROCARDIOGRAM
			ERROR MONITOR REGISTER
			ENTRY MONITORING SYSTEM
			EXTRA-VEHICULAR MOBILITY UNIT
			ENGINE
			ELECTRICAL POWER SYSTEM
			ERROR
			ELECTRONIC SUPPORT EQUIPMENT
			RANGE SAFETY SUPERVISOR KSC
			CALLOUT
			EASTERN TEST RANGE
			EXTRA-VEHICULAR ACTIVITY
			EVAPORATOR
			EXTRA-VEHICULAR TRANSFER
			EXTRA-VEHICULAR VISOR ASSEMBLY
			FORWARD/AFT
			FUEL CELL OR FLIGHT CONTROL
			FLIGHT COMBUSTION STABILITY MONITOR
			FLIGHT DIRECTOR
			FLIGHT DIRECTOR ATTITUDE INDICATOR
			FLIGHT DYNAMICS OFFICER
			FLIGHT DYNAMICS OFFICER
			FIGURE
			FIRE IN THE HOLE

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APPENDIX A - ACRONYMS AND SYMBOLS

REV ITEM

R	ITEM						
	FL	FULL LIFT		LMDE	LM DESCENT ENGINE		
	FM	FREQUENCY MODULATION		LMP	LM MODULE PILOT		
	FPS	FEET PER SECOND		L/O	LIFTOFF		
	FQR	FLIGHT QUALIFICATION RECORDER		LOI	LUNAR ORBIT INSERTION		
	FTP	FIXED THROTTLE POINT		LOS	LINE-OF-SIGHT		
				LOX	LIQUID OXYGEN		
				L/R	LEFT/RIGHT		
				LV	LOW-VOLTAGE		
	G	GRAVITY		L/V	LAUNCH VEHICLE		
	G&C	GUIDANCE AND CONTROL		LVDA	LAUNCH VEHICLE DATA ADAPTER		
	GASTA	GIMBAL ANGLE SEQUENCE TRANSLATION ASSEMBLY		LVDC	LAUNCH VEHICLE DIGITAL COMPUTER		
	GBI	GRAND BAHAMA ISLAND					
	GDA	GIMBAL DRIVE ASSEMBLY					
	GDC	GYRO DISPLAY COUPLER					
	GET	GROUND ELAPSED TIME					
	GETI	GROUND ELAPSED TIME OF IGNITION		MALF	MALFUNCTION		
	GMT	GREENWICH MEAN TIME		MCC	MISSION CONTROL CENTER		
	GMTLO	GREENWICH MEAN TIME OF LIFTOFF		MCC	MIDCOURSE CORRECTION		
	GSN	GUIDANCE AND NAVIGATION		MCCW	MASTER CAUTION AND WARNING		
	GN2	GASEOUS NITROGEN		MDAS	MEDICAL DATA ACQUISITION SYSTEM		
	GNC	GUIDANCE NAVIGATION CONTROL		MED	MANUAL ENTRY DEVICE		
	GNCS	GUIDANCE, NAVIGATION, AND CONTROL SYSTEM		MESC	MASTER EVENTS SEQUENCE CONTROLLER		
	GND	GROUND		MFCO	MANUAL FUEL CUTOFF		
	GRR	GUIDANCE REFERENCE RELEASE		MFV	MAIN FUEL VALVE		
	GSFC	GODDARD SPACE FLIGHT CENTER		MGA	MIDDLE GIMBAL AXIS		
	GTS	GIMBAL TRIM SYSTEM		MIL	MERRITT ISLAND		
	GUIDO	GUIDANCE OFFICER		MITE	MASTER INSTRUMENTATION TIMING EQUIPMENT		
				MNFLD	MANIFOLD		
				MGO	MAINTENANCE AND OPERATION		
				MOC	MISSION OPERATIONS COMPUTER		
				MSFN	MANNED SPACE FLIGHT NETWORK		
	H2	HYDROGEN		MSK	MANUAL SELECT KEYBOARD		
	H2O	WATER		MSTC	CSM SPACECRAFT TEST CONDUCTOR		
	HA	HEIGHT OF APOGEE		MTVC	MANUAL THRUST VECTOR CONTROL		
	HAW	HAWAII		MUX	MULTIPLEXER		
	HBR	HIGH-BIT-RATE					
	HF	HIGH FREQUENCY					
	HP	HEIGHT OF PERIGEE					
	HS	HIGH-SPEED					
	HZ	HERTZ					
				NASA	NATIONAL AERONAUTICS AND SPACE ADMINISTRATION		
				NCC	COMBINED CORRECTIVE MANEUVER		
				NP	NAUTICAL MILES		
				NPV	NON-PROPULSIVE VENT		
				NSR	COELLIPTICAL MANEUVER		
	IC	INTERCOMMUNICATIONS EQUIPMENT					
	IGA	INNER GIMBAL AXIS					
	IMU	INERTIAL MEASUREMENT UNIT					
	INJ	INJECTOR					
	INST	INSTRUMENTATION					
	INV	INVERTER					
	IP	IMPACT POINT OR IMPACT PREDICTION		O2	OXYGEN		
	IRIG	INERTIAL RATE INTEGRATING GYRO		O/B	ONBOARD		
	ISOL	ISOLATION		ODOP	OFFSET DOPPLER AND POSITION		
	ISS	INERTIAL SUBSYSTEM		OGA	OUTER GIMBAL AXIS		
	IU	INSTRUMENTATION UNIT		OMSF	OFFICE OF MANNED SPACE FLIGHT		
	IVT	INTRAVEHICULAR TRANSFER		OPS	OXYGEN PURGE SYSTEM		
				ORDEAL	ORBITAL RATE DRIVE ELECTRONICS		
					APOLLO LM		
				OXID	OXIDIZER		
	JD	JET DRIVER					
				PAFB	PATRICK AIR FORCE BASE		
				PAM	PULSE AMPLITUDE MODULATION		
	KOH	POTASSIUM HYDROXIDE		PB	PUSH-BUTTON		
	KSC	KENNEDY SPACE CENTER		PC	PERICYNTHION		
				PCM	PULSE CODE MODULATION		
				PCMGS	PULSE CODE MODULATION GROUND STATION		
	LB	POUND		PCO2	PARTIAL PRESSURE CARBON DIOXIDE		
	LBR	LOW-BIT-RATE		PDS/DD	PLOTTING DISPLAY SUBCHANNEL/DATA DISTRIBUTION		
	LCG	LIQUID COOLING GARMENT					
	LES	LAUNCH ESCAPE SYSTEM		PGA	PRESSURE GARMENT ASSEMBLY		
	LET	LAUNCH ESCAPE TOWER		PGNCS	PRIMARY GUIDANCE AND NAVIGATION CONTROL SYSTEM CSM		
	LGC	LM GUIDANCE COMPUTER					
	LH2	LIQUID HYDROGEN		PGNS	PRIMARY GUIDANCE AND NAVIGATION SYSTEM LM		
	LIOH	LITHIUM HYDROXIDE					
	LM	LUNAR MODULE					

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RLV ITEM

R	ITEM					
	PIPA	PULSE INTEGRATING PENDULOUS ACCELEROMETER	SODB	SPACECRAFT OPERATIONAL DATA BOOK		
	PLSS	PORTABLE LIFE SUPPORT SYSTEM	SOL	SOLENOID		
	PO	POWER OUT	SOP	STANDARD OPERATING PROCEDURE		
	PO2	PARTIAL PRESSURE OXYGEN	SOV	SHUT-OFF VALVE		
	POS	POSITION	SPAN	SPACECRAFT PLANNING AND ANALYSIS		
	POS	PRIMARY OXYGEN SYSTEM	SPS	SERVICE PROPULSION SYSTEM		
	PPM	PARTS PER MILLION	SRO	SUPERINTENDENT RANGE OPERATIONS		
	PGGS	PROPELLANT QUANTITY GAGING SYSTEM	SSC	SPACE SUIT COMMUNICATOR		
	PRELN	PRELAUNCH	STBY	STANDBY		
	PRESS	PRESSURE	SW	SWITCH		
	PRI	PRIMARY	SXT	SEXTANT		
	PROC	PROCEDURE				
	PROP	PROPELLANT	TB	TIME BASE		
	PSA	POWER SERVO AMPLIFIER	TBD	TO BE DETERMINED		
	PSI	POUNDS PER SQUARE INCH	TC	TEST CONDUCTOR		
	PSID	POUNDS PER SQUARE INCH DIFFERENCE	T/C	TELEMETRY AND COMMUNICATIONS		
	PS	PAD SAFETY SUPERVISOR	TCE	CONDENSER EXHAUST TEMPERATURE		
	PTA	PULSE TORQUE ASSEMBLY	TCP	THRUST CHAMBER PRESSURE		
	PTP	PREFERRED TARGET POINT	TDGE	TRANSPORTATION, DOCKING AND EJECTION		
	PTV	PITCH THRUST VECTOR	TDP	TELEMETRY DATA PROCESSOR		
	PU	PROPELLANT UTILIZATION	TELCOM	LM EECOM		
	PUGS	PROPELLANT UTILIZATION AND GAGING SYSTEM	TEMP	TEMPERATURE		
	PVT	PRESSURE-VOLUME-TEMPERATURE	TFF	TIME OF FREE FALL		
	PYRO	PYROTECHNICS	THC	THRUST AND CONTROLLER		
			TIG	TIME OF IGNITION		
	QTY	QUANTITY	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		
	RAD	RADIATOR				
	RET	RETRACT				
	RCS	REACTION CONTROL SYSTEM				
	RCU	REMOTE CONTROL UNIT				
	RCVR	RECEIVER				
	REF	REFERENCE				
	REFSMMAT	REFERENCE STABLE MEMBER MATRIX				
	REDD	REQUIRED				
	RETRB	RETRO ELAPSED TIME TO REVERSE B	U/D	UP/DOWN		
	RETRO	RETROFIRE OFFICER	UDL	UPDATE LINK		
	REV	REVOLUTION	UMF	ULTRA HIGH FREQUENCY		
	RF	RADIO FREQUENCY	UNDKD	UNDOCKED		
	RFO	RETROFIRE OFFICER	USB	UNIFIED S-BAND		
	RGA	RATE GYRO ASSEMBLY				
	RHC	ROTATION HAND CONTROLLER	VC	VELOCITY COUNTER		
	RIP	RANGE OF IMPACT POINT	VEI	INERTIAL VELOCITY AT ENTRY		
	RL	ROLL LEFT	VGX	VELOCITY TO BE GAINED X-AXIS		
	RNDZ	RENDEZVOUS	VGX	VELOCITY TO BE GAINED Y-AXIS		
	RP-RT	DOWNRANGE ERROR	VGX	VELOCITY TO BE GAINED Z-AXIS		
	RR	RENDEZVOUS RADAR	VMF	VERY HIGH FREQUENCY		
	RR	ROLL RIGHT	VLV	VALUE		
	RSI	ROLL STABILITY INDICATOR	VSM	VIDEO SWITCHING MATRIX		
	RSD	RANGE SAFETY OFFICER				
	RSVR	RESOLVER				
	RTACF	REAL-TIME AUXILIARY COMPUTING FACILITY	WBD	WIDE-BAND DATA		
	RTC	REAL-TIME COMMAND	WMS	WASTE MANAGEMENT SYSTEM		
	RTCC	REAL-TIME COMPUTER COMPLEX	WT	WEIGHT		
	S/C	SPACECRAFT	XFEED	CROSSPEED		
	SCE	SIGNAL CONDITIONING EQUIPMENT	XMIT	TRANSMIT		
	SCS	STABILIZATION AND CONTROL SYSTEM	XMTR	TRANSMITTER		
	SEC	SECONDARY				
	SEC	SECOND				
	SECO	SUSTAINER ENGINE CUTOFF S-IVBCUTOFF	Y	YAW OR Y-AXIS		
	SECS	SEQUENTIAL EVENTS CONTROL SYSTEM	YTV	YAW THRUST VECTOR		
	SHE	SUPER-CRITICAL HELIUM				
	SIG	SIGNAL				
	SLA	SPACECRAFT LM ADAPTER	Z	Z-AXIS		
	SLV	SATURN LAUNCH VEHICLE				
	SM	SERVICE MODULE				
	SMJC	SERVICE MODULE JETTISON CONTROLLER				

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REV ITEM

R	ITEM
	<p>SYMBOLS</p> <p>H ALTITUDE DELTA VIN DELTA VELOCITY IN INSERTION DELTA TB DELTA BURN TIME DELTA H DELTA ALTITUDE</p>

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DISTRIBUTION
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CHANGE CONTROL

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APPENDIX C - CHANGE CONTROL

REV ITEM

R	ITEM						
		<u>CHANGE CONTROL</u>					
1.0	INTRODUCTION						
1.1	PURPOSE	<p>THE PURPOSE OF THIS APPENDIX IS TO DELINEATE CHANGE CONTROL PROCEDURES FOR THE AS-905/106/LM-4</p> <p>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).</p>					
1.2	EFFECTIVITY	APRIL 14, 1969					
2.0	CHANGE PROCEDURES						
2.1	SUBMISSION OF CHANGES	<p>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.</p>					
2.1.1	FORMAT	<p>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.</p> <p>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.</p>					
2.2	APPROVAL						
2.2.1	COORDINATION	<p>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.</p>					
2.2.2	SIGNOFF/DISAPPROVAL	<p>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.</p>					
2.2.3	DISAPPROVED CHANGES	<p>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.</p>					
2.3	PUBLICATION AND DISTRIBUTION OF INTERIM CHANGES	<p>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).</p>					
3.0	REVISIONS						
3.1	DEVELOPMENT	<p>THE AFD WILL COMPILER 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.)</p>					
		MISSION	REV	DATE	SECTION	GROUP	PAGE
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		<p>3.2 APPROVAL</p> <p>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.</p> <p>3.3 PUBLICATION</p> <p>3.3.1 SCHEDULE</p> <p>REVISIONS WILL BE MADE ON AN 'AS REQUIRED' BASIS.</p> <p>3.3.2 DISTRIBUTION</p> <p>REVISIONS WILL BE PRINTED AND DISTRIBUTED THROUGH THE NORMAL ADMINISTRATIVE CHANNELS.</p>					
		NASA-MANNED SPACECRAFT CENTER				DATE _____	
		MISSION RULE REQUEST/REVISION:					
REV	RULE	CONDITION/MALFUNCTION	PHASE	RULING	DATE	INITIALS	
<p>RATIONALE: <input type="checkbox"/> NEW TECHNICAL DATA <input type="checkbox"/> CLARIFICATION <input type="checkbox"/> TYPOGRAPHICAL ERROR</p>							
ORIGINATOR:		APPROVED:		APPROVED:			
NAME _____		ORGANIZATION _____ EXT _____		ORGANIZATION BRANCH CHIEF _____		FLIGHT DIRECTOR _____	
AFD: _____	BSE: _____	FIDO: _____	GUID: _____	PETP: _____	GAC: _____	ECON: _____ OTHER: _____	
FIGURE C-1.- MISSION RULE CHANGE REQUEST FORM.							
		MISSION	REV	DATE	SECTION	GROUP	PAGE
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