FC021
9/10/69

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FINAL FLIGHT MISSION RULES

APOLLO 12
(AS-507/108/LM-6)

SEPTEMBER 10, 1969

PREPARED BY

FLIGHT CONTROL DIVISION

MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

FOR NASA/DOD INTERNAL USE ONLY
INCLUDING APPROPRIATE CONTRACTORS

FC2/C. S. Harlan

FC021
10/31/69

APOLLO 12

FINAL FLIGHT MISSION RULES

REV. B

PREFACE

THIS DOCUMENT CONTAINS REVISION B TO THE FINAL FLIGHT MISSION RULES FOR APOLLO 12 AS OF OCTOBER 31, 1969. REVISION B IS A PAGE CHANGE REVISION AND THE PAGES SHOULD BE INSERTED IN ACCORDANCE WITH THE REVISION INSTRUCTION SHEET WHICH FOLLOWS THIS PAGE. THIS AND ALL SUBSEQUENT REVISIONS TO THIS DOCUMENT WILL BE PRINTED ON DIFFERENT COLORED PAGES FOR EASY RECOGNITION.

IT IS REQUESTED THAT ANY ORGANIZATION HAVING COMMENTS, QUESTIONS, OR SUGGESTIONS CONCERNING THESE MISSION RULES CONTACT MR. JOHN H. TEMPLE, FLIGHT CONTROL OPERATIONS BRANCH, BUILDING 45, ROOM 637, 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:

for Sigurd A. Sjoberg
CHRISTOPHER C. KRAFT, JR.
DIRECTOR OF FLIGHT OPERATIONS

FC 2/C.S. Harlan

FC021
10/15/69

APOLLO 12

FINAL FLIGHT MISSION RULES

REV. A

PREFACE

THIS DOCUMENT CONTAINS REVISION A TO THE FINAL FLIGHT MISSION RULES FOR APOLLO 12 AS OF OCTOBER 15, 1969. REVISION A IS A PAGE CHANGE REVISION AND THE PAGES SHOULD BE INSERTED IN ACCORDANCE WITH THE REVISION INSTRUCTION SHEET WHICH FOLLOWS THIS PAGE. THIS AND ALL SUBSEQUENT REVISIONS TO THIS DOCUMENT WILL BE PRINTED ON DIFFERENT COLORED PAGES FOR EASY RECOGNITION.

IT IS REQUESTED THAT ANY ORGANIZATION HAVING COMMENTS, QUESTIONS, OR SUGGESTIONS CONCERNING THESE MISSION RULES CONTACT MR. JOHN H. TEMPLE, FLIGHT CONTROL OPERATIONS BRANCH, BUILDING 45, ROOM 627, 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

APOLLO 12

FINAL FLIGHT MISSION RULES

REVISION A

REVISION INSTRUCTION SHEET

ii	3-10	4-9	6-8	7-15	15-2	21-1	25-1
1-4	3-11	5-1	6-9	8-1	15-4	21-4	25-9
1-6	3-13	5-6	6-10	8-2	15-5	21-5	25-10
1-13	3-14	5-8	6-11	8-3	15-7	22-3	26-[illegible]
2-4	3-15	5-9	7-2	8-4	15-12	22-3	27-[illegible]
2-5	3-16	5-11	7-3	8-5	16-1	22-4	27-6
2-6	3-17	5-12	7-4	10-3	16-4	22-5	ANNEX B
207	3-18	5-13	7-5	10-4	17-2	22-6	B-1
3-2	3-19	5-14	7-6	10-6	18-2	22-7	B-2
3-3	3-20	5-15	7-7	11-1	19-1	22-8	B-3
3-4	3-22	5-16	7-9	12-3	19-2	23-9	B-4
3-5	3-23	6-2	7-10	12-7	19-4	23-10	B-5
3-6	3-24	6-3	7-11	12-9	19-5	23-11	B-6
3-7	3-30	6-5	7-12	12-12	20-3	23-13	
3-8	4-2	6-6	7-13	13-4	20-7	24-2	
3-9	4-8	6-7	7-14	14-5	20-10	24-14	

ADD THE FOLLOWING NEW PAGES:

iia	31-5
21-6	31-6
22-9	31-7
7-16	31-8
31-1	31-9
31-2	31-10
31-3	31-11
31-4	31-12

PAGES DELETED BY THIS REVISION:

6-12
6-13

FC021
9/10/69

APOLLO 12

FINAL FLIGHT MISSION RULES

PREFACE

THIS DOCUMENT CONTAINS THE FINAL FLIGHT MISSION RULES FOR APOLLO 12 AS OF SEPTEMBER 10, 1969. THIS AND ALL SUBSEQUENT REVISIONS TO THIS DOCUMENT WILL BE PRINTED ON DIFFERENT COLORED PAGES FOR EASY RECOGNITION.

IT IS REQUESTED THAT ANY ORGANIZATION HAVING COMMENTS, QUESTIONS, OR SUGGESTIONS CONCERNING THESE MISSION RULES CONTACT MR. JOHN H. TEMPLE, FLIGHT CONTROL OPERATIONS BRANCH, BUILDING 45, ROOM 637, PHONE HU3-3838.

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:

for Sigurd A. Sjoberg
CHRISTOPHER C. KRAFT, JR.
DIRECTOR OF FLIGHT OPERATIONS

PART I
INTRODUCTION AND GEN GUIDELINES

PART II
1 GENERAL RULES AND SOP'S

2 FLIGHT OPERATIONS RULES

3 MISSION RULE SUMMARY

4 GROUND INSTRUMENTATION REQUIREMENTS

5 TRAJECTORY AND GUIDANCE

6 SLV – TB1 THROUGH TB4/TB4A (LAUNCH)

7 SLV – TB5 AND TB7 (COAST)

8 SLV – TB6 (RESTART)

9 SLV – TB8 (SAFING AND SLINGSHOT)

10 CSM ENVIRONMENTAL CONTROL

11 CSM CRYOGENICS

12 CSM ELECTRICAL POWER SYSTEM

13 DOCKING AND UMBILICAL

14 CSM SEQUENTIAL

15 CSM GUIDANCE AND CONTROL

16 CSM SERVICE PROPULSION SYSTEM

17 CSM SM-RCS

18 CSM CM-RCS

19 EMU/EVA

20 COMMUNICATIONS/ INSTRUMENTATION

21 LM SEQUENTIAL AND PYROTECHNIC

22 LM ELECTRICAL POWER

23 LM ENVIRONMENTAL CONTROL

24 LM GUIDANCE AND CONTROL

25 LM DPS

26 LM APS

27 LM REACTION CONTROL SYSTEM

28 SPACE ENVIRONMENT

29 RECOVERY

30 AEROMEDICAL

31 ALSEP

APPENDICES

A ACRONYMS AND SYMBOLS

B DISTRIBUTION LIST

C CHANGE CONTROL

REV	ITEM

TABLE OF CONTENTS

	PAGE
INTRODUCTION AND PURPOSE	1
PART I GENERAL GUIDELINES	
OMSF GENERAL RULES	I-1
PART II FLIGHT MISSION RULES	
SECTION	
1 GENERAL RULES AND SOP'S	
GENERAL	1-1
DEFINITIONS	1-3
TARGET POINT SELECTION CRITERIA	1-7
PRELAUNCH RULES	1-8
LAUNCH ABORT RULES	1-9
CREW ABORT LIMITS	1-13
2 FLIGHT OPERATIONS RULES	
GENERAL	2-1
3 MISSION RULE SUMMARY	
LAUNCH PHASE	3-1
EARTH ORBIT	3-3
TDGE	3-5
TRANSLUNAR COAST	3-6
LUNAR ORBIT	3-7
DOI PHASE	3-8
POWERED DESCENT	3-9
ASCENT	3-11
ALL PHASES	3-12
CONSUMABLES	3-22
4 GROUND INSTRUMENTATION REQUIREMENTS	
GENERAL	4-1
MCC	4-2
GSFC/ESC MSFN	4-6
GROUND INSTRUMENTATION REQUIREMENTS (TBD)	4-10
5 TRAJECTORY AND GUIDANCE	
LAUNCH	5-1
EARTH ORBIT AND TLI	5-3
MANEUVERS	5-7
TRANSLUNAR COAST	5-8
LUNAR ORBIT	5-10
DESCENT	5-11
ASCENT	5-14
RENDEZVOUS	5-16
TRANSEARTH AND ENTRY	5-17
RANGE SAFETY	5-19
6 SLV - T01 THROUGH T04/T04A (LAUNCH)	6-1
7 SLV - T05 AND T07 (COAST)	7-1
8 SLV - T06 (RESTART)	8-1
9 SLV - T08 (SAFING AND SLINGSHOT)	9-1
PRELAUNCH INSTRUMENTATION	9-3

NASA - Manned Spacecraft Center

MISSION RULES

TABLE OF CONTENTS

REV	ITEM

10 CSM ENVIRONMENTAL CONTROL SYSTEM

GENERAL 10-1
MANAGEMENT 10-3
SUIT/CABIN 10-5
COOLANT 10-10
WATER & WASTE MANAGEMENT 10-13
INSTRUMENTATION REQUIREMENTS 10-15

11 CSM CRYOGENICS

GENERAL 11-1
MANAGEMENT 11-2
SPECIFIC 11-3
INSTRUMENTATION REQUIREMENTS 11-4

12 CSM ELECTRICAL POWER SYSTEM

GENERAL 12-1
MANAGEMENT 12-2
FUEL CELLS 12-4
BATTERIES/CHARGER 12-6
DC DISTRIBUTION 12-8
AC DISTRIBUTION 12-12
INSTRUMENTATION REQUIREMENTS 12-13

13 DOCKING AND UMBILICAL

GENERAL 13-1
MANAGEMENT 13-2
SPECIFIC 13-3

14 CSM SEQUENTIAL

GENERAL 14-1
MANAGEMENT 14-2
SPECIFIC 14-3
INSTRUMENTATION REQUIREMENTS 14-7

15 GUIDANCE AND CONTROL

GENERAL 15-1
SYSTEMS/MANAGEMENT 15-4
SCS 15-5
GSN 15-11
INSTRUMENTATION REQUIREMENTS 15-14

16 CSM SERVICE PROPULSION SYSTEM

GENERAL 16-1
MANAGEMENT 16-4
SPECIFIC 16-5
INSTRUMENTATION REQUIREMENTS 16-10

17 CSM RM-RCS

GENERAL 17-1
MANAGEMENT 17-2
SPECIFIC 17-3
INSTRUMENTATION REQUIREMENTS 17-6

18 CSM CM-RCS

GENERAL 18-1
MANAGEMENT 18-2
SPECIFIC 18-3
INSTRUMENTATION REQUIREMENTS 18-5

19 EMU/EVA

GENERAL/MANAGEMENT 19-1
SPECIFIC 19-2
PRELAUNCH INSTR 19-5

REV	ITEM

20 COMMUNICATIONS AND INSTRUMENTATION

FUNCTIONAL COMM GENERAL 20-1
FUNCTIONAL COMM MANAGEMENT 20-2
FUNCTIONAL COMM SPECIFIC 20-3
CSM INSTRUMENTATION GENERAL 20-5
CSM INSTRUMENTATION MANAGEMENT 20-6
CSM INSTRUMENTATION SPECIFIC 20-7
LM INSTRUMENTATION GENERAL 20-8
LM INSTRUMENTATION MANAGEMENT 20-9
LM INSTRUMENTATION SPECIFIC 20-10
PRELAUNCH REQUIREMENTS 20-11

21 LM SEQUENTIAL & PYROTECHNIC

GENERAL 21-1
MANAGEMENT 21-2
SPECIFIC 21-3
PRELAUNCH INSTRUMENTATION 21-6

22 LM ELECTRICAL POWER

GENERAL 22-1
MANAGEMENT 22-4
SPECIFIC 22-5
INSTRUMENTATION REQUIREMENTS 22-8

23 LM ENVIRONMENTAL CONTROL

GENERAL 23-1
MANAGEMENT 23-5
SPECIFIC 23-6
INSTRUMENTATION REQUIREMENTS 23-12

24 LM GUIDANCE AND CONTROL

GENERAL 24-1
MANAGEMENT 24-5
SPECIFIC - PGNS/CES/AGS 24-7
PRELAUNCH INSTRUMENTATION 24-14

25 LM GUIDANCE AND CONTROL

GENERAL 25-1
MANAGEMENT 25-3
SPECIFIC - DPS 25-6
PRELAUNCH INSTRUMENTATION 25-11

26 LM DPS

GENERAL 26-1
MANAGEMENT 26-2
SPECIFIC 26-4
PRELAUNCH INSTRUMENTATION 26-6

27 LM RCS

GENERAL 27-1
MANAGEMENT 27-2
SPECIFIC 27-3
PRELAUNCH INSTRUMENTATION 27-7

28 SPACE ENVIRONMENT

GENERAL 28-1
MANAGEMENT 28-2
SPECIFIC 28-3
INSTRUMENTATION REQUIREMENTS 28-5

REV	ITEM

29	RECOVERY	
	SPECIFIC	29-1
30	AEROMEDICAL	
	GENERAL	30-1
	SPECIFIC - PHYSIOLOGICAL	30-2
	SPECIFIC - EQUIPMENT	30-4
	INSTRUMENTATION REQUIREMENTS	30-5
31	ALSEP	
	TO BE PROVIDED	
APPENDIX A - ACRONYMS AND SYMBOLS		A-1
APPENDIX B - DISTRIBUTION LIST		B-1
APPENDIX C - CHANGE CONTROL		C-1

PART I
INTRODUCTION AND
GEN GUIDELINES

REV	ITEM

* INTRODUCTION & PURPOSE *

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

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

A. THE CONDITION/MALFUNCTION COLUMN DEFINES THE FAILURE.

B. THE PHASE COLUMN IDENTIFIES THE TIME INTERVAL IN WHICH THE CONDITION/MALFUNTION 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.

REV	ITEM	
		' OMSF GENERAL RULES '
	I-1	MISSION RULES ARE EFFECTIVE DURING THE LAUNCH COUNTDOWN, FLIGHT, RECOVERY, AND DURING PRELAUNCH TESTS WHEN APPLICABLE. FOR A LUNAR LANDING MISSION, RULES WILL BE APPLICABLE UNTIL RELEASE OF THE FLIGHT CREW, FLIGHT HARDWARE, AND LUNAR SAMPLES, WHICHEVER OCCURS LATER.
	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 COOT 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 MALFUNTION. SUBSEQUENTLY, THE MISSION DIRECTOR WILL BE INFORMED OF ESTIMATED TIME TO REPAIR AND RECOMMENDED PROCEED, HOLD, RECYCLE, OR SCRUB ACTION AS IT DEVELOPS.

REV	ITEM	
	I-9	IF A MANDATORY ITEM FAILS DURING THE COUNTDOWN, IT WILL BE CORRECTED PRIOR TO LAUNCH; HOLDING OR RECYCLING THE COUNTDOWN AS NECESSARY. IF A MANDATORY ITEM CANNOT BE CORRECTED TO PERMIT LIFTOFF WITHIN THE LAUNCH WINDOW, THE MISSION DIRECTOR MAY PROCEED WITH THE LAUNCH AFTER APPROPRIATE COORDINATION WITH THE APPROPRIATE OPERATIONS AND PROGRAM MANAGERS. GENERALLY THE LOSS OF A MANDATORY ITEM WILL RESULT IN A SCRUB.
	I-10	AS THE DESIGNATED REPRESENTATIVE OF THE PROGRAM DIRECTOR, ONLY THE MISSION DIRECTOR MAY SCRUB THE MISSION. FURTHER, THE MISSION DIRECTOR RETAINS THE PRIMARY AUTHORITY TO DOWNGRADE A MANDATORY ITEM. THIS AUTHORITY SHALL BE EXERCISED AS CIRCUMSTANCES DICTATE AND AFTER APPROPRIATE RECOMMENDATIONS FROM THE PROGRAM MANAGERS, LAUNCH DIRECTOR, AND FLIGHT DIRECTOR.
	I-11	CONSIDERATION WILL BE GIVEN TO THE REPAIR OF ANY HIGHLY DESIRABLE ITEM, BUT IN NO CASE WILL THE LAUNCH BE SCRUBBED FOR ANY SINGLE HIGHLY DESIRABLE ITEM. IF TWO OR MORE HIGHLY DESIRABLE ITEMS FAIL AND/OR OTHER AGRAVATING CIRCUMSTANCES OCCUR, THE MISSION DIRECTOR MAY SCRUB THE MISSION AFTER COORDINATION WITH THE APPROPRIATE OPERATIONS AND PROGRAM MANAGERS.
	I-12	THE COUNTDOWN WILL NOT BE HELD NOR THE LAUNCH SCRUBBED FOR FAILURE OF DESIRABLE ITEMS.
	I-13	WHENEVER POSSIBLE, THE LAUNCH SITE AND MCC WILL VERIFY TELEMETRY READOUT DISCREPANCIES OCCURRING PRIOR TO LIFTOFF. IF THE MCC LOSES A PARAMETER BUT THE LAUNCH SITE HAS A VALID READOUT, THE MCC WILL CONTINUE ON THE LAUNCH SITE READOUT. THIS IS TRUE EXCEPT FOR THOSE MANDATORY PARAMETERS (LISTED IN THE FLIGHT MISSION RULES) UPON WHICH MISSION RULES ACTION IS TAKEN. IN THIS CASE, A HOLD MAY BE CALLED TO EVALUATE THE PROBLEM.
	I-14	THE COUNTDOWN WILL CONTINUE WHERE POSSIBLE CONCURRENTLY WITH CORRECTION OF AN EXISTING PROBLEM.
	I-15	WHERE POSSIBLE, ALL MANUAL ABORT REQUESTS FROM THE GROUND DURING FLIGHT WILL BE BASED ON TWO INDEPENDENT INDICATIONS OF THE FAILURE. CREW ABORT ACTION WILL NORMALLY BE BASED UPON TWO CUES.
	I-16	PRIOR TO LIFTOFF, THE DIRECTOR OF LAUNCH OPERATIONS WILL BE RESPONSIBLE FOR ALL ACTIONS IN THE EVENT OF LAUNCH SITE EMERGENCIES, EXCEPT FOR RECOVERY OPERATIONS OF SPACECRAFT AND CREW RESULTING FROM A PAD ABORT.
	I-17	THE LAUNCH OPERATIONS MANAGER MAY SEND AN ABORT REQUEST FROM THE TIME THE LAUNCH ESCAPE SYSTEM IS ARMED UNTIL THE SPACE VEHICLE REACHES SUFFICIENT ALTITUDE TO CLEAR THE TOP OF THE UMBILICAL TOWER. THE CRITERIA FOR SENDING AN ABORT REQUEST WILL BE ESTABLISHED IN THE LAUNCH RULES.

REV	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 INFLIGHT 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 SPLASHDOWN.
	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.
	I-28	THE APOLLO MISSION DIRECTOR IS RESPONSIBLE FOR THE BIOCONTAINMENT OF ALL LUNAR EXPOSED MATERIALS: LUNAR SAMPLES: AND LUNAR CREWS FROM THE COMPLETION OF PRELAUNCH MICROBIAL SAMPLING UNTIL RELEASE OF ASTRONAUTS: SAMPLES: AND MISSION-RELATED EQUIPMENT.
		RULE NUMBERS I-29 THROUGH I-39 ARE RESERVED.

REV	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 THE FLIGHT. WHEN USED IN CENTER CONTROL DOCUMENTATION THE PRIMARY OBJECTIVE MAY BE AMPLIFIED BUT NOT MODIFIED. DETAILED OBJECTIVES WILL BE GENERATED AND AMPLIFIED TO FULFILL EACH MISSION OBJECTIVE.
	I-39	PRINCIPAL DETAILED OBJECTIVE---A SCIENTIFIC, ENGINEERING OR OPERATIONAL OBJECTIVE WHICH AMPLIFIES A PRIMARY OBJECTIVE OR DETAILS A MAJOR DEVELOPMENTAL PURPOSE OR FEATURE OF THE FLIGHT PERIOD.
	I-40	RESERVED
	I-41	SECONDARY DETAILED OBJECTIVE---A SCIENTIFIC, ENGINEERING OR OPERATIONAL OBJECTIVE WHICH WOULD PROVIDE SIGNIFICANT DATA OR EXPERIENCE--BUT WHICH IS NOT NECESSARY TO THE ACCOMPLISHMENT OF A PRIMARY OBJECTIVE.
	I-42	MANDATORY (M)---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 PRIMARY OBJECTIVES.
	I-43	HIGHLY DESIRABLE (HD)---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 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---INTERRUPTION OF THE COUNTDOWN FOR UNFAVORABLE WEATHER, REPAIR OF HARDWARE, OR CORRECTION OF CONDITIONS UNSATISFACTORY FOR LAUNCH OR FLIGHT.

REV	ITEM	
	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 CLOSEOUT, 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.
	I-57	MISSION PERIOD TERMINATION (LUNAR LANDING MISSION)--- MISSION PERIOD TERMINATION OCCURS UPON THE RELEASE OF THE FLIGHT CREW, FLIGHT HARDWARE, OR RELEASE OF THE LUNAR SAMPLES TO APPROVED PRINCIPLE INVESTIGATORS, WHICHEVER OCCURS LATER.

PART II
1 GENERAL RULES
AND SOP'S

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 DETAILED OBJECTIVES WILL BE COMPROMISED.
	1-4	WHEN A CONFLICT OF FLIGHT PLAN ACTIVITIES OCCURS, THE FLIGHT DIRECTOR WILL DETERMINE THE PRIORITY OF ACTIVITIES.
	1-5	IN SOME INSTANCES, THE SPECIFIC MISSION RULES MAY DEVIATE FROM THE GENERAL GUIDELINES CONTAINED IN PART I OR FROM THESE GENERAL RULES. THE SPECIFIC MISSION RULE WILL APPLY IN ALL CASES, AND THE DEVIATIONS FROM THE GENERAL GUIDELINES WILL BE NOTED.
	1-6	THE FLIGHT DIRECTOR MAY, AFTER ANALYSIS OF THE FLIGHT, CHOOSE TO TAKE ANY NECESSARY ACTION REQUIRED FOR THE SUCCESSFUL COMPLETION OF THE MISSION.
	1-7	MISSION RULE LIMITS THAT ARE CONSIDERED TO BE INTERIM OR UNCONFIRMED NUMBERS WILL BE UNDERLINED IN THIS PUBLICATION AND ALL SUBSEQUENT REVISIONS UNTIL THE NUMBERS ARE CONFIRMED BY THE RESPONSIBLE NASA AGENCY.
	1-8	THE SYSTEMS LIMITS LISTED IN THESE RULES ARE THE ACTUAL VEHICLE LIMITS AS WELL AS THEY ARE KNOWN AND UNDERSTOOD AND ARE NOT BIASED TO COMPENSATE FOR TIME DELAYS OR INSTRUMENTATION ERRORS WITHIN THE SPACECRAFT AND MSFN DATA/DISPLAY SYSTEMS.
	1-9	UNLESS STATED OTHERWISE, MANDATORY AND HIGHLY DESIRABLE INSTRUMENTATION REQUIREMENTS ARE SATISFIED BY EITHER ONBOARD OR PCM CAPABILITY.

REV	ITEM	
	1-10	MANDATORY SPACE VEHICLE INSTRUMENTATION FOR THE PURPOSES OF FLIGHT MISSION RULES MUST BE IN CONSONANCE WITH THE FOLLOWING CRITERIA--- (REFERENCE OMSF GENERAL RULE I-62). A. REQUIRED TO INSURE FLIGHT CREW SAFETY. B. REQUIRED TO IMPLEMENT RULES RESULTING IN LAUNCH ABORTS. C. REQUIRED TO IMPLEMENT RULES RESULTING IN EARLY MISSION TERMINATION. D. REQUIRED TO MAKE DECISION TO CONTINUE TO THE NEXT MISSION PHASE. THE MANDATORY INSTRUMENTATION LISTINGS IN THIS DOCUMENT WILL BE CROSS-REFERENCED TO THE APPROPRIATE MISSION RULE MEETING THE ABOVE CRITERIA.
	1-11	THE CRITERION FOR CATEGORIZING INSTRUMENTATION AS HIGHLY DESIRABLE IN THE FLIGHT MISSION RULES IS ANY INSTRUMENTATION REQUIRED FOR NORMAL SYSTEMS MANAGEMENT OR REQUIRED FOR FLIGHT CONTROL DECISIONS NOT IN THE MANDATORY CATEGORY.
	1-12	RF COMMANDS WILL NOT BE TRANSMITTED TO THE SPACECRAFT OR LAUNCH VEHICLE DURING THE LAUNCH PHASE UNLESS SPECIFIC MISSION RULES ARE INVOKED WHICH REQUIRE COMMAND ACTIVITY.
	1-13	THE LAUNCH OPERATIONS MANAGER WILL INFORM THE FLIGHT DIRECTOR WHEN THE SPACE VEHICLE HAS CLEARED THE UMBILICAL TOWER BY STATING "CLEAR TOWER" OVER CHANNEL 111.
	1-14	THE COMMAND PILOT MAY INITIATE SUCH INFLIGHT ACTION AS HE DEEMS ESSENTIAL FOR CREW SAFETY.
	1-15	IN THE EVENT OF LOSS OF COMMUNICATIONS BETWEEN THE MSFN AND THE S/C, THE COMMAND PILOT WILL ASSUME RESPONSIBILITY OF MISSION DIRECTION WITHIN THE FRAME WORK OF THE MISSION RULES.
		RULE NUMBERS 1-16 THROUGH 1-23 ARE RESERVED.

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 LOI1, LOI2, 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.

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 NMI) IN THE EVENT OF AN SLV FAILURE OCCURRING IMMEDIATELY PRIOR TO INSERTION; OR IN THE EVENT OF DEGRADED SLV PERFORMANCE.
	1-34	S-IVB DESTRUCT PACKAGE SAFING---THE EMERGENCY DESTRUCT PACKAGE IS SAFED BY THE RSO TRANSMITTING A COMMAND WHICH PERMANENTLY REMOVES POWER FROM THE RANGE SAFETY RECEIVERS.
	1-35	S-IVB SAFING---A PASSIVATION SEQUENCE IN WHICH S-IVB LOX, LH2, AND HIGH PRESSURE SPHERES ARE DEPLETED.
	1-36	PRELAUNCH PHASE (PRELN)---THE TIME INTERVAL FROM THE COMPLETION OF THE FLIGHT READINESS REVIEW TO LIFTOFF.
	1-37	FLIGHT PHASE---THE INTERVAL FROM LIFTOFF THROUGH SPLASHDOWN. FOR MISSION RULE PURPOSES THE FLIGHT PHASE IS FURTHER SUBDIVIDED AS SHOWN BELOW--- A. LAUNCH PHASE--- FROM LIFTOFF THROUGH INSERTION (TB1 THROUTH TB4). B. EARTH ORBIT PHASE---FROM INSERTION THROUGH S-IVB CUTOFF FOR TRANSLUNAR INJECTION (TLI). C. TDGE PHASE---FROM CSM/S-IVB SEPARATION THROUGH LM EJECTION FROM SLA. D. TRANSLUNAR COAST PHASE---FROM S-IVB CUTOFF FOR TLI THROUGH LOI1 CUTOFF. E. DOCKED PHASE---THE TIME INTERVALS DURING WHICH THE LM AND CSM ARE DOCKED. F. LUNAR ORBIT PHASE---FROM LOI1 CUTOFF TO UNDOCKING AND FROM REDOCKING TO TEI CUTOFF. G. UNDOCKED PHASE---THE TIME INTERVAL BETWEEN LM AND CSM UNDOCKING UNTIL THE LM DOI MANEUVER. H. DOI PHASE---THE TIME INTERVAL FROM THE DOI MANEUVER TO THE INITIATION OF THE PDI MANEUVER. I. POWERED DESCENT---THE TIME INTERVAL FROM THE INITIATION OF THE PDI MANEUVER TO TOUCH DOWN. 1. PDI TO PDI +5---DURING THIS TIME PERIOD THE LM CAN ABORT THE POWERED DESCENT AND GET INTO ORBIT USING THE SPS ONLY AND RETAIN THE DESCENT STAGE AFTER INSERTION. 2. PDI +5 TO LO GATE---LO GATE IS THE POINT AT WHICH THE CREW TAKES OVER AND MANUALLY FLIES THE DESCENT. 3. LO GATE TO TOUCH DOWN---THE TIME INTERVAL FROM CREW TAKEOVER (APPROXIMATELY 500 FT ALTITUDE) TO LANDING. J. LUNAR STAY PHASE---THE TIME INTERVAL FROM TOUCHDOWN UNTIL LIFTOFF. EVA---THE TIME INTERVAL FROM LM DEPRESSURIZATION UNTIL LM REPRESSURIZATION. K. ASCENT PHASE---THE TIME INTERVAL FROM LIFTOFF TO LM INSERTION INTO LUNAR ORBIT. L. 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. M. TRANSEARTH COAST PHASE---FROM TEI CUTOFF TO CM/SM SEPARATION. N. ENTRY PHASE---FROM CM/SM SEPARATION TO SPLASHDOWN.

REV	ITEM	
	1-38	RECOVERY PHASE---THE TIME INTERVAL FROM SPLASHDOWN TO DELIVERY OF THE FLIGHT CREW AND SPACECRAFT TO DESIGNATED LAND BASED INSTALLATIONS.
	1-39	REENTRY DEFINITIONS--- A. AUTOMATIC---REENTRY CONTROLLED BY CMC WHICH OUTPUTS BANK ANGLE COMMAND TO THE RCS. B. CLOSED LOOP---REENTRY CONTROLLED BY THE CREW MANUALLY FLYING BANK ANGLE MODULATION USING CMC ENTRY PROGRAM OUTPUTS. C. OPEN LOOP REENTRY---REENTRY CONTROLLED BY THE CREW USING SPACECRAFT DISPLAYS AND FLYING--- 1. BANK ANGLE (RR 0-90) AND RETRB (RL 0-90). 2. CONSTANT BANK ANGLE---CREW ESTABLISHES AND MAINTAINS A CONSTANT BANK ANGLE. (CONSTANT BANK ANGLES GREATER THAN 90 DEGREES WILL NOT BE FLOWN EXCEPT WHEN SKIPOUT RULE IS VIOLATED.) 3. ROLLING REENTRY---MAINTAIN CONSTANT 18 DEGREES PER SECOND ROLL RATE. 4. EMS RANGING---CONSTANT BANK ANGLE IS HELD TO 18. THEN THE RANGE TO GO DISPLAY AND THE RANGE POTENTIAL LINES ARE COMPARED TO MODULATE THE BANK ANGLE. AT RETRB THE PRESENT BANK ANGLE IS REVERSED. D. CONSTANT G ENTRY---CREW CONTROLS THE BANK ANGLE TO MAINTAIN A SPECIFIED G LEVEL. E. EMS REENTRY---CREW CONTROLS THE BANK ANGLE TO MAINTAIN A CONSTANT G UNTIL VELOCITY LESS THAN 25,500 FPS. THE EMS IS THEN USED TO CONTROL RANGE BY NULLING THE DIFFERENCE BETWEEN THE RANGE TO GO COUNTER AND THE RANGE POTENTIAL GLIDELINES. ALL MANEUVERS ARE OVERRIDDEN AS NECESSARY TO PREVENT AN ONSET OR UPSET VIOLATION.
	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 ACHIEVE IN THE FOLLOWING ORDER OF PRIORITY--- 1. A REDUCTION IN THE PROBABILITY OF S-IVB AND SPACECRAFT RECONTACT. 2. A REDUCTION IN THE PROBABILITY OF S-IVB EARTH IMPACT. 3. A REDUCTION IN THE PROBABILITY OF S-IVB LUNAR IMPACT.

REV	ITEM	
	1-43	LUNAR ABORT MODES AFTER EARLY LOI1 SHUTOFF (REFERENCE RULE 5-62 FOR ABORT MANEUVER DEFINITION)

A. DPS

1. MODE-I--- 0 TO 650 FPS (APPROX LOI IGN TO 1+30)
2. MODE-II--- 650 TO 1270 FPS (APPROX 1+30 TO 2+50)
3. MODE-III--- 1270 TO COMPLETION (APPROX 2+50 TO C/O)

NOTE

GENERAL ABORT PLAN IS TO USE THE DPS FOR THE FIRST ABORT MANEUVER. ABORTS FROM LOI IGN PLUS 40 SEC TO LOI IGN PLUS 2+24 REQUIRES THE SPS OR APS IN ADDITION TO THE DPS.

1-44 SATURN L/V TIMEBASES---

TIME BASE	DEFINITION	NOMINAL INITIATE TIME
TB1	LIFTOFF TO S-IC INBOARD ENGINE CUTOFF	0+00
TB2	S-IC INBOARD ENGINE CUTOFF TO S-IC OUTBOARD ENGINE CUTOFF (S-IC/S-II STAGING)	2+15
TB3	S-IC OUTBOARD ENGINES CUTOFF TO S-II CUTOFF (S-II/S-IVB STAGING)	2+42
TB4	S-II CUTOFF TO S-IVB FIRST BURN CUTOFF	9+11
TB5	S-IVB FIRST BURN CUTOFF TO S-IVB RESTART PREPARATIONS (RESTART MINUS 9' 38'')	11+30
TB6	S-IVB RESTART MINUS 9' 38'' TO S-IVB SECOND BURN CUTOFF	2+37+42
TB7	S-IVB SECOND CUTOFF TO START OF S-IVB EVASIVE MANEUVER BURN	2+53+05
TB8	START OF EVASIVE BURN TO END OF S-IVB/IU LIFETIME.	APPROX. TB7 + 1+40+00 (BY GROUND CMD.)

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

REV	ITEM	

* CRITERIA FOR TARGET POINT SELECTION *

1-48 THE CRITERIA STATED 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 PASS 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.

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.

REV	ITEM	
		LAUNCH ABORTS
	1-66	ABORT REQUEST COMMANDS ARE COMMANDS TRANSMITTED FROM THE MCC OR LCC WHICH ILLUMINATE THE ABORT REQUEST LIGHT ON THE COMMAND PILOT'S PANEL. THE "ABORT LIGHT" AND A VOICE REPORT "ABORT" OVER A/G ARE CONSIDERED TWO CUES FOR THE CREW TO TAKE THE NECESSARY ACTION TO ABORT THE MISSION. THE GROUND WILL USE TWO INDEPENDENT CUES PRIOR TO TRANSMITTING "ABORT REQUEST." ADDITIONAL CUES FOR THE CREW WILL COME FROM ONBOARD INDICATIONS.
	1-67	ABORT ACTION CAN BE INITIATED ONLY BY THE CREW OR THE EOS.
	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 RSC 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 RSC 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 MFCO COMMAND WHICH ALSO LIGHTS THE ABORT REQUEST LIGHT ON THE SPACECRAFT. THE MFCO WILL INITIATE AN AUTO-ABORT IF TRANSMITTED PRIOR TO EOS DISABLE. THE MFCV COMMAND INITIATES A 4.1 SEC TIMER ON THE GROUND (CAPE RSO CONSOLE ONLY) RSO INSERTS MANUAL TIME DELAY, WHICH IN TURN ENABLES DESTRUCT CAPABILITY IF TRANSMITTED. THE RSO DESTRUCT COMMAND CAN THEN DESTRUCT THE SLV. THE RSO WILL ALWAYS SAFE THE SLV AFTER TRANSMITTING MFCO UPON VERIFICATION OF CUTOFF IF THE DESTRUCT COMMAND IS NOT TO BE TRANSMITTED.

REV	ITEM	
	1-74	THE RSO WILL SAFE THE S-IVB DESTRUCT SYSTEM AFTER CONFIRMATION OF S-IVB C/O FROM THE FLIGHT DYNAMICS OFFICER. IF COMMUNICATIONS ARE LOST WITH THE FIDO, THE S-IVB DESTRUCT SYSTEM WILL BE SAFED BASED ON THE RSO'S VERIFICATION OF S-IVB CUTOFF. ONCE SAFED, THE S-IVB DESTRUCT SYSTEM CANNOT BE REINITIATED. IF THE RSO INITIATES MECO, THE RSO WILL INITIATE SAFING AFTER VERIFICATION OF S-IVB CUTOFF.
	1-75	EMERGENCY ENGINE SHUTDOWN METHODS.

INITIATOR	METHOD	STAGE	TIME FRAME
ASTRONAUT	CCW ON THC	S-IC, S-II, S-IVB	T + 30 SEC. TO S-IVB CUTOFF
ASTRONAUT	S-II/ S-IVB L/V STAGE SWITCH	S-II, S-IVB	T + 2-33 TO S-IVB CUTOFF
RSO	RF CMD (MECO)	S-IC, S-II, S-IVB	T-0 TO S-IVB CUTOFF
EDS	2 OF 3 VOTING LOGIC	S-IC	T + 30 SEC TO EDS AUTO OFF AT T+ 2-00 PIN NOTE---EDS WILL INITIATE ABORT FROM T-0 TO T + 30 SEC. HOWEVER, S-IC ENGINES WILL NOT BE SHUTDOWN

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

REV	ITEM	
	1-77	ABORT MODES---
		MODE I — BOUNDARY OF APPLICATION
		1A — LES ABORT ENABLE (APPROX. T-45 MIN) TO GET 42 SEC. (10 K FEET)
		1B — GET 42 SEC TO 100K FEET ALTITUDE (GET APPROX. 3 + 50)
		1C — 100K FEET ALTITUDE TO TOWER JETTISON (GET APPROX. 3 + 07)
	1-78	MODE II — BOUNDARY OF APPLICATION
		TOWER JETTISON (GET APPROX. 3 + 07) UNTIL FULL LIFT SPLASHPOINT IS 3200 NM DOWNRANGE (GET APPROX. 10+13)

PROCEDURES

A. MCC PROVIDES
   1. GET OF 600K
   2. PITCH AT .050
   3. GET DROGUE

B. ENTRY IS FULL LIFT

REV	ITEM			
	1-79	MODE III	BOUNDARY OF APPLICATION BETWEEN FULL LEFT SPLASH POINT +3200 NM AND INSERTION.	PROCEDURES A. MCC PROVIDES--- 1. GETI AT S-IVB CUTOFF PLUS 2-05 2. DELTA V FOR 3350 NM SPLASH POINT 3. BURN DURATION 4. GET OF ROOK 5. PITCH AT .05G 6. GET DROGUE B. MANEUVER IS SCS AUTO. C. ENTRY IS ROLL LEFT 55 DEGREES.
			NOTE MODE III "NO BURN" WILL BE CALLED IF THE ROLL LEFT 55 DEG. ENTRY RANGE IS LESS THAN 3350 NM.	
	1-80	MODE IV	BOUNDARY OF APPLICATION CONTINGENCY ORBIT INSERTION CAPABILITY TO INSERTION (BASED ON CCI LINE ON GAMMA VS V PLOT FOR NEAR NOMINAL ALTITUDE)	PROCEDURES A. MCC PROVIDES--- 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 B. MANEUVER IS SCS RATE CMD
	1-81	MODE APOGEE KICK	BOUNDARY OF APPLICATION PRE-APOGEE CUTOFF; OUTSIDE THE CCI BOUNDARY; CORRECTABLE TO SAFE ORBITAL CONDITIONS BY A MANEUVER AT APOGEE.	PROCEDURES A. MCC PROVIDES--- 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 B. MANEUVER IS SCS AUTO
		RULES 1-82 THROUGH 1-86 ARE RESERVED		

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 (NOT APPLICABLE TO ANY ENGINE OUT PRIOR TO 50 SEC.)	ABORT MODE I (ACTION ONLY AFTER BOTH HAVE REACHED THRESHOLD.)

1-88 RATES AND ATTITUDE

	PROCEDURES
A. PITCH AND YAW 1. L/O TO 2 MIN = 4 DEG/SEC 2. 2 MIN TO S-IVB CUTOFF = 8 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 S-IVB CUTOFF = 20 DEG/SEC	ABORT MODE I, MODE II, MODE III, OR MODE IV

1-89 ECO 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 ROLL	 4.0 +/- .5 DEG/SEC 20.0 +/- 1.5 DEG/SEC

B. ANY TWO ENGINES OUT

C. CM TO IV BREAKUP

1-90 S-IVB TANK PRESSURE LIMITS

A. BULKHEAD DELTA P (FIRST S-IVB C/O TO S/C L/V SEP)
FUEL GREATER THAN OXID + 20 PSID
OXID GREATER THAN FUEL + 30 PSID

B. LOX TANK PRESS GREATER THAN OR EQUAL TO 30 PSIA (L/O TO S/C L/V SEP)

1-91 ENGINE FAILURES

	PROCEDURES
LOSS OF 3 OR MORE S-II ENGINES	ABORT MODE II OR MODE III
PRIOR TO S-IVB TO COI CAPABILITY	

2 FLIGHT OPERATIONS RULES

REV	ITEM	

* GENERAL *

2-1 PRELAUNCH

A. LAUNCH AZIMUTH LIMITATIONS RESTRICT LAUNCHES TO OCCUR BETWEEN 72 DEG. AND 96 DEG.

B. THE FLIGHT DIRECTOR WILL EVALUATE WIND SIMULATIONS ALONG THE MODE 1 (TOWER) ABORT TRACK PRIOR TO THE START OF CRITICAL COUNTDOWN ACTIVITIES AND WILL ADVISE THE LAUNCH DIRECTOR OF ANY PREDICTED PERIODS OF LAND LANDING. IF THE FLIGHT DIRECTOR IS UNABLE TO PROVIDE THIS EVALUATION, A LAND LANDING WILL BE ASSUMED AND THE SPACECRAFT WIND CONSTRAINTS FOR LAND (P'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 34 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 60 SEC. CONTINUOUS TELEMETRY COVERAGE IS REQUIRED FROM THE SLV FROM LIFTOFF THROUGH INSERTION PLUS 60 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.

REV	ITEM	
	2-3	EARTH ORBIT

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

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

C. THE DEORBIT CAPABILITIES REQUIRED FOR EARTH ORBIT ARE---

1. TWO METHODS OF DEORBIT ARE REQUIRED.

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

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

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

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

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

(A) SM-RCS

(B) LM PROP PLUS SM-RCS

(C) SM-CM/RCS HYBRID

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

RULE NUMBERS 2-4 THROUGH
2-10 ARE RESERVED

REV	ITEM	
	2-11	TRANSLUNAR INJECTION

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

1. THERE HAVE BEEN NO FAILURES IN THE LAUNCH VEHICLE WHICH RESULTS IN ---

(A) A CATASTROPHIC HAZARD,

(B) ACHIEVEMENT OF AN S-IVB ENGINE BURN WITH EXPECTED CUTOFF OR SHUTDOWN CONDITIONS DEFINITELY PRECLUDING AN ACCEPTABLE LUNAR MISSION. IN APPLYING THIS CRITERIA TO SPECIFIC MISSION RULES, A NO GO RECOMMENDATION WILL BE REQUIRED IF INSUFFICIENT S-IVB CONSUMABLES OR PROPULSION PERFORMANCE IS AVAILABLE TO ASSURE A FINITE PROBABILITY OF ACHIEVING A CUTOFF ORBIT WITH 65,000 N.M. APOGEE ALTITUDE.

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

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

C. THE TLI MANEUVER WILL BE INITIATED AND CONTINUED UNDER MANUAL CONTROL FOR A SATURN GUIDANCE REFERENCE FAILURE.

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

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

REV	ITEM	
	2-13	TRANSLUNAR COAST A. NO MCC WILL BE PERFORMED IF LOI CAN BE TARGETED WITHIN OPERATIONAL CONSTRAINTS. B. TRANSLUNAR COAST WILL BE TERMINATED IF ADEQUATE CONSUMABLES ARE NOT AVAILABLE FOR A CIRCUMLUNAR EARTH RETURN + 12 HRS. C. THE CREW WILL USE THEIR DISCRETION TO MAN THE LM FOR BACKUP COMMUNICATIONS AND RETURN IF CSM COMMUNICATIONS ARE LOST WITH THE MSFN. IF CSM COMMUNICATIONS CANNOT BE MAINTAINED. A LUNAR ORBIT MISSION WILL NOT BE FLOWN. D. A HYBRID TRAJECTORY WILL NOT BE FLOWN UNLESS THERE ARE ENOUGH CSM CONSUMABLES FOR A LUNAR LANDING MISSION. AND THE CSM SYSTEMS MEET THE LOI CRITERIA. E. TRANSLUNAR MIDCOURSE CORRECTIONS RESULTING IN A HYBRID TRAJECTORY WILL BE DESIGNED TO MEET LOI TARGETING CONSTRAINTS WHILE RESERVING A CAPABILITY TO PERFORM A RETURN TO EARTH MANEUVER WITH THE DPS ENGINE AS LATE AS 2 HRS AFTER PERILUNE ON THE CIRCUMLUNAR TRAJECTORY.
	2-14	LUNAR ORBIT INSERTION LOI WILL BE INHIBITED AND A LUNAR FLYBY PERFORMED IF THE CSM DOES NOT SATISFY ANY OF THE FOLLOWING CONDITIONS:--- A. FULL CRITICAL SYSTEMS REDUNDANCY. B. ADEQUATE CONSUMABLES FOR MINIMUM LUNAR ORBIT OPERATIONS WITH CAPABILITY TO SUSTAIN A TANK LOSS AND RETURN TO EARTH WITH AN AVERAGE POWER LEVEL OF 40 AMPS. 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. A DPS LOI WILL BE PERFORMED IF REQUIRED TO ACCOMPLISH A LUNAR ORBIT MISSION.
	2-15	LUNAR ORBIT A. LOI DISPERSIONS 1. IF A STABLE ORBIT HAS NOT BEEN ACHIEVED. A DPS 30 MIN ABORT WILL BE EXECUTED FOLLOWED BY A SPS OR APS MANEUVER IF REQUIRED. 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 REDUNDANT CAPABILITY MUST BE MAINTAINED IN ALL CSM SYSTEMS CRITICAL FOR TEI AND LIFE SUPPORT. C. SUFFICIENT CONSUMABLES MUST REMAIN TO COMPLETE THE NEXT MISSION PHASE WITH CAPABILITY TO SUSTAIN A TANK LOSS AT ANY POINT DURING THE PHASE AND RETURN TO EARTH WITH AN AVERAGE POWER LEVEL OF 40 AMPS. D. THE CSM MUST MAINTAIN AN SPS FUEL RESERVE CAPABILITY FOR THE TEI MANEUVERS AND TRANSEARTH MCC'S. E. THE CSM MUST MAINTAIN RCS PROPELLANT RESERVE TO ACCOMPLISH TEI CONTROL. 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	INTRAVEHICULAR TRANSFER ONE HARDSUIT IVT FROM THE CSM TO THE LM WILL BE ACCOMPLISHED IF A REASONABLE CHANCE EXISTS THAT CORRECTIVE ACTION CAN BE TAKEN FOR A LM/TUNNEL PRESSURIZATION PROBLEM.

REV	ITEM	
	2-17	DOCKED LM OPERATION FOR AN IMPENDING HAZARDOUS SITUATION RESULTING FROM A DESCENT STAGE PROBLEM, THE STAGE WILL BE JETTISONED AND ASCENT STAGE OPERATIONS WILL CONTINUE AFTER THE VEHICLE HAS MOVED TO A SAFE DISTANCE.
		RULE NUMBERS 2-18 THROUGH 2-20 ARE RESERVED
	2-21	CSM/LM UNDOCKING AND SEPARATION A. A MANNED LM WILL NOT BE UNDOCKED FROM THE CSM WITHOUT INDEPENDENT MANEUVER CAPABILITY OF BOTH VEHICLES TO TERMINATE UNDOCKED ACTIVITIES AND TO ACCOMPLISH DOCKING. THE LM CAPABILITY TO REDOCK MUST STILL EXIST IF THE LM IS REQUIRED TO STAGE. B. VHF VOICE COMMUNICATIONS BETWEEN THE LM AND CSM ARE MANDATORY FOR UNDOCKING. C. EVT CAPABILITY IS REQUIRED FOR MANNED UNDOCKING. D. CREWMEN WILL BE SUITED DURING UNDOCKING AND DOCKING. E. IF NO LANDING ATTEMPT WILL BE MADE NO UNDOCKED MANNED ACTIVITIES WILL BE PERFORMED.
	2-22	CSM LUNAR ORBIT UNDOCKED A. UNDOCKING TO PDI 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. B. PDI TO LANDING NO CSM FAILURES, EXCEPT FOR TIME-CRITICAL SPS FAILURES, BOTH H2 CRYO OR BOTH O2 CRYO TANKS (TO LO GATE), OR 3 FUEL CELLS, WILL BE CAUSE FOR ABORT DURING POWERED DESCENT. C. LUNAR STAY FAILURE TO MAINTAIN REDUNDANT CAPABILITY IN SYSTEMS REQUIRED FOR TEI OR LIFE SUPPORT WILL BE CAUSE FOR TERMINATION OF LUNAR STAY.
	2-23	LM-DOI FOR DOI, THE LM MUST HAVE THE CAPABILITY TO LAND, STAY ONE CSM REV, ASCEND, RENDEZVOUS AND DOCK WITHOUT VIOLATING ANY SPECIFIC MISSION RULES OR REDLINES.
	2-24	LM-PDI FOR PDI, THE LM MUST HAVE THE CAPABILITY TO LAND, STAY FOR ONE CSM REV, ASCEND, RENDEZVOUS AND DOCK WITHOUT VIOLATING ANY SPECIFIC MISSION RULES OR REDLINES.

REV	ITEM	
	2-25	LM-POWERED DESCENT IF A SYSTEMS FAILURE OCCURS AND A CHOICE IS AVAILABLE--- A. EARLY IN POWERED DESCENT WHEN DPS-TO-ORBIT CAPABILITY IS AVAILABLE: (UP TO PDI + 3 MINUTES) 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. B. DURING THE REMAINDER OF POWERED 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.
	2-26	LM-LUNAR STAY A. ONLY THOSE TIME-CRITICAL SYSTEMS FAILURES OR TRENDS THAT INDICATE IMPENDING LOSS OF THE CAPABILITY TO ASCEND AND ACHIEVE A SAFE ORBIT WILL BE CAUSE FOR AN IMMEDIATE ABORT (ANYTIME LIFTOFF) FROM THE LUNAR SURFACE. B. LOSS OF REDUNDANT CAPABILITY IN CRITICAL LM SYSTEMS IS CAUSE FOR ABORT AT THE NEXT BEST OPPORTUNITY.
	2-27	EVA A. FOR THE NOMINAL (TWO-MAN) EVA: TOTAL EMU LIFE SUPPORT SYSTEMS CAPABILITY: EVA TO EVA DUPLEX VOICE: EVA TO MSFN VOICE: AND CRITICAL INSTRUMENTATION FOR BOTH ASTRONAUTS ARE REQUIRED. FOR THE TWO-MAN EVA: THE CDR WILL ALWAYS EGRESS FIRST AND INGRESS LAST TO MAINTAIN PROPER LM CREW STATION CONFIGURATION UNLESS THE CDR HAS INITIATED AN OPS PURGE. B. TO INITIATE THE EVA PHASE: THE EMU MUST HAVE SUFFICIENT CONSUMABLES TO SUPPORT CHECKOUT: PLANNED EVA (3+30) AND A 30 MINUTE POST-EVA RESERVE. C. THE DUAL EVA WILL BE OPEN-ENDED TO 4+00. D. IN THE EVENT PLSS TELEMETRY IS MANDATORY FOR CRITICAL INSTRUMENTATION AND FM INHIBITS EITHER LM OR PLSS TRANSMISSION: THE ERECTABLE S-BAND ANTENNA WILL BE DEPLOYED PRIOR TO LMP EGRESS. E. AN EARLY TERMINATION OF THE EVA WILL BE BASED ON THE ASTRONAUT'S CAPABILITY TO COMMUNICATE WITH EACH OTHER: THE CAPABILITY OF MSFN TO COMMUNICATE WITH ONE CREWMAN: THE CAPABILITY TO MONITOR THE EMU CRITICAL INSTRUMENTATION: AND UPON THE CONSUMABLES REQUIRED TO SUPPORT SRC CLOSEOUT (LMP INGRESS) AND TRANSFER TO LM, PLUS A 30 MINUTE POST EVA RESERVE. F. BOTH EVA CREWMEN WILL NOT REMAIN OUTSIDE OF MSFN COMM COVERAGE FOR A PERIOD EXCEEDING 5 MIN. G. CONSIDERATION WILL BE GIVEN: TIME PERMITTING: FOLLOWING AN EARLY TERMINATION OF A TWO MAN EVA TO REINITIATE A ONE MAN EVA TO RETRIEVE LUNAR SAMPLES. H. FAILURE OF ONE PLSS: ONE OPS: EVA TO EVA DUPLEX VOICE: OR THE LOSS OF CRITICAL INSTRUMENTATION WILL BE CAUSE FOR ONE-MAN ALTERNATE EVA. I. ANY EMU PROBLEM REQUIRING A LM REPRESSURIZATION: AN OPS PURGE IN EXCESS OF TBD MINUTES (REALTIME DETERMINATION): OR INABILITY TO RECONFIGURE THE EMU TO A NORMAL PLSS OPERATION FOLLOWING A FINITE PURGE WILL RESULT IN AN IMMEDIATE TWO MAN EVA TERMINATION. J. ANY EMU PROBLEM REQUIRING THE ACTIVATION OF THE OPS IN A MAKEUP MODE WILL RESULT IN THAT ASTRONAUT RETURNING TO THE VICINITY OF THE LM WHILE THE OTHER ASTRONAUT INITIATES THE NOMINAL TWO MAN EVA TERMINATION. PROPER CREW STATION CONFIGURATION WILL BE OBSERVED. K. ALL EVA EXCURSIONS WILL BE LIMITED TO THAT VICINITY OF LM WHICH WILL ALLOW A SAFE 20 MINUTE RETURN (3000 FT TRAVERSE) TO THE LM WHILE OPERATING ON THE OPS. L. BOTH PLSS'S AND OPS'S WILL BE RETAINED UNTIL TWO LIFE SUPPORT UNITS (2 OPS: 2 PLSS: OR 1 PLSS+1 OPS) HAVE BEEN VERIFIED TO HAVE SUFFICIENT CONSUMABLES TO SUPPORT CEVA.

REV	ITEM	
	2-28	ASCENT IN THE EVENT OF PROCEDURAL ERRORS OR SYSTEMS PROBLEMS WHICH RESULT IN LOSS OF SOME CAPABILITY USED FOR ASCENT OR FOR RENDEZVOUS AND WHICH CAN BE CORRECTED IN ONE REV, IT IS BETTER TO DELAY ASCENT FOR ONE REV AND CORRECT THE SITUATION THAN IT IS TO LIFT OFF ON TIME.
	2-29	RENDEZVOUS SELECTION OF THE ACTIVE VEHICLE FOR RENDEZVOUS AND DOCKING WILL BE DETERMINED BY THE FLIGHT DIRECTOR AND THE FLIGHT CREW BASED UPON CONSUMABLES AND SYSTEMS PERFORMANCE. THE TOTAL LM CAPABILITY WILL BE DEDICATED TO ACCOMPLISHING THE RENDEZVOUS.
	2-30	TRANSEARTH COAST A. THE STEEP TARGET LINE WILL BE USED FOR MCC'S UNLESS THE VELOCITY AT ENTRY INTERFACE IS LESS THAN 39,000 FPS AND THE GEN IS GO - THEN THE SHALLOW TARGET LINE WILL BE USED. B. MCC'S MAY BE USED FOR LANDING AREA CONTROL PRIOR TO ENTRY INTERFACE MINUS 24 HOURS FOR RECOVERY ACCESS VIOLATIONS, UNACCEPTABLE WEATHER, OR LAND MASSES IN ANY PART OF THE OPERATIONAL FOOTPRINT. C. IF THE FLIGHTPATH ANGLE IS OUTSIDE THE ENTRY CORRIDOR, AN MCC WILL BE EXECUTED AS SOON AS PRACTICAL. D. MCC'S WILL BE ACCOMPLISHED BY THE SPS IF NECESSARY TO MAINTAIN RCS REDLINES.
	2-31	ALTERNATE MISSION A. E.O. 1. CSM ONLY - APPROXIMATE 100 NM E.O. PHOTOGRAPHY, SPS INCLINATION CHANGE. SPS MNVR TO LOWER APOGEE IF REQUIRED. 2. CSM/LM - LM SYSTEMS POWER UP AND DPS MNVR TO LOWER APOGEE IF REQUIRED, APPROXIMATE 100 NM E.O. PHOTOGRAPHY MISSION, INCLINATION CHANGE. B. L.O. 1. CSM ONLY - LUNAR ORBIT PHOTOGRAPHY, FREE RETURN TRAJECTORY 2. CSM/LM (NO LANDING CAPABILITY) - LM SYSTEMS POWER UP, LO PHOTOGRAPHY, PC MANEUVER. C. IN ANY ALTERNATE MISSION WITHIN THE CONSTRAINTS OF PROPELLANT REMAINING AND OTHER OPERATIONAL CONSIDERATIONS SUCH AS CREW SAFETY AND SYSTEMS LIFETIME, THE COMBINED LM ASC/DES STAGES WILL BE DISPOSED OF IN THE FOLLOWING ORDER OF DESCENDING PRIORITY--- 1. SOLAR ORBIT 2. LUNAR IMPACT 3. LUNAR ORBIT 4. OCEAN IMPACT
	2-32	RESERVED

3 MISSION RULE
SUMMARY

REV	ITEM	
		THIS SECTION IS A SUMMARY OF THE DATA PRIORTY GUIDELINES BY MISSION PHASE, SLV RULES BY MISSION PHASE, AND S/C SYSTEMS GO/NO-GO CRITERIA ON CHARTS BY MISSION PHASE.
		THE SUMMARY RULES PLUS THE CHART ARE REQUIRED TO ENCOMPASS EACH PHASE.
		THE CAPABILITY LISTED IN THE CHARTS ARE THE REQUIREMENTS FOR INITIATION OR CONTINUATION OF A MISSION PHASE OR EVENT, MISSION EVENTS FROM UNDOCKING TO TOUCHDOWN REQUIRED THE CAPABILITY TO LAND; STAY ONE CSM REV; ASCEND; RENDEZVOUS; AND DOCK.
		---------- ' LAUNCH PHASE ' ----------
	3-1	THE LAUNCH WILL BE ABORTED FOR THE FOLLOWING REASONS---
		A. SLV
		S-IB GIMBAL ACTUATOR HARDOVER INBOARD PRIOR TO S-IVB TO COI 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) (POSSIBLE COI CAPABILITY)
		S-IVB LOX TANK PRESS GREATER THAN 50 PSI BEFORE TWR JETT
		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

REV	ITEM	
	3-2	THE S-IVB EARLY STAGING WILL BE USED AFTER "S-IVB TO CO!" CAPABILITY FOR THE FOLLOWING --- S-II GIMBAL ACTUATOR INBOARD HARDOVER S-II ENGINE FAILURES (TIME DEPENDENT) S-IVB COLD HE SHUTOFF VALVE(S) FAILS OPEN (AFTER TWR JETT)
	3-3	SWITCHOVER TO CSM GUIDANCE WILL BE PERFORMED FOR-- SATURN GUIDANCE REFERENCE FAILURE
	3-4	RESERVED
	3-5	RESERVED
		RULE NUMBERS 3-6 THROUGH 3-10 ARE RESERVED.

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)
		*S-IVB RANGE SAFETY PROPELLANT DISPERSAL SYSTEM ARMS INADVERTENTLY AFTER INSERTION AND PRIOR TO SAFING
		*S-IVB LOX TANK PRESS IS GREATER THAN 30 PSI
		LOSS OF ATTITUDE CONTROL DURING TB3
		*S-IVB COMMON BULKHEAD DELTA PRESSURE EXCEEDS LIMITS
		*START BOTTLE GREATER THAN 1800 PSIA
		*PERFORM SPS MANEUVER TO A SAFE DISTANCE
	3-12	CSM SEPARATION FROM THE S-IVB (WITH LM EXTRACTION) WILL BE PERFORMED FOR---
		A. S-IVB NO-GO FOR TLI
		B. CSM NO-GO FOR TLI BUT GO FOR EARTH ORBIT MISSION
	3-13	TLI WILL BE INHIBITED FOR---
		INSUFFICIENT PROPELLANT REMAINS FOR ACHIEVING A 65,000 NM APOGEE ELLIPSE
		S-IVB ENGINE MAIN LOX VALVE FAILS TO CLOSE AT CUTOFF
		LOSS OF ATTITUDE CONTROL
		CONFIRMED ACTUATOR HARDOVER
		LOSS OF ENGINE HYDRAULIC FLUID
		MISALIGNMENT RATE BETWEEN THE IU AND IMU IS OUTSIDE LIMITS
		UNACCEPTABLE DIFFERENCES BETWEEN CMC AND IU PLATFORM VELOCITY COMPONENTS OR TOTAL VELOCITY AT INSERTION
		UNACCEPTABLE DIFFERENCE BETWEEN MSFN AND IU ORBITAL DECISION PARAMETERS

REV	ITEM	
	3-16	TLI WILL BE TERMINATED FOR --- A. PITCH OR YAW BODY RATES GREATER THAN 10 DEG./SEC B. ROLL BODY RATE GREATER THAN 20 DEG/SEC C. PITCH OR YAW ATTITUDE DIVIATIONS FROM NOMINAL PROFILES EXCEED 45 DEG.
	3-19	CSM TAKEOVER WILL BE PERFORMED FOR SATURN GUIDANCE REFERENCE FAILURE OR SATURN LOSS OF ATTITUDE CONTROL IN EARTH ORBIT OR DURING TLI.
		RULES 3-16 THROUGH 3-20 ARE RESERVED.

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. LOX TANK PRESSURE GREATER THAN 50 PSI
		RULE NUMBERS 3-22 THROUGH 3-29 ARE RESERVED.

REV	ITEM

! TRANSLUNAR COAST !

3-30 RESERVED

3-31 DURING THE LOI BURN, THE FLIGHT CREW WILL TAKE THE FOLLOWING ACTION---

A. TERMINATE THE BURN FOR THE CONDITIONS DEFINED BELOW

LOI ABORT MODES

MODE	TIME	DELTA VM	SPS LIMITS	TYPE ABORT
I	0-20	0-135	TIGHT	DPS 30 (CAN SLIP TO 2 HR)
I	20-40	135-290	TIGHT	DPS 30
I	40-90	290-650	TIGHT	DPS 30 + SPS/APS 2 1/2
II	90-144	650-1060	LOOSE	DPS 2 + DPS AND APS PC
II	144-170	1060-1270	LOOSE	DPS 2 + DPS PC
III	170-210	1270-1600	LOOSE	DPS PC
III	210-C/O	1600-C/O	TIGHT	DPS PC

LOI SPS SHUTDOWN RULES

TIGHT SPS LIMITS---

FUEL - OXID DELTA P GREATER THAN 20 PSI CONFIRMED BY LOW PC

PROP TANK PRESS LESS THAN 160 PSI CONFIRMED BY LOW PC

PC LESS THAN 80 PSI OR DECAYS 10 PSI DURING THE BURN

ANY BALL VALVE FAILS TO OPERATE, OR CLOSES PREMATURELY, AND THE OTHER BANK GN2 TANK PRESSURE HAS DECAYED TO 1500 PSI (SHUT DOWN DECAYING BANK FIRST). IF STILL BURNING, CONTINUE!

NOTE--- IF THE FIRST BANK SELECTED FAILS TO OPERATE UNDER G & N CONTROL, ATTEMPT TO START THAT BANK UNDER SCS CONTROL. IF THE BANK STARTS UNDER SCS CONTROL, CONTINUE THE BURN AND EVALUATE G & N STEERING. IF THE BANK FAILS TO START UNDER SCS CONTROL, INHIBIT LOI.

LOOSE SPS LIMITS---

PC LESS THAN 70 PSI CONFIRMED BY OTHER CUES

PROP TANK PRESS LESS THAN 115 PSI CONFIRMED BY LOW PC

PHYSIOLOGICAL INDICATIONS OF ERRATIC ENGINE PERFORMANCE

(VIBRATION, POPPING, ETC)

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

1. GBN 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 INADVERTENT SPS SHUTDOWN.

RULES NUMBER 3-32 THROUGH
3-37 ARE RESERVED.

REV	ITEM	
		---------- ' LUNAR ORBIT ' ----------
	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 BE SCHEDULED, AS NEEDED, BETWEEN LOI2 AND UNDOCKING TO CORRECT DISPERSIONS.
		RULE NUMBERS 3-39 THROUGH 3-44 ARE RESERVED.

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. DOI MAY BE ATTEMPTED ONE REV LATER DEPENDING ON AN ANALYSIS OF THE PROBLEM.

3-46 DOI TERMINATION

THE FLIGHT CREW WILL TERMINATE DOI FOR THE FOLLOWING---

A. ATTITUDE DEVIATIONS GREATER THAN 5 DEG.

B. RATES GREATER THAN 5 DEG./SEC.

C. PNGS DELTA VG NEGATIVE OR OVERBURN OF 2 SECONDS AND AGS DELTA V INDICATES AN OVERBURN OF GREATER THAN 2 FPS.

D. DPS FUEL OR OXIDIZER ULLAGE PRESSURE LESS THAN 123 PSIA.

3-47 DOI TO PDI

A. DOI RESIDUALS OF LESS THAN 5 FPS WILL NOT BE TRIMMED.

B. FOLLOWING DOI CUTOFF---

IF PNGS RESIDUALS (ANY AXIS) ARE LESS THAN 10 BUT MORE THAN 5 FPS. TRIM PNGS X-AXIS RESIDUALS TO 5 FPS AND

1. IF AGS AGREES TO LESS THAN 2 FPS - CONTINUE TO PDI

2. IF AGS DISAGREES BY MORE THAN 5 FPS AND RR CONFIRMS AGS - PERFORM DIRECT ABORT

3. IF AGS DISAGREES BY MORE THAN 2 FPS BUT LESS THAN 5 FPS AND AT 30 MINUTES AFTER DOI THE RR AGREES WITH AGS - PERFORM NO PDI +12 ABORT

C. DIRECT RETURN TO THE CSM WILL BE PERFORMED FOR THE FOLLOWING REASONS (NOTE CAPABILITY REMAINS TILL APPROXIMATELY DOI + 10 MIN).

1. LM CONDITIONS

(A) ECS

(1) LOSS OF BOTH COOLANT LOOPS

(2) FIRE, SMOKE, OR FREE GLYCOL IN CABIN OR SUIT

(B) GSC

PNGS FAIL

RULE 3-48 IS RESERVED

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. PDI MAY BE ATTEMPTED 1 REV LATER, DEPENDING ON AN ANALYSIS OF THE PROBLEM.

3-50 PDI TO LO GATE

POWERED DESCENT WILL BE ABORTED FOR THE FOLLOWING---

A. LR DATA IS REQUIRED FOR LANDING - NO LR DATA BY 10 K FT - ABORT.

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

2. LR DATA ACCEPTED AND CONVERGED CONTINOUS TO P-64 - CONTINUE MISSION IF LOSS OF LOCK OCCURS IN P-64.

3. LR DATA ACCEPTED AND CONVERGED WITH SUBSEQUENT DROPOUT - CONTINUE TO P-64.

(A) LANDING RADAR REGAINED IN P-64.

(1) DELTA H LESS THAN 1000 FT BETWEEN PGNS AND LR - CONTINUE MISSION.

(2) DELTA H GREATER THAN 1000 FT BETWEEN PGNS AND LR - ABORT.

(B) LR NOT REGAINED AT P-64 - ABORT.

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

(A) DELTA H LESS THAN 1000 FT BETWEEN PGNS AND LR - CONTINUE MISSION.

(B) DELTA H GREATER THAN 1000 FT BETWEEN PGNS AND LR - ABORT.

B. PGNS ALTITUDE LESS THAN 22,000 FEET AND PNGS NAVIGATION ERRORS, CONFIRMED BY MSFN OR DOPPLER RESIDUALS, THAT CAUSE THE AGS-PGNS RADIAL VELOCITY DIFFERENCE TO EXCEED MINUS 10 FPS, PRIOR TO LANDING RADAR ALTITUDE INCORPORATION AND CONVERGENCE (A MINUS VELOCITY DIFFERENCE INDICATES THAT THE AGS TRAJECTORY IS LOWER THAN THE PNGS TRAJECTORY).

C. PNGS NAVIGATION ERRORS, CONFIRMED BY MSFN OR DOPPLER RESIDUALS, THAT RESULT IN THE FOLLOWING AGS-PNGS VELOCITY DIFFERENCES---

DELTA X DOT (DOWNRANGE) GREATER THAN +/- 10 FPS
DELTA Y DOT (CROSSRANGE) GREATER THAN +/- 20 FPS
DELTA Z DOT (RADIAL) GREATER THAN +/- 10 FPS

D. PGNS ALTITUDE LESS THAN 10,000 FEET AND PNGS NAVIGATION ERRORS, CONFIRMED BY DOPPLER BUT NOT BY AGS, CAUSE THE MSFN-PGNS RADIAL VELOCITY DIFFERENCE TO EXCEED MINUS 20 FPS PRIOR TO LANDING RADAR ALTITUDE INCORPORATION AND CONVERGENCE.

E. PNGS NAVIGATION ERRORS CONFIRMED BY DOPPLER RESIDUALS BUT NOT BY AGS, THAT RESULT IN THE FOLLOWING MSFN-PNGS VELOCITY DIFFERENCES---

DELTA Y DOT (CROSSRANGE) GREATER THAN +/- 200 FPS.
DELTA Z DOT (RADIAL) GREATER THAN +/- 20 FPS.

NOTE---RULES C AND E ARE INDEPENDENT OF ANY TYPE OF LANDING RADAR UPDATE. FOR RULES B AND C, SWITCHOVER TO AGS WILL BE PERFORMED.

REV	ITEM	
		F. COMMANDED THRUST INCREASING PRIOR TO THROTTLE DOWN OR P63 TGO=80 SEC.
		G. NO LANDING SITE VISIBILITY BY P64 PLUS 60 SEC.
		H. NO THROTTLE RECOVERY BY P63/P64 PROGRAM SWITCH PLUS 15 SEC.
		I. FAILURE TO ACHIEVE PTP BY NOMINAL TIG +31 SEC. (ABORT AT GTC DIVERGENCE).
		J. FAILURE TO ENTER P64 WHEN TGO EQUALS 60 SECONDS.
		K. THE FOLLOWING PNGS ALARMS---20109,00214, 20430,20607,21103,01107, 21204,21302,21501,00402 (CONTINUING).
		NOTE---THE CREW WILL BE ADVISED AND CONSIDERATION WILL BE GIVEN TO TERMINATION OF POWERED DESCENT IF THE TIME BIASED DPS ABORT BOUNDARY IS VIOLATED.
	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.

REV	ITEM	

ASCENT

3-61 ASCENT

A. GUIDANCE SWITCHOVER TO AGS WILL BE PERFORMED FOR ---

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

2. PGNS NAVIGATION ERRORS, DURING ASCENT OR FOLLOWING DESCENT ABORT, THAT RESULT IN ANY OF THE FOLLOWING CONDITIONS---

(A) AGS PREDICTED HP AT INSERTION LESS THAN 40,000 FT

(B) AGS PREDICTED HA AT INSERTION GREATER THAN TARGET VALUE PLUS 40 NAUTICAL MILES.

(C) AGS PREDICTED INSERTION WEDGE ANGLES GREATER THAN 1.0 DEG.

3. CONFIRMED PNGS NAVIGATION ERRORS THAT RESULT IN THE FOLLOWING MAFN PNGS VELOCITY DIFFERENCES

DELTA VX GREATER THAN +/- 26 FPS
DELTA VY GREATER THAN +/- 20 FPS
DELTA VZ GREATER THAN +/- 37 FPS

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

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

1. PGNS PREDICTED INSERTION HP LESS THAN 30,000 FT.

2. PGNS PREDICTED INSERTION HA GREATER THAN TARGET VALUE PLUS 40 NM.

3. PGNS PREDICTED INSERTION WEDGE ANGLE GREATER THAN 1.0 DEGREE.

RULE 3-62 THROUGH
3-79 ARE RESERVED.

REV	ITEM	
		ALL PHASES
	3-80	A NON-CRITICAL SPS MANEUVER WILL BE INHIBITED FOR---
		A. GSC
		1. LOSS OF TWO TVC SERVO LOOPS
		2. LOSS OF THREE TVC CONTROL MODES (GSN: SCS AUTO: AND MTVC - RATE CMD IF UNDOCKED)
		3. LOSS OF THREE TVC CONTROL MODES (GSN: SCS AUTO: AND MTVC - ACCEL CMD IF DOCKED)
		B. SPS
		1. LOSS OF BOTH GN2 BOTTLES (LESS THAN 400 PSI)
		2. FUEL OR OXIDIZER FEEDLINE TEMP LESS THAN 40 DEG. F.
		3. FLANGE TEMP GREATER THAN 480 DEG. F. ON PREVIOUS BURN
		4. CHAMBER PRESSURE LESS THAN 70 PSI ON PREVIOUS BURN
		5. FUEL/OXIDIZER DELTA P GREATER THAN 20 PSI
		6. LOSS OF ULLAGE CAPABILITY FOR FIRST BURN SUBSEQUENT TO DOCKED SPS BURN: OR AFTER STORAGE TANKS EMPTY
		7. FIRST BURN SUBSEQUENT TO DOCKED SPS WAS LESS THAN 40 SEC. CONTINUOUS
		8. PRESSURE IN EITHER FUEL OR OXIDIZER TANK LESS THAN 140 PSI
		9. DELTA V REMAINING LESS THAN MANEUVER PLUS DEORBIT REQUIREMENT

REV	ITEM
	3-01

THE FOLLOWING MANEUVERS WILL BE TERMINATED AFTER MANUAL TAKEOVER; OR COMPLETED BY SCS (MTVC OR AUTO) OR AGS TAKEOVER FOR---

MANEUVER	EXCURSION	RATES	ERRORS	TERMINATE AFTER MANUAL TAKEOVER (NON CRITICAL)	COMPLETE BY SCS OR AGS TAKEOVER (CRITICAL)
MODE III	5	5	5		X
MODE IV	5	5	5		X
APOGEE KICK	5	5	5		X
MCC 1 (SPS OR SPS)	10	10	10	X	
MCC 2 (SPS OR DPS)	10	10	10	X	
MCC 3 (SPS OR DPS)	10	10	10	X	
MCC 4 (SPS OR DPS)	10	10	10	X	
LOI 1 (SPS OR DPS)	10	10	10		X
LOI 2 (SPS OR DPS)	10	10	10	X	
DOI	5	5	5	X (TERM THEN STABILIZE)	
LOPC					
CSM ONLY OR ASC STG. ONLY	10	10	10	X	
UNSTAGED LM	5	5	5	X	
TEI	10	10	10		X
MCC 3,6,7, (FOR ENTRY COORIDOR CONTROL	10	10	10		X
EARTH DEORBIT	10	10	10		X
TRANSLUNAR ABORT	10	10	10		X

REV	ITEM	
	3-83	IN GENERAL THE FOLLOWING MANEUVERS WILL BE TRIMMED TO THE FOLLOWING RESIDUAL VALUES---

A. MANEUVER

	BODY AXIS X	Y	Z
MCC1 (1)	0.2 FPS	NO	NO
MCC2 (2)	0.2 FPS	NO	NO
MCC3 (3)	0.2 FPS	NO	NO
MCC4	1 FPS	NO	NO
LOI1	NO	NO	NO
LOI2	1 FPS	NO	NO
DOI (4)	NO	NO	NO
LOPC1	NO	NO	NO
ASCENT	REAL TIME CALL OUT		
CSI	NULL	NULL	NULL
PC	NULL	NULL	NULL
COH	NULL	NULL	NULL
TPI	NULL	NULL	NULL
LOPC2	NO	NO	NO
TEI	0.2 FPS	NO	0.2 FPS
MCC5	0.2 FPS	NO	NO
MCC6	0.2 FPS	NO	NO
MCC7	0.2 FPS	NO	NO
EARTH DEORBIT	0.2 FPS	0.2 FPS	0.2 FPS
TRANSLUNAR ABORT	NO	NO	NO

(1), (2), (3) IF X LESS THAN OR EQUAL TO 2 FPS, TRIM TO 0.2 FPS--- IF X GREATER THAN 2 FPS, DO NOT TRIM

(4) SPECIFIC MISSION RULE REFERENCE 3-47

B. DOCKED DPS WILL NOT BE TRIMMED.

REV	ITEM	
	3-84	THE FOLLOWING MANEUVERS WILL BE MANUALLY TERMINATED AFTER VIOLATION OF THESE OVERBURN CRITERIA---

A. TLI - 8 SEC AND V (PNGS) EQUALS V (PAD).

B. LCI1

1. SPS- 10 SEC

2. DPS - 10 SEC AND DELTA V (AGS) GREATER THAN 10 FPS

C. LCI2 - 1 SEC

D. DOI - PNGS DELTA VG NEGATIVE OR 2 SECOND OVERBURN AND AGS DELTA VG INDICATES AN OVERBURN OF GREATER THAN 2 FPS.

E. TEI

1. OVERBURN

(A) SPS - 2 SEC AND DELTA VC INDICATING A 40 FPS OVERBURN

(B) DPS - 10 SEC AND DELTA V (AGS) GREATER THAN 2 FPS

2. UNDERBURN

(A) SPS - FOR A GEN C/O OCCURING GREATER THAN 3 SEC EARLY AND THE DELTA VC GREATER THAN 50 FPS, SWITCH TO SCS AUTO AND RESTART SPS

F. SPS MCC - 1 SEC

RULES 3-85 THROUGH 3-89 ARE RESERVED.

CSM RECOVERED CRITERIA

GROUND RULE ITEM	EARTH ORBIT		TLC			LUNAR ORBIT (BEFORE UNDOCKING)		UNDOCKING	DOI	POWERED DESCENT				LUNAR STAY			LUNAR ORBIT (POST INDOC)
	CONF DOCKT	CONF L.O.	TLI	PSALE	CONF TLC	LOI	CONF L.O.			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	CONF L.O.
ECS																	
CABIN INTEGRITY	(10) CABIN INTEGRITY						CABIN INTEGRITY			(2)					CABIN INTEGRITY		
NO FIRE OR SMOKE IN CABIN	NO FIRE OR SMOKE IN CAB						NO FIRE OR SMOKE IN CABIN			(2)					NO FIRE/SMOKE IN CAB		
NO O_2 MANIFOLD LEAKS	(10) NO O_2 LEAKS						NO O_2 MANIFOLD LEAKS										NO O_2 MANIFOLD LEAKS
MAN O_2 REGULATORS	(10) 1 OF 2		(3) BOTH				1 OF 2										1 OF 2
ECS COOLANT LOOPS		1 OF 2 (5)	BOTH			BOTH		PRIMARY							1 OF 2		PRIMARY
ECS RADIATORS		1 OF 2 (5)	BOTH			BOTH		(1) PRIMARY (1)							1 OF 2		PRIMARY
ECS GLYCOL PUMPS																	
SUIT INTEGRITY	5 (10)																
NO GLYCOL LEAK		NO LEAK					NO GLYCOL LEAK								NO GLYCOL LEAK		
NO EXCESSIVE CABIN HUMIDITY		NO HUMID				NO EXCESSIVE CABIN HUMIDITY				(2)					NO EXCESSIVE CABIN HUMIDITY		
POTABLE H2O TANK		NOP															POT
WASTE H2O TANK																	
SUIT COMPRESSORS	(10) 1 OF 2		BOTH				1 OF 2			(2)					1 OF 2		
SUIT CIRCUIT	(10) SUIT CIRCUIT						SUIT CIRCUIT			(2)					SUIT CIRCUIT		
OVERBOARD VENTS		1 OF 3				1 OF 3											1 OF 3
CSM																	
O_2 TANKS		1 OF 2	BOTH					BOTH			1 OF 2				BOTH		
H_2 TANKS		1 OF 2	BOTH					BOTH			1 OF 2				BOTH		
EPS																	
FUEL CELLS	2 OF 3	2 OF 3	ALL		(6)	(6) ALL (6)		(6) ALL	(6)	2 OF 3	1 OF 3			(6)	ALL (6)	(6)	(6)
CRYO HEATERS	2 OF 3	2 OF 3	ALL		(6)	(6) ALL (6)		(6) ALL		(6)				(6)	ALL (6)	(6)	(6)
MAIN BUSES	1 OF 2	BOTH						BOTH		(2)					BOTH		
BATTERY BUSES	1 OF 2	BOTH						BOTH		(2)					BOTH		
AC BUSES	1 OF 2 (3)	BOTH						BOTH		(2)					BOTH		
BAT RELAY BUS		BAT RELAY BUS			BAT RELAY BUS										BAT RELAY BUS		
HEATERS	1 OF 2 (3)	2 OF 3						2 OF 3		(2)					2 OF 3		
AC & DC 1 AND 2	1 OF 2	BOTH						BOTH		(2)					BOTH		
DOCKING																	
DOCKING LATCHES						9 OF 12		(8) 2 OF 4									
GN_2 BOTTLES																	
SPS																	
SMJC NOT ACTIVATED		SMJC NOT ACT					SMJC NOT ACTIVATED			(2)				SMJC NOT ACTIVATED			
SEMI-CRITICAL SYSTEMS		BOTH			BOTH												

1. BASED ON AMOUNT OF WATER AVAILABLE, CONSIDERATION WILL BE GIVEN TO CONTINUING MISSION WITH SECONDARY RADIATOR AND PRIMARY EVAPORATOR
2. REQUIREMENT EXISTS ONLY IF DESCENT STAGE CAN BE RETAINED POST TEI
3. IF ONE MANIFOLD HAS FAILED OPEN AND THE OTHER IS FUNCTIONING NORMALLY, TLI WILL BE PERFORMED
4. DELETED
5. MUST BE IN SAME COOLANT LOOP
6. BASED ON FAILURE MODE, CONSIDERATION WILL BE GIVEN TO CONTINUING
8. BASED ON FAILURE MODE, CONSIDERATION WILL BE GIVEN TO UNDOCKING WITH ONE GN2 BOTTLE REMAINING IN AN OPERABLE SYSTEM
9. MODE I AND II ONLY, 6 THEREAFTER
10. MUST HAVE CABIN INTEGRITY OR VIABLE SUIT LOOP. ITEMS MARKED BY * ARE REQUIRED TO MAINTAIN VIABLE SUIT LOOP

LEGEND: NO REQUIREMENT

C500 GNC GO CRITERIA

GO/NO-GO ITEM	EARTH ORBIT		TLC			LUNAR ORBIT (BEFORE UNDOCKING)			UNDOCK	DOI		POWERED DESCENT				LUNAR STAY			LUNAR ORBIT (P RND 2)
	CONF DEORBIT	CONF L.O.	TLI	TMLC	CONF TLC	LOI	CONF LOI	CONF L.O.		DOI	CONF DOI	PDI	PDI TO PDI +5	PDI+5 TO LD GATE	LD GATE TO T/D	STAY W/O EVA	2-MAN EVA	3-MAN EVA	CONF L.O.
GNC SYS																			
DEORBIT CAPABILITY																			
AUTO ATTITUDE CONTROL				3 ARIS			N/A		3 ARIS			3 ARIS					2 ARIS		3 ARIS
RATE DAMPING				3 ARIS			N/A		3 ARIS			3 ARIS					2 ARIS		3 ARIS
UNDECP RCS				3 ARIS			N/A		3 ARIS			3 ARIS					2 ARIS		3 ARIS
BRAKS P.P		1 OF 2				1 OF 2			1 OF 2			1 OF 2					1 OF 2		
BRAKS B		1 OF 2				1 OF 2													1 OF 2
FDAI		1 OF 2				1 OF 2			1 OF 2			1 OF 2							1 OF 2
THC			THC				N/A		THC										
RHC			1 OF 2			1 OF 2	N/A		1 OF 2			1 OF 2							1 OF 2
EBPS																			2 MS
CMC			CMC			CMC			CMC			CMC					CMC		
MSS			MSS			MSS			MSS			MSS					MSS		
UPS			UPS			UPS	N/A		PROPS OR UPS										
OPTICS DAC			O-DAC			O-DAC			O-DAC			O-DAC					O-DAC		
HO VALVE AND DRIVE							N/A												
PWC SERVO LOOP	1 OF 2		BOTH			BOTH	1 OF 2		BOTH			BOTH					BOTH		
DIAM			1 OF 2			1 OF 2			1 OF 2			1 OF 2					1 OF 2		
SPS																			
PROP TANK PRVD LEAK		PROP				PROP	>1MP		PROP TANK			PROP TANK					PROP TANK >1MP		
GAS TANK PRVD LEAK		GAS	GAS			1 OF 2			BOTH			1 OF 2					BOTH		
BALL VALVE BANK	1 OF 2		BOTH			BOTH	①		BOTH			BOTH					BOTH		
PEDOUNE TEMP >400°F		>400°F				>400°F	N/A		>400°F			>400°F					>400°F		
PROP ΔP < 20 PSI		< 20							< 20			< 20					< 20		
PLANES TEMP < 400°F	< 400°F		N/A						<400										
PC > 20 PSI	> 20		N/A			> 20			>20										
ULLAGE CAPABILITY			BOTH			1 OF 2	N/A		1 OF 2			1 OF 2							
HE TANK PRVD LEAK			HE TANK			HE TANK			HE TANK										
SUBACS																			
HE TANK PRVD LEAK		3 OF 4	ALL			ALL		3 OF 4	ALL	1 OF 4		3 OF 4					3 OF 4		
HE LEAK BELOW PRVD VLV		3 OF 4	ALL	3 OF 4		ALL		3 OF 4	ALL	1 OF 4		3 OF 4					3 OF 4		
PRC TEMP >5°F		3 OF 4	ALL	3 OF 4		ALL		3 OF 4	ALL	1 OF 4		3 OF 4					3 OF 4		ALL
PHRS TEMP		ALL	②																②
LM RCS																			
HE TANK PRVD LEAK	1 OF 2		BOTH						1 OF 2			1 OF 2					1 OF 2		BOTH
MANIFOLD PRVD LEAK	1 OF 2		BOTH						1 OF 2			1 OF 2					1 OF 2		BOTH
NOT ARMED			NOT ARMED																NOT ARMED

① 0 TO 650 PSI - 1 BANK - OTHERWISE >1500 PSI
650 TO 1400 PSI - 1 BANK
1400 TO C/O - 1 BANK - OTHERWISE >1100 PSI

② REQUIRES 3 ARIS ATTITUDE CONTROL AND TRANSLATION 3 ARIS, ONE LATERAL ARIS MAY BE DEGRADED

LEGEND: NO REQUIREMENT

LM TELMU GO CRITERIA
10/31/69

GO/NO-GO ITEM		UNDOCK	DOI		POWERED DESCENT				LUNAR STAY			RENDEZVOUS LM ACTIVE		DOCKING
			DOI	CONT DOI	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	CSI/CDH	TPI/TPF	
PYRO														
1. PYRO SYSTEMS		BOTH			BOTH					BOTH				
ELECTRICAL														
1. CDR AND LMP BUS (1)		BOTH			BOTH								1 OF 2	
2. DC FEEDERS (1)(2)	DESCENT	BOTH					BOTH							
	ASCENT	BOTH			BOTH								1 OF 2	
3. BATTERIES (7)(3)	DESCENT	2 OF 4			2 OF 4					2 OF 4				
	ASCENT	BOTH			BOTH					BOTH			1 OF 2	
4. INVERTERS		1 OF 2			1 OF 2									
5. AC BUSES		BUS A			BUS A OR B									
ENVIRONMENTAL														
1. SUIT/CABIN INTEGRITY		SUIT AND CABIN			SUIT AND CABIN			SUIT	SUIT AND CABIN					
2. SUIT FANS		BOTH			1 OF 2					BOTH				
3. O_2 DEMAND REGS		1 OF 2			1 OF 2						1 OF 2 (4)			
4. H_2O SEPARATORS AND LCG COOLANT LOOP		BOTH H_2O SEPS OR 1 OF 2 H_2O SEPARATORS + LCG			BOTH H_2O SEPS OR 1 OF 2 H_2O SEPARATORS + LCG				BOTH H_2O SEPS OR 1 OF 2 H_2O SEPS + LCG					
5. O_2 TANKS (3)	DESCENT	ANY			ANY					DESCENT				
	ASCENT	2 OF 3			2 OF 3				1 OF 2					
6. COOLANT LOOPS	PRIMARY	BOTH			BOTH									
	SECONDARY			(6)						BOTH		1 OF 2		
7. H_2O FEED PATHS		PRIMARY		(6)	PRIMARY					PRIMARY		PRI OR SEC		
8. H_2O TANKS (3)	DESCENT	DES					ANY			DES				
	ASCENT	BOTH			BOTH		2 OF 3			BOTH		1 OF 2		
9. NO FIRE, SMOKE OR GLYCOL IN SUIT OR CABIN				(6)										

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

(2) A SHORTED DC FEEDER WILL ALWAYS BE REASON FOR ABORTING THE LANDING MISSION. ONE OPEN DESCENT FEEDER WILL NOT BE REASON FOR ABORTING THE LANDING MISSION; HOWEVER, A NEXT BEST L/O IS REQUIRED

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

(4) ASSUMES CREWMAN IN LM OPERATING ON LM ECS

(5) RESERVED

(6) PERFORM DIRECT RETURN

(7) THE TWO REMAINING DESCENT BATTERIES MUST FEED SEPARATE BUSES DURING LUNAR STAY ONLY

LEGEND: RETAIN DESCENT STAGE ALAP; NO REQUIREMENT

LM CONTROL GO CRITERIA
10/31/69

GO/NO GO ITEM	UNDOCKING	DESCENT ORBIT		POWERED DESCENT					LUNAR STAY			RIDE LM ACTIVE		DOCKING
		DOI	CONT DOI	PDI	PDI TO PDI +5	PDI +5 TO IN GATE	IN GATE TO LOGATE	LOGATE TO TD	STAY WITHIN EVA	2 MAN EVA	1 MAN EVA	CSM/CSM	TPI, TPF	
GNC														
1. PGNS				PGNS TO AGS FT										
2. AGS	AGS (4)	AGS (4)			AGS (4)							AGS OR PGNS		
3. 3 AXIS AUTO ATT CNTR	REDNT (4)	REDNT (4)	PGNS		REDNT (4)		PGNS			PGNS			AGS OR PGNS	
4. 3 AXIS CONTROL	REDNT	REDNT	3 AXIS		REDNT		3 AXIS			REDNT			3 AXIS	
5. ACA	1 ACA	1 ACA				1 ACA								1 ACA
6. 3 AXIS TRANSLATION	3 AXIS + AUTO ULLAGE			ABORT HIGH ATC								1 AXIS	1 AXIS	
7. TTCA	1 TTCA	1 TTCA			1 TTCA		(5)						1 TTCA	
8. FDAI - ATT/RATES/ERRORS	CREW OPTION	CREW OPTION				CREW OPTION								
9. THROTTLE RESPONSE IN 40 SEC														
10. VHF RNG/CSM DPT TOK	ONE	ONE												
11. HR TRANSPONDER	ON	ON												
12. AOT	AOT (1)													
13. LR	LR	LR			LR									
14. RPS AUTO ON														
15. REDUNDANT ASC ENG ON/OFF														
16. PITCH AND ROLL GDA TRIM	PITCH AND ROLL GDA TRIM WITHIN CONSTR				NO IMPINGEMENT LIMITS				REDNT AVAILABLE					
17. MAN THROTTLE	MAN THROTTLE				MAN THROTTLE		(5)							
18. AUTO THROT	AUTO (3)	AUTO (3)				AUTO (3)								
RPS														
1. PU OR INLET ULLAGE PRESS PSI	<65	>30/>30		>1/>125										
	>65		N/A											
2. PU OR AP PU HIGH/OR HIGH ≤25 PSID	<FTP	N/A		N/A		>100/>100								
	FTP		N/A											
3. PROP TEMP >50° <90°														
4. PROP AT	<-10/<-25			<100°										
5. PROP QTY >LOW LEVEL/PA														
6. SHE AVAIL PRIOR 6:30														
7. VENT WITHIN 5 MIN														
8. FU/OR HIGH 60-13 (2)	N/A													
9. 30% EROSION EXCEEDED	N/A													
APS														
1. NO PROPVIE LEAKS				NO PROPELLANT LEAKS										
2. FU/OR INLET PRESS >60 AND <220									IMMEDIATE CAPCOM					
3. FU/OR AP (EITHER HIGH) <90														
4. PROPELLANT TEMP >50° AND <90°												APS NOT USED FOR RIDE		
5. PROP AT <100°														
RCS														
1. NO PROP LEAKS		NO PROPELLANT LEAKS							NO PROPELLANT LEAKS					
2. FU/OR MANIF PRESS >100 PSI	A AND B		A OR B		A AND B		A OR B			A AND B			A OR B	
3. PROP TEMP >40°F <100°F	A AND B				A AND B		A OR B			A AND B			A OR B	
4. 3 AXIS ATT CNTR CAPABILITY	REDUNDANT		3 AXIS		REDUNDANT		3 AXIS			REDUNDANT			3 AXIS	
5. 3 AXIS TRANSLATION	3 AXIS												3 AXIS	
6. NO IMPINGEMENT LIMITS EXCEEDED	NO IMPINGEMENT				NO IMPINGEMENT									

1. AOT REQUIRED UNTIL FIRST POST ALIGNMENT
3. MANUALLY FOLLOW CMD THRUST METER IF POSSIBLE
4. CONSIDERATION WILL BE GIVEN TO CONTINUING BASED UPON THE FAILING MODE
5. CONSIDERATION WILL BE GIVEN TO CONTINUING BASED UPON NOMINAL TRAJECTORY AND GUIDANCE

(2) MSFN WILL EVALUATE CAPABILITY TO LAND WITH RESPECT TO PROPELLANT REMAINING

LEGEND: NO REQUIREMENT

COMMUNICATIONS/INSTRUMENTATION GO CRITERIA
10/31/69

GO/NO-GO ITEM	EARTH ORBIT		TLC			LUNAR ORBIT			UNDOCKING	DOI		POWERED DESCENT				LUNAR STAY			RENDEZVOUS LM ACTIVE		LUNAR ORBIT POST RENDEZVOUS
	CONT BOOST	CONT E.O.	TLI	TD&E	CONT TLC	LOI	CONT LOI	CONT L.O.	NOMINAL MISSION	DOI	CONT DOI	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	CSI/CDH	TPI/TPF	CONT L.O.
USB 2-WAY VOICE COMM		(1)	CSM			CSM		CSM OR LM	CSM AND LM			CSM AND LM	(2) LM (2)			CSM OR LM (3)	CSM OR LM (3)	CSM OR LM (3)			
VHF COMM LM/CSM									SIMPLEX OR DUPLEX												CSM
VHF COMM LM/EVA																	SIMP OR DUP	DUPLEX			
VHF COMM EVA/EVA																	DUPLEX				
MSFN/EVA VOICE																	EITHER CREWMAN				
CRITICAL INSTRUMENTATION		CSM				CSM		CSM	LM AND CSM				LM			LM AND CSM			LM		CSM
LM TELEMETRY									LBR			LBR (4)	(4)			LBR					
CSM TELEMETRY		HBR OR LBR			HBR OR LBR				HBR OR LBR							HBR OR LBR					
CSM SCE			SCE			SCE															HBR OR LBR

(1) VHF IS ACCEPTABLE
(2) CSM RELAY TO LM IS ACCEPTABLE
(3) LM RELAY TO CSM IS ACCEPTABLE
(4) ADEQUATE DATA TO MAKE FINAL GO/NO GO TO CONTINUE POWERED DESCENT

LEGEND: NO REQUIREMENT

EMU GO CRITERIA

GO/NO-GO ITEM	UNDOCKING	DOI		POWERED DESCENT				LUNAR STAY (2)		
		DOI	CONT DOI	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
CRITICAL INSTRUMENTATION									← EMU →	
LCG/LTL COOLING									2 OF 2	1 OF 2
PRIMARY O_2 SUPPLY(S)	← (1) →								2 OF 2	1 OF 2
PLSS O_2 PRESSURE REG(S)									2 OF 2	1 OF 2
PLSS FAN(S)									2 OF 2	1 OF 2
PLSS BATTERY(S)									2 OF 2	1 OF 2
EMU PRESSURE INTEGRITY									2 OF 2	1 OF 2
OPS O_2 BOTTLE(S)	← (1) →								2 OF 2	1 OF 2
OPS PRESSURE REG(S)									2 OF 2	1 OF 2

(1) NOMINALLY BOTH OPS'S SOURCE PRESSURES WILL BE CHECKED OUT PRIOR TO UNDOCKING - SHOULD ONE OPS SOURCE PRESSURE FAIL TO MEET THE OPS GO/NO-GO CRITERIA AS DEFINED IN RULE 3-103, A CHECK OF POS PRESSURE WILL BE MADE ON A PLSS TO FULFILL THE RQMT FOR TWO LIFE-SUPPORT UNITS

(2) SUFFICIENT PLSS AND/OR OPS CONSUMABLES WILL BE RETAINED AT LM LIFTOFF TO SUPPORT A 30 MINUTE CEVA

LEGEND: NO REQUIREMENT

REV	ITEM	

CONSUMABLES

3-90 SPS

A. AFTER TDSE AND THE FIRST DOCKED SPS MCC, THE DELTA V REQUIRED TO CONTINUE WITH A LUNAR MISSION IS 9300 FPS (CSM UNDOCKED CAPABILITY).

B. THE DELTA V REQUIRED FOR LOI GO IS LOI3 (FUNCTION OF LAUNCH DAY AND LAUNCH AZI +190 FPS (LOI2, DOCKED) +2960 FPS (TEI AND TEC MCC'S).

C. THE DELTA V REQUIRED FOR GO FOR UNDOCKING IS 4039 FPS. THIS DELTA V INCLUDES---

700 FPS, LM RESCUE

375 FPS, LOPCE

2800 FPS, TEI (APPROXIMATELY 70 HR RETURN)

160 FPS, 3 SIGMA MCC BASED ON SCS CONTROLLED TEI

4035 FPS

3-91 SM RCS

A. THE CSM RESCUE REDLINE AT EARTH LAUNCH IS 932 LB. THE REDLINE INCLUDES NOMINAL USAGE UP TO LM JETTISON, NOMINAL TEI AND TEC USAGE, AND FULL CSM RESCUE CAPABILITY (INCLUDING FOUR 11-SECOND ULLAGES AND CSM BRAKING). RCS MIDCOURSE CORRECTIONS AND THE CSM SOLO PHOTOGRAPHY USAGE ARE NOT INCLUDED IN THE RESCUE REDLINE.

THE RESCUE REDLINE IS ALSO A LINE OF GO/NO GO POINTS FOR THE NOMINAL MISSION (E.G., UNDOCKING GO/NO GO BASED ON RCS PROPELLANT IS THE RESCUE REDLINE VALUE AT THE GET OF UNDOCKING).

B. THE REDLINE FOR TDSE IS 650 LB. AND IS CONSISTENT WITH A CSM ONLY LUNAR ORBIT MISSION (C PRIME RCS BUDGET).

C. THE SMRCS PROPELLANT REQUIRED AT MCC2 TO COMMIT TO THE HYBRID TRAJECTORY IS 380 LB. THIS REDLINE INCLUDES---

330 LB. LOI REDLINE
50 LB. NOMINAL USAGE, MCC2 TO LOI

D. THE SMRCS PROPELLANT REQUIRED FOR LOI COMMITMENT IS 330 LB. THIS REDLINE INCLUDES---

140 LB. LUNAR ORBIT REDLINE
135 LB. FIRST DAY DOCKED LUNAR ORBIT ACTIVITIES
50 LB. 1 DAY CSM SOLO PHOTOGRAPHY

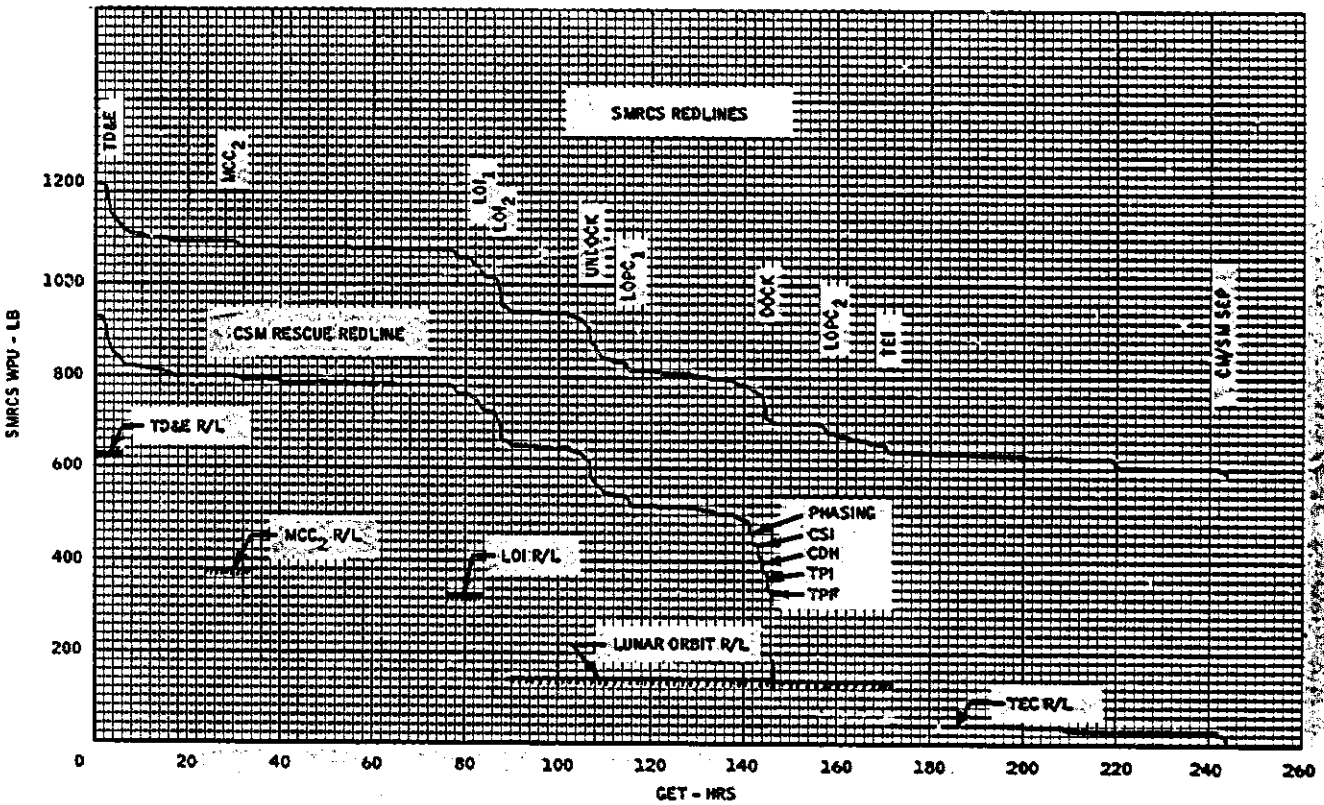
E. VIOLATION OF THE LUNAR ORBIT REDLINE WILL RESULT IN TERMINATION OF LUNAR ORBIT ACTIVITIES. PRIOR TO LM JETTISON, THE LUNAR ORBIT REDLINE IS 140 LB. AND INCLUDES---

80 LB. LM SEP, 2 REVS LUNAR ORBIT, TEI ULLAGE, NOMINAL TEC USAGE
65 LB. 20 FPS TEMC (BASED ON 30 MIN TEI CUTOFF)

AFTER LM JETTISON, THE LUNAR ORBIT REDLINE IS 135 LB. AND INCLUDES THE ABOVE ALLOWANCES LESS LM SEP.

F. THE TEC REDLINE IS THE MINIMUM RCS QUANTITY TO INSURE SAFE RETURN. RCS MIDCOURSES ARE NOT INCLUDED IN THE REDLINE. AT TEI CUTOFF, THE REDLINE VALUE IS 45 LB.

RULE NUMBERS 3-92 AND 3-93 ARE ARE RESERVED.


SMRCS REDLINES
CSM RESCUE REDLINE
TD&E
MCC2
LOI1
LOI2
UNLOCK
LOPC3
DOCK
LOPC2
TEI
CM/SM SEP
TD&E R/L
MCC2 R/L
LOI R/L
PHASING
CSI
CDH
TPI
TPF
LUNAR ORBIT R/L
TEC R/L
SMRCS WPU - LB
GET - HRS
0
200
400
600
800
1000
1200
20
40
60
80
100
120
140
160
180
200
220
240
260

REV	ITEM
	3-96

CSM BATTERY ENERGY AND CRYOGENIC O2 AND H2

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

	LAUNCH	LOI	UNDOCK	P.C.I
BATT AMP-HOURS REMAINING **	86.2	73.4	66.7	63.2
BATT AMP-HOURS REMAINING ***	59.1	45.8	42.6	41.0
O2 (PERCENT EACH TANK)	84.5	60.0	52.9	36.2
H2 (PERCENT EACH TANK)	91.1	63.0	55.1	38.4

**BATTERY AMP HOURS NECESSARY TO PERFORM NOMINAL MISSION WITHOUT BATTERY CHARGER.

***ENERGY REQUIREMENT IN TWO LOWEST BATTERIES.

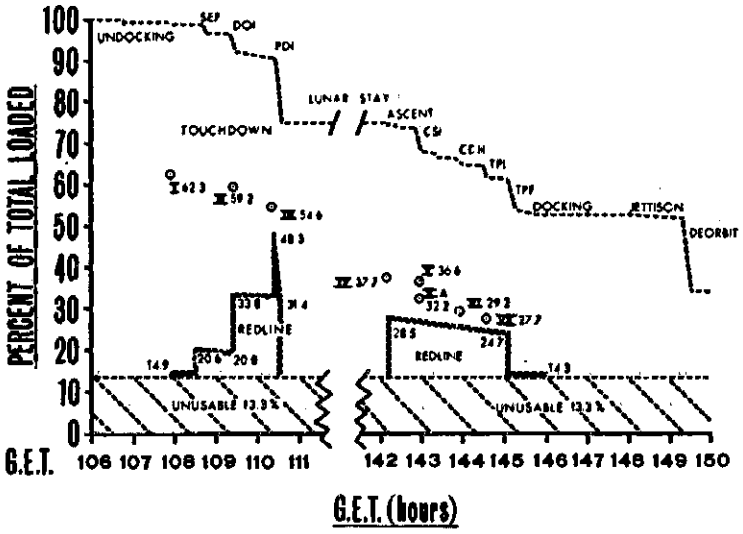
BATTERY RED LINES ARE BASED ON FAILURE OF THE BATTERY CHARGER PRIOR TO ACCOMPLISHING ANY BATTERY CHARGING. THESE REDLINES ALLOW COMPLETION OF NOMINAL MISSION WITH FULL ENTRY AND POST LANDING CAPABILITY WITH THREE BATTERIES WITH POWER DOWN OF ECS RADIATORS HEATERS OVERLOAD SENSING AT THE OCCURRENCE OF LOSS OF THE BATTERY CHARGER. THE REDLINES FOR LOI AND UNDOCKING ALLOW FOR A SUBSEQUENT LOSS OF AN ENTRY BATTERY WITH EARLY TEI, POWERED DOWN GSN ENTRY, AND 12 HOURS POSTLANDING TIME.

CRYOGENIC REDLINES ARE BASED ON CAPABILITY TO PERFORM NOMINAL MISSION WITH CAPABILITY TO RETURN TO EARTH WITH A 40 AMP AVERAGE POWER LEVEL AFTER LOSS OF ONE CRYO TANK AT NOMINAL TEI -12 HOURS (WORST CASE TIME FOR FAILURE).

RULES 3-95 AND 3-96 ARE RESERVED.

REV	ITEM

UM RCS PROPELLANT PROFILE



MISSION	REV	DATE	SECTION	GROUP	PAGE
APOLLO 12	B	10/31/9	MISSION RULE SUMMARY	CONSUMABLES	3-29

REV	ITEM
	7-97

LM-RCS PROPELLANT GO/NO-GO'S AND REDLINES

A. ASSUMPTIONS

1. TOTAL LOADED 633 LBS EQUAL 100 PERCENT

UNUSABLE

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

2. OPS RESERVE

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

(B) AFTER TPF - CSM ACTIVE DOCKING EQUAL 3.0 PERCENT

B. GO/NO-GO'S

1. UNDOCKING/SEPARATION---

I. PROPELLANT REQUIRED FOR UNDOCKING, DOI, DESCENT, ASCENT AND RENDEZVOUS PLUS OPS RESERVE.

2. DOI

II. PROPELLANT REQUIRED FOR DOI, DESCENT, ASCENT AND RENDEZVOUS PLUS OPS RESERVE.

3. PDI

III. PROPELLANT REQUIRED FOR DESCENT, ASCENT AND RENDEZVOUS PLUS OPS RESERVE.

4. IMMEDIATELY AFTER ASCENT

IV. PROPELLANT REQUIRED FOR NOMINAL LM ACTIVE RNDZ PLUS OPS RESERVE.

5. CSI

V. PROPELLANT REQUIRED FOR REMAINDER OF RNDZ PLUS OPS RESERVE.

V.A. PROPELLANT FOR CSI, LOS TO TPI, TPI, BRAKING, DOCKING PLUS OPS RESERVE.

6. COH

VI. PROPELLANT REQUIRED FOR REMAINDER OF RNDZ PLUS OPS RESERVE.

7. TPI

VII. PROPELLANT REQUIRED FOR REMAINDER OF RENDZVOUS PLUS OPS RESERVE.

REV	ITEM	
	3-97 CONT.	C. REDLINES 1. UNDOCKING TO SEP PROPELLANT REQUIRED FOR NOMINAL DOCKING PLUS OPS RESERVE 2. SEP TO DOI PROPELLANT REQUIRED FOR REMAINDER OF MINI FOOTBALL, DOCKING PLUS OPS RESERVE. 3. DOI TO PDI PROPELLANT REQUIRED FOR LOS IN LONGEST ABORT RNDZ WITH DPS ATTACHED UNTIL JUST BEFORE TPI (P-20 MAXIMUM DEADBAND), STAGING, BRAKING, DOCKING PLUS OPS RESERVE. 4. PDI TO TOUCHDOWN PROPELLANT REQUIRED FOR DESCENT, NOM ASCENT, LONGEST LOS FOR CSM RESCUE (P-20 MAXIMUM DEADBAND), BRAKING, DOCKING PLUS OPS RESERVE. 5. INSERTION TO TPF PROPELLANT REQUIRED FOR LOS TO TPF, BRAKING, DOCKING, PLUS OPS RESERVE. NOTE RCS REQUIRED DECREASES WITH LESS LOS UNTIL TPF. 6. TPI TO DOCKING PROPELLANT REQUIRED FOR OPS RESERVE.
	3-98	LM DPS THE NOMINAL DPS PROPELLANT MARGIN IS APPROXIMATELY 1,491.5 LBS. THERE ARE NO REDLINES OR GO/NO-GO'S PLANNED.
	3-99	LM APS THE NOMINAL APS PROPELLANT MARGIN AT INSERTION IS APPROXIMATELY 319.6 LBS. THERE ARE NO REDLINES OR GO/NO-GO'S PLANNED. RULE NUMBERS 3-100 AND 3-101 ARE RESERVED.

REV	ITEM	
	3-102	LM EPS, ECS

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

A. FROM UNDOCKING TO TOUCHDOWN, THE MINIMUM REQUIREMENTS ARE BASED ON THE TIME TO COMPLETE A LANDING, A TWO-HOUR STAY, ASCENT AND A NOMINAL (FIVE-HOUR) RENDEZVOUS THROUGH CREW TRANSFER, A TWO HOUR ORBITAL CONTINGENCY AND REDUNDANT ASCENT SOURCES FOR THE RENDEZVOUS.

THE TIME TO COMPLETE A LANDING AND THE TWO-HOUR LUNAR STAY MAY BE SUPPORTED BY ANY COMBINATION OF DESCENT AND ASCENT CONSUMABLES. IN ADDITION, EACH ASCENT BATTERY, H2O TANK AND ONE ASCENT O2 TANK (THE LM CABIN IS CONSIDERED A REDUNDANT O2 SOURCE) MUST CONTAIN THE CONSUMABLES REQUIRED FOR LIFTOFF AND NOMINAL RENDEZVOUS THROUGH CREW TRANSFER. THE TWO-HOUR ORBITAL CONTINGENCY, INSOFAR AS ASCENT O2, H2O AND ELECTRICAL POWER ARE CONCERNED, IS CONSIDERED TO BE SATISFIED BY THE REDUNDANCY REQUIREMENT.

HOWEVER, FOR THE FIRST CSM REVOLUTION AFTER TOUCHDOWN, THE MINIMUM REQUIREMENTS SHALL PROVIDE FOR A T3 LIFTOFF, NOMINAL INSERTION AND CSM RESCUE CAPABILITY.

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

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

REV	ITEM
	3-102 CONT.

	GO/NO GO			STAY/NO STAY			
	UNDOCK	DOI	PDI	LUNAR STAY			
	ROM(1) WITH 2-HR STAY	ROM WITH 2-HR STAY	ROM WITH 2-HR STAY	T1 AND T2 (3)	ROM(2) WITH 16.75-HR STAY	ROM(2) 24.5-HR WITH 1 EVA	ROM(2) 30.5-HR WITH 2 EVA'S
ASC O2 (LBS EITHER TANK)	1.5	1.5	1.5		1.5	1.5	1.5
PLUS							
ASC/DES O2 (LBS)	1.71	1.1	.01		8.0	23.2	32.5
ASC H2O (LBS EACH TANK)	29	29	29	(3)	29	29	29
PLUS							
ASC/DES H2O (LBS)	33	27	19	(3)	94	114	150
ASC AMP HRS (EACH BAT)	240	240	240	(3)	220	220	220
PLUS							
ASC/DES AMP HOURS	227	157	104	(3)	598	691	801

(1) ROM = REMAINDER OF MISSION

(2) APPLIED AT T3-60 MIN, I.E. TOTAL SURFACE STAY TIMES ARE 19.75, 25.5 AND 31.5 HOURS.

(3) LM IS "STAY" IF SUFFICIENT ASCENT/DESCENT H2O AND ELECTRICAL POWER ARE AVAILABLE TO PROVIDE A T3 LIFTOFF, NOMINAL INSERTION & CSM RESCUE CAPABILITY AS A MINIMUM. LM IS "STAY" EVEN IF ALL TANKED O2 IS LOST.

GENERAL NOTE

VALUES IN TABLE ARE THE REQUIRED USABLE AMOUNTS. UNUSABLES ARE---

	O2	H2O	A-H
ASC	.37	2.88	11
DES	9.34	16.4	38

(PER TANK OR BATTERY FOR A FOUR DESCENT/TWO ASCENT BATTERY CONFIGURATION)

REV	ITEM	
	3-103	EMU PLSS AMP HRS, O2, LIOH, & H2O REDLINES A. NOMINAL EVA-THE PLSS AMP-HRS, O2, LIOH, AND H2O REDLINES FOR EACH OF THE NOMINAL EVA'S ARE DEFINED IN TWO CATAGORIES--- 1. THOSE VALUES REQUIRED FOR TWO MAN EVA TERMINATION AND SAFE RETURN TO A PRESSURIZED LM CABIN PLUS THE VALUES REQUIRED FOR 30 MINUTES OF POST-EVA RESERVE. 2. THOSE VALUES REQUIRED FOR TWO MAN EVA TERMINATION, TRANSFER OF ONE SRC, AND SAFE RETURN TO A PRESSURIZED LM CABIN PLUS 30 MINUTES OF POST-EVA RESERVE. B. ALTERNATE EVA- THE PLSS AMP-HOURS, O2, LIOH, AND H2O REDLINES FOR THE ALTERNATE EVA'S ARE DEFINED IN TWO CATAGORIES--- 1. THOSE VALUES REQUIRED FOR ONE MAN EVA TERMINATION AND SAFE RETURN TO A PRESSURIZED LM CABIN PLUS THE VALUES REQUIRED FOR 30 MINUTES OF POST-EVA RESERVE. 2. THOSE VALUES REQUIRED FOR ONE MAN EVA TERMINATION, TRANSFER OF ONE SRC, AND SAFE RETURN TO A PRESSURIZED LM CABIN PLUS 30 MINUTES OF POST-EVA RESERVE.

REV	ITEM
	3-103 CONT.

C. PLSS AMP-HRS, O2, LIOH AND H2O GO/NO-GO'S ARE DEFINED AS THOSE VALUES REQUIRED TO COMPLETE THE EVA (NOMINAL OR ALTERNATE) PLUS THE VALUES REQUIRED FOR 30 MINUTES OF POST-EVA RESERVE.

	GO/NO-GO'S	
	EVA NO. 1 3HR 30MIN	EVA NO. 2 3HR 30MIN
CDR		
POS (PSIA)	896	916
H2O (LBS)	6.36	6.46
AMP-HRS	13.6	13.6
LIOH (BTU'S)	4001	3996
LMP		
POS (PSIA)	882	882
H2O (LBS)	6.15	6.15
AMP-HRS	13.6	13.6
LIOH (BTU'S)	4235	3970

REV	ITEM
	3-103 CONT.

D. OPS O2, PLSS O2, H2O AND AMP-HRS GO/NO-GO'S ARE DEFINED AS THOSE VALUES REQUIRED TO COMPLETE A 30-MINUTE CEVA.

CEVA GO/NO-GO TABLE

OPS	ACTIVATED	4600 PSIA/4.8 LBS
	UNACTIVATED	5380 PSIA/5.6 LBS
PLSS	POS	422 PSIA/0.5 LBS
	H2O	1.7 LBS
	BAT	4.8 AMP-HRS

4 GROUND INSTRUMENTATION REQUIREMENTS

REV	ITEM	
	4-1	GENERAL

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

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

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

NOTE

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

A. RECEIVE AND DISPLAY TELEMETRY AND TRACKING DATA.

B. MAINTAIN VOICE COMMUNICATIONS WITH THE CREW.

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	4-2	TELEMETRY			
		A. CONSOLE DISPLAY (D/TV, EVENTS, ANALOGS)	PRELAUNCH	MANDATORY	A. FOR DISPLAY OF MANDATORY S/V PARAMETERS.
		B. PCM GROUND STATIONS (4)	PRELAUNCH	1 OF 4 MANDATORY, 1 HIGHLY DESIRABLE	B. FOR DISPLAY OF MANDATORY S/V EVENTS AND ANALOGS.
		C. RECORDING AND PLAYBACK			
		ALDS	PRELAUNCH	BOTH DESIRABLE	
		MSFN			
		D. PM - GROUND STATION	PRELAUNCH	HIGHLY DESIRABLE	
	4-3	COMMAND			
		A. MOCR TOGGLE SWITCHES (BOTH A AND B)			A. FOR LAUNCH PHASE ABORT REQUEST
		1. BSE ABORT REQUEST	PRELAUNCH	HIGHLY DESIRABLE	
		2. FIDO ABORT REQUEST	PRELAUNCH	HIGHLY DESIRABLE	
		3. FD ABORT REQUEST	PRELAUNCH	HIGHLY DESIRABLE	
		B. COMMAND PANELS--- INCO, GUIDO, BSE, TELCOM, CONTROL, CCATS	PRELAUNCH	HIGHLY DESIRABLE	
		C. MOCR CONSOLE/SITE SELECT CAPABILITY			
		1. RTC CONSOLE (CCATS)	PRELAUNCH	HIGHLY DESIRABLE	
		2. CCATS CMD CONSOLE MED			
		D. PC/MED SWITCHING CAPABILITY			
		1. CCATS	PRELAUNCH	HIGHLY DESIRABLE	
		2. CCATS CMD MED			
	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	3 MANDATORY	1. (A) INDEPENDENT VERIFICATION OF S/V NAVIGATION. (B) PROTECTION AGAINST VIOLATION OF LAUNCH ENVELOPE.
		2. IU AND CMC TR VECTORS FROM LIFTOFF TO INSERTION PLUS 60 SECONDS.	PRELAUNCH	BOTH MANDATORY	A.2. REQUIRED FOR ORBIT GO/NO-GO
		B. RTCC - DATA SELECT CAPABILITY	PRELAUNCH	MANDATORY	B. TO SELECT BEST AVAILABLE DATA SOURCE.

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	4-5	COMMUNICATIONS			
		A. MOCR---			
		APD CONF LOOP FD LOOP	PRELAUNCH	1 OF 2 MANDATORY	FOR MISSION CONTROL
		MOCR DYN MOCR SYS 1 & 2 A/G 1 LOOP A/G 2 LOOP	PRELAUNCH	ALL HIGHLY DESIRABLE	
		B. MCC/LAUNCH COMPLEX---			
		121 CLTC 111 CVTS 212 HSTC	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 CIF/USB LOOP	PRELAUNCH	DESIRABLE	USED FOR MONITORING SPACE VEHICLES SUBSYSTEM CHECKOUT
		E. MCC/REMOTED SITES---			
		ONE A/G PATH VIA GSFC	PRELAUNCH	MANDATORY	USED FOR COMMUNICATION WITH CREW
	4-6	COMPUTER			
		A. MOC (IBM 360/75)	PRELAUNCH	MANDATORY	TO PROCESS MANDATORY S/V PARAMETERS AND TRAJECTORY DATA
		B. DSC (IBM 360/75)	PRELAUNCH	HIGHLY DESIRABLE	AN DSC (IBM 360/75) IS AVAILABLE AS BACKUP TO THE MOC OR DSC.
		C. CCATS (UNIVAC 494)- ONLINE	PRELAUNCH	1 MANDATORY AND 1 HIGHLY DESIRABLE	TO THROUGH PROCESS MANDATORY S/V PARAMETERS TO MOC
		CCATS (UNIVAC 494) - STANDBY			
		D. RTACP - 2	PRELAUNCH	1 HIGHLY DESIRABLE	PRELAUNCH IP PREDICTIONS FOR MODE 3 ABORTS.
	4-7	TIMING MITE (2)	PRELAUNCH	1 MANDATORY	MCC TIMING STANDARD TO SUPPORT MANDATORY RTCC/CCATS COMPUTERS

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	4-8	MCC POWER			
		A. BUS A1	PRELAUNCH	MANDATORY	UNINTERRUPTABLE POWER FOR D/TV CONVERTERS
		B. BUS A2	PRELAUNCH	MANDATORY	UNINTERRUPTABLE POWER FOR D/TV DATA DISTRIBUTORS AND VSM
		C. BUS B1	PRELAUNCH	HIGHLY DESIRABLE	20 SECONDS INTERRUPTABLE POWER FOR THE FOLLOWING HIGHLY DESIRABLE ITEMS--- • FLT DYN SSR CONSOLES AND PLOTBOARDS • RTCC CONSOLES (EXCEPT COMP SUP) • RTACP • PDSDD • CMCC • TTV
		D. BUS B2	PRELAUNCH	MANDATORY	20 SECONDS INTERRUPTABLE POWER FOR MOCR AND SSR CONSOLES
	4-9	DISPLAY			
		A. MOCR D/TV CHANNELS POSITION — NO. OF CHANNELS RETRO — 1 FIDO — 1 GUIDO — 1 EECOM — 1 GNC — 1 RTCC — 1 BOOSTER — 4	PRELAUNCH	10 OF 36 MANDATORY	FOR DISPLAY OF MANDATORY S/V PARAMETERS
		B. TRAJECTORY DISPLAY			
		1. FDO LAUNCH DIGITALS	PRELAUNCH	MANDATORY ON D/TV	FOR CONTINGENCY ORBIT INSERTION MANEUVER DATA AND TFF LIMITS.
		2. GAMMA VS V	PRELAUNCH	MANDATORY OR 1 OF 4--- (A) 18 X 28 SCRIBER PLOTTER (B) D/TV (C) RTCC PLOTBOARD (D) SSR PLOTBOARD	FROM SELECTED TRACKING DATA SOURCE.
		3. RFO LAUNCH DIGITALS	PRELAUNCH	MANDATORY ON D/TV	MONITOR FOR MODES III AND IB MANEUVER DATA.
		4. GAMMA(II) VS V(II)	PRELAUNCH	MANDATORY ON 1 OF 2--- (A) D/TV (B) SSR PLOTBOARD	MONITOR FOR G-LIMIT VIOLATION.

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	4-9 CONT	5. PHI VS LAMBDA	PRELAUNCH	HIGHLY DESIRABLE ON 1 OF 2--- PLOTBOARD (A) RTCC (B) SBR PLOTBOARD	MONITOR FOR CROSS-RANGE LIMITS
		6. T(PF) VS R(IP)	PRELAUNCH	HIGHLY DESIRABLE ON 1 OF 2--- (A) D/TV (B) SRR PLOTBOARD	MONITOR FOR ABORT MODES II, III, AND IB.
		7. H VS D	PRELAUNCH	HIGHLY DESIRABLE ON 10 X 10 SCRIBER PLOTTER	
		8. GAMMA(I) VS V(I) (CMC DYNAMIC STATUS)	PRELAUNCH	HIGHLY DESIRABLE ON 10 X 10 SCRIBER PLOTTER	MONITOR FOR L/V AND S/C NAVIGATION PERFORMANCE (GUIDANCE SYSTEM ANALYSIS - COMPARES CMC WITH TRACKING).
		9. WEDGE ANGLE MONITOR	PRELAUNCH	HIGHLY DESIRABLE ON D/TV	MONITOR FOR L/V AND S/C NAVIGATION PERFORMANCE
		10. GUIDO ANALOG CHART RECORDERS ONE AND TWO	PRELAUNCH	HIGHLY DESIRABLE ON D/TV	
		11. INSERTION/INJECTION DIGITALS	PRELAUNCH	MANDATORY ON D/TV	FOR 66A GO/NO-GO
		C. ADEG CHANNELS 90-95	PRELAUNCH	HIGHLY DESIRABLE	FOR DSC DISPLAYS
		D. VSM	PRELAUNCH	MANDATORY	FOR D/TV
		E. AUX VSM	PRELAUNCH	HIGHLY DESIRABLE	
		F. EIDOPHORS (3)	PRELAUNCH	2 HIGHLY DESIRABLE	

NOTE--- INDIVIDUAL FLIGHT CONTROLLERS WILL BE RESPONSIBLE FOR REPORTING LOSS OF DISPLAY CAPABILITY OF MANDATORY PARAMETERS TO THE FLIGHT DIRECTOR.

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

REV	ITEM	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 4-10 AND FIGURES 4-1 THROUGH 4-51 TO DETERMINE CAPABILITY.			
		A. CMD			
		CCS	PRELAUNCH	HIGHLY DESIRABLE	
		B. TELEMETRY			
		S-IC (VHF)	PRELAUNCH	HIGHLY DESIRABLE	S-IC DATA IS ONLY HIGHLY DESIRABLE SINCE THE MCC IS NOT PRIME FOR REQUESTING AN ABORT FOR S-IC MALFUNCTIONS.
		S-II (VHF)	PRELAUNCH	HIGHLY DESIRABLE FROM LIFTOFF TO S-II CUTOFF (APPROX. 8 + 36 SEC)	FOR ABORT CUES FROM MCC
		S-IVB VHF (CP-1)	PRELAUNCH	HIGHLY DESIRABLE	
		IU CCS (DP-18)	PRELAUNCH	MANDATORY	FOR BULKHEAD DELTA P AFTER S/C SEP
		IU VHF (DP-1)		HIGHLY DESIRABLE	
		CSM (USB)	PRELAUNCH	MANDATORY FROM LIFTOFF THROUGH S-IVB CUTOFF PLUS 60 SEC.	FOR ABORT CUES FROM MCC
		C. TRACKING			
		THAT CAPABILITY REQUIRED TO SATISFY RULE 4-4 (TRAJECTORY) IS MANDATORY			
		D. A/G COMMUNICATIONS			
		1. MILA VHF USB	PRELAUNCH	1 OF 2 MANDATORY	
		2. MSFN VHF USB	PRELAUNCH	1 OF 2 MANDATORY	

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

REV	ITEM	CONDITION/MALFUNCTION*	PHASE	RULING	CUES/NOTES/COMMENTS
	4-15	HSK, GDS, MAD			
		IT IS MANDATORY 2 OF 3 OF THESE SITES PROVIDE THE FOLLOWING CAPABILITIES---			
		A. TV USB	PRELAUNCH	MANDATORY	A. TO COVER TRANSLUNAR COAST AND LPO.
		B. TRACK USB	PRELAUNCH	MANDATORY	
		C. VOICE USB	PRELAUNCH	MANDATORY	
		D. CMD USB	PRELAUNCH	HIGHLY DESIRABLE	
	4-16	BIOMITER NETWORK SITES	PRELAUNCH		
		A. GIMA		HIGHLY DESIRABLE	
		B. CRO CYI		1 OF 2 HIGHLY DESIRABLE	

REV	ITEM	
	4-17	INTRODUCTION TO SITE FAILURE DECISION MATRIX (FIGURES 4-3)

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

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

(NOMINAL INSERTION IS 12 + 40)

TO USE THE MATRIX

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

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

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

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

REV	ITEM

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

NOTES---

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

2. GO ON TM BECAUSE OF ALDS DATA UNTILL 08-49.

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

9 TRAJECTORY AND GUIDANCE

REV	ITEM	
	9-1	THE LAUNCH PHASE WILL BE TERMINATED FOR ANY OF THE FOLLOWING CONDITIONS--- A. VIOLATION OF THE VEHICLE BREAKUP LINE. B. TFF IS LESS THAN OR EQUAL TO 1 + 40 AND DECREASING AFTER TOWER JETTISON. C. VIOLATION OF ENTRY "G" LIMIT. D. VS INCREASING. E. OVERSPEED CONDITIONS AT INSERTION. F. VIOLATION OF EAIT HEATING LINE.
	9-2	THE LES WILL NOT BE JETTISONED UNTIL MODE II CAPABILITY IS ESTABLISHED BY TFF IS GREATER THAN OR EQUAL TO 1 + 20 AND INCREASING.
	9-3	MODE II, III, IV, AND APOGEE KICK. A. THE GROUND IS PRIME FOR ABORT MODE DETERMINATION AND MODE III MANEUVER COMPUTATION. THE CREW WILL BE PRIME FOR MODE IV AND APOGEE KICK MANEUVERS. B. MANEUVERS WILL BE INTERRUPTED WHEN TFF = 1 + 40 AND DECREASING. C. MODE IV MANEUVERS WILL BE INTERRUPTED IF THE CURRENT ALTITUDE IS 75 NM, DECREASING AND HP IS LESS THAN 300K FT. D. IF ENTERING, UTILIZE LIFT OF AVOID LAND. UNAVOIDABLE LAND LANDING USE RL 90 DEG. E. IF NO SLA SEP OR IF SPS FAILS--- 1. HP IS LESS THAN 40 - EXECUTE CM/SM SEP BY TFF = 1 + 40. 2. HP IS BETWEEN 40 AND 75 - GROUND WILL DECIDE TO USE SM RCS ASAP OR AT APOGEE TO REDUCE HP TO 40 NM.
	9-4	MODE III ABORTS. A. PREDICTED TFF AFTER SPS C/O IS LESS THAN 1 + 40. 1. FULL LIFT IF ON WATER - DO NOT BURN. 2. G&N GO AND FULL LIFT IF ON LAND - BURN TO TFF = 1 + 40, RL 90 DEG. 3. G&N NO-GO AND FULL LIFT IF ON LAND - BURN A REDUCED DELTA V TO MAINTAIN TFF AFTER C/O AND RL 90 DEG. B. IF DELTA TB IS LESS THAN OR EQUAL TO 2 SEC, DO NOT BURN. C. IF IGNITION OCCURS AFTER GETI +10 SEC, BURN UNTIL G&N DELTA R = 0, RL 55 DEG. [IF UNABLE TO BURN DELTA R = 0, RL 90 DEG.]

REV	ITEM	
	5-5	THE S/C CMC WILL BE NO-GO FOR ABORT MANEUVER DETERMINATION AND MONITORING FOR ANY OF THE FOLLOWING--- A. CMC PROGRAM ALARMS--- 00212, 00214, 00217, 00421, 00777, 01107, 01301, 01407, 03777, 04777, 07777, 10777, 13777, 14777, 21103, 21206, 21210, 21302, 21501, 21502, 31104, 31203, 31202, 31205, (SEE RATIONAL FOR DEFINITIONS) B. RTCC AND CMC TFF DIFFERENCE OF GREATER THAN 60 SEC. C. CONFIRMED ERROR IN S/C PLATFORM VELOCITY COMPONENTS OF GREATER THAN 50 FPS IN X OR 100 FPS IN Z. D. CMC TRAJECTORY SOURCE INDICATES ''GO'' OR ''NO-GO'' INCONSISTENT WITH BEST TRAJECTORY SOURCE(S) INDICATION.
	5-6	THE ORBIT IS ''GO'' IF HP IS GREATER THAN OR EQUAL TO 75 NM.
		RULES 5-7 THROUGH 5-19 ARE RESERVED.

REV	ITEM	
	5-20	EARTH ORBITAL ALTITUDE CONSTRAINTS--- A. REAL-TIME MISSION PLANNING PERIGEE = 85 NM MINIMUM. MAXIMUM HP IS DETERMINED BY SM RCS AVAILABLE FOR HYBRID DEORBIT. B. CONTINGENCY PERIGEE = 75 NM MINIMUM (VIOLATIONS WILL BE CORRECTED ASAP) IF HP LESS THAN 75 NM AND MANEUVER TO RAISE HP IS NOT POSSIBLE--- 1. HP IS BETWEEN 60 AND 75 = EXECUTE SPS RETROGRADE ASAP UNTIL HP IS LESS THAN 60. IF NO SPS, USE SM-RCS. 2. HP IS LESS THAN 60 = 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 = 55 FPS SPS ASAP (7000 FT SEPARATION REQUIRED IN 200 SEC.) B. S-IVB ATTITUDE RATES IS GREATER THAN OR EQUAL TO 5 DEG/SEC = 5 FPS RCS ASAP. C. S-IVB YAW ATTITUDE GREATER THAN 45 DEG = 5 FPS RCS ASAP. D. CSM RETROFIRE REQUIRED WHILE ATTACHED TO THE S-IVB OR LM = SEPARATION 20 MINUTES PRIOR TO RETRO. 5 FPS RCS RETROGRADE WITH LINE ON HORIZON.
	5-22	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 9 MIN. IF NOT, RETARGET FOR NEXT PTP.
	5-24	DELETED
	5-25	PLANNED G&N AND SCS RETROFIRE MANEUVERS WILL BE UPDATED IF--- A. THE COMPUTED RETROFIRE POSITION CHANGES BY GREATER THAN 0.5 DEG LONGITUDE PRIOR TO GETI -30 MIN. B. THE COMPUTED RETROFIRE POSITION CHANGES BY GREATER THAN 2 DEG LONGITUDE AFTER GETI -30 MIN.

REV	ITEM	
	5-26	IF A GDN FAILURE IS DETECTED PRIOR TO RETROFIRE, CREW USES SCS DELTA V MODE WITH AN EMS ENTRY.
	5-27	IF SPS FAILS AFTER EPO RETROFIRE IGNITION OR NO SLA SEP---
		A. HP IS GREATER THAN 75 NM - RETARGET FOR NEXT BEST PTP USING RCS.
		B. HP BETWEEN 40 AND 75 - PITCH UP TO LOCAL HORIZONTAL ATTITUDE AND BURN SM RCS USING FOLLOWING PRIORITIES---
		1. BURN HP TO PAD VALUE
		2. BURN MAXIMUM SM RCS DELTA V AVAILABLE
		3. BURN CM RCS TO HP = 40 NM IF SM RCS DELTA V NOT SUFFICIENT TO OBTAIN HP = 40 NM IF HP IS LESS THAN OR EQUAL TO 40 NM TERMINATE ALL THRUSTING AT TFF = 2 MIN.
		C. HP IS LESS THAN 40 NM - REMAIN IN RETRO ATTITUDE AND BURN SM RCS USING THE FOLLOWING PRIORITY---
		1. BURN DELTA V RISIDUALS.
		2. BURN MAXIMUM SM DELTA V AVAILABLE.
		NOTE THE S-IVB LOX DUMP CAPABILITY MAY BE USED TO SHAPE THE ORBIT FOR RETROFIRE MANEUVER OR TO REDUCE THE S-IVB WEIGHT TO OBTAIN MORE SM RCS DELTA V.

REV	ITEM	
	5-28	THE GSN IS NO-GO FOR ENTRY IF--- A. THE CMC VALUE OF DOWNRANGE ERROR (RP - RT) AT .25 DIFFERS GREATER THAN +/- 100 NM FROM GROUND VALUE OR IS GRATER THAN +/- 130 NM FROM BACKUP CHART VALUE. CREW FAILOVER TO EMS ENTRY AS FIRST PRIORITY OR GROUND BANK ANGLE AND RETRO AS SECOND PRIORITY. B. V AND GAMMA AT 400K ARE OUTSIDE THE CORRIDOR. GROUND WILL PROVIDE ENTRY PROFILE.
	5-29	BOOSTER NAVIGATION AND TARGET UPDATES FOR TLI--- A. AN IU NAVIGATION UPDATE WILL BE PERFORMED FOR EITHER TLI OPPORTUNITY WHERE A SATURN ACCELEROMETER FAIL OCCURED PRIOR TO EARTH-ORBIT INSERTION. THE UPDATE WILL BE TIMETAGGED PRIOR TO GET = 2 HR 21 MIN FOR THE FIRST OPPORTUNITY OR GET = 3 HR 49 MIN FOR THE SECOND OPPORTUNITY. B. IU ORBIT TARGET UPDATES WILL BE PERFORMED WHERE A SATURN GUIDANCE REFERENCE FAILURE HAS OCCURRED PRIOR TO TLI.
	5-30	THE CMC STATE VECTOR WILL BE UPDATED PRIOR TO TLI WITH THE BEST MSFN VECTOR.
	5-31	GUIDANCE SYSTEM REQUIREMENTS FOR TLI A. A PROPERLY OPERATING SPACECRAFT GSN (CMC, IMU, AND OSSI SYSTEM IS MANDATORY FOR TLI. B. SATURN GUIDANCE FAILURES 1. FOR SATURN GUIDANCE REFERENCE FAILURES, TLI WILL BE PERFORMED USING MANUAL CONTROL AND CUTOFF TECHNIQUES. 2. FOR SATURN ACCELEROMETER FAILURES, TLI WILL BE CONTROLLED BY THE IU COMPUTER AND CUTOFF MANUALLY BASED ON TOTAL INERTIAL VELOCITY FROM THE CMC.
	5-32	THE MAXIMUM ALLOWABLE MISALIGNMENT RATES BETWEEN THE IU AND IMU ARE 0.6 DEG/HR (IU) AND 1.5 DEG/HR (IMU).
	5-33	THE S/C L/O RESFMMAT WILL BE USED FOR BOTH TLI OPPORTUNITIES.
	5-34	DISPERSED TLI C/O--- PREDICTED DELTA V CAPABILITY (CSM ALONE) AFTER TDGE AND DOCKED SPS MIDCOURSE--- A. GREATER THAN 5500 FPS - CONTINUE MISSION B. LESS THAN 5500 FPS - EXECUTE EARTH ORBIT ALTERNATE

REV	ITEM	
	5-35	DIFFERENCE IN CMC AND IU PLATFORM VELOCITY COMPONENTS OR TOTAL VELOCITY AT INSERTION--- A. VIOLATION OF ANY OF THE FOLLOWING MEANS TLI IS NO-GO--- DELTA XDOT IS GREATER THAN +/- 38 FPS DELTA YDOT IS GREATER THAN +/- 73 FPS DELTA ZDOT IS GREATER THAN +/- 87 FPS DELTA VT IS GREATER THAN +/- 34 FPS B. VIOLATION OF ANY OF THE FOLLOWING MEANS TLI IS TEMPORARILY NO-GO--- DELTA XDOT IS BETWEEN +/- 7.5 AND +/- 38 FPS DELTA YDOT IS BETWEEN +/- 41 AND +/- 73 FPS DELTA ZDOT IS BETWEEN +/- 28 AND +/- 87 FPS DELTA VT IS BETWEEN +/- 14 AND +/- 34 FPS NOTE TLI IS NO-GO UNTIL PARTS C AND 5-36 ARE DETERMINED (ORBITAL PARAMETER DECISIONS). C. VIOLATION OF ANY OF THE FOLLOWING ORBITAL DECISION PARAMETERS AT GET = 1 HR 45 MIN MEANS TLI IS NO-GO. PARAMETERS ARE IU VERSUS MSFN. SEMI-MAJOR AXIS IS GREATER THAN +/- 19,900 FT CROSSRANGE VELOCITY IS GREATER THAN +/- 32 FPS
	5-36	DIFFERENCE IN MSFN AND IU DOWNRANGE POSITION (DELTA RV) IS GREATER THAN +/- 109,100 FT AT GET = 56 MIN MEANS TLI IS NO-GO.
	5-37	WITH AN S-IVB GUID REF FAIL OR AN S-IVB ACCELEROMETER FAIL DURING LAUNCH PHASE: VIOLATION OF ANY OF THE FOLLOWING ORBITAL DECISION PARAMETERS MEANS TLI IS NO GO. PARAMETERS ARE CMC VERSUS MSFN. A. DIFFERENCE IN DOWNRANGE POSITION IS GREATER THAN +/- 535,900 FEET AT GET = 56 MIN. B. DIFFERENCE IN SEMIMAJOR AXIS IS GREATER THAN +/- 11.6 N. MI AT GET = 1 HR 45 MIN. C. DIFFERENCE IN CROSSRANGE VELOCITY IS GREATER THAN +/- 78.7 FPS AT GET = 1 HR 45 MIN. RULES 5-38 THROUGH 5-45 ARE RESERVED.

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

A. COMPUTER PROGRAM ALARMS--- 00232, 00214, 00217, 00421, 00777, 01107, 01301, 01407, 03777, 04777, 07777, 10777, 13777, 14777, 21103, 21206, 21210, 21302, 21501, 21502, 31104, 31201, 31202, 31203. (SEE RATIONAL FOR DEFINITIONS).

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

1. SEXTANT STAR CHECK--- AUTO OPTICS POSITIONING DOES NOT PLACE SELECTED STAR IN FIELD OF VISION OF SXT.

2. HORIZON CHECK ERROR IS GREATER THAN 4 DEG FOR RETROFIRE FROM EPO.

C. LGC/EMU ALIGNMENT DISCREPANCY INDICATE BY GREATER THAN 2 DEG FROM PREDICTED GDAS COORDINATES.

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

1. LATITUDE IS GREATER THAN .02 DEG.

2. LONGITUDE IS GREATER THAN .02 DEG.

3. H IS GREATER THAN .2 NM.

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

	CMC (SEC)	LGC (SEC)	AGS (SEC)
A. RETROFIRE	2	--------	--------
B. ENTRY	2	--------	--------
C. TLI	2	--------	--------
D. MCC'S	2	--------	--------
E. LOI	2	2	--------
F. TEI	2	2	--------
G. DESCENT	.5	.5	.5
H. ASCENT	.5	.5	.5
I. RENDEZVOUS	.5	.5	.5
J. SXT TRACKING	.5	--------	--------

RULES 5-48 THRU 5-55 ARE RESERVED.

REV	ITEM	
1	5-56	MIDCOURSE CORRECTION NOMINAL EXECUTION POINTS WILL BE AT THE FOLLOWING--- A. TLI C/O +9 HRS. B. TLI C/O +28 HRS. C. LOI -22 HRS. D. LOI1 -5 HRS.
	5-57	TRANSLUNAR MCC EXECUTION CRITERIA A. SPS MCC'S SHOULD BE GREATER THAN 3 SEC. B. MCC 2 AND 4 ARE PREFERRED EXECUTION POINTS. C. CONSIDERING THE ABOVE: FIRST MIDCOURSE WILL BE DELAYED UNTIL MCC 2 IF COST IS NOT PROHIBITIVE. D. IF THE NOMINAL MISSION DESIGN IS FREE RETURN: A NON-FREE MCC 2 OF 3 SEC SPS WILL BE EXECUTED TO AVOID MCC 3 WHEN FEASIBLE. E. FOR A NOMINAL HYBRID MISSION: THE MANEUVER TO GO NON-FREE RETURN WILL BE EXECUTED AT MCC 2.
	5-58	THE GSN WILL BE THE PRIMARY MODE OF EXECUTING TRANSLUNAR MCC.
		RULE 5-59 IS RESERVED.
	5-60	LOI SHALL BE TARGETED WITHIN THESE CONSTRAINTS--- A. HP IS BETWEEN 50 AND 65 NAUTICAL MILES (LUNAR PARKING ORBIT). B. THE PERICYNTHION OF THE APPROACH HYPERBOLA WILL BE MAINTAINED WITHIN 50 AND 70 N.M. C. THE ALTITUDE OF THE NODE (BETWEEN THE APPROACH HYPERBOLA AND THE DESIRED LPO) WILL BE MAINTAINED BETWEEN 50 AND 70 N.M.
	5-61	A "GO" FOR LOI REQUIRES THE FOLLOWING--- A. COMMITMENT TO LEAST 4 HRS IN LPO - (PROVIDES ONE REV OF TRACK AFTER LOI1 FOR CALCULATION OF TEI1). B. ADEQUATE FUEL REMAINING FOR SUBSEQUENT LUNAR ORBIT OPERATIONS (MINIMUM WOULD BE LOI2 AND TEI1).

REV	ITEM	
	5-62	PREMATURE LOI SHUTDOWN (SPS PROBLEMS)

A. FREE RETURN TRAJECTORY.

1. SHUTDOWN IN MODE I REGION (LOI IGN. TO LOI IGN. + 1+50) - EXECUTE AN SPS 15 MIN. DIRECT ABORT OR A DPS 2-HR. DIRECT ABORT.

2. SHUTDOWN IN MODE II REGION (LOI IGN. + 1+50 TO LOI IGN. + 3+00) - EXECUTE AN SPS 15-MIN. DIRECT ABORT OR A DPS TWO IMPULSE CIRCUMLUNAR ABORT.

3. SHUTDOWN IN MODE III REGION (LOI IGN. + 3+00 TO C/O) - EXECUTE TEI (SPS OR DPS) AT NEAR PERICYNTHIAN OR INITIATE AN ALTERNATE MISSION.

B. HYBRID TRAJECTORIES.

1. PREMATURE LOI SHUTDOWN AND SPS WITHIN SYSTEMS LIMITS. RESTART SPS TO COMPLETE LOI.

2. PREMATURE LOI SHUTDOWN AND SPS OUT OF SYSTEMS LIMITS. ABORT AS FOLLOWS---

(A) NOMINAL ABORT REGIONS.

(1) MODE I - 0 TO 650 FPS (APPROX 0 TO 1+30)

(2) MODE II - 650 TO 3270 FPS (APPROX 1+50 TO 2+50)

(3) MODE III - 3270 TO COMPLETION (APPROX 2+50 TO C/O)

(NOTE--- ABORTS FROM LOI IGN + 40 SEC TO LOI IGN + 2+25 REQUIRES THE SPS OR APS IN ADDITION TO THE DPS)

(B) SHUTDOWN IN MODE I - EXECUTE A DPS DIRECT ABORT AT LOI IGN + 30 MIN (BASED ON CREW CHART). AN SPS/APS BURN AT DPS + 2 HRS (GROUND COMPUTED) REQUIRED FOR ABORTS AFTER LOI IGN + 40 SEC. (ABORTS PRIOR TO LOI IGN + 20 SEC MAY BE PERFORMED AT 2 HRS WITH THE DPS).

(C) SHUTDOWN IN MODE II - EXECUTE A DPS TWO-IMPULSE CIRCUMLUNAR ABORT (FIRST IMPULSE AT LOI IGN PLUS 2 HRS) AN SPS/APS BURN IS REQUIRED TO COMPLETE SECOND IMPULSE FOR ABORTS PRIOR TO LOI IGN + 2+24. (ALL MANEUVERS GROUND COMPUTED).

(D) SHUTDOWN IN MODE III - EXECUTE TEI (DPS OR SPS) AT NEAR OPPORTUNITY OR INITIATE AN ALTERNATE MISSION.

NOTE

1. MODE I SPS SYSTEMS LIMITS ALLOW SPS RESTART.

2. MODE II SPS SYSTEMS LIMITS DO NOT ALLOW SPS RESTART.

5-63 IF THE SPS FAILS AT IGNITION---

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

B. LOI1 - EXECUTE MCCS ABORT MANEUVER WITH DPS/SM-RCS.

C. LOI2 - EXECUTE GROUND COMPUTED TEI WITH DPS AS SOON AS PRACTICAL.

RULES 5-64 THROUGH 5-75
ARE RESERVED.

REV	ITEM	
	5-76	THE LOI2 MANEUVER WILL BE TARGETED TO MINIMIZE THE LLS MISS DISTANCE AND TO ACHIEVE A 60 NM CIRCULAR ORBIT AT RENDEZVOUS.
	5-77	A "GO" FOR LOI2 REQUIRES COMMITMENT TO AT LEAST 4 HRS IN LUNAR ORBIT. (NOTE--- THIS PROVIDES ONE FULL REV OF TRACK AFTER LOI2 FOR CALCULATION OF TEI.)
		RULES 5-78 THROUGH 5-80 ARE RESERVED.

REV	ITEM	
	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 LOI2 AND UNDOCKING TO CORRECT DISPERSIONS.
	5-82	AN UPDATE TO THE LLS WILL BE PROVIDED THE CREW DURING PDI TO CORRECT ANY DOWNRANGE ERRORS THAT HAVE ACCUMULATED IN THE LGC ESTIMATE OF POSITION PROVIDING THIS UPDATE IS NO LESS THAN 2000 FT, NOR MORE THAN 35,000 FT.
	5-83	RESERVED
	5-84	THE PREMISSION LLS POSITION WILL BE UPDATED IF THE LLS SXT SIGHTINGS CHANGE BY--- A. SITE 7 1. DELTA H LESS THAN 4000 FT. 2. DELTA LATITUDE LESS THAN 8000 FT. 3. DELTA LONGITUDE LESS THAN 4000 FT. B. SITE 5 1. DELTA H LESS THAN 2000 FT. 2. DELTA LATITUDE LESS THAN 6000 FT. 3. DELTA LONGITUDE LESS THAN 3000 FT.
	5-85	THE PGNS AND AGS VARIABLE TARGETING CONSTANTS WILL BE UPDATED FOR ALL PDI OPPORTUNITIES.
	5-86	FOLLOWING DOI CUTOFF--- A. IF PGNS RESIDUALS (ANY AXIS) ARE GREATER THAN 10 FPS = PERFORM A DIRECT ABORT. B. IF PGNS RESIDUALS (ANY AXIS) ARE LESS THAN 10 BUT MORE THAN 5 FPS, TRIM PNGS X-AXIS RESIDUALS TO 1 FPS AND--- 1. IF AGS AGREES TO LESS THAN 2 FPS = CONTINUE TO PDI 2. IF AGS DISAGREES BY MORE THAN 5 FPS AND RR CONFIRMS AGS = PERFORM DIRECT ABORT. 3. IF AGS DISAGREES BY MORE THAN 2 FPS BUT LESS THAN 5 FPS AND AT 30 MINUTES AFTER DOI, THE RR AGREES WITH AGS = PERFORM NO PDI + 12 ABORT. RULE 5-87 IS RESERVED.

REV	ITEM	
	5-88	DOI WILL BE SLIPPED ONE REV FOR--- A. FAILURE TO IGNITE THE DPS BY DOI TIG + 2 MIN. B. LM PS2 GYRO TORQUE ANGLES EXCEED GROUND COMPUTED VALUES BY 0.8 DEG IN Y (PITCH) OR 3.6 DEG IN X (YAW) OR Z (ROLL).
	5-89	LR DATA IS REQUIRED FOR LANDING--NO LR DATA BY 10K FT =ABORT. A. LR CONVERGENCE (ALTITUDE ONLY) = DATA NOT BEING ACCEPTED OR CONVERGING FOLLOWING LOCKON FOR 60 SECONDS = ABORT. B. LR DATA ACCEPTED AND CONVERGED CONTINUOUS TO P-64 = CONTINUE MISSION IF LOSS OF LOCK OCCURS IN P-64. C. LR DATA ACCEPTED AND CONVERGED WITH SUBSEQUENT DROPOUT = CONTINUE TO P-64. 1. LANDING RADAR REGAINED IN P-64. (A) DELTA H LESS THAN 1000FT BETWEEN PGNS AND LR = CONTINUE MISSION. (B) DELTA H GREATER THAN 1000 FT BETWEEN PGNS AND LR = ABORT. 2. LR NOT REGAINED AT P-64 = ABORT. D. LATE LR LOCKON WITH DATA BEING INCORPORATED AND CONVERGING = CONTINUE TO P-64. 1. DELTA H LESS THAN 1000 FT BETWEEN PGNS AND LR = CONTINUE MISSION. 2. DELTA H GREATER THAN 1000 FT BETWEEN PGNS AND LR = ABORT.
	5-90	A. POWERED DESCENT WILL BE TERMINATED FOR--- 1. PGNS ALTITUDE LESS THAN 22,000 FEET AND PNGS NAVIGATION ERRORS, CONFIRMED BY MSFN OR DOPPLER RESIDUALS, THAT CAUSE THE AGS-PGNS RADIAL VELOCITY DIFFERENCE TO EXCEED MINUS 10 FPS, PRIOR TO LANDING RADAR ALTITUDE INCORPORATION AND CONVERGENCE (A MINUS VELOCITY DIFFERENCE INDICATES THAT THE AGS TRAJECTORY IS LOWER THAN THE PNGS TRAJECTORY). 2. PNGS NAVIGATION ERRORS, CONFIRMED BY MSFN OR DOPPLER RESIDUALS, THAT RESULT IN THE FOLLOWING AGS-PNGS VELOCITY DIFFERENCES--- DELTA X DOT (DOWNRANGE) GREATER THAN +/- 30 FPS DELTA Y DOT (CROSSRANGE) GREATER THAN +/- 30 FPS DELTA Z DOT (RADIAL) GREATER THAN +/- 35 FPS 3. PGNS ALTITUDE LESS THAN 10,000 FEET AND PNGS NAVIGATION ERRORS, CONFIRMED BY DOPPLER BUT NOT BY AGS, CAUSE THE MSFN-PGNS RADIAL VELOCITY DIFFERENCE TO EXCEED MINUS 20 FPS PRIOR TO LANDING RADAR ALTITUDE INCORPORATION AND CONVERGENCE. 4. PNGS NAVIGATION ERRORS CONFIRMED BY DOPPLER RESIDUALS BUT NOT BY AGS, THAT RESULT IN THE FOLLOWING MSFN-PNGS VELOCITY DIFFERENCES--- DELTA Y DOT (CROSSRANGE) GREATER THAN +/- 100 FPS. DELTA Z DOT (RADIAL) GREATER THAN +/- 35 FPS. NOTE---RULES 3 AND 4 ARE INDEPENDENT OF ANY TYPE OF LANDING RADAR UPDATE. FOR RULES 1 AND 2, SWITCHOVER TO AGS WILL BE PERFORMED. 5. COMMANDED THRUST INCREASING PRIOR TO THROTTLE DOWN OR P63 T60+60 SEC. 6. DELETED 7. NO THROTTLE RECOVERY BY P63/664 PROGRAM SWITCH PLUS 15 SEC. 8. FAILURE TO ACHIEVE PTP BY NOMINAL TIG +31 SEC. (ABORT AT GTC DIVERGENCE). 9. FAILURE TO ENTER P64 WHEN TGO EQUALS 60 SECONDS. 10. THE FOLLOWING PGNS ALARMS---20105, 00214, 20430, 20607, 21105, 01107, 21204, 21302, 21501, 00402 (CONTINUING). B. THE CREW WILL BE ADVISED AND CONSIDERATION WILL BE GIVEN TO TERMINATION OF POWERED DESCENT IF THE TIME BIASED DPS ABORT BOUNDARY IS VIOLATED.
	5-91	THERE ARE NO TRAJECTORY OR GUIDANCE CONSTRAINTS WHICH ARE CAUSE FOR ABORT AFTER CREW TAKEOVER OF POWERED DESCENT.

REV	ITEM	
	9-92	THE FOLLOWING RENDEZVOUS OPTIONS/RESCUE MODES WILL BE UTILIZED AS NECESSARY FOR FAILURES REQUIRING TERMINATION OF THE LUNAR LANDING---

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.)

B. FOR FAILURES FROM DOI +10 TO PDI, EXECUTE THE NO PDI +12 ABORT SEQUENCE. DOCKING IN ABOUT 9-1/4 HOURS.

C. ABORTS DURING POWERED DESCENT WILL INSERT THE LM INTO ORBIT UTILIZING THE ONBOARD VARIABLE ABORT TARGETING UTILIZING THE CPP SEQUENCING. FOR ABORTS DURING THE FIRST 10 MIN DOCKING SHOULD OCCUR WITHIN 9 1/4 HRS AND FOR ABORTS AFTER 10 MIN DOCKING WILL OCCUR APPROXIMATELY 9 1/4 HRS LATER.

D. FOR COMPLETE LM FAILURES PRIOR TO PDI, THE CSM WILL EXECUTE A FIVE IMPULSE RESCUE WITH DOCKING ABOUT 7-1/4 HOURS FROM PDI.

RULES 9-93 THROUGH 9-100 ARE RESERVED.

REV	ITEM	
	5-101	LM LIFTOFF WILL BE DELAYED ONE REVOLUTION RATHER THAN ACCEPTING A SLIP IN NOMINAL LIFTOFF TIME GREATER THAN 90 SEC.
	5-102	FOLLOWING A DESCENT ABORT, GUIDANCE SWITCHOVER TO AGS WILL BE PERFORMED FOR--- A. THE FOLLOWING PGNS ALARMS--- 20105, 00214, 20430, 20607, 21103, 01107, 21204, 21302, AND 21501 B. PGNS NAVIGATION ERRORS THAT RESULT IN--- 1. AGS PREDICTED INSERTION HP LESS THAN 40,000 FEET. 2. AGS PREDICTED INSERTION HA GREATER THAN TARGET VALUE PLUS 40 NAUTICAL MILES. 3. AGS PREDICTED INSERTION WEDGE ANGLE GREATER THAN 1.0 DEGREE.
	5-103	DURING ASCENT, GUIDANCE SWITCHOVER TO AGS WILL BE PERFORMED FOR--- A. THE FOLLOWING PGNS ALARMS--- 20105, 00214, 20430, 20607, 21103, 01107, 21204, 21302, AND 21501 B. PNGS NAVIGATION ERRORS, CONFIRMED BY AGS RESIDUALS, THAT RESULT IN THE FOLLOWING MSFN-PNGS VELOCITY DIFFERENCES--- DELTA X DOT (DOWNRANGE) GREATER THAN +/- 24 FPS DELTA Y DOT (CROSSRANGE) GREATER THAN +/- 90 FPS DELTA Z DOT (RADIAL) GREATER THAN +/- 37 FPS C. PGNS NAVIGATION ERRORS THAT RESULT IN--- 1. AGS PREDICTED INSERTION HP LESS THAN 40,000 FEET. 2. AGS PREDICTED INSERTION HA GREATER THAN TARGET VALUE PLUS 40 NAUTICAL MILES. 3. AGS PREDICTED INSERTION WEDGE ANGLES GREATER THAN 1.0 DEGREE. D. IF MSFN NOT VALID DURING ASCENT THE FOLLOWING DOPPLER RESIDUALS WILL BE USED TO CONFIRM SWITCHOVER CRITERIA--- 1. AGS - PGNS DELTA X DOT (DOWNRANGE) GREATER THAN +/- 24 FPS AND DOPPLER - PGNS RESIDUAL GREATER THAN 33 FPS. 2. AGS - PGNS DELTA Z DOT (RADIAL) GREATER THAN +/- 37 FPS AND DOPPLER - PGNS RESIDUAL GREATER THAN 33 FPS.

REV	ITEM	
	5-104	DURING ASCENT, THE AGS WILL BE DECLARED NO-GO FOR CONFIRMED AGS NAVIGATION ERRORS THAT RESULT IN--- A. PGNS PREDICTED INSERTION HP LESS THAN 30,000 FT. B. PGNS PREDICTED INSERTION HA GREATER THAN TARGET VALUE PLUS 40 N.M. C. PGNS PREDICTED INSERTION WEDGE ANGLE GREATER THAN 1.0 DEGREE.
	5-105	THE GROUND WILL NOT REQUEST SWITCHOVER AFTER AGS TGO LESS THAN 30 SEC.
		RULES 5-106 THRU 5-110 ARE RESERVED.

REV	ITEM	
	5-111	THE PGNCS IS PRIME FOR CSI, COH, AND TPI MANEUVER COMPUTATION/EXECUTION WITH THE AGS AS BACKUP UTILIZING THE ACCEPTED SOLUTION. THE AVAILABLE SOLUTIONS FOR THESE MANEUVERS ARE PGNS, CMC, AND AGS. A. THE FOLLOWING VOTING LOGIC WILL BE OBSERVED FOR ALL MANEUVERS--- 1. COMPARE PGNS AND CMC. IF THEY AGREE EXECUTE PGNS SOLUTION. 2. IF "1" ABOVE FAILS, COMPARE PGNS AND AGS. IF THEY AGREE, EXECUTE PGNS SOLUTION. 3. IF "2" ABOVE FAILS, EXECUTE CMC SOLUTION. B. AGREEMENT BETWEEN SOURCES IS DEFINED AS--- 1. CSI = 3 FPS IN DELTA VZ 2. COH = 2 FPS IN DELTA VX-- 6 FPS IN DELTA VZ 3. TPI = 2 FPS IN DELTA VX-- 3 FPS IN DELTA VY-- 6 FPS IN DELTA VZ C. THE CMC SOLUTION FOR THE PLANE CHANGE MANEUVER WILL ALWAYS BE EXECUTED IF GREATER THAN 3 FPS IN MAGNITUDE. NOTE--- FOR CASES WHEN A
	5-112	RENDEZVOUS PLANS SHALL, WHERE POSSIBLE, SATISFY THE FOLLOWING CONSTRAINTS--- A. RENDEZVOUS MANEUVERS MUST BE AT LEAST 30 MIN APART. B. THE NOMINAL DELTA H FOR TPI WILL BE 15 NM ABOVE OR BELOW. C. THE REQUIRED ELEVATION ANGLE OF 24.8 DEG (BELOW) OR 28.3 DEG (ABOVE) WILL BE TARGETED TO OCCUR 25 MINUTES PRIOR TO SUNRISE. D. ARRIVAL AT THE TPI ELEVATION ANGLE CANNOT BE MOVED EARLIER THAN 21 MINUTES PRIOR TO SUNRISE. RULES 5-113 THROUGH 5-120 ARE RESERVED.

REV	ITEM	
	5-121	TRANSEARTH MCC WILL BE TARGETED TO ACHIEVE ENTRY CONDITIONS AS FOLLOWS--- A. IF VEI GREATER THAN 31000 FPS USE STEEP TARGET LINE. B. IF VEI LESS THAN 31000 FPS AND GEN GO. USE SHALLOW TARGET LINE. C. TRANSEARTH MIDCOURSE CORRECTION NOMINAL EXECUTION POINTS WILL BE AT THE FOLLOWING--- 1. TEI +15 HRS. 2. EI - 22 HRS. 3. EI - 3 HRS.
	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---MCC8). C. THE LAST MCC WILL BE SCHEDULED NO LATER THAN EI-3 HOURS. D. THE GEN WILL BE THE PRIMARY MODE OF EXECUTION FOR ALL TEC MCC. E. MCC GREATER THAN 10 FPS WILL USE THE SPS IF PRACTICAL.
	5-123	TEC MCC FOR LANDING AREA CONTROL--- A. PRIOR TO EI-24 HRS---WILL BE EXECUTED FOR RECOVERY ACCESS VIOLATIONS. UNACCEPTABLE WEATHER AT IP. OR IF ANY PART OF THE OPERATIONAL FOOTPRINT IS ON LAND. B. 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 3 AND 5 G'S. B. EMS RANGING WILL NOT BE ATTEMPTED UNTIL V IS LESS THAN 25500 FPS.
	5-126	WEATHER AVOIDANCE WITH AERODYNAMIC LIFT WILL NOT BE ATTEMPTED UNLESS THE GEN IS OPERATIONAL. OR EMS-INDICATED VELOCITY IS LESS THAN 25500 FPS.

REV	ITEM	
	5-127	PREDICTED ENTRY CORRIDOR VIOLATION AFTER THE LAST MCC OPPORTUNITY--- A. UNDERSHOOT LINE EXCEEDED--- GROUND ADVISE CREW TO FLY FULL LIFT UNTIL PEAK G IS PASSED; THEN FLY G6N. B. OVERSHOOT LINE EXCEEDED---GROUND ADVISE CREW TO FLY NEGATIVE LIFT TO 2 G'S FOLLOWED BY A G CONSTANT ENTRY.
	5-128	IF THE EMS INDICATES A SKIP CONDITION, NEGATIVE LIFT SHOULD BE ACHIEVED PRIOR TO VERIFYING THE EMS WITH CROSS CHECKS.
	5-129	IF THE EMS INDICATES AN UNDERSHOOT CONDITION EXISTS, FULL LIFT SHOULD BE ACHIEVED PRIOR TO VERIFYING THE EMS WITH CROSS CHECKS.
	5-130	THE G6N IS NO-GO DURING ENTRY IF--- A. P63 VALUE OF VL DIFFERS FROM THE GROUND COMPUTED LIMITS B. P63 VALUE OF DL DIFFERS FROM THE GROUND COMPUTED LIMITS. C. CAUSES TRAJECTORY TO VIOLATE THE OFFSET LIMITS (SKIP) ON EMS SCROLL. D. CAUSES TRAJECTORY TO VIOLATE THE ONSET LIMITS (G) ON EMS SCROLL. E. IF THE G6N TRIM ATTITUDES AT CM/SM SEP DIFFER FROM THE HORIZON MONITOR ATTITUDE BY GREATER THAN 5 DEG. F. IF THE G6N TRIM ATTITUDES AT .05 G DIFFERS FROM THE GROUND VALUES BY GREATER THAN 5 DEG. G. IF THE CMC FAILS TO SEQUENCE FROM P63 TO P64 AT RET .05 G +/- 5 SEC.

REV	ITEM	
		! RANGE SAFETY RULES AND AGREEMENTS !
		! GENERAL !
	5-140	RANGE SAFETY POLICIES AND CRITERIA ARE SPECIFIED IN AFETR MANUAL (AFETRM) 127-1 DATED 1 JANUARY 1969. THE FOLLOWING MISSION RULES CONCERNING SPECIFIC AFETR/NASA INTERFACE SUPPLEMENT AFETRM 127-1.
	5-141	THE RSO WILL ACCOMPLISH THE PAD EMERGENCY RANGE CUTOFF PROCEDURE IF THE SPACE VEHICLE WILL NOT LIFT OFF AFTER IGNITION AND NASA IS UNABLE TO ACCOMPLISH CUTOFF. THE RSO WILL SEND "ARM/MECO" ONLY IN RESPONSE TO A CODED VERBAL REQUEST FROM THE NASA LAUNCH VEHICLE TEST CONDUCTOR (LTC). THE LTC WILL CALL THE RSO ON THE LTC-RSO DIRECT LINE TO TRANSMIT THIS REQUEST. THE RSO WILL NOT EXECUTE THIS PROCEDURE IF HE HAS A LIFTOFF INDICATION.
	5-142	THE FLIGHT DIRECTOR (FD) WILL INITIATE ABORT IN RESPONSE TO A CODED VERBAL REQUEST FROM THE RSO. THIS PROCEDURE WILL BE EXECUTED IF RANGE SAFETY FLIGHT TERMINATION CRITERIA HAVE BEEN VIOLATED AND RSO EFFORTS TO TERMINATE THRUST HAVE FAILED. THE REQUEST FROM RSO TO FD WILL BE TRANSMITTED ON THE FLIGHT DIRECTOR LOOP WITH THE FIDO-RSO PRIVATE LINE AS BACKUP.
	5-143	THE RSO WILL SEND "ARM/MECO" IN RESPONSE TO A CODED VERBAL REQUEST FROM THE FLIGHT DIRECTOR (FD) OR THE FLIGHT DYNAMICS OFFICER (FIDO). THIS PROCEDURE WILL BE EXECUTED IF ABORT LIMITS HAVE BEEN EXCEEDED AND ABORT ACTION HAS BEEN UNSUCCESSFUL. THE REQUEST FROM FD/FIDO TO THE RSO WILL BE TRANSMITTED ON THE RSO LOOP (CAPE 1111) WITH THE FIDO-RSO PRIVATE LINE AS BACKUP.
	5-144	THE FD WILL INFORM THE RSO WHEN THE S-IC NO. 3 OR NO. 4 ENGINE HAS SHUT DOWN BY STATING "RSO: NO. 3 OUT (NO. 4 OUT)" ON THE RSO LOOP (CAPE 1111) AND/OR ACTIVATE THE ENGINE CUT LIGHT ON THE RSO CONSOLE. THE NO. 3 ENGINE OUT LIGHT CIRCUIT FOR FD TO RSO IS HIGHLY DESIRABLE.
	5-145	IF RANGE SAFETY DESTRUCT LINES ARE VIOLATED, THE RSO WILL SEND "ARM/MECO" AND NOTIFY THE FD/FIDO. NO SPS THRUSTING WILL BE INITIATED FOLLOWING SUCH RANGE SAFETY ACTION.
	5-146	IF AN ESTABLISHED IMPACT PREDICTION (IP) POINT IS ON THE CAPE KENNEDY LAND AREA, "DESTRUCT/FD" WILL BE TRANSMITTED.

REV	ITEM
	5-131

TEI ABORTS AND RESIDUAL TRIMMING PHILOSOPHY.

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

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

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

3. FOR PREMATURE SHUTDOWN---

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

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

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

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

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

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

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

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

RULES 5-132 THRU 5-139 ARE RESERVED.

REV	ITEM	
	5-147	IF AN ATTEMPT TO TERMINATE THRUST BY "ARM/MFCO" IS UNSUCCESSFUL WHILE THE IP IS ON THE CAPE KENNEDY LAND AREA, "DESTRUCT/PD" WILL BE SENT.
	5-148	WHEN THE IP HAS MOVED OFF THE CAPE, FLIGHT TERMINATION ACTION WILL BE LIMITED TO "ARM/MFCO" OR CREW INITIATED ABORT. THE "DESTRUCT/PD" FUNCTION WILL BE SENT ONLY AFTER FD/FIDO CONFIRMATION OF SATISFACTORY SPACECRAFT SEPARATION, AND ONLY IF FUEL DISPERSION IS NECESSARY.
	5-149	IF AN IP POINT IS ESTABLISHED AND "DESTRUCT/PD" IS DEEMED UNNECESSARY, THE RSO WILL NOTIFY FD/FIDO. "SAFE WILL BE SENT UPON FD/FIDO'S REQUEST---"RSO SEND SAFE".
	5-150	FD/FIDO WILL DECLARE TO THE RSO WHEN THERE IS NO POSSIBILITY OF INSERTING THE SPACECRAFT INTO AN ORBIT, AND THE RSO WILL NOT ALLOW THE AFRICAN GATE TO BE OVERFLOWN.
	5-151	AN ETR RANGE SAFETY OFFICER (BRSO) IS REQUIRED AT BERMUDA TO MONITOR PRESENT POSITION AND IMPACT PREDICTION CHARTS, TO OBSERVE TELEMETRY DISPLAYS, AND TO TRANSMIT THE RANGE SAFETY FUNCTIONS WHEN COMMANDED TO DO SO BY THE RSO. FOR FLIGHT AZIMUTHS LESS THAN 090 DEGREES THE BRSO WILL ASSUME PRIMARY RANGE SAFETY RESPONSIBILITY IN THE EVENT OF LOSS OF COMMUNICATIONS BETWEEN THE BRSO AND THE RSO.
	5-152	SAFING BY THE RSO WILL BE TRANSMITTED AFTER GATE PENETRATION AND FIRST S-IVB CUTOFF WHEN THE FD/FIDO REQUESTS---"RSO SEND SAFE." WHEN SAFING IS CONFIRMED, THE RSO WILL STATE "SAFING CONFIRMED". IN THE EVENT OF LOSS OF COMM WITH FD/FIDO, THE RSO WILL SEND SAFE ONLY IF HE CAN CONFIRM S-IVB CUTOFF.
	5-153	IF SAFING CANNOT BE CONFIRMED BY THE RSO, ANOTHER SAFING ATTEMPT WILL BE MADE BY THE RSO ON THE FIRST ORBITAL PASS OVER THE CAPE. COORDINATION WILL BE EFFECTED WITH THE SUPERINTENDENT OF RANGE OPERATIONS (SRO) AND FIDO TO ENSURE COMMAND COVERAGE, AND TELEMETRY DISPLAY AVAILABILITY. AT THE AGREED TIME, FIDO WILL STATE, " RSO SEND SAFE". UPON CONFIRMATION, THE RSO WILL STATE, "SAFING CONFIRMED".
	5-154	THE FD/FIDO WILL INFORM THE RSO IMMEDIATELY UPON DETERMINATION OF A SPACECRAFT SEPERATION. THIS NOTIFICATION WILL BE TRANSMITTED ON THE RSO LOOP (CAPE 1111) WITH THE FIDO-RSO PRIVATE LINE AS BACKUP.

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

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

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

REV	ITEM	
		' COMMUNICATIONS '
	5-162	ONE (1) OF TWO (2) PRIVATE, INDEPENDENT, GEOGRAPHICALLY DIVERSIFIED COMMUNICATIONS LINKS BETWEEN THE RSO AND BRSO IS MANDATORY AND THE OTHER IS HIGHLY DESIRABLE.
	5-163	ONE (1) OF THE FOLLOWING THREE (3) COMMUNICATIONS LINKS IS MANDATORY BETWEEN THE RSO AND FD/FIDO AND THE OTHERS ARE HIGHLY DESIRABLE. (1) RSO LOOP (CAPE 111) . (2) RSO PRIVATE LINE. (3) FLIGHT DIRECTOR LOOP.
	5-164	A COMMUNICATIONS LINK BETWEEN THE RSO AND THE RANGE SAFETY SUPERVISOR (CRSS) AT THE LAUNCH CONTROL CENTER IS MANDATORY FOR T-40 MINUTE DESTRUCT CHECKS.
	5-165	A DIRECT LINE COMMUNICATIONS LINK BETWEEN THE RSO AND THE LAUNCH VEHICLE TEST CONDUCTOR (CLTC) IS HIGHLY DESIRABLE.

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

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

$ SLV = TB1 THROUGH
TB4/TB4A (LAUNCH)

REV	ITEM

SUMMARY OF LAUNCH PHASE RULES

6-1 S-IC LOSS OF THRUST
6-2 LOSS OF ATTITUDE CONTROL
6-3 INERTIAL PLATFORM FAILURE - ACCELEROMETER
6-4 SLV INERTIAL PLATFORM FAILURE
6-7 S-II LOSS OF THRUST
6-8 S-II GIMBAL SYSTEM FAILURE
6-9 S-II SECOND PLANE SEPERATION FAILS
6-10 S-IVB LOSS OF HYDRAULIC FLUID
6-11 S-IVB LOSS OF THRUST
6-12 S-IVB COLD HELIUM SHUTOFF VALVE(S) FAIL OPEN

THE FOLLOWING MISSION RULES ALSO APPLY TO THIS SECTION---
NONE

REV	ITEM
1	

A. BSE GENERALIZED SWITCH SELECTOR COMMAND CAPABILITY EXISTS---

1. WHEN CREW ENABLES IU COMMAND SYSTEM (EXCEPT AS NOTED BELOW IN ITEM D)

2. AFTER TB7 + 20 MIN.

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

C. BSE HAS NAVIGATION UPDATE CAPABILITY (FMR 6-3) AND TARGET UPDATE CAPABILITY (FMR 6-4)

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

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

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

1. A CATASTROPHIC HAZARD

2. ACHIEVEMENT OF AN S-IVB ENGINE MAINSTAGE BURN WITH EXPECTED CUTOFF OR SHUTDOWN CONDITIONS DEFINITELY PRECLUDING AN ACCEPTABLE LUNAR MISSION. IN APPLYING THIS CRITERIA TO SPECIFIC MISSION RULES, A GO/NO GO RECOMMENDATION WILL BE REQUIRED IF INSUFFICIENT S-IVB CONSUMABLES OR PROPULSION PERFORMANCE IS AVAILABLE TO ASSURE ANY FINITE PROBABILITY OF ACHIEVING A CUTOFF ORBIT WITH 65,000 N.M. APOGEE ALTITUDE.

G. IN THE EVENT OF NO S-IVB IGNITION AT RESTART OR AN EARLY S-IVB SECOND BURN CUTOFF, THE SPACECRAFT SHOULD REMAIN ATTACHED TO THE S-IVB/IU AND MONITOR LH2 AND LOX ULLAGE PRESSURES UNTIL THE STAGE STATUS CAN BE ASSESSED BY GROUND. IF EMERGENCY SEPARATION IS REQUIRED IMMEDIATELY AFTER S-IVB CUTOFF, THE SPACECRAFT SHOULD IMMEDIATELY GO TO A SAFE DISTANCE (7000 FT) FROM THE S-IVB/IU.

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

6-1 S-IC LOSS OF THRUST

6-2 LOSS OF ATTITUDE CONTROL

**6-7 S-II LOSS OF THRUST

**6-8 S-II ANY SINGLE ACTUATOR HARDOVER INBOARD

6-9 S-II SECOND PLANE SEPARATION FAILS TO OCCUR AT TB3 + 31 SEC

6-10 S-IVB LOSS OF ENGINE HYDRAULIC FLUID PRIOR TO FIRST S-IVB BURN

6-11 S-IVB STAGE LOSS OF THRUST

6-12 S-IVB COLD HELIUM SHUTOFF VALVE(S) FAILS OPEN

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

6-4 LAUNCH VEHICLE INERTIAL PLATFORM FAILURE-ATTITUDE REFERENCE

7-8 LOSS OF ATTITUDE CONTROL DURING TB5, TB7

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

**6-7 S-II LOSS OF THRUST

**6-8 S-II ANY SINGLE ACTUATOR HARDOVER INBOARD

**6-12 S-IVB COLD HELIUM SHUTOFF VALVE(S) FAILS OPEN

** TIME DEPENDENT

REV	ITEM	
		K. TLI INHIBIT PRIOR TO RESTART OR SPACECRAFT SEPARATION WILL BE RECOMMENDED FOR THE FOLLOWING---
		7-1 INSUFFICIENT PROPELLANTS REMAIN FOR ACHIEVEMENT OF ACCEPTABLE ALTERNATE MISSIONS.
		7-5 FAILURE OF RANGE SAFETY SYSTEM AFTER INSERTION
		7-8 LOSS OF ATTITUDE CONTROL
		7-22 S-IVB LOSS OF ENGINE HYDRAULIC FLUID
		8-6 S-IVB ACTUATOR CONFIRMED HARDOVER PRIOR TO TB6 + 9 MIN 10 SEC
		8-8 LOSS OF ATTITUDE CONTROL DURING S-IVB SECOND BURN
		L. SPACECRAFT SEPARATION OR TLI INHIBIT WILL BE RECOMMENDED UNLESS COMMAND ACTION IS SUCCESSFUL FOR THE FOLLOWING---
		7-4 J-2 ENGINE MAIN OXIDIZER VALVE FAILS TO CLOSE AT FIRST SIVB CUTOFF
		*7-6 S-IVB COLD HELIUM SHUTOFF VALVES FAIL TO CLOSE
		*7-14 S-IVB STAGE COMMON BULKHEAD DELTA PRESSURE REACHES OR EXCEEDS +36 OR -26 PSID
		7-20 J-2 ENGINE START BOTTLE PRESSURE OUTSIDE RESTART LIMITS
		* EMERGENCY SEPARATION REQUIRED
		M. FOR EARLY SPACECRAFT SEPARATION THE CREW SHOULD ENABLE THE IU COMMAND SYSTEM AND THE BSE SHOULD GROUND COMMAND TO LOCK OPEN THE IU COMMAND SYSTEM, PRIOR TO SPACECRAFT SEPARATION IF AT ALL POSSIBLE.
		N. BSE WILL INHIBIT TB6 IN THE EVENT A TLI NO-GO DECISION IS MADE IN TB5.
		O. THERE MUST BE AT LEAST AN 80 MIN COAST PERIOD BETWEEN SIVB FIRST AND SECOND BURNS.

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	6-1	S-IC STAGE LOSS OF THRUST	LAUNCH	A. CONTINUE MISSION	A&B. CUES---
		A. ANY SINGLE ENGINE PRIOR TO T83		BSE INFORM FLIGHT AND FIDO.	1. THRUST OK SWITCHES - OFF (K33-115 THROUGH K47-115)
		B. ANY TWO OR MORE ENGINES		B. ABORT/CONTINUE MISSION	2. THRUST CHAMBER PRESSURE LESS THAN 500 PSIA (D8-101 THROUGH D8-105).
		1. PRIOR TO DEACTIVATION OF TWO ENGINES AUTO ABORT		1. ABORT BSE INFORM FLIGHT AND TRANSMIT ABORT REQUEST.	3. LONGITUDINAL ACCELERATION - ZERO (A2-603).
		2. AFTER DEACTIVATION OF TWO ENGINES AUTO ABORT		2. CONTINUE MISSION BSE INFORM FLIGHT AND FIDO. CAPCOM ADVISE CREW OF POTENTIAL OVERRATE CONDITION.	4. FINAL THRUST OR CUTOFF - ON (K52-115 THROUGH K56-115).
					A&B. NOTE---
					CREW MAY DEACTIVATE AUTOMATIC ABORT AFTER T83 + 120 SEC.
		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)	LAUNCH	C. CONTINUE MISSION	C. CUES---
				BSE INFORM FLIGHT AND FIDO. FLIGHT INFORM RSO.	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).
		1. VOICE COMM WITH RSO		1.(A) FLIGHT CONFIRM ENGINE 3 OR 4 OUT VIA RSO PRIVATE LINE.	3. ENGINE 3 OR 4 FINAL THRUST OR CUTOFF (K54-115, K55-115).
					C. NOTES---
				(B) FLIGHT CONFIRM NO OTHER KNOWN ANOMALIES BY LITE ACTIVATION AND VOICE REPORT.	1. RSO LOOP 115 OR FD LOOP BACKUP TO PL.
					2. CONFIRMATION OF NO OTHER KNOWN ANOMALIES WILL BE BASED ON ENGINE CHAMBER PRESSURE NOT DECREASING AND TOK SWITCHES ON.
		2. NO VOICE COMM WITH RSO		2. FLIGHT CONFIRM ENGINE 3 OR 4 OUT AND NO OTHER KNOWN ANOMALIES BY LITE ACTIVATION.	

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	6-2	LOSS OF ATTITUDE CONTROL A. PRIOR TO T01 + 2 MIN	LAUNCH	A. CONTINUE MISSION SSE INFORM FLIGHT AND FIDO CREW WILL ABORT ON LIMITS (NOTE A.1)	CUES--- A.1. ANGULAR RATES-PITCH (R4-602)OR YAW (R5-602) GREATER THAN 2 DEG/SEC AND NOT DECREASING. ROLL (R6-602) GREATER THAN 5 DEG/SEC AND NOT DECREASING. 2. ANGULAR RATES-PITCH (R13-602) OR YAW (R6-602) GREATER THAN 2 DEG/SEC AND NOT DECREASING. ROLL (R12-602) GREATER THAN 5 DEG/SEC AND NOT DECREASING (SEE NOTE A.2) 3. LOSS OF ATTITUDE CONTROL ALERT (SEE NOTE A.3.) NOTES--- A.1. CREW ABORT LIMITS--- (A) PITCH AND YAW RATE +/- 4 DEG/SEC (B) ROLL RATE +/- 20 DEG/SEC (C) PITCH, YAW, OR ROLL ERROR +/- 5 DEG AND G-BALL DELTA P +/- 3.2 PSID 2. THESE CUES ARE VALID IF RATE CHANNEL SWITCHOVER HAS NOT OCCURRED. 3. LOSS OF ATTITUDE CONTROL ALERT WILL BE GIVEN FOR THE FOLLOWING CONDITIONS--- (A) LVDC/LVDA COMPUTATIONAL FAILURE (B) ATTITUDE ERROR SIGNALS GREATER THAN +/- 5 DEG. (C) FAILURE TO INITIATE PROPER GUIDANCE SEQUENCE (D) S-IC ENGINE ACTUATOR HARDOVER GREATER THAN +/- 5 DEG.
		B. BETWEEN T01 + 2 MIN AND T05 INITIATE	LAUNCH	B. CONTINUE MISSION SSE INFORM FLIGHT AND FIDO CREW WILL ABORT ON LIMITS (NOTE B.1.)	CUES--- B.1. ANGULAR RATES - PITCH (R4-602), YAW (R5-602), OR ROLL (R6-602) GREATER THAN 5 DEG/SEC AND NOT DECREASING. 2. ANGULAR RATES - PITCH (R13-602), YAW (R6-602), OR ROLL (R12-602) GREATER THAN 5 DEG/SEC AND NOT DECREASING. (SEE NOTE B.2) 3. LOSS OF ATTITUDE CONTROL ALERT. (SEE NOTE B.3) NOTES--- B.1 CREW ABORT LIMITS--- (A) PITCH OR YAW RATE +/- 10 DEG/SEC (B) ROLL RATE +/- 20 DEG/SEC 2. THESE CUES ARE VALID IF RATE CHANNEL SWITCH OVER HAS NOT OCCURRED. NOTES---

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	6-2 CONT				3. LOSS OF ATTITUDE CONTROL ALERT WILL BE GIVEN FOR THE FOLLOWING CONDITIONS--- (A) LVDC/LVDA COMPUTATIONAL FAILURE. (B) ATTITUDE ERROR SIGNALS PITCH, YAW, OR ROLL GREATER THAN + 3 DEG (TB1 + 120 SEC AND S-IC BURN)-- ROLL GREATER THAN +/- 3.5 DEG, PITCH AND YAW GREATER THAN +/- 3 DEG (S-IVB BURN ONLY) (C) FAILURE TO INITIATE PROPER GUIDANCE SEQUENCE (D) S-IVB ENGINE ACTUATOR HARDOVER GREATER THAN +/- 3 DEG (S-II BURN ONLY) (E) FAILURE OF S-IVB ENGINE HYDRAULICS (S-IVB BURN ONLY) 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 3 DEG AND NOT DECREASING. (M10-603, M11-603, M12-603) NOTES--- 1. NO EFFECT ON VEHICLE TRAJECTORY DURING S-IC STAGE BURN. 2. LVDC SWITCHES TO A BACKUP MODE AND UTILIZES A PRECOMPUTED P/M PROFILE FOR FAILED AXIS DURING THE S-IC, S-II, AND S-IVB BURNS. THE IU STATE VECTOR THERE AFTER MAY NOT REFLECT THE ACTUAL FLIGHT TRAJECTORY. 3. IU STATE VECTOR AT INSERTION MAY BE NO GO AND A NAV UPDATE MAY BE REQUIRED FOR PROPER INITIATION OF TB6 AND PROPER TLI GUIDANCE. 4. CREW WILL INITIATE MANUAL S-IVB CUTOFF FOR OVERSPEED. 5. THE SECOND BURN PRECOMPUTED P/M PROFILE FOR THE FAILED AXIS ASSUMES NOMINAL PROPULSION PERFORMANCE AND NOMINAL MASS HISTORY.
I	6-3	INERTIAL PLATFORM FAILURE - ACCELEROMETER (ONE OR MORE AXIS)	LAUNCH COAST RESTART	CONTINUE MISSION BSE INFORM FLIGHT FIDO, AND GUIDO CAPCOM ADVISE CREW	CUES--- 1. GUIDANCE STATUS WORD (MODE CODE 24 (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 3 DEG AND NOT DECREASING. (M10-603, M11-603, M12-603) NOTES--- 1. NO EFFECT ON VEHICLE TRAJECTORY DURING S-IC STAGE BURN. 2. LVDC SWITCHES TO A BACKUP MODE AND UTILIZES A PRECOMPUTED P/M PROFILE FOR FAILED AXIS DURING THE S-IC, S-II, AND S-IVB BURNS. THE IU STATE VECTOR THERE AFTER MAY NOT REFLECT THE ACTUAL FLIGHT TRAJECTORY. 3. IU STATE VECTOR AT INSERTION MAY BE NO GO AND A NAV UPDATE MAY BE REQUIRED FOR PROPER INITIATION OF TB6 AND PROPER TLI GUIDANCE. 4. CREW WILL INITIATE MANUAL S-IVB CUTOFF FOR OVERSPEED. 5. THE SECOND BURN PRECOMPUTED P/M PROFILE FOR THE FAILED AXIS ASSUMES NOMINAL PROPULSION PERFORMANCE AND NOMINAL MASS HISTORY.

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	6-4	LAUNCH VEHICLE INERTIAL PLATFORM FAILURE - ATTITUDE REFERENCE	ALL	CONTINUE MISSION BSE INFORM FLIGHT AND RECOMMEND SPACECRAFT GUIDANCE TAKEOVER IF THE FAILURE OCCURS DURING LAUNCH PHASE OR ORBIT PHASE, BSE SEND TARGET UPDATE (SEE NOTE 2)	CUES--- 1. GUIDANCE REFERENCE FAILURE (D04 OR D06 MODE CODE 26 BIT D8 SET TO "ONE" (H60-603) 2. GUIDANCE STATUS WORD-(MODE CODE 24) (H60-603) BITS D20 AND D19 FOR Z GIMBAL SET TO "ONE" BITS D18 AND D17 FOR X GIMBAL SET TO "ONE" BITS D16 AND D15 FOR Y GIMBAL SET TO "ONE" 3. LADDER OUTPUTS CONSTANT FOR FILED AXES (H54-603, H55-603, H56-603) 4. ATTITUDE ERROR CONSTANT FOR FAILED AXES(H69-602, H70-602, H71-602) NOTES--- 1. IN THE EVENT OF THIS FAILURE PRIOR TO T06, THE CREW WILL HAVE TO INITIATE T06. 2. FOR AN ATTITUDE REFERENCE FAILURE DURING LAUNCH PHASE, OR ORBIT PHASE A LAUNCH VEHICLE TARGET UPDATE SHOULD BE SENT PRIOR TO T05 + 2 HR 0 MIN. THE TARGET UPDATE SHOULD BE ACCOMPLISHED SO THAT THE LVDC COMPUTED T06 INITIATE TIME WILL OCCUR SEVERAL MINUTES LATER THAN THE CREW INITIATED T06 TIME.

RULE NUMBERS 6-5 THROUGH 6-6 ARE RESERVED

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	6-7	S-II LOSS OF THRUST	LAUNCH		A. CUES---
		A. ANY SINGLE ENGINE FAILURE TO ATTAIN THRUST OR LOSS OF THRUST PRIOR TO NOMINAL S-II CUTOFF		A. CONTINUE MISSION BSE INFORM FLIGHT AND FIDO.	1. THRUST OK SWITCHES-OFF (K205-201 THROUGH 205; K206-201 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. THRUST OK SWITCHES OFF (K205-201 THROUGH 205-- K206-201 THRU 205) 2. THRUST CHAMBER PRESSURE ZERO (D13-201 THROUGH 205) 3. LONGITUDINAL ACCELERATION (A2-603) 4. COMMANDED ANGLES AND GIMBAL ANGLES (H60-603)
		1. IF THE DIFFERENCE IN COMMANDED AND GIMBAL ANGLES IS LESS THAN 40 DEG IN PITCH AND YAW		1. CONTINUE MISSION BSE INFORM FLIGHT AND FIDO.	
		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	B.1. NOTE--- CREW WOULD ABORT ON OVERRATE CONDITION.
		C. THREE OR MORE ENGINES OUT		C. ABORT/EARLY STAGE/ CONTINUE MISSION	C. CUES---
		1. PRIOR TO S-IVB TO CO2 CAPABILITY		1. ABORT BSE INFORM FLIGHT AND TRANSMIT ABORT REQUEST.	C.1. THRUST OK SWITCHES OFF (K205-201 THRU 205-- K206-201 THRU 205) 2. THRUST CHAMBER PRESSURE ZERO (D13-201 THRU 205) 3. LONGITUDINAL ACCELERATION (A2-603)
		2. AFTER S-IVB TO CO2 CAPABILITY BUT PRIOR TO LOW LEVEL SENSE ARM		2. EARLY STAGE BSE INFORM FLIGHT AND RECOMMEND EARLY STAGING.	C. NOTE--- AFTER PROGRAMMED S-II CENTER ENGINE CUTOFF, ENGINES OUT REFERS ONLY TO CONTROL ENGINES.
		3. AFTER LOW LEVEL SENSE ARM		3. EARLY STAGE/ CONTINUE MISSION	
		(A) 3 CONTROL ENGINES OUT		(A) EARLY STAGE BSE INFORM FLIGHT AND RECOMMEND EARLY STAGE.	
		(B) ALL ENGINES OUT		(B) CONTINUE MISSION BSE INFORM FLIGHT	

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	6-8	S-II STAGE ANY SINGLE ACTUATOR HARDOVER INBOARD A. PRIOR TO S-IVB TO COI CAPABILITY B. BETWEEN S-IVB TO COI CAPABILITY AND 30 SEC PRIOR PRIOR TO S-II CUTOFF C. AFTER S-II CUTOFF MINUS 30 SEC	LAUNCH	ABORT/EARLY STAGE/CONTINUE MISSION A. ABORT- BSE INFORM FLIGHT AND TRANSMIT ABORT REQUEST B. EARLY STAGE BSE INFORM FLIGHT AND RECOMMEND EARLY STAGING C. CONTINUE MISSION- BSE INFORM FLIGHT	CUES--- 1. YAW ACTUATOR POSITION EXCEEDS +8 DEG (68-201 THRU 204; 830-201 THRU 204) 2. PITCH ACTUATOR POSITION EXCEEDS +8 DEG (69-201 THRU 204; 831-201 THRU 204) 3. ADJACENT CONTROL ENGINE ACTUATOR IN SAME PLANE MOVES 4 1/2 DEG INBOARD (SAME MEASUREMENTS AS CUES 1 AND 2) NOTES--- 1. THE CREW SHOULD ABORT OR EARLY STAGE AS SOON AS POSSIBLE AFTER MALFUNCTION OCCURS TO PRECLUDE EXCESSIVE THERMAL PROBLEM IN APT INTERSTAGE.
	6-9	S-II SECOND PLANE SEPARATION FAILS TO OCCUR AT TB3 + 31 SEC	LAUNCH	ABORT BSE INFORM FLIGHT AND TRANSMIT ABORT REQUEST. CREW ABORT PRIOR TO TB3 + 86 SEC.	CUES--- 1. SECOND PLANE SEPARATION INDICATION SHOWS NO SEPARATION (M86-206; M87-206) 2. GUIDANCE MODE WORD 1 MODE CODE 28 BIT D15 REMAINS ZERO (M60-605). 3. IGNITION BUS VOLTAGE RE- MAINS AT APPROXIMATELY 28 VOLTS (M129-207). 4. RECIRCULATION BUS VOLTAGE REMAINS AT APPROXIMATELY 56 VOLTS (M111-207) NOTES--- THE CREW SHOULD ABORT AS SOON AS POSSIBLE AFTER MALFUNCTION OCCURS TO PRECLUDE EXCESSIVE THERMAL PROBLEMS IN APT INTERSTAGE.

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	6-10	S-IVB LOSS OF ENGINE HYDRAULIC FLUID PRIOR TO S-IVB BURN	LAUNCH	NO SIVB START BSE INFORM FLIGHT AND FIDO AND RECOMMEND NO S-IVB START. CAPCOM ADVISE CREW	CUES--- 1. HYDRAULIC RESERVOIR OIL LEVEL APPROX ZERO PERCENT (LT-403). 2. HYDRAULIC SYSTEM PRESSURE LESS THAN 1700 PSIA (D41- 403). 3. HYDRAULIC RESERVOIR PRES- SURE APPROX ZERO PSIA (D42-403). NOTES--- 1. LT-403 PLUS ONE OF THE OTHER CUES ARE REQUIRED FOR IMPLEMENTATION OF THIS RULE. 2. IF ALL THREE CUES ARE FUNCTIONING PROPERLY, THEY ARE REQUIRED FOR IMPLEMENTATION OF THIS RULE. 3. SPACECRAFT SHOULD HAVE COI CAPABILITY AT S-II CUTOFF 4. AT SII CUTOFF, THE CREW SHOULD INHIBIT THE SIVB START WITH THE TRANSLATION HANDCONTROLLER.
	6-11	S-IVB STAGE LOSS OF THRUST A. FAILS TO ATTAIN THRUST OR PREMATURE SHUTDOWN PRIOR TO OBTAINING PARKING ORBIT B. FAILS TO ATTAIN THRUST OR PREMATURE SHUTDOWN PRIOR TO VELOCITY CUTOFF FOR SECOND BURN	 LAUNCH TLI	 A. SPACECRAFT SEPARATION BSE INFORM FLIGHT AND FIDO B. CONTINUE MISSION BSE INFORM FLIGHT AND FIDO. THE SPACECRAFT SHOULD REMAIN ATTACHED TO THE S-IVB/IU AND MONITOR LH2 AND LOX TANK ULLAGE PRESSURES. IF SEPARATION IS REQUIRED, THE SPACECRAFT SHOULD IMMEDIATELY GO TO A SAFE DISTANCE (7000 FT) FROM THE S-IVB/IU.	CUES--- 1. THRUST CHAMBER PRESSURE = ZERO (D1-403). 2. THRUST OK SWITCHES = OFF (K14-403, K15?-403). 3. LONGITUDINAL ACCELERATION = ZERO (A2-403). 4. TBS IS INITIATED, MODE CODE 25, BIT D2 SET TO ONE (M60-603). 5. TBT IS INITIATED, MODE CODE 26, BIT D20 SET TO ONE (M60-603) NOTE--- SEPARATION WILL BE REQUIRED FOR VIOLATION OF PMR T-6 OR PMR T-14.

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	8-12	S-IVB COLD HELIUM SHUTOFF VALVE(S) FAILS OPEN	LAUNCH		CUES---
		A. PRIOR TO LAUNCH ESCAPE TOWER JETTISON AND LOX TANK ULLAGE PRESSURE IS 50 PSIA OR SATURATED AT UPPER LEVEL		A. ABORT BSE INFORM FLIGHT AND TRANSMIT ABORT REQUEST	A. 1. LOX TANK ULLAGE PRESSURE (D179-406) 2. LOX TANK ULLAGE PRESSURE (D180-406)
		B. BETWEEN LAUNCH ESCAPE TOWER JETTISON AND 30 SEC PRIOR TO SII CUTOFF		B. EARLY STAGE BSE INFORM FLIGHT AND RECOMMEND EARLY STAGING IMMEDIATELY	B&C 1. COLD HELIUM REG DISCHARGE PRESSURE REMAINS GREATER THAN 200 PSIA FOR A MINIMUM OF 20 SECONDS (D183-403)
		C. AFTER S-II CUTOFF MINUS 30 SEC		C. CONTINUE MISSION BSE INFORM FLIGHT	2. LOX ULLAGE PRESSURE AT RELIEF SETTING (41-44 PSIA) AND RELIEVING (D179-406; D180-406) 3. COLD HE BOTTLE PRESSURE DECAYING (D261-403, D263-403)

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	6-10	S-IVB LOSS OF ENGINE HYDRAULIC FLUID PRIOR TO S-IVB BURN	LAUNCH	NO SIVB START BSE INFORM FLIGHT AND FIDO AND RECOMMEND NO S-IVB START. CAPCOM ADVISE CREW	CUES--- 1. HYDRAULIC RESERVOIR OIL LEVEL APPROX ZERO PERCENT (LT-403). 2. HYDRAULIC SYSTEM PRESSURE LESS THAN 1700 PSIA (D41- 403). 3. HYDRAULIC RESERVOIR PRES- SURE APPROX ZERO PSIA (D42-403). NOTES--- 1. LT-403 PLUS ONE OF THE OTHER CUES ARE REQUIRED FOR IMPLEMENTATION OF THIS RULE. 2. IF ALL THREE CUES ARE FUNCTIONING PROPERLY, THEY ARE REQUIRED FOR IMPLEMENTATION OF THIS RULE. 3. SPACECRAFT SHOULD HAVE COI CAPABILITY AT S-II CUTOFF 4. AT SII CUTOFF, THE CREW SHOULD INHIBIT THE SIVB START WITH THE TRANSLATION HANDCONTROLLER.
	6-11	S-IVB STAGE LOSS OF THRUST			CUES---
		A. FAILS TO ATTAIN THRUST OR PREMATURE SHUTDOWN PRIOR TO OBTAINING PARKING ORBIT	LAUNCH	A. SPACECRAFT SEPARATION BSE INFORM FLIGHT AND FIDO	1. THRUST CHAMBER PRESSURE = ZERO (D1-403). 2. THRUST OR SWITCHES = OFF (R14-403, R15T-403). 3. LONGITUDINAL ACCELERATION = ZERO (A2-403).
		B. FAILS TO ATTAIN THRUST OR PREMATURE SHUTDOWN PRIOR TO VELOCITY CUTOFF FOR SECOND BURN	TLI	B. CONTINUE MISSION BSE INFORM FLIGHT AND FIDO. THE SPACECRAFT SHOULD REMAIN ATTACHED TO THE S-IVB/IU AND MONITOR LH2 AND LOX TANK ULLAGE PRESSURES. IF SEPARATION IS REQUIRED, THE SPACECRAFT SHOULD IMMEDIATELY GO TO A SAFE DISTANCE (7000 FT) FROM THE S-IVB/IU.	4. T85 IS INITIATED. MODE CODE 25, BIT D2 SET TO ONE (M60-403). 5. T87 IS INITIATED. MODE CODE 26, BIT D20 SET TO ONE (M60-403) NOTE--- SEPARATION WILL BE REQUIRED FOR VIOLATION OF FMR 7-6 OR FMR 7-16.

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	6-12	S-IVB COLD HELIUM SHUTOFF VALVE(S) FAILS OPEN	LAUNCH		CUES---
		A. PRIOR TO LAUNCH ESCAPE TOWER JETTISON AND LOX TANK ULLAGE PRESSURE IS 50 PSIA OR SATURATED AT UPPER LEVEL		A. ABORT BSE INFORM FLIGHT AND TRANSMIT ABORT REQUEST	A. 1. LOX TANK ULLAGE PRESSURE (D179-406) 2. LOX TANK ULLAGE PRESSURE (D180-406)
		B. BETWEEN LAUNCH ESCAPE TOWER JETTISON AND 50 SEC PRIOR TO S1I CUTOFF		B. EARLY STAGE BSE INFORM FLIGHT AND RECOMMEND EARLY STAGING IMMEDIATELY	B,C,&D 1. COLD HELIUM REG DISCHARGE PRESSURE REMAINS GREATER THAN 200 PSIA FOR A MINIMUM OF 20 SECONDS (D105-403)
		C. AFTER S-II CUTOFF MINUS 50 SEC		C. CONTINUE MISSION BSE INFORM FLIGHT	2. LOX ULLAGE PRESSURE AT RELIEF SETTING (41-44 PSIA) AND RELIEVING (D179-406, D180-406)
		D. BETWEEN TB3 + 5 MIN 32 SEC AND S-II CUTOFF MINUS 50 SEC - FOR PREMATURE S-II ENGINE(S) CUTOFF ONLY		D. EARLY STAGE BSE INFORM FLIGHT AND RECOMMEND EARLY STAGING	3. COLD HE BOTTLE PRESSURE DECAYING (D261-403, D263-403)

? SLV - TB6 AND
TB7(COAST)

REV	ITEM

SUMMARY OF COAST PHASE RULES

7-1 INSUFFICIENT PROPELLANT
7-2 LOSS OF ONE APS MODULE
7-3 MAIN FUEL VALVE FAILS TO CLOSE
7-4 MAIN OXIDIZER VALVE FAILS TO CLOSE
7-5 RANGE SAFETY SYSTEM NOT SAFED AFTER INSERTION
7-6 COLD HELIUM SHUTOFF VALVE FAILS OPEN
7-7 AUXILIARY HYDRAULIC PUMP FAILS
7-8 LOSS OF ATTITUDE CONTROL
7-9 CONTINUOUS VENT REGULATOR FAILS TO OPEN
7-10 APS ULLAGE ENGINE FAILS ON
7-11 RESERVED
7-12 RESERVED
7-13 IU ENVIRONMENTAL CONTROL SYSTEM FAILS
7-14 COMMON BULKHEAD DELTA P
7-15 LOSS OF S-IVB STAGE PNEUMATICS
7-16 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 33 PSIA
7-20 J-2 ENGINE START BOTTLE PRESSURE OUTSIDE RESTART LIMITS
7-21 PU VALVE FAILURE
7-22 S-IVB LOSS OF HYDRAULIC FLUID
7-23 RESERVED
7-24 RESERVED
7-25 LOX NON-PROPULSIVE VENT FAILS TO OPEN
7-26 LH2 LATCHING VENT VALVE FAILS TO OPEN
7-27 GH2 START BOTTLE DUMP FAILS TO OCCUR
7-28 COLD HELIUM DUMP FAILS TO OCCUR
7-29 RESERVED
7-30 RESERVED

THE FOLLOWING MISSION RULES ALSO APPLY TO THIS SECTION---

6-3 INERTIAL PLATFORM FAILURE - ACCELEROMETER
6-4 LAUNCH VEHICLE INERTIAL PLATFORM FAILURE-ATTITUDE REFERENCE

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	7-1	PRIOR TO RESTART, INSUFFICIENT PROPELLANT REMAINS FOR ACHIEVEMENT OF ACCEPTABLE ALTERNATE MISSION.	EARTH ORBIT	NO S-IVB RESTART BSE INFORM FLIGHT AND RECOMMEND NO S-IVB RESTART.	CUE--- PROPELLANT REMAINING AS ASCERTAINED DURING REAL-TIME EVALUATIONS
	7-2	LOSS OF ONE APS MODULE			
		A. TBS TO TB6+9 "20"	EARTH ORBIT TLC	A. CONTINUE MISSION 1. BSE INFORM FLIGHT AND COMMAND- S-IVB BURN MODE ON 2. CREW WILL STABILIZE THE VEHICLE WITH CSM RCS	CUES--- 1. MANIFOLD PRESSURE MOD. 1 (D70-4141, D71-4141) 2. MANIFOLD PRESSURE MOD. 2 (D72-4151, D73-4151)
		B. TB7 TO TB7+15 MIN		B. CONTINUE MISSION 1. BSE INFORM FLIGHT AND COMMAND - S-IVB BURN MODE ON AND TDGE MANEUVER INHIBIT 2. CREW WILL STABLIZE VEHICLE WITH CSM RCS	
		C. TB7+15 MIN TO LM EJECTION		C. CONTINUE MISSION 1. BSE INFORM FLIGHT AND COMMAND - SIVB BURN MODE ON 2. CREW DISCRETION FOR DOCKING	
		D. LM EJECTION TO EVASIVE MANEUVER INITIATE		D. CONTINUE MISSION 1. BSE INFORM FLIGHT AND COMMAND - S-IVE BURN MODE ON 2. SPACECRAFT WILL DO EVASIVE MANEUVER 3. DO NOT INITIATE TB8 4. BSE PERFORM NON-PROPULSIVE S-IVB SAFING BY GROUND COMMAND	
		E. AFTER EVASIVE ATTITUDE MANEUVER		E. CONTINUE MISSION BSE INFORM FLIGHT AND 1. AFTER ULLAGE BURN, COMMAND - S-IVB BURN MODE ON 2. AFTER LOX DUMP AND PRIOR TO APS BURN, COMMAND - S-IVB BURN MODE OFF	NOTES--- LIMITS IN FMR 7-8 CONDITION/MALFUNCTION "D" DO NOT APPLY TO THE FAILURE IN 7-2 CONDITION/MALFUNCTION E.

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	T-3	J-2 ENGINE MAIN FUEL VALVE (MFV) FAILS TO CLOSE AT--- 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 CYCLE AND CLOSE MFV IF SUCCESSFUL, BSE COMMAND--- 3. PREVALVE AND RECIRC SHUTOFF VALVES OPEN	CUES--- 1. MAIN FUEL VALVE POSITION (S4-4031). 2. MAIN FUEL VALVE OPEN (E118-4013). 3. FUEL FLOWMETER FLOWRATE (F2-4011). 4. FUEL RECIRC FLOWRATE (F5-4041). 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 T-1). 3. A FAILURE FOLLOWING SECOND BURN CUTOFF WILL REQUIRE A RE-EVALUATION OF SLINGSHOT VELOCITY DESIRED.
		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 AT TIME OF DESIRED LOX DUMP TERMINATION, BSE COMMAND--- 4. PREVALVES AND RECIRC SHUTOFF VALVES CLOSE	

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	7-4	J-2 ENGINE MAIN OXIDIZER VALVE (MOV) FAILS TO CLOSE AT--- A. FIRST S-IVB CUTOFF	EARTH ORBIT	A. CONTINUE MISSION/ NO S-IVB RESTART BSE INFORM FLIGHT AND COMMAND (ASAP)--- 1. PREVALVES AND RECIRC SHUTOFF VALVES CLOSED 2. ATTEMPT TO CLOSE MOV IF A.2 IS SUCCESSFUL, BSE INFORM FLIGHT AND COMMAND 3. PREVALVES AND RECIRC SHUTOFF VALVES OPEN IF A.2. IS UNSUCCESSFUL, BSE INFORM FLIGHT AND RECOMMEND NO SIVB RESTART	CUES--- 1. MAIN OXIDIZER VALVE POSITION (G3-601) GREATER THAN 10 DEG. 2. MAIN OXIDIZER VALVE OPEN-ON (K120-601). 3. LOX FLOWMETER FLOWRATE (F1-601) GREATER THAN 47 LB/SEC. NOTES--- 1. THIS FAILURE FOLLOWING SECOND CUTOFF WILL REQUIRE A REEVALUATION OF SLINGSHOT VELOCITY DESIRED. 2. IF THE MOV IS OPEN, THE LOX PUMP INLET PRESSURE WILL GO TO ZERO AFTER COMMAND ACTION (A.1)
		B. SECOND BURN CUTOFF	TLC	B. CONTINUE MISSION BSE INFORM FLIGHT AND COMMAND--- 1. PREVALVES AND RECIRC SHUTOFF VALVES CLOSED 2. ATTEMPT TO CLOSE MOV AT INITIATION OF LOX DUMP, BSE COMMAND--- 3. PREVALVES AND RECIRC SHUTOFF VALVES OPEN AT TIME OF DESIRED LOX DUMP TERMINATION, BSE COMMAND--- 4. PREVALVES AND RECIRC VALVES CLOSED.	

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	7-5	RANGE SAFETY SYSTEM NOT SAFED AFTER INSERTION A. PROPELLANT DISPERSION SYSTEM NOT ARMED B. PROPELLANT DISPERSION SYSTEM ARMED AND RSO HAS NOT SENT MECO	EO	A. CONTINUE MISSION BSE INFORM FLIGHT AND RECOMMEND RSO SEND SAFE COMMAND B. SPACECRAFT SEPARATION BSE INFORM FLIGHT AND 1. RECOMMEND SPACECRAFT SEPARATION TO A SAFE DISTANCE (7000 FT). 2. WHEN SPACECRAFT HAS REACHED A SAFE DISTANCE: RECOMMEND RSO SEND SAFE COMMAND.	CUES--- 1. FIRING UNIT 1 RS EBW GREATER THAN OR EQUAL TO 1.6 VOLTS (M30-411). 2. FIRING UNIT 2 RS EBW GREATER THAN OR EQUAL TO 1.6 VOLTS (M31-411). 3. RANGE SAFETY RECEIVER NO. 1 ENABLE (N57-411) BETWEEN 2.4 AND 4.5 VOLTS. 4. RANGE SAFETY RECEIVER NO. 2 ENABLE (N62-411) BETWEEN 2.4 AND 4.5 VOLTS. 5. RSO DISPLAY AND COMMAND SYSTEM STATUS. NOTES--- 1. RSO SHOULD NOT ATTEMPT TO SAFE THE RANGE SAFETY RECEIVERS ON REVS 2 AND 3 UNTIL MCC CONFIRMS THE PROPELLANT DISPERSION SYSTEM IS NOT ARMED (CONDITION A ONLY). 2. EITHER CUE 1 OR CUE 2 IS SUFFICIENT FOR IMPLEMENTING RULE B. 3. CUES 364 ARE VALID ONLY WHEN THE VEHICLE IS RECEIVING 450 MHZ RADIATION.
	7-6	S-IVB STAGE COLD HELIUM SHUTOFF VALVES FAIL TO CLOSE AT--- A. TB5 + 1.4 SEC	EARTH ORBIT	A. CONTINUE MISSION/SPACECRAFT SEPERATION BSE INFORM FLIGHT AND COMMAND--- 1. LOX NPV VALVE OPEN (REF NOTE 3) 2. ATTEMPT TO CLOSE STAGE COLD HELIUM SHUTOFF VALVES IF 2 SUCCESSFUL, BSE COMMAND IMMEDIATELY--- 3. LOX NPV VALVE CLOSE (REF NOTE 3) 4. IF LOX ULLAGE PRESSURE AT 50 PSIA OR SATURATED BSE INFORM FLIGHT AND RECOMMEND IMMEDIATE SPACECRAFT SEPERATION TO A SAFE DISTANCE.	CUES--- 1. COLD HELIUM REGULATOR DISCHARGE PRESSURE GREATER THAN 200 PSIA (D0105-403). 2. LOX TANK ULLAGE PRESSURES (D0179-406,D0180-406). 3. COLD HELIUM BOTTLE PRESSURE DECAYING (D261-403, D263-403). NOTES--- 1. ACTION REQUIRED TO AVOID EXCEEDING LOX TK OVER PRESS OR BULKHEAD POSTIVE DELTA PRESS LIMITS (FMR7-14). 2. SEE FMR 7-18 FOR RESTART CRITERIA FOR OFF-NOMINAL COLD HELIUM PRESSURE. 3. IF LOX NPV VALVE FAILS TO OPEN THE LOX VENT VALVE CAN BE OPENED AS BACKUP.

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
		B. TB7 + 1:1 SEC	TLC	B. CONTINUE MISSION AFTER TB7 + 2 MIN 30 SEC: BSE INFORM FLIGHT AND COMMAND--- 1. LOX NPV VALVE OPEN (REF NOTE 3) AT TB7 + 15 MIN BSE SEND--- 2. LOX NPV VALVE CLOSE (REF NOTE 3)	
	7-7	S-IVB AUXILIARY HYDRAULIC PUMP FAILS			CUES--- A.1. SYSTEM PRESSURE (D41-403). 2. RESERVOIR LEVEL (LT-403). 3. AFT BUS NO. 2 CURRENT (M22-4041). 4. HYDRAULIC RESERVOIR OIL PRESSURE (D42-403).
		A. TO TURN OFF AS SEQUENCED	EARTH ORBIT	A. CONTINUE MISSION BSE INFORM FLIGHT AND 1. ATTEMPT TO TURN OFF AUXILIARY HYDRAULIC PUMP AS SOON AS POSSIBLE	NOTES--- FAILURE TO TURN OFF HYDRAULIC PUMP DEPLETES AFT NO. 2 BATTERY IN APPROXIMATELY 90 MIN AND OVERHEATS HYDRAULIC SYSTEM IN APPROXIMATELY 70 MIN
		B. TO TURN ON 1. AS SEQUENCED AND THE HYDRAULIC FLUID TEMP IS BELOW OR PREDICTED TO DROP BELOW 10 DEG F BEFORE NEXT STATION AOS		B. CONTINUE MISSION 1. BSE INFORM FLIGHT AUXILIARY HYDRAULIC AND ATTEMPT TO TURN ON PUMP	CUES--- B.1. SYSTEM PRESSURE (D41-403). 2. RESERVOIR OIL LEVEL (LT-403). 3. AFTER BUS NO. 2 CURRENT (M22-4041). 4. RESERVOIR PRESSURE (D42-403). 5. HYDRAULIC PUMP INLET OIL TEMP (C50-403). 6. RESERVOIR OIL TEMP (C51-403).
		2. AT TB6 + 3 MIN 39 SEC	TLS	2. BSE INFORM FLIGHT AND COMMAND AUXILIARY HYDRAULIC PUMP OFF	

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	7-8	LOSS OF ATTITUDE CONTROL DURING			CUES---
		A. TB5 AND TB7 TO TB7 + 15 MIN	EARTH ORBIT/ TLC	A. SPACECRAFT GUIDANCE TAKEOVER/ SPACECRAFT SEPARATION BSE INFORM FLIGHT AND RECOMMEND SPACECRAFT GUIDANCE TAKEOVER IF UNSUCCESSFUL; BSE RECOMMEND SPACECRAFT SEPARATION	A. 1. ANGULAR RATES - PITCH (R4-602), OR YAW (R5-602) GREATER THAN 0.5 DEG/SEC AND NOT DECREASING; OR ROLL (R6-602, R12-602), GREATER THAN 0.5 DEG/SEC AND NOT DECREASING . 2. ANGULAR RATES-PITCH (R13-602), OR YAW (R8-602) GREATER THAN 0.5 DEG/SEC AND NOT DECREASING; OR ROLL (R12-602) GREATER THAN 0.5 DEG/SEC AND NOT DECREASING (SEE NOTE 3) 3. LOSS OF ATTITUDE CONTROL ALERT (SEE NOTE 2)
		B. TB6 TO TB6 + 9 MIN 20 SEC	TLI	B. TLI INHIBIT BSE INFORM FLIGHT AND RECOMMEND TLI INHIBIT	B. 1. ANGULAR RATES - PITCH (R4-602), YAW (R5-602), OR ROLL (R6-602) GREATER THAN 0.5 DEG/SEC AND NOT DECREASING 2. ANGULAR RATES-PITCH (R-13-602),YAW (R8-602), OR ROLL (R12-602) GREATER THAN 0.5 DEG/SEC AND NOT DECREASING GREATER THAN 0.5 DEG/SEC AND NOT DECREASING, OR ROLL (R12-602) GREATER THAN 0.5 DEG/SEC AND NOT DECREASING (SEE NOTE 3) 3. LOSS OF ATTITUDE CONTROL ALERT (SEE NOTE 2)

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	7-8 CONT	C. AFTER TB7 + 15 MIN	TLC	C. CREW DISCRETION BSE INFORM FLIGHT AND FIDO 1. DO NOT START EVASIVE MANEUVER 2. DO NOT INITIATE TB8 3. BSE PERFORM NON-PROPULSIVE SIVB SAFING BY GROUND COMMAND.	C. 1. ANGULAR RATES (A) FROM TB7+15 MIN TO NEXT MANEUVER INITIATE AFTER TD&E MANUEVER- PITCH (R4-602); YAW (R5-602); OR ROLL (R6-602) GREATER THAT 0.7 DEG/SEC AND NOT DECREASING. (B) AFTER NEXT MANEUVER INITIATE FOLLOWING TD&E MANEUVER AND BEFORE TD&E INITIATE- PITCH OR YAW GREATER THAN 0.3 DEG/SEC AND NOT DECREASING OR ROLL GREATER THAN 0.5 DEG/SEC AND NOT DECREASING. 2. ANGULAR RATES (SEE NOTE 3) (A) FROM TB7+15 MIN TO NEXT MANEUVER INITIATE AFTER TD&E MANEUVER- PITCH (R13-602); YAW (R6-602); OR ROLL (R12-602) GREATER THAN 0.7 DEG/SEC AND NOT DECREASING. (B) AFTER NEXT MANEUVER INITIATE FOLLOWING TD&E MANEUVER AND BEFORE TB8 INITIATE- PITCH OR YAW GREATER THAN 0.3 DEG/SEC AND NOT DECREASING OR ROLL GREATER THAN 0.5 DEG/SEC AND NOT DECREASING. 3. LOSS OF ATTITUDE CONTROL ALERT (SEE NOTE 2)

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	T-0 CONT	0. AFTER TB8 INITIATE	TLC	0. CONTINUE MISSION BSE INFORM FLIGHT AND FIDO AND TERMINATE---> 1. PROPELLANT DUMP 2. ULLAGE ENGINE BURNS	0. 1. ANGULAR RATES PITCH (R4-602); OR YAW (R5-602) GREATER THAN 0.5 DEG/SEC AND NOT DECREASING; OR ROLL (R6-602) GREATER THAN 0.5 DEG/SEC AND NOT DECREASING. 2. ANGULAR RATES- PITCH (R13-602); OR YAW (R8-602) GREATER THAN 0.5 DEG/SEC AND NOT DECREASING; OR ROLL (R6-602) GREATER THAN 0.5 DEG/SEC AND NOT DECREASING (SEE NOTE 3) 3. LOSS OF ATTITUDE CONTROL ALERT (SEE NOTE 3) 1. IMMEDIATELY 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 ROLL GREATER THAN 3.5 DEG (TB5 TO TB7 + 15 MIN) GREATER THAN 6.5 DEG (AFTER TB7 + 15 MIN TO NEXT MANUEVER INITIATE FOLLOWING THE TD&E MANUEVER) AND GREATER THAN 3.5 DEG. (AFTER NEXT MANEUVER INITIATE FOLLOWING THE TD&E MANEUVER); AND PITCH AND YAW GREATER THAN 2.5 DEG. (TB5; TB7+0 MIN TO TB7+15 MIN); GREATER THAN 3.5 DEG. (TB6 TO TB6+383 SEC) GREATER THAN 6.5 DEG (TB7+15 MIN TO NEXT MANEUVER INITIATE FOLLOWING TD&E MANEUVER) AND GREATER THAN 2.5 DEG. (AFTER NEXT MANEUVER FOLLOWING TD&E MANEUVER) (C) FAILURE TO INITIATE PROPER GUIDANCE SEQUENCE 3. THESE CUES ARE VALID IF RATE CHANNEL SWITCHOVER HAS NOT OCURRED 4. LOSS OF ATTITUDE CONTROL ALERT IS SUFFICIENT FOR IMPLEMENTING THIS RULE

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	7-9	CONTINUOUS VENT SYSTEM (CVS) REGULATOR FAILS TO OPEN IN TB5 (TB5 + 59 SEC)	EARTH ORBIT TLI	CONTINUE MISSION BSE INFORM FLIGHT AND 1. ATTEMPT TO OPEN CVS RELIEF OVERRIDE SHUTOFF VALVE IF UNSUCCESSFUL, BSE--- 2. VENT THE LH2 TANK PRIOR TO TB6 + 8 MIN 40 SEC TO A VALUE BELOW THE PRESSURE REQUIRED FOR S-IVB RESTART. IF THE LH2 BLOWDOWN IS COMPLETED WITHIN 30 MINUTES PRIOR TO TB6 INITIATE COMMAND--- 3. ULLAGE ENGINES ON AFTER 90 SEC OF ULLAGE SEND--- 4. ULLAGE ENGINES OFF ULLAGING SHOULD BE COMPLETED PRIOR TO THE AMBIENT REPRESSURIZATION.	CUES--- 1. CVS NOZZLE PRESSURE (D101-409, D102-409). 2. CVS REGULATOR CLOSED (K154-411). 3. LH2 ULLAGE PRESSURE (D177-408, D178-408). NOTES--- 1. IF THE CVS REGULATOR FAILS TO OPEN, THE LH2 SATURATION TEMPERATURE WILL INCREASE ABOVE NOMINAL RESTART LIMITS. 2. COMMAND ACTION WILL REQUIRE EVALUATION OF LH2 RESIDUALS TO DETERMINE ADEQUACY FOR TLI VELOCITY CUTOFF.
			EARTH ORBIT	IF NEITHER COMMAND ACTION(S) 1 NOR 2 IS SUCCESSFUL, BSE INFORM FLIGHT	

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	7-10	APS VILLAGE ENGINE(S) THRUST FAILS TO TERMINATE AT SEQUENCED TIMES	EARTH ORBIT/ TLI/TLC	CONTINUE MISSION BOE INFORM FLIGHT AND ATTEMPT TO TERMINATE VILLAGE ENGINE THRUST IF UNSUCCESSFUL; BOE INFORM FLIGHT OF IMPENDING LOSS OF ATTITUDE CONTROL CAPABILITY	CUES--- 1. VILLAGE ENGINE THRUST CHAMBER PRESSURE (D220-414; D221-415). 2. APS HELIUM SPHERE PRESSURE DECREASING (D35-414; D36-415; D250-414; D251-415).
		RULE NUMBERS 7-11 AND 7-12 ARE RESERVED.			

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	7-13	SV ECS WATER VALVE FAILS TO CYCLE OPEN AND CLOSED A. WATER VALVE CLOSED AND COOLANT INLET CONTROL TEMPERATURE IS 64 DEG. F OR HIGHER; AND THE INERTIAL GIMBAL TEMPERATURE IS 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 125 DEG. F BEFORE THE NEXT SITE AOS B. WATER VALVE OPEN AND COOLANT INLET CONTROL TEMP IS 35 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.	ALL	A. CONTINUE MISSION BSE INFORM FLIGHT AND SEND--- 1. ECS LOGIC INHIBIT COMMAND 2. WATER VALVE OPEN B. CONTINUE MISSION BSE INFORM FLIGHT AND SEND--- 1. ECS LOGIC INHIBIT COMMAND 2. WATER VALVE CLOSED	CUES--- 1. WATER VALVE CLOSED/OPEN (69-601; 84-601). 2. ME/MSO TEMP (C15-601). 3. GNC MODE CODE 27 BIT DO SET TO ZERO (N60-601). 4. S1-124 INERTIAL GIMBAL TEMP (C34-601). 5. SUBLIMATOR INLET TEMP (C11-601). 6. LVDC MEMORY TEMP (C54-601). 7. LVDA TEMP NO. 1 (C55-601). 8. LVDA TEMP NO. 2 (C56-601).

REV	ITEM	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 BE INFORM FLIGHT AND COMMAND--- LH2 AND/OR LOX VENT VALVES OPEN OR CLOSED TO PRECLUDE REACHING SEPARATION LIMITS B. SPACECRAFT SEPARATION BE INFORM FLIGHT AND FIDO AND RECOMMEND SPACECRAFT SEPARATION TO A SAFE DISTANCE	CUES--- 1. LH2 TANK ULLAGE PRESSURE (D177-406, D178-406). 2. LOX TANK ULLAGE PRESSURE (D180-406, D179-406) 3. LH2 PUMP INLET PRESSURE (D2-403). 4. LOX PUMP INLET PRESSURE (D3-403). NOTES--- 1. MINUS DELTA PRESSURE IS DEFINED AS A FUEL TANK ULLAGE PRESSURE GREATER THAN THE LOX TANK ULLAGE PRESSURE. 2. PLUS DELTA PRESSURE IS DEFINED AS A LOX TANK ULLAGE PRESSURE GREATER THAN THE FUEL TANK ULLAGE PRESSURE. 3. THE MINIMUM RECOMMENDED DISTANCE BETWEEN THE S-IVB AND THE SPACECRAFT IS 7,000 FT. 4. THE BULKHEAD WILL STRUCTURALLY FAIL AT THE ULTIMATE LIMITS OF MINUS 38.5 PSID OR PLUS 42.0 PSID.

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	7-15	S-IVB STAGE PNEUMATIC SUPPLY PRESSURE DECAY EXCESSIVE IN TBS OR TBT	EARTH ORBIT TLC	CONTINUE MISSION BSE INFORM FLIGHT AND 1. ATTEMPT TO TERMINATE PUMP PURGE AND/OR CLOSE AMBIENT HELIUM SUPPLY SHUTOFF VALVE. 2. RE-OPEN AMBIENT HELIUM SUPPLY SHUTOFF VALVE AS REQUIRED.	CUES--- 1. ENGINE PUMP PURGE PRESSURE (D0030-403). 2. AMBIENT HELIUM PNEUMATIC SPHERE PRESSURE (D0236-403; D0296-403). 3. LOX REPRESS SUPPLY PRESSURE (D0088-403; D0294-403). NOTE--- 1. AN EXCESSIVE PNEUMATIC SUPPLY PRESSURE DECAY IS ONE WHICH WILL RESULT IN DEPLETION OF STAGE PNEUMATIC PRIOR TO COMPLETION OF TBS SAFING AND SLINGSHOT FUNCTIONS.
	7-16	S-IVB ENGINE CONTROL BOTTLE PRESSURE LESS THAN 400 PSIA	EARTH ORBIT/ TLI	CONTINUE MISSION BSE INFORM FLIGHT	CUES--- 1. ENGINE CONTROL BOTTLE PRESSURE (019-403; D242-403). 2. REPRESSURIZATION BOTTLE PRESSURE (020-403; D08-403; D249-403; D254-403). NOTE--- THE 400 PSIA LIMIT IS VALID ONLY IF THE REPRESS SPHERES ARE AVAILABLE FOR BACKUP.

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	7-17	LOW LH2 TANK ULLAGE PRESSURE		CONTINUE MISSION	CUES---
		A. LH2 TANK ULLAGE PRESSURE LESS THAN 17 PSIA IN TB 5	EARTH ORBIT TLI	A. CONTINUE MISSION BSE INFORM FLIGHT AND COMMAND	1. LH2 ULLAGE PRESSURE (D177-400; D178-408).
					2. LH2 PUMP INLET PRESSURE (D2-403).
				1. LH2 TANK VENT VALVES BOOST CLOSE ON AND OFF AND/OR CVS REGULATOR CLOSED; (ORIFICE OPEN) (NOTE 1)	3. LH2 VENT CLOSED DISCRETES (K1-410; K210-410).
				IF THE SITUATION CANNOT BE CORRECTED; AFTER INITIATION OF BURNER REPRESS; BSE COMMAND---	NOTES---
				2. SECOND BURN RELAY OFF.	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.
		B. LH2 TANK ULLAGE PRESSURE DELTA FROM AMBIENT REPRESS LESS THAN REQUIRED AT TB6 9 MIN 10 SEC.		B. CONTINUE MISSION BSE INFORM FLIGHT	2. IF LH2 TANK ULLAGE PRESSURE DROPS BELOW 19.5 PSIA DURING TB5; RESULTING PROPELLANT LOSSES SHOULD BE INCLUDED IN THE EVALUATION OF CAPABILITY TO ACHIEVE ACCEPTABLE ALTERNATE MISSION PER FMR 7-1.
	7-18	LOW COLD HELIUM SUPPLY PRESSURE			CUE---
		A. EXCESSIVE COLD HELIUM SUPPLY PRESSURE DECAY (NOTE 1)	EARTH ORBIT	A. CONTINUE MISSION BSE INFORM FLIGHT AND COMMAND FROM LAST STATION PRIOR TO TB6---	COLD HELIUM SPHERE PRESSURE (D261-409; D263-409).
				1. BURNER LOX SHUTDOWN VALVE CLOSE ON	
		B. LESS THAN 800 PSIA PRIOR TO RESTART	TLI	C. CONTINUE MISSION BSE INFORM FLIGHT	NOTES--- 1. AN EXCESSIVE COLD HELIUM SUPPLY PRESSURE DECAY IS ONE WHICH WILL RESULT IN A COLD HELIUM BOTTLE PRESSURE OF LESS THAN 1000 PSIA AT TB6 INITIATE OR LESS THAN 800 PSIA AT COMPLETION OF CRYOGENIC REPRESSURIZATION

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	7-19	LOW LOX TANK ULLAGE PRESSURE	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).
		A. LOX ULLAGE PRESSURE LESS THAN 31 PSIA IN TB5			
		B. LOX ULLAGE PRESSURE LESS THAN 20 PSIA FOR FIRST OPPORTUNITY RESTART OR LESS THAN 23 PSIA FOR SECOND OPPORTUNITY RESTART AT TB6 + 9 MIN 20 SEC		B. CONTINUE MISSION BSE INFORM FLIGHT	
	7-20	J-2 ENGINE START BOTTLE PRESSURE OUTSIDE RESTART LIMITS	EARTH ORBIT		CUES--- 1. START BOTTLE PRESSURE (D17-401; D241-401)
		A. ABOVE 1400 PSIA DURING ORBITAL COAST FOR FIRST OPPORTUNITY RESTART OR ABOVE 1500 PSIA FOR SECOND OPPORTUNITY RESTART		A. CONTINUE MISSION BSE INFORM FLIGHT AND SEND--- 1. START BOTTLE VENT OPEN FOR 3 SEC 2. REPEAT COMMAND AS NECESSARY TO INSURE A PRESSURE OF LESS THAN 1400 PSIA FOR FIRST OPPORTUNITY RESTART OR 1500 PSIA FOR SECOND OPPORTUNITY RESTART	
		B. ABOVE 1500 PSIA PRIOR TO RESTART		B. SPACECRAFT SEPARATION BSE INFORM FLIGHT AND FIDO AND RECOMMEND SPACECRAFT SEPARATION	

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	7-21	PU VALVE FAILS TO A MIXTURE RATIO GREATER THAN 5.0 TO 1 ANY TIME PRIOR TO RESTART	EARTH ORBIT/ TLI	RECOMMEND NO S-IVB RESTART 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 PMR 7-11). 2. PU FEEDBACK VOLTAGE M61: IS ONLY VALID WHEN PU SYSTEM POWER IS ON
	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	CUES--- 1. HYDRAULIC RESERVOIR OIL LEVEL APPROX ZERO PERCENT (L7-403). 2. HYDRAULIC SYSTEM PRESSURE LESS THAN 1700 PSIA (D41-403). 3. HYDRAULIC RESERVOIR PRESSURE APPROXIMATELY ZERO PSIA (D42-403). NOTES--- 1. L7-403 PLUS ONE OF THE OTHER CUES ARE REQUIRED FOR IMPLEMENTATION OF THIS RULE. 2. IF ALL 3 CUES ARE FUNCTIONING PROPERLY: THEY ARE REQUIRED FOR IMPLEMENTATION OF THIS RULE.
		RULE NUMBERS 7-23 AND 7-24 ARE RESERVED.			

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	7-25	S-IVB STAGE LOX NONPROPULSIVE VENT (NPV) FAILS A. TO OPEN AT TB7 + 0.7 SEC	TLC	A. CONTINUE MISSION BSE INFORM FLIGHT AND VENT THE LOX TANK TO 18-20 PSIA PRIOR TO TB7 + 15 MIN.	CUES--- 1. LOX NPV NOZZLE PRESSURES (D243-404; D244-404). 2. LOX TANK ULLAGE PRESSURE (D179-406; D180-406). 3. LOX NPV DISCRETES (K198-424; K199-424).
		B. TO LATCH OPEN AT TB8 + 25 MIN 22.2 SEC	TLC	B. CONTINUE MISSION BSE INFORM FLIGHT AND 1. ATTEMPT TO LATCH OPEN THE LOX VENT IF UNSUCCESSFUL, BSE COMMAND--- 2. LOX NPV OPEN IF B2 UNSUCCESSFUL, BSE COMMAND--- 3. LOX VENT OPEN	
	7-26	LH2 LATCHING VENT VALVE FAILS TO LATCH OPEN AS PROGRAMMED	TLC	CONTINUE MISSION BSE INFORM FLIGHT AND 1. ATTEMPT TO OPEN THE LH2 LATCHING VENT VALVE IF UNSUCCESSFUL, BSE COMMAND--- 2. LH2 LATCHING VENT VALVE CLOSED 3. LH2 VENT VALVE OPEN AT TB7 + 15 MIN OR TB7 + 1 HR 15 MIN COMMAND--- 4. LH2 VENT VALVE CLOSE	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).
	7-27	ENGINE START BOTTLE DUMP FAILS TO INITIATE	TLC	CONTINUE MISSION BSE INFORM FLIGHT AND ATTEMPT TO OPEN THE START BOTTLE VENT VALVE	CUES--- 1. GH2 START BOTTLE PRESSURE (D17-401; D241-401).

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	7-28	S-IVB STAGE COLD HELIUM DUMP FAILS TO INITIATE	TLC	CONTINUE MISSION SSE INFORM FLIGHT AND 1. ATTEMPT TO INITIATE THE COLD HELIUM DUMP THROUGH LH2 COIL ON O2/H2 BURNER. IF UNSUCCESSFUL, SSE INFORM FLIGHT AND AFTER LOX NPV OPEN IN TB6 COMMAND--- 2. LOX PRESSURIZATION SHUTOFF VALVES OPEN	CUES--- 1. COLD HELIUM BOTTLE PRESSURE (D261-403, D263-403).
		RULE NUMBERS 7-29 AND 7-30 ARE RESERVED.			

$ SLV - 786
(RESTART)

REV	ITEM

SUMMARY OF RESTART PHASE RULES

NOTE

MISSION RULES REQUIRING GROUND SUPPORT DURING T86 CANNOT BE IMPLEMENTED ON APOLLO 12 BECAUSE OF MSFN COVERAGE LIMITATION. THOSE RULES ARE MARKED BY AN ASTERIX.

8-1 RESERVED

*8-2 O2/H2 BURNER LH2 VALVE FAILS

*8-3 LH2 CHILLDOWN SYSTEM FAILS

*8-4 LOX CHILLDOWN SYSTEM FAILS

*8-5 RESERVED

*8-6 S-IVB ACTUATOR HARDOVER

*8-7 CONTINUOUS VENT REGULATOR FAILS TO CLOSE

8-8 LOSS OF ATTITUDE CONTROL DURING SECOND BURN

THE FOLLOWING MISSION RULES ALSO APPLY TO THIS SECTION---

8-3 INERTIAL PLATFORM FAILURE - ACCELEROMETER

8-4 LAUNCH VEHICLE INERTIAL PLATFORM FAILURE ATTITUDE REFERENCE

8-11 S-IVB STAGE LOSS OF THRUST

*7-7 S-IVB AUXILIARY HYDRAULIC PUMP FAILS

*7-8 LOSS OF ATTITUDE CONTROL DURING T86 TO T86 + 9 MIN 10 SEC (CREW IMPLEMENTATION)

*7-9 CONTINUOUS VENT REGULATOR FAILS TO OPEN

7-13 IU ECS WATER VALVE FAILS TO CYCLE OPEN AND CLOSED

7-14 S-IVB STAGE COMMON BULKHEAD DELTA PRESSURE REACHES OR EXCEEDS MINUS 30 PSID OR PLUS 30 PSID: MINUS 30 PSID OR PLUS 30 PSID (CREW IMPLEMENTATION)

*7-16 S-IVB ENGINE CONTROL BOTTLE PRESSURE LESS THAN 400 PSIA

7-17 LH2 TANK VENT FAILURE OR LEAK DURING ORBITAL COAST

*7-18 LOW COLD HELIUM SUPPLY PRESSURE

*7-19 LOX TANK ULLAGE PRESSURE LOW (CREW IMPLEMENTATION)

*7-20 J-2 ENGINE START BOTTLE PRESSURE OUTSIDE RESTART LIMITS.

*7-21 PU VALVE FAILS TO A MIXTURE RATIO GREATER THAN 5.0 TO 1 ANY TIME PRIOR TO RESTART

*7-22 S-IVB LOSS OF ENGINE HYDRAULIC FLUID

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
		RULE 8-1 IS RESERVED.			
	8-2	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. CRYO REPRESSURIZATION OFF	CUES--- 1. BURNER CHAMBER DOME TEMPERATURE (C2034-403; C302-403). 2. BURNER PROPELLANT VALVE POSITIONS (K180-404; K192-403). 3. AMBIENT REPRESSURIZATION MODE SELECT (K195-404). NOTE--- THE O2/H2 BURNER VOTING CIRCUIT WILL NOT DETECT FAILURE OF THE BURNER TO IGNITE OR BURNER FLAME-OUT IN THE EVENT THE FUEL PROPELLANT VALVE FAILS CLOSED.
	8-3	LH2 CHILLDOWN SYSTEM FAILS DURING RESTART PREPARATIONS	TLI	CONTINUE MISSION BSE INFORM FLIGHT AND--- 1. ATTEMPT TO CORRECT SITUATION SPECIFIED IN NOTE 1.A; 1.B; 1.D IF UNSUCCESSFUL, BSE INFORM FLIGHT	CUES--- 1. LH2 PUMP INLET TEMP (C3-403) 2. LH2 RECIRC FLOW (F3-404) 3. LH2 PUMP INLET PRESS (D8-403) 4. LH2 PREVALVE DISCRETES (K111-404; K112-404) 5. LH2 BLEED VALVE CLOSE (K127-401) 6. LH2 RECIRC VALVE CLOSE (K136-403) 7. LH2 ULLAGE PRESS (D177-406; D178-406). NOTES--- 1. LH2 CHILLDOWN WILL NOT BE SATISFACTORY IF--- (A) PREVALVE IS OPEN (B) RECIRCULATION VALVE IS CLOSED (C) BLEED VALVE IS CLOSED (D) CHILLDOWN PUMP IS NOT ON

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	8-4	S-IVB STAGE LOX CHILLDOWN SYSTEM FAILS DURING RESTART PREPARATIONS	TLI	CONTINUE MISSION BSE INFORM FLIGHT AND— 1. ATTEMPT TO CORRECT SITUATION SPECIFIED IN NOTE 1.a, 1.b, 1.c IF 1 IS UNSUCCESSFUL, BSE INFORM FLIGHT AND COMMAND AT TB6 + 7 MIN 42 SEC (SEE NOTE 2) 2. LOX LEAD FOR 8 SEC THRU THE PREVALVES 3. IMMEDIATELY AFTER LOX LEAD, COMMAND LOX DOME PURGE FOR 8 TO 10 SEC IF 1 OR 2 IS UNSUCCESSFUL, BSE INFORM FLIGHT AND CONTINUE MISSION. IF 2 IS NOT TERMINATED BY GROUND COMMAND AFTER 20 SEC OF PUMP, BSE INFORM FLIGHT AND RECOMMEND TLI INHIBIT	CUES— 1. LOX PUMP INLET TEMPERATURE (C4-403) 2. LOX CHILLDOWN FLOW RATE (F4-624). 3. LOX PUMP INLET PRESSURE (P3-403) AND LOX TANK ULLAGE PRESSURE (P179-506, P180-406) 4. LOX PREVALVE DISCRETES (E109-403, E110-403) 5. LOX BLEED VALVE CLOSED (E126-403) 6. LOX RECIRCULATION VALVE CLOSED (E139-624) NOTES— 1. LOX CHILLDOWN WILL NOT BE SATISFACTORY IF— (A) PREVALVE IS OPEN (B) RECIRCULATION VALVE IS CLOSED (C) BLEED VALVE IS CLOSED (D) CHILLDOWN PUMP IS NOT ON 2. THE 8-SEC LOX LEAD SHOULD BE COMMANDED AS NEAR AS POSSIBLE TO TB6 + 7 MIN 42 SEC BUT CAN BE COMMANDED AS LATE AS TB6 + 8 MIN 22 SEC. 3. THE BSE MAY ELECT NOT TO INITIATE THE LOX LEAD IF CIRCUMSTANCES INDICATE THE DESIRED LOX LEAD MAY NOT BE ACCOMPLISHED—RESTART ATTEMPT IS ACCEPTABLE WITH NO LOX LEAD.

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
I	8-5	RESERVED			
	8-6	S-IVB ACTUATOR CONFIRMED HARDOVER PRIOR TO T86 + + 8 MIN 10 SEC AND AUXILIARY HYDRAULIC PUMP IS OPERATING	TLI	TLI INHIBIT BSE INFORM FLIGHT AND RECOMMEND TLI INHIBIT	CUE--- 1. ACTUATOR POSITIONS +/- . DEG OR GREATER (61-400; 61-403; 62-400; 62-403). NOTE--- BOTH INDIVIDUAL ACTUATOR POSITIONS MUST CONFIRM MALFUNCTION PRIOR TO RECOMMENDING TLI INHIBIT.
I	8-7	S-IVB STAGE CONTINUOUS VENT SYSTEM (CVS) REGULATOR FAILS TO CLOSE DURING RESTART SEQUENCE	TLI	CONTINUE MISSION BSE INFORM FLIGHT AND COMMAND--- 1. SECOND BURN RELAY OFF 2. ATTEMPT TO CLOSE THE CVS REGULATOR IF NEITHER 1 OR 2 ARE SUCCESSFUL BSE INFORM FLIGHT 3. IF 2 IS UNSUCCESSFUL BSE COMMAND BURNER SHUTDOWN.	CUES--- 1. CVS NOZZLE PRESSURE REMAINS GREATER THAN 3 PSIA (0101-409; 0102-409). 2. CVS REGULATOR CLOSED (6104-411). 3. LH2 TANK ULLAGE PRESSURE (0177-400; 0178-409).

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	8-8	LOSS OF ATTITUDE CONTROL DURING S-IVB SECOND BURN	TLI	CONTINUE MISSION SSE INFORM FLIGHT AND FIDO. CREW WILL SEPERATE ON LIMITS (NOTE 3)	CUES--- 1. ANGULAR RATES - PITCH (84-6021) YAW (85-6021) OR ROLL (86-6021) GREATER THAN 5 DEG/SEC AND NOT DECREASING 2. ANGULAR RATES-PITCH (213-6021) YAW (88-6021) OR ROLL (812-6021) GREATER THAN 5 DEG/SEC AND NOT DECREASING. (SEE NOTE 3) 3. LOSS OF ATTITUDE CONTROL ALERT (SEE NOTE2). NOTES--- 1. TLI BURN WILL BE TERMINATED FOR--- A. PITCH OR YAW BODY RATES GREATER THAN +/- 10 DEG/SEC B. ROLL BODY RATE GREATER THAN +/-20 DEG/SEC C. PITCH OR YAW ATTITUDE DEVIATION FROM NOMINAL PROFILES GREATER THAN 45 DEG 2. LOSS OF ATTITUDE CONTROL ALERT WILL BE GIVEN FOR THE FOLLOWING CONDITIONS--- (A) LVDC/LVDA COMPUTATIONAL FAILURE. (B) ATTITUDE ERROR SIGNALS ROLL GREATER THAN +/- 3.5 DEG. PITCH AND YAW GREATER THAN +/- 5 DEG. (C) FAILURE TO INITIATE PROPER GUIDANCE SEQUENCE. (D) FAILURE OF S-IVB ENGINE HYDRAULICS. 3. THE CUES ARE VALID IF RATE CHANNEL SWITCHOVER HAS NOT OCCURRED.

SLV – T88 (SAFING AND SLINGSHOT)

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 RESERVED

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 TB6 + 9 MIN 20 SEC AFTER SPACECRAFT SEPARATION, AFTER TB8 INITIATE

7-13 EU 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

REV	ITEM	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 (D90-403). 2. AMBIENT HELIUM SUPPLY PRESSURE (D238-403, D258-403).
	9-2	S-IVB LOX DUMP FAILS TO INITIATE	TLC	CONTINUE MISSION BSE INFORM FLIGHT AND COMMAND THE MAIN OXIDIZER VALVE OPEN	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 (F1-403). NOTE--- 1. IF A LOX DUMP IS UNSUCCESSFUL, A RE-EVALUATION OF THE SLINGSHOT DELTA VELOCITY WILL BE REQUIRED.
	9-3	ENGINE CONTROL BOTTLE DUMP FAILS TO INITIATE	TLC	CONTINUE MISSION BSE INFORM FLIGHT AND 1. ATTEMPT TO OPEN THE ENGINE HELIUM CONTROL VALVE	CUE--- 1. ENGINE CONTROL REG. PRESS (D18-401). 2. ENGINE CONTROL HELIUM SPHERE PRESSURE (D19-401, D242-403).
		RULES 9-4 AND 9-5 ARE RESERVED.			

REV	ITEM

PRELAUNCH INSTRUMENTATION

MEASUREMENT DESCRIPTION	MEAS NUMBER ONBOARD	TRANSDUCERS	CATEGORY	EFFECTIVITY	MISSION RULE REF
STAGE COMMUNICATIONS SYSTEM AND FLIGHT CONTROL MEASUREMENT CATEGORIZATION					
STAGE COMMUNICATIONS SYSTEM					
S-II STAGE					
LINK BP1			MD		
MUX BP180			MD		
MUX BP180			MD		
S-IVB STAGE					
LINK CP1			MD		
MUX CP180 (VIA IU)			M		
MUX CP180			MD		
INSTRUMENT UNIT					
LINK DP1			MD		
LINK DP18			M		
MUX CP180 (VIA S-IVB)			MD		
MUX DP180			MD		
EMERGENCY DETECTION SYSTEM (EDS)			M		
COMMAND COMMUNICATIONS SYSTEM (CCS) UPLINK			M		
FLIGHT CONTROL MEASUREMENTS					
S-IVB STAGE					
PRESS: FUEL PUMP INLET	D2-403				7-14
PRESS: FUEL TANK ULLAGE EDS 1	D177-408	METER *	COMMON	2 OF 3	7-14
PRESS: FUEL TANK ULLAGE EDS 2	D178-408	METER *	COMMON	M	7-14/19
PRESS: OXID PUMP INLET	D3-403				
PRESS: OXID TANK ULLAGE EDS 1	D179-406	METER *	COMMON	2 OF 3	7-14/19;8-5
PRESS: OXID TANK ULLAGE EDS 2	D180-406	METER *	COMMON	M	7-14/19;8-5
INSTRUMENT UNIT					
GUIDANCE COMPUTER OPERATION	H60-603			M	6-1/4/7/9; 7-8/11;8-1/8
COMPUTER RESET PULSE NO. 1-GUIDANCE DECODER	J71-603			1 OF 2	REQUIRED TO COMPLETE MULTIPLE WORD GROUND COMMANDS
COMPUTER RESET PULSE NO. 2-GUIDANCE DECODER	J72-603			M	

*ONBOARD DISPLAY MANDATORY

10 CSM ENVIRONMENTAL CONTROL

REV	ITEM	
		GENERAL
	10-1	LAUNCH LAUNCH WILL BE CONTINUED AS LONG AS THE SUIT CIRCUIT AND O2 SUPPLY WILL SUPPORT FLIGHT CREW DEMANDS FOR AT LEAST ONE REV AND ENTRY INTO Z-1. THERE ARE NO COOLANT FAILURES FOR WHICH LAUNCH/INSERTION PHASE WILL BE TERMINATED. TLC & TEC WATER EVAPORATION WILL BE LIMITED TO COMPONENT TESTING. POWERED DESCENT THERE ARE NO CSM ENVIRONMENTAL CONTROL SYSTEMS FAILURES FOR WHICH POWERED DESCENT WILL BE TERMINATED. ALL PHASES A. BACKUP SYSTEMS AND BACKUP COMPONENTS WILL NORMALLY BE USED FOR THE MOST RAPID PRACTICAL RETURN TO EARTH. NOT FOR MISSION CONTINUATION. B. LM SYSTEMS WILL BE USED AS REQUIRED FOR CSM SYSTEMS BACKUP. IF CSM SYSTEMS REQUIRE LM BACKUP THE DESCENT STAGE WILL BE RETAINED WHERE POSSIBLE. C. TO CONTINUE. WATER QUANTITY PREDICTIONS MUST REFLECT ADEQUATE QUANTITIES TO MEET NORMAL MISSION REQUIREMENTS.

REV	ITEM	
	10-2	DEFINITIONS

LOSS OF CABIN INTEGRITY---

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

LOSS OF SUIT INTEGRITY---

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

LOSS OF SUIT CIRCUIT---

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

LOSS OF O2 MANIFOLD---

AN O2 MANIFOLD OR REGULATOR FAILURE WITH WHICH THE SUIT CIRCUIT O2 DEMANDS CANNOT BE SUPPLIED FOR ENTRY.

LOSS OF PRIMARY LOOP COOLING---

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

LOSS OF SECONDARY LOOP COOLING---

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

LOSS OF COOLANT LOOP RADIATORS---

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

LOSS OF ALL COOLING---

LOSS OF PRIMARY AND SECONDARY LOOP COOLING.

LOSS OF SURGE TANK AND/OR REPRESS PACK---

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

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

REV	ITEM	
1	10-10	O2 SYSTEM

! SYSTEMS MANAGEMENT !

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

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

C. DELETED

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

E. THE SUIT CIRCUIT MUST BE PURGED OF ACCUMULATED N2 ONCE EVERY 6 HOURS FOR ONE MINUTE WHEN ALL CREWMEN ARE SUITED AND THE SUIT CIRCUIT IS ISOLATED.

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

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

H. THE CM ECS WILL NORMALLY SUPPLY ALL O2 FOR CONSUMPTION AND LEAKAGE DURING IVT PHASES.

I. THE FLIGHT CREW WILL DON SUITS FOR THE FOLLOWING---

1. INABILITY TO MAINTAIN CABIN PRESSURE ABOVE 4.5 PSIA.
2. ALL UNDOCKED OPERATIONS.
3. TD&E.
4. GLYCOL LEAKS IN COMMAND MODULE.
5. FIRE, SMOKE, CONTAMINATION IN CABIN.

J. THE FLIGHT CREW WILL DOFF SUITS (TIME AND CONDITIONS PERMITTING) FOR THE FOLLOWING---

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

COOLANT MANAGEMENT

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

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

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

D. SECONDARY COOLANT WILL BE OFF FOR LAUNCH.

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

REV	ITEM
	10-10 (CONT)

WATER SYSTEM

A. WASTE WATER WILL BE MANUALLY DUMPED OVERBOARD AS REQUIRED TO MAINTAIN INDICATED QUANTITY LESS THAN 85-90 PERCENT. WASTE WATER WILL NORMALLY BE DUMPED TO 25 PERCENT. HOWEVER, IF WASTE WATER QUANTITY INSTRUMENTATION (CF0009) IS LOST, WASTE WATER WILL BE DUMPED UNTIL POTABLE WATER QUANTITY (CF0010) BEGINS TO DECREASE.

B. WATER DUMPS WILL BE MANAGED SO THAT---

1. AT LOI; THE WASTE TANK WILL CONTAIN GREATER THAN 75 PERCENT.

2. AT CM-SM SEPARATION; THE POTABLE TANK WILL BE FULL AND THE WASTE TANK WILL BE 90 PERCENT FULL.

C. IN ORDER TO REDUCE TRAJECTORY CALCULATION PERTUBATIONS; WATER DUMPS, AND FUEL CELL PURGES WILL NOT BE SCHEDULLED---

1. BETWEEN MCC 3 AND LOI-1, PLUS TWO HOURS

2. WITHIN THREE REVS OF PRE-DOI UNDOCKING

3. BETWEEN TEI AND SEXTANT STAR CHECK PRIOR TO MCC 5

4. DURING MSFN COVERAGE IN LUNAR ORBIT (DUMPS AND PURGES SHOULD BE SCHEDULED AS CLOSE TO THE LOS MIDPOINT AS POSSIBLE)

5. WITHIN ONE HOUR PRIOR TO OPTICAL NAVIGATION SIGHTINGS

6. BETWEEN MCC 6 AND EI

SYSTEM BACKUP

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

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

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
				* SPECIFIC *	
	16-20	CABIN PRESSURE CANNOT BE RELIEVED	LAUNCH	CONTINUE MISSION	NORMAL RELIEF STARTS AT 30 SECONDS
	16-21	CABIN PRESSURE DECREASING AND/OR LESS THAN 4.5 PSIA AND...			CREW OPTION TO USE LM ENVIRONMENT FOR EARTH RETURN IN LIEU OF SUITED RETURN.
		A. SUIT PRESSURE GREATER THAN 3.5 PSIA	LAUNCH	A.1. CONTINUE MISSION	
			DOI	A. ENTER NEAT NEST DTO. NO GO FOR POIA RETAIN DESCENT STAGE FOR TEI.	
			POWERED DESCENT	B. CONTINUE MISSION. NO GO FOR LUNAR STAY	
			ALL	B. ENTER NEAT NEST DTO IF CABIN PRESS NOT RESTORED GREATER THAN 4.5 PSIA.	
		B. SUIT PRESSURE LESS THAN 3.5 PSI	LAUNCH	B.1. ABORT ASAP	
			ALL	B. ENTER ASAP	
		C. LOSS OF SUIT CIRCULATION	LAUNCH	C.1. ABORT ASAP OPEN DIRECT O2 AS DEC FROM LAUNCH SETTING.	C.1. CORRESPONDS TO 12.6 LB/HR (APPROX 3 CFM/CREWMAN)
			ALL	D. ENTER ASAP	

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
1	10-22	LOSS OF SUIT CIRCUIT CABIN STABLE AND GREATER THAN 4.5 PSIA			LM SYSTEMS (IF AVAILABLE) WILL BE USED FOR CO2 AND H2O REMOVAL.
			LAUNCH	A. CONTINUE MISSION OPEN DIRECT O2 VALVE 45 DEG FROM LAUNCH SETTING.	A. CORRESPONDS TO 12.6 LB/HR (APPROX 3 CFM/CREWMAN)
			EO	B. ENTER NEXT BEST DTP 1. DOFF SUITS. 2. OPEN WASTE OVERBOARD DRAIN VALVE TO OBTAIN CABIN BLEED FLOW. 3. RUN FACE FANS AFTER 1 HOUR	B.2. WASTE OVERBOARD BLEED = 1.0 LB O2/HR B.3. TIME REQUIRED FOR CM CO2 PARTIAL PRESSURE TO INCREASE TO 7.6 MM HG 1 CREWMAN--- 6 HR. 3 CREWMAN--- 88 MIN.
			DOI	C. ENTER NEXT BEST DTP. NO GO FOR MSC RETAIN LM DESCENT STAGE FOR TEST	
			POWERED DESCENT	D. CONTINUE MISSION. NO GO FOR LUNAR STAY	
			ALL	E. ENTER NEXT BEST DTP	

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	18-23	LOSS OF SURGE TANK OR REPRESS PACK	LAUNCH	A. CONTINUE MISSION	FOR LEAK IN SURGE TANK: ISOLATE SURGE TANK AND PLACE REPRESS PRG VALVE TO FILL.
			ALL	B. CONTINUE MISSION	
	18-24	LOSS OF SURGE TANK AND REPRESS PACK	LAUNCH	A. CONTINUE MISSION	
			ALL	B. CONTINUE MISSION PLAN TO RESTORE ENTRY O2 BY STORING OPS IN CM AT FINAL LM EGRESS.	B. OPS O2 ST**** ALDS/OPS (TWO OPS AVAILABLE)
			TEC	C. CONTINUE MISSION DOFF SUITS FOR ENTRY.	
	18-25	FIRE OR SMOKE IN COMMAND MODULE	LAUNCH	A. ABORT 1. DECOMPRESS CABIN 2. TROUBLESHOOT ELECTRICAL SYSTEM PER FLIGHT CREW CHECKLIST BOOST FIRE PROCEDURES.	
			BOT	B. ENTER NEXT BEST STAT. NO GO FOR PMI: RETAIN LM DESCENT STAGE FOR TEI	
			POWERED DESCENT	C. CONTINUE MISSION. NO GO FOR LUNAR STAY	
			ALL	D. 1. TROUBLESHOOT/COMBAT FIRE PER FLIGHT CREW CHECKLIST EMERGENCY PROCEDURES. 2. ASSESS DAMAGE AND REMOVE POWER FROM AFFECTED SYSTEMS 3. ENTER NEXT BEST PTP	

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	10-26	CONTAMINATION IN CABIN	ALL	CREW MAY ELECT TO DECOMPRESS	IF UNABLE TO CLEAR CONTAMINATION, MISSION MAY BE TERMINATED EARLY.
	10-27	LOSS OF SUIT INTEGRITY	LAUNCH	A. CONTINUE MISSION	
			ALL	B. CONTINUE MISSION NO-GO FOR UNDOCK	
	10-28	LOSS OF O2 MANIFOLD A. O2 MANIFOLD LEAKS GREATER THAN 6 LB/HR AND CABIN PRESSURE GREATER THAN 4.5 PSIA	LAUNCH	A.1. CONTINUE MISSION	A.2. APPROXIMATELY 6 HOURS ARE REQUIRED TO DEPLETE CABIN O2 FROM 4.8 TO 3.5 PSIA, WITH 0.456 LB/HR USAGE RATE (CREW + CABIN LEAK + TANK PRESS BLEED)
			UNDOCKED DOI/ POWERED DESCENT/ LUNAR STAY	2. CONTINUE MISSION.	
			ALL	3. ENTER NEAT BEAT PIP (A) VERIFY SURGE TANK AND REPRESS PACK ISOLATED UNTIL ENTRY. (B) RETRIEVE OPS FROM LM; IF DOCKED	A.3.(B) CREW OPTION TO USE LM ENVIRONMENT FOR EARTH RETURN IN LIEU OF MANUAL CABIN PRESSURE REGULATION.
		B. O2 MANIFOLD LEAKS GREATER THAN 6 LB/HR AND CABIN PRESSURE LESS THAN 4.5 PSIA	LAUNCH	B.1. ABORT ASAP	
			ALL	2. ENTER ASAP USE OPS IN SUITED MODE FOR ENTRY IF PRACTICAL	LM O2 TIP AVAILABLE; MAY BE USED TO SUPPLEMENT CSM SUPPLY.
	10-29	LOSS OF ONE MAIN REGULATOR			
		A. FAILED CLOSED	LAUNCH	A.1. CONTINUE MISSION.	
			EO	2. CONTINUE MISSION. NO GO FOR TLI	
			ALL	3. CONTINUE MISSION	
		B. FAILED OPEN	ALL	B. CONTINUE MISSION	

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	10-30	BOTH MAIN REGULATORS FAILED CLOSED	LAUNCH	A. CONTINUE MISSION	LM SYSTEMS (IF AVAILABLE) MAY BE USED IN LIEU OF CSM SYSTEMS
			UNDOCKED/ DOI/ POWERED DESCENT/ LUNAR STAY	B. CONTINUE MISSION	
			ALL	C. ENTER NEXT BEST PTP	
	10-31	LOSS OF ONE SUIT COMPRESSOR	LAUNCH	A. CONTINUE MISSION	
			EO	B. CONTINUE MISSION- NO GO FOR TLI	
			ALL	C. CONTINUE MISSION	
	10-32	LOSS OF TWO SUIT COMPRESSORS	LAUNCH	A. CONTINUE MISSION- OPEN DIRECT O2 45 DEG FROM LAUNCH SETTING	
			DOI	B. ENTER NEXT BEST PTP- RETAIN LM DESCENT STATE FOR TEI	
			POWERED DESCENT	C. CONTINUE MISSION- NO GO FOR LUNAR STAY	
			ALL	D. ENTER NEXT BEST PTP- USE LM SUIT LOOP IF AVAILABLE.	
		RULE NUMBERS 10-33 THROUGH 10-39 ARE RESERVED.			

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	10-40	PRIMARY COOLANT LOOP MALFUNCTIONS			
		A. LOSS OF EVAPORATOR	LAUNCH	A.1. CONTINUE MISSION	
			ALL	2. CONTINUE MISSION ACTIVATE SECONDARY COOLANT LOOP WITH RADIATORS IN BYPASS AS REQUIRED TO MAINTAIN PRIMARY EVAPORATOR OUT TEMP LESS THAN 80 DEG F OR AS REQUIRED FOR CREW COMFORT	A.1.(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	
			EO	2. NO-GO FOR TLI (A) ACTIVATE SECONDARY LOOP (B) USE PRIMARY LOOP IN ADDITION TO SECONDARY LOOP FOR GSN OPERATIONS.	B.1. ALTERNATE MISSION MAY BE PERFORMED
			TLC	3. ENTER NEAR BEST PTP NO-GO FOR LOI	
			LUNAR ORBIT UNDOCKED	4. BASED ON WATER AVAILABLE FOR EVAPORATIVE COOLING; CONSIDERATION WILL BE GIVEN TO CONTINUING MISSION USING SECONDARY RADIATORS SUPPLEMENTED BY PRIMARY LOOP EVAPORATOR.	
			DOI/ POWERED DESCENT	5. CONTINUE MISSION	
			LUNAR STAY	6. CONTINUE MISSION. ACTIVATE SECONDARY LOOP.	
		C. TOTAL LOSS OF LOOP	LAUNCH	C.1. CONTINUE MISSION ACTIVATE SECONDARY LOOP	
			EO	2. CONTINUE MISSION NO-GO FOR TLI ACTIVATE SECONDARY LOOP	C.2. ALTERNATE MISSION MAY BE PERFORMED.
			DOI/ POWERED DESCENT/ LUNAR STAY	3. CONTINUE MISSION. ACTIVATE SECONDARY LOOP.	
			ALL	4. ENTER NEAR BEST PTP ACTIVATE SECONDARY LOOP	

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	10-41	SECONDARY LOOP MALFUNCTIONS			
		A. LOSS OF EVAPORATOR	ALL	A. CONTINUE MISSION	
		B. LOSS OF RADIATORS	EO	B.1. NO-GO FOR TLI LOOP IS STILL OPERATIONAL IN EVAPORATIVE MODE.	
			TLC	2. ENTER NEXT BEST PTP	
			LUNAR ORBIT	3. CONTINUE MISSION	
		C. TOTAL LOSS OF LOOP	EO	C.1. NO-GO FOR TLI	
			TLC	2. ENTER NEXT BEST PTP	
			LUNAR ORBIT	3. CONTINUE MISSION	
	10-42	LOSS OF PRIMARY AND SECONDARY EVAPORATORS	ALL	A. CONTINUE MISSION	
	10-43	LOSS OF ALL COOLING, PRIMARY AND SECONDARY			LM SYSTEMS (IF AVAILABLE) WILL BE USED TO SUPPLEMENT CSM OPERATIONS.
			LAUNCH	A. CONTINUE MISSION	
			EO	B. ENTER NEXT BEST ATP OR PTP MAXIMUM ORBIT TIME--- 4 HOURS EMERGENCY POWER DOWN FOLLOWED BY 1.5 HOURS OF POWER UP FOR ENTRY.	B. LOSS OF TWO FUEL CELLS. POWER DOWN
			POWERED DESCENT	C. CONTINUE MISSION.	
			ALL	D. ENTER ABAP	

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	10-44	CONFIRMED LEAK OF GYLCOL COOLANT			LM ENVIRONMENT (IF AVAILABLE) MAY BE USED FOR EARTH RETURN IN LIEU OF CSM.
		A. IN COMMAND MODULE	LAUNCH	A.1. CONTINUE MISSION	
			EO	2. ENTER NEXT BEST PTP DON SUITS. PURGE SUIT LOOP WITH DIRECT O2.	
			POWERED DESCENT	3. CONTINUE MISSION- NO GO FOR LUNAR STAY	
			ALL	4. 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.	
			DOI	3. CONTINUE MISSION NO GO FOR LUNAR STAY	
			ALL	4. ENTER NEXT BEST PTP	
		RULE NUMBERS 10-45 THROUGH 10-49 ARE RESERVED.			

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	10-50	LOSS OF OVERBOARD DUMPS			A.1. UTILIZE AUXILIARY DUMP FOR URINE AND WASTE WATER DISPOSAL.
		A. NORMAL OVERBOARD DUMPS FROZEN OR BLOCKED	ALL	A. CONTINUE MISSION	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	B.1. ENTER NEXT BEST PTP	B.1.(A) IF POTABLE AND WASTE T/ (OR WASTE TANKS ALONE) BECOME FU . FORCED WATER BOILING WILL BE NECESSARY TO ALLOW FUEL CELL AND/OR CYCLIC ACCUMULATOR OPERATION. (B) LM URINE STORAGE BAGS (IF AVAILABLE) WILL BE USED.
			UNDOCKED/ DOI/ POWERED DESCENT/ LUNAR STAY	2. CONTINUE MISSION	2. UNDOCKING MAY BE PERFORMED.
	10-51	UNCONTROLABLE HIGH HUMIDITY			LM SYSTEMS MAY BE USED FOR HUMIDITY CONTROL.
			LAUNCH	A. CONTINUE MISSION	
			DOI	B. ENTER NEXT BEST PTP. NO GO FOR POI. RETAIN LM DESCENT STAGE FOR TEI	
			POWERED DESCENT	C. CONTINUE MISSION. NO GO FOR LUNAR STAY	
			ALL	D. ENTER NEXT BEST PTP	
	10-52	WASTE WATER TANK LEAK OR LOSS OF WASTE WATER STORAGE CAPABILITY			LM SYSTEMS (IF AVAILABLE) MAY BE USED TO SUPPLEMENT CSM WHEN POTABLE WATER TANK BECOMES FULL, FUEL CELL WATER WILL BE DUMPED THROUGH OVERBOARD PRESSURE RELIEF VALVES
			ALL	CONTINUE MISSION	

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	10-53	CONFIRMED LEAK IN POTABLE WATER TANK OR UNABLE TO TRANSFER FUEL CELL WATER TO POTABLE TANK.			LM SYSTEMS (IF AVAILABLE) MAY BE USED TO SUPPLEMENT CSM.
			LAUNCH	A. CONTINUE MISSION	
			EO	B. CONTINUE MISSION GO FOR TLI. ENTER NEXT BEST PTP AFTER TANK DEPLETION IF TLI NOT PERFORMED AND UNABLE TO EXTRACT LM	
			TLI-LO UNDOCKING DOI. PWRD DESCENT. LUNAR STAY	C. CONTINUE MISSION. USE LM WATER FOR CREW CONSUMPTION. IF UNABLE TO DO TOSE ENTER NEXT BEST PTP.	
			POST RNDZ	D. ENTER NEXT BEST PTP TRANSFER LM WATER TO CM	D. APPROX. 28 POUNDS OF LM WATER REMAIN POST RNDZ.
		RULE NUMBERS 10-54 THROUGH 10-59 ARE RESERVED.			

REV	ITEM	MEAS DESCRIPTION	INSTRUMENTATION REQUIREMENTS PCM	ONBOARD	TRANSDUCER	CATEGORY	REFERENCE
	10-60	CABIN PRES	CP0001P	METER	COMMON	1 OF	10-20
		SUIT PRES	CP0012P	METER	COMMON	3 M	
		TANK BLADDER PRES	CP0120P	-----	------		
		SUIT PRESS (CUFF GAGES)	-------	-----	------	MANDATORY (EACH CREWMAN)	10-21
		SURGE TANK PRESS	CP0006P	METER	COMMON	1 OF	10-28
		OXYGEN REPRESS PRESS	-------	METER	------	2 M	
		PRIM ACCUM QTY	CP0019Q	METER	COMMON	1 OF	10-40,
		PRIM PUMP OUT PRESS	CP0016P	METER	COMMON	2 M	10-44
		POTABLE H2O QTY	CP0010Q	METER	COMMON	MD	10-53,
		WASTE H2O QTY	CP0009Q	METER	COMMON	MD	10-52
		SEC STEAM PRESS	CP0073P	METER	COMMON	1 OF	10-41
		SEC EVAP OUT TEMP	CP0071T	METER	COMMON	2 M	
		SEC ACCUM QTY	CP0072P	METER	COMMON	MD	
		SEC PUMP OUT PRESS	CP0070P	METER	COMMON	MD	
		PRIM EVAP OUT TEMP	CP0018T	METER	COMMON	MD	
		PRIM STEAM PRESS	CP0034	METER	COMMON	MD	
		ECS O2 FLOW	CP0035R	METER	COMMON	MD	
		O2 MANIFOLD PRESS	CP0036P	-----	------	MD	
		SUIT COMP PRESS	CP0015P	METER	COMMON	MD	
		PRIM RAD OUT TEMP	CP0020T	METER	COMMON	MD	
		PRIM EVAP INLET TEMP	CP0101T	-----	------	MD	
		STEAM DUCT TEMP	CP0017T	-----	------	MD	
		SEC RAD OUT TEMP	SP0256T	METER	------	MD	

11 CSM CRYOGENICS

REV	ITEM	
		~~ * GENERAL * ~~~~~~~~~~~~
	II-1	LAUNCH THERE ARE NO CRYO FAILURES FOR WHICH THE LAUNCH/INSERTION PHASE WILL BE TERMINATED. FOR COMPLETE LOSS OF THE SYSTEM RESULTING IN THREE FUEL CELL FAILURES, ENTRY WILL BE PLANNED INTO PTP 2-3. THREE ENTRY BATTERIES ARE CAPABLE OF SUPPORTING THE LAUNCH. ONE REV OF POWER DOWN AND SCS ENTRY.
	II-2	ALL PHASES THE CRYOGENICS SYSTEM IS REQUIRED UNTIL CM/SM SEP SO THAT THE ENTRY AND LANDING PHASES WILL BE ENTERED INTO WITH FULL CONSUMABLES POTENTIAL, THAT IS, FULLY CHARGED ENTRY BATTERIES AND ENTRY O2 TANKS. IF THIS CAPABILITY IS POTENTIALLY JEOPARDIZED BY CRYO SYSTEMS DEPLETION OR MALFUNCTION, MISSION TERMINATION PROCEDURES WILL BE ENACTED IN WHATEVER TIME FRAME IS APPROPRIATE OR AVAILABLE. ANY ENTRY BATTERY OR ENTRY O2 USAGE AFTER LOSS OF RECHARGE CAPABILITY FROM THE CRYO SYSTEM WILL REDUCE SUPPLY AVAILABLE FOR ENTRY, LANDING, AND POSTLANDING.
	II-3	POWERED DESCENT THE ONLY CRYO SYSTEM FAILURES FOR WHICH POWERED DESCENT WILL BE TERMINATED ARE LOSS OF BOTH O2 TANKS OR BOTH H2 TANKS. GO GATE TO TD WILL NOT BE TERMINATED FOR EITHER OF THESE FAILURES.
	II-4	LOSS OF CRYOGENIC TANK IS DEFINED AS--- PRESSURE CANNOT BE MAINTAINED ABOVE 150 PSIA FOR O2 AND 100 PSIA FOR H2.
	II-5	LUNAR MISSION WILL BE CONTINUED IF ENOUGH CRYO (O2, H2) IS MAINTAINED IN LOWEST TANK TO PERFORM AN EARTH RETURN FROM ANY POINT WITH AT LEAST A POWER LEVEL OF 40 AMPS AVERAGE. EARTH ORBIT MISSION WILL BE CONTINUED AS LONG AS ENOUGH TOTAL CRYO (O2, H2) IS AVAILABLE TO PERFORM AN ENTRY INTO THE NEXT DAILY GO/NO GO AREA.
		RULE NUMBERS II-6 THROUGH II-9 ARE RESERVED.

REV	ITEM	

****
* SYSTEMS MANAGEMENT *
****

11-10 CRYO MANAGEMENT

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

1. TANK PRESSURES GREATER THAN 250 PSIA O2 AND 200 PSIA FOR H2.

2. QUANTITY BALANCE WITHIN 4 PERCENT O2 AND 3 PERCENT FOR H2.

B. ONE FUEL CELL MAY BE PURGED OR THE SPACECRAFT ELECTRICAL LOADS MAY BE INCREASED TO PRECLUDE CRYO TANK VENTING.

C. O2 TANK FANS AND H2 TANK FANS WILL NOT BE OPERATED IN THE AUTO MODE.

11-11 CRYO GAGING

A. ONBOARD CRYOGENIC QUANTITY GAGING IS PRIME. ACCURACY IS +/-2.65 PERCENT (+/-0.46 LB O2, +/-0.72 LB H2) PER TANK.

B. MCC CALCULATED QUANTITY USING PRESSURE VERSUS TEMPERATURE IS BACKUP.

RULE NUMBERS 11-12 THROUGH
11-19 ARE RESERVED.

REV	ITEM	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	A. CONTINUE MISSION	LM, PLSS, AND OPS O2 WILL B EUSED AS REQUIRED TO SUPPLEMENT CSM O2.
			EO	B. CONTINUE MISSION NO-GO FOR TLI	
			POWERED DESCENT	C. CONTINUE MISSION NO GO FOR LUNAR STAY	
			ALL	D. ENTER NEXT BEST PTP	
	11-21	LOSS OF BOTH O2 AND/OR H2 CRYO TANK (TANK PRESSURE LESS THAN 150 O2, LESS THAN 100 H2, RESPECTIVELY)	LAUNCH	A. CONTINUE MISSION ISOLATE SURGE TANK PRIOR TO 800 PSIA	
			POWERED DESCENT	B.1. PDI TO LO GATE- ENTER NEXT BEST PTP RETAIN LM DESCENT STAGE FOR TEI IF POSSIBLE.	B. IF THREE FUEL CELLS ARE LOST PRIOR TO CM/SM SEP, SMJC'S WILL BE INOPERATIVE.
				2. LO GATE TO TD - CONTINUE MISSION, NO GO FOR LUNAR STAY.	
			ALL	C. ENTER NEXT BEST ATP OR PTP MAXIMUM TIME IS 4.75 HOURS FOR LOSS OF THREE FUEL CELLS.	
		RULE NUMBERS 11-22 THROUGH 11-49 ARE RESERVED.			

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS

INSTRUMENTATION REQUIREMENTS

	MEAS DESCRIPTION	PCM	ONBOARD	TRANSDUCERS	CATEGORY	MISSION RULE REFERENCE
11-50	O2 TANK 1 QTY	SC00320	METER	COMMON	1 OF 2	11-20
	O2 TANK 2 QTY	SC00330	METER	COMMON	MANDATORY	
	O2 TANK 1 TEMP	SC00417	-----	------	HIGHLY	11-20
	O2 TANK 2 TEMP	SC00427	-----	------	DESIRABLE	
	H2 TANK 1 QTY	SC00300	METER	COMMON	1 OF 2	11-20
	H2 TANK 2 QTY	SC00310	METER	COMMON	MANDATORY	
	H2 TANK 1 TEMP	SC00437	-----	------	HIGHLY	11-20
	H2 TANK 2 TEMP	SC00447	-----	------	DESIRABLE	
	O2 TANK 1 PRESS	SC00370	METER	COMMON	1 OF 2	11-20
	O2 TANK 2 PRESS	SC00380	METER	COMMON	MANDATORY	11-20
	H2 TANK 1 PRESS	SC00390	METER	COMMON	1 OF 2	11-20
	H2 TANK 2 PRESS	SC00400	METER	COMMON	MANDATORY	11-20

12 CSM ELECTRICAL
POWER SYSTEM

REV	ITEM	

! GENERAL !

12-1 LAUNCH

A. LAUNCH WILL BE CONTINUED AS LONG AS SUFFICIENT ENERGY IS AVAILABLE TO PERFORM AN ENTRY INTO AT LEAST PTP 2-1. THERE MUST BE AT LEAST ONE MAIN BUS AND ONE AC BUS OPERATIONAL TO CONTINUE.

B. 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.

12-2 POWERED DESCENT

THERE ARE NO EPS FAILURES FOR WHICH POWERED DESCENT WILL BE TERMINATED EXCEPT FOR LOSS OF THREE FUEL CELLS.

12-3 ALL PHASES

THE MISSION WILL BE CONTINUED AS LONG AS THE REQUIRED NUMBER OF FUEL CELLS ARE AVAILABLE AND ARE CAPABLE OF SUPPORTING MISSION REQUIREMENTS OF 75 TO 90 AMPS (WITHOUT BATTERY SUPPLEMENT EXCEPT DURING SPS DELTA V'S) AND THREE GOOD ENTRY BATTERIES REMAIN.

12-4 BATTERY IS CONSIDERED FAILED IF---

A. 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).

B. SUSTAINED BATTERY CHARGER OUTPUT IS GREATER THAN 2.0 AMPS AND ALL LOADS REMOVED.

12-5 AN AC BUS IS CONSIDERED FAILED IF ANY TWO PHASES CANNOT BE MAINTAINED GREATER THAN 95 VOLTS.

12-6 AN INVERTER IS CONSIDERED FAILED IF---

A. OUTPUT VOLTAGE ON ANY PHASE IS GREATER THAN 130 VAC.

B. OUTPUT VOLTAGE ON ANY TWO PHASES IS LESS THAN 95 VAC.

12-7 FUEL CELL IS CONSIDERED FAILED FOR MISSION PLANNING IF---

A. FUEL CELL CANNOT SUPPLY SUFFICIENT POWER TO MEET ITS OWN PARASITIC LOADS (5 AMPS PLUS INLINE HEATER POWER AS REQUIRED).

B. FUEL CELL H2 LOOP IS CONTAMINATED WITH KOH.

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

12-8 TLI MINIMUN PURGE CAPABILITY IS BOTH OXYGEN AND HYDROGEN ON ONE FUEL CELL AND AT LEAST OXYGEN ON ONE OTHER FUEL CELL.

RULE NUMBERS 12-9 THROUGH 12-19 ARE RESERVED.

! SYSTEMS MANAGEMENT !

REV	ITEM	

12-20 BUS MANAGEMENT

A. ONE AND ONLY ONE FUEL CELL WILL BE TIED TO BOTH MAIN BUSES.

B. INVERTERS WILL BE CONFIGURED SUCH THAT MAIN BUS A WILL SUPPLY AC BUS 1 AND MAIN BUS B WILL SUPPLY AC BUS 2.

C. MAIN BUS VOLTAGE WILL BE MAINTAINED GREATER THAN 26.5 VDC AND LESS THAN 31 VDC. ONE FUEL CELL MAY BE OPEN CIRCUITED FOR OPTIMUM VOLTAGE AND POWER MANAGEMENT.

D. THE BATTERY CHARGER WILL BE USED TO CHECK OUT A SUSPECTED SHORTED BUS (EXCEPT MAIN BUSES) AFTER ALL EQUIPMENT AND POWER SOURCES HAVE BEEN REMOVED FROM BUS.

E. MINIMUM MAIN BUS VOLTAGE WILL BE MAINTAINED TO BE COMPATIBLE WITH ONLINE OPERATION EQUIPMENT.

1.	SPS	24.5
2.	PGNS	25.0
3.	AUTO SM-RCS	22.0
4.	AUTO CM-RCS	21.0
5.	DIRECT SM-RCS	21.0
6.	DIRECT CM-RCS	17.0
7.	INVERTERS	19.0

12-21 BATTERY MANAGEMENT

A. BATTERIES A AND B WILL BE USED TO SUPPLEMENT MAIN BUS LOADS FROM T-75 SECONDS TO INSERTION.

B. BATTERIES A AND B WILL BE USED TO SUPPLEMENT MAIN BUS LOADS FOR SPS MANEUVERS. BATTERY C WILL BE ROTATED TO MAINTAIN BATTERY BALANCE IN THE EVENT THE BATTERY CHARGER FAILS.

C. BATTERY CHARGING WILL BE TERMINATED FOR ONE OF THE FOLLOWING, WHICHEVER OCCURS FIRST---

1. INTEGRATED AMP-HOURS INTO BATTERY BY CHARGER EQUALS INTEGRATED AMP-HOURS OUT OF BATTERY BY LOADS.

2. WHEN BATTERY CHARGER VOLTAGE AS INDICATED BY BATTERY BUS VOLTAGE INCREASES TO 39.5 VDC.

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.

REV	ITEM	
	12-22	FUEL CELL MANAGEMENT

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

1. SUSTAINED CURRENT OUTPUT LESS THAN 9 AMPS.
2. FUEL CELL H2 LOOP IS CONTAMINATED WITH KOH.
3. REACTANT LEAKAGE JEOPARDIZING MISSION DURATION.

B. FUEL CELL MAY BE "OPEN CIRCUITED" FOR THE FOLLOWING---

1. SKIN TEMP GREATER THAN 475 DEG. F.
2. TCE TEMP GREATER THAN 225 DEG. F.
3. FAILURE OF H2 PUMP OR GLYCOL PUMP.
4. VOLTAGE MANAGEMENT.
5. FUEL CELL CANNOT BE PURGED AND TIME TO GO IS GREATER THAN PREDICTED FUEL CELL LIFETIME.

C. FUEL CELL O2 AND H2 PURGES WILL NORMALLY BE PERFORMED AT 12 AND 48 HOUR INTERVALS, RESPECTIVELY. HOWEVER, THE INTERVALS WILL BE FLEXIBLE TO COINCIDE WITH WATER DUMPS (REF. MR 10-10 C)

D. ADDITIONAL PURGES WILL BE INITIATED AS OPERATIONAL CONDITIONS DICTATE.

E. FUEL CELLS WILL NOT BE PURGED FOR CONFIRMED HIGH PH INDICATION.

F. EACH H2 PURGE WILL NORMALLY BE PRECEDED BY 20 MINUTES OF H2 VENT HEATER OPERATION FOLLOWED BY 10 MIN OF HEATER OPERATION AFTER PURGE COMPLETION

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

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

I. ADDITIONAL POWER LOADS WILL BE ADDED AS REQUIRED TO MAINTAIN FC RAD OUT TEMP GREATER THAN -40 DEG. IF CRYO BUDGET JEOPARDIZED OR RAD OUT TEMPS NOT MAINTAINED GREATER THAN -40 DEG. FC RAD WILL BE PLACED IN EMERGENCY BYPASS.

J. ONE FUEL CELL MAY BE PURGED TO PRECLUDE VENTING OF CRYO TANKS OR FOR CRYO PRESSURE MANAGEMENT.

12-23 INVERTER MANAGEMENT

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

A. INVERTER TEMP GREATER THAN 190 DEG. F.

B. SPACECRAFT LOAD MANAGEMENT

RULE NUMBERS 12-24 THROUGH
12-29 ARE RESERVED

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
				SPECIFIC MISSION RULES	
	12-30	LOSS OF ONE FUEL CELL (OUTPUT LESS THAN 5 AMPS)	LAUNCH	A. CONTINUE MISSION	
			EO	B. NO-GO FOR TLI 1. OPEN CIRCUIT FUEL CELL. 2. RECONFIGURE REMAINING TWO FUEL CELLS TO ONE FUEL CELL ONLY PER MAIN BUS. 3. IF FUEL CELL CANNOT BE RESTORED; PERFORM SHUTDOWN.	
			TLC LUNAR ORBIT LUNAR STAY	C. BASED ON THE FAILURE MODE; CONSIDERATION WILL BE GIVEN TO CONTINUING WITH NOMINAL MISSION	
			DOI	D. CONTINUE MISSION-	
			ALL	E. CONTINUE MISSION	
	12-31	LOSS OF TWO FUEL CELLS (OUTPUT LESS THAN 5 AMPS EACH)			A. LM SYSTEMS MAY BE USED TO SUPPLEMENT CSM POWER.
			LAUNCH	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.	
			POWERED DESCENT	B. CONTINUE MISSION- NO GO FOR LUNAR STAY	
			ALL	C. ENTER NEXT BEST PTP 1. CONNECT REMAINING FUEL CELL TO BOTH MAIN BUSES. 2. PERFORM "LOSS OF TWO FC POWER DOWN."	C. ONE ENTRY BATTERY MAY BE USED TO SUPPLEMENT REMAINING FC FOR G&N ALIGNMENT PRIOR TO DEORBIT.

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	12-32	LOSS OF THREE FUEL CELLS			LM SYSTEMS (IF AVAILABLE) MAY BE USED TO SUPPLEMENT FUEL CELL POWER.
		A. OUTPUT LESS THAN 10 AMPS EACH	LAUNCH	A. CONTINUE MISSION	
				1. AFTER 2 + 00 EDS AUTO/OFF TO OFF.	A.1. IF TOTAL OUTPUT CAPABILITY LESS THAN 8 AMPS AT 22 VDC, SMJC WILL BE INOPERATIVE FOR CM/SM SEP.
				2. TIE BAT C TO BOTH MAIN BUSES.	
				3. POWER DOWN AT INSERTION ENTER 2-1 IF FUEL CELLS CANNOT BE RESTORED.	A.3. 4.75 HOURS LEFT IN ORBIT BEFORE DEORBIT MANEUVER.
			POWERED DESCENT	B.1. PDI TO LO GATE - ENTER NEXT BEST PTP, RETAIN LM DESCENT STAGE FOR TEI IF POSSIBLE.	
				2. LO GATE TO TD - CONTINUE MISSION NO GO FOR LUNAR STAY.	
			ALL	C. ENTER NEXT BEST PTP	
	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
			POWERED DESCENT	C.1. PDI TO LO GATE - ENTER NEXT BEST PTP, RETAIN LM DESCENT STAGE FOR TEI.	
				2. LO GATE TO TD - CONTINUE MISSION. NO GO FOR LUNAR STAY.	
			ALL	D. ENTER NEXT BEST PTP PERFORM EMERGENCY POWER DOWN	

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	12-34	DEGRADED FUEL CELLS-(UNABLE TO SUPPORT NORMAL DRIFTING FLIGHT LOADS - SCS & SSM POWERED DOWN- AND MAINTAIN MN BUS VOLTAGE GREATER THAN 26.5 VDC	LAUNCH	A. CONTINUE MISSION-	
			POWERED DESCENT	B.1. PDI TO LO GATE - ENTER NEXT BEST PTP. RETAIN LM DESCENT STAGE FOR TEI IF POSSIBLE. 2. LO GATE TO TD - CONTINUE MISSION. NO GO FOR LUNAR STAY.	
			ALL	C. ENTER NEXT BEST PTP-	
		RULE NUMBERS 12-35 THROUGH 12-39 ARE RESERVED.			
	12-40	LOSS OF ONE ENTRY BATTERY (OUTPUT LESS THAN 3 AMPS WHEN TIED TO MAIN BUS)	LAUNCH	A. CONTINUE MISSION 1. EDS AUTO/OFF TO OFF. 2. IF LOSS OF BAT A: TIE BAT C TO MAIN A. 3. IF LOSS OF BAT B: TIE BAT C TO MAIN B.	
			EO	B. NO-GO FOR TLI	B. IF LOST DURING SPS MANEUVER, CONTINUE ON REMAINING BATTERY.
			DOI	C. CONTINUE MISSION-	
			ALL	D. BASED ON FAILURE MODE, CONSIDERATION WILL BE GIVEN TO CONTINUING NOMINAL MISSION.	
	12-41	LOSS OF TWO ENTRY BATTERIES (OUTPUT LESS THAN 3 AMPS EACH WHEN CONNECTED TO MAIN BUS)	LAUNCH	A. CONTINUE MISSION 1. EDS AUTO/OFF TO OFF. 2. ENTER 2-1 POWERED DOWN.	
			DOI	B. ENTER NEXT BEST PTP- NO GO FOR PDI	
			POWERED DESCENT	C. CONTINUE MISSION- NO GO FOR LUNAR STAY	
			ALL	D. ENTER NEXT BEST PTP USE ONE BATTERY ENTRY PROCEDURE.	D. IF LOSS DURING SPS MANEUVER, ATTEMPT TO TIE BATTERY C TO BOTH MAINS.

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
1	12-42	LOSS OF BATTERY CHARGER	EO	A. CONTINUE MISSION ROTATE BATTERY C FOR BURNS TO MAINTAIN BALANCED BATTERIES	
1			TLC	B. NO-GO FOR LOI IF SUM OF TWO LOWEST ENTRY BATTERIES LESS THAN 49.0 AMP HRS.	
1			LO	C. NO-GO FOR UNDOCK IF SUM OF TWO LOWEST ENTRY BATTERIES LESS THAN 42.0 AMP HRS.	
		RULE NUMBERS 12-43 THROUGH 12-49 ARE RESERVED.			

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	12-50	MAIN BUS TIE MOTOR SWITCH FAILURES			
		A. ONE MOTOR SWITCH FAILS OPEN	LAUNCH	A.1. CONTINUE MISSION (A) IF MOTOR SW B/C TIE BAT C TO MAIN BUS B. (B) IF MOTOR SW B/C TIE BAT C TO MAIN BUS B.	
			ALL	B. CONTINUE MISSION CLOSE ALTERNATE MOTOR SW AND USE MAIN BUS TIE CB'S AS MOTOR SWITCHES.	A.2. BATTERIES MUST BE CHARGED THROUGH OPEN MOTOR SW. LEAVE BAT RLY CB CLOSED FOR CHARGING.
		B. ONE OR BOTH MOTOR SW FAILED CLOSED	ALL	B. CONTINUE MISSION USE CB'S AS MOTOR SWITCHES.	B. IF BOTH MOTOR SWITCHES FAIL CLOSED, BATTERIES CANNOT BE CHARGED.
	12-51	MAIN BUS SHORTED CAUSING FUEL CELL REVERSE CURRENT DISCONNECT			
		A. FUEL CELL 3 DISCONNECTS FROM MAIN A	LAUNCH	A.1. CONTINUE MISSION (A) PLACE DES AUTO/OFF TO OFF. (B) P/C 3 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 35 AMPS SHORT ON MAIN B WILL CAUSE REVERSE DISCONNECT DURING LAUNCH
			DOI	A.2. ENTER NEXT DEAT DTP. NO GO FOR DOI	
			POWERED DESCENT	A.3. CONTINUE MISSION. NO GO FOR LUNAR STAY	
			ALL	A.4. ENTER NEXT DEAT DTP IF BUS NOT RESTORED POWER DOWN MAIN BUS B.	

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
1	12-51 CONT	B. FUEL CELL 3 DISCONNECTS FROM MAIN B	LAUNCH	B.1. CONTINUE MISSION (A) PLACE EDS AUTO/OFF TO OFF. (B) FC 3 TO BUS B ONLY. (C) TIE BAT C TO MAIN BUS B. (D) INVERTER 3 TO AC BUS 3: MAIN B. (E) POWER DOWN MAIN BUS A. (F) FYC GIMBAL DRIVE (P.T.Y.Z. (G) GIMBAL MOTOR CONTROL TRAN 3: PITCH 3: BAT B OVER FOLLOWING GIMBAL MOTOR TURN ON.	B.1: GREATER THAN 20 AMPS SHORT ON MAIN A WILL CAUSE REVERSE DISCONNECT DURING LAUNCH
			DOI	B.2. ENTER NEXT BEST PTP-NO GO FOR DOI	
			POWERED DESCENT	B.3. CONTINUE MISSION-NO GO FOR LUNAR STAY	
			ALL	B.4. 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 DOI	C.1. ABORT 2. ENTER NEXT BEST PTP IF AN BUS NOT RESTORED-NO GO FOR DOI: RETAIN LM DESCENT STAGE FOR TEI	C.1: FAILURE OF MOTOR SWITCH TO DISCONNECT FROM SHORTED BUS INDICATED BY FC SHORTED BUS F/B ONLY.
			POWERED DESCENT	3. CONTINUE MISSION-NO GO FOR LUNAR STAY IF AN BUS NOT RESTORED.	
			ALL	4. ENTER NEXT BEST PTP IF MAIN BUS NOT RESTORED.	C.4: IF FUEL CELL PERM CIRCUITRY SHORTED: CLOSE FC REACTANT VALVES.

REV	ITEM	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 EBS 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 LESS THAN OR EQUAL TO MAIN BUS VOLTAGE.
			DOI	2. ENTER NEXT BEST PTP-NO GO FOR POI RETAIN LM DESCENT STAGE FOR TEI	
			POWERED DESCENT	3. CONTINUE MISSION-NO GO FOR LUNAR STAY	
			ALL	4. ENTER NEXT BEST PTP IF BUS NOT RESTORED	A.4. REMOVE POWER FROM BUS; IF SHORTED LESS THAN OR EQUAL TO 10 AMPS, POWER BUS JUST PRIOR TO ENTRY TO MAINTAIN SECS REDUNDANCY.
		B. BATTERY BUS SHORTED LESS THAN 5 AMPS	ALL	B. CONTINUE MISSION REMOVE POWER FROM BUS EXCEPT FOR MANEUVERS AND ENTRY	
	12-53	BATTERY RELAY BUS SHORTED			
		A. SHORT GREATER THAN 2.0 AMPS	LAUNCH	A.1. CONTINUE MISSION	
			UNDOCKED/ POI/ POWERED DESCENT	2. CONTINUE MISSION, NO GO FOR LUNAR STAY	A.2. UNDOCKING MAY BE PERFORMED.
			ALL	3. ENTER NEXT BEST PTP OPEN BATTERY BUS TO BATTERY RELAY BUS CB'S.	
		B. SHORT LESS THAN 2.0 AMPS	ALL	B. CONTINUE MISSION	B. CHARGE BAT B CONTINUOUSLY WITH BAT B POWER ENTRY AND POST LANDING CB OPEN. CONSIDER BATTERY CHARGER LOST FOR MISSION PLANNING.

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	12-34	A. LOSS OF ONE BATTERY BUS, MAIN BUS, (UNABLE TO POWER BUS)	LAUNCH	A.1. CONTINUE MISSION	
			DOI	2. ENTER NEXT BEST PTP- NO GO FOR PDI, RETAIN LM DESCENT STAGE FOR TEI.	
			POWERED DESCENT	3. CONTINUE MISSION- NO GO FOR LUNAR STAY	
			ALL	4. ENTER NEXT BEST PTP	
		B. LOSS OF BATTERY RELAY BUS (UNABLE TO POWER BUS	LAUNCH	B.1. CONTINUE MISSION	
			UNDOCKED/ DOI/ POWERED DESCENT	2. CONTINUE MISSION NO GO FOR LUNAR STAY	B.2. UNDOCKING MAY BE PERFORMED
			ALL	3. ENTER NEXT BEST PTP.	
		RULE NUMBERS 12-35 THROUGH 12-39 ARE RESERVED.			

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	12-60	LOSS OF TWO INVERTERS	LAUNCH	A. CONTINUE MISSION	
			DOI	B. ENTER NEXT BEST PTP-NO GO FOR PDI. RETAIN LM DESCENT STAGE FOR TEI	PLACE REMAINING INVERTER ON BOTH A CBUSES.
			POWERED DESCENT	C. CONTINUE MISSION-NO GO FOR LUNAR STAY	
			ALL	D. ENTER NEXT BEST PTP	D. 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	A. CONTINUE MISSION	
			DOI	B. ENTER NEXT BEST PTP-NO GO FOR PDI. RETAIN LM DESCENT STAGE FOR TEI	
			POWERED DESCENT	C. CONTINUE MISSION-NO GO FOR LUNAR STAY	
			ALL	D. ENTER NEXT BEST PTP	
	12-62	LOSS OF BOTH AC BUSES	LAUNCH	A. ABORT MODE I OR MODE II	A. REF MR---
				1. OPEN DIRECT O2 FOR SUIT VENTILATION.	
				2. IF AFTER MODE II, ENTER PTP 2-1.	A.2. INITIATE CONTINUOUS PC N2 PURGE FOR COOLING.
			POWERED DESCENT	B. CONTINUE MISSION-	
			ALL	C. ENTER NEXT BEST PTP OR ATP	C.1. USE LM SYSTEMS (IF AVAILABLE) FOR AC POWERED FUNCTIONS TO ENTRY.
				IF SUITED, REMOVE HELMET AND GLOVES. IF TIME PERMITS, REMOVE SUITS. IF CABIN DEPRESSURIZED, USE DIRECT O2 UNTIL CABIN IS REPRESSURIZED.	2. FOR CSM ONLY, ENTER WITHIN 1-1/2 HOURS. INITIATE CONTINUOUS PC N2 PURGE FOR COOLING.
		RULE NUMBERS 12-63 THROUGH 12-69 ARE RESERVED.			

REV	ITEM
	12-70

INSTRUMENTATION REQUIREMENTS

MEAS DESCRIPTION	PCM	ONBOARD	TRANSDUCERS	CATEGORY	MISSION RULE REFERENCE
AC BUS 1 PHASE A VAC	CC0200V	METER	SEPARATE	HIGHLY DESIRABLE	
AC BUS 1 PHASE B VAC	-------	METER	----------	HIGHLY DESIRABLE	12-5,6,61
AC BUS 1 PHASE C VAC	-------	METER	----------	HIGHLY DESIRABLE	
		COMMON METER			
AC BUS 2 PHASE A VAC	CC0203V	METER	SEPARATE	HIGHLY DESIRABLE	
AC BUS 2 PHASE B VAC	-------	METER	----------	HIGHLY DESIRABLE	12-5,6,61
AC BUS 2 PHASE C VAC	-------	METER	----------	HIGHLY DESIRABLE	
MAIN BUS A VDC	CC0206V	METER	SEPARATE	1 OF 2	12-32,52,20C
MAIN BUS B VDC	CC0207V	METER	SEPARATE	MANDATORY	12-22
BAT BUS A VDC	CC0210V	METER	SEPARATE	HIGHLY DESIRABLE	
BAT BUS B VDC	CC0211V	METER	SEPARATE	HIGHLY DESIRABLE	
BAT RELAY BUS VDC	CC0212V	METER	SEPARATE	HIGHLY DESIRABLE	
BAT A CURRENT	CC0222C	METER	COMMON		
BAT B CURRENT	CC0223C	METER	COMMON	2 OF 3 MANDATORY	12-6,33,40,41
BAT C CURRENT	CC0224C	METER	COMMON		
FC 1 CURRENT	SC2113C	METER	COMMON		
FC 1 O2 FLO	SC2141R	METER	COMMON	1 OF 3 MANDATORY	12-7,31,32,33, 22A
FC 1 H2 FLO	SC2139R	METER	COMMON		
FC 2 CURRENT	SC2114C	METER	COMMON		
FC 2 O2 FLO	SC2142R	METER	COMMON	1 OF 3 MANDATORY	12-7,31,32,33, 22A
FC 2 H2 FLO	SC2140R	METER	COMMON		
FC 3 CURRENT	SC2115C	METER	COMMON		
FC 3 O2 FLO	SC2144R	METER	COMMON	1 OF 3 MANDATORY	12-7,31,32,33, 22A
FC 3 H2 FLO	SC2143R	METER	COMMON		
BAT CHARGER CURRENT	SC0213C	METER	COMMON	HIGHLY DESIRABLE	
FC 1 SKIN TEMP	SC20867	METER	COMMON	HIGHLY DESIRABLE	
FC 2 SKIN TEMP	SC20857	METER	COMMON	HIGHLY DESIRABLE	12-220
FC 3 SKIN TEMP	SC20867	METER	COMMON	HIGHLY DESIRABLE	
FC 1 COND TEMP	SC20817	METER	COMMON	HIGHLY DESIRABLE	
FC 2 COND TEMP	SC20827	METER	COMMON	HIGHLY DESIRABLE	12-220
FC 3 COND TEMP	SC20837	METER	COMMON	HIGHLY DESIRABLE	
FC 1 RAD OUT TEMP	SC20877	METER	COMMON	HIGHLY DESIRABLE	
FC 2 RAD OUT TEMP	SC20887	METER	COMMON	HIGHLY DESIRABLE	12-221
FC 3 RAD OUT TEMP	SC20897	METER	COMMON	HIGHLY DESIRABLE	
BAT MANIFOLD PRESS	-------	METER	------	HIGHLY DESIRABLE	-------
INV 1 TEMP	CC01757	NCWS	COMMON	HIGHLY DESIRABLE	-------
INV 2 TEMP	CC01767	NCWS	COMMON	HIGHLY DESIRABLE	-------
INV 3 TEMP	CC01777	NCWS	COMMON	HIGHLY DESIRABLE	-------
FC 1 PH	SC2160R	TALKBACK	COMMON	HIGHLY DESIRABLE	
FC 2 PH	SC2161R	TALKBACK	COMMON	HIGHLY DESIRABLE	12-22E
FC 3 PH	SC2162R	TALKBACK	COMMON	HIGHLY DESIRABLE	

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

13 DOCKING AND UMBILICAL

REV	ITEM	
		' GENERAL '
	13-1	THREE GOOD DOCKING RING LATCHES 120 DEG. APART ARE REQUIRED FOR AN IVT.
		RULE 13-2 IS RESERVED.
	13-3	DOCKED SPS OR DPS BURNS REQUIRE AT LEAST NINE GOOD 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, TOSS 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

REV	ITEM	

' MANAGEMENT '

13-11 FOR MISFIRE OF A DOCKING RETRACT SQUIB: THE REMAINING SQUIB IN THE SAME SYSTEM WILL BE USED TO ATTEMPT COMPLETION OF DOCKING: TWO NITROGEN BOTTLES REMAINING ARE NORMALLY REQUIRED TO ALLOW UNDOCKING--HOWEVER: BASED ON THE FAILURE MODE: CONSIDERATION WILL BE GIVEN TO UNDOCKING WITH ONE NITROGEN BOTTLE REMAINING IN AN OPERABLE SYSTEM.

13-12 THE CM FORWARD AND LM UPPER HATCH NORMALLY WILL BE INSTALLED FOR ANY TYPE OF MANEUVER OR DOCKING.

13-13 DURING OPERATIONS WHEN CM/LM DOCKED STATUS IS MAINTAINED BY PROBE PRELOAD ONLY (DOCKING LATCHES COCKED) CM/LM THRUSTER ACTIVITY ABOUT CM/LM X-AXIS IS LIMITED AS FOLLOWS---

TUNNEL PRESSURE PSIA	COMBINED CM/LM ACTIVE THRUSTERS
GREATER THAN 1.5 PSIA	INHIBIT ALL CSM ROLL AND LM YAW CONTROL
BETWEEN 0 AND 1.5 PSIA	NO MORE THAN 2 JETTS
0 PSIA	NO MORE THAN 4 JETTS

13-14 LOW PROBE TEMPERATURE WILL NOT INHIBIT DOCKING ATTEMPTS.

RULE NUMBERS 13-15 THROUGH 13-19 ARE RESERVED.

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
				SPECIFIC MISSION RULES	
	13-20	FAILURE TO ACHIEVE OR MAINTAIN POWER TO X-LUNAR BUS LOADS FROM CSM	DOCKED	CONTINUE MISSION - 1. INSURE LM DESCENT BATTERY LOW VOLTAGE TAPS - ON 2. OPEN LM CB (111) & CB (161) EPS---DES ECA CIRCUIT BREAKERS WITHIN 8 HOURS OF THE TIME THE DESCENT BATTERIES WERE TURNED ON. 3. CLOSE LM CB (111) & CB (161) EPS---DES ECA CIRCUIT BREAKERS AT FIRST PLANNED MANNING.	. NOMINAL MISSION MAY BE PERFORMED BECAUSE ECA THERMAL CONSTRAINTS WILL NOT BE VIOLATED WITH DESCENT ECA CIRCUIT BREAKERS OPEN; OVER CURRENT PROTECTION; HOWEVER; IS LOST UNTIL THESE CIRCUIT BREAKERS ARE CLOSED. EXTRA DESCENT AMP HOURS USED MAY AFFECT LUNAR STAY TIME.
	13-21	FAILURE TO ACHIEVE S-IVB/LM SEPARATION OR FAILURE TO MATE LM UMBILICALS (P23 AND P241	TDEE	PERFORM CSM/LM FINAL SEP	S-IVB/LM SEP CANNOT BE ACHIEVED WITHOUT MATING AT LEAST ONE UMBILICAL. POWER CAN BE SWITCHED AND MAINTAINED WITH EITHER PLUG.
	13-22	FAILURE TO ACHIEVE CSM/LM FINAL SEPARATION	DOCKED	MUST PERFORM NORMAL UNDOCKING A. RETRIEVE PROBE AND DROGUE AND INSTALL. B. AFTER UNDOCKING; DEPRESS CSM AND JETTISON PROBE OVERBOARD.	
	13-23	FAILURE TO INDICATE DOCKING PROBE EXTEND OR BOTH TALK BACK INDICATORS ARE BARBER POLE.	TDEE UNDOCKED	A. CONTINUE MISSION ATTEMPT TDEE 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	TDEE DOCKED	A. PERFORM CSM/LM FINAL SEP B. PERFORM CSM/LM FINAL SEP IF LM MANNED; PERFORM EVT TO CSM.	

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	13-25	CANNOT REMOVE DOCKING PROBE, LM DROGUE, AND/OR LM UPPER HATCH.	DOCKED	CONTINUE MISSION PERFORM EVT IF LM MANNED	SPS AND SM RCS MANEUVERS MAY BE PERFORMED
	13-26	FAILURE TO RELEASE CAPTURE LATCHES	DOCKED	REDOCK	
	13-27	PRIMARY FORWARD HATCH LOCK/UNLOCK MECHANISM INOPERATIVE	ALL	CONTINUE MISSION	
	13-28	FAILURE TO LOCK CSM FORWARD HATCH	TDSE DOCKED	CONTINUE MISSION ENTER IN SUITS	REF SCP A13 1. A (ASSUMES HATCH CAN BE SEALED AND SECURED WITH CABIN PRESSURE)
	13-29	FAILURE TO REINSTALL PROBE AND/OR DROGUE OR FAILURE TO CLOSE LM UPPER HATCH	DOCKED	NO UNDOCKING	
	13-30	LOSS OF PRIMARY OR SECONDARY DOCKING SYSTEM	DOCKED	CONTINUE MISSION BASED ON FAILURE MODE, CONSIDERATION WILL BE GIVEN TO UNDOCKING WITH ONE GN2 BOTTLE REMAINING IN AN OPERABLE SYSTEM.	

14 CBM SEQUENTIAL

REV	ITEM	
		' GENERAL '
	14-1	LAUNCH THERE ARE NO SEQUENTIAL MALFUNCTIONS FOR WHICH LAUNCH WILL BE TERMINATED.
	14-2	IF AN ENTRY BATTERY IS LOST, THE EDS WILL BE FLOWN OPEN LOOP.
	14-3	ALL MISSION PHASES EXCEPT LUNAR ORBIT TO CONTINUE THE MISSION, BOTH PYRO BUSES AND BOTH LOGIC BUSES ARE REQUIRED.
	14-4	POWERED DESCENT THERE ARE NO CSM SEQUENTIAL SYSTEM FAILURES FOR WHICH POWERED DESCENT WILL BE TERMINATED
	14-5	SEQUENTIAL LOGIC BUS IS CONSIDERED FAILED IF--- A. VOLTAGE IS LESS THAN 22 VDC AND UNABLE TO ACTIVATE RCS ENABLE AND/OR SLA SEP RELAYS (CD0170X AND/OR CD0123X SYSTEM A; CD0171X AND/OR CD0124X SYSTEM B). B. LOGIC BUS SHORTED GREATER THAN 10 AMPS.
	14-6	PYRO BUS IS CONSIDERED FAILED IF--- A. SHORTED GREATER THAN 10 AMPS. B. FAILURE TO PERFORM ANY SEQUENTIAL FUNCTION WITH SUSPECTED FAILED PYRO SYSTEM.
		RULE NUMBERS 14-7 THROUGH 14-9 ARE RESERVED

REV	ITEM	
		' MANAGEMENT '
	14-18	ARMING OF THE SEQUENTIAL SYSTEM WILL BE PERFORMED WHILE IN CONTACT WITH A GROUND TELEMETRY SITE. THE FLIGHT CREW WILL ARM THE LOGIC BUSES AND STAND BY FOR A GO FROM THE GROUND TO PROCEED WITH ARMING THE PYRO BUSES.
		RULE NUMBERS 14-11 THROUGH 14-19 ARE RESERVED

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
				SPECIFIC MISSION RULES	
	14-20	SEQUENTIAL LOGIC BUS A OR B LESS THAN OR EQUAL TO 32 VDC AND UNABLE TO ACTIVATE RCS ENABLE AND/OR SLA SEP RELAYS			CD0170X AND/OR CD0133X SYSTEM A; CD0171X AND/OR CD0126X SYSTEM B
			LAUNCH	A. CONTINUE MISSION ENTER 3-1 IF BUS NOT RESTORED	
			EO TLC	B. TERMINATE OPERATIONS ENTER NEXT BEST PTP IF BUS NOT RESTORED	
			LUNAR ORBIT/ LUNAR STAY	C. CONTINUE MISSION	
	14-21	PYRO BUS A OR B LESS THAN OR EQUAL TO 35 VDC			
		A. SHORTED GREATER THAN 10 AMPS	LAUNCH	A.1. CONTINUE MISSION	
			EO TLC	2. TERMINATE OPERATIONS ENTER NEXT BEST PTP	A.2. USE BATTERY TIE FOR PYRO POWER TO AFFECTED B.S
			LUNAR ORBIT/ LUNAR STAY	3. CONTINUE MISSION	B. USE BATTERY TIE FOR PYRO POWER TO AFFECTED BUS
		B. SHORTED LESS THAN 10 AMPS	ALL	B. CONTINUE MISSION	
		C. PYRO BUS TM READS 0 VDC AND PYRO BAT ONBOARD GREATER THAN 35 VDC	LAUNCH	C.1. CONTINUE MISSION	
			ALL	2. ATTEMPT FUNCTION USING SUSPECTED FAILED BUS ONLY--- (A) IF FUNCTION NORMAL, CONTINUE MISSION (B) IF FUNCTION DOES NOT WORK NORMALLY, ENTER NEXT BEST PTP	C.2. ASSUME PYRO BAT VERIFIED GREATER THAN 35 VDC PRIOR TO ARMING. IF ENTRY BAT USED IN LIEU OF PYRO BAT, VOLTAGE SHOULD BE APPROXIMATELY = TO BAT BUS VOLTAGE.

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	14-22	TELEMETRY INDICATES AN EDS VOTE INPUT 1, 2, OR 3	LAUNCH	CONTINUE MISSION A. IF ANY ENTRY BATTERY LESS THAN 22 VDC, EDS AUTO/OFF SWITCH TO OFF B. ALL ENTRY BATTERIES GREATER THAN 22 VDC---CHECK CORRESPONDING EDS CB'S 1, 2, OR 3 CLOSED	PARAMETERS ARE CD0122X, CD0195X, AND CD0194X RESPECTIVELY. A. BAT C VOLTAGE CAN ONLY BE MONITORED ONBOARD
	14-23	LET JETTISON MOTOR DOES NOT FIRE	LAUNCH	CONTINUE MISSION ATTEMPT JETTISON PER CREW CHECKLIST EMERGENCY PROCEDURE	
	14-24	SMJC ACTIVATES PREMATURELY	DOI	A. ENTER NEXT BEST PTP-NO GO FOR PDI; RETAIN LM DESCENT STAGE FOR TEI	
			POWERED DESCENT	B. CONTINUE MISSION-NO GO FOR LUNAR STAY	
			ALL	C. ENTER NEXT BEST PTP 1. TERMINATE OPERATIONS AND POWER DOWN AFFECTED MAIN BUS. DO NOT ARM AFFECTED PYRO BUS 2. IF UNDOCKED, RETURN TO CSM AND PERFORM CSM/LM FINAL SEP 3. REPOWER AFFECTED MAIN BUS AFTER CM/SM SEP	C.1. 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. C.2. USE GOOD SEQUENTIAL SYSTEM
	14-25	ACTIVATED CM RCS PRESS LOGIC RELAYS.	ALL	CONTINUE MISSION A. PRIOR TO CM RCS PRESS---DO NOT ARM RESPECTIVE PYRO BUS (FOR BOTH INDICATIONS PERFORM SLA SEP WITH SECS ARM CB'S OPEN.) B. AT CM RCS PRESS---ARM RESPECTIVE PYRO BUS	CD0173X AND/OR CD0174X

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	14-26	ACTIVATED SLA DEPLOY LOGIC RELAYS	ALL	CONTINUE MISSION A. PRIOR TO SLA SEP---DO NOT ARM RESPECTIVE PYRO BUS B. FOR SLA SEP---ARM RESPECTIVE PYRO BUS FIRST	CD0123X AND/OR CD0124X
	14-27	UNABLE TO PERFORM SLA SEPARATION	TLC	ENTER NEXT BEST PTP	REF MR---
	14-28	LOST GROUND TO RESISTOR NETWORK FOR LOGIC OR PYRO BUS VOLTS MEASUREMENTS	LAUNCH EO TD+E	CONTINUE MISSION ARM BOTH SYSTEMS	ARMING AFFECTED SYSTEM WILL RESULT IN LOSS OF FOLLOWING PCM MEASUREMENTS--- LOGIC A SC2142R FC 1 O2 FLOW SP0930P FU SM/ENG INTERFACE P LOGIC B SC2140R FC 2 H2 FLOW ST0832K ALPHA CT. RATE CHAN 3 PYRO A SC2143R FC 2 O2 FLOW PYRO B SC2139R FC 1 H2 FLOW ST0831K ALPHA CT. RATE CHAN 2
			ALL	B. CONTINUE MISSION DO NOT ARM AFFECTED SYSTEM UNTIL SEQUENTIAL GO/NO GO PRIOR TO ENTRY UNLESS OTHER SYSTEM FAILS.	
		RULE NUMBERS 14-29 THROUGH 14-39 ARE RESERVED.			
	14-40	ACTIVATED APEX JETTISON LOGIC RELAYS	LUNAR ORBIT LUNAR STAY	A. CONTINUE MISSION DO NOT ARM PYRO BUSES UNTIL MALFUNCTION HAS BEEN ISOLATED	DETECTED AT SECS POWER UP (CD0230X AND CD0231)
			ALL	B. ENTER NEXT BEST PTP DO NOT ARM PYRO BUSES UNTIL MALFUNCTION HAS BEEN ISOLATED.	
	14-41	ACTIVATED DROGUE CHUTE DEPLOY LOGIC RELAY	LUNAR ORBIT/ LUNAR STAY	A. CONTINUE MISSION DO NOT ARM PYRO BUSES UNTIL MALFUNCTION HAS BEEN ISOLATED	MAY BE DETECTED AT ANY TIME (CE0001X AND/OR CE0002X)
			ALL	B. ENTER NEXT BEST PTP. DO NOT ARM PYRO BUSES UNTIL MALFUNCTION HAS BEEN ISOLATED.	

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	14-63	ACTIVATED PILOT CHUTE DEPLOY LOGIC RELAY	LUNAR ORBIT/ LUNAR STAY	A. CONTINUE MISSION DO NOT ARM PYRO BUSES UNTIL MALFUNCTION HAS BEEN ISOLATED	DETECTED AT SECS POWER UP PRIOR TO ENTRY (CE000031 AND/OR CE000481 WITH ELS BAT A(B) CB CLOSED
			ALL	B. ENTER NEXT BEST PTP DO NOT ARM PYRO BUSES UNTIL MALFUNCTION HAS BEEN ISOLATED	
		RULE NUMBERS 14-63 THROUGH 14-69 ARE RESERVED.			

REV	ITEM
	14-50

INSTRUMENTATION REQUIREMENTS

MEAS DESCRIPTION	PCM	ONBOARD	TRANSDUCERS	CATEGORY	MISSION RUL REFERENCE
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	BS0080X	-----	------	MD	-----
EDS ABORT REQ B	BS0081X	-----	------	MD	-----
DOCKING PROBE TEMP	CS0220T	-----	------	MD	
CSM-LM LOCK RING SEP RELAY A	CD1154X	-----	------	MD	19-23
CSM-LM LOCK RING SEP RELAY B	CD1155X	-----	------	MD	19-23
LM CURRENT	SC2962C	METER	COMMON	MD	-----

18 CSM GUIDANCE
AND CONTROL

REV	ITEM	

****
* GENERAL *
****

15-1 LAUNCH

THERE ARE NO FAILURES OF THE CSM GUIDANCE AND CONTROL SYSTEM WHICH ARE CAUSE FOR ABORT.

15-2 EARTH ORBIT PHASE

A. IN ORDER TO CONTINUE THE MISSION PAST THE NEXT BEST PTP: THE GUIDANCE AND CONTROL SYSTEMS MUST PROVIDE SPS CRITICAL BURN CAPABILITY AND ONE BACKUP DEORBIT METHOD (SM OR HYBRID). THE FOLLOWING MINIMUM CAPABILITIES MUST BE AVAILABLE---

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

2. TVC (CRITICAL BURNS)--- ONE TVC SERVO LOOP IN EACH AXIS AND ONE TVC CONTROL MODE (ACCEL CMD EXCLUDED).

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

(A) SM DEORBIT REQUIREMENTS---
- TRANSLATION CAPABILITY
- ONE OPERATIONAL FDAI
- RATE DAMPING IN ALL THREE AXES DAP OR SCS

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

B. IN ORDER TO PERFORM A NON-CRITICAL BURN AFTER THE STORAGE TANKS ARE EMPTY: THE G&C SYSTEMS MUST PROVIDE THE THE CAPABILITY TO EXECUTE AN ULLAGE MANEUVER BY EITHER CMC AUTO (RCS DAP): SCS AUTO: OR DIRECT ULLAGE.

C. IN ORDER TO COMMIT TO THE TRANSLUNAR COAST PHASE: THE GUIDANCE AND CONTROL SYSTEMS MUST PROVIDE SPS NON-CRITICAL GUIDANCE AND CONTROL SYSTEMS BURN CAPABILITY. THE FOLLOWING MINIMUM CAPABILITIES MUST ALSO BE AVAILABLE TO BE GO FOR TLI---

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

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

3. G&N---CMC: IMU: AND MDC DSKY FULLY OPERATIONAL AND OPTICS CAPABLE OF ALIGNING PLATFORM.

4. DISPLAYS---ONE OPERATIONAL FDAI.

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

15-3 TRANSLUNAR COAST

IN ORDER TO CONTINUE THE MISSION PAST THE NEXT BEST PTP: THE GUIDANCE AND CONTROL SYSTEMS MUST PROVIDE THE FOLLOWING MINIMUM CAPABILITIES---

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

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

REV	ITEM	
	15-4	LOI: LUNAR ORBIT A. LOI WILL BE INHIBITED OR LUNAR ORBIT TERMINATED EARLY IF EITHER REDUNDANT ATTITUDE CONTROL, REDUNDANT SPS CONTROL OR NON-CRITICAL SPS CAPABILITY IS LOST. IN ADDITION, THE FOLLOWING MINIMUM CAPABILITIES MUST BE AVAILABLE BEFORE COMMITTING TO OR CONTINUING LUNAR ORBIT. 1. ATTITUDE CONTROL---DIRECT RCS AND RATE DAMPING IN EACH AXIS. 2. TVC---BOTH SERVO LOOPS AND TWO TVC CONTROL MODES (ACCEL CMD EXCLUDED). 3. G&N---THE G&N MUST BE FULLY OPERATIONAL WITH THE EXCEPTION OF OPTICS AND NAV DSKY. OPTICS MUST BE CAPABLE OF ALIGNING PLATFORM. 4. RCS TRANSLATION---X-AXIS VIA AUTO COILS OR DIRECT ULLAGE PUSHBUTTON. B. IN ORDER TO PERFORM A NON-CRITICAL BURN THE G&C SYSTEMS MUST PROVIDE THE CAPABILITY TO EXECUTE AN ULLAGE MANEUVER BY EITHER CMC AUTO (RCS DAP), SCS AUTO, OR DIRECT ULLAGE.
	15-5	UNDOCKED THE UNDOCKED PHASE WILL BE DELETED OR TERMINATED IF THE G&C SYSTEMS CANNOT PROVIDE REDOCKING OR LM RESCUE CAPABILITY. THE G&C SYSTEMS MUST PROVIDE DIRECT RCS, RATE DAMPING AND TRANSLATION CAPABILITY IN EACH AXIS FOR DOCKING/UNDOCKING CONTROL. IN ADDITION, THE FOLLOWING MINIMUM CAPABILITIES FOR LM RESCUE MUST BE AVAILABLE--- - OPERATIONAL OPTICS OR VHF SUBSYSTEM - ONE DSKY - TRANSLATION CAPABILITY IN EACH AXIS - RATE DAMPING IN ALL THREE AXES - OPERATIONAL IMU AND CMC - ONE OPERATIONAL RHC - ONE OPERATIONAL FDAI - DIRECT RCS - NON CRITICAL SPS BURN CAPABILITY

REV	ITEM	
	15-8	ASCENT, DESCENT---THERE ARE NO GUIDANCE AND CONTROL SYSTEM FAILURES THAT AFFECT THE ASCENT OR DESCENT PHASES.
	15-9	LUNAR STAY PHASE LUNAR STAY WILL BE TERMINATED EARLY IF REDUNDANT SPS CONTROL CAPABILITY IS LOST. IN ADDITION, THE FOLLOWING MINIMUM CONTROL CAPABILITIES MUST BE AVAILABLE FOR THE ACCOMPLISHMENT OF TEI. 1. ATTITUDE CONTROL - DIRECT RCS IN TWO AXES AND RATE DAMPING IN TWO AXES. 2. TVC - BOTH SERVO LOOPS AND TWO TVC CONTROL MODES (ACCEL CMD EXCLUDED). 3. G&N - THE G&N MUST BE FULLY OPERATIONAL WITH THE EXCEPTION OF OPTICS AND NAV DSKY.

RULES 15-8 AND 15-9 ARE RESERVED.

REV	ITEM	
		SYSTEMS MANAGEMENT
	15-10	ATTITUDE CONTROL---CSM IN ACTIVE RCS CONTROL- LM WILL NOT BE IN ACTIVE ATTITUDE HOLD. LM IN ACTIVE RCS CONTROL- CSM WILL NOT BE IN ACTIVE ATTITUDE HOLD. FOR DOCKING ACTIVITIES AFTER OPENING THE APS INTERCONNECT (BOTH VEHICLES IN ACTIVE RCS CONTROL): THE CSM MUST BE IN A TIGHTER DEADBAND THAN THE LM.
	15-11	PIPA BIAS WILL BE UPDATED WHEN ACTUAL BIAS DIFFERS FROM THE VALUE IN CMC ERASABLE BY +/-.005 FT/SEC2. THE FAILURE LIMIT ON THE CSM ACCELEROMETER IS +/-.164 FT/SEC2. THE FIRST GYRO BIAS DRIFT WILL BE UPDATED IF THE DRIFT IS +/- 3 MERU (.015 DEG/HR). THEREAFTER: +/- 3 MERU (+/- .045 DEG/HR) WILL BE THE UPDATE CRITERIA. THE FAILURE LIMIT ON THE CSM GYRO IS +/- 100 MERU (+/- 1.5 DEG/HR).
	15-12	DELTA V COUNTER DRIFT 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.
	15-13	SAP INITIALIZATION GIMBAL TRIM---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 RCS CONTROLLED. IF THE PREVIOUS MANEUVER WAS SCS CONTROLLED: THE CMC STORED VALUES WILL BE USED. TRIMS WILL BE REINITIALIZED FROM THE GROUND AFTER EACH VEHICLE CONFIGURATION CHANGE AND AFTER EACH WEIGHT UPDATE. TRIMS MUST BE UPDATED WHEN GROUND COMPUTED VALUES DIFFER FROM CMC STORED VALUES BY 0.5 DEGREE. CSM: LM WEIGHT--- 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.
		RULE NUMBERS 15-14 THROUGH 15-19 RESERVED.

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
				SPECIFIC MISSION RULES	
	19-20	LOSS OF EITHER DRAG 1 OR 2 IN EITHER PITCH OR YAW CHANNEL	ALL	CONTINUE MISSION	A: REF MALF PROC--- SGC-1,3,4+6 SCS-1,3,3A,+6 B: NO SCS AUTO TVC C: IF IN YAW CHANNEL: AFTER .050: RSI IS USABLE IF REMAINING GYRO IS SELECTED FOR RATE. RSI MUST BE REALIGNED IN ADDITION TO THE ABOVE: FOR YAW FAILURE AFTER .050.
	19-21	LOSS OF BOTH DRAG 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	D.1: IN LUNAR ORBIT DO DPS TEI. 2: IN EARTH ORBIT: LOSS OF PITCH CHANNEL RESULTS IN ALL THREE DEORBIT METHODS BEING SUBJECTED TO SINGLE FAILURES IN THE GGA SYSTEM. THE YAW LOSS PRECLUDES HYBRID DEORBIT AND SUBJECTS BOTH REMAINING DEORBIT METHODS TO SINGLE FAILURES IN THE GGA SYSTEM
			ENTRY	E: CONTINUE MISSION	E: RSI AND SCS PGAI ROLL UNUSABLE WITH YAW CHANNEL FAILURES.
	19-22	LOSS OF ROLL DRAG			
		A: NUMBER ONE	ALL	A: CONTINUE MISSION	A.1: MANUAL ROLL ATTITUDE CONTROL REQUIRED IN ALL SCS MODES. 2: NO SCS PGAI ROLL: RSI VALID.
		B: NUMBER TWO	ALL	B: CONTINUE MISSION	B.1: USE OF ATT 1/RATE 2 AND LIM CYCLE MAY PROVIDE RATE DAMPED ATTITUDE HOLD WHEN SCS GAP IS NOT USED. STBY PACKAGE 2 MUST BE POWERED DOWN TO EFFECT ATTITUDE HOLD IF FAILURE IS HARDOVER. 2: SELECTION OF RATE 1 WILL PROVIDE BOTH RSI AND SCS PGAI ROLL FOR ENTRY: RSI MUST BE REALIGNED FOR ROLL FAILURE AFTER .050.

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	15-23	LOSS OF BOTH ROLL RHAG'S	LAUNCH	A. CONTINUE MISSION	
			EO	B. 1. NO GO FOR TLI 2. ENTER NEAT BEST PTP IF SM DEORBIT NOT AVAILABLE	
			TLC	C. NO-GO FOR LOI	C. NO SCS FDAI ROLL OR RSI AVAILABLE FOR ENTRY.
			LO	D. CONTINUE MISSION	
			ALL OTHERS	E. CONTINUE MISSION	
	15-24	LOSS OF EITHER TVC SERVO LOOP IN EITHER PITCH OR YAW AXIS			* MAINTAIN 20 LBS/QUAD/AXIS FOR HARDOVER RECOVERY FOR UNDOCKED AND *** LBS/QUAD/ AXIS FOR HARDOVER RECOVERY FOR DOCKED SPS MANEUVERS.
			LAUNCH/ EO	A. CONTINUE ALTERNATE EO MISSION SELECT 1 OR 2 ON TVC GIMBAL DRIVE SWITCH IN APPROPRIATE AXIS	
			TLC	B. NO-GO FOR LOI	
			DESCENT	C. CONTINUE MISSION	
			ALL OTHERS	D. TERMINATE PHASE AND ENTER NEAT BEST PTP	D. IN LUNAR ORBIT DO DPS TEI.
	15-25	LOSS OF BOTH TVC SERVO LOOPS	LAUNCH	A. CONTINUE MISSION	A.1. REF HALF PROC 66C-1. 66N-4. SCS-A1 2. NO MODE III OR IV CAPA- BILITY. LIMITED LANDING POINT CONTROL IN MODE III OR IV WITH SM-RCS.
			EO	B. ENTER NEXT BEST PTP RCS DEORBIT	
			TLC	C. NO-GO FOR LOI	
			DESCENT	D. CONTINUE MISSION	
			ALL OTHERS	E. TERMINATE PHASE AND ENTER NEAT BEST PTP	E. IN LUNAR ORBIT DO DPS TEI.
	15-26	LOSS OF PROPORTIONAL CONTROL FROM**			
		A. EITHER RHC	ALL	A. CONTINUE MISSION USE REMAINING RHC	
		B. BOTH RHC'S	ALL	B. CONTINUE MISSION USE DIRECT RCS OR ACCEL CMD FOR MANUAL MANEUVERS	B. NO MTVC RATE OR MTVC ACCEL CMD CAPABILITY

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	15-27	LOSS OF DIRECT RCS CONTROL FROM---			• REF MALF PROC SCS 5
		A. EITHER RHC: ANY OR ALL AXES	ALL	A. CONTINUE MISSION	
		B. BOTH RHC'S: SAME AXIS	LAUNCH	B.1. CONTINUE MISSION	
			DESCENT	2. CONTINUE MISSION	
			LUNAR STAY	3. CONTINUE MISSION	
			ALL OTHERS	4. TERMINATE PHASE AND ENTER NEXT BEST PTP	B.4. FAILURE VIOLATES DIRECT RCS REQUIREMENT.
		C. BOTH RHC'S: TWO AXES	LUNAR STAY	C. TERMINATE PHASE AND ENTER NEXT BEST PTP.	
	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 DR 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 GNC-1;2;3;4;5;6
		A. ONE	ALL	A. CONTINUE MISSION	
		B. BOTH	LAUNCH	B.1. CONTINUE MISSION	
			TLC	2. NO-GO FOR LOI	
			DESCENT	3. CONTINUE MISSION	
			LUNAR STAY	4. CONTINUE MISSION	
			ALL OTHERS	5. TERMINATE PHASE AND ENTER NEXT BEST PTP	5. IN LUNAR ORBIT: DO DPS TEI.

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	15-30	LOSS OF AC1 PHASE A			- LOSS OF AC1 PHASE A RESULTS IN THE LOSS OF--- A. REDUNDANT SERVO LOOP POWER. BOTH SERVO LOOPS MUST BE POWERED BY THE SAME BUS. B. PROPORTIONAL ATTITUDE CONTROL FROM BOTH RHC'S. ALL PROPORTIONAL CONTROL FROM RHC NO. 1. C. FDAI NO. 1 D. GYRO ASSEMBLY NO. 1 E. SCS TOTAL ATTITUDE ERROR F. SCS TOTAL ATTITUDE G. SCS AUTO TVC CAPABILITY H. SCS MINIMUM IMPULSE CAPABILITY I. SCS ATTITUDE CONTROL RATE DAMPING J. GPI P&Y DRIVE NO. 1. . IN EARTH ORBIT. LOSS OF AC1 PRECLUDES HYBRID DEORBIT AND SUBJECTS BOTH REMAINING DEORBIT METHODS O A SINGLE FAILURE (AC2 PHASE A)
			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 TEST.

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	15-31	LOSS OF AC2 PHASE A			- LOSS OF AC2 PHASE A RESULTS IN THE LOSS OF---
					A. REDUNDANT SERVO LOOP POWER
					B. ALL PROPORTIONAL CONTROL
					C. FDAI NO. 2
					D. GYRO ASSEMBLY NO. 2
					E. SCS PITCH AND YAW TOTAL ATTITUDE
					F. ALL SCS TVC CAPABILITY (AUTO: RATE AND ACCEL CMD)
					G. RSI
					H. GPI P67 DRIVE NO. 2
					. IN EARTH ORBIT: LOSS OF AC2 RESULTS IN ALL THREE DEORBIT METHODS BEING SUBJECTED TO A SINGLE FAILURE (AC1 PHASE A).
			LAUNCH	A. CONTINUE MISSION	
			TLC	B. NO-GO FOR LOI	
			DESCENT	C. CONTINUE MISSION	
			ALL OTHERS	D. TERMINATE PHASE AND ENTER NEAT BEST PTP	D. IN LUNAR ORBIT DO DPS TEI.
	15-32	LOSS OF ORBIT RATE DISPLAY (CORDEALP EARTH AND LUNAR	ALL	CONTINUE MISSION	REF MALF PROC 66C-4+5
	15-33	LOSS OF ENTRY MONITOR SYSTEM	LO POST ANDE	TERMINATE PHASE AND ENTER NEAT BEST PTP	REF MALF PROC EMS-1
	15-34	GROUND AT EITHER SPS SOL DRIVER OUTPUT AND UNABLE TO REMOVE	ALL	CONTINUE MISSION- OPEN SPS PILOT VALVE CB'S	. REF MALF PROC 66C-1

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	15-35	LOSS OF TRANSLATION HAND CONTROLLER	LAUNCH	A. CONTINUE MISSION	
			EARTH ORBIT	B. ENTER NEXT BEST PTP	B. VIOLATES BOTH SM AND HYBRID DEORBIT MINIMUM REQUIREMENTS.
			TLC	C. CONTINUE MISSION	
			LO	D. NO-GO FOR UNDOCKING	D. VIOLATES LM RESCUE MINIMUM REQUIREMENTS.
			UNDOCKED	E. DOCK	
			ALL OTHERS	F. CONTINUE MISSION	
		RULE NUMBERS 15-36 THROUGH 15-49 ARE RESERVED.			

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	15-50	LOSS OF COMMAND MODULE COMPUTER			• REF MALF PROC G6N-5
			LAUNCH	A. CONTINUE MISSION	
			EO	B. CONTINUE ALTERNATE EO MISSION IF BOTH SPS AND SM DEORBIT CAPABILITY AVAILABLE	B. VIOLATES HYBRID DEORBIT MINIMUM REQUIREMENTS
			TLC	C. NO-GO FOR LOI	
			LO	D. ENTER NEXT BEST PTP	
			UNDOCKED	E. DOCK	E. VIOLATES LM RESCUE MINIMUM 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.

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	15-52	LOSS OF INERTIAL SUBSYSTEM			• REF MALF PROC G6R-6
			LAUNCH	A. CONTINUE MISSION	
			EO	B. CONTINUE ALTERNATE EO MISSION IF BOTH SPS AND SM DEORBIT CAPABILITY AVAILABLE	B: VIOLATES HYBRID DEORBIT MINIMUM REQUIREMENTS
			TLC	C. NO-GO FOR LOI	
			LO	D. ENTER NEXT BEST PTP	
			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-1: VIOLATES LM RESCUE MINIMUM REQUIREMENTS 2: IN LUNAR ORBIT DO DPS TEI
	15-53	LOSS OF OPTICS SUBSYSTEM			• REF MALF PROC G6R-5
			LAUNCH	A. CONTINUE MISSION	
			EO	B. CONTINUE ALTERNATE EO MISSION USE BACKUP ALIGNMENT PROCEDURE (COAS)	
			TLC	C. NO-GO FOR LOI	
			ALL OTHERS	D. CONTINUE MISSION	

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	15-54	LOSS OF OPTICS SUBSYSTEM COUPLING DATA UNIT DIGITAL TO ANALOG CONVERTER			REF MALF PROC 66C-1 CONSTITUTES LOSS OF TVC DAP
			LAUNCH	A. CONTINUE MISSION	
			EO	B. CONTINUE ALTERNATE EO MISSION IF BOTH SPS AND SM DEORBIT CAPABILITY AVAILABLE	
			TLC	C. NO-GO FOR LOI	
			LO	D. ENTER NEXT BEST PTP	
			UNDOCKED	E. DOCK	
			DESCENT	F. CONTINUE MISSION	
			ALL OTHERS	G. TERMINATE PHASE AND NEXT BEST PTP	
		RULE NUMBERS 15-55 THROUGH 15-59 ARE RESERVED.			

REV	ITEM
	15-60

INSTRUMENTATION REQUIREMENTS

MEAS DESCRIPTION	PCM	ONBOARD	TRANSDUCERS	CATEGORY	MISSION RULE REFERENCE
CMC DIGITAL DATA	C60001V	-	-	MANDATORY	15-50
SPS SOL DRIVER 1	CM3604X	EMS-SPS-ON	SEPARATE	HIGHLY DESIRABLE	15-34
SPS SOL DRIVER 2	CM3605X	EMS-SPS-ON	SEPARATE	HIGHLY DESIRABLE	15-34
PITCH GIMBAL POS 1 & 2	CM3517M	GPI	COMMON	1 OF 2 MANDATORY -OB/HD-PCM	15-24/25
YAW GIMBAL POS 1 & 2	CM3518M	GPI	COMMON	1 OF 2 MANDATORY -OB/HD-PCM	15-24/25
TM BIAS 2.5 VDC	C61110V	-	-	HIGHLY DESIRABLE	15-52/53/54
PIPA TEMP	C62300T	-	-	HIGHLY DESIRABLE	15-52
IMU HTR +28 VDC	CM1513X	-	-	HIGHLY DESIRABLE	15-52
CMC OPERATE +28 VDC	C61535X	-	-	HIGHLY DESIRABLE	15-50
OPTX OPERATE +28 VAC	C61539X	-	-	HIGHLY DESIRABLE	15-54
IG 1X RSVR OUT SIN	C62112V	FDAI	COMMON	HIGHLY DESIRABLE	15-52
IG 1X RSVR OUT COS	C62113V	FDAI	COMMON	HIGHLY DESIRABLE	15-52
MG 1X RSVR OUT SIN	C62142V	FDAI	COMMON	HIGHLY DESIRABLE	15-52
MG 1X RSVR OUT COS	C62143V	FDAI	COMMON	HIGHLY DESIRABLE	15-52
OG 1X RSVR OUT SIN	C62172V	FDAI	COMMON	HIGHLY DESIRABLE	15-52
OG 1X RSVR OUT COS	C62173V	FDAI	COMMON	HIGHLY DESIRABLE	15-52
SHAFT CDU DAC OUT	C65721V	-	-	HIGHLY DESIRABLE	15-34
TRUNNION CDU DAC OUT	C65722V	-	-	HIGHLY DESIRABLE	15-34
CMC WARNING	C65040X	C&W	COMMON	HIGHLY DESIRABLE	15-50
PITCH ATT ERROR	CM3500M	FDAI	COMMON	HIGHLY DESIRABLE	15-20/21/22/23
YAW ATT ERROR	CM3501M	FDAI	COMMON	HIGHLY DESIRABLE	15-20/21/22/23
ROLL ATT ERROR	CM3502M	FDAI	COMMON	HIGHLY DESIRABLE	15-20/21/22/23
SCS PITCH BODY RATE	CM3503R	FDAI	COMMON	HIGHLY DESIRABLE	15-20/21/22/23
SCS YAW BODY RATE	CM3504R	FDAI	COMMON	HIGHLY DESIRABLE	15-20/21/22/23
SCS ROLL BODY RATE	CM3505R	FDAI	COMMON	HIGHLY DESIRABLE	15-20/21/22/23
SCS TVC PITCH AUTO CMD	CM3582V	-	-	HIGHLY DESIRABLE	15-24/25
SCS TVC YAW AUTO CMD	CM3583V	-	-	HIGHLY DESIRABLE	15-24/25
MTVC PITCH CMD	CM3585M	-	-	HIGHLY DESIRABLE	15-24/25
MTVC YAW CMD	CM3586M	-	-	HIGHLY DESIRABLE	15-24/25
FDAI ERROR 5; RATE 5	CM3592X	-	-	HIGHLY DESIRABLE	15-20/21/22/23
FDAI ERROR 50/15; RATE 50/15	CM3593X	-	-	HIGHLY DESIRABLE	15-20/21/22/23
PITCH DIFF CLUTCH CUR	CM3666C	-	-	HIGHLY DESIRABLE	15-24/25
YAW DIFF CLUTCH CUR	CM3667C	-	-	HIGHLY DESIRABLE	15-24/25

16 CSM SERVICE
PROPULSION
SYSTEM

REV	ITEM	

****
* GENERAL *
****

16-3 A. CATEGORIES OF FAILURES---

FAILURES AFFECTING THE SPS FAIL INTO ONE OF THREE CATEGORIES---

1. FAILURES WHICH CAUSE THE SPS TO BE UNSAFE-- THESE FAILURES RESULT IN MISSION TERMINATION ASAP.

2. FAILURES WHICH CAUSE THE SPS TO BE INOPERABLE OR HAZARDOUS TO OPERATE-- THESE FAILURES RESULT IN ALTERATION OF THE MISSION TO MINIMIZE USAGE OF THE SPS.

3. FAILURES SUCH THAT CONTINUED OPERATION WILL RESULT IN SUBSEQUENT DEGRADATION-- THESE FAILURES ALLOW PERFORMANCE OF CRITICAL BURNS ONLY.

B. ULLAGE REQUIREMENTS--- SUBSEQUENT TO THE DEPLETION OF STORAGE TANK PROPELLANTS AN ULLAGE MANEUVER WILL NORMALLY BE PERFORMED PRIOR TO ANY BURN. HOWEVER, INABILITY TO PERFORM AN ULLAGE WILL NOT PRECLUDE A CRITICAL BURN.

C. PREMATURE TERMINATION OF BURNS--- CRITICAL BURNS WILL NOT BE TERMINATED BECAUSE OF ANOMALIES. NON-CRITICAL BURNS WILL BE TERMINATED UNDER VARIOUS CONDITIONS AS SPECIFIED IN RULE 3-31 AND THE SPECIFIC RULES OF THIS SECTION.

16-2 LAUNCH PHASE

THERE ARE NO SPS FAILURES WHICH REQUIRE A LAUNCH ABORT.

16-3 DELETED

REV	ITEM	
	16-4	EARTH ORBIT PHASE

A. CRITICAL BURNS IN THIS PHASE ARE MODE IV: APOGEE KICK AND DEORBIT. IF THE SPS IS INCAPABLE OF PERFORMING CRITICAL BURNS: THE MISSION WILL BE TERMINATED BY ENTRY INTO THE NEAR 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.

REV	ITEM	
	16-5	TRANSLUNAR COAST PHASE

A. CRITICAL BURNS IN THIS PHASE ARE TIME CRITICAL ABORTS: BURNS TO ASSURE FREE RETURN OR BURNS TO AVOID LUNAR OR LAND IMPACT. HOWEVER: ONCE INITIATED WITH THE SPS: THESE BURNS ARE CONSIDERED NON-CRITICAL BECAUSE SUFFICIENT TIME IS AVAILABLE FOR ANALYSIS AND POSSIBLE CORRECTIVE ACTION.

B. IF THE SPS IS INCAPABLE OF PERFORMING NON-CRITICAL MANEUVERS: FURTHER NON-CRITICAL BURNS AND LOI WILL BE INHIBITED.

C. CERTAIN ABORT BURNS: BURNS TO ASSURE FREE RETURN OR BURNS TO AVOID LUNAR OR LAND IMPACT MAY USE THE LM DPS AND LM RCS.

REV	ITEM	
	16-6	LUNAR ORBIT PHASE A. TEI IS THE ONLY CRITICAL BURN IN THIS PHASE. B. IF THE SPS IS INCAPABLE OF PERFORMING NON-CRITICAL BURNS, FURTHER NON-CRITICAL BURNS WILL BE INHIBITED. C. LM DPS MAY BE USED FOR TEI IF THE CAPABILITY EXISTS.
	16-7	DESCENT PHASE THE LM POWERED DESCENT WILL BE ABORTED FOR SPS PROPELLANT LEAKS BECAUSE THE CAPABILITY TO PERFORM TEI IS DECREASING WITH TIME.
	16-8	UNDOCKED AND LUNAR STAY PHASES A. THE LUNAR ORBIT PLANE CHANGE IS A CRITICAL BURN IF OUTSIDE TOTAL LM CAPABILITY. B. THESE PHASES WILL BE TERMINATED FOR CONFIRMED LOSS OF SPS REDUNDANCY.
	16-9	ASCENT PHASE LM RESCUE BURNS MAY BE REQUIRED, AND THEY ARE CRITICAL.
	16-10	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.

REV	ITEM	
		* SYSTEMS MANAGEMENT *
	16-11	PROPELLANT GAGING A. PRIME METHOD---ONBOARD GAGING SYSTEM(1 PERCENT). B. BACKUP METHOD---FLOW RATE X BURN TIME (3 PERCENT).
	16-12	THE PU VALVE WILL BE USED TO MAINTAIN THE UNBALANCE READING--- A. PRIOR TO CROSSOVER---AT THE STABLE VALUE OCCURING APPROXIMATELY 25 SEC AFTER LOI IGNITION. (PRIOR TO LIFTOFF IT WILL BE POSITIONED ACCORDING TO PRELAUNCH PREDICTIONS AND WILL NOT BE MOVED UNTIL LOI 1.) B. AFTER CROSSOVER--- AT APPROXIMATELY ZERO UNBALANCE.
	16-13	DUAL BANK VS SINGLE BANK OPERATION THE SPS WILL ALWAYS BE STARTED USING A SINGLE BANK. HOWEVER, THE OTHER BANK WILL BE OPENED 2 TO 3 SECONDS AFTER IGNITION FOR BURNS PLANNED TO BE LONGER THAN 6 SECONDS. BANK A WILL BE USED FOR THE FIRST ENGINE IGNITION.
	16-14	PROPELLANT MANAGEMENT A. THE SPS PROPELLANT REDLINE PRE LOI PROVIDE CAPABILITY FOR LOI, CIRCULARIZATION, TEI AND TEMC FOR THE NOMINAL MISSION IS TBD PERCENT INDICATED PROPELLANT REMAINING. B. THE SPS PROPELLANT REDLINE PREUNDOCKING TO PROVIDE CAPABILITY FOR LM RESCUE, LOPC 1, TEI AND TEMC FOR THE NOMINAL MISSION IS TBD PERCENT INDICATED PROPELLANT REMAINING.
	16-15	PROPELLANT FEEDLINE TEMPERATURE MANAGEMENT SPS LINE HEATERS WILL BE MANUALLY CYCLED TO MAINTAIN FEEDLINE TEMPERATURES BETWEEN 45 DEG. F AND 75 DEG. F. AND ENGINE VALVE TEMPERATURE ABOVE 45 DEG. F.
	16-16	ULLAGE MANAGEMENT IN GENERAL, SPS BURNS REQUIRING ULLAGE WILL BE PRECEDED BY A TWO -JET ULLAGE. SPS BURNS ASSOCIATED WITH LM RESCUE WILL ORDINARILY BE PRECEDED BY 4-JET ULLAGES.
		RULE NUMBERS 16-17 THROUGH 16-19 ARE RESERVED.

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
				SPECIFIC MISSION RULES	
	16-20	SUSTAINED PRESSURE DECAY IN EITHER THE FUEL OR OXIDIZER TANK (COULD BE HELIUM OR FUEL OR OXIDIZER)			• MALF PROC--- SPS 18
			LAUNCH	CONTINUE MISSION PLAN RCS DEORBIT AT NEXT BEST PTP IF LAND IMPACT IS IMMINENT AFTER ABORTING REPRESS MANUALLY AND PERFORM BURN TO AVOID LAND.	• 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	A.1. REDOCK 2. VERIFY OPERATION OF SUSPECTED BANK BY ACTIVATING IT AFTER STARTING ON GOOD BANK	• MALF PROC--- SPS 9 • TRANSDUCER INDICATION CANNOT BE VERIFIED WITHOUT ENGINE OPERATION.
			ALL OTHERS	B. CONTINUE MISSION	

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	16-22	LOSS OF ONE BANK OF BALL VALVES			MALF PROC SPS-9
			LAUNCH/ EO	A. N/A	
			TLC	B. NO-GO FOR LOI	
			LO	C. ENTER NEXT BEST PTP USE LM DPS IF AVAILABLE	
			UNDOCKED/ DESCENT LUNAR STAY	D. N/A	
				E. ENTER NEXT BEST PTP	
	16-23	LOSS OF BOTH GN2 TANK PRESSURES (LESS THAN 400 PSIA)	LAUNCH	A. CONTINUE MISSION	. MALF PROC--- SPS 9
			EO	B. ENTER NEXT BEST PTP RCS DEORBIT	. TRANSDUCER INDICATION CANNOT BE VERIFIED WITHOUT ENGINE OPERATION.
			TLC	C. NO-GO FOR LOI	
			LO	D. PLAN TEI ASAP WITH LM DPS	
			UNDOCKED	E. DOCK ASAP	E. DO NOT STAGE LM
			DESCENT	F. CONTINUE MISSION	
			LUNAR STAY	G. RETURN TO CSM ASAP	
			TEC	H. CONTINUE MISSION	
	16-24	FUEL FEEDLINE AND/OR OXIDIZER FEEDLINE TEMP LESS THAN 40 DEG F. AND UNABLE TO INCREASE.			. MALF PROC--- SPS 11 LIMITATION FOR CRITICAL BURNS IS 25 DEG F.
			LAUNCH	A. CONTINUE MISSION	
			EO	B. ENTER NEXT BEST PTP RCS DEORBIT	
			TLC	C. NO-GO FOR LOI	
			LO	D. PLAN TEI ASAP WITH LM DPS	
			UNDOCKED	E. DOCK ASAP	F. DO NOT STAGE LM
			DESCENT LUNAR STAY	F. CONTINUE MISSION G. RETURN TO CSM ASAP	
			TEC	H. CONTINUE MISSION	

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	16-25	ENGINE FLANGE TEMP GOES HIGHER THAN 480 DEG F DURING AN SPS BURN.			
			LAUNCH	NOT APPLICAPLE	
			EO	ENTER NEXT BEST PTP RCS DEORBIT	
			LO	ENTER NEXT BEST PTP. USE DPS IF AVAILABLE.	
		A. DURING NON-CRITICAL BURN	ALL	A. TERMINATE BURN INHIBIT FURTHER NON-CRITICAL BURNS	
		B. DURING CRITICAL BURN	ALL	B. CONTINUE BURN INHIBIT FURTHER NON-CRITICAL BURNS	
	16-26	THRUST CHAMBER PRESSURE LESS THAN 70 PSI CONFIRMED BY OTHER INSTRUMENTATION			• MALF PROC--- SPS 6
			LAUNCH	NOT APPLICABLE	• CONFIRMING INSTRUMENTATION INCLUDES ONBOARD PC METER, CREW, DEGRADED THRUST, FU AND OX INTERFACE PRESSURES, F/O VALVE POSITIONS, FU AND OX TANK PRESSURES.
			EO	ENTER NEXT BEST PTP - RCS DEORBIT	
			LO	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	

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	16-27	LACK OF ULLAGE CAPABILITY	LAUNCH	A. NOT APPLICABLE	
			EO	B. NO-GO FOR TLI CONTINUE MISSION IN EO WITH SUITABLE ALTERNATE	
			TLC	C. NO-GO FOR LOI	
			LO	D. ENTER NEXT BEST PTP	PRECLUDES LM RESCUE
			UNDOCKED	E. REDOCK	
			ALL OTHERS	F. CONTINUE MISSION INHIBIT NON-CRITICAL BURNS IF POSSIBLE	
	16-28	DELTA P BETWEEN FUEL AND OX TANK PRESSURES GREATER THAN 20 PSI AND UNABLE TO DECREASE	LAUNCH	CONTINUE MISSION	HALF 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	

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	16-29	LEAK OR COMPLETE LOSS OF HELIUM SUPPLY PRESSURE OR BOTH HELIUM VALVES FAIL CLOSED.			* BLOWDOWN DELTA V REMAINING IS A FUNCTION OF ULLAGE VOLUME AT TIME OF FAILURE.
			LAUNCH	A. CONTINUE MISSION	HALF PROC--- SPS 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	
			ALL OTHERS	F. CONTINUE MISSION	
		RULE NUMBERS 16-30 THROUGH 16-49 ARE RESERVED.			

REV	ITEM
	16-50

INSTRUMENTATION REQUIREMENTS

MEAS DESCRIPTION	PCM	ONBOARD	TRANSDUCERS	CATEGORY	MISSION RULE REFERENCE
OX TK PRESS	SP0003P	METER/C&W	COMMON	M O/B	16-20; 28
OX SM/ENG INTERFACE P	SP0931P	"	"	MD	16-20;29
FU TK PRESS	SP0006P	METER/C&W	COMMON	M O/B	16-20; 28
FU SM/ENG INTERFACE P	SP0930P	"	"	MD	16-20; 28
SPS VLV ACT PRESS-PRI	SP0600P	METER	COMMON		16-21; 22
SPS VLV ACT PRESS-SEC	SP0601P	METER	COMMON	-1 OF 2 M O/B	16-21; 22
SPS FU FEEDLINE TEMP	SP0048T	METER	COMMON		16-24
SPS OX FEEDLINE TEMP	SP0049T	SYS TEST	COMMON	-1 OF 2 M	
ENG CHAMBER PRESS	SP0661P	METER	COMMON	M O/B	16-26
HE TK PRESS	SP0001P	METER	SEPARATE	1 OF 2 M	16-29
FU/OX VLV 1 POS	SP0022M	DISPLAY	SEPARATE M		16-21; 26
FU/OX VLV 2 POS	SP0023M	DISPLAY	SEPARATE M	1 OF 2 O/B	16-21; 26
FU/OX VLV 3 POS	SP0024M	DISPLAY	SEPARATE M	1 OF 2 O/B	16-21; 26
FU/OX VLV 4 POS	SP0025M	DISPLAY	SEPARATE M		16-21; 26
OX TK 1 QTY - TOTAL AUX	SP0655Q	DISPLAY	COMMON	MD	16-10; 11; 13
OX TK 2 QTY	SP0656Q	DISPLAY	COMMON	MD	16-10; 11; 13
FU TK 1 QTY - TOTAL AUX	SP0657Q	DISPLAY	COMMON	MD	16-10; 11; 13
FU TK 2 QTY	SP0658Q	DISPLAY	COMMON	MD	16-10; 11; 13

17 CSM SM-RCS

REV	ITEM	

* GENERAL *

17-1 LAUNCH

THE LOSS OF ONE QUAD IS NOT CAUSE FOR ABORT AND THERE ARE NO SINGLE FAILURES NOR ANY REASONABLE REALISTIC COMBINATION OF FAILURES WHICH LEAD ONLY TO LOSS OF MULTIPLE QUADS. THERE ARE, THEREFORE, NO SM-RCS FAILURES WHICH ARE CONSIDERED CAUSE FOR ABORT.

17-2 EARTH ORBIT PHASE

A. LOSS OF ONE QUAD, IN ITSELF, IS NOT NECESSARILY CAUSE FOR EARLY TERMINATION OF THE MISSION. THE GUIDELINE IS THAT AS LONG AS THE SPACECRAFT ATTITUDE CAN BE CONTROLLED AND THE SPS CAN BE BURNED THE MISSION NEED NOT BE TERMINATED EARLY. HOWEVER, LOSS OF ONE QUAD WILL REQUIRE TLI BE INHIBITED AND MAY LEAD TO EARLY MISSION TERMINATION SINCE THE CAPABILITY TO PERFORM SM OR HYBRID DEORBIT WILL BE AFFECTED.

B. LOSS OF TWO OR MORE QUADS IS CAUSE FOR ENTRY INTO THE NEAR BEST PTP.

1. LOSS OF TWO ADJACENT QUADS WILL DESTROY THE CAPABILITY TO PERFORM ULLAGE MANEUVERS AND WILL REQUIRE DELETION OF NON-CRITICAL SPS MANEUVERS. LOSS OF TWO ADJACENT QUADS PRECLUDES SM OR HYBRID DEORBIT.

2. LOSS OF TWO OPPOSITE QUADS WILL DESTROY THE CAPABILITY TO PERFORM PRECISE 3-AXIS ATTITUDE CONTROL AND PRECLUDES SM OR HYBRID DEORBIT.

17-3 TRANSLUNAR COAST

LOSS OF ONE QUAD IS NOT, IN ITSELF, CAUSE FOR TERMINATION OF THE MISSION. HOWEVER, DEPENDING ON LM RCS CAPABILITY, THE TRANSLUNAR COAST PHASE MAY BE TERMINATED BY ENTRY INTO THE NEAR 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 NOT, IN ITSELF, CAUSE FOR EARLY TERMINATION OF LUNAR ORBIT OR LUNAR STAY PHASES. UNDOCKING WILL BE NO-GO BECAUSE LOSS OF ONE QUAD PRECLUDES CSM ACTIVE DOCKING. LOSS OF TWO QUADS IS CAUSE FOR TERMINATING LUNAR ORBIT OR LUNAR STAY PHASES, AND IS ALSO CAUSE FOR PERFORMING TEI WITH THE LM DPS OR RETAINING THE LM ASCENT STAGE THROUGH TEI FOR ATTITUDE CONTROL.

RULE NUMBERS 17-5 THROUGH
17-14 ARE RESERVED.

REV	ITEM	

! SYSTEMS MANAGEMENT !

17-15 PROPELLANT GAGING

A. PRIME METHOD---RTCC EQUATION (8 PERCENT).

B. BACKUP METHOD---HELIUM PRESSURE/TEMPERATURE (11 PERCENT) (ONBOARD)

17-16 QUAD PROPELLANT BALANCE

PROP ISOLATION VALVES WILL NOT BE USED FOR QUAD PROPELLANT BALANCE. PROPELLANT BALANCE WILL BE ACCOMPLISHED BY SELECTING TWO-JET +X AND -X TRANSLATIONS WITH EITHER THE PITCH OR YAW QUAD AND BY CHOOSING SUITABLE JETS FOR ATTITUDE CONTROL. PROPELLANT DIFFERENCES BETWEEN QUADS WILL BE MAINTAINED WITHIN +/- 50 POUNDS.

17-17 SECONDARY PROPELLANT FUEL PRESSURE VALVE

THE RCS SECONDARY FUEL PRESSURIZATION VALVE WILL BE OPENED WHEN THE PRIMARY FUEL MANIFOLD PRESSURE REACHES 150 PSIA OR RTCC SHOWS LESS THAN 110 LBS.

RULE NUMBERS 17-18 THROUGH
17-19 ARE RESERVED.

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
				SPECIFIC MISSION RULES	
	17-20	SUSTAINED LEAK IN HELIUM TANK			• MALF PROC--- RCS 2
		A. ONE OR MORE QUADS	LAUNCH	A. CONTINUE MISSION	• QUAD WILL REMAIN USABLE UNTIL HE MANIFOLD PRESSURE REACHES 75 PSI
		B. ONE QUAD (ALL OTHER QUADS NORMAL)	EO	B.1. NO-GO FOR TLI	
			TLC	2. NO-GO FOR LOI	
			LO	3. NO GO FOR UNDOCKING	
			UNDOCKED	4. DOCK ASAP	
			DESCENT/ LUNAR STAY	5. CONTINUE MISSION	
		C. MORE THAN ONE QUAD	EO	C.1. CONTINUE MISSION ENTER PRIOR TO LOSS OF HYBRID DEORBIT CAPABILITY	
			TLC	2.(A) NO GO FOR LOI (B) CONTINUE MISSION IF SUFFICIENT BLOWDOWN CAPABILITY EXISTS	
			DESCENT	3. CONTINUE MISSION	
			ALL OTHERS	4. TERMINATE PHASE AND ENTER NEXT BEST PTP	C.4.(A) IN LUNAR ORBIT. DO DPS TEI. (B) RETAIN LM ASCENT STAGE THRU TEI DEPENDING UPON LM RCS PROPELLANT REMAINING.

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	17-21	SUSTAINED LEAK BELOW HE ISOLATION VALVE (COULD BE HELIUM OR FUEL OR OXIDIZER)			• MALF PROC--- RCS 1C • QUAD WILL REMAIN USABLE UNTIL HE MANIFOLD PRESSURE REACHES 75 PSI.
		A. ONE OR MORE QUADS	LAUNCH	A. CONTINUE MISSION	
		B. ONE QUAD (ALL OTHER QUADS NORMAL)	EO	B.1. NO-GO FOR TLI	
			TLC	2.(A) NO GO FOR LOI (B) ENTER NEAT BEST PTP IF LM NOT AVAILABLE	
			LO	3. NO GO FOR UNDOCKING	
			UNDOCKED	4. DOCK ASAP	
			DESCENT	5. CONTINUE MISSION	
			LUNAR STAY	6. CONTINUE MISSION	
		C. MORE THAN ONE	DESCENT	C.1. CONTINUE MISSION	
			ALL OTHER	2. TERMINATE PHASE AND ENTER NEAT BEST PTP.	C.2.(A) IN LUNAR ORBIT DO DPS TEI. (B) RETAIN LM ASCENT STAGE FOR TEI DEPENDING UPON LM APS/ RCS PROPELLANT REMAINING.
	17-22	PACKAGE TEMP LESS THAN 55 DEG F. AND UNABLE TO INCREASE	LAUNCH	NOT APPLICABLE	• MALF PROC--- RCS 1A
		A. ONE QUAD (ALL OTHER QUADS NORMAL)	EO	A.1. NO-GO FOR TLI	
			TLC	2.(A) NO GO FOR LOI (B) ENTER NEAT BEST PTP IF LM NOT AVAILABLE	
			LO	3. NO GO FOR UNDOCKING	
			UNDOCKED	4. DOCK ASAP	
			DESCENT	5. CONTINUE MISSION	
			LUNAR STAY	6. CONTINUE MISSION	
		B. MORE THAN ONE QUAD	DESCENT	B.1. CONTINUE MISSION	
			ALL OTHER	2. TERMINATE PHASE AND ENTER NEAT BEST PTP.	B.2.(A) IN LUNAR ORBIT DO DPS TEI (B) RETAIN LM ASCENT STAGE FOR TEI DEPENDING UPON LM APS/ RCS PROPELLANT.

REV	ITEM	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	A.1. NO-GO FOR UNDOCKING	
			UNDOCKED	2. DOCK ASAP	
			ALL OTHERS	3. CONTINUE MISSION	
		B. LOSS OF FOLLOWING THRUSTER COMBINATIONS---	EO	B.1. CONTINUE ALTERNATE EO MISSION	
		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		IF BOTH SPS AND SM RCS DEORBIT CAPABILITY AND ALL AXIS ATTITUDE CONTROL AVAILABLE	
			TLC	2. NO-GO FOR LOI	
				3. PLAN TEI FOR NEXT OPPORTUNITY	
			TLC UNDOCKED	4. DOCK ASAP	
			DESCENT	5. CONTINUE MISSION	
			LUNAR STAY	6. ENTER NEAT BEST PTP	
					B.5. RETAIN LM ASCENT STAGE FOR TEI IF LOSS OF ALL THRUSTERS IN ONE DIRECTION IN SAME AXIS
		C. LOSS OF +X 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 17-69 ARE RESERVED.			

REV	ITEM
	17-50

* INSTRUMENTATION REQUIREMENTS *

MEAS DESCRIPTION	PCM	ONBOARD	TRANSDUCERS	CATEGORY	MISSION RULE REFERENCE
SM HE TK A PRESS	SR5001P	METER	COMMON		17-20, 21
QTY SM-RCS PROP SYS A	SR5025Q	METER	COMMON	-1 OF 2 M	17-20, 21
SM HE TK B PRESS	SR5002P	METER	COMMON		17-20, 21
QTY SM-RCS PROP SYS B	SR5026Q	METER	COMMON	-1 OF 2 M	17-20, 21
SM HE TK C PRESS	SR5003P	METER	COMMON		17-20, 21
QTY SM-RCS PROP SYS C	SR5027Q	METER	COMMON	-1 OF 2 M	17-20, 21
SM HE TK D PRESS	SR5004P	METER	COMMON		17-20, 21
QTY SM-RCS PROP SYS D	SR5028Q	METER	COMMON	-1 OF 2 M	17-20, 21
SM ENG PKG A TEMP	SR5065T	METER/C&W	COMMON	ND	17-22
SM ENG PKG B TEMP	SR5066T	METER/C&W	COMMON	ND	17-22
SM ENG PKG C TEMP	SR5067T	METER/C&W	COMMON	ND	17-22
SM ENG PKG D TEMP	SR5068T	METER/C&W	COMMON	ND	17-22
SM HE TK A TEMP	SR5013T	METER	COMMON	ND	17-20, 21
SM HE TK B TEMP	SR5014T	METER	COMMON	ND	17-20, 21
SM HE TK C TEMP	SR5015T	METER	COMMON	ND	17-20, 21
SM HE TK D TEMP	SR5016T	METER	COMMON	ND	17-20, 21
SM HE MAN A PRESS	SR5789P	-----	------	ND	17-20, 21
SM HE MAN B PRESS	SR5796P	-----	------	ND	17-20, 21
SM HE MAN C PRESS	SR5817P	-----	------	ND	17-20, 21
SM HE MAN D PRESS	SR5850P	-----	------	ND	17-20, 21
SM FU MAN A PRESS	SR5737P	METER/C&W	COMMON	ND	17-12, 21
SM FU MAN B PRESS	SR5784P	METER/C&W	COMMON	ND	17-12, 21
SM FU MAN C PRESS	SR5822P	METER/C&W	COMMON	ND	17-12, 21
SM FU MAN D PRESS	SR5823P	METER/C&W	COMMON	ND	17-12, 21
SM OX MAN A PRESS	SR5783P	-----	------	ND	17-21
SM OX MAN B PRESS	SR5780P	-----	------	ND	17-21
SM OX MAN C PRESS	SR5820P	-----	------	ND	17-21
SM OX MAN D PRESS	SR5821P	-----	------	ND	17-21

10 CSM CM-RCS

REV	ITEM	

GENERAL

18-1 LAUNCH

A. A SUSTAINED LEAK IN OR THE LOSS OF HELIUM SUPPLY PRESSURE OR HELIUM MANIFOLD PRESSURE IN ONE CM RCS RING IS NOT CAUSE FOR ABORT SINCE THE REMAINING RING IS CAPABLE OF ABORT OR ENTRY ATTITUDE CONTROL. THIS FAILURE WILL REQUIRE ENTRY INTO PTP 6-4 SINCE SYSTEMS ARE NO LONGER REDUNDANT.

B. A SUSTAINED LEAK IN OR THE LOSS OF HELIUM SUPPLY PRESSURE OR HELIUM MANIFOLD PRESSURE IN BOTH CM RCS RINGS PRIOR TO TOWER JETTISON IS JUSTIFICATION FOR A MODE I ABORT. AFTER TOWER JETTISON, IT IS NOT CAUSE FOR ABORT SINCE THE ABILITY TO PERFORM A SAFE ENTRY INTO THE ATLANTIC AT THE END OF THE FIRST REV STILL EXISTS BY USING THE CONTINGENCY SM RCS SPIN UP PRIOR TO CM/SM SEP. THIS METHOD OF ENTRY IS CONSIDERED OPERATIONALLY PREFERABLE TO PERFORMING AN ABORT AND PRESENTS LESS POTENTIAL HAZARD TO CREW RECOVERY. FURTHERMORE, CM RCS CONTROL IS REQUIRED FOR ABORTS IN THE MODE II AND MODE III REGIONS; AND TO ABORT THE LAUNCH IN THESE REGIONS FOR LOSS OF CM RCS CAPABILITY WOULD PUT THE SPACECRAFT AND CREW INTO AN UNSAFE ENVIRONMENT.

18-2 LUNAR ORBIT, LUNAR STAY PHASES

A. LUNAR ORBIT ACTIVITIES WILL BE CONTINUED FOR LOSS OR IMPENDING LOSS OF ONE CM RCS SYSTEM.

B. THESE PHASES WILL ALSO BE CONTINUED IF THE CM-RCS IS ARMED.

C. LOSS OF ONE SYSTEM AND ANY DEGRADATION IN THE REMAINING SYSTEM IS CAUSE FOR ENTRY INTO THE NEXT BEST PTP.

18-3 LM DESCENT PHASE

THERE ARE NO CSM RCS FAILURES THAT ARE CAUSE FOR TERMINATING THE DESCENT PHASE.

18-4 ALL OTHER PHASES

A. SUSTAINED LEAK IN OR LOSS OF HELIUM SUPPLY PRESSURE OR HELIUM MANIFOLD PRESSURE (COULD BE EITHER FUEL OR OXIDIZER) IN ONE CM RCS RING DELETES THE REDUNDANCY OF THE ENTRY ATTITUDE CONTROL SYSTEM AND REDUCES THE DELTA V AVAILABLE FOR HYBRID DEORBIT. LOSS OF HELIUM SUPPLY PRESSURE OR HELIUM MANIFOLD PRESSURE IN BOTH CM RCS RINGS DELETES ALL ENTRY ATTITUDE CONTROL CAPABILITY REQUIRING CONTINGENCY SM RCS SPIN UP PRIOR TO CM/SM SEP. THE LOSS OF ONE OR BOTH CM RCS RINGS IS CAUSE FOR TERMINATING THE PHASE AND MISSION BY ENTRY INTO THE NEXT BEST PTP.

B. ARMING OF THE CM RCS RINGS, WHETHER THE PROPELLANT ISOLATION VALVES ARE OPENED OR CLOSED, IS CAUSE FOR TERMINATING THE PHASE AND MISSION INTO THE NEXT BEST PTP.

RULE NUMBERS 18-5 THROUGH
18-9 ARE RESERVED.

REV	ITEM	
		' SYSTEMS MANAGEMENT '
1	18-10	THRUSTER TEMP CONTROL CM RCS THRUSTERS MAY BE HEATED PRIOR TO ENTRY FOR 20 MINUTES OR UNTIL THE LOWEST INDICATED TEMPERATURE IS 28 DEG. F.; WHICHEVER COMES FIRST. IF THRUSTER(S) HEATER FUNCTION FAILS; CM RCS IS STILL CONSIDERED OPERATIONAL PENDING RESULTS OF CM RCS CHECKOUT PRIOR TO ENTRY. HALF PROC RCS 9.
	18-11	HELIUM INTERCONNECT AS A LAST RESORT, IF THE HELIUM IN ONE RING IS DEPLETED DUE TO A LEAK AND THE PROPELLANT IS DEPLETED IN THE OTHER RING; THE SYSTEMS MAY BE INTERCONNECTED IF THE REMAINING PROPELLANT IS REQUIRED FOR CONTROL. ONCE INTERCONNECTED; THE RINGS CANNOT BE ISOLATED. HALF PROC RCS 4.
		RULE NUMBERS 18-12 THROUGH 18-19 ARE RESERVED.

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
				SPECIFIC MISSION RULES	
	10-20	SUSTAINED LEAK IN OR COMPLETE LOSS OF 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 NEAT 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 NEAT BEST PTP	B.3. CONTINGENCY SM RCS SPINUP PRIOR TO CM/SM SEP FOR DEORBIT AND TBD FOR LUNAR RETURN ENTRY.
	10-21	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 NEAT 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 NEAT BEST PTP	B.3. CONTINGENCY SM RCS SPINUP PRIOR TO CM/SM SEP FOR DEORBIT AND TBD FOR LUNAR RETURN ENTRY.

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

REV	ITEM

' INSTRUMENTATION REQUIREMENTS '

18-50	MEAS DESCRIPTION	PCM	ONBOARD	TRANSDUCERS	CATEGORY	MISSION RULE REFERENCE
	CM HE TK A PRESS	CR0001P	METER	COMMON	M	18-20
	CM HE TK B PRESS	CR0002P	METER	COMMON	M	18-20
	CM TK A TEMP	CR0003P	METER	COMMON	MD	18-20
	CM TK B TEMP	CR0004P	METER	COMMON	MD	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

10 EMU/EVA

REV	ITEM	

GENERAL

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

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

ANY COMBINATION OF TWO OPS AND/OR PLSS UNITS SATISFYING THE FOLLOWING---

1. OPS SOURCE PRESSURE

2. SUFFICIENT O2 CONSUMABLES (PLSS H2O, LIOH AND BATTERY ARE NOT CHECKED PRIOR TO UNDOCKING) TO SUPPORT A 30 MINUTE CONTINGENCY EVA (CEVA)

B. EVA

1. CRITICAL INSTRUMENTATION

2. LCG/LTL COOLING

3. EMU PRESSURE INTEGRITY

4. PLSS O2 PRESSURE REGULATOR

5. PLSS FAN

6. PLSS BATTERY

7. OPS O2 PRESSURE REGULATOR

8. SUFFICIENT PLSS CONSUMABLES TO SUPPORT CHECKOUT, PLANNED EVA (3+30) AND A 30 MINUTE POST-EVA RESERVE.

9. SUFFICIENT OPS CONSUMABLES TO SUPPORT 30 MINUTE PURGE OPERATIONS.

19-2 DEFINITIONS

LOSS OF EMU PRESSURE INTEGRITY

1. UNABLE TO MEET 0.3 PSI/MIN PRESSURE DECAY CRITERIA DURING EMU PRESSURE INTEGRITY CHECK.

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

LOSS OF PRIMARY OXYGEN SUB-SYSTEM (POS) OXYGEN SUPPLY

1. SOURCE PRESSURE LESS THAN 192 PSIA

2. UNABLE TO SUPPLY OXYGEN TO OXYGEN VENTILATION LOOP

LOSS OF PLSS BATTERY

1. PLSS BATTERY VOLTAGE LESS THAN 16.0 VDC AND DECREASING

2. PLSS BATTERY CURRENT DRAIN GREATER THAN 3.3 AMPS AND INCREASING (DOES NOT INCLUDE CHECKOUT)

LOSS OF LIQUID COOLING GARMENT/LIQUID TRANSPORT LOOP (LCG/LTL) THERMAL CONTROL

1. LOSS OF LCG/LTL CIRCULATION (FLOW RATE LESS THAN 3.5 LBS/MIN AND DECREASING)

2. LCG H2O INLET TEMPERATURE OF 50 DEG F AND INCREASING AD LCG H2O DELTA T LESS THAN 5 DEG F AND DECREASING WITH DIVERTER VALVE IN "NA/" POSITION (THIS CONSTITUTES A FAILED SUBLIMATOR)

30 MINUTE OPS PURGE FLOW LIFETIME

CONSISTS OF 20 MINUTES (5000 FT) FOR TRAVERSAL OF THE LUNAR SURFACE AND 10 MINUTES FOR TERMINATION AND INGRESS.

REV	ITEM	
	19-3	CREWMAN MAY ELECT TO ATTEMPT A WET SUBLIMATOR RESTART IF BREAKTHROUGH OCCURS.
	19-4	OPS PURGE CAPABILITY IS REQUIRED FOR EVA.
	19-5	VACCUUM TRANSFERS WILL ONLY BE USED IN SUPPORT OF (1) CONTINGENCY EXTRAVEHICULAR TRANSFER (CEVT) BETWEEN S/C, AND (2) A LM CABIN REPRESS FAILURE.
	19-6	AN EMU/LM ECS HYBRID LIFE SUPPORT AND COMM CONFIGURATION IS ACCEPTABLE IF WITHIN SYSTEMS CAPABILITIES AND IF REQUIRED TO PRECLUDE TIMELINE IMPACT.
		RULES 19-7 THRU 19-9 ARE RESERVED.
		---------- ' MANAGEMENT ' ----------
	19-10	THE PLSS BATTERY IS CONSIDERED TO HAVE A MINIMUM OF 16 AMP-HR CAPABILITY. THIS CONSUMABLE IS GAGED BY MONITORING GT0140C/GT0240C AND PROCESSING IN THE RTCC TO OBTAIN AMP-HRS.
	19-11	THE PLSS PRIMARY OXYGEN SUBSYSTEM (POS) MUST CONTAIN THE MINIMUM LOADED PRESSURE OF 1030 PSIA TO SATISFY THE FIRST PLANNED EVA. THE MINIMUM PRESSURE REQUIRED FOR THE SECOND EVA IS 895 PSIA. THIS CONSUMABLE IS GAGED BY MONITORING GT0182P/GT0282P AND PROCESSING IN THE RTCC TO OBTAIN LBS MASS.
	19-12	THE PLSS FEEDWATER RESERVOIR IS CONSIDERED TO HAVE A NOMINAL LOADING OF 8.8 LBS. THIS CONSUMABLE IS GAGED BY MONITORING GT0194T/GT0294T, GT0196T/GT0296T, GT0182P/GT0282P, GT0110P/GT0210P AND PROCESSING IN THE RTCC AND HAND CALCULATIONS TO OBTAIN LBS REMAINING.
	19-13	THE CONTAMINANT CONTROL ASSEMBLY IS CONSIDERED TO HAVE A 4800 BTU TOTAL METABOLIC CAPABILITY. THIS CONSUMABLE (LIOH) IS GAGED BY MONITORING POS CONSUMPTION.
	19-14	SUFFICIENT PLSS AND/OR OPS CONSUMABLES WILL BE RETAINED AT LM LIFTOFF TO SUPPORT A 30 MINUTE CEVA
	19-15	TERMINATION OF EVA ACTIVITIES WILL BE BASED UPON THE CONSUMABLES (AMP-HOURS, O2, LIOH, AND H2O) REQUIRED TO SUPPORT SAMPLE RETURN CONTAINER CLOSEOUT AND TRANSFER TO LM PLUS 30 MINUTES POST-EVA RESERVE.
		RULES 19-16 THROUGH 19-19 ARE RESERVED.

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
				SPECIFIC	
	19-20	LOSS OF EMU PRESSURE INTEGRITY	EVA	TERMINATE EVA 1. ACTIVATE OPS	REF MALF EMU
	19-21	PLSS O2 PRESSURE REGULATOR FAILURE	EVA	TERMINATE EVA 1. ACTIVATE OPS 2. IF REG. FAILS OPEN CLOSE POS SHUTOFF VALVE	REF MALF EMU
	19-22	PLSS FAN FAILURE	EVA	TERMINATE EVA IMMEDIATELY 1. ACTIVATE OPS 2. OPEN PGA PURGE VALVE	REF MALF EMU
	19-23	LOSS OF WATER SEPARATOR	EVA	TERMINATE EVA IMMEDIATELY 1. IF DEHUMIDIFICATION IS REQUIRED, ACTIVATE OPS AND OPEN PURGE PGA VALVE	REF MALF EMU
	19-24	CONTAMINATION IN VENTILATION SYSTEM	EVA	TERMINATE EVA IMMEDIATELY 1. ACTIVATE OPS 2. OPEN PGA PURGE VALVE	REF MALF EMU
		RULES 19-25 THROUGH 19-29 ARE RESERVED.			

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	19-30	LOSS OF LCG/LTL	EVA	TERMINATE EVA 1. IF ADDITIONAL COOLING IS REQUIRED, ACTIVATE OPS AND OPEN PGA PURGE VALVE	REF HALF EMU
	19-31	FEED H2O PRESSURE LESS THAN 2.5 PSIA AND DECREASING	EVA	TERMINATE EVA 1. IF ADDITIONAL COOLING IS REQUIRED, ACTIVATE OPS AND OPEN PGA PURGE VALVE	REF HALF EMU
	19-32	LOSS OF POS O2 SUPPLY	EVA	TERMINATE EVA 1. ACTIVATE OPS	REF HALF EMU
	19-33	LOSS OF PLSS BATTERY	EVA	TERMINATE EVA IMMEDIATELY 1. ACTIVATE OPS 2. OPEN PGA PURGE VALVE	REF HALF EMU
		RULE 19-34 IS RESERVED.			
	19-35	LOSS OF CRITICAL INSTRUMENTATION	EVA	TERMINATE EVA	REF MR 19-42
		NOTE--- REF SECTION 20 FOR EVA COMMUNICATIONS RULES			
		RULES 19-36 THROUGH 19-40 ARE RESERVED.			

REV	ITEM

INSTRUMENTATION REQUIREMENTS

19-41

MEAS DESCRIPTION	PAM FM/FM	ONBOARD	TRANSDUCERS	CATAGORY	MISSION RULE REFERENCE
FEED H2O PRESS	GT0110P/GT0210P		COMMON	MD	19-2;3;31
LOW FEED H2O PRESS		FLAG ANNUNCIATOR		M	
PLSS EKG	GT0124J/GT0224J			*	
PLSS BAT CUR	GT0140C/GT0240C			MD	
PLSS BAT VOLT	GT0141V/GT0241V			MD	
LCG H2O TEMP	GT0194T/GT0294T			MD	
PGA PRESS	GT0168P/GT0268P			MD	19-1;2;6;20;
PGA PRESS GAGE		METER		M	21;31;32
LOW PGA PRESS		FLAG ANNUNCIATOR		M	
SUBL O2 OUT TEMP	GT0170T/GT0270T			MD	
PLSS O2 PRESS	GT0182P/GT0282P		COMMON	MD	
PLSS O2 QTY IND		METER		M	19-1;2;20;32
HIGH O2 FLOW		FLAG ANNUNCIATOR		M	19-1;2;20;31
LOW VENT FLOW		FLAG ANNUNCIATOR		M	19-1;22
LCG H2O DELTA T	GT0196T/GT0296T			MD	
OPS PRESS GAGE		METER		M	19-1;4;14
OPS REG PRESS GAGE		METER		**M	
EVC SYNC	GT0100X/GT0200X			M	
EVC CAL 0 VDC	GT0101V/GT0201V			MD	
EVC CAL 5 VDC	GT0102V/GT0202V			MD	

* 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	GT0182P/ GT0282P	METER	COMMON
PGA PRESS GAGE/LOW PGA PRESS FLAG ANNUNCIATOR/PGA PRESS	GT0168P/ GT0268P	METER/TONE-FLAG	
LOW VENT FLOW FLAG ANNUNCIATOR		TONE-FLAG	

26 COMMUNICATIONS/
INSTRUMENTATION

REV	ITEM	

GENERAL

20-1 A. BASELINE REQUIREMENTS (ALL PHASES EXCEPT LAUNCH)

1. TWO-WAY VOICE COMM BETWEEN SPACECRAFT.

2. TWO-WAY VOICE COMM BETWEEN CSM OR LM AND MSFN DURING ALL DOCKED ACTIVITIES AND BETWEEN BOTH SPACECRAFT AND MSFN DURING UNDOCKED ACTIVITIES.

B. LAUNCH

THERE ARE NO COMMUNICATIONS FAILURES FOR WHICH THE LAUNCH/ INSERTION PHASE WILL BE TERMINATED.

C. POWERED DESCENT ADDITIONAL REQUIREMENTS.

LM VOICE REQUIRED TILL LO GATE. THERE ARE NO CSM COMMUNICATIONS SYSTEMS FAILURES FOR WHICH LM POWERED DESCENT WILL BE TERMINATED.

D. LUNAR STAY ADDITIONAL REQUIREMENTS.

1. FOR TWO-MAN EVA---VOICE COMM BETWEEN MSFN AND ONE EVA PLUS DUPLEX VOICE BETWEEN BOTH EVA CREWMAN.

2. FOR ONE-MAN EVA---VOICE COMM BETWEEN MSFN AND LM OR EVA PLUS DUPLEX VOICE BETWEEN THE LM AND EVA CREWMAN.

20-2 VHF EVA COMMUNICATIONS PRIORITIES ARE---

A. TWO-MAN EVA

1. PRIME---EVA-1 AR/EVA-2 AR (RELAY MODE-ALLOWS DUPLEX VOICE BETWEEN EVA'S PLUS THE TRANSMISSION OF VOICE AND DATA FROM BOTH EVA'S TO LM. PLUS THE RECEPTION OF LM VOICE BY BOTH EVA'S)

2. BACKUP---EVA-1 AR/EVA-2B OR EVA-1 A/EVA-2B OR EVA-1 B/EVA-2A (EITHER MODE COMBINATION ALLOWS DUPLEX VOICE BETWEEN EVA'S PLUS THE TRANSMISSION OF VOICE FROM BOTH THE EVA'S TO THE LM PLUS THE TRANSMISSION OF DATA FROM ONE EVA TO THE LM AND THE RECEIVING OF LM VOICE BY ONE EVA.)

B. ONE-MAN EVA

1. PRIME---EVA-1A OR EVA-2A (ALLOW DUPLEX VOICE BETWEEN EVA AND THE LM PLUS THE TRANSMISSION OF DATA FROM EVA TO LM)

2. BACKUP---EVA-1B OR EVA-2B (ALLOWS DUPLEX VOICE BETWEEN EVA AND LM)

RULES 20-3 THROUGH
20-6 ARE RESERVED.

REV	ITEM	

****
* MANAGEMENT *
****

20-7 VOICE CONFIGURATION

A. LM/CSM/MSFN

1. VHF DUPLEX B AND USB WILL BE TRANSMITTED/RECEIVED SIMULTANEOUSLY FOR LAUNCH THROUGH CVI: REV 1. VHF SIMPLEX A AND USB WILL BE TRANSMITTED/RECEIVED SIMULTANEOUSLY FOR EARTH ORBIT AFTER CVI: REV 1 LOS.

2. VHF A SIMPLEX 296.8 MHZ IS PRIME VOICE COMM BETWEEN VEHICLES EXCEPT DURING RANGING WHEN DUPLEX B (CSM) AND DUPLEX A (LM) WILL BE USED.

3. VHF B SIMPLEX 259.7 MHZ IS BACKUP TO VHF A SIMPLEX 296.8 MHZ.

4. USB IS PRIME VOICE COMM BETWEEN MSFN AND CSM OR LM.

5. USB/VHF RELAY IS VOICE COMM BACKUP TO USB BETWEEN MSFN AND MALFUNCTIONED S/C.

6. NORMAL VOICE COMM WILL USE SIMULTANEOUS MSFN UPLINK TO BOTH VEHICLES. HOWEVER, IF REQUIREMENT SHOULD EXIST, SIMULTANEOUS INDEPENDENT MSFN/CSM AND MSFN/LM COMM MODES WILL BE INITIATED.

7. THE PRIME CSM/LM COMMUNICATIONS MODE DURING THE LUNAR ORBIT PHASE IS VHF. THE PRIME VHF MODE IS VHF A SIMPLEX UNLESS THIS MODE IS PRECLUDED BY THE USE OF VHF RANGING. DURING LUNAR STAY PHASE THE PRIME CSM/LM MODE IS MSFN RELAY WITH EACH S/C MONITORING THE VHF A FREQUENCY.

8. THE CSM AND LM WILL TRANSMIT SIMULTANEOUSLY ON VHF AND USB DURING ALL LM POWERED UP PHASES IN LUNAR ORBIT.

9. IN THE EVENT OF A COMPLETE LOSS OF CSM S-BAND COMMUNICATIONS WITH MSFN, THE LM WILL BE CONFIGURED FOR LM TWO-WAY RELAY AND RETAINED FOR TEI AND TEC.

B. LM/CSM/EVA/MSFN

1. LM TWO-WAY RELAY WITH TWO-MAN EVA IS THE PRIME MODE PLANNED FOR EVA OPERATION. CSM---USB TRANSMIT/RECEIVE ONLY---LM--- TRANSMIT VHF A. RECEIVE VHF A AND B. MSFN CONFIGURED FOR USB RELAY.

20-8 CSM VHF/USB MANAGEMENT

A. FOR CREW REST PERIODS, CSM S-BAND ANTENNAS WILL BE SELECTED BY GROUND COMMANDS.

B. NORMAL CONTROL OF THE S-BAND MODES WILL BE BY GROUND COMMAND. CSM COMMUNICATIONS SWITCH POSITION WILL REFLECT OUT-OF-SITE CONTACT CONFIGURATION.

20-9 LM STEERABLE ANTENNA MANAGEMENT

A. DURING ALL PHASES THE STEERABLE ANTENNA TEMPERATURE SHOULD BE MAINTAINED BETWEEN -65 DEG. F AND 185 DEG. F.

RULES 20-10 THROUGH
20-12 ARE RESERVED.

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
				SPECIFIC	
	20-13	LOSS OF TWO-WAY VHF VOICE COMM BETWEEN SPACECRAFT	DOCKED	CONTINUE NO GO FOR SEP MNVR	REF LM MAL PROC COMM 3. LOSS OF VHF VOICE COMM WITH CSM
			UNDOCKED	DOCK ASAP NO GO FOR DOI	
			DESCENT ORBIT	CONTINUE MISSION	REF CSM MAL PROCEDURE COMM 5 - LOSS OF VHF COMM WITH LM
			POWERED DESCENT	CONTINUE MISSION	
			LUNAR STAY	CONTINUE MISSION	NOTE---MSFN RELAY MAY BE UTILIZED
	20-14	LOSS OF TWO-WAY VOICE COMM WITH MSFN			REF CSM MAL PROCEDURES 766 - LOSS OF CSM VOICE COMM
		A. CSM ONLY	LAUNCH	A.1. CONTINUE MISSION	
			EARTH ORBIT	2. ENTER NEXT BLOCK DATA POINT	
			TLC	3. CONTINUE MISSION NO GO FOR LOI	A.3 ENTER LM EARLY TO USE LM S-BAND FOR VOICE COMM WITH MSFN.
			DOI/ POWERED DESCENT	4. CONTINUE MISSION	
			LUNAR STAY	5. CONTINUE MISSION	UTILIZE VHF OF VHF RELAY FROM LM. IF UNABLE TERMINATE LUNAR STAY AND PERFORM A DOCKED TEI.
		B. LM ONLY	DOCKED	B.1. CONTINUE MISSION NO GO FOR DOI	1 REF LM MAL PROC COMM--
			UNDOCKED DESCENT ORBIT	2. RETURN TO VICINITY OF CSM NO GO FOR PDI	4 LOSS OF S-BAND VOICE COMM 5 S-BAND RECEIVER CANNOT ACQUIRE PHASE LOCK.
			POWERED DESCENT	3.A.PDI TO LO GATE RETURN TO VICINITY OF CSM ASAP B.LO GATE TO TOUCHDOWN CONTINUE MISSION.	B.3. CSM RELAY ACCEPTABLE
			LUNAR STAY	5. LM LIFTOFF NEXT ASCENT OPPORTUNITY.	
	20-15	LOSS OF TWO CSM AUDIO CENTERS	EPO	CONTINUE MISSION NO GO FOR TLI	
			ALL	CONTINUE MISSION-NO GO FOR LOI	
	20-16	LOSS OF VOICE FROM EVA-2 TO EVA-1	DUAL EVA	CONTINUE MISSION EVA-2 GO TO POSITION "B"	EVA-1 HAS EVC-1 EVA-2 HAS EVC-2

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	20-17	LOSS OF VOICE FROM EVA-1 TO EVA-2	DUAL EVA	CONTINUE MISSION 1. EVA-2 GO TO POSITION "A" 2. EVA-1 GO TO POSITION "B"	
	20-18	LOSS OF DUPLEX VOICE BETWEEN EVA-1 AND EVA-2	DUAL EVA	TERMINATE EVA	
	20-19	LOSS OF TWO-WAY VOICE BETWEEN MSFN AND EVA	DUAL EVA	TERMINATE EVA 1. EVA-2 GO TO POSITION "A" EVA-1 GO TO POSITION "B" 2. IF UNABLE TO RE-ESTABLISH COMM EVA-2 RETURN TO LM AND RECONFIGURE COMM 3. IF ABLE TO RE-ESTABLISH COMM; CONTINUE EVA.	
	20-20	LOSS OF TWO-WAY VOICE BETWEEN MSFN AND BOTH LM AND EVA	ALT EVA (ONE-MAN)	TERMINATE EVA 1. RECONFIGURE LM TO RE-ESTABLISH COMM. 2. IF ABLE TO RE-ESTABLISH COMM; CONTINUE EVA.	
	20-21	LOSS OF DUPLEX VOICE BETWEEN LM AND EVA	ALT EVA (ONE-MAN)	TERMINATE EVA 1. RECONFIGURE LM AND EVA TO VHF BACKUP MODE. 2. IF ABLE TO RE-ESTABLISH DUPLEX COMM; CONTINUE EVA.	
		RULES 20-22 THROUGH 20-25 ARE RESERVED.			

REV	ITEM	

GENERAL

20-26 A. BASELINE REQUIREMENT (ALL PHASES EXCEPT LAUNCH)

1. CRITICAL INSTRUMENTATION (CRITICAL INSTRUMENTATION IS THAT INSTRUMENTATION REQUIRED TO VERIFY MISSION GO/NO-GO CRITERIA)

B. LAUNCH

THERE ARE NO CSM INSTRUMENTATION FAILURES FOR WHICH THE LAUNCH/INSERTION PHASE WILL BE TERMINATED.

C. POWERED DESCENT ADDITIONAL REQUIREMENTS

THERE ARE NO CSM INST. SYS FAILURES FOR WHICH LM POWERED DESCENT WILL BE TERMINATED.

20-27 THE MISSION WILL BE CONTINUED WITH THE LOSS OF THE---

A. CSM UPDATA LINK

B. CSM CAUTION AND WARNING SYSTEM

C. CSM DSE

D. CSM HIGH GAIN ANTENNA

E. CSM FM DOWNLINK

F. CSM USB RANGING (PRN)

G. VHF RANGING

RULES 20-28 THROUGH
20-29 ARE RESERVED.

REV	ITEM	
		' MANAGEMENT '
	20-30	DSE MANAGEMENT
		A. LM AND CSM LOW BIT RATE TELEMETRY WILL BE RECORDED CONTINUOUSLY WHEN NOT IN CONTACT WITH GROUND TELEMETRY SITES EXCEPT DURING PERIODS OF VHF RANGING. WHEN NO LM TM WILL BE RECORDED, AND WILL BE NORMALLY PLAYED BACK AT LEAST ONCE PER REVOLUTION IN LUNAR ORBIT.
		B. CM HIGH BIT RATE DSE RECORDINGS WILL BE MADE DURING THE FOLLOWING OPERATIONS--- 1. LAUNCH 2. S-IVB/CSM SEPARATION 3. TDGE 4. ALL SPS MANEUVERS 5. CM/SM SEPARATION AND ENTRY 6. DTO REQUIREMENTS (TBD) 7. LM FINAL SEP
		C. DURING SLEEP PERIODS 1. USING HIGH GAIN ANTENNAS, DSE RECORDING AND DUMPING WILL BE MANAGED PER (A) ABOVE. 2. USING OMNI'S, LM AND CSM LOW BIT RATE TELEMETRY WILL BE RECORDED CONTINUOUSLY WHEN NOT IN CONTACT WITH GROUND TELEMETRY SITES. DATA WILL NOT BE DUMPED UNLESS A MALFUNCTION SO DICTATES. IN THIS CASE THE HGA WILL BE ACTIVATED FOR THE DUMP.
	20-31	CTE MANAGEMENT
		A. CTE WILL BE CONFIGURED TO CLOCK IN BIT FOR FLIGHT. HOWEVER, IF A HOLD OCCURS AFTER T-15 MINUTES, CTE WILL NOT BE CORRECTED UNTIL COMPLETION OF POWERED FLIGHT.
		B. CTE WILL BE ALLOWED TO DRIFT +/-5 SEC BEFORE BEING UPDATED AFTER ORBIT INSERTION.
		RULES 20-32 THROUGH 20-34 ARE RESERVED.

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
				SPECIFIC	
	20-35	LOSS OF CSM TM A. HBR OR LBR B. ALL TM	ALL LAUNCH EO LO POWERED DESCENT LUNAR STAY	A. CONTINUE MISSION B.1. CONTINUE MISSION 2. ENTER NEXT BEST PTP 3. NO GO FOR LUNAR OPERATIONS 4. CONTINUE MISSION 5. LM LIFTOFF AT THE NEXT ASCENT OPPORTUNITY.	REF CSM MAL PROCEDURE. COMM 10 - MSFN REPORTS LOSS OF REALTIME PCM. DSE MAY BE UTILIZED FOR TM IF AVAILABLE.
	20-36	LOSS OF CRITICAL INSTRUMENTATION	LAUNCH EO TLC LOI	CONTINUE MISSION ENTER NEXT BEST PTP NO GO FOR TLI CONTINUE MISSION NO GO LOI NO GO FOR LUNAR OPERATIONS	
	20-37	LOSS OF ONE CSM PMP POWER SUPPLY	ALL	CONTINUE MISSION	
	20-38	LOSS OF BOTH CSM POWER AMPLIFIERS	EPO ALL	NO GO FOR TLI CONTINUE MISSION IF HI GAIN ANT IS AVAILABLE	
	20-39	LOSS OF THE SCE	EPO TLC LUNAR ORBIT LUNAR STAY	CONTINUE MISSION NO GO FOR TLI CONTINUE MISSION NO GO FOR LOI CONTINUE MISSION CONTINUE MISSION	
		RULES 20-40 THROUGH 20-44 ARE RESERVED.			

REV	ITEM	
		* GENERAL *
	20-45	A. BASELINE REQUIREMENT
		1. CRITICAL INSTRUMENTATION (CRITICAL INSTRUMENTATION IS THAT INSTRUMENTATION ONBOARD OR TM DURING MSFN AOS, OR ONBOARD ONLY DURING MFSN LOS REQUIRED TO VERIFY MISSION GO/NO-GO CRITERIA)
		B. POWERED DESCENT ADDITIONAL REQUIREMENTS
		LM HBR TELEMETRY
		C. LUNAR STAY ADDITIONAL REQUIREMENTS
		LM LBR OR HBR TM IS REQUIRED. IF LM TM DATA IS LOST DURING THE EVA, ONE CREWMAN WILL RETURN AND ATTEMPT TO RE-ESTABLISH THE LOST COMMUNICATIONS LINK.
	20-46	THE MISSION WILL BE CONTINUED WITH THE LOSS OF THE---
		A. LM UPDATA LINK
		B. LM CAUTION AND WARNING SYSTEM
		C. LM DSEA
		D. EVA TELEMETRY
		E. LM FM DOWNLINK
		F. LM USB RANGING (PRN)
		G. VHF RANGING
		RULES 20-47 THROUGH 20-49 ARE RESERVED.

REV	ITEM	
		MANAGEMENT
	20-50	LM USB/TM MANAGEMENT
		A. FOR NORMAL LM POWERED UP PHASES, THE LM STEERABLE ANTENNA WITH THE POWER AMPLIFIER WILL BE USED. DURING LUNAR STAY, IF THE ERECTABLE ANTENNA IS USED, THE POWER AMPLIFIER MAY BE TURNED OFF IF HBR TM AND VOICE CIRCUIT MARGINS ARE ADEQUATE.
		B. DURING PERIODS OF LM OUT-OF-STATION CONTACT (LUNAR FAR SIDE), THE TM BIT RATE WILL BE SWITCHED FROM HBR TO LBR AND TRANSMITTED TO THE CSM OVER VHF B EXCEPT DURING VHF RANGING AND PERIODS OF CRITICAL VOICE COMMUNICATIONS.
		SYSTEM MONITORING
		DURING SLEEP PERIODS <u>TWO</u> CREWMEN WILL SLEEP WITH HEADSETS TO MONITOR FOR MASTER ALARMS OR GROUND COMMUNICATIONS.
		RULES 20-51 THROUGH 20-54 ARE RESERVED.

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
				SPECIFIC	
	20-55	LOSS OF LM TM			REF MAL PROC COMM 6
		A. LOSS OF LBR ONLY	ALL	A. CONTINUE MISSION	
		B. LOSS OF HBR ONLY	ALL	B.1. CONTINUE MISSION	MSFN REPORTS LOSS OF FCM
					ADEQUATE DATA TO MAKE FINAL GO/NO GO TO CONTINUE POWERED DESCENT.
		C. LOSS OF ALL TM	DOCKED	C.1. CONTINUE MISSION-NO GO FOR UNDOCKING	
			ALL	2. RETURN TO VICINITY OF CSM	
			POWERED DESCENT	3.(A) PDI TO LO GATE - ABORT-DOCK ASAP	
				(B) LO GATE TO TD - CONTINUE MISSION	
			LUNAR STAY	4. LM LIFTOFF NEXT LAUNCH OPPORTUNITY	
	20-56	LOSS OF CRITICAL INSTRUMENTION			
			DOCKED	DO NOT UNDOCK	
			UNDOCKED	DOCK ASAP	
		RULES 20-57 THROUGH 20-59 ARE RESERVED.			

REV	ITEM

! CSM- INSTRUMENTATUON REQUIREMENTS !

20-60

MEAS DESCRIPTION	PCM	ONBOARD	TRANSDUCERS	CATEGORY	MISSION RULE REF
UDL VALIDITY SIGNAL	CT0262V	-	-	HD	20-27A
USB RECEIVER AGC	CT0620E	METER	COMMON	HD	20-27;20-7A19; 20-38
USB RECEIVER AGC	METER	-	-	HD	
USB RECEIVER ERROR	CT0604F	-	-	HD	
DSE TAPE MOTION	CT0012X	TB	-	HD	20-27;20-30
CTE TIME	CT0149P	-	-	HD	20-31
SCE 18 VDC	CT0018V	-	-	HD	
SCE 5 VDC	CT0017V	-	-	HD	
SCE 20 VDC	CT0015V	-	-	HD	
SCE +20 VDC	CT0016V	-	-	HD	
PCM HI REF 85 PERCENT	CT0125V	-	-	HD	
PCM HI REF 15 PERCENT	CT0126V	-	-	HD	

! LM- INSTRUMENTATION REQUIREMENTS !

20-61

MEAS DESCRIPTION	PCM	ONBOARD	TRANSDUCERS	CATEGORY	MISSION RULE REF
PCM OSC FAIL 2	GL0422V	-	-	1 OF 3	
PCM OSC FAIL 3	GL0423V	-	-	HD	
CAL 85 PCT	GL0401V	-	-	HD	
CAL 15 PCT	GL0402V	-	-	HD	
MET	GL0501W	-	-	HD	
CSM PWR FAIL	GL4094X	CAUTION	-	HD	
MASTER ALARM	GL4069X	MASTER ALARM	-	HD	
DUA STATUS	GT0461X	-	-	HD	20-46
S-BND ST PM ERR	GT0992B	-	-	HD	
S-BND RCVR SIG	GT0994V	METER	-	HD	20-46
STEERABLE ANT TEMP	GT0484	METER	-	HD	20-98;20-99
ANTR PO	GT0993	------	-	HD	20-46;20-95

21 LM SEQUENTIAL
AND PYROTECHNIC

REV	ITEM	
		GENERAL
	21-1	TO INITIATE MANNED LM MISSION PHASES: THE PYROTECHNIC SYSTEM MUST PROVIDE THE FOLLOWING MINIMUM CAPABILITIES---
		A. DOCKED OPERATIONS
		ONE OPERATIONAL PYRO SYSTEM
I		B. UNDOCKED/SEPERATION AND SUBSEQUENT PHASES SEE LM TELCOM GO/NO GO CRITERIA - PAGE 3-18.
	21-2	DEFINITIONS---
		LOSS OF PYRO SYSTEM
		A. PYRO BATTERY OPEN CIRCUIT VOLTAGE LESS THAN 35 VDC
		B. UNABLE TO ARM SYSTEM
	21-3	A PYRO SYSTEM WILL BE DISABLED IF---
		A. ANY RELAY K2 THROUGH K6 INADVERTENTLY CLOSES (REF MR 21-13)
		B. ANY RELAY K7 THROUGH K15 INADVERTENTLY CLOSES. SYSTEM WILL BE USED FOR APS PRESSURIZATION, DPS VENTING AND STAGING
		A PYRO SYSTEM IS DISABLED BY OPENING THE APPROPRIATE "LOGIC POWER" CIRCUIT BREAKER
	21-4	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.
	21-5	ANY SPECIFIC PYRO MISSION RULE REQUIRING A NEAT BEST OPPORTUNITY LIFTOFF WILL BE CAUSE FOR TERMINATION OF AN EVA. ADDITIONALLY, SHOULD A PYRO SYSTEM EXHIBIT A K1-K6 RELAY CLOSURE DURING THE EVA: ONE CREWMAN WILL RETURN AND ATTEMPT TO CORRECT THE MALFUNCTION.
		RULE NUMBERS 21-6 THROUGH 21-9 ARE RESERVED.

REV	ITEM	
		MANAGEMENT
	21-10	APS WILL NOMINALLY BE PRESSURIZED IMMEDIATELY PRIOR TO STAGING. APS WILL NOT NORMALLY BE PRESSURIZED MORE THAN 24 HOURS PRIOR TO THE LAST APS BURN--- HOWEVER, IN A CONTINGENCY CASE, THE APS MAY BE PRESSURIZED UP TO 3-1/2 DAYS PRIOR TO THE LAST APS BURN.
	21-11	IF UNABLE TO DEPLOY ONE OR MORE LANDING GEAR, A LANDING WILL NOT BE ATTEMPTED. DESCENT ENGINE BURNS WILL BE CONTINUED SINCE CONTROL PROBLEMS ARE NOT EXPECTED TO EXIST AND DAMAGE TO THE LANDING GEAR FROM THE BURN WILL NOT AFFECT ALTERNATE MISSIONS.
	21-12	UNDOCKED STAGING WITH ONE PYRO SYSTEM WILL BE PERFORMED ONLY IF ABSOLUTELY NECESSARY TO MAINTAIN CREW SAFETY.
	21-13	FOR A K1 THROUGH K4 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.
	21-14	AN ARMED PYRO SYSTEM(S) THAT CANNOT BE DEARMED IS CONSIDERED UNSAFE FOR THE VIBRATION/SHOCK ENVIRONMENT ASSOCIATED WITH LUNAR TOUCHDOWN.
		RULE NUMBERS 21-15 THROUGH 21-19 ARE RESERVED.

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
				SPECIFIC	
	21-20	LOSS OF---			REF MALF PROC ED---
		A. ONE PYRO SYSTEM	ALL	A. 1. DELAY STAGING AS LONG AS POSSIBLE	1 ED RELAY
			DOCKED	2. CONTINUE MISSION	CSM RESCUE MAY BE REQUIRED DUE TO RCS REDLINES
			UNDOCKED	NO-GO DOI	
			DESCENT ORBIT	3. DOCK ASAP NO-GO PDI	
			POWERED DESCENT	4. (A) PDI TO PDI + 5 ABORT (B) PDI + 5 TO TD - CONTINUE MISSION	
			LUNAR STAY	5. LIFT OFF AT NEXT BEST OPPORTUNITY	
		B. TWO PYRO SYSTEMS	ALL	B. 1. DOCK ASAP	
			POWERED DESCENT	2. ABORT	
	21-21	UNABLE TO DISARM PYRO SYSTEM(S)	ALL	CONTINUE MISSION NO-GO PDI	REF MALF PROC ED---
				FOR UNSTAGED OPERATION, PLACE ONE ASCENT BATTERY ON BUS POWERING THE ACTIVE GUIDANCE SYSTEMS.	1 ED RELAY
				STAGE AS REQUIRED IN ORBIT	CSM RESCUE MAY BE REQUIRED DUE TO RCS REDLINE
			POWERED DESCENT	ABORT	
			LUNAR STAY	LIFT OFF AT NEAT BEST OPPORTUNITY NO-GO EVA	

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	21-22	A RELAY R7 THROUGH R15 INADVERTENTLY CLOSES	ALL		RELAYS R7 = RCS PRES R8 = LAND GEAR DEPLAY R8A = LAND GEAR DEPLOY R9 = DPS CRYO HE PRESS R10 = ASC HE TANK 1 R11 = ASC HE TANK 2 R12 = ASC FUEL AND OX COMP VALVE (SYSTEM B ONLY) R12A = ASC FUEL AND OX COMP VALVES R13 = DPS FUEL AND OX VENT R14 = DPS AMBIENT HE R15 = DPS FUEL AND OX COMP VALVES
		A. SYSTEM A		A. CONTINUE MISSION OPEN LOGIC POWER "A" C/B UNTIL AFTER DPS SHE PRESSURIZATION. CLOSE DES PROPULSION FUEL AND OXID VENTS THEN CLOSE LOGIC POWER "A" C/B.	A AND B - PRIOR TO DPS CRYO HE PRESS; THE FAILED SYSTEM WILL BE DISABLED FOR ALL PYRO FUNCTIONS; SUBSEQUENT PYRO FUNCTIONS WILL BE ACCOMPLISHED USING SYSTEMS A AND B.
		B. SYSTEM B		B. CONTINUE MISSION OPEN LOGIC POWER "B" C/B UNTIL AFTER DPS SHE PRESSURIZATION. CLOSE DES PROPULSION FUEL AND OXID VENTS THEN CLOSE LOGIC POWER "B" C/B.	
		C. BOTH SYSTEMS		C. 1. CONTINUE MISSION 2. PRIOR TO POSITIONING MASTER ARM SW TO "ON"—CLOSE DES HE REG 1 AND 2 AND DES PROPULSION FUEL AND OXID VENTS; ALSO, THE DESCENT PROPELLANT TANK VLV SWITCH MUST BE HELD IN THE FIRE POSITION WHEN THE MASTER ARM SWITCH IS POSITIONED TO "ON" FOR THE FIRST TIME. 3. OPEN DES HE REG 1 AT TIG OF DPS 1 BURN	

MISSION	REV	DATE	SECTION	GROUP	PAGE
APOLLO 10	A	10/10/69	LM SEQUENTIAL AND PYROTECHNIC	SPECIFIC MANAGEMENT	21-6

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	21-23	UNABLE TO STAGE			THIS RULE ONLY APPLIES TO ALTERNATE MISSIONS
		A: ASCENT AND DESCENT STAGES STILL RIGIDLY TIED TOGETHER	RND2	A: 1: CONTINUE MISSION 2: USE RCS FOR MANEUVERS	A: CSM RESCUE MAY BE INITIATED DUE TO RCS REDLINES
		B: INCOMPLETE STAGING: VEHICLE NOT RIGID	RND2	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			

REV	ITEM

! PRELAUNCH INSTRUMENTATION !

	MEAS DESCRIPTION	PCM	ONBOARD		CATEGORY	MISSION RULE REFERENCE
21-90	ED RLY A K1-K6	6Y0201X	SYS A STAGING LIGHT	COMMON CAUTION LIGHT	M MD	21-1; 2; 3; 13; 20; 21;
	ED RLY B K1-K6	6Y0202X	SYS B STAGING LIGHT		M	21-1; 2; 3; 13; 20; 21;
	ED RLY A K7-K13	6Y0231X	--------		MD	21-1; 3; 22
	ED RLY B K7-K13	6Y0232X	--------		MD	21-1; 3; 22
	SELECTED EC BAT VOLT	------	METER		M	21-1; 2; 20

22 LM ELECTRICAL POWER

REV	ITEM	
		GENERAL
I	22-1	TO INITIATE MANNED LM MISSION PHASES, THE ELECTRICAL POWER SYSTEM MUST PROVIDE THE FOLLOWING MINIMUM CAPABILITIES---
		NOTE
		LM ACTIVE RENDEZVOUS/CONTINGENCY RETURN ASSUMED
		A. DOCKED WITH HATCH OPEN AND TUNNEL CLEAR
		1. CDR OR LMP BUS
		2. TWO DESCENT BATTERIES WITH ASSOCIATED FEEDER OR ONE ASCENT BATTERY WITH ASSOCIATED FEEDER.
		3. SUFFICIENT AVAILABLE ASCENT OR DESCENT ELECTRICAL ENERGY TO COMPLETE THE PLANNED ACTIVITY PERIOD.
		B. DOCKED WITH HATCH CLOSED
		1. CDR AND LMP BUSES
		2. TWO DESCENT BATTERIES PLUS ONE ASCENT BATTERY OR BOTH ASCENT BATTERIES.
		3. BOTH ASCENT FEEDERS
		4. SUFFICIENT AVAILABLE ASCENT OR DESCENT ELECTRICAL ENERGY TO COMPLETE THE PLANNED ACTIVITY PERIOD PLUS A RESERVE OF 1 HOUR.
I		C. UNDOCKED/SEPARATION AND SUBSEQUENT PHASES SEE LM TELCOM GO/NO GO CRITERIA - PAGE 3-16.

REV	ITEM	
	22-2	DEFINITIONS---

LOSS OF CDR OR LMP BUS

A. INABILITY TO MAINTAIN BUS VOLTAGE GREATER THAN 26.5 VDC

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

LOSS OF AN EPS BATTERY

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

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

C. INABILITY TO MEET VOLTAGE REGULATION AT REQUIRED LOAD

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

E. BATTERY OPEN CIRCUIT VOLTAGE BELOW 31.8 VDC STEADY STATE

LOSS OF A DC BUS FEEDER

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

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

LOSS OF OVERCURRENT PROTECTION

A. DEFINITE LOSS IF---

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

(2) FAILURE OF AN ASCENT BATTERY NORMAL FEED CONTACTOR

B. PROBABLE LOSS IF---

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

(2) UNABLE TO TAKE THE BATTERY OFF LINE

LOSS OF AN INVERTER AND/OR ASSOCIATED AC DISTRIBUTION

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

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

C. POWER CANNOT BE SUPPLIED TO AN AC BUS

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

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

B. AN INVERTER MALFUNCTION IF THE STEERABLE ANTENNA IS AFFECTED (ASSUMES THE ERECTABLE ANTENNA IS NOT DEPLOYED).

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

REV	ITEM	
		********** * MANAGEMENT * **********
	22-10	THE MISSION WILL BE CONTINUED AFTER LIFTOFF WITH THE LOSS OF OVERCURRENT PROTECTION * IF THIS PROTECTION IS LOST PRIOR TO LIFTOFF, A HOLD WILL BE CALLED. A. IF OVERCURRENT PROTECTION IS LOST ON AN INDIVIDUAL DESCENT BATTERY, THE BATTERY WILL BE LEFT ON LINE EXCEPT FOR EVA. B. IF ALL DESCENT OVERCURRENT PROTECTION IS LOST, BOTH ASCENT BATTERIES WILL BE PARALLELED WITH THE DESCENT BATTERIES ON LINE PERIODICALLY TO MONITOR CURRENT AND OBTAIN A CONSUMABLE TREND. C. IF ONE OR BOTH ASCENT BATTERY NORMAL FEED CONTACTORS FAIL OPEN, THE SPACECRAFT WILL BE CONFIGURED WHEN ASCENT STAGE ONLY OPERATIONS ARE REQUIRED, USING THE BACKUP FEEDS ON BOTH ASCENT BATTERIES WITH THE CROSSTIES LEFT OPEN.
	22-11	THE ASCENT BATTERIES WILL BE PRECONDITIONED FOR-- A. TWO ASCENT BATTERY/SPLIT BUS OPERATION AND THE CURRENT STEPS ASSOCIATED WITH AN ABORT STAGE BY REMOVING 5 AMP HOURS FROM BATTERY 6 AND 2.5 AH FROM BATTERY 5 IMMEDIATELY PRIOR TO PDI. B. TWO ASCENT BATTERY/SPLIT BUS OPERATION BY REMOVING 2.5 AMP HOURS FROM EACH BATTERY PRIOR TO REMOVING THE LAST DESCENT BATTERY ON EACH BUS BEFORE LUNAR LIFTOFF. C. ONE ASCENT BATTERY/TWO BUS OPERATION BY REMOVING A MINIMUM OF 5 AMP HOURS IMMEDIATLEY PRIOR TO REMOVING THE LAST DESCENT BATTERY.
	22-12	THE BAL LOAD CROSSTIES (30A) WILL BE OPEN FOR MAIN PROPULSION BURNS, STAGING, AND WHENEVER AGS IS IN THE OPERATE MODE WITH BOTH ''AEA'' CIRCUIT BREAKERS CLOSED. THE BUS CROSSTIES (100A) WILL NOMINALLY NEVER BE CLOSED.
	22-13	ELECTRICAL POWER WILL NEVER BE INTENTIONALLY APPLIED TO A SHORT TO HELP DETERMINE ITS LOCATION UNLESS THE FEEDER FAULT LIGHT HAS FAILED. A GOOD BUS WILL NEVER BE CROSSTIED INTO A SHORT OR POSSIBLE SHORT.
	22-14	THE INVERTERS WILL BE SWITCHED FOR A VOLTAGE LESS THAN OR EQUAL TO 112 VAC OR A FREQUENCY GREATER THAN OR EQUAL TO 402 OR LESS THAN OR EQUAL TO 398 HZ.

REV	ITEM	
	22-15	BATTERY MANAGEMENT WILL BE PERFORMED ONLY DURING LUNAR STAY PERIODS AND THEN ONLY IF IT CAN PREVENT VIOLATION OF CONSUMABLE REDLINES DUE TO LOSS OF A SINGLE DESCENT BATTERY.
	22-16	FOR A SHORTED DESCENT FEED TO THE ASCENT BATTERIES WILL BE PLACED ON NORMAL FEED WITH THE SHORT ISOLATED VIA THE DEADFACE RELAY. OPERATIONALLY THIS RESULTS IN THE LOSS OF ALL REMAINING DESCENT ELECTRICAL ENERGY FOR CONSUMABLE CONSIDERATIONS. THE TWO DESCENT BATTERIES THAT STILL HAVE AN OPERABLE FEED PATH WILL BE USED ONLY IF NECESSARY TO MAINTAIN CREW SAFETY.
	22-17	WITH THE LOSS OF ONE ASCENT BATTERY, THE REMAINING ASCENT BATTERY WILL BE PLACED ON ITS BACKUP FEEDPATH WITH THE BUS CROSSTIES (100A) CLOSED FOR STAGED OPERATIONS. ALSO PRIOR TO INITIATING AN ABORT STAGE THE DESCENT ECA C/B'S MUST BE OPENED TO PREVENT THE FAILED BATTERY FROM BEING AUTOMATICALLY PLACED ON LINE THRU ITS NORMAL FEEDPATH.
	22-18	FOR AN OPEN DESCENT FEEDER OR FOR THE LOSS OF TWO DESCENT BATTERIES ON THE SAME BUS AN ASCENT BATTERY WILL BE CONNECTED TO THAT BUS VIA NORMAL FEED PATH. THE CROSS TIE BAL LOAD CIRCUIT BREAKERS MAY BE CLOSED ON THE LUNAR SURFACE IF REQUIRED FOR PROPER BATTERY SHARING.
	22-19	FOR A SHORTED ASCENT FEEDER ON THE LUNAR SURFACE, THE ASCENT BATTERIES WILL NOT BE CONNECTED UNTIL THE NOMINAL TIME TO MEET PRECONDITIONING REQUIREMENTS.

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
				SPECIFIC	
	22-20	LOSS OF EITHER DC BUS	ALL DOCKED	A. DELAY STAGING ALAP B. CONTINUE MISSION 1. DO NOT UNDOCK 2. CREWMEN OPERATE WITH CONNECTING HATCHES OPEN AND TUNNEL CLEAR 3. PERFORM LIMITED SYSTEMS EVALUATION	REF HALF PROC EPS--- 1 UNSTAGED DC BUS 2 STAGED DC BUS 1. LOSS OF DC BUS RESULTS IN LOSS OF ONE PYRO SYSTEM 2. LOSS OF EITHER DC BUS DURING DESCENT ENGINE BURNS RESULTS IN THROTTLING TO 300 PERCENT. IF ON INV 2: LOSS OF THE LMP BUS CAUSES THE ENG TO SHUT DOWN.
			UNDOCKED	C. DOCK ASAP/ NO GO DOI	
			DESCENT ORBIT	D. NO GO PDI/ DOCK ASAP	
			POWERED DESCENT	E. ABORT DOCK ASAP	
			LUNAR STAY	F. LIFTOFF AT NEXT BEST OPPORTUNITY	

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

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	22-22	LOSS OF ASCENT BATTERY(S)			REF MALF PROC EPS---
		A. LOSS OF ONE ASCENT BATTERY	DOCKED UNDOCKED	A. 1. CONTINUE MISSION DO NOT STAGE UNLESS DESCENT BATTERIES AND O2 ARE DEPLETED	2 STAGED DC BUS 4 STAGED C AND W POWER 9 STAGED BATTERY
			DESCENT ORBIT	2. RETURN TO VICINITY OF CSM ASAP NO GO PDI DO NOT STAGE UNLESS DESCENT BATTERIES AND O2 ARE DEPLETED	
			POWERED DESCENT	3.(A) PDI TO PDI + 5 - ABORT DELAY STAGING ASAP (B) PDI + 5 TO TD - CONTINUE MISSION	
			LUNAR STAY	4. LIFTOFF AT NEXT BEST OPPORTUNITY	
		B. LOSS OF TWO ASCENT BATTERIES	ALL	B. 1. DO NOT STAGE DO NOT UNDOCK DOCK ASAP IF UNDOCKED	NOTE--- THIS RULE DOES NOT APPLY AFTER PDI + 5

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	22-23	LOSS OF DESCENT BATTERY(IES)			REF MALF PROC EPS---
		A. LOSS OF ONE DESCENT BATTERY	ALL	A. CONTINUE MISSION	1 UNSTAGED DC BUS 5 UNSTAGED BAT TO ABNORMAL
		B. LOSS OF TWO DESCENT BATTERIES (ONE ON EACH BUS)	ALL	B.1. CONTINUE MISSION	NOTE--- SEE MANAGEMENT RULE 22-18. ASCENT CONSUMABLES DICTATE GO/NO GO FOR REMAINING MISSION PHASES.
		C. LOSS OF TWO DESCENT BATTERIES ON THE SAME BUS	DOCKED UNDOCKED DESCENT ORBIT POWERED DESCENT	C. 1. CONTINUE MISSION	
			LUNAR STAY	2. LIFTOFF AT NEXT BEST OPPORTUNITY	
		D. LOSS OF THREE OR MORE DESCENT BATTERIES	DOCKED	D. 1. DO NOT UNDOCK OPERATE WITH CONNECTING HATCHES OPEN AND TUNNEL CLEAR	
			UNDOCKED	2. DOCK ASAP. NO GO DOI	
			DESCENT ORBIT	3. NO GO PDI DOCK ASAP	
			POWERED DESCENT	4. (A) PDI TO LO GATE - ABORT DOCK ASAP (B) LO GATE TO TD - CONTINUE MISSION	
			LUNAR STAY	5. LIFT OFF AT NEXT BEST OPPORTUNITY	

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	22-24	LOSS OF INVERTER(S)			REF MALF PROC EPS---
		A. LOSS OF ONE INVERTER	ALL	A. 1. CONTINUE MISSION	6 INVERTER
		B. LOSS OF BOTH INVERTERS	DOCKED UNDOCKED	B. 1. CONTINUE MISSION NO GO DOI	. LOSS OF AC POWER RESULTS IN LOSS OF DPS GIMBALS, RR, S-BND STEERABLE ANT (HBR TM), BOTH FDAI SPHERES. . HBR TM IS AVAILABLE FROM AN OMNI ANTENNA AND A 210 FT. MSFN SITE.
			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 MALF PROC EPS---
		A. LOSS OF BUS A	DOCKED UNDOCKED	A. 1. CONTINUE MISSION NO GO FOR DOI	6 INVERTER
			DESCENT ORBIT/ POWERED DESCENT/ LUNAR STAY	2. CONTINUE MISSION	LOSS OF AC BUS A RESULTS IN LOSS OF DPS GIMBAL CONTROL, RENDZ RADAR, AND INTEGRAL LIGHTING LOSS OF AC BUS B RESULTS IN LOSS OF S-I BD STEERABLE ANTENNA (HBR TM) AND NUMERIC LIGHTING. HBR TM IS AVAILABLE FROM AN OMNI ANTENNA AND A 210 FT MSFN SITE. LOSS OF BOTH AC BUSES RESULTS IN THE ABOVE PLUS LOSS OF BOTH FDAI SPHERES AND THE AOT
		B. LOSS OF BUS B	ALL	B. CONTINUE MISSION	
		C. LOSS OF BOTH BUS A AND B	DOCKED/ UNDOCKED	C.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	
		RULE NUMBERS 22-26 THROUGH 22-49 ARE RESERVED.			

REV	ITEM
	22-50

INSTRUMENTATION REQUIREMENTS

MEAS DESCRIPTION	PCM	ONBOARD	CATEGORY	MISSION RULE REFERENCE
AC BUS FREQ	0C0185F	CAUT	1 OF 2	22-2,5,24,25
AC BUS VOLTS	0C0071V	METER; CAUT	M	
BAT 1 CUR	0C1201C	METER	1 OF 2	
BAT 2 CUR	0C1202C	METER	M PCM	
CDR BUS VOLTS	0C0201V	METER	1 OF 2	
BAT 1 VOLTS	0C0201V	METER	M	
BAT 2 VOLTS	0C0202V	METER		22-2,10,14,20,21,23
BAT 3 CUR	0C1203C	METER	1 OF 2	
BAT 4 CUR	0C1204C	METER	M PCM	
LMP BUS VOLTS	0C0202V	METER	1 OF 2	
BAT 3 VOLTS	0C0203V	METER	M	
BAT 4 VOLTS	0C0204V	METER		
BAT 5 VOLTS	0C0205V	METER	M	
BAT 6 VOLTS	0C0206V	METER	M	22-2,10,14,20,21,22
BAT 5 CUR	0C1205C	METER	M PCM	
BAT 6 CUR	0C1206C	METER	M PCM	
BAT 1 MAL	0C9961U	CAUT; COMP	MD	
BAT 2 MAL	0C9962U	CAUT; COMP	MD	
BAT 3 MAL	0C9963U	CAUT; COMP	MD	22-2,10,14,20,21,23
BAT 4 MAL	0C9964U	CAUT; COMP	MD	
BAT 5 MAL	0C9965U	CAUT; COMP	MD	
BAT 6 MAL	0C9966U	CAUT; COMP	MD	
BATTERY MAL	0L4047X	COMP	MD	22-2,10,20,21,22,23
			MD	
BAT 1 LOW TAP	0C4362X	FLAG	MD	
BAT 2 LOW TAP	0C4364X	FLAG	MD	
BAT 3 LOW TAP	0C4365X	FLAG	MD	22-2,10,20,21,23
BAT 4 LOW TAP	0C4368X	FLAG	MD	
BAT 5 D/V CDR	0C4369X	FLAG	MD	
BAT 6 NORM CDR	0C4370X	FLAG	MD	
BAT 5 NORM LMP	0C4371X	FLAG	MD	22-2,10,17,20,21,22
BAT 6 D/V LMP	0C4372X	FLAG	MD	

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

LM ENVIRONMENTAL CONTROL

REV	ITEM	
		---------- * GENERAL * ----------
	23-1	TO INITIATE THE MANNED LM PHASES THE ENVIRONMENTAL CONTROL SYSTEM MUST PROVIDE THE FOLLOWING MINIMUM CAPABILITIES---
		NOTE LM ACTIVE RENDEZVOUS/CONTINGENCY RETURN IS ASSUMED
		A. DOCKED WITH HATCH OPEN AND TUNNEL CLEAR
		1. COMBINED VEHICLE PRESSURE INTEGRITY
		2. ONE LM COOLANT LOOP
		B. DOCKED WITH HATCH CLOSED
		1. CABIN PRESSURE INTEGRITY
		2. SUIT LOOP INTEGRITY
		3. ONE SUIT FAN
		4. ONE DEMAND REGULATOR
		5. ONE COOLANT LOOP
		6. SUFFICIENT O2, H2O, AND LIOH CONSUMABLES TO COMPLETE THE PLANNED ACTIVITY PERIOD PLUS A RESERVE OF 1 HOUR
		C. UNDOCKED/SEPARATION AND SUBSEQUENT PHASES SEE LM TELCOM GO/NO GO CRITERIA - PAGE 3-18.

PSV	ITEM	
	23-2	DEFINITIONS--- LOSS OF CABIN INTEGRITY LM PRESSURE VESSEL LEAKAGE SUCH THAT CABIN PRESSURE CANNOT BE MAINTAINED GREATER THAN OR EQUAL TO 4.6 PSIA WITH AN O2 FLOW RATE OF 0.8 LBS/HR. FOR DOCKED ACTIVITIES THIS WILL BE RELAXED TO A FLOW RATE OF 6 LBS/HR. LOSS OF SUIT LOOP INTEGRITY 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. LOSS OF COOLANT LOOP A. SUSTAINED GLYCOL TEMPERATURE GREATER THAN OR EQUAL TO 50 DEGREE F AND RISING EXCEPT DURING COOLANT LOOP STARTUP AND DRYOUT (SUBLIMATOR LOST) B. GLYCOL PUMP DELTA P LESS THAN OR EQUAL TO 6 PSID (CIRCULATION LOST) OR KNOWN LOSS OF H2O FEED CAPABILITY TO THE SUBLIMATOR(S). GLYCOL COOLANT LEAK OBSERVED FLUID IN CABIN CONFIRMED BY TASTE OR PRESENCE OF GLYCOL LOW INDICATION CONFIRMED BY STATIC PRESSURE DROP. LOSS OF DESCENT O2 TANK INABILITY TO TRANSFER O2 FROM DESCENT TANK OR MSFN CONFIRMATION OF INADEQUATE DESCENT TANK PRESSURE WITH O2 MANIFOLD PRESSURE. LOSS OF ASCENT O2 TANK A. MSFN CONFIRMATION OF LOSS OF ASCENT TANK PRESSURE WITH O2 MANIFOLD PRESSURE-- OR B. IF O2 MANIFOLD PRESSURE CANNOT BE READ, AND VEHICLE IS UNSTAGED AND DESCENT O2 TANK GREATER THAN 35 PERCENT, CREW MAY CONFIRM LOSS BY BALANCING ONE TANK AGAINST THE OTHER, WITH MSFN COVERAGE--- OR C. IF STAGED OR IF DESCENT O2 LESS THAN 35 PERCENT, LOSS OF ONBOARD AND MSFN READOUT. LOSS OF DESCENT H2O TANK A. MSFN CONFIRMATION OF LOSS OF DESCENT TANK PRESSURE WITH DES H2O P AND H2O DELTA P B. INABILITY TO SUPPLY H2O TO W/S RESULTING IN RISING GLYCOL AND SUIT LOOP TEMPERATURE (CREW AND MSFN) AND DROP IN H2O DELTA P (MSFN ONLY). LOSS OF ASCENT H2O TANK A. LOSS OF MEASUREMENT AND REMAINING TANK FEEDING AT TWICE NORMAL RATE B. ONE TANK FEEDING TWICE NORMAL RATE AND NO CHANGE IN MEASUREMENT OR OTHER TANK.
	23-3	IF A SUBLIMATOR IS LOST DUE TO BREAKTHROUGH, NO RESTART ATTEMPT WILL BE MADE.
	23-4	OXYGEN PURGE SYSTEM AND PLSS CONSUMABLES WILL BE RESERVED FOR POSSIBLE EVT AND WILL NOT BE CONSIDERED FOR LM GO/NO-GO'S OR REDLINES.
	23-5	TWO POUNDS OF OXYGEN CONTAINED IN THE LM CABIN WILL BE CONSIDERED AVAILABLE IN CALCULATING GO/NO-GO'S OR REDLINES. THE CABIN CAN BE CONSIDERED, WHEN DISCUSSING FUNCTIONAL PRESSURE VESSEL REQUIREMENTS, AS A BACKUP TO THE ASCENT O2 TANKS.
	23-6	ANY SPECIFIC MISSION RULES REQUIRING A NEXT BEST OPPORTUNITY LIFTOFF WILL BE CAUSE FOR TERMINATION OF AN EVA. ADDITIONALLY, A CREWMAN WILL BE REQUIRED TO RETURN FROM AN EVA TO CORRECT A FAILED OPEN DEMAND REGULATOR. RULE NUMBERS 23-7 THROUGH 23-9 ARE RESERVED.

REV	ITEM	
		* SYSTEMS MANAGEMENT *
	23-10	DELETED
	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.
		RULE NUMBERS 23-14 THROUGH 23-19 ARE RESERVED.

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
				SPECIFIC MISSION RULES	
	23-20	LOSS OF SUIT LOOP INTEGRITY	DOCKED	CONTINUE MISSION 1. PERFORM SYSTEMS EVALUATION WITHIN CONSUMABLES LIFETIME CONSTRAINTS WITH HATCH OPEN AND TUNNEL CLEAR 2. NO-GO FOR UNDOCKING	REF MALF PROC ECS--- 4A SUIT FAN
			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 OPPORTUNITY	
			RNDZ	CONTINUE MISSION DOCK ASAP	

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	23-21	LOSS OF CABIN PRESSURE INTEGRITY			• REF MALF PROC ECS----
			DOCKED	CONTINUE MISSION	ZA CABIN
				1. PERFORM SYSTEMS EVALUATION WITHIN CONSUMABLES LIFETIME CONSTRAINTS WITH ONE CREWMAN ON THE CSM UMBILICALS	
				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 LO GATE - ABORT	
				DOCK ASAP	
				3. LO GATE TO TD - CONTINUE MISSION	
			LUNAR STAY	LIFTOFF AT NEXT BEST OPPORTUNITY	
			AND2	CONTINUE MISSION DOCK ASAP	

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	23-22	SUIT FAN(S) FAILURE			• REF MALF PROC ECS---
		A. ONE SUIT FAN	DOCKED UNDOCKED	A.1. CONTINUE MISSION	7A ECS
			DESCENT ORBIT	2. RETURN TO VICINITY OF CSM DELAY STAGING ALAP	
			POWERED DESCENT	3.(A) PDI TO PDI +5 ABORT DELAY STAGING ALAP (B) PDI +5 TO TD- CONTINUE MISSION	
			LUNAR STAY	4. LIFTOFF AT NEXT BEST OPPORTUNITY	
			RNDZ	5. CONTINUE MISSION DOCK ASAP	
		B. TWO SUIT FANS	DOCKED	B.1. CONTINUE MISSION WITH TUNNEL CLEAR AND ON TRANSFER UMBILICAL OR CW GARMENT W/O SUIT NO-GO FOR UNDOCKING	B. REMOVE HELMET AND GLOVES • REF MALF PROC ECS--- 4 SUIT FAN
			UNDOCKED	2. DOCK ASAP NO-GO FOR DOI DO NOT STAGE WHILE UNDOCKED	
			DESCENT ORBIT	3. DOCK ASAP DO NOT STAGE WHILE UNDOCKED	
			POWERED DESCENT	4.(A) PDI TO PDI +5- ABORT DOCK ASAP DO NOT STAGE (B) PDI +5 TO LO GATE ABORT (C) LO GATE TO TD CONTINUE MISSION PLACE DEMAND REG B TO "DIRECT OFF" IMMEDIATELY	
			LUNAR STAY	5. LIFTOFF AT NEXT BEST OPPORTUNITY	
			RNDZ	6. DOCK ASAP	

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	23-23	DEMAND REGULATOR(S) FAIL OPEN OR CLOSED			1 REF MALF PROC ECS--
		A. ONE REGULATOR	ALL	A. CONTINUE MISSION	3 CABIN PRESS IND HI
		B. TWO REGULATORS	DOCKED	B.1. DO NOT UNDOCK	6 O2 QTY
			UNDOCKED DESCENT ORBIT	2. DOCK ASAP DELAY STAGING ALAP	
			POWERED DESCENT	3. CONTINUE MISSION	
			LUNAR STAY	4. CONTINUE MISSION DEPENDING UPON THE O2 RECYCLE REQUIREMENT.	
			RNDZ	5. CONTINUE MISSION	

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	23-24	LOSS OF H2O SEPARATOR(S) AND/OR LCG LOOP			• REF MALF PROC ECS----
					TB 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	
			AND2	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	
			AND2	5: CONTINUE MISSION AND DOCK ASAP	

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	23-29	LOSS OF O2 TANK(S)			
		A. ONE ASCENT TANK	ALL	A. CONTINUE MISSION	
		B. TWO ASCENT TANKS	DOCKED	B.1. DO NOT UNDOCK	
			UNDOCKED	2. DOCK ASAP DELAY STAGING ALAP	
			DESCENT ORBIT		
			POWERED DESCENT	3.(A) PDI TO PDI + 5 - ABORT DELAY STAGING ALAP	
				(B) PDI + 5 TO LO GATE ABORT	
				(C) LO GATE TO TOUCHDOWN CONTINUE MISSION	3(C) ASSUMES DESCENT O2 STILL AVAILABLE
			LUNAR STAY	4. LIFT OFF AT NEXT BEST OPPORTUNITY	
			AND2	5. CONTINUE MISSION	
		C. DESCENT TANK	ALL	C.1. CONTINUE MISSION	
			LUNAR STAY	2. LIFTOFF NEXT BEST OPPORTUNITY	

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	23-26	LOSS OF COOLANT LOOP(S) A. PRIMARY OR SECONDARY LOOP	DOCKED UNDOCKED	A. 1. CONTINUE MISSION ON SECONDARY LOOP NO-GO FOR DOI	• REF MALF PROC ECS— TE ECS B GLYCOL
			DESCENT ORBIT	2. RETURN TO VICINITY OF CSM	
			POWERED DESCENT	3.(A) PDI TO LO GATE - ABORT (B) LO GATE TO TD - CONTINUE MISSION	A.3.(B) FOR PRIMARY LOOP LOSS. LIFT OFF IMMEDIATELY AFTER TOUCHDOWN.
			LUNAR STAY	4. LIFTOFF NEXT BEST OPPORTUNITY FOR LOSS OF PRIMARY LOOP--- (A) OPEN CB (II) IMU OPR (B) AT LIFTOFF- 60 MIN. CLOSE CB (II) IMU OPR AND CONTINUE MISSION	
			RNDZ	5. CONTINUE MISSION	
		B. BOTH LOOPS (ANY COMBINATION OF LOSS OF CIRCULATION, SUBLIMATION CAPABILITY, OR H2O FEED FOR BOOTH LOOPS	DOCKED	B. 1. INGRESS CSM ASAP NO-GO FOR UNDOCKING	
			UNDOCKED DESCENT ORBIT	2. DOCK ASAP DO NOT STAGE	
			POWERED DESCENT	3.(A) PDI TO PDI + 5- ABORT DOCK ASAP DO NOT STAGE (B) PDI + 5 TO LO-GATE- ABORT DOCK ASAP (C) LO-GATE TO TD - CONTINUE MISSION	B.3.(C) LIFT OFF IMMEDIATELY AFTER TOUCHDOWN.
			LUNAR STAY	4. LIFTOFF ASAP	
			RNDZ	5. INITIATE CSM RESCUE	

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	33-27	LOSS OF PRIMARY H2O FEEDPATH	DOCKED UNDOCKED	CONTINUE MISSION	* REF MALF PROC ECS---
				NO-GO FOR UNDOCKING	$ GLYCOL
			DESCENT ORBIT	RETURN TO VICINITY OF CSM	
			POWERED DESCENT	1. PDI TO PDI + 5 - ABORT	
				2. PDI + 5 TO TD - CONTINUE MISSION	
			LUNAR STAY	LIFTOFF NEXT BEST OPPORTUNITY	
			RNDZ	CONTINUE MISSION	
	33-28	LOSS OF H2O TANK(S)			
		A. ONE ASCENT TANK	DOCKED UNDOCKED	A.1. CONTINUE MISSION	
			DESCENT ORBIT	2. RETURN TO VICINITY OF CSM ASAP DELAY STAGING ALAP NO GO PDI	
			POWERED DESCENT	3.(A) PDI TO PDI + 5- ABORT DELAY STAGING ALAP	DURING POWERED DESCENT, IT IS IMPOSSIBLE TO CONFIRM THE LOSS OF AN ASCENT TANK
				(B) PDI + 5 TO TOUCHDOWN CONTINUE MISSION	
			LUNAR STAY	4. LIFT OFF NEXT BEST OPPORTUNITY	
			RNDZ	5. CONTINUE MISSION	
		B. TWO ASCENT TANKS	DOCKED UNDOCKED	B.1. CONTINUE MISSION	
			DESCENT ORBIT	2. RETURN TO VICINITY OF CSM ASAP DO NOT STAGE NO GO PDI	
			POWERED DESCENT	3.(A) PDI TO PDI + 5- ABORT DO NOT STAGE	
				(B) PDI + 5 TO LO-GATE ABORT	
				(C) LO GATE TO TOUCHDOWN CONTINUE MISSION	
			LUNAR STAY	4. LIFTOFF NEXT BEST OPPORTUNITY	
			RNDZ	5. INITIATE CSM RESCUE	POWER DOWN LM
		C. DESCENT TANK	ALL	C.1. CONTINUE MISSION	
			DOCKED	2. CONTINUE MISSION NO GO DOI	
			LUNAR STAY	3. LIFTOFF NEXT BEST OPPORTUNITY	

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

REV	ITEM

* INSTRUMENTATION REQUIREMENTS *

23-50

MEAS DESCRIPTION	PCM	ONBOARD	CATEGORY	MISSION RULE REF
SUIT PRESS	GF1301P	METER WARNING	M MD	23-1,2,6,20,21,23
CABIN PRESS	GF3571P	METER	1 OF 3	
U/H RLF PRESS	GF3591P	-----	M	23-1,2,5,13,20,21,
F/H RLF PRESS	GF3592P	-----		23,29
DES O2 PRESS	GF3584P	METER, CAUT	1 OF 2	
O2 FLO PRESS	GF3589P	----------	M	23-1,2,6,11,12,13,
ASC 1 O2 PRESS	GF3582P	METER, CAUT	1 OF 3	21,23,25
ASC 2 O2 PRESS	GF3583P	METER, CAUT	M	
GLYCOL PUMP DELTA P	GF2021P	-----	1 OF 2	
SEC GLYCOL PUMP PRESS	GF2931P	-----	M	23-1,2,3,6,26,31
GLYCOL PUMP PRESS	GF9997U	METER		
SEL GLYCOL LVL LOW	GF9986U	CAUT		
GLYCOL TEMP	GF9990U	METER, CAUT	1 OF 2	23-1,2,3,6,26,31
GLYCOL OUTLET TEMP	GF3981T	----------	M	
SUIT TEMP	GF1281T	METER		
GLYCOL INLET TEMP	GF2931T	-----		
DES H2O QTY	GF6581Q	METER, CAUT	1 OF 2	
DES H2O PRESS	GF6501P	----------	M	23-1,2,27,28
ASC 1 H2O QTY	GF6582Q	METER, CAUT	1 OF 2	
ASC 2 H2O QTY	GF6583Q	METER, CAUT	M	
PRI H2O REG DELTA P	GF6101P	----------	M	23-1,2,27,28
RTG TEMP	GL8275T	----------	MD	
REPR ELEC OPEN	GF3572X	WARNING	MD	23-1,2,5,13,20,21,23,
CO2 PART PRESS	GF1521P	METER, CAUT, COMP	MD	23-1,24,30
H2O SEP RATE	GF9999U	CAUT, COMP	MD	23-1,22,24
SUIT DIV EGRESS	GF1221X	----------	MD	23-1,20,21,22,29

24 LM GUIDANCE
AND CONTROL

REV	ITEM	

GENERAL

24-1 RESERVED

24-2 DEFINITIONS

3-AXIS AUTO ATTITUDE CONTROL AND HOLD CAPABILITY

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.

3-AXIS CONTROL

3-AXIS CONTROL IS DEFINED AS THE ABILITY TO CHANGE THE EXISTING VEHICLE ATTITUDE. TO HAVE THIS CAPABILITY THE LM REQUIRES AN OPERATIONAL MANUAL OR AUTOMATIC CONTROL SYSTEM.

OPERATIONAL PGNS

AN OPERATIONAL PGNS IS DEFINED AS NO LGC FAILURE, NO ISS FAILURE, AND NO DSKY FAILURES.

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.

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.

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.

OPERATIONAL AGS

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

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.

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.

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.

D. ANY FAILURE OF THE CES HARDWARE THAT PREVENTS ATTITUDE CONTROL WHILE IN AGS IS CONSIDERED A CES FAILURE.

3-AXIS TRANSLATION

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.

REV	ITEM	
		' MANAGEMENT '
	24-3	IMU
		A. IRIG BIAS UPDATES WILL BE ACCOMPLISHED AS FOLLOWS---
		1. INFLIGHT: WHEN GYRO DRIFT IS GREATER THAN OR EQUAL TO +/- .075 DEG/HR (5 MERU)
		2. ON LUNAR SURFACE: WHENEVER THE GYRO DRIFT IS GREATER THAN OR EQUAL TO +/- .075 DEG/HR (5 MERU) AS CALCULATED BETWEEN TWO ALIGNMENTS USING THE SAME OPTION AND ALIGNMENT TECHNIQUE.
		3. DOCKED ALIGNMENT: NO ATTEMPT WILL BE MADE TO UPDATE IRIG BIAS BASED ON DOCKED IMU ALIGNMENT
		B. THE PGNS WILL BE CONSIDERED NO-GO WITH A GYRO DRIFT GREATER THAN OR EQUAL TO +/-1.5 DEG/HR (100 MERU). THE MAXIMUM ALLOWABLE VALUE WITHIN THE LGC IS +/-1.93 DEG/HR (128 MERU).
		C. PIPA BIAS UPDATES WILL BE ACCOMPLISHED AS FOLLOWS---
		1. NO BIAS UPDATES WILL BE ACCOMPLISHED PRIOR TO 30 MIN OF IMU OPERATION.
		2. THE INITIAL BIAS UPDATES WILL BE ACCOMPLISHED IF THE ABSOLUTE VALUE IS GREATER THAN OR EQUAL TO +/- 0.1 CM/SEC 2 AND THE DELTA BI'S IS GREATER THAN OR EQUAL TO +/- 0.03 CM/SEC 2.
		3. SUBSEQUENT TO THE INITIAL BIAS UPDATE: UPDATES WILL BE ACCOMPLISHED WHENEVER THE ABSOLUTE BIAS IS GREATER THAN OR EQUAL TO +/- 0.1 CM/SEC 2 AND THE DELTA BIAS IS GREATER THAN OR EQUAL TO +/-0.1 CM/SEC 2.
		4. PIPA BIAS WILL NOT BE UPDATED WHILE THE LM IS ON THE LUNAR SURFACE.
		D. PNGS NO-GO FOR PIPA BIAS--- THE PNGS WILL BE CONSIDERED NO-GO IF THE PIPA BIAS EXCEEDS +/- 5.06 CM/SEC . SEC (.166 FT/SEC . SEC). THE MAXIMUM LOAD VALUE WITHIN THE LGC IS +/- 12.5 CM/SEC . SEC.
	24-4	LGC
		A. A MASS UPDATE IS REQUIRED IF THE DIFFERENCE BETWEEN THE GROUND CALCULATION AND LGC VALUE DIFFER BY MORE THAN 200 LBS.
		B. ALL DESCENT ENGINE STARTS MUST NOMINALLY BE PRECEDED BY A PROPELLANT SETTLING MANEUVER USING TWO SYSTEM B JETS OR IN CASE OF A CONTINGENCY TWO SYSTEM A JETS.
		C. ULLAGE FOR ALL APS BURNS MAY BE 4 JET OR 2 JET SYSTEM A OR B.
		D. ALL +/-(U-V) JETS WILL BE INHIBITED VIA V65 DURING DOCKED DPS BURNS.
		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.
	24-5	RENDEZVOUS RADAR
		A. THE RR MUST NOT BE OPERATED UNTIL 2 1/2 HOURS AFTER OPERATE HEATER ACTIVATION AND THE ANTENNA TEMPERATURE (HPM) IS GREATER THAN OR EQUAL TO 10 DEG. F AND THE GYRO PACKAGE IS ESTIMATED TO BE GREATER THAN OR EQUAL TO 15 DEG F.
		B. THE RR SHOULD NOT BE OPERATED AT AN ANTENNA TEMPERATURE GREATER THAN OR EQUAL TO 145 DEG F AND/OR A GYRO PACKAGE TEMP (ESTIMATED) OF GREATER THAN OR EQUAL TO 200 DEG F.
		C. IF IT IS ESTIMATED THAT THE RR GYRO PACKAGE WILL EXCEED 200 DEG F (HPM APPROX. 135 DEG F) PRIOR TO COMPLETION OF THE BRAKING PHASE: THE RR SHOULD BE TURNED OFF UNTIL REQUIRED FOR TPI AND BRAKING.
		D. IF THE ESTIMATED GYRO PACKAGE TEMP SHOULD EXCEED 200 DEG F (HPM APPROX. 135 DEG F) ANYTIME DURING THE BREAKING PHASE: THE AC POWER TO THE RR SHOULD NOT BE TURNED OFF.

REV	ITEM	
		D. IF THE ESTIMATED GYRO PACKAGE TEMP SHOULD EXCEED 200 DEG F (HPM APPROX. 335 DEG F) ANYTIME DURING THE BREAKING PHASE, THE AC POWER TO THE RR SHOULD NOT BE TURNED OFF. E. IF THE RR ANTENNA TEMP (HPM) EXCEEDS THE NOMINAL TEMP PROFILE BY 15 DEG F, THE RR SHOULD BE TURNED OFF IF IT IS NOT NEEDED. F. IF THE RR OVEN HEATERS ARE TURNED OFF (BOTH THE PGNS--- RNDZ RDR AND HEATERS---RNDZ RDR OPR OPEN), RR RANGE DATA MUST NOT BE USED UNTIL 17 MIN AFTER RE-ENERGIZING, ASSUMING THE OVEN TEMP HAS DROPPED TO THE COLD RAIL TEMP.

REV	ITEM	
	24-6	LANDING RADAR
		A. THE LR SHOULD NOT NORMALLY BE OPERATED AT AN ANTENNA TEMP LESS THAN + 30 DEG F. HOWEVER, THE LUNAR LANDING MISSION WILL BE ATTEMPTED IF THE ANTENNA TEMP IS ABOVE THE CRITICAL LIMIT OF -19 DEG F (HARDWARE DAMAGE).
		B. LR ACTIVATION WILL BE DELAYED TO PDI + 4 MIN IF THE LR TEMP IS GREATER THAN 138 DEG F, AT NOMINAL TIG -1.5 MIN (LR ACTIVATION).
		C. PDI WILL BE DELAYED ONE REV IF THE LR TEMP IS GREATER THAN 147 DEG.F, AT NOMINAL TIG -1.5 MIN (LR ACTIVATION).
	24-7	AGS
I		A. THE AGS IS DECLARED NO-GO WITH A TEMPERATURE OF LESS THAN + 40 DEG F OR GREATER THAN + 150 DEG F.
		B. THE AGS IS DECLARED NO-GO DURING A GYRO AND ACCELEROMETER CALIBRATION IF THE GYRO DRIFT CHANGE IS GREATER THAN 2.00 DEG/HR AND IF THE ACCELEROMETER BIAS CHANGE IS GREATER THAN 0.039 FT/SEC2 FROM THE VALUE AT THE START OF THE CALIBRATION.
		C. THE AGS MUST BE UPDATED WITHIN 7 MINUTES OF A BURN.
		D. THE AGS CAN BE USED TO PERFORM DOCKED ATTITUDE HOLD CONTROL.
		E. THE AGS IN PULSE MODE USING ONLY TTCA CONTROL CAN BE USED TO PERFORM A DOCKED DPS BURN.
		RULE NUMBERS 24-8 THROUGH 24-19 ARE RESERVED.

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
				SPECIFIC	
	24-20	LOSS OF OPERATIONAL PGNS	DOCKED/ UNDOCKED	1. RETURN TO CSM ASAP 2. NO-GO FOR DOI	1 REF MALF PROC PGNS--- 2 ISS WARN
			DESCENT/ ORBIT	1. STOP BURN IF BURNING 2. RETURN TO CSM ASAP 3. NO-GO FOR PDI	2 LGC WARN 3 TEMP CAUTION
			POWERED DESCENT	1. PRIOR TO 4000 FT. (A) NO-GO FOR LANDING (B) ABORT 2. AFTER 4000 FT. (A) LAND MANUALLY (B) NO-GO FOR EXTENDED LUNAR STAY	4 GIMBAL LOCK
			LUNAR STAY	ASCENT AT NEXT BEST OPPORTUNITY	
			RNDZ	1. SWITCH TO AGS 2. CONTINUE MISSION	
	24-21	LOSS OF FDAI FUNCTIONS (ATT. RATES. ERRORS)	ALL	CONTINUE MISSION CREW OPTION	
	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	

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	24-23	LOSS OF RENDEZVOUS RADAR AND/OR TRANSPONDER	DOCKED/ UNDOCKED	1. RETURN TO CSM ASAP	. REF MALF PROC PGNS---
				2. NO-GO FOR DOI	5 TRACKER
			ALL OTHERS	CONTINUE MISSION	8 RNDZ RADAR CAUTION
					8A NO TRACK
					REF MALF PROC HTRS---
					1C RR TEMP ABNORMAL
	24-24	LOSS OF LANDING RADAR	DOCKED/ UNDOCKED	1. RETURN TO CSM ASAP	
				2. NO-GO FOR DOI	
			DESCENT ORBIT	1. RETURN TO CSM ASAP	
				2. NO-GO FOR PDI	
			POWERED DESCENT	1. PRIOR TO ADEQUATE ALTITUDE UPDATING OF LM STATE VECTORS---	1. GUIDO TO DECIDE WHEN ADEQUATE UPDATING OF LM STATE VECTORS HAS BEEN ACCOMPLISHED.
				(A) NO-GO FOR LANDING	REF MALF PROC PGNS---
				(B) ABORT	6 ALT LT
				2. AFTER ADEQUATE ALTITUDE UPDATING OF LM STATE VECTORS---	7 VEL LT
					REF MALF PROC HTRS---
				CONTINUE MISSION	2 LR TEMP ABNORMAL
	24-25	VHF RANGING/OPTICAL TRACKING			CSM OPTICAL TRACKING CAPABILITY REQUIRES THE LM TRACKING LIGHT AND THE ABILITY TO VISUALY TRACK.
		A. LOSS OF EITHER	ALL	A. CONTINUE MISSION	
		B. LOSS OF BOTH	DOCKED/ UNDOCKED	B.1.(A) RETURN TO CSM ASAP	
				(B) NO GO FOR DOI	
			ALL OTHERS	2. CONTINUE MISSION	
		RULE 24-26 IS RESERVED.			

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	24-27	LOSS OF AUTOMATIC 3-AXIS ATTITUDE CONTROL AND HOLD CAPABILITY---			1. REF MALF PROC CES---
					1 ABNORMAL VEHICLE DYNAMICS
					2 LM DRIFTS
		A. LOSS OF AGS CAPABILITY	DOCKED/ UNDOCKED	A.1. RETURN TO CSM- NO GO FOR DOI	NOTE---
			DESCENT ORBIT	2. RETURN TO CSM ASAP - NO GO FOR PDI	CONSIDERATION WILL BE GIVEN TO CONTINUING BASED ON AGS FAILURE MODE
			POWERED DESCENT	3.(A) PRIOR TO HI-GATE- ABORT	
				(B) AFTER HI-GATE- CONTINUE MISSION	
			LUNAR STAY	4. CONTINUE MISSION	
		B. LOSS OF PGNS CAPABILITY	DOCKED/ UNDOCKED	B.1.(A) RETURN TO CSM (B) NO-GO FOR DOI	
			DESCENT ORBIT	2.(1) STOP BURN, IF BURNING	
				(B) NO-GO FOR PDI	
				(C) RETURN TO CSM ASAP	
			POWERED DESCENT	3.(A) PRIOR TO 4000 FT. ABORT	
				(B) AFTER 4000 FT.	
				(1) LAND MANUALLY	
				(2) NO-GO FOR EXTENDED LUNAR STAY	
			LUNAR STAY	4. ASCENT AT THE NEXT BEST OPPORTUNITY	

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	24-20	LOSS OF 3-AXIS CONTROL			
		A. REDUNDANT	DOCKED/ UNDOCKED	A.1.(A) RETURN TO CSM ASAP (B) NO-GO FOR DOI	
			DESCENT ORBIT	2.(A) RETURN TO CSM ASAP (B) NO-GO FOR PDI	
			POWERED DESCENT/	3.(A) PRIOR TO PI GATE - ABORT (B) AFTER PI GATE - CONTINUE MISSION	
			LUNAR STAY	4. ASCENT AT NEXT BEST OPPORTUNITY	
			RNDZ	5. CONTINUE MISSION	
		B. ANY AXIS	POWERED DESCENT	B.1.(A) PDI TO LOW GATE ABORT (B) AFTER LOW GATE CONTINUE MISSION NO-GO FOR EXTENDED LUNAR STAY	
			RNDZ	2. NO-GO FOR LM ACTIVE RNDZ	

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	24-29	LOSS OF TRANSLATION CAPABILITY			A.1. CAN NOT DETECT FAILURE UNTIL LGC COMMANDS ULLAGE
		A. AUTOMATIC ULLAGE (+X)	DOCKED/ UNDOCKED	A.1. DO NOT UNDOCK DOI INHIBITED	. REF MALF PROC CES---
			DESCENT ORBIT	2.(A) RETURN TO CSM ASAP	1 ABNORMAL VEHICLE DYNAMICS
				(B) DOI INHIBITED	6 TTCA CMDS ABNORMAL
				(C) DO NOT BACK UP ULLAGE MANUALLY	
				(D) NO-GO FOR POI	
			POWERED DESCENT	3.(A) PRIOR TO POI	
				(1) RETURN TO CSM ASAP	
				(2) POI INHIBITED	
				(3) DO NOT BACK UP ULLAGE MANUALLY	
				(4) NO-GO FOR LANDING	
				(B) AFTER POI CONTINUE MISSION	
		B. EITHER +/-Y; +/-Z; +/-X TRANSLATION	DOCKED/ UNDOCKED	B.1.(A) RETURN TO CSM ASAP	
				(B) NO-GO FOR DOI	
			DESCENT ORBIT	2.(A) PRIOR TO DOI	
				(1) RETURN TO CSM ASAP	
				(2) DOI INHIBITED	
				(3) NO-GO FOR POI	
				(B) AFTER DOI	
				(1) CONTINUE MISSION	
				(2) NO-GO FOR LM ACTIVE TPI AND TPF	
			POWERED DESCENT	3.(A) CONTINUE MISSION	
				(B) NO-GO FOR LM ACTIVE TPI AND TPF	
			RNDZ	4.(A) CSI-COM	B.4.(A) A MINIMUM OF ONE AXIS TRANSLATION IS REQUIRED DURING THIS PHASE
				(1) CONTINUE MISSION	
				(2) NO-GO FOR TPI-TPF	
				(B) TPI-TPF	
				(1) CSM ACTIVE RNDZ AND DOCKING	

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	24-30	LOSS OF PITCH OR ROLL GDA	ALL	ENGINE GIMBAL - OFF CONTINUE MISSION UNLESS RCS IMPINGEMENT CONSTRAINTS ARE VIOLATED.	RCS IMPINGEMENT CONSTRAINTS ARE A FUNCTION OF THE GDA POSITION AT THE TIME OF FAILURE. SODB INFO WILL BE USED TO DETERMINE CAPABILITY TO COMPLETE DESCENT FOR A GIVEN GDA POSITION.
	24-31	LOSS OF AUTO ENGINE ON/OFF CAPABILITY	DOCKED/ UNDOCKED	1. RETURN TO CSM ASAP	- REF MALF PROC CES---
				2. NO-GO FOR DOI	10 MPS DOES NOT THRUST WHEN EVENT TIMER IND 00:00
			DESCENT ORBIT	1. RETURN TO CSM ASAP	
				2. DOI INHIBITED	
				3. NO-GO FOR PDI	
			POWERED DESCENT	1. BACKUP PDI WITH DES ENG CMD OVRD SW	
				2. PDI TO PDI + 5: ABORT ONLY IF FAILURE AFFECTS ASCENT ENGINE.	
				3. AFTER PDI + 5: CONTINUE THROUGH LANDING.	
				4. NO-GO FOR EXTENDED LUNAR STAY IF FAILURE AFFECTS ASCENT ENGINE.	
			LUNAR STAY	ASCENT AT NEXT BEST OPPORTUNITY CAPABILITY VIA MANUAL START	
	24-32	ENGINE DOES NOT IGNITE AFTER DES ENG CMD OVRD SW IS USED	POWERED DESCENT	1. INHIBIT PDI	- REF MALF PROC CES ---
				2. RETURN TO CSM ASAP	10 MPS DOES NOT THRUST WHEN EVENT TIMER IND 00:00
	24-33	LOSS OF OPERATIONAL AGS	DOCKED/ UNDOCKED	A. RETURN TO CSM ASAP - NO GO FOR DOI	- REF MALF PROC AGS---
					1 AGS WARNING LIGHT
			DESCENT ORBIT	B. RETURN TO CSM ASAP - NO GO FOR PDI	2 DEDA RESPONSE IS ABNORMAL
			POWERED DESCENT	C. (1) PRIOR TO H1 GATE - ABORT	NOTE---
				(2) AFTER H1 GATE - CONTINUE MISSION	CONSIDERATION WILL BE GIVEN TO CONTINUING BASED UPON AGS FAILURE MODE.
			LUNAR STAY/ RNDZ	D. CONTINUE MISSION	

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	24-34	LOSS OF AUTO THRUST CONTROL	DOCKED/ UNDOCKED	1. RETURN TO CSM ASAP	• REF MALF PROC CES---
				2. NO-GO FOR DOI	11 ENG THR AND CMD DO NOT AGREE DURING DPS BURN
			DESCENT ORBIT	1. RETURN TO CSM ASAP	11 CMD THR DOES NOT RESPOND TO TTCA OR DOES NOT FOLLOW TIMELINE.
				2. IF BURNING, CONTINUE BURN	
				3. NO-GO FOR PDI	
			POWERED DESCENT	1. PRIOR TO 4000 FT.	
				(A) IF CMDED THROTTLE INDICATION GOOD WITH LOW ENG THRUST	
				(1) DO NOT SEL MAN THROTTLE	
				(2) SUPPLEMENT AUTO THROTTLE WITH MAN THROTTLE	
				(B) ANY OTHER AUTO THROTTLE FAILURE	
				(1) ABORT USING DPS	
				(2) ABORT STAGE 20 SEC AFTER LOW LEVEL	
				2. AFTER 4000 FT.	
				(A) SWITCH TO MANUAL THROTTLE	
				(B) CONTINUE MISSION	
	24-35	LOSS OF ALL MANUAL THRUST CONTROL	DOCKED/ UNDOCKED	1. RETURN TO CSM ASAP	SEE MANAGEMENT RULE 25-15 FOR ALLOWABLE TIME IN NON THROTTABLE REGION.
				2. NO-GO FOR DOI	
			DESCENT ORBIT	1. RETURN TO CSM ASAP	
				2. IF BURNING, CONTINUE BURN	• REF MALF PROC CES---
				3. NO-GO FOR PDI	11 ENG THR AND CMD THR DO NOT AGREE DURING DPS BURN
			POWERED DESCENT	1. DO NOT SWITCH TO MANUAL THROTTLE	11 CMD THR DOES NOT RESPOND TO TTCA OR DOES NOT FOLLOW TIMELINE
				2. SELECT OTHER TTCA	
				(A) REGAIN WITHIN ALLOWABLE TIME CONTINUE MISSION	REF 25-15
				(B) IF THROTTLE OPERATED FOR MORE THAN ALLOWABLE TIME IN NON-THROTTLEABLE REGION - ABORT	REF 25-15
				3. AFTER THROTTLE DOWN, THROTTLE REQUIREMENT MAY BE DELETED BASED ON NOMINAL TRAJECTORY AND GUIDANCE.	

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	24-36	LOSS OF ACA A. ONE B. BOTH	ALL	A. CONTINUE MISSION	1 REF MALF PROCCES 2 LM DRIFTS OUT OF DEADBAND 3 PROP CMDS ABNORMAL
			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	
	24-37	LOSS OF TTCA A. ONE B. BOTH	ALL	A. CONTINUE MISSION	1 REF MALF PROCCES --- 2 ABNORMAL VEHICLE DYNAMICS 3 ABSENCE OF NORMAL RESPONSE VIA TTCA
			DOCKED/ UNDOCKED	B.1.(A) RETURN TO CSM ASAP (B) NO-GO FOR DOI	
			DESCENT ORBIT	2.(A) RETURN TO CSM ASAP (B) IF BURNING CONTINUE BURN (C) NO-GO FOR TPI. TPF. AND DOCKING	
			POWERED DESCENT	3.(A) DO NOT SWITCH TO MANUAL THROTTLE (B) ABORT USING DPS. ABORT STAGE AFTER ALLOWABLE TIME IN NON THROTTABLE RANGE (C) AFTER THROTTLE DOWN MANUAL THROTTLE REQUIREMENT MAY BE DELETED BASED ON NOMINAL TRAJECTORY AND GUIDANCE.	REF 25-15
			LUNAR STAY RNDZ	4. CONTINUE MISSION 5. THE CSM MUST BE THE ACTIVE VEHICLE FOR TPI. TPF. AND DOCKING	
	24-38	LOSS OF LUNAR CONTACT LIGHTS	POWERED DESCENT	CONTINUE MISSION	
		RULE NUMBER 24-39 IS RESERVED.			

REV	ITEM

' PRELAUNCH INSTRUMENTATION '

	MEAS DESCRIPTION	PCM	ONBOARD	TRANSDUCERS	CATEGORY	MISSION RULE REFERENCE
24-40	LGC DOWNLINK	GG0001U	-	-	M	24-20
	PLS TORQ REF	GG1040V	-	-	MD	24-20
	2.5 VDC TM BIAS	GG1110V	-	-	MD	24-20
	IMU 28 VAC 800	GG1281V	-	-	MD	24-20
	IRIG SUSP 3.2 RC	GG1351V	-	-	MD	24-20
	IMU STBY	GG1151X	-	-	MD	24-20
	LGC OPR	GG1152X	-	-	MD	24-20
	X PIPA OUT IN PHASE	GG2001V	-	-	MD	24-20
	Y PIPA OUT IN PHASE	GG2021V	-	-	MD	24-20
	Z PIPA OUT IN PHASE	GG2041V	-	-	MD	24-20
	IG SVO ERR IN PHASE	GG2107V	-	-	MD	24-20
	IG IR RSVR OUT SIN	GG2112V	PDAI	COMMON	MD	24-20
	IG IR RSVR OUT COS	GG2113V	PDAI	COMMON	MD	24-20
	MG SVO ERR IN PHASE	GG2137V	-	-	MD	24-20
	MG IR RSVR OUT SIN	GG2142V	PDAI	COMMON	MD	24-20
	MG IR RSVR OUT COS	GG2143V	PDAI	COMMON	MD	24-20
	OG SVO ERR IN PHASE	GG2167V	-	-	MD	24-20
	OG RSVR OUT SIN	GG2172V	PDAI	COMMON	MD	24-20
	OG RSVR OUT COS	GG2173V	PDAI	COMMON	MD	24-20
	PITCH ATT ERR	GG2219V	PDAI	COMMON	MD - PCM	24-20
	YAW ATT ERR	GG2249V	PDAI	COMMON	MD - PCM	24-20
	ROLL ATT ERR	GG2279V	PDAI	COMMON	MD - PCM	24-20
	PIPA TEMP	GG3000T	C&W	SEPARATE	M-PCM	24-20
	RR SHFT SIN	GG3304V	PDAI	COMMON	MD - PCM	24-23
	RR SHFT COS	GG3305V	PDAI	COMMON	MD - PCM	24-23
	RR TRUN SIN	GG3324V	PDAI	COMMON	MD - PCM	24-23
	RR TRUN COS	GG3325V	PDAI	COMMON	MD - PCM	24-23
	LGC WARNING	GG0001X	C&W	COMMON	MD - PCM	24-23
	IGS WARNING	GG0002X	C&W	COMMON	MD - PCM	24-20
	LR ANT TEMP	GN75657T	TEMP MONITOR	COMMON	M - PCM	
	RR NO TRACK	GN76211X	C&W	COMMON	MD - PCM	24-23
	RR ANT TEMP	GN77237T	TEMP MONITOR	COMMON	M-PCM	24-23
	YAW ERR CMD	GM1247V	-	-	M	24-20
	PITCH ERR CMD	GM1248V	-	-	M	24-20
	ROLL ERR CMD	GM1249V	-	-	M	24-20
	JD AND OUTPUT	GM1419V	-	-	MD	24-27
	RCS TCP AND	GR5032X	-	-	MD	24-27
	JD BID OUTPUT	GM1423V	-	-	MD	24-27
	RCS TCP BID	GR5036X	-	-	MD	24-27
	JD AID OUTPUT	GM1427V	-	-	MD	24-27
	RCS TCP AID	GR5040X	-	-	MD	24-27
	JD BID OUTPUT	GM1431V	-	-	MD	24-27
	RCS TCP BID	GR5044X	-	-	MD	24-27
	JD BAU OUTPUT	GM1418V	-	-	MD	24-27
	JD BAF OUTPUT	GM1420V	-	-	MD	24-27
	JD BAR OUTPUT	GM1421V	-	-	MD	24-27
	JD BDU OUTPUT	GM1422V	-	-	MD	24-27
	JD BDA OUTPUT	GM1424V	-	-	MD	24-27
	JD BDR OUTPUT	GM1425V	-	-	MD	24-27
	JD BDV OUTPUT	GM1426V	-	-	MD	24-27
	JD BDA OUTPUT	GM1428V	-	-	MD	24-27
	JD BDL OUTPUT	GM1429V	-	-	MD	24-27
	JD BDV OUTPUT	GM1430V	-	-	MD	24-27
	JD BDF OUTPUT	GM1432V	-	-	MD	24-27
	JD BDL OUTPUT	GM1433V	-	-	MD	24-27
	RCS TCP BAU	GR5031X	-	-	MD	24-27
	RCS TCP BAF	GR5033X	-	-	MD	24-27
	RCS TCP BAR	GR5034X	-	-	MD	24-27
	RCS TCP BDU	GR5035X	-	-	MD	24-27
	RCS TCP BDA	GR5037X	-	-	MD	24-27
	RCS TCP BDR	GR5038X	-	-	MD	24-27
	RCS TCP BDV	GR5039X	-	-	MD	24-27
	RCS TCP BDA	GR5041X	-	-	MD	24-27
	RCS TCP BDL	GR5042X	-	-	MD	24-27
	RCS TCP BDV	GR5043X	-	-	MD	24-27
	RCS TCP BDF	GR5045X	-	-	MD	24-27
	RCS TCP BDL	GR5046X	-	-	MD	24-27
	YAW ATT ERR	GM1455V	PDAI	COMMON	MD	24-20
	PITCH ATT ERR	GM1456V	PDAI	COMMON	MD	24-20

REV	ITEM	MEAS DESCRIPTION	PCM	ONBOARD	TRANSDUCERS	CATEGORY	MISSION RULE REFERENCE.
	24-46 CONT	ROLL ATT ERR	GM1457V	PDAI	COMMON	MD	24-28
		RGA YAW RATE	GM1461V	PDAI	COMMON	M OR BOAR	24-28
		RGA PITCH RATE	GM1462V	PDAI	COMMON	M PCM/MD	24-28
		RGA ROLL RATE	GM1463V	PDAI	COMMON	M	24-28
		AGS SEL	GM1621X	-	-	MD	24-33
		ROLL PLSO/DIR	GM1628X	-	-	MD	24-33
		PITCH PLSO/DIR	GM1629X	-	-	MD	24-33
		YAW PLSO/DIR	GM1630X	-	-	MD	24-33
		AUTO ON	GM1214X	-	-	MD	24-31
		APS ARM	GM1230X	-	-	M	24-31
		ENG FIRE OVRD	GM1206X	-	-	MD	24-31
		MAN THRUST CMD	GM1311V	METER	SEPARATE	M	24-34,24-35
		PITCH GDA POS	GM1313V	-	-	M	24-30
		ROLL GDA POS	GM1314V	-	-	M	24-30
		P TRM FAIL	GM1329X	C&W	COMMON	MD	24-30
		R TRM FAIL	GM1330X	C&W	COMMON	MD	24-30
		AUTO THRUST CMD	GM1331V	METER	SEPARATE	MD	24-34
		DPS ARM	GM1240X	-	-	MD	24-32,24-31
		VAR INJ ACT POS	006606M	-	-	MD	24-34,24-35
		CES AC PWR FAIL	GL40326X	C&W	COMMON	MD	24-30
		CES DC PWR FAIL	GL40327X	C&W	COMMON	MD	24-30
		AGS DOWNLINK DATA	GT00001X	-	-	MD	24-33
		ASA TEMP	GT33017	-	-	MD	24-33
		ASA PWR/AEA FAIL	GL40328X	C&W	COMMON	MD	24-33
		AUTO OFF	GM1317X	-	-	MD	24-32,24-31
		AGS AUTO	GM1641X	-	-	MD	24-27
		AGS ATT HOLD	GM1642X	-	-	MD	24-27
		PGNS AUTO	GM1643X	-	-	MD	24-27
		PGNS ATT HOLD	GM1644X	-	-	MD	24-27
		LR RNG DATA NO GOOD	GM7521X	C&W	COMMON	MD	
		LR VEL DATA NO GOOD	GM7557X	C&W	COMMON	MD	

25 LM DPS

REV	ITEM	
		' GENERAL '
	25-1	RESERVED
	25-2	DEFINITIONS

A. AN OPERATIONAL DPS IS DEFINED AS FOLLOWS---

1. FUEL AND/OR OXID ENGINE INLET PRESSURE GREATER THAN 30 PSIA AT DOI INITIATION.

2. FUEL AND/OR OXID ENGINE INLET PRESSURES GREATER THAN 120 PSIA (ULLAGE PRESSURES GREATER THAN 123 PSIA.) DURING A BURN WITH THROTTLE LESS THAN 65 PERCENT OR GREATER THAN 150 PSIA (ULLAGE PRESSURES GREATER THAN 160 PSIA.) WITH THROTTLE GREATER THAN 65 PERCENT.

3. TO INITIATE A BURN, THE OXIDIZER AND FUEL BULK TEMPERATURES MUST BE GREATER THAN 50 DEG F AND LESS THAN 90 DEG F.

4. DELTA TEMP BETWEEN FUEL AND OXID LESS THAN 25 DEG F FOR BURNS LESS THAN 400 SEC, AND LESS THAN 10 DEG F FOR BURNS GREATER THAN 400 SEC ONLY TO INITIATE A BURN.

5. (A) DELTA PRESSURE BETWEEN FUEL AND OXID ENGINE INLET PRESSURES LESS THAN 25 PSID PRIOR TO LOW GATE.

(B) DELTA PRESSURE (FUEL HIGH) LESS THAN 50 PSID AT START OF ANY BURN.

6. SUPERCRITICAL HELIUM ADEQUATE TO COMPLETE MISSION.

B. THE LOW THROTTLE POINT IS DEFINED AS THE MINIMUM POSITION THAT THE THROTTLE ACTUATOR WILL ASSUME WITH MINIMUM MANUAL THROTTLE COMMAND VOLTAGE (10.0 FOR LM-6).

RULES 25-3 THROUGH 25-10 ARE RESERVED.

REV	ITEM

DATA ON THIS PAGE DELETED

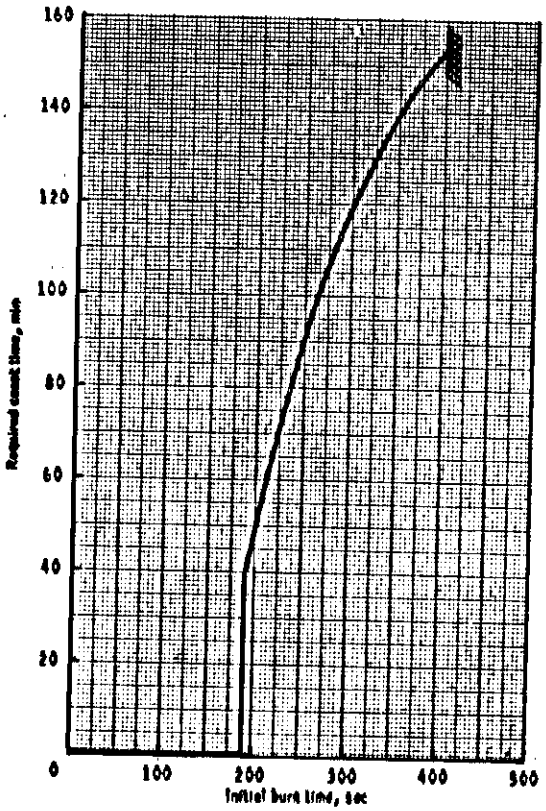
REV	ITEM	
		! SYSTEMS MANAGEMENT !
		RULE 25-11 IS RESERVED.
	25-12	RESERVED
	25-13	THE DPS ENGINE WILL NOT NORMALLY BE OPERATED FOR LESS THAN 3.5 SEC. A 2 SEC COAST BEFORE RESTART AT LTP AND A 30 MINUTE COAST BEFORE RESTARTS GREATER THAN LTP IS REQUIRED.
	25-14	RESERVED
|	25-15	30 SECONDS IN THE NON THROTTABLE REGION (65 PERCENT TO FTPI) IS AN ALLOWABLE EVENT AND ALLOWS COMPLETION OF THE NOMINAL MISSION DUTY CYCLE.
	25-16	FROM A SAFETY STANDPOINT SUPERCRITICAL HELIUM BURST DISC RUPTURE DURING MANNED OPERATION IS AN ALLOWABLE EVENT.
	25-17	RESERVED
	25-18	RESERVED

REV	ITEM	
	25-19	DPS ENGINE RESTARTS CAN BE MADE WITH THE FOLLOWING CONSTRAINTS---

INITIAL BURN	REQUIRED COAST TIME	MAXIMUM RESTART BURN TIME
A. 5.5 SEC TO 40 SEC AT PTP	2 SECONDS(SINGLE RESTART ONLY)	NO CONSTRAINT
B. 40 SEC TO 190 SEC AT PTP	2 SECONDS(SINGLE RESTART ONLY)	400 SECS
C. 190 SECS TO 400 SECS AT PTP	SEE FIGURE BELOW	100 SECS*
D. GREATER THAN 400 SECS AT PTP	NO RESTART	---

THESE CONSTRAINTS ARE BASED ON ENGINE THRUST CHAMBER HEATING AND SOAK BACK LIMITS. TERMINATE THE BURN IF THE MAXIMUM RESTART BURN TIME IS EXCEEDED.

*THERE SHALL BE NO MORE THAN 4 RESTARTS (60 SEC MAX DURATION EACH) AFTER THE INITIAL BURN.



LMDE required coast time vs initial burn time for engine chamber heating limitations.

REV	ITEM	
	25-20	RESERVED
	25-21	PROPELLANT GAGING A. PRIME METHOD--- PUGS (TM, ONBOARD) (1.3 PERCENT) B. BACKUP METHOD--- GROUND MASS CALCULATION (0.8 PERCENT)
	25-22	IF POWERED DESCENT IS ABORTED PRIOR TO POI + 5 OR IF A DOCKED DPS CONTINGENCY IS REQUIRED, THE DES HE REG 1 AND REG 2 SWITCHES SHOULD BE CLOSED AT IGNITION + 8 MINUTES AND 20 SECONDS TO INSURE A LOW ENOUGH TANK PRESSURE TO PREVENT A VIOLATION OF FRACTURE MECHANICS LIMITS FROM HEAT SOAK BACK. RULE NUMBERS 25-23 THROUGH 25-29 ARE RESERVED.

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING SPECIFIC MISSION RULES	CUES/NOTES/COMMENTS
	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 120 PSIA)	DOCKED/ UNDOCKED	A. INHIBIT DPS BURNS	REF MAL PROC DPS--- 1 DES REG 1A FUEL/OXID PRESS ABNORMAL 2 FUEL/OXID TEMP ABNORMAL 3 HE PRESS ABNORMAL
			DESCENT ORBIT	B. STOP DOI IF IN PROGRESS 1. INHIBIT PDI 2. RNDZ WITH APS	
			POWERED DESCENT	C. ABORT STAGE	
	25-31	START TANK LEAK PRIOR TO PRESSURIZATION A. FUEL AND/OR OXID ENGINE INLET P GREATER THAN 30 PSIA.	ALL	A. CONTINUE MISSION INHIBIT FIRING DPS START TANK SQUIB	REF MAL PROC DPS--- 3 HE PRESS ABNORMAL
		B. FUEL AND/OR OXID ENGINE INLET P LESS THAN 30 PSIA.		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 30 PSIA.	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 30 PSIA.	ALL	A. 1. CONTINUE MISSION	REF MAL PROC DPS--- 1 DES REG 3 HE PRESS ABNORMAL
		2. INLET PRESS LESS THAN 30 PSIA.		2. INHIBIT ALL DPS BURNS	
		B. VIA SUPERCRITICAL HELIUM	DESCENT ORBIT	B. CUT OFF DOI ON INLET PRESSURES IF NECESSARY 1. IF DOI ACCOMPLISHED (A) ARM PYRO PRIOR TO PDI. (B) SWITCH DES HE REGS AT PDI IGNITION. 2. IF DOI SHUTDOWN (A) NO GO FOR PDI. (B) RNDZ WITH APS.	

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	25-33	LOSS OF SUPERCRITICAL PRESSURE (DPS IN BLOWDOWN MODE)			REF NAL PROC DPS 3 HE PRESS ABNORMAL
1		A. PRIOR TO PDI + 6 MIN. 30 SECS.	POWERED DESCENT	A. ABORT ABORT STAGE PRIOR TO INLET PRESSURES LESS THAN OR EQUAL TO 150 PSIA. (ULLAGE PRESSURE LESS THAN 160 PSIA.)	
1		B. AFTER PDI + 6 MIN. 30 SECS.		B. CONTINUE MISSION	REF RULE 25-2.

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	25-34	LEAK BETWEEN HE REG SHUTOFF AND QUAD CHECK VALVES DETECTED---			REF MAL PROC DPS 1 DES REG 3 HE PRESS ABNORMAL
		A. PRIOR TO BLOWING AMB TANK SOVIB	ALL	A. PRESSURIZE DPS WITH AMB TANK WHILE IN SITE COVERAGE 1. INHIBIT DPS BURNS FOR LEAK RATE GREATER THAN 20 PSI/SEC. 2. IF LEAK RATE LESS THAN 20 PSI/SEC (A) CLOSE HE REG 1 (B) OPEN DES HE REG 2 IMMEDIATELY AFTER IGNITION. (C) CLOSE DES HE REG 2 JUST PRIOR TO DOI SHUTDOWN. (D) OPEN DES HE REG 2 AT POI ISN	
		B. AFTER AMB PRESSURIZATION BUT PRIOR TO DOI.	ALL	B.1. INHIBIT DPS BURNS FOR LEAK RATE GREATER THAN 20 PSI/SEC. 2. IF LEAK RATE LESS THAN 20 PSI/SEC (A) CLOSE DES HE REG 1 (B) OPEN DES HE REG 2 PRIOR TO EACH BURN	
		C. AFTER DOI	DESCENT ORBIT	C.1. INHIBIT FURTHER DPS BURNS 10 HOURS FOR RISE RATE GREATER THAN 150 PSI/HR AFTER COMPLETION OF DOI. (A) CLOSE DES HE REG 1 (B) OPEN DES HE REG 2 AT IGNITION OF SUBSEQUENT BURNS. (C) CLOSE DES HE REG 2 AT SHUTDOWN OF SUBSEQUENT BURNS. 2. IF SHE RISE RATE IS LESS THAN 150 PSI/HR AFTER COMPLETION OF DOI CONTINUE MISSION (A) CLOSE DES HE REG 1 (B) OPEN DES HE REG 2 AT PDI IGNITION	SHE CAPABILITY MUST BE OBTAINED REAL TIME FROM ACF - SHE PROGRAM TO IDENTIFY REMAINING CAPABILITIES.

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	25-35	LEAK BETWEEN SHE SQUIB AND DES HE REG 1 AND 2 SHUTOFF VALVES.	DOCKED/ UNDOCKED	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	REF MAL PROC DPS 1 DES REG 3 HE PRESS ABNORMAL
			DESCENT ORBIT	B.1. SHE PRESS RISE GREATER THAN 150 PSI/HR AFTER COMPLETION OF DOI (A) INHIBIT FURTHER DPS BURNS AFTER COMPLETION OF DOI 2. SHE PRESS RISE LESS THAN 150 PSI/HR (A) CONTINUE MISSION	
	25-36	95 SEC AFTER LO LEVEL SENSE	DESCENT	CREW EVALUATION LAND OR ABORT	• 5 SEC CAPABILITY AT FTP • 20 SEC CAPABILITY AT 25 PERCENT THROTTLE
	25-37	LOW LEVEL CONFIRMS INSUFFICIENT PROPELLANT TO LAND OR DELTA BETWEEN FUEL AND OXIDIZER PQGS READINGS GREATER THAN 13 PERCENT	POWERED DESCENT	A. ABORT B. ABORT STAGE 20 SECONDS AFTER LOW LEVEL	REF MAL PROC DPS 6 DES QTY
	25-38	PQGS READING 2 PERCENT (EITHER FUEL OR OXID) AND NO VALID TIME ESTIMATE FROM LOW LEVEL	POWERED DESCENT	ABORT ABORT STAGE AT DPS DEPLETION	REF MAL PROC DPS 7 PQGS IND ABNORMAL NOTE— THE GROUND CALC DPS QUANTITY WILL BE USED IF BOTH THE LOW LEVEL AND PQGS FAIL.
	25-39	EXCESSIVE PROPELLANT USAGE (PREDICTED MARGIN AT TOUCHDOWN LESS THAN -0.2 PERCENTS).	POWERED DESCENT	A. PRIOR TO P64 - CONTINUE MISSION B. AFTER P64 BUT PRIOR TO LO GATE. 1. ABORT 2. ABORT STAGE 20 SECONDS AFTER LOW LEVEL.	NOTE—THROTTLEDOWN TIME, THRUST LEVEL, AND SYSTEM PRESSURES ARE SECONDARY CUES WHICH INDICATE OFF NOMINAL DPS PERFORMANCE.

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	25-40	UNABLE TO VENT DPS AFTER LANDING	LUNAR STAY	ASCEND ASAP	
	25-41	30 PERCENT THROAT AREA INCREASE EXCEEDED	ALL	ABORT STAGE	NOTE--- THROTTLE DOWN TIME, THRUST LEVEL, AND SYSTEM PRESSURES ARE SECONDARY CUES WHICH INDICATE OFF NOMINAL DPS PERFORMANCE
		RULES 25-42 THROUGH 25-49 ARE RESERVED.			

REV	ITEM

! DPS - PRELAUNCH INSTRUMENTATION !

	MEAS DESCRIPTION	PCM	ONBOARD	TRANSDUCER	CATEGORY		MISSION RULE REFERENCE
	START TNK PRESS	6030159	HE MON	COMMON	M		25-31;32;35
	HE REG PRESS	6030160	CSW	COMMON	MD	1 OF 2	25-34;30;35
	HE REG PRESS	6030259			MD	M-PCM	25-34;30;35
	HE PRESS	6036359			MD	1 OF 2	25-33;30;32
	HE PRESS	6036360	PRESS		MD	M	25-33;30;32
	FU TNK 1 QTY	6036030	QTY	COMMON	MD	1 OF 2	25-37;38;39
	FU TNK 2 QTY	6036040	QTY	COMMON	MD	M	25-37;38;39
	OX TNK 1 QTY	6041030	QTY	COMMON	MD	1 OF 2	25-37;38;39
	OX TNK 2 QTY	6041040	QTY	COMMON	MD	M	25-37;38;39
	FU 1 TEMP	6037187	TEMP MON	COMMON	MD	1 OF 2	25-37;38;39
	FU 2 TEMP	6037197	TEMP MON	COMMON	MD	M	25-30
	OX 1 TEMP	6042187	TEMP MON	COMMON	MD	1 OF 2	25-30
	OX 2 TEMP	6042197	TEMP MON	COMMON	MD	M	25-30
	FU PRESS	6036111P			M		25-30
	OX PRESS	6041111P			M		25-30;31;32;33;35
	TCP	6066310P	THRUST	COMMON	M-PCM		25-30;31;32;33;35
	LOW LEVEL	6046455X	DPS LOW	COMMON	M		25-30
							25-36

REV	ITEM	
		********** * GENERAL * **********
	26-1	RESERVED
	26-2	DEFINITIONS---

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

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

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

1. ADEQUATE SOURCE PRESSURE FOR DELTA V REQUIRED.
2. DELTA TEMP BETWEEN APS FUEL AND OXID LESS THAN 60 DEG F FOR BURNS LESS THAN 100 SECONDS AND 10 DEG F FOR BURNS GREATER THAN 100 SECONDS.
3. APS FUEL AND/OR OXID TEMP GREATER THAN 50 DEG F AND LESS THAN 120 DEG F FOR BURNS LESS 100 SECONDS AND GREATER THAN 50 DEG F AND LESS THAN 90 DEG F FOR BURNS GREATER THAN 100 SECONDS.
4. APS FUEL AND/OR OXID INLET PRESSURES GREATER THAN 115 PSIA. (ULLAGE PRESSURE GREATER THAN 125 PSIA)
5. DELTA PRESSURE BETWEEN FUEL AND OXID INLET PRESSURES LESS THAN OR EQUAL TO 15 PSID.

RULES 26-3 THROUGH 26-9 ARE RESERVED

REV	ITEM	
		* SYSTEMS MANAGEMENT *
	26-10	RESERVED
	26-11	RESERVED
		RULE 26-12 IS RESERVED.
	26-13	THE MINIMUM IMPULSE OF THE APS ENGINE IS 1257 PLUS OR MINUS 104 LBS - SEC, WHICH CORRESPONDS TO AN ELECTRICAL ON/OFF TIME OF 0.5 SEC.
	26-14	ONLY PREMISSION APPROVED APS MULTIBURN PROFILES WILL BE EXECUTED, SINCE NO DATA EXISTS TO ALLOW REALTIME SUPPORT FOR EXAMINING APS FREEZING, CHARRING, BACKWALL TEMPERATURE CONSTRAINTS FOR MULTIBURN PROFILES.
	26-15	PROPELLANT GAGING (NO ONBOARD READOUT)--- A. PRIME METHOD--- APS QTY FROM LGC MASS CALCULATION (ONE PERCENT) B. BACKUP METHOD--- FLOW RATE X TIME (5 PERCENT)
		RULES 26-16 THROUGH 26-19 ARE RESERVED.

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
				SPECIFIC	
	26-20	LOSS OF AN OPERATIONAL APS	DOCKED/ UNDOCKED	A. RETURN TO CSM NO-GO FOR DOI	REF MAL PROC APS 1 ASC PRESS 2 FUEL OR OXID TEMP ABNORMAL 2A FUEL OR OXID PRESS ABNORMAL 3 HE PRESS ABNORMAL OR DECR.
			DESCENT ORBIT	B. RETURN TO CSM ASAP NO-GO FOR PDI	
			POWERED DESCENT	C. ABORT USE DPS AS LONG AS POSSIBLE	
			LUNAR STAY	D. ASCEND NEXT BEST OPPORTUNITY	
	26-21	APS HE SOURCE PRESSURE			REF MAL PROC APS 1 ASC PRESS 3 HE PRESS ABNORMAL OR DECR.
		A. LEAK PRIOR TO PRESSURIZATION	DOCKED/ UNDOCKED	A. 1. RETURN TO CSM NO-GO FOR DOI	NOTE ONE HELIUM BOTTLE CAN SUPPLY SUFFICIENT APS DELTA V CAPABILTY FOR NONLANDING ALTERNATE MISSIONS.
			DESCENT ORBIT	2. RETURN TO CSM NO-GO FOR PDI	
			POWERED DESCENT	3. ABORT (A) USE DPS AS LONG AS POSSIBLE (B) SELECT ALTERNATE APS HELIUM TANK (C) AFTER APS GOES IN BLOWDOWN, CONFIRMED BY ULLAGE PRESS LESS THAN OR EQUAL TO 160 PSIA, SELECT LEAKING TANK IF PRESS GREATER THAN OR EQUAL TO GOOD TANK PRESS	
			LUNAR STAY	4. ASCEND NEXT BEST OPPORTUNITY (A) SELECT ALTERNATE APS HELIUM TANK (B) DO NOT ASC FEED (C) AFTER APS GOES IN BLOWDOWN, CONFIRMED BY ULLAGE PRESS LESS THAN OR EQUAL TO 160 PSIA, SELECT LEAKING TANK IF PRESS GREATER THAN OR EQUAL TO GOOD TANK PRESS	
		B. LEAK AFTER PRESSURIZATION	LUNAR STAY	B. 1. (A) ASCEND IMMEDIATELY (B) DO NOT ASC FEED	
			RNDZ	2. CONTINUE MISSION	

REV	ITEM	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	A. RETURN TO CSM NO-GO FOR DOI	REF MAL PROC APS 3 HE PRESS ABNORMAL OR DECR.
			DESCENT ORBIT	B. RETURN TO CSM NO-GO FOR PDI	NOTE SHORT APS BURNS MIGHT BE POSSIBLE.
			POWERED DESCENT	C. ABORT (1) USE DPS AS LONG AS POSSIBLE (2) PRESSURIZE WITH HE BOTTLE IMMEDIATELY PRIOR TO IGNITION (3) USE SECOND HE BOTTLE WHEN APS ULLAGE PRESS GREATER THAN OR EQUAL TO TO 125 PSIA OR AFTER 280 SEC INTO THE ASCENT BURN	
			LUNAR STAY	D. CONTINUE MISSION 1. PRESSURIZE WITH ONE BOTTLE IMMEDIATELY PRIOR TO IGNITION 2. DO NOT ASC FEED 3. USE SECOND BOTTLE WHEN APS ULLAGE PRESS GREATER THAN OR EQUAL TO 125 PSIA OR AFTER 280 SEC INTO THE ASCENT BURN	
			RNDZ	E. CONTINUE MISSION CLOSE HE SOV'S	
	26-23	APS PROPELLANT VAPOR LEAK DOWNSTREAM OF QUAD CHECK VALVES			REF MAL PROC APS 1 ASC PRESS 2A FUEL OR OXID PRESS ABNORMAL 3 HE PRESS ABNORMAL OR DECR.
			UNDOCKED	A. DOCK ASAP	
			DESCENT ORBIT	B. DOCK ASAP	
			POWERED DESCENT	C. ABORT 1. USE DPS AS LONG AS POSSIBLE	
			LUNAR STAY	D. 1. LIFTOFF IMMEDIATELY DO NOT ASC FEED	
			RNDZ	F. CONTINUE MISSION	

NASA - Manned Spacecraft Center

MISSION RULES

SECTION 26 - LM PROPULSION - APS

REV	ITEM	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 & ASC UTY
		RULES 26-26 THROUGH 26-29 ARE RESERVED.			

MISSION	REV	DATE	SECTION	GROUP	PAGE
APOLLO 12	PML	8/18/69	LM PROPULSION - APS	SPECIFIC	26-5

REV	ITEM
	26-30

* APS - PRELAUNCH INSTRUMENTATION *

MEAS DESCRIPTION	PCM	ONBOARD TRANSDUCER		CATEGORY	MISSION RULE REFERENCE
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			MD 1 OF 2	26-20,22
APS HE REG PRESS	GP0025P	C&W	COMMON	MD M - PCM	26-20,22
APS HE 1 TEMP	GP0201T	HEL MON	COMMON	MD - PCM	26-21
APS HE 2 TEMP	GP0202T	HEL MON	COMMON	MD - PCM	26-21
APS FUEL TEMP	GP0718T	TEMP	COMMON	M - PCM	26-20
APS FUEL LOW	GP0908X	C&W	COMMON	MD	26-25
APS OXID TEMP	GP1218T	TEMP	COMMON	M - PCM	26-20
APS OXID LOW	GP1408X	C&W	COMMON	MD	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			MD	26-24
VLVS B DELTA POS	GP2998U			MD	26-25
APS TCP	GP2010P			MD	

27 LM REACTION CONTROL SYSTEM

REV	ITEM	
		' GENERAL '
	27-1	RESERVED
	27-2	DEFINITIONS
		A. RCS SYSTEM
		AN RCS SYSTEM CONTAINS EIGHT OPERATIONAL THRUSTERS SUPPLIED BY ITS OWN PRESSURIZATION AND PROPELLANT FEED SYSTEM INDEPENDENT OF ASCENT FEED AND CROSSFEED.*
		*INDIVIDUAL THRUSTERS REQUIRED FOR DIFFERENT MISSION PHASES WILL BE COVERED SEPARATELY.
		B. OPERATIONAL RCS SYSTEM
		1. FUEL AND/OR OXID MANIFOLD PRESSURES GREATER THAN OR EQUAL TO 100 PSI.
		2. FUEL TEMP GREATER THAN OR EQUAL TO 40 DEG F AND LESS THAN OR EQUAL TO 100 DEG F.
		3. QUAD TEMP GREATER THAN 110 DEG F.
		RULE NUMBERS 27-3 THROUGH 27-9 ARE RESERVED.

REV	ITEM	

SYSTEMS MANAGEMENT

27-10 THRUSTER TEMP

27-11 USABLE RCS PROPELLANT IS 548.9 LBS OR 86.7 PERCENT OF TOTAL LOADED

TOTAL LOADED	633.0 LBS	100.0 PERCENT
TRAPPED AND LOADING ERROR	-46.2 LBS	- 7.3 PERCENT
TM ERROR*	-37.9 LBS	- 6.0 PERCENT
USABLE	548.9 LBS	86.7 PERCENT

*BASED ON A GROUND COMPUTATIONAL ACCURACY OF 6 PERCENT.

27-12 PROPELLANT GAGING

A. PRIME METHOD ---

GROUND RCS PROGRAM (6.0 PERCENT)

B. BACKUP METHOD---

POND (ONBOARD READOUT 13.0 PERCENT; GROUND READOUT 10.0 PERCENT)

27-13 CROSSFEED

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

RULE NUMBERS 27-14 THROUGH 27-19 ARE RESERVED.

REV	ITEM	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	REF MAL PROC RCS 1 RCS 1A HE PRESS LOW OR DECR. 1B PQMD ABNORMAL 2 RCS PRESS OR TEMP ABNORMAL 3 RCS A(B) REG
				B. CROSSFEED FROM GOOD SYSTEM	
			DOCKED	DO NOT UNDOCK	
			UNDOCKED	DOCK ASAP	
				NO-GO FOR DOI	
			DESCENT	RETURN TO CSM ASAP	
			ORBIT	NO-GO FOR DOI	
			POWERED DESCENT	A. PRIOR TO PDI + 5 - ABORT	
				B. AFTER PDI + 5 - CONTINUE THROUGH LANDING NO GO FOR LUNAR STAY	
			LUNAR STAY	ASCENT NEXT BEST OPPORTUNITY	
			ANOZ	CONTINUE MISSION	

NASA - Manned Spacecraft Center

MISSION RULES

SECTION 27 - LM REACTION CONTROL SYSTEM

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	27-21	RCS THRUSTER PAIR			REF MAL PROC RCS
		A. ONE PAIR ISOLATED	DOCKED	A. 1. DO NOT UNDOCK	& RCS TCA
			UNDOCKED	2. DOCK ASAP NO-GO FOR DOI	
			DESCENT	3. RETURN TO CSM ASAP NO-GO FOR PDI	
			ORBIT		
			POWERED DESCENT	4. (A) PRIOR TO PDI + 5 - ABORT (B) AFTER PDI + 5 - CONTINUE MISSION NO GO FOR LUNAR STAY	
			LUNAR STAY	5. ASCENT NEXT BEST OPPORTUNITY	
			RNDZ	6. CONTINUE MISSION	
		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 NO-GO FOR PDI: CSM ACTIVE DOCKING	
			ORBIT		
			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 RESCUE AND ACTIVE DOCKING	

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	27-22	DECREASING OR LOSS OF RCS HE PRESSURE	ALL	A. 1. CONTINUE USING BOTH SYSTEMS UNTIL MFLD PRESS IN BAD SYSTEM IS LESS THAN 100 PSI, THEN CLOSE MAINS OF BAD SYSTEM 2. CROSSFEED FROM GOOD SYSTEM	REF MAL PROC RCS 1 RCS 1A HE PRESS LOW OR DECR. 1B PQMD ABNORMAL WHEN MFLD PRESS DROPS BELOW 100 PSI, THE SYSTEM IS CONSIDERED NON-OPERATIONAL REF RULE 27-2
			DOCKED	B. DO NOT UNDOCK UNLESS SUFFICIENT PROPELLANT TO REDOCK EXISTS IN BLOWDOWN	
			UNDOCKED	C. RETURN TO CSM AND DOCK ASAP NO-GO FOR DOI	
			DESCENT ORBIT	D. RETURN TO CSM AND DOCK ASAP NO-GO FOR PDI	
			POWERED DESCENT/ RNDZ	E.1. PDI TO PDI + 5 CONTINUE MISSION IF SUFFICIENT BLOWDOWN CAPABILITY EXISTS IN FAILED SYSTEM FOR 6 HRS OF LINE OF SIGHT AND 5 MIN OF ATT HOLD 2. PDI + 5 TO TOUCHDOWN CONTINUE MISSION	E. REQUIRES 50 LBS (19.8 PERCENT OF TOTAL LOADED IN ONE SYSTEM.)
			LUNAR STAY	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 NEXT BEST OPPORTUNITY	
	27-23	RCS PROPELLANT LEAK	DOCKED	A. NO GO FOR DOI UNDOCK AND STATIONKEEP	REF MAL PROC RCS 1 RCS 1A HE PRESS LOW OR DECR. 1B PUMP ABNORMAL
			UNDOCKED	B. DOCK ASAP NO-GO FOR DOI	
			DESCENT ORBIT	C. DOCK ASAP 1. NO-GO FOR PDI	
			POWERED DESCENT	D.1. PDI TO PDI + 5 = ABORT 2. PDI + 5 TO TD = CONTINUE MISSION	
			LUNAR STAY	E. ASCEND NEXT BEST OPPORTUNITY	
			RNDZ	F. CONTINUE MISSION	

NASA - Manned Spacecraft Center

MISSION RULES

SECTION 27 - LM REACTION CONTROL SYSTEM

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	27-24	RCS QUAD TEMP LESS THAN 119 DEG	ALL	ISOLATE BOTH THRUSTER PAIRS IN AFFECTED QUAD (REF RULE 27-21)	REF MAL PROC HTR. IA RCS QUAD 1, 2, 3, 4 TEMP ABNORMAL QUAD TEMP LESS THAN 119 DEG INDICATES THE POSSIBILITY OF INCOMPLETE COMBUSTION, WHICH COULD CAUSE HARD STARTS AND POSSIBLE EXPLOSIONS.
	27-25	IMPINGEMENT CONSTRAINTS VIOLATED	DOCKED/ UNDOCKED	A. DOCK ASAP CSM ACTIVE DOCKING	REF MAL PROC RCS IB POND ABNORMAL
			DESCENT ORBIT	B. CSM RESCUE CSM ACTIVE DOCKING	
			POWERED DESCENT	C. PDI TO TOUCHDOWN 1. ABORT 2. ABORT STAGE AS SOON AS POSSIBLE	
			LUNAR STAY/ RNDZ	D. CONTINUE MISSION	
		RULES 27-26 THROUGH 27-29 ARE RESERVED.			

REV	ITEM
	27-30

* PRELAUNCH INSTRUMENTATION *

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	GR1095U	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	MD	
RCS MAIN "B" CLSD	GR9610U	MAIN SOV	COMMON	MD	
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	MD	
QUAD 1 "A" TCA ISOL VLV	GR9667U	SYS A QUAD 1	COMMON	MD	27-21
QUAD 2 "A" TCA ISOL VLV	GR9665U	SYS A QUAD 2	COMMON	MD	27-21
QUAD 3 "A" TCA ISOL VLV	GR9663U	SYS A QUAD 3	COMMON	MD	27-21
QUAD 4 "A" TCA ISOL VLV	GR9661U	SYS A QUAD 4	COMMON	MD	27-21
QUAD 1 "B" TCA ISOL VLV	GR9668U	SYS B QUAD 1	COMMON	MD	27-21
QUAD 2 "B" TCA ISOL VLV	GR9666U	SYS B QUAD 2	COMMON	MD	27-21
QUAD 3 "B" TCA ISOL VLV	GR9664U	SYS B QUAD 3	COMMON	MD	27-21
QUAD 4 "B" TCA ISOL VLV	GR9662U	SYS B QUAD 4	COMMON	MD	27-21
QUAD 1 TEMP	GR6004T	TEMP MON C&W	COMMON	MD	27-24
QUAD 2 TEMP	GR6003T	TEMP MON C&W	COMMON	MD	27-24
QUAD 3 TEMP	GR6002T	TEMP MON C&W	COMMON	MD	27-24
QUAD 4 TEMP	GR6001T	TEMP MON C&W	COMMON	MD	27-24
ASC FEED OXID "A" OPEN	GR9641U	SYS A ASC OXID ASC FUEL	COMMON	MD	
ASC FEED FUEL "A" OPEN	GR9631U	SYS A ASC OXID ASC FUEL	COMMON	MD	
ASC FEED FUEL "B" OPEN	GR9632U	SYS B ASC OXID ASC FUEL	COMMON	MD	
ASC FEED OXID "B" OPEN	GR9642U	SYS B ASC OXID ASC FUEL	COMMON	MD	

28 SPACE
ENVIRONMENT

REV	ITEM	
		* GENERAL *
	28-1	ALL DECISIONS WILL BE BASED ON CONFIRMED MEASUREMENTS AND/OR EVENTS AND PROJECTIONS BASED ON CONFIRMED EVENTS.
	28-2	DEFINITIONS---
		A. THE MAXIMUM OPERATIONAL DOSE (MOD) IS THE MAXIMUM RADIATION DOSE TO WHICH THE CREW WOULD BE SUBJECTED BASED ON A SKIN DOSE OF 400 RAD AND/OR A DEPTH (GASTROINTESTINAL) DOSE OF 50 RAD.
		B. THE PLANNING OPERATIONAL DOSE (POD) IS THE MAXIMUM RADIATION DOSE TO THE CREW WHICH ANY MISSION WOULD BE DESIGNED DURING THE PLANNING PERIOD BASED ON A SKIN DOSE OF 250 RAD AND/OR A DEPTH DOSE OF 25 RADS.
		C. THESE DOSES REPRESENT THE CUTOFF POINT WHERE A DECISION MUST BE MADE WHETHER TO CONTINUE OR TERMINATE THE MISSION.
		D. THE RADIATION ABSORBED DOSE (RAD) IS A UNIT OF ABSORBED DOSE WHICH IS EQUAL TO AN ENERGY DEPOSITION OF 100 ERGS/GRAM.
		E. THE RELATIVE BIOLOGICAL EFFECTIVENESS (RBE) EXPRESSES THE EFFECTIVENESS OF PARTICULAR TYPES OF RADIATION IN PRODUCING THE SAME BIOLOGICAL RESPONSE.
		THE AVERAGE RBE THAT WILL BE USED FOR SOLAR PARTICLE EVENT RADIATION FROM PROTONS IS 1.2.
		F. THE ROENTGEN EQUIVALENT MAN (REM) IS THE PRODUCT OF THE RAD AND THE RBE (REM = RAD X RBE).
		G. A CONFIRMED EVENT IS DEFINED AS AN EVENT THAT HAS BEEN MEASURED BY TWO OR MORE INDEPENDENT SOURCES.
		H. A SIGNIFICANT INCREASE OF THE MOD WILL BE DEFINED BY THE FLIGHT SURGEON IN REAL TIME BASED ON THE CHARACTER AND ACCURACY OF THE DATA AT THE TIME.

REV	ITEM	
		========== * MANAGEMENT * ==========
	28-3	THE EXISTING AND PROJECTED RADIATION ENVIRONMENT WILL BE A PART OF THE GO/NO-GO DECISION PROCESS.
	28-4	PRIORITY OF DATA--- A. NATURAL (SOLAR PARTICLE EVENT) 1. PRELAUNCH AND EPO (A) SOLAR PARTICLE ALERT NETWORK (SPAN) (B) VELA NATURAL RADIATION SATELLITE (C) PIONEER RADIATION SATELLITE (D) EXPLORER RADIATION SATELLITE (E) SOLAR PARTICLE MONITORING SYSTEM (SPMS) 2. ALL OTHER PHASES (A) S/C INSTRUMENTATION (1) VAN ALLEN BELT DOSIMETER (VABD) (2) PERSONAL RADIATION DOSIMETER (PRD) (3) NUCLEAR PARTICLE DETECTION SYSTEM (NPDS) (B) SOLAR PARTICLE ALERT NETWORK (SPAN) (C) VELA NATURAL RADIATION SATELLITE (D) PIONEER RADIATION SATELLITE (E) EXPLORER RADIATION SATELLITE (F) SOLAR PARTICLE MONITORING SYSTEM (SPMS) B. ARTIFICIAL 1. ALL PHASES EXCEPT EPO (A) JAEIC (B) RIOMETERS 2. EPO (A) JAEIC (B) RIOMETERS (C) PRD 3. EARTH ORBITAL MISSION (A) PRD (B) JAEIC (C) RIOMETERS (D) SAAP
		RULE NUMBERS 28-5 THROUGH 28-9 ARE RESERVED.

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
				SPECIFIC MISSION RULES	
	28-10	ANY SOURCE REPORTS A POSSIBLE ARTIFICIAL EVENT	ALL	PROCEED UNTIL VERIFICATION FROM ALL OTHER SOURCES.	
	28-11	DEFINITE ARTIFICIAL EVENT CONFIRMED BY REPORTING SOURCES	PRE-LAUNCH	A. HOLD UNTIL INFORMATION FROM REPORTING SOURCES INDICATES THE MOD WILL NOT BE EXCEEDED.	
			EPO	B. 1. CONTINUE MISSION, UNLESS DATA ANALYSIS INDICATES THAT THE DOSE PROJECTED THROUGH TLI WILL EXCEED THE MOD BY A SIGNIFICANT AMOUNT. IF THE MOD WILL BE EXCEEDED BY A SIGNIFICANT AMOUNT, PERFORM A LOW EARTH ORBIT ALTERNATE MISSION. 2. FOR DOSES APPROACHING THE MOD CONTINUE MISSION WITH CONTINUOUS PRD MONITORING AND CREW ASSESSMENT. CONSIDERATIONS WILL BE GIVEN TO CHANGING THE TRAJECTORY TO A LOW EARTH ORBIT OR REENTERING ASAP BASED ON ACTUAL CONDITIONS.	B. 1. CREW SHOULD BEGIN PERSONAL DOSIMETER READOUTS PER SOP 2-8
			ALL OTHER	C. CONTINUE MISSION.	
	28-12	RADIATION CONFIRMED BY PRD READOUTS OR ONBOARD TM AND PROJECTED TO EXCEED THE MOD	ALL	REENTER NEXT BEST PTP	ALSO APPLIES TO ALTERNATE EARTH ORBIT MISSION.
	28-13	MAJOR SOLAR FLARE PREDICTED	ALL	CONTINUE MISSION.	

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	28-24	MAJOR SOLAR FLARE HAS OCCURRED			
		A. UNCONFIRMED PARTICLE EVENT	ALL	A. CONTINUE MISSION.	
		B. CONFIRMED PARTICLE EVENT AND SOLAR PARTICLE ALERT NETWORK/KTACF ANALYSIS INDICATES THE MOD WILL BE EXCEEDED DURING THE MISSION	PRE-LAUNCH	B.1. HOLD UNTIL DATA ANALYSIS INDICATES THAT THE MOD WILL NOT BE EXCEEDED.	
			EPO	B.2. CONTINUE MISSION. IF DATA ANALYSIS INDICATES THAT THE MOD WILL BE EXCEEDED BY A SIGNIFICANT AMOUNT PRIOR TO MISSION COMPLETION. TLI IS NO-GO.	
			ALL OTHERS	3. CONTINUE MISSION. CONSIDERATION WILL BE GIVEN TO EARLY (OR EXTENDED) TEI AND INHIBITING CREW TRANSFER TO LM.	
		C. CONFIRMED PARTICLE EVENT AND S/C TLM OR PRD READOUT PROJECTIONS - INDICATE THE MOD WILL BE EXCEEDED DURING THE MISSION	TLC	C.1. CONTINUE MISSION. CONSIDERATION SHOULD BE GIVEN TO ENTER IN NEXT BEST PTP IF THE TOTAL DOSE CAN BE REDUCED SIGNIFICANTLY WITHOUT INCREASING THE TOTAL RISK TO THE CREW.	C.1. CREW SHOULD BEGIN PERSONAL DOSIMETER AND RADIATION SURVEY METER READOUTS PER SOP 2-8
			LO	2. CONTINUE MISSION. CONSIDER EXTENDING LUNAR ORBIT STAY TIME IF THE TOTAL DOSE TO THE CREW WOULD BE REDUCED SIGNIFICANTLY BY LUNAR SHIELDING.	2.(A) MATCH-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	

REV	ITEM

* INSTRUMENTATION REQUIREMENTS *

MEAS DESCRIPTION	PCM	ONBOARD	TRANSDUCERS	CATEGORY	MISSION RULE REF
28-15 RADIATION DOSIMETER 1 (CM DEPTH DOSE RATE)	CK1051K	-	-	MD	28-12
VABD					
RADIATION DOSIMETER 2 (CM SKIN DOSE RATE)	CK1052K	-	-	MD	28-12
DOSIMETER RATE CHANGE	CK1053R	-	-	MD	28-12
NPDS					
PROTON COUNT RATE CHAN 1	ST0820K	-	-	MD	28-14
PROTON COUNT RATE CHAN 2	ST0821K	-	-	MD	28-14
PROTON COUNT RATE CHAN 3	ST0822K	-	-	MD	28-14
PROTON COUNT RATE CHAN 4	ST0823K	-	-	MD	28-14
ALPHA COUNT RATE CHAN 1	ST0830K	-	-	MD	28-14
ALPHA COUNT RATE CHAN 2	ST0831K	-	-	MD	28-14
ALPHA COUNT RATE CHAN 3	ST0832K	-	-	MD	28-14
PROTON INTEGER COUNT RATE	ST0838K	-	-	MD	28-14
TEMP NUCLEAR PART. DET	ST0840T	-	-	MD	28-14
TEMP NUCLEAR PART. ANAL	ST0841T	-	-	MD	28-14
PERSONAL RADIATION DOSIMETER (PRD)	-	3 - ONBOARD	-	MANDATORY TO BE ONBOARD	28-14
RATE SURVEY METER (RSM)	-	1 - ONBOARD	-	MANDATORY TO BE ONBOARD	28-14

20 RECOVERY

NASA - Manned Spacecraft Center

MISSION RULES

SECTION 29 - RECOVERY

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
				SPECIFIC	
	29-1	ACCEPTABLE WEATHER CONDITIONS AND RECOVERY CAPABILITY* IN THE LAUNCH SITE AREA.	PRELAUNCH	MANDATORY	
	29-2	ACCEPTABLE WEATHER CONDITIONS AND RECOVERY CAPABILITY* IN THE LAUNCH ABORT AREA TO 1000 NM DOWNRANGE AND IN THE MIDPACIFIC RECOVERY ZONE	PRELAUNCH	HIGHLY DESIRABLE	
	29-3	MINIMUM OF 71 AMP HOURS OF CM POSTLANDING POWER AVAILABLE AT LANDING.		HIGHLY DESIRABLE	TO PROVIDE 40 HOURS OF CM POSTLANDING POWER PLUS ONE UPRIGHTING.
	29-4	MINIMUM OF 35 AMP HOURS OF CM POSTLANDING POWER AVAILABLE AT LANDING.		MANDATORY	TO PROVIDE 18 HOURS OF CM POSTLANDING POWER PLUS ONE UPRIGHTING.
	29-5	UNTIL ENTRY - 24 HOURS, RETAIN DELTA V CAPABILITY TO MOVE ENTRY POINT +/-500 NM		HIGHLY DESIRABLE	TO PROVIDE WEATHER AVOIDANCE CAPABILITY.

*RECOVERY CAPABILITY WILL BE BASED PRIMARILY UPON THE LOCAL RECOVERY UNIT COMMANDER'S EVALUATION OF HIS CAPABILITY TO PERFORM THE RECOVERY OPERATION. WEATHER CONDITIONS AT THE TIME OF CM LANDING AFFECT BOTH RECOVERY CAPABILITY AND STRUCTURAL INTEGRITY OF THE CM. THE FOLLOWING GUIDELINES ARE USED TO INDICATE WHEN IT MAY BE NECESSARY TO RE-EVALUATE---

	WORLD WIDE	LAUNCH SITE
SURFACE WINDS	25 KNOTS	25 KNOTS
CEILING	1500 FT	500 FT.
VISIBILITY	3 NM	1/2 NM
WAVE HEIGHT	8 FT	8 FT

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	29-6	AN ELLIPSE 103 NM UPRANGE, 152 NM DOWNRANGE AND 59 NM TO EITHER SIDE OF 55 DEG/55DEG TARGET POINT-- AND AN ELLIPSE 109 NM UPRANGE AND DOWNRANGE AND 40 NM TO EITHER SIDE OF THE ROLL RIGHT 90 DEG (DELAYED) TARGET POINT WILL BE CLEAR OF ALL LAND.	EARTH ORBITAL	MANDATORY	
	29-7	REMAINDER OF MANEUVER FOOTPRINT AND AN ELLIPSE 109 NM UPRANGE AND DOWNRANGE AND 40 NM TO EITHER SIDE OF 90 DEG/90DEG TARGET POINT-- AND ELIPSE 105 NM UPRANGE AND DOWNRANGE AND 40 NM TO EITHER SIDE OF ROLL RIGHT 90 DEG TARGET POINT WILL BE CLEAR OF LARGE LAND MASSES.	EARTH ORBITAL	HIGHLY DESIRABLE	
	29-8	A 5 NM RADIUS CIRCLE CENTERED ON THE GNCS TARGET POINT AND AN ELLIPSE 58 NM UPRANGE, 58 NM DOWNRANGE AND 40 NM EITHER SIDE OF THE EMS TARGET POINT WILL BE CLEAR OF ALL LAND.	POST-TLI	MANDATORY	
	29-9	REMAINER OF OPERATIONAL FOOTPRINT AND AN ELLIPSE 112 NM UPRANGE, 112 NM DOWNRANGE, AND 47 NM TO EITHER SIDE OF THE CONSTANT "B" TARGET POINT WILL BE CLEAR OF LARGE LAND MASSES	POST-TLI	HIGHLY DESIRABLE	

AEROMEDICAL

REV	ITEM	
		********** * GENERAL * **********
	30-1	PRELAUNCH PRIOR TO COMMITING TO LAUNCH, THE FOLLOWING CONDITIONS MUST BE MET--- A. SATISFACTORY FLIGHT CREW PHYSIOLOGICAL STATUS. B. THE MINIMUM CABIN OXYGEN CONCENTRATION FOR LAUNCH IS 60 PERCENT. C. THE MINIMUM SUIT OXYGEN CONCENTRATION FOR LAUNCH IS 95 PERCENT.
	30-2	THE SUIT CIRCUIT MUST BE MAINTAINED AT LEAST 2 IN. WATER PRESSURE ABOVE THE CABIN PRESSURE. SUIT LOOP PURGE IS REQUIRED IF THE SUIT-TO-CABIN DELTA PRESSURE REMAINS AT ZERO FOR A PERIOD OF 5 MINUTES.
	30-3	THE POTABLE WATER PH MUST BE WITHIN 6.0 TO 8.0 AT SERVICING AND FINAL SAMPLING.
	30-4	THE MAXIMUM ALLOWABLE CONCENTRATION OF PCO2 IS 5MM OF HG.
	30-5	LAUNCH THERE ARE NO MEDICAL REASONS FOR ABORTING DURING THE LAUNCH PHASE OTHER THAN THOSE CONDITIONS INTOLERABLE TO THE CREW.
	30-6	EARTH ORBIT AND DEEP SPACE OPERATIONS. EARLY MISSION TERMINATION FOR MEDICAL FALL INTO TWO CATEGORIES--- A. ONSET OF CONDITIONS WHICH ADVERSELY AFFECT CREW SAFETY HEALTH, OR FUNCTION AND PERFORMANCE. B. FAILURE OF SPACECRAFT SYSTEMS TO MAINTAIN A PHYSIOLOGICALLY SATISFACTORY ENVIRONMENT.
	30-7	WATER PALATABILITY CREW EVALUATION OF THE DRINKING WATER TASTE WILL BE THE BASIS FOR DETERMINING WATER PALATABILITY, EVEN FOR KOH CONTAMINATION.
		RULE NUMBERS 30-8 THROUGH 30-14 ARE RESERVED

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

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	30-19	DYSBARISM IN ANY CREWMAN	LAUNCH	A. CONTINUE MISSION CREW MAY ELECT TO ABORT IF CONDITION IS INTOLERABLE	A.1. CHECK SUIT INTEGRITY. 2. IF CONDITIONS PERMIT CREW MAY ELECT TO OVER- PRESSURIZE. (A) ALL THREE SUITS CONNECTED TO SUIT CIRCUIT. (B) SUIT DEMAND REG TO PRESS POSITION (C) MONITOR SUIT PRESS (SHOULD REACH 4 PSID IN 75 SEC). (D) SELECT SUIT DEMAND REG INLET SEL VALVE TO OFF WHEN SUIT PRESS REACHES 4.0 PSID. (E) MAINTAIN SUIT OVERPRESSURE BY OPENING INLET SELECTOR VALVE AS NECESSARY. NOTE--- RELIEF FUNCTION OF DEMAND REGULATOR IS ISOLATED WHEN USING THIS PROCEDURE.
			ALL	B. TERMINATE PHASE ENTER NEXT BEST PTP	B. MCC SURGEON WILL EVALUATE AND MAY RECOMMEND EARLY MISSION TERMINATION IF CORRECTIVE ACTION IS NOT EFFECTIVE.
	30-20	ORAL TEMP EXCEEDS 101 DEG F. DESPITE CORECTIVE 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 NEAT BEST PTP	
		B. IF RESULTANT FROM THERMAL OVERLOAD	LAUNCH	B.1. NOT APPLICABLE	
			ALL	2. TERMINATE PHASE ENTER NEAT BEST PTP	
	30-21	PLSS METABOLIC OVERLOAD.	EVA	A. IF AMBER LINE IS EXCEEDED--- DECREASE ACTIVITY.	A. AMBER LINE LIMIT IS WORK SUSTAINED AT A RATE GREATER THAN 2500 BTU/HR FOR A PERIOD LONGER THAN 5 MINUTES. AS DETERMINED BY PREFLIGHT ERGOMETRY CALIBRATIONS. THE MCC SURGEON WILL EVALUATE AND MAY RECOMMEND DECREASED CREW ACTIVITY.
				B. IF RED LINE IS EXCEEDED--- STOP ACTIVITY AND REST.	B. RED LINE LIMIT IS WORK SUSTAINED AT A RATE GREATER THAN 3000 BTU/HR FOR A PERIOD LONGER THAN 2 MINUTES. AS DETERMINED BY PREFLIGHT ERGOMETRY CALIBRATIONS. MCC SURGEON WILL EVALUATE AND MAY RECOMMEND THAT THE CREW STOP ACTIVITY AND REST.
		RULE NUMBERS 30-22 THROUGH 30-24 ARE RESERVED.			

NASA - Manned Spacecraft Center

MISSION RULES

SECTION 30 - AEROMEDICAL

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	30-25	INCREASE IN PCO2 A. IS GREATER THAN OR EQUAL TO 7.6 MM HG	LAUNCH	A.1. CONTINUE MISSION	A. PCO2 SHOULD DECREASE BELOW 2 MM HG WITHIN 30 MINUTES.
			ALL	2. CONTINUE MISSION CHANGE LIOH CANISTER	
		B. GREATER THAN OR EQUAL TO 7.6 MM HG AND UNABLE TO DECREASE	LAUNCH	B.1. CONTINUE MISSION	
			ALL	2. CONTINUE MISSION (A) OPEN SUITS AND BREATHE FROM CABIN (B) CHANGE SECOND LIOH CANISTER (C) TEST PCO2 SENSOR	B.2. LIOH CANISTERS WILL NOT BE CHANGED IN AN UNPRESSURIZED CABIN. B.2.(C) PCO2 SENSOR TEST--- • ISOLATE SUIT CIRCUIT BY DISCONNECTING SUIT HOSES FROM THE SPACECRAFT • SUIT CIR RET AIR VALVE CLOSED • CRACK O2 METERING VALVE TO OPEN • PURGE FOR 30 SECONDS • CLOSED O2 METERING VALVE • IF ABOVE PROCEDURE RESULTS IN A 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 NEAT BEST PTP	
	30-26	PCO2 INSTRUMENTATION FAILURE	ALL	CONTINUE MISSION USE ONBOARD CO2 TAPES	
		RULE NUMBER 30-27 THROUGH 30-34 ARE RESERVED.			

REV	ITEM
	30-35

* INSTRUMENTATION REQUIREMENTS *

CSM

MEAS DESCRIPTION	PCM	ONBOARD	TRANSDUCERS	CATEGORY	MISSION RULE REFERENCE
ELECTROCARDIOGRAM	CJ0060J	NOT DISPLAYED		M*	30-15/16
ELECTROCARDIOGRAM	CJ0061J	NOT DISPLAYED		M*	30-15/16
ELECTROCARDIOGRAM	CJ0062J	NOT DISPLAYED		M*	30-15/16
CO2 PARTIAL PRESSURE	CF0005P	METER	COMMON	MD	30-2/27/28
SUIT CABIN DELTA PRESS	CF0003P	NOT DISPLAYED		MD	30-9/19
ORAL TEMPERATURE		CLINICAL THERMOMETER		M*	30-20
PNEUMOGRAM	CJ0200R	NOT DISPLAYED		MD	30-17
PNEUMOGRAM	CJ0201R	NOT DISPLAYED		MD	30-17
PNEUMOGRAM	CJ0202R	NOT DISPLAYED		MD	30-17

LM

CO2 PARTIAL PRESSURE	GF1521P	METER		MD	
ELECTROCARDIOGRAM	GT9999	NOT DISPLAYED		M*	30-15/16
PNEUMOGRAM		NOT DISPLAYED		MD	30-17

PLSS

PLSS ELECTROCARDIOGRAM	GT0124J			M*	30-15/16

*MANDATORY TO CABIN CLOSEOUT

01 ALSEP

REV	ITEM

! GENERAL !

1. GENERAL

(A) THESE ALSEP GENERAL OPERATIONAL GUIDELINES ARE BASED ON OBJECTIVES IN THE FOLLOWING PRIORITIES---

(1) PSE

(2) LSM

(3) SWS

(4) SIDE

(5) ENGINEERING

(B) THE GATHERING OF SCIENTIFIC DATA WILL NOT BE COMPROMISED FOR ENGINEERING OR TEST PURPOSES.

(C) 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.

(D) BIT RATES WILL NOT BE CHANGED ON THE ALSEP 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 ALSEP WILL BE CONFIGURED BACK TO NORMAL (1.06 KBPS) PRIOR TO TERMINATION OF SUPPORT OF THAT SITE.

(E) BEFORE IMPLEMENTING ANY MISSION RULE ACTION BASED ON AN APPARENT ALSEP MALFUNCTION; IT WILL BE ASCERTAINED THAT THERE IS NO PROBLEM WITH THE MSFN SUPPORTING SITE.

(F) THE TIMER INHIBIT COMMAND WILL NOT BE SENT PRIOR TO ALL EXPERIMENTS BEING ON AND PROPERLY ADJUSTED FOR OPTIMUM SCIENTIFIC DATA RETURN.

(G) THE TIMER WILL NEVER BE INHIBITED WHILE THE ALSEP TRANSMITTER IS OFF; AND THE ALSEP TRANSMITTER WILL NEVER BE COMMANDED OFF WHILE THE TIMER IS INHIBITED.

(H) ALSEP EXPERIMENTS WILL NOT BE COMMANDED TO "STANDBY OFF" ("STANDBY" IN THE CASE OF LSM) UNLESS THE ACTION IS JUSTIFIED BY AN ANOMALY.

(I) ANYTIME THERE IS AN AUTOMATIC SWITCHOVER TO PCU NO. 2 NOT IDENTIFIABLE TO A FAILURE IN PCU NO. 1; A ONE-TIME COMMAND WILL BE ATTEMPTED TO RETURN TO PCU NO. 1 IF THE +12 VDC BUS IS GREATER THAN 11.0.

(J) NO COMMAND FUNCTION CAN BE EXECUTED (OTHER THAN "STANDBY OFF," "STANDBY SELECT," OR "OPERATE SELECT") IN AN EXPERIMENT; BY GROUND COMMAND OR BY ONBOARD TIMER; UNLESS THE EXPERIMENT IS IN THE "OPERATE" MODE.

(K) THE ALSEP TURN-ON SEQUENCE IS---

(1) ASTRONAUT REMOVE SHORTING PLUG SWITCH ASAP AFTER DEPLOYMENT OF THE PSE; LSM; SIDE AND SWS.

(2) CREW WILL ACTIVATE ASTRO SWITCH NO. 1 PER DIRECTION FROM THE GROUND; SWITCH NO. 1 ACTIVATION WILL BE BASED ON PREDICTED AVAILABILITY OF 34.5 WATTS FROM THE RTG (SEE FIGURE 4.1; ALSEP SYSTEMS HANDBOOK).

(L) IF THE GROUND IS UNABLE TO COMMAND TRANSMITTER A ON AND/OR EXPERIMENTS ON; THE ASTRONAUT WILL TURN ON ASTRO SWITCHES NO. 2 AND/OR NO. 3 DURING EVA NO. 2.

(M) THE CENTRAL STATION HEATERS AND POR'S WILL BE UTILIZED TO MAINTAIN AN AVERAGE INTERNAL THERMAL PLATE TEMPERATURE WITH THE LOWEST TEMPERATURE GREATER THAN 0 DEG F, AND THE HIGHEST TEMPERATURE LESS THAN 135 DEG F.

REV	ITEM

2. PSE

(A) THE PSE WILL BE UNCAGED ASAP AFTER THE PSE IS COMMANDED ON.

(B) THE PSE LEVELING MOTORS WILL NOT BE ACTIVATED PRIOR TO UNCAGING.

(C) 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).

(D) FOR PROPER OPERATION OF THE PSE, THE FEEDBACK FILTER MUST BE IN THE FOLLOWING MODES (CMD 101, PSE FILTER IN/OUT)--

(1) LEVELING MODE--FILTER OUT

(2) LONG PERIOD CALIBRATION--FILTER IN.

(3) NORMAL OPERATIONAL MODE--FILTER IN.

(E) THE X-AXIS AND Y-AXIS MASSES OF THE PSE SHOULD BE LEVEL BEFORE LEVELING THE Z-AXIS MASS.

(F) THE PSE SENSOR HEATERS SHOULD BE OFF DURING OPERATION OF THE PSE LEVELING MOTORS.

(G) DURING FORCED LEVELING OPERATIONS, CAUTION SHALL BE EXERCISED PRIOR TO INITIATING LEVELING MOTOR OPERATION TO INSURE THAT PROPER DIRECTION AND SPEED HAVE BEEN SELECTED.

3. LSM

(A) A SITE SURVEY WILL NOT BE PERFORMED UNTIL THE FUNCTIONAL VERIFICATION OF EXACTLY FOUR FLIP/CALS IS COMPLETE. NO FLIP/CAL WILL BE ALLOWED BETWEEN THE X, Y AND Z SITE SURVEYS. TIMER INITIATED FLIP/CALS SHALL BE INHIBITED (BY LSM FLIP/CAL INHIBIT) UNTIL COMPLETION OF THE SITE SURVEY.

(B) OPERATIONAL POWER WILL NOT BE REMOVED FROM THE LSM DURING THE LUNAR NIGHT PERIODS, EXCEPT AS NOTED IN RULE 91-93. (CRITICAL TEMPERATURE IS -90 DEG C.)

(C) NO ALSEP CMD'S SHOULD BE PLANNED DURING THE SITE SURVEY.

4. AMA

HIGH GAIN (CMD 122) THREE TIMES WITHIN 10 SECONDS) WILL BE COMMANDED WHEN LEVEL 14 READS 25 PA DURING OPERATE MODE.

5. SIDE

(A) GROUND COMMAND 107 (REMOVE DUST COVER) WILL NOT BE SENT TO THE ALSEP PRIOR TO LM LUNAR ASCENT.

(B) THE SIDE SHOULD REMAIN IN THE OPERATE MODE UNTIL AFTER DUST COVER REMOVAL.

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	31-1	A. ST-01 FAILED CLOSED		A. DSS 3 HTR (LOW)--OFF	A. DSS 3 HTR OFF--CMD 025 CUE--- AT-04 THERMAL PLATE TEMP 2 GREATER THAN 15 DEG F.
		B. ST-01 FAILED OPEN		B. SEE GENERAL RULE NO. 1H	
		31-2 TO 31-10 RESERVED FOR THERMAL			

NASA - Manned Spacecraft Center

MISSION RULES

SECTION 31 - ALSEP 1

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	31-11	FAILURE OF AUTO SWITCHOVER TO PCU NO. 2		SELECT PCU NO. 2	PCU NO. 2 SEL--CMD 062 AUTO SWITCHOVER TO PCU NO. 2 SHOULD OCCUR AT +12 VDC OUT OF LIMITS (LESS THAN 11 VDC/GREATER THAN 13 VDC) CUE--- THE FOLLOWING TM WILL BE OUT-OF-LIMITS--- TM NOMINAL HI LO AE-9 +12 +13.0 +11.0 AE-7 +29 +31.3 +25.7 AE-8 +15 +16.2 +13.8 AE-10 +5 +5.4 +4.6 AE-11 -12 -11.0 -13.0 AE-12 -6 -5.5 -6.5
	31-12	RESERVE POWER LESS THAN 24 OW		COMMAND EXPERIMENTS TO "STANDBY ON" IN THE FOLLOWING PRIORITY--- SIDE SWS LSM PSE	CUE--- CB2 FOR PCU NO. 1 CB4 FOR PCU NO. 2
		31-13 TO 31-20 RESERVED FOR ELECTRICAL			

NASA - Manned Spacecraft Center

MISSION RULES

SECTION 21 - ALSEP 1

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	21-21	ALSEP FAILS TO RESPOND TO A COMMAND		A. REINITIATE THE COMMAND B. IF UNSUCCESSFUL, SELECT OTHER DECODER (ALSEP 1A OR 1B) AND REINITIATE THE COMMAND.	CUE--- NO FUNCTIONAL VERIFICATION AND NO CMD VERIFICATION WORD (CVW) VERIFY RECEIVER CB (CB-01) HAS NOT OPENED. AE-14 OR AE-13 OUT-OF-LIMITS. 12 HR PULSE WILL CLOSE CB.
	21-22	CMD YIELDS FUNCTION BUT NO CVW		A. SEND "SPARE" CMD B. IF NO CVW, SWITCH TO OTHER DATA PROCESSOR	A. "SPARE" CMDS SHOULD YIELD CVW BUT NO FUNCTION. CMD 150, 153, 154 AND 155 ARE "SPARE" CMDS. B. CMD 034 PROC. "X" SEL CMD 035 PROC. "Y" SEL
		21-23 TO 21-25 RESERVED FOR CMD			

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	31-26	WEAK TM SIGNAL		A. SELECT REDUNDANT XMTR B. SELECT LOW BIT RATE	A. XMTR A SEL--CMD 012 XMTR B SEL--CMD 015 B. LOW BIT RATE SEL--CMD 007 LSM DATA NOT USABLE IN LOW BIT RATE.
	31-27	LOSS OF SYNC OR BAD DECOMMED DATA		A. SELECT REDUNDANT PROCESSOR B. SELECT LOW BIT RATE	A. PROC "X" SEL--CMD 034 B. LOW BIT RATE SELECT--CMD 007
	31-28	LOSS OF TM SIGNAL		A. SEND TM ON. B. SELECT REDUNDANT XMTR C. AFTER NEXT 12 HR PULSE--REPEAT A & B.	A. TM ON--CMD 013 B. XMTR A SEL--CMD 012 XMTR B SEL--CMD 015 C. IF RCVR CB (CB-01) OPEN, NEXT 12 HR PULSE WILL RESET IT. NOTE--- IF PSE LEVELING IS IN PROGRESS, SEND PSE STBY SEL-- CMD 037.
	31-29	DATA DEMAND SIGNAL FROM DATA PROCESSOR FAILS HIGH		SELECT REDUNDANT PROCESSOR USING THE OTHER DECODER	CUE--- CVW IS STEADILY INDICATING AN ERRONEOUS PATTERN OTHER THAN ALL ZEROS (CVW LIGHT ON EVERY 0.6 SECONDS) AFTER A CMD HAS BEEN SENT. PROC "A" SEL--CMD 034 PROC "X" SEL--CMD 035
		31-30 RESERVED FOR TELEMETRY			

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	31-31	FAILURE OF AUTOMATIC LEVELING MODE		PERFORM FORCED LEVELING BY GROUND COMMANDS	PSE ACTIVATION PRESETS LEVELING MODE TO AUTOMATIC. CMD 103 WILL SWITCH TO FORCED MODE. CMD 103 IS A TWO-STATE CMD; PSE LEVELING MODE AUTO/FORCED.
	31-32	PSE LEVELING MOTOR FAILS ON		ALTERNATELY GND CMD PSE TO STANDBY SELECT AND TO OPERATE SELECT	CUE--- LEVELING MOTOR WILL DRAW 3 WATTS FROM RESERVE POWER. PSE STBY SEL--CMD 037 PSE OPER. SEL--CMD 038
	31-33	PSE LEVELING MOTOR FAILS OFF		NO ACTION TO BE TAKEN	CUE--- NO DROP IN RESERVE POWER (NORMALLY 3 WATTS) WHEN REPEATED EFFORTS ARE MADE TO TURN MOTOR ON; AND NO ACTIVITY ON SHORT PERIOD Z-DATA CHANNEL.
	31-34	FAILURE OF MECHANICAL LEVEL DRIVE		SELECT LOW SPEED AND HIGH SPEED AND DIRECTION REVERSALS ALTERNATELY.	CUE--- NO MOTION OF THE PLATFORM CAN BE DETECTED ON THE LP HORIZONTAL OR LP-Z COMPONENT TIDAL OUTPUT. X-MTR ON/OFF--CMD 070 Y-MTR ON/OFF--CMD 071 Z-MTR ON/OFF--CMD 072 DIRECTION PLUS/MINUS--CMD 074 SPEED LOW/HIGH--CMD 075
	31-35	MISALIGNED COARSE SENSOR		A. COMMAND COARSE SENSOR OUT WHEN CORRESPONDING MOTOR IS IN LEVELING OPERATION. B. PERFORM FORCED LEVELING OF THE PSE BY GND CMD.	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. COARSE SENSOR OUT--CMD 102
	31-36	FAILURE OF COARSE LEVEL SENSOR		A. SELECT FORCED PSE LEVELING MODE. B. GROUND COMMAND COARSE LEVEL SENSOR OUT. C. PROCEED WITH FORCED LEVELING FOR COARSE LEVELING. D. USE AUTO MODE FOR FINE LEVELING.	CUE--- NO HIGH SPEED MOTOR OPERATION IS NOTICED DURING INITIAL LEVELING PHASE AND COMPONENT DOES NOT CENTER WITHIN EXPECTED TIME (45 MINUTES MAXIMUM IN AUTO MODE). USE HIGH SPEED LEVELING FOR COARSE LEVELING. CMD 103--PSE LEVELING MODE AUTO/FORCED. CMD 102--COARSE LEVEL SENSOR OUT

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	31-37	LONG PERIOD COMPONENT STICKS		A. USE HIGH SPEED; FORCED 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 5 MIN 30 SEC IN HIGH SPEED. X-MTR ON/OFF--CMD 070 Y-MTR ON/OFF--CMD 071 Z-MTR ON/OFF--CMD 072 DIRECTION PLUS/MINUS--CMD 074 SPEED HIGH/LOW--CMD 075
	31-38	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.
	31-39	AUTOMATIC SWITCHOVER OF PSE TO STANDBY		IF PSE HAS NOT BEEN RIPPLED OFF; CMD PSE TO OPERATE SELECT	IF CIRCUIT BREAKER CB-06 HAS OPENED FROM OVERCURRENT (500 MA +/- 10 PERCENT); STANDBY MODE WILL BE SELECTED AND THE CB WILL BE RESET AUTOMATICALLY. PSE OPER SEL--CMD 056
	31-40	FAILURE OF PSE UNCAGE SEQUENCE		A. TO UNCAGE ARM--- 1. SEND UNCAGE ARM/FIRE. 2. IF UNSUCCESSFUL; FIRST 10 MR TIMER PULSE WILL ARM ACTUATOR. 3. IF UNSUCCESSFUL; 90 MR OR MIN PULSE FROM DELAYED CMD SEQUENCER WILL ARM ACTUATOR B. TO UNCAGE FIRE (AFTER ACTUATOR HAS BEEN ARMED). 1. SEND UNCAGE ARM/FIRE 2. IF UNSUCCESSFUL; SEND CMD 057; PSE STANDBY SEL. 3. IF UNSUCCESSFUL; NEXT 10-MR TIMER PULSE WILL ARM AND FIRE THE ACTUATOR.	NORMAL UNCAGING IS ACCOMPLISHED BY SENDING CMD 071--UNCAGE ARM/FIRE--TWICE; ONCE TO ARM AND ONCE TO FIRE THE ACTUATOR. NOTE--- UNCAGING MAY NOT BE POSSIBLE UNLESS AT 08 THERMAL PLATE 5 TEMP IS ABOVE +35 DEG F. NOTE--- SELECTING PSE STANDBY WILL RESET ARM LOGIC IF ACTUATOR IS NOT FIRED. NOTE--- 30 SEC IS REQUIRED BETWEEN ARM AND FIRE TO CHARGE CAPACITOR.

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	31-41	PSE GOES OFF WHILE IN STANDBY MODE		DURING NORMAL OPERATIONS, CMD PSE TO STBY SEL	CUE--- EXP 1 STBY DISCRETE EXTINGUISHES, AND RESERVE POWER INCREASES SINCE POWER IS REMOVED FROM THE HEATERS. IF FUSE (F-03) HAS BEEN BLOWN BY OVERCURRENT (900 MA), CAPABILITY TO SELECT PSE STBY MODE IS LOST. CMD 037--PSE STBY SEL CMD 017--PDR 1 ON
	31-42	PSE TEMP LOW AND AUTO THERMAL CONTROL FAILS		COMMAND HEATER TO MANUAL ON	ASSUME AUTOMATIC THERMOSTAT CONTROL FAILED. CMD 076 IS A 4-STATE CMD, WHICH CAN SEQUENTIALLY STEP THRU THE FOLLOWING MODES TO CONTROL THE PSE SENSOR HEATER. 1 OFF 2. MANUAL HTR ON 3. OFF 4. AUTOMATIC THERMOSTATE CONTROL ENABLED DL-07 PSE INSTRUMENT TEMP LOW LIMIT IS 120 DEG F. MINIMUM OF 4 WATTS RESERVE POWER IS REQUIRED.
	31-43	PSE TEMP HIGH AND AUTO THERMAL CONTROL FAILS		A. COMMAND HEATER OFF B. IF UNSUCCESSFUL, CMD PSE TO STBY, THEN TO OPERATE	A. CMD 076 IS 4-STATE CMD. 1. OFF 2. MANUAL HTR ON 3. OFF 4. AUTOMATIC THERMOSTAT CONTROL ENABLED. DL-07 PSE INSTRUMENT TEMP HIGH LIMITS IS +130 DEG F. B. SELECTING PSE TO STBY WILL REINITIALIZE TO AUTOMATIC THERMOSTAT CONTROL.
	31-44	LOSS OF DOWNLINK DURING LEVELING MOTOR OPERATION		SEND PSE STBY SEL	NOTE--- PSE STBY SEL WILL STOP MOTORS.
	31-45	HORIZONTAL DATA LESS THAN -20/ GREATER THAN +20 M RAD		LEVEL PSE X AND/OR Y AXIS	CUE--- DL-4 (X-AXIS) DL-5 (Y-AXIS)
	31-46	VERTICAL DATA LESS THAN -3/GREATER THAN +3 M GAL		LEVEL PSE Z-AXIS	CUE--- DL-6
		31-47 TO 31-50 RESERVED FOR PSE			

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	31-51	LOSS OF LSM DATA		A. VERIFY NORMAL BIT RATE. B. CMD LSM OPER.	NORMAL BIT RATE SEL--CMD 106 LSM OPER--042 NOTE--- LSM DATA NOT USABLE IN LOW BIT RATE.
	31-52	MAINTAIN LSM TEMP 40 +/- 10 DEG C.		A. SELECT Y SENSOR THERMOSTAT. B. IF TEMP CONTINUES HIGH, TURN HTRS OFF.	CMD 334 IS 3-STATE CMD--- 1. X SENSOR THERMOSTAT SEL (PRESET) 2. Y SENSOR THERMOSTAT SEL 3. ALL HTRS OF CUE--- DM-1 FOR X-AXIS DM-2 FOR Y-AXIS
	31-53	FAILURE OF FLIP/CAL TO STOP		CMD THE FOLLOWING SEQUENCE--- LSM STBY--043 LSM OPER--042	NOTE--- NORMAL FLIP/CAL SEQUENCE IS 390 SEC. NOTE--- DURING [illegible] NIGHT, RETURN TO OPER WITHIN [illegible] AFTER STBY.
	31-54	FLIP/CAL SEQUENCE NOT INITIATED BY TIMER AT 12-HR INTERVALS		A. VERIFY FLIP/CAL INHIBIT OFF B. CMD FLIP/CAL GO. C. IF UNSUCCESSFUL, SEND FOLLOWING CMD SEQUENCE--- 1. 043--STBY SEL 2. 042--OPER ON 3. 127--FLIP/CAL INHIBIT OFF 4. 131--FLIP/CAL GO	A. CUE--- DM-23 IS A "0." CMD 127 B. CMD 131 C. REINITIALIZE LOGIC. NOTE--- AFTER 48 HRS OF NO FLIP/CALS--PRIORITY LOWERED TO 4.
		31-55 TO 31-60 RESERVED FOR LSM			

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	31-61	UNABLE TO BREAK CCGE SEAL AND/OR UNABLE TO REMOVE SIDE DUST COVERS		WAIT FOR DELAYED TIMER TO INITIATE CMDS	PET 96 HRS 2 MIN--BREAK SEAL PET 96 HRS 3 MIN--EXECUTE PET 96 HRS 4 MIN--REMOVE DUST COVERS PET 96 HRS 5 MIN--EXECUTE
	31-62	CMD REGISTER DOES NOT AGREE WITH UPLINK COMMAND		RESET LOAD REGISTER	CUE--- DI-64 RESET REGISTER BY UPLINKING CMDS 104, 105, 106, AND 107-- THEN EXECUTE WITH 110 EXCEPT AS NOTED IN GENERAL RULE 5A.
	31-63	INTERNAL ARCING		CMD TO STBY	CUE--- DI-1 (FRAME COUNTER) ERRATIC CMD 053
		31-64 TO 31-70 RESERVED FOR SIDE			

REV	ITEM	CONDITION/MALFUNCTION	PHASE	RULING	CUES/NOTES/COMMENTS
	31-71	INTERNAL ARCING		CMD TO STBY	CUE--- DW-1 AND/OR DW-2 (SEQUENCE COUNTER) ERRATIC
	31-72	A. TEMP LESS THAN DEG C		A. CMD TO STBY	CMD--046 A. CMD 046--TURN ON 4 WATTS OF HEAT.
		B. TEMP GREATER THAN DEG C		B. CMD TO OFF	B. CMD 046 THEN CMD 050 WILL TURN OFF ALL HTRS.
					DURING OPERATE MODE, THERMOSTAT CONTROL IS 20 +/- ____ DEG C.
		31-73 TO 31-80 RESERVED FOR SWS			CUE--- DW-11, 12, 13 AND 14

APPENDICES

A ACRONYMS AND SYMBOLS

REV	ITEM

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

REV	ITEM

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

REV	ITEM

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

REV	ITEM

SYMBOLS

H	ALTITUDE
DELTA VIN	DELTA VELOCITY IN INSERTION
DELTA TB	DELTA BURN TIME
DELTA H	DELTA ALTITUDE

B DISTRIBUTION LIST

REV	ITEM

' DISTRIBUTION LIST '

DIRECTOR OF FLIGHT OPERATIONS

FA/KRAFT, C.C., JR. (3)
SJOBERG, S.A.
ROSE, R.G.
KOONS, W.E.

FLIGHT CONTROL DIVISION

FC/KRANZ, E.F.
LUNNEY, G.S.
CHARLESWORTH, C.E.
GRIFFIN, G.D.
WINDLER, M.L.
FRANK, M.P.
ROACH, J.W.
BROOKS, M.F.
MILLER, M.G.

FLIGHT CONTROL OPERATIONS BRANCH

FC2/HARLAN, C.S.
LEWIS, C.R.
FENDEL, E.I. (13)
EALICK, P.L. (3)
PLATT, W.E. (9)
MOLNAR, W.M.

CSM SYSTEMS BRANCH

FC3/ALDRICH, A.D.
HUTCHINSON, N.B.
LOE, T.R. (20)
WILLOUGHBY, B.N. (18)
BLAIR, W.L. (2)

LM SYSTEMS BRANCH

FC4/HANNIGAN, J.E. (4)
PUDDY, D.R. (20)
CARLTON, R.L. (20)
EDELIN, F. (4)

FLIGHT DYNAMICS BRANCH

FC5/BOSTICK, J.C.
SHAFFER, P.C.
LLEWELYN, J.S. (4)
PARKER, C.B. (5)
PAVELKA, E.L. (5)

MISSION SIMULATIONS BRANCH

FC6/SHELLEY, C.B. (28)

MISSION CONTROL REQUIREMENTS

FC7/PETTITT, G.I. (2)

EXPERIMENTS SYSTEMS BRANCH

FC8/SAULTZ, J.E. (12)
MILEY, R.R. (2)

REV	ITEM

MSFC FLIGHT CONTROL OFFICE

P-MO-F/HAMNER, R.S. (20)

FLIGHT SUPPORT DIVISION

SYSTEMS ENGINEERING BRANCH

FS2/SATTERFIELD, J.M.

SUPPORT SYSTEMS BRANCH

FS/635EGOTA, P. (3)

OPERATIONS SUPPORT BRANCH

FS4/FRERE, J.A.
SANDORN, S.D. (20)
MONKVIC, J.A. (2)

FLIGHT SOFTWARE BRANCH

FS5/STOKES, J.D. (3)
GIBSON, P.F., JR.
GARMAN, J.R. (2)

MISSION PLANNING AND ANALYSIS DIVISION

FM/MAYER, J.P. (2)
HUSS, C. (2)
TINDALL, M.W.
OWEN, D.H.

FLIGHT ANALYSIS BRANCH

FM3/ALLEN, C.F. (24)

LANDING ANALYSIS BRANCH

FM2/BENNETT, F.V.
ALPHIN, J.
BOLT, D.R.
DUPNICK, E.
GRAVES, C.A.
MARPOLD, J.C.
MANSDEN, V.

MATH PHYSICS BRANCH

FM4/MCPHERSON, J.C. (2)

MISSION ANALYSIS BRANCH

FM5/BERRY, R. (4)

RENDEZVOUS ANALYSIS BRANCH

FM6/LINEBERRY, E.C. (2)
CORNATZ, M.L.

REV	ITEM

GUIDANCE AND PERFORMANCE BRANCH

FM7/CASSETTI, M.D. (2)

APOLLO TRAJECTORY SUPPORT OFFICE

FM13/PARTEN, R.
COLLINS, M.
BENNETT, W.J.

LANDING AND RECOVERY DIVISION

FL/HAMMACK, J.B. (8)

DIRECTOR OF FLIGHT CREW OPERATIONS

CA/SLAYTON, D.K. (2)

ASTRONAUT OFFICE

CB/SHEPARD, A.B. (20)
DUKE, C.M. (2)

FLIGHT CREW SUPPORT DIVISION

CF/NORNT, W.J.
GRIMM, D.M.
BILOCEAU, J.W.
DEMENT, M.E. (4)
ALLEN, L.D. (4)
KRAMER, P.C. (3)
WARREN, D.K. (3)
ANDERSON, W.M.
WOODLING, C.M.
RICHARD, L.G. (CF25) (2)
RUEHNEL, M.A. (4)
VAN BOCKEL, J.J. (2)
O NEILL, J.W. (10)
FABER, S. (3)
MITCHELL, J. (CFK-10)
COLLINS, M.G. (CFK-15) KSC
MCCAFFERTY, R. (CFK-6)
CF/FRANKLIN, G.C.

DIRECTOR OF MEDICAL RESEARCH AND OPERATIONS

DA/BERRY, C.A., M.D.
CATTERSON, A.D., M.D.
DD/MEDICAL OPERATIONS (12)

PUBLIC AFFAIRS OFFICE

AP/DUPP, B.
AP3/GREEN, G.J. (5)

APOLLO SPACECRAFT PROGRAM OFFICE

PA/ LOW, GEORGE M.
PA22/MC DIVISION, J.A.
MORRIS, O.
KLEINKNECHT, K.S.
SIMPKINSON, J.
PA2/APOLLO FILES
PD/KUBICKI, D.
DENNETT, A.
PD5/GORES, J.
PD7/KOMRS, R.
SILVER, P. (40)
PD9/CRAIG, J.

REV	ITEM

PG32/ZARCARO: J. (2)
PP/MCCLINTOCK: J.
PP32/TASH: M.L. (2)
RA/BLAND: W.M. (2)
PT/ARABIAN: D.O.
PT3/DATA LIBRARY (8)
BM86 MISSION DATA PACK (16)
NA3/SEIGLER: J.P. (2)

DIRECTOR OF ENGINEERING AND DEVELOPMENT

EA/FAGET: M.A.
GARDINER: R.A.
CHAMBERLIN: J.A.
BOND: A.C.
EA5/DEANS: P.M.
EB/KYLE: H.
EB3/TRAVIS: D.
STOKER: C.
EB5/NEWLIN: R.
EC/SHYLIE: R.E.
EC2/MC ALLISTER: P.
GILLEN: R.J.
TUCKER: E.M.
EC9/STUTESMAN: M.L.
EE/SWINT: R.
SAXTER: R.S.
EE4/RIEGERT: D.
JOHNSON: G.
MUNFORD: R.E.
ROTRAMEL: F.
CAMPOS: R.B.
DIETZ: R.H.
FENNER: R.G.
WALTER: R.T.
GIESECKE: R.L.
PARKER: A.
EE2/LUSE: M.B.
EE13/TREMONT: R.
EDMISTON: C.R.
EG27/MONTGOMERY: J.
EG29/COX: R.J.; DR.
EG25/MANAWAT: J.
EG21/WASSON: C.
EG42/WILSON: R. (2)
EG43/LEWIS: R.E.
KURTEN: P.M.
SHELTON: D.M.
EP2/TOWNSEND: R.A.
HUMPHRIES: C.E.
HAMMOCK: W.R.
EP4/KARAKULKO: W.
WEART: D.
EP5/BELL: D.
OWENS: D.
TROUT: D.
DRAGO: D.
EP3/STROMHAL: D.
EP12/SMITH: J.
EP12/OLTHM: P.C.
WEISS: S.P.
PAYLOART: J.E.
EX/SILVERIA: M.
EX21/REDO: D.

FLIGHT SAFETY OFFICE

MSC/SA FRENCH: J.C.
SF/GREENWELL: D.
RSC/MT VAUGHN: R.D.

RELIABILITY AND CERTIFICATION OFFICE

MR2/WILLIAMS: M.L. (8)

	MISSION	REV	DATE	SECTION	GROUP	PAGE
	APOLLO 15	B	10/31/9	APPENDIX B - DISTR LIST		B-6

REV	ITEM

DIRECTOR OF SCIENCE AND APPLICATIONS

TG5/BATES, J.P.
TA/CALIO, A.J.
TF2/STEPHENSON, B. (15)

TRW HOUSTON

ROBERTSON, R.L. (3)
TRW TECHNICAL INFORMATION CENTER, HOUSTON OPERATIONS (2)
H2/2064-MITCHELL R.A.

NORTH AMERICAN ROCKWELL HOUSTON

HARMAN, H.A. (2)

GODDARD SPACE FLIGHT CENTER

KNOX, C.B. (9)
CODE 821.1
MANNED FLIGHT OPERATIONS DIVISION, REQUIREMENTS SECTION

JOHN F. KENNEDY SPACE CENTER NASA - MSOB

KENNEDY SPACE CENTER, FLORIDA
ATTEN: MO/ASTRO OFF (6)
CO/DE BUS: R.L. DR.
AS-SAT/BARNETT, V. (2)
AP-ECO/BEDDINGFIELD, S.
AP-OPR/BLACKWOOD, M. (2)
LO/KAPTRAN, W.J.
LO-OPR/DONNELLY, P.
LO-PLN-2/KNIGHT, G.W. (2)
LV/GRUENE, H.
LV-ENG/RIGELL, F.A.
LV-TOM-1/HART, J.J.
LV-TOM-4/YOUMANS, R.E.
LV-GDC/LEALMAN, R.E.
LV-INS/EDWARDS, R.D.
LS/WILLIAMS, J.J.
LS-ENG-1/GARK/MOS, R.D. (4)
MARS, C.D. (4)
TEC: SLIS/PARK, J.E. (2)
NAR: 2M16/WEAVER, R.A. (2)
MDC: 2T012/SMAPPER, J.R. (2)
IOM: 3M1/GROVIER, P.M. (2)
FS/CLARK, R.L. (5)
AP-STR/MOORE, A.M. (6)
IN/SENDLER, R. (5)
SO/GORMAN, R. (2)
IS-TOM2/CLARK, D.
BEASON, W.P.
PAR/MORSE, A.E.
ESC MISSION DIRECTOR'S OFFICE, R2101 MSC BLDG
GAEC/LOPRESTI, R. (10), R1047 MSOB

MARSHALL SPACE FLIGHT CENTER

MSFC/P-MO-MSR, MISSION OPERATIONS OFFICE (30)
HOUSTON

OFFICE MANNED SPACEFLIGHT

MUELLER, G.E., DR.
PHILLIPS, D.C., MAJ. GEN.
MAGE, G.M.
ALLEN, R.O. (20)
STOUT, P.G. (2)
DRAPER, C.M., TC (9)
SCHULMAN, A.M. MSP

	MISSION	REV	DATE	SECTION	GROUP	PAGE
	APOLLO 12	B	10/31/69	APPENDIX B - DISTR LIST		B-6

REV	ITEM

DOD MSF SUPPORT OFFICE PAFB, FLA.

OLSON, R.B., COL. (5)
FRESE, F.J., JR., COL., MC (2)
DOMS-N/DEARM N. J., CAPT.
ETOOP-2 PAFB FLA. 32925 (6)

MIT LABORATORIES BOSTON, MASS.

NEVINS, J. (12)
COPPS, E. (2)
SPARS, N.

NORTH AMERICAN ROCKWELL, DOWNEY, CALIF.

POTTS, J.R. CODE A070 (1)

GRUMMAN AIRCRAFT ENGINEERING CORP., BETHPAGE, NEW YORK

PRATT, R. (35)

BOEING, HOUSTON TEXAS

BOEING DATA MANAGEMENT, N/S MA-04 (2)

BOEING COMPANY SPACE DIVISION (955 L "ENFANT PLAZA" N. SW, WASHINGTON, D.C. 20024)
CAMPBELL, R.L. (3)

NASA, DAYTONA BEACH OPER., P.O. BOX 2800, DAYTONA BEACH, FLA. 32015
CAMALAN, P.P. MA-20

GENERAL ELECTRIC, 3850 NASA BLVD., HOUSTON, TEXAS 77058
HORNSBY, J. CODE 755

MISSION	REV	DATE	SECTION	GROUP	PAGE
APOLLO 12	0	10/31/69	APPENDIX B - DISTR LIST		B-6

C CHANGE CONTROL

REV	ITEM

CHANGE CONTROL

1.0 INTRODUCTION

1.1 PURPOSE

THE PURPOSE OF THIS APPENDIX IS TO DELINEATE CHANGE CONTROL PROCEDURES FOR THE MISSION RULES. THIS WILL INSURE THE PROPER COORDINATION OF CHANGES, PROVIDE A RECORD OF PROPOSED CHANGES (INCLUDING THE RATIONALE FOR MAKING THEM), AND WILL PROVIDE A MEANS FOR PROMULGATING INDIVIDUAL RULE UPDATES BETWEEN REVISIONS (INTERIM CHANGES).

1.2 EFFECTIVITY

SEPTEMBER 10, 1969

2.0 CHANGE PROCEDURES

2.1 SUBMISSION OF CHANGES

PROPOSED CHANGES ARE SOLICITED FROM ANY INDIVIDUAL OR ORGANIZATION HAVING A VALID INPUT. CHANGES ORIGINATING OUTSIDE THE FLIGHT CONTROL TEAM WILL BE SUBMITTED DIRECTLY TO THE ASSISTANT FLIGHT DIRECTOR (AFD). CHANGES ORIGINATING WITHIN THE FLIGHT CONTROL TEAM WILL BE SUBMITTED TO THE AFD VIA PRIME MISSION OPERATIONS CONTROL ROOM (MOCR) POSITION CONCERNED.

2.1.1 FORMAT

PERSONS DESIRING TO SUBMIT A PROPOSED CHANGE WILL COMPLETE ALL ITEMS ON THE FORM SHOWN IN FIGURE C-1 (FORM MUST BE TYPED). ADDITIONAL PAGES MAY BE USED IF THE SPACE PROVIDED IS NOT ADEQUATE. THE COMPLETED ORIGINAL FORM AND ONE COPY WILL THEN BE FORWARDED TO THE AFD.

THE AFD WILL REVIEW THE FORM FOR COMPLETENESS AND PROPER MISSION RULE FORMAT, AND MAKE CORRECTIONS AS REQUIRED. THE ORIGINATOR WILL BE ADVISED OF ANY SUCH CHANGES.

2.2 APPROVAL

2.2.1 COORDINATION

THE ORIGINATOR OF THE CHANGE MAY OBTAIN PRELIMINARY CONCURRENCES. THE AFD WILL, HOWEVER, OBTAIN FORMAL CONCURRENCES OR DISAPPROVALS (VERBALLY OR BY INITIATING) FROM THE NECESSARY PERSONNEL. VERBAL CONCURRENCES WILL BE INDICATED IN THE APPROPRIATE SIGNATURE BOX.

2.2.2 SIGNOFF/DISAPPROVAL

UPON OBTAINING THE REQUIRED CONCURRENCES OR NEGATIVE COMMENTS, THE AFD WILL PRESENT THE PROPOSED CHANGE TO THE FLIGHT DIRECTOR FOR FINAL APPROVAL OR DISAPPROVAL. THE AFD MAY SIGN OFF OR DISAPPROVE PROPOSED CHANGES IN THE ABSENCE OF THE FLIGHT DIRECTOR.

2.2.3 DISAPPROVED CHANGES

IF A CHANGE IS DISAPPROVED THE AFD WILL RETURN THE COPY TO THE ORIGINATOR. A COPY OF THE REQUESTED CHANGE WILL BE RETAINED FOR FUTURE REFERENCE.

2.3 PUBLICATION AND DISTRIBUTION OF INTERIM CHANGES

INTERIM CHANGES WILL BE DISTRIBUTED VIA AN ABBREVIATED DISTRIBUTION LIST CONSISTING OF THE MISSION CONTROL TEAM, PERTINENT NASA ORGANIZATIONS, AND THE APPROPRIATE VEHICLE CONTRACTORS.

3.0 REVISIONS

3.1 DEVELOPMENT

THE AFD WILL COMPILE THE EFFECTIVE INTERIM CHANGES AND CORRECTIONS OF MINOR TYPOGRAPHICAL ERRORS INTO COMPLETE PAGE CHANGES TO THE BASIC DOCUMENT. (TIPPER AND INKIT CHANGES MAY BE USED TO CORRECT TYPOGRAPHICAL ERRORS IF THERE ARE NO OTHER CHANGES IN THE PAGE CONCERNED.)

REV	ITEM

3.2 APPROVAL

SINCE ALL INTERIM CHANGES WILL HAVE RECEIVED PRIOR CONCURRENCES AND APPROVALS ONLY THE FLIGHT DIRECTOR (OR THE AFD IN THE FLIGHT DIRECTOR'S ABSENCE) WILL BE REQUIRED TO APPROVE REVISIONS.

3.3 PUBLICATION

3.3.1 SCHEDULE

REVISIONS WILL BE MADE ON AN "AS REQUIRED" BASIS.

3.3.2 DISTRIBUTION

REVISIONS WILL BE PRINTED AND DISTRIBUTED THROUGH THE NORMAL ADMINISTRATIVE CHANNELS.

END
DATE
FILMED
JUL 10
1972