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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-115

April 28, 1969

APOLLO 10 (MISSION F) MISSION PLANNING BRIEFINGS

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(NASA-TM-X-69701) APOLLO 10 (MISSION F) MISSION PLANNING BRIEFINGS (NASA) 104 p
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MSC INTERNAL NOTE NO. 69-FM-115

PROJECT APOLLO

APOLLO 10 (MISSION F) MISSION PLANNING BRIEFINGS

By Mission Planning and Analysis Division

April 28, 1969

MISSION PLANNING AND ANALYSIS DIVISION
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Approved: D. H. Owen
for John P. Mayer, Chief
Mission Planning and Analysis Division

FOREWORD

The purpose of this document is to present the slides used for the Apollo 10 (Mission F) mission planning briefings given to North American Rockwell on April 4, 1969 and to the Grumman Aircraft Engineering Corporation on April 18, 1969.

The briefings were designed to give the primary contractors a comprehensive description of the ways in which their systems are to be used for the nominal and alternate F missions. Also presented were the abort modes available throughout the mission and a summary of the consumables analysis. A brief discussion of the navigation gains of the F mission was also included.

This document is published for general information; therefore, no detailed explanation of the slides is given. The scheduled Mission Planning and Analysis Division (MPAD) operational documents, (section 7) will explain and refine this information.

Please direct any questions concerning this briefing to W. J. Bennett, Mission Planning Support Office, extension 4907.

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1.0 NOMINAL TRAJECTORY PROFILE

Gene W. Ricks

MISSION OBJECTIVES

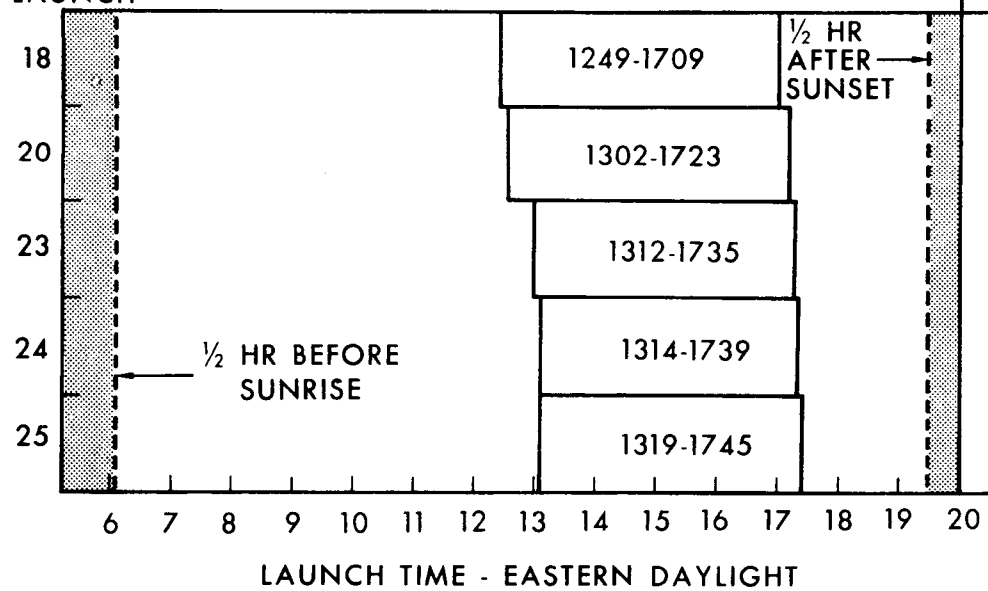
- CSM AND LM OPERATIONS WITH LUNAR TIME LINES
- LUNAR ORBIT NAVIGATION FOR POWERED DESCENT TARGETING
- LUNAR POTENTIAL EFFECTS ON RENDEZVOUS
- GROUND SUPPORT FOR LUNAR ORBIT RENDEZVOUS
- LM POWERED FLIGHT MONITORING

APOLLO 10 DESIGN GROUND RULES AND GUIDELINES

- ENTIRE MISSION TO FOLLOW THE G MISSION TIMELINE AS CLOSELY AS POSSIBLE
- FIVE POSSIBLE LAUNCH DAYS ACROSS EIGHT DAY PERIOD WITH 1,3,6,7,8 TYPE SPACING
- LAUNCH WILL BE TARGETED TO ACHIEVE MOST FAVORABLE LIGHTING FOR PRIME G SITES 2, 3, 4, AND 5
- THE TWO ADDITIONAL LAUNCH DAYS PAST THE NORMAL G WINDOW ARE TARGETED TO THE LAST G SITE - ACCEPTING HIGH SUN ELEVATIONS AT SITE 5
- DAYLIGHT LAUNCH AND LANDING
- TLI TARGETED FOR FREE RETURN CIRCUMLUNAR
  - PERILUNE 60 N. MI.
  - EARTH-RETURN PERIGEE 20 N. MI.
- TWO STAGE LOI TWO REVS IN 60 BY 170 CIRCULARIZE TO 60 BY 60

MPAD 5257 S

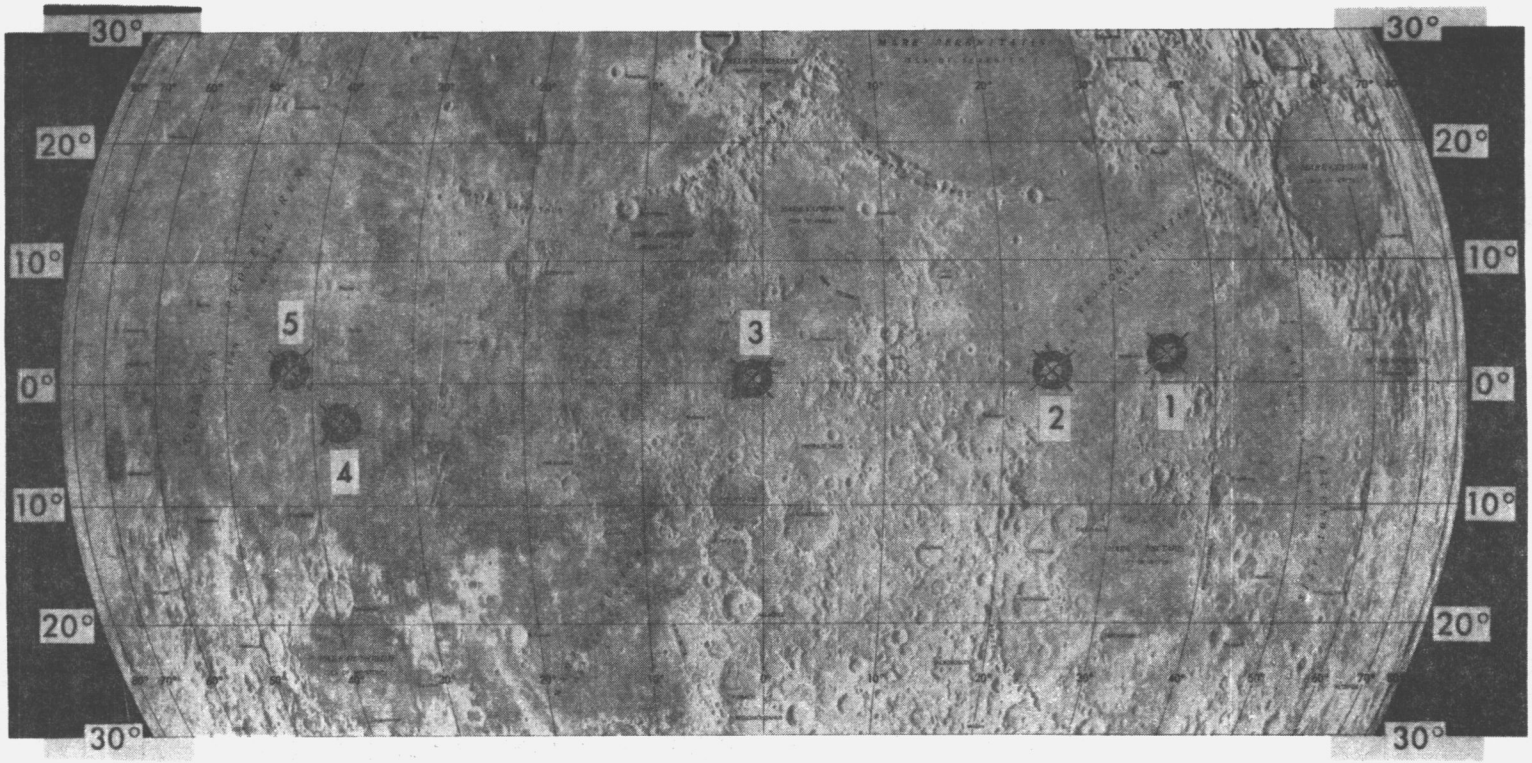
LAUNCH WINDOW SUMMARY
PACIFIC INJECTION



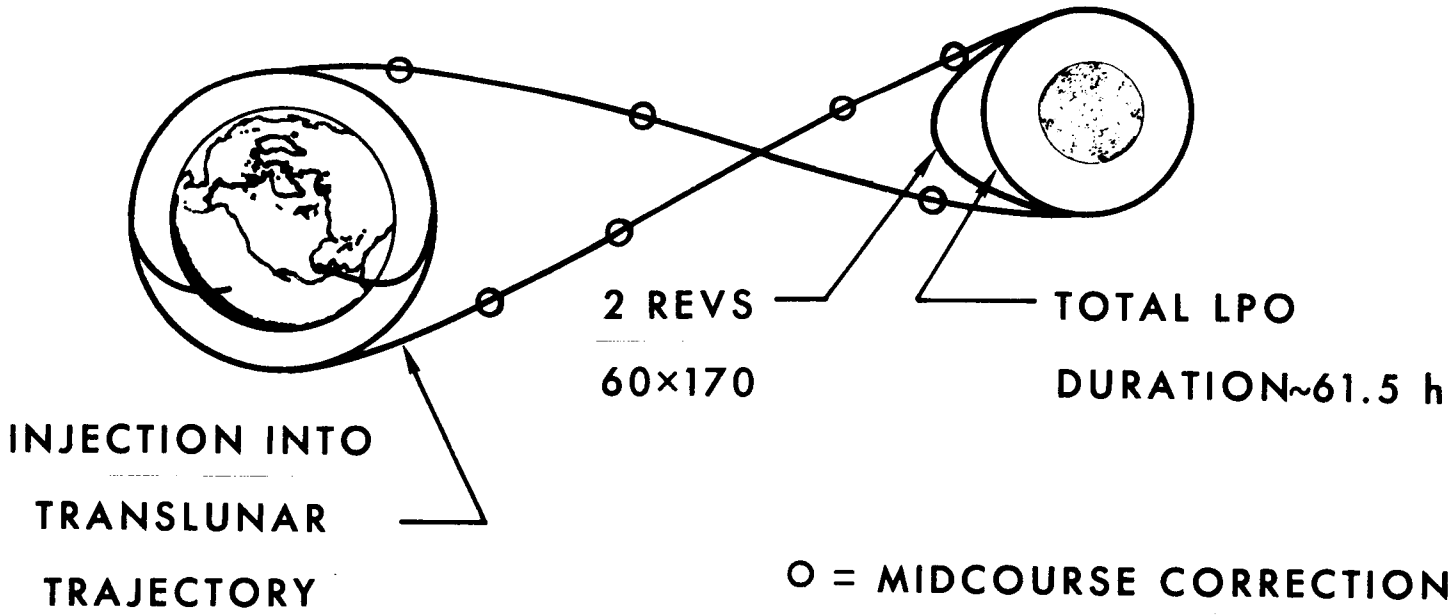
LAUNCH AZIMUTHS	LLS*	SUN EL AT LLS
72-108°	2	11.4
	3	10.9
	4	10.3
	5	17.0
72-108°	5	28.0

*LLS - LUNAR LANDING SITE

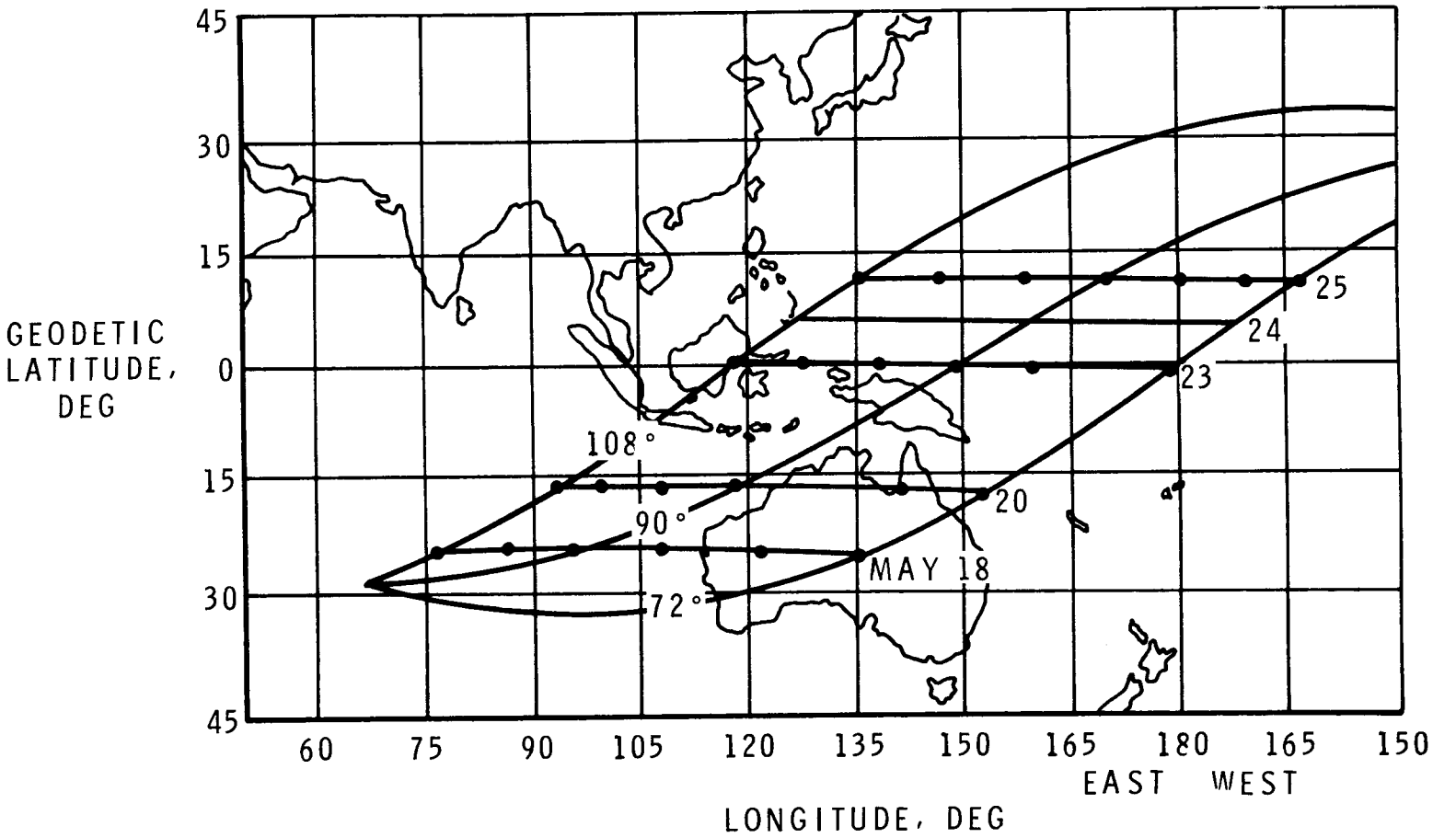
APOLLO CANDIDATE LUNAR LANDING SITES



MISSION PROFILE



TRANSLUNAR INJECTION POSITIONS



EARTH PARKING ORBIT COAST TIMES

(Δt FROM EOI TO TLI IGNITION)

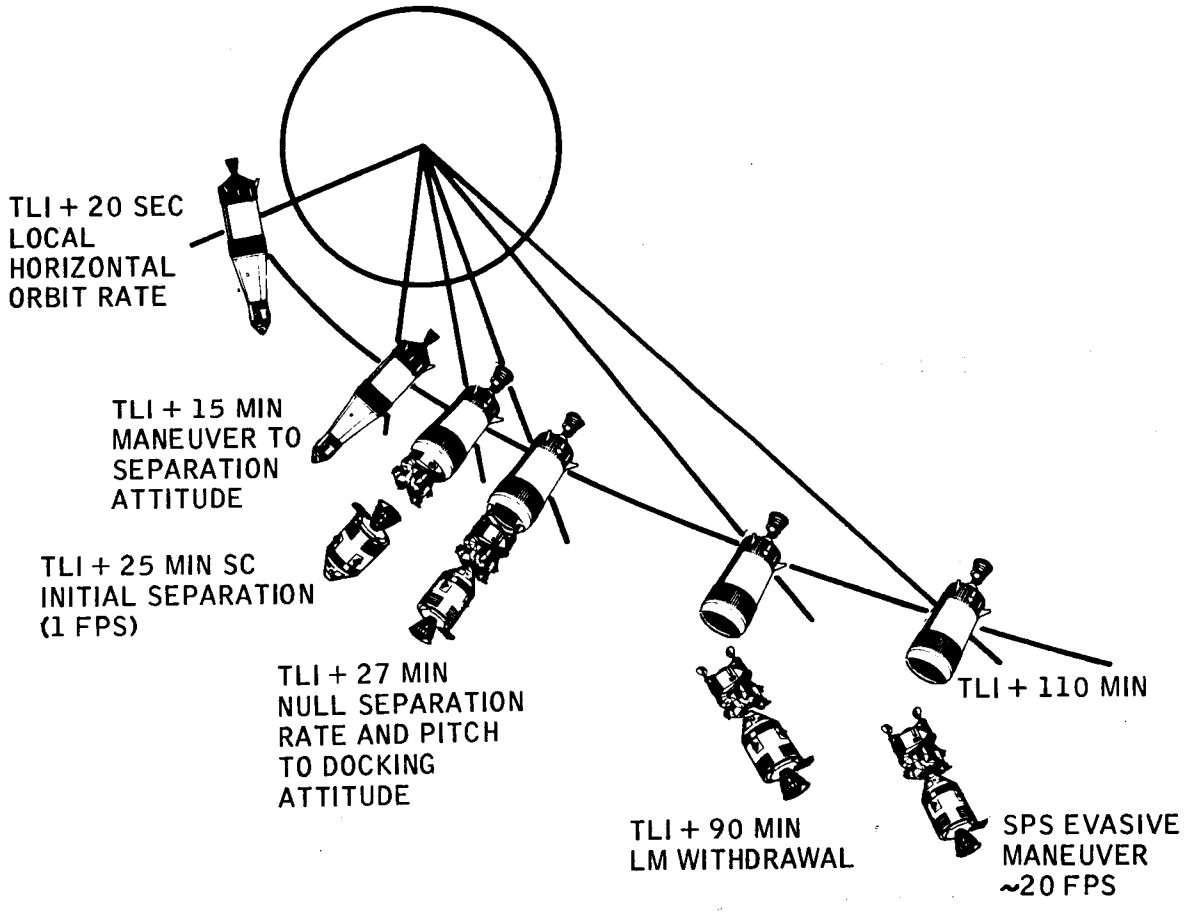
INJECTION OPPORTUNITY	MAY 18 → MAY 25
1	2 HR : 20 MIN → 2 HR : 40 MIN ↓ ↓ 2 HR : 06 MIN → 2 HR : 25 MIN
2	3 HR : 48 MIN → 4 HR : 09 MIN ↓ ↓ 3 HR : 35 MIN → 3 HR : 55 MIN

MPAD 5273 S

MISSION SUMMARY
MAY 18, 72°-1

	G.E.T. HR:MIN
LAUNCH	0:00
TRANSLUNAR INJECTION	2:33
LOI-1	75:46
LOI-2	80:11
UNDOCKING	98:05
DOI	99:34
PHASING	100:46
INSERTION	102:43
DOCKING	105:58
APS BURN TO DEPLETION	108:39
TEI	137:20
TOUCHDOWN	192:05

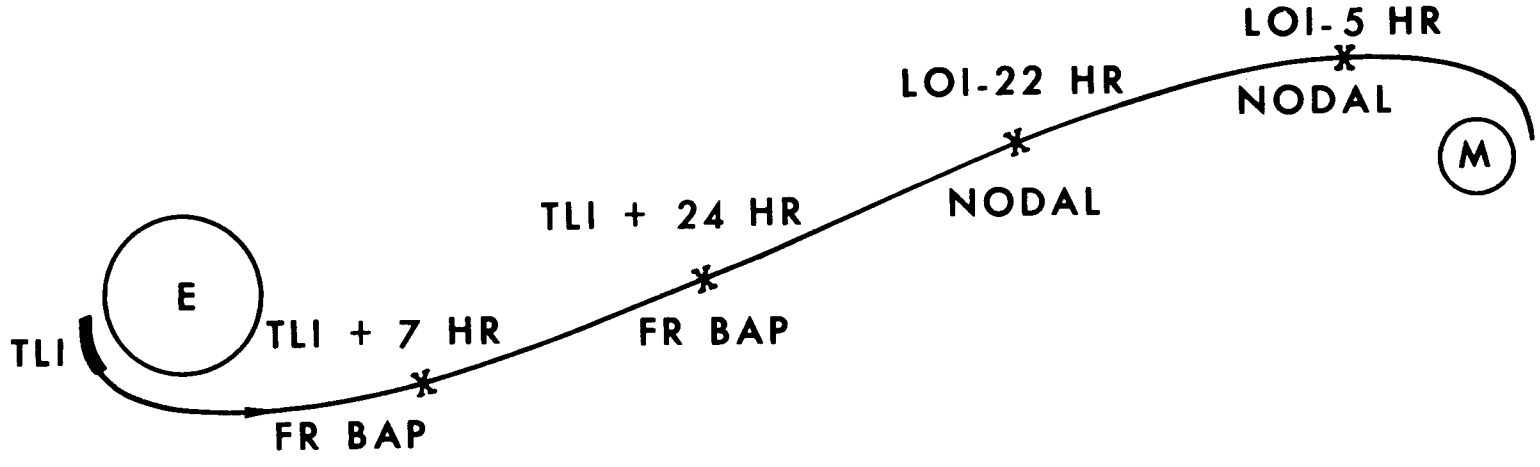
POST TLI TIMELINE



JENNESS/LMAB 2/17/69

G+P SUB PANEL/MARSHALL

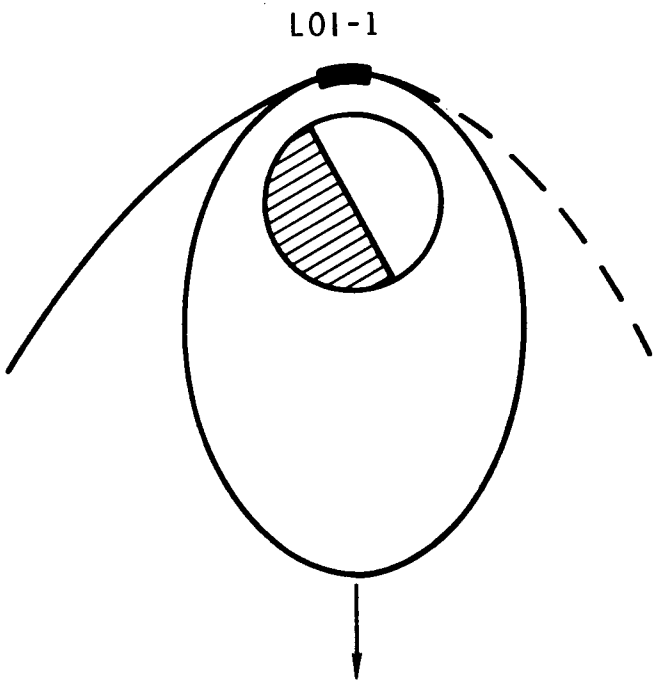
TRANSLUNAR MIDCOURSE CORRECTION STRATEGY



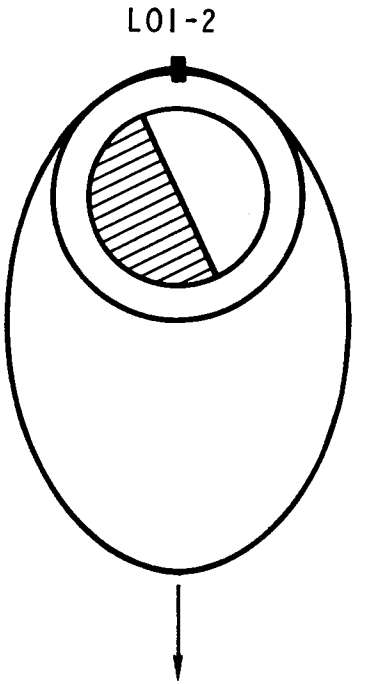
TRANSLUNAR MIDCOURSE GUIDELINES

- MINIMIZE RCS PROPELLANT USAGE
- MCC-3 PRIMARY (SINGLE CORRECTION)

LUNAR ORBIT INSERTION

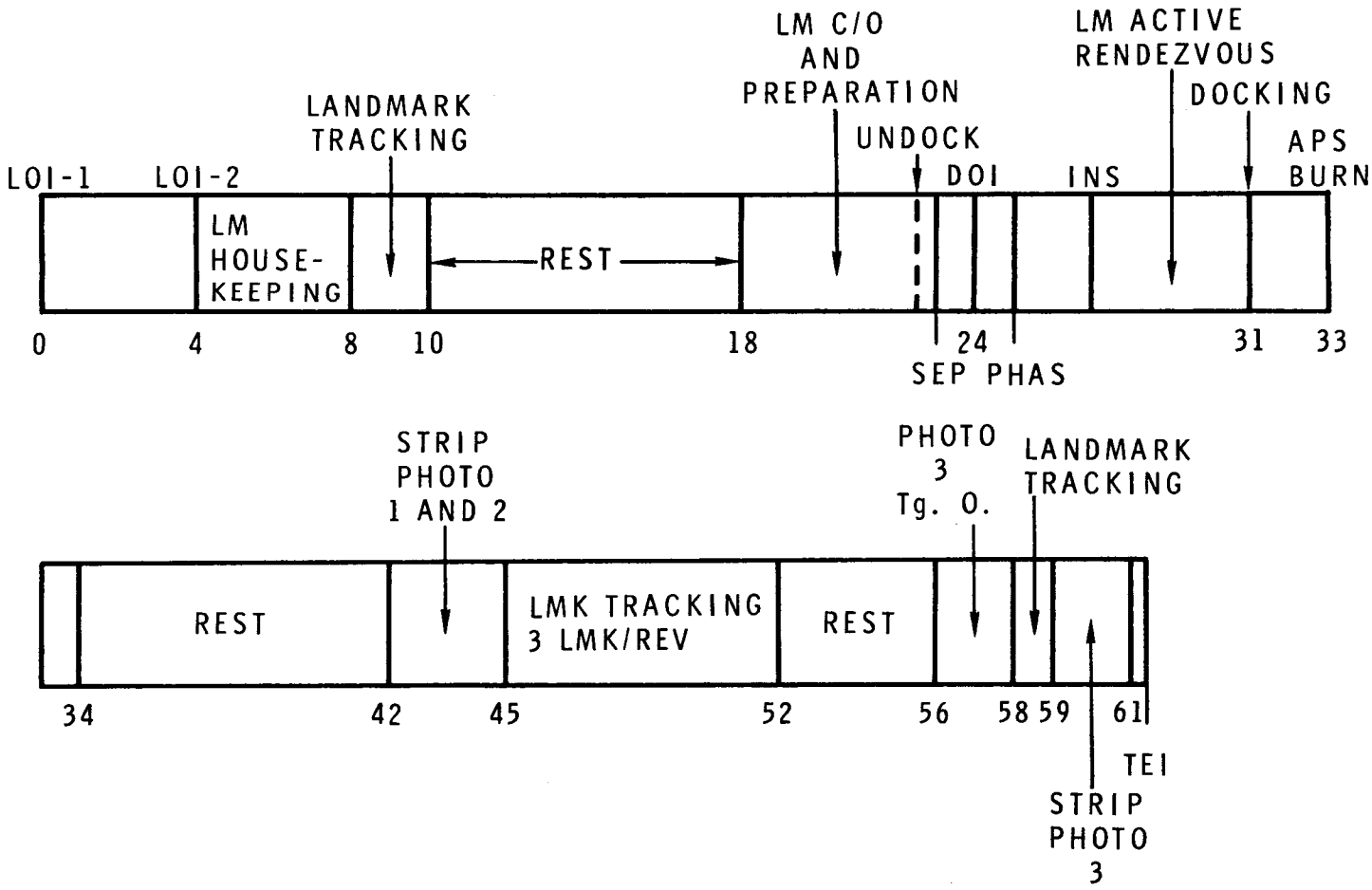


G.E.T.$_{IGN}$	75^H46^M
ΔV	2,978 FPS
BURN TIME	5^M52^S
PROPELLANT USED	23,561 LB

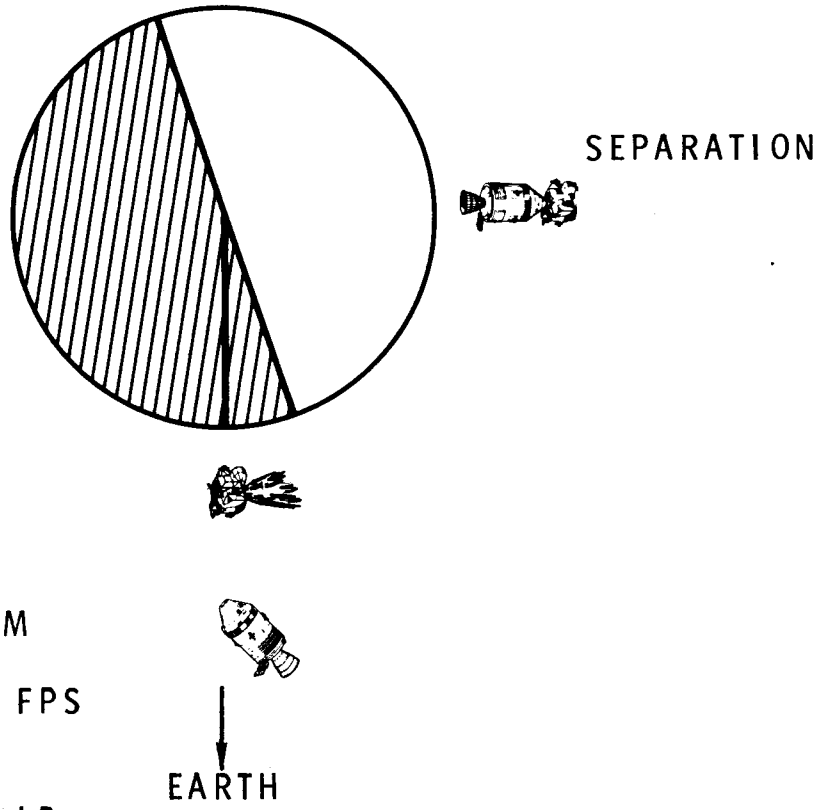


G.E.T.$_{IGN}$	80^H11^M
ΔV	138 FPS
BURN TIME	14^S
PROPELLANT USED	935 LB

LUNAR ORBIT ACTIVITIES

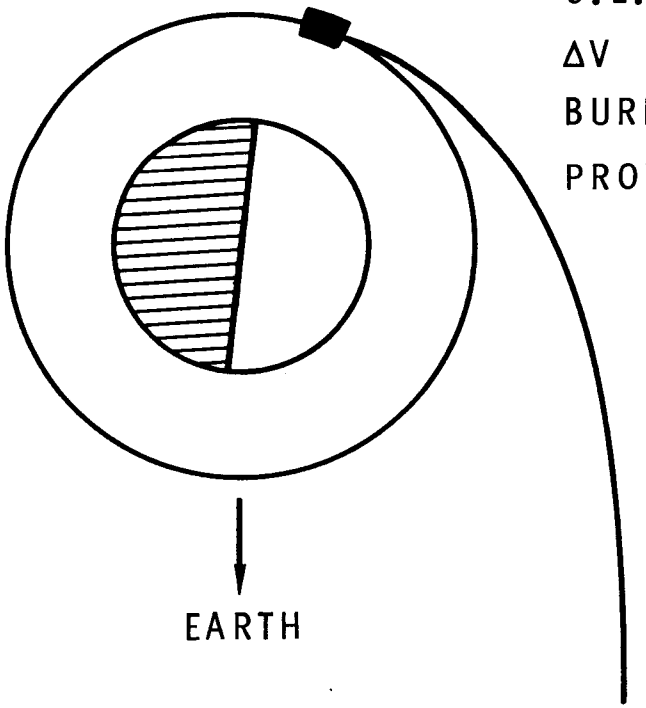


APS BURN TO DEPLETION



G.E.T. IGN	$108^{H}39^{M}$
ΔV	3,837 FPS
BURN TIME	$3^{M}35^{S}$
PROPELLANT USED	2,451 LB

TRANSEARTH INJECTION

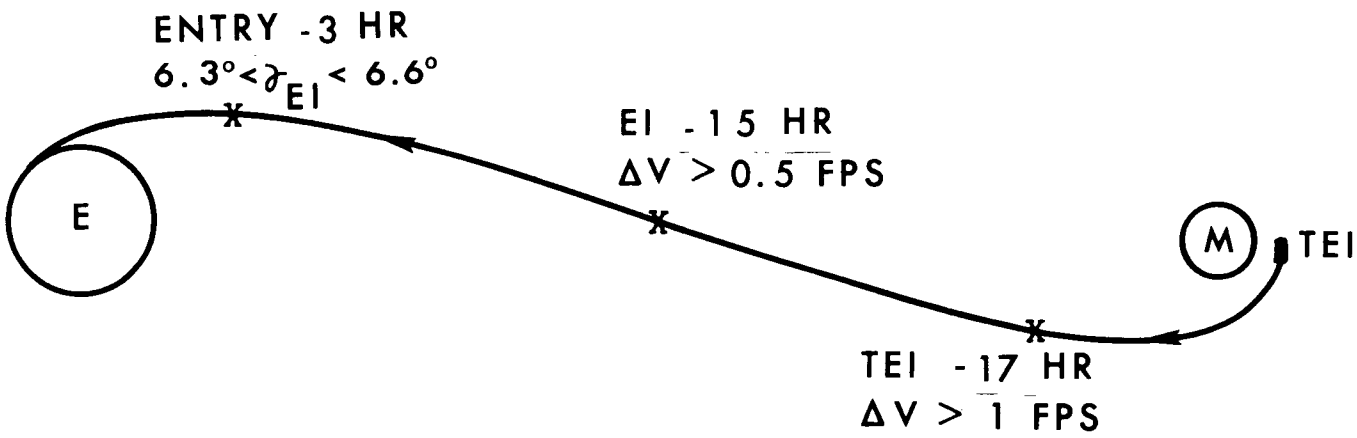


G.E.T.$_{IGN}$	$137^{H}20^{M}$
ΔV	3,623 FPS
BURN TIME	$2^{M}49^{S}$
PROPELLANT USED	11,004 LB

TRANSEARTH MIDCOURSE CORRECTION PHILOSOPHY

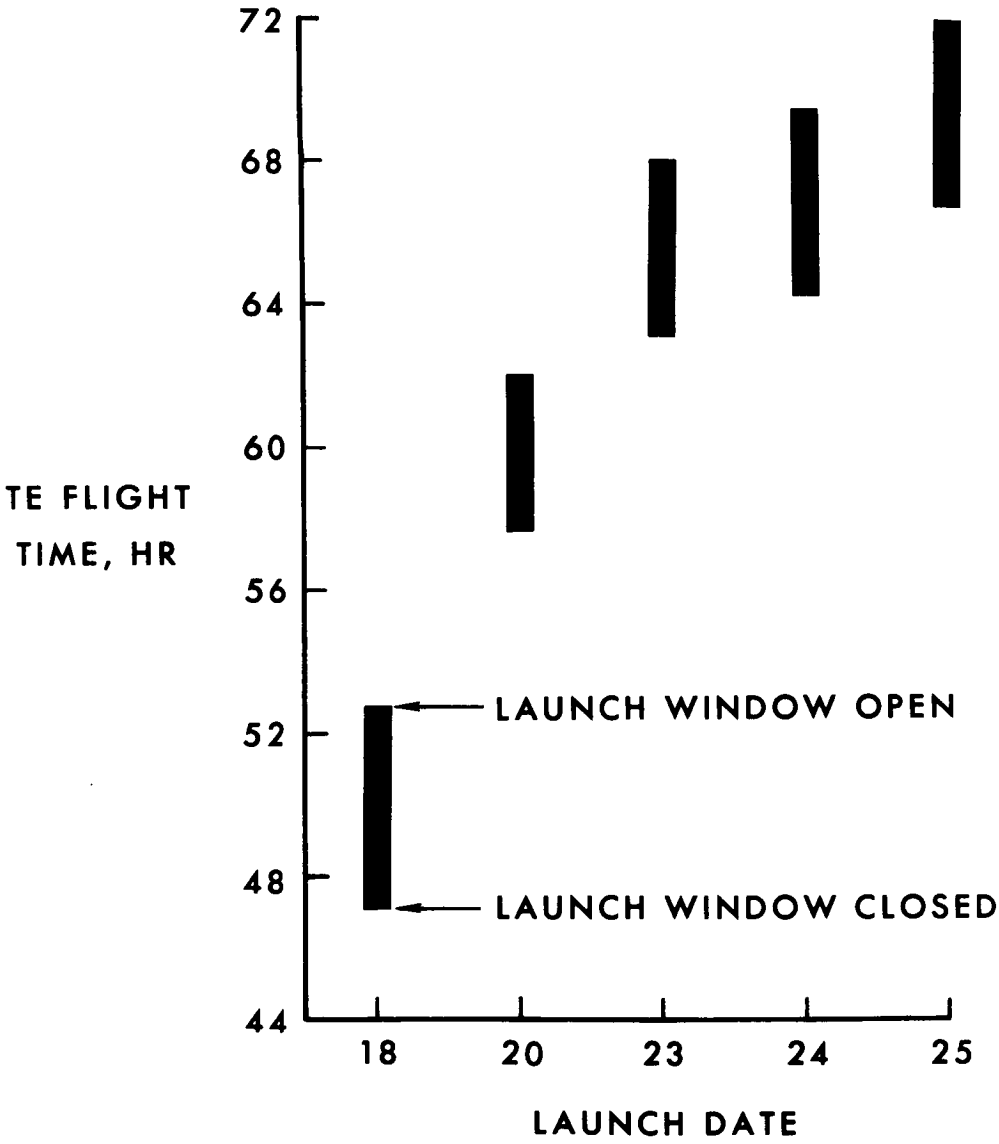
- CORRECTIONS FOR CORRIDOR CONTROL ONLY
- MAINTAIN SAFE ENTRY CONDITIONS WITHIN MSFN UNCERTAINTY
- MAKE CORRECTIONS AT CONVENIENT TIMES IF ΔV GREATER THAN LOCAL MSFN UNCERTAINTY

TRANSEARTH MIDCOURSE CORRECTION STRATEGY

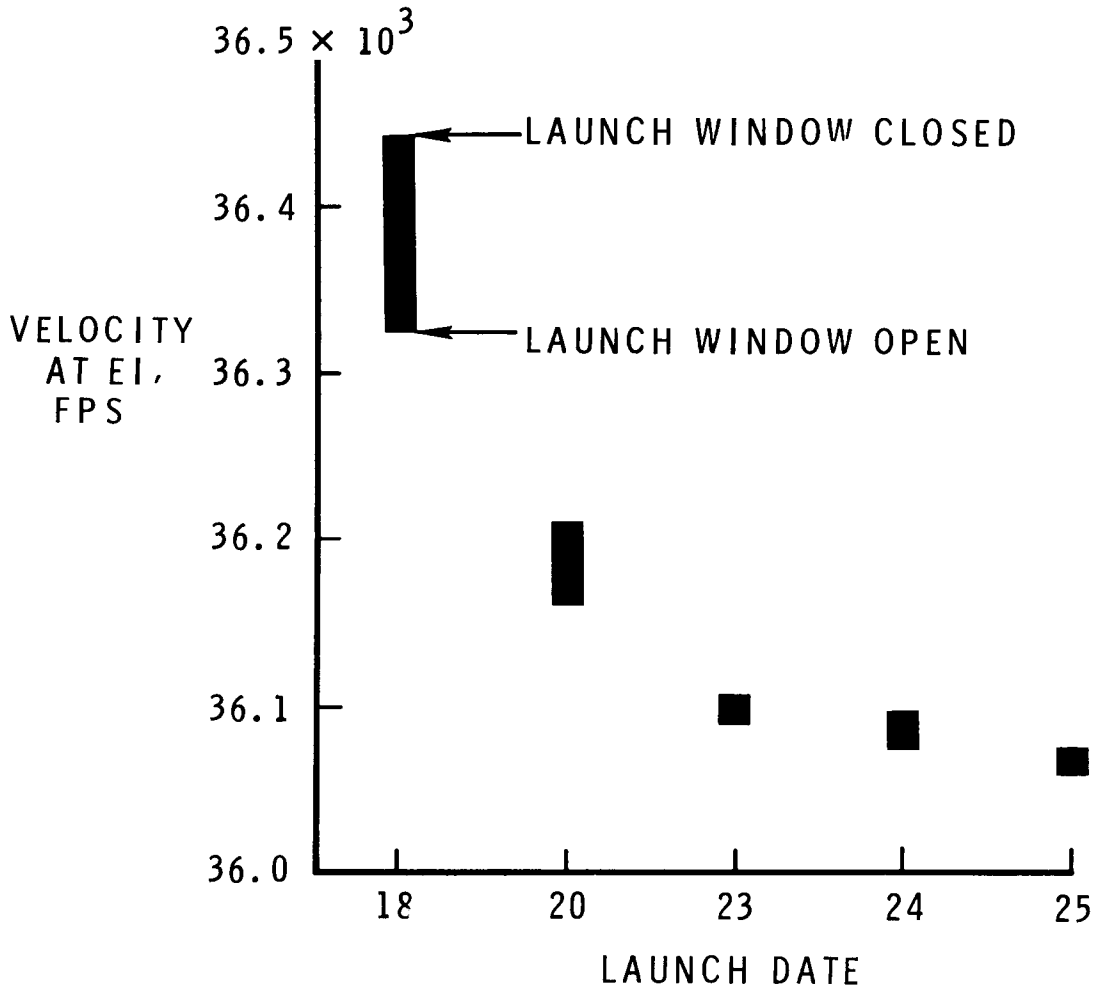


MPAD 4993 S

TRANSEARTH SUMMARY MAY 1969



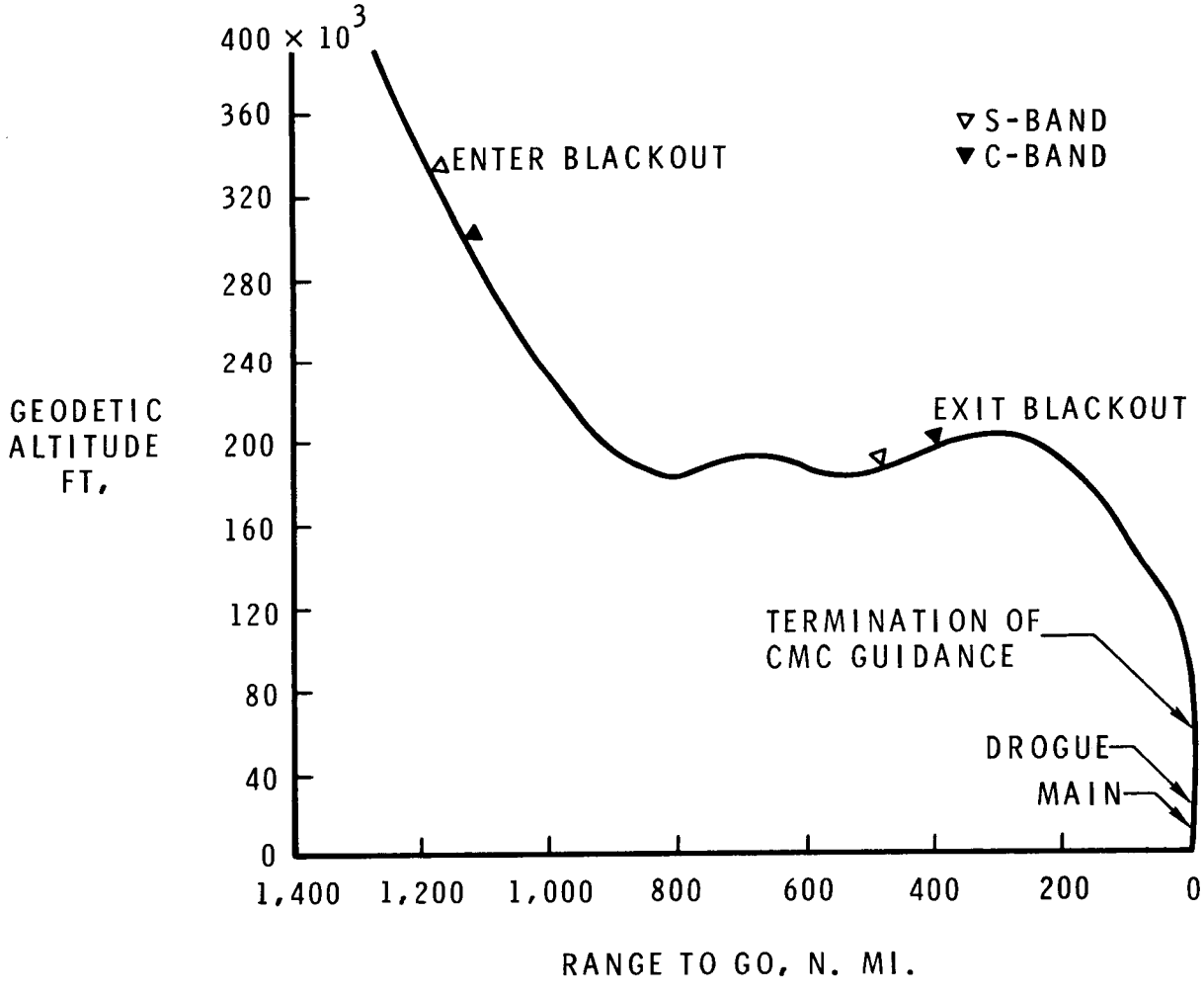
VELOCITY AT ENTRY INTERFACE



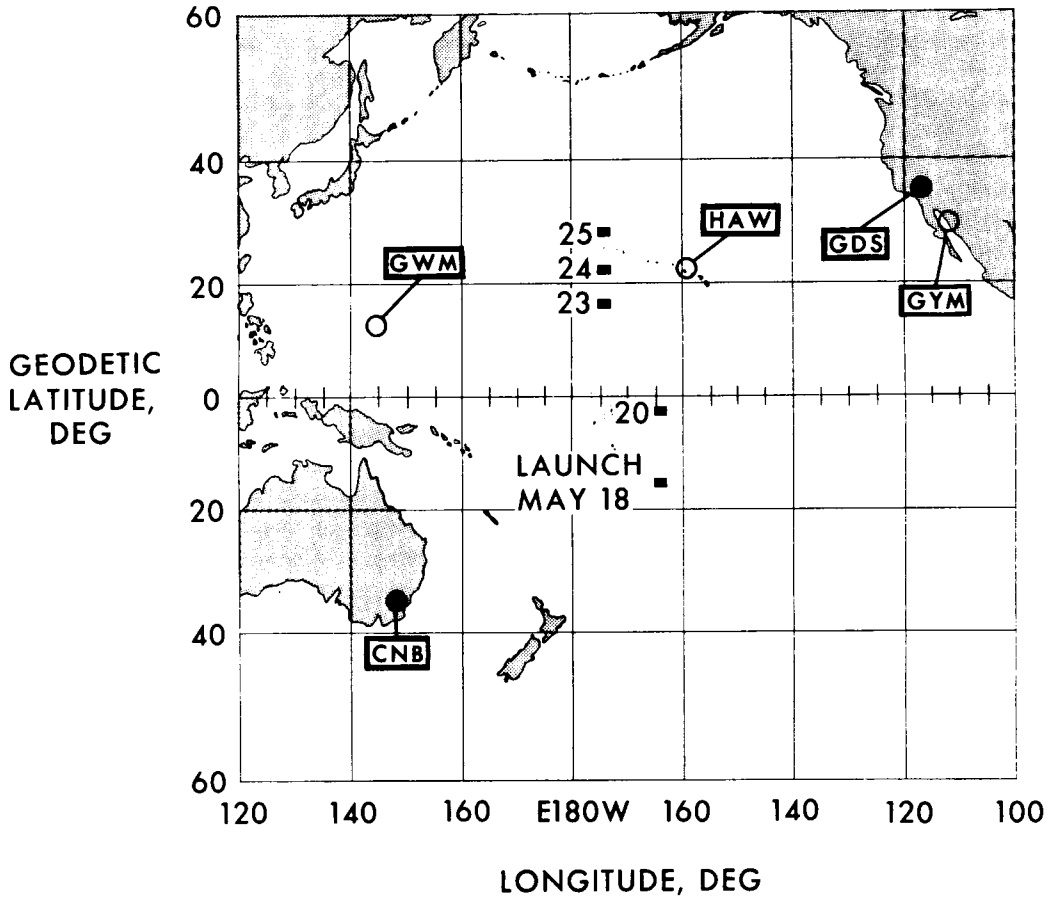
ENTRY

- ENTRY RANGE CAPABILITY - 1200 TO 2500 N. MI.
- NOMINAL ENTRY RANGE - 1285 N. MI.
- SHORT RANGE SELECTED FOR NOMINAL MISSION BECAUSE:
  - RANGE FROM ENTRY TO LANDING CAN BE SAME FOR PRIMARY AND BACKUP CONTROL MODES
  - PRIMARY MODE EASIER TO MONITOR WITH SHORT RANGE
- WEATHER AVOIDANCE, WITHIN ONE DAY PRIOR TO ENTRY, IS ACHIEVED USING ENTRY RANGING CAPABILITY TO 2500 N. MI.
- UP TO ONE DAY PRIOR TO ENTRY USE PROPULSION SYSTEM TO CHANGE LANDING POINT

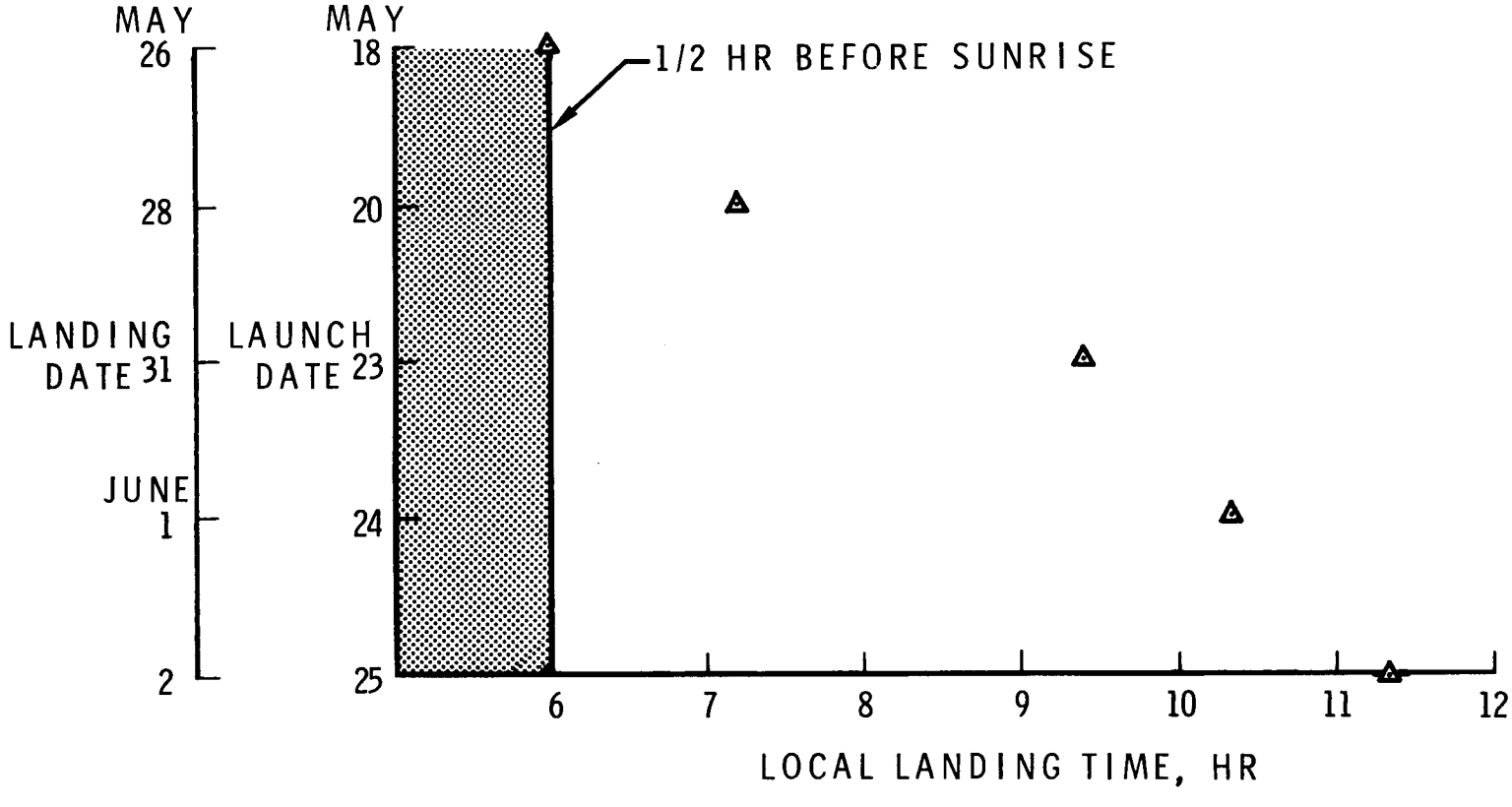
ALTITUDE VERSUS RANGE TO GO



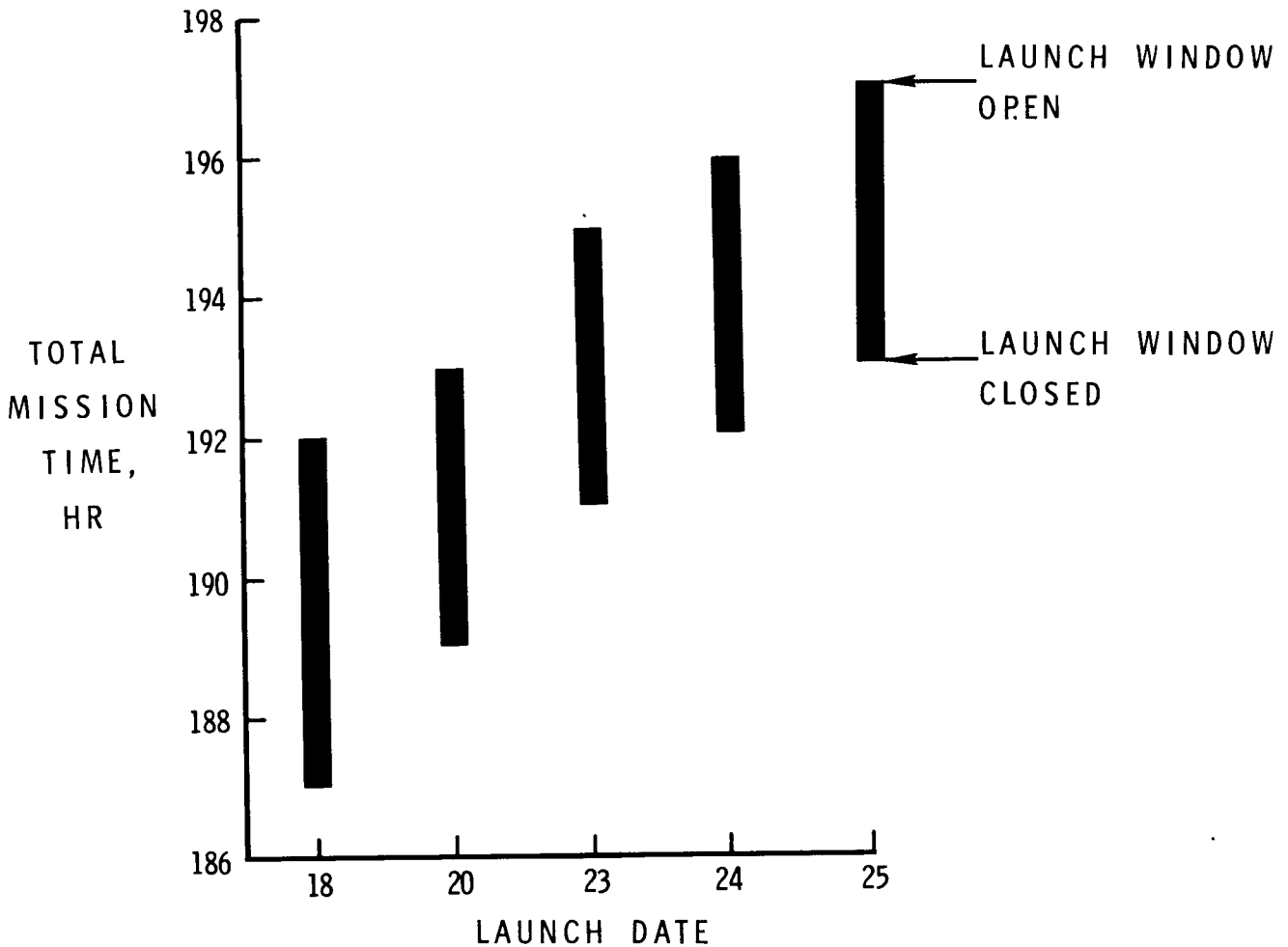
MAY WINDOW
NOMINAL RETURN LOCI



MAY WINDOW RETURN LANDING TIMES



MISSION DURATIONS



2.0 RENDEZVOUS PROFILES

Kenneth A. Young

2.1 Nominal Rendezvous

KEY

MSFN — MANNED SPACEFLIGHT NETWORK

LOS — LOSS OF MSFN SIGNAL

AOS — ACQUISITION OF MSFN SIGNAL

DPS — DESCENT PROPULSION SYSTEM

APS — ASCENT PROPULSION SYSTEM

DOI — DESCENT ORBIT INSERTION

CSI — CONCENTRIC SEQUENCE INITIATION

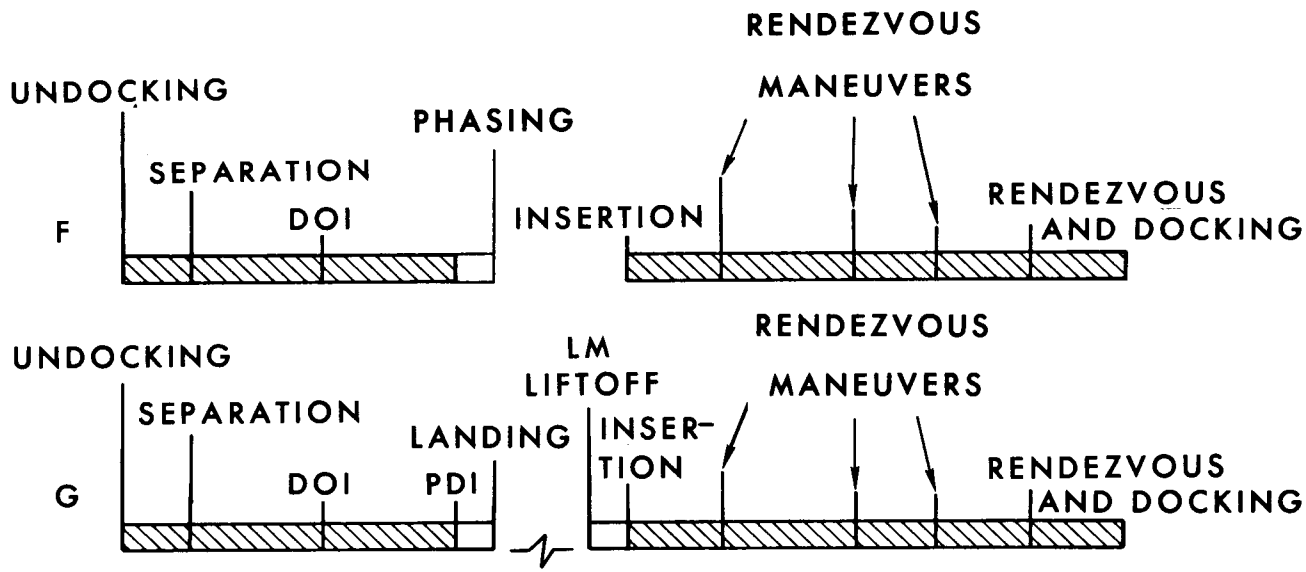
CDH — CONSTANT DIFFERENTIAL HEIGHT

TPI — TERMINAL PHASE INITIATION

APOLLO 10 RENDEZVOUS SEQUENCE

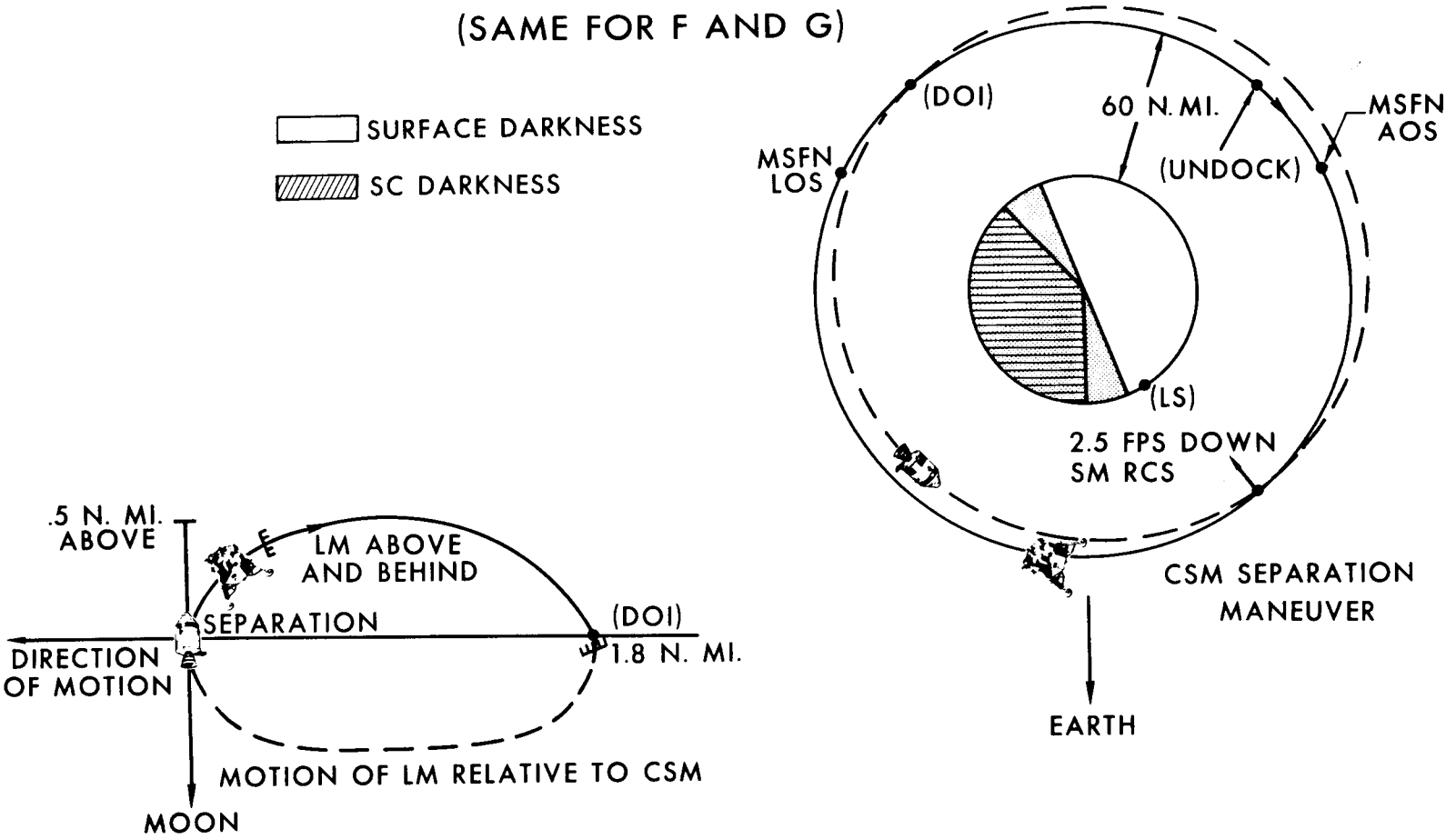
MANEUVER	G.E.T.	ΔV, FPS	ENGINE
SEPARATION	98:35:23	2.5	SM RCS
DOI	99:33:59	71.0	DPS
PHASING	100:46:21	195.0	DPS
INSERTION	102:43:18	207.0	APS
CSI	103:33:46	50.5	LM RCS
CDH	104:31:42	3.4	LM RCS
TPI	105:09:00	24.8	LM RCS
BRAKING	~105:55:00	~60.0	LM RCS
DOCKING	~106:20:00	~5.0	SM RCS

COMPARISON OF F AND G LM OPERATIONS PHASE



MPAD 4978 S

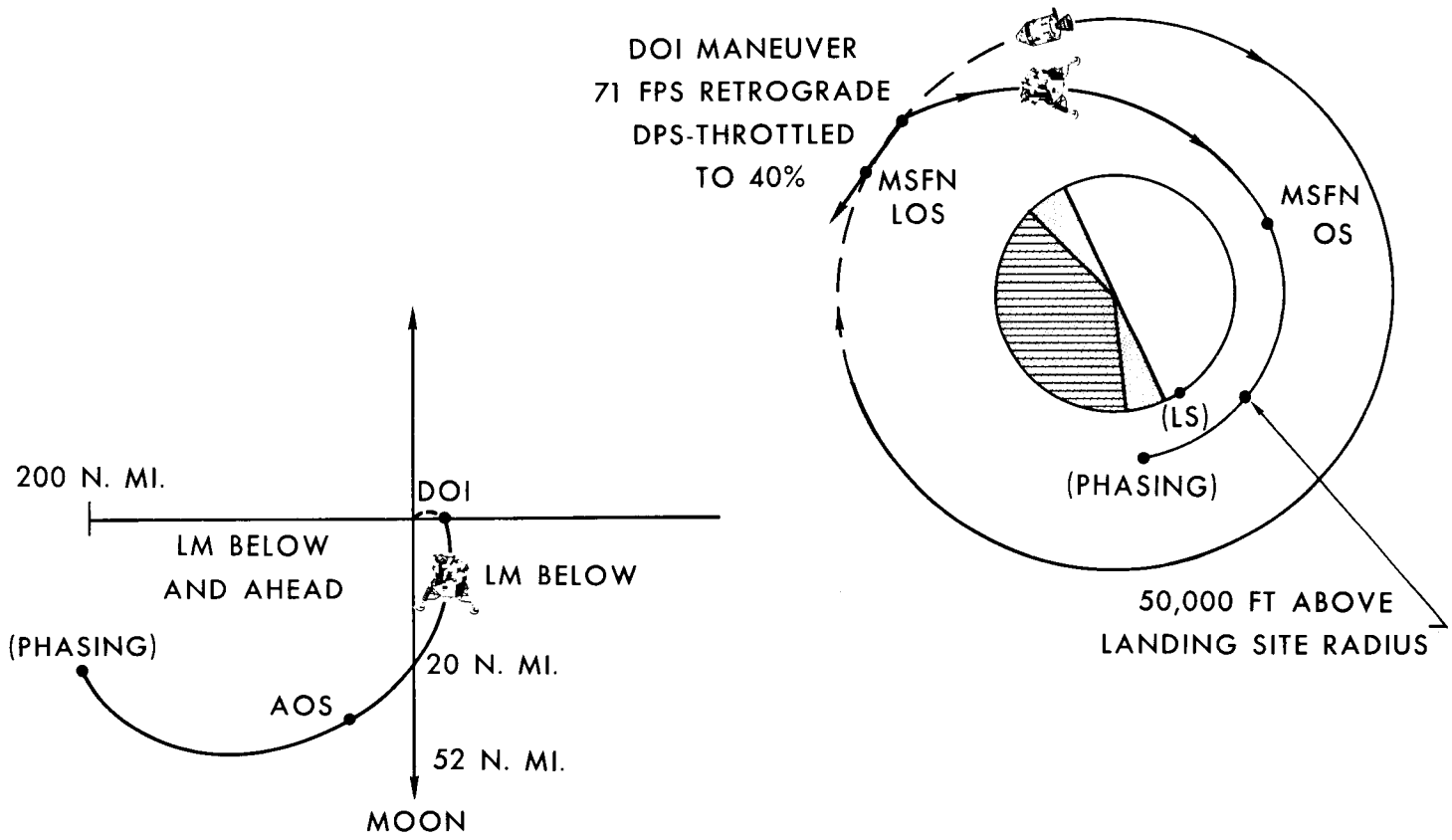
SEPARATION
(SAME FOR F AND G)



MPAD 5265 S

DESCENT ORBIT INSERTION

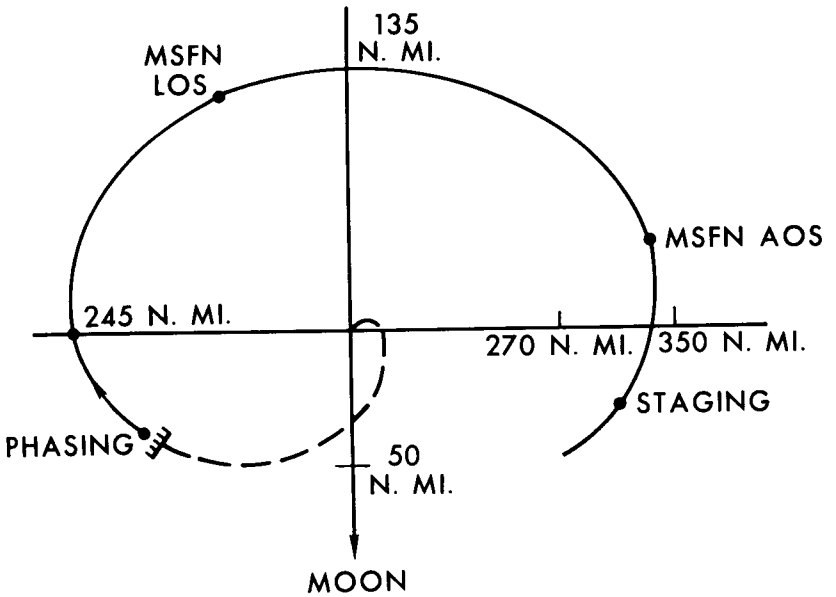
(SAME ON F AND G)

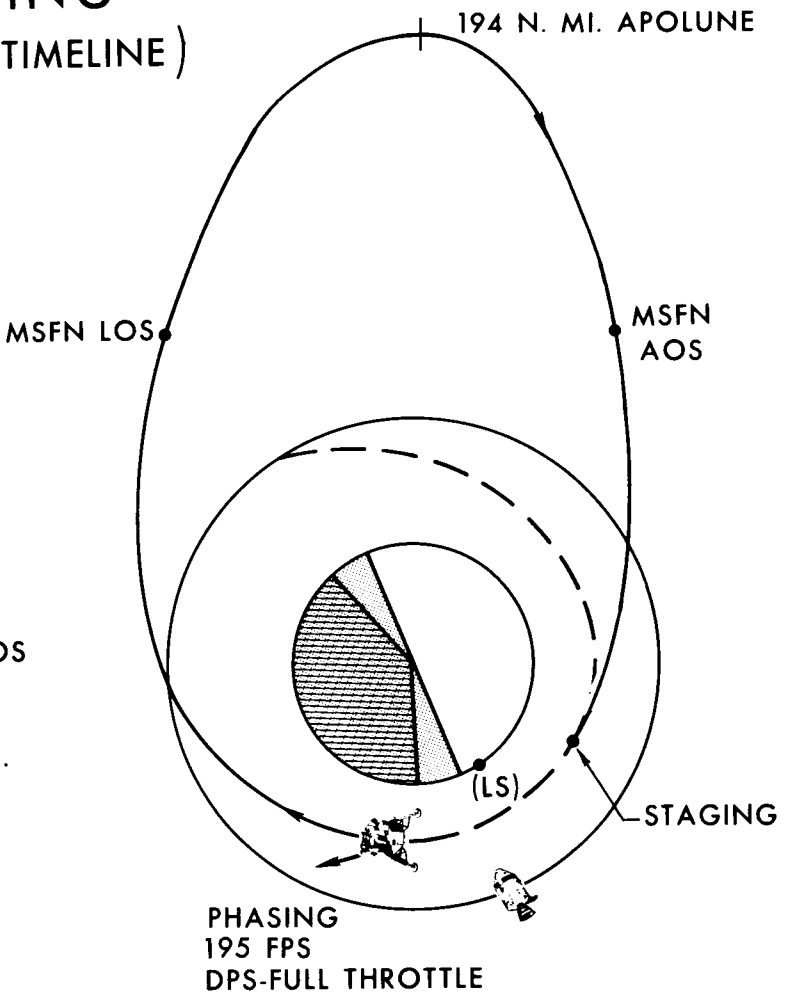


MPAD 5267 S

PHASING

(DEPART G TIMELINE)

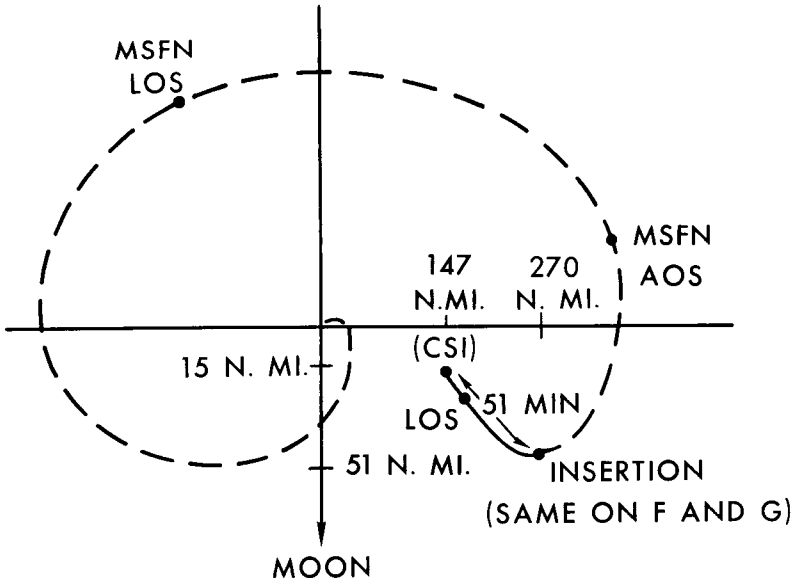


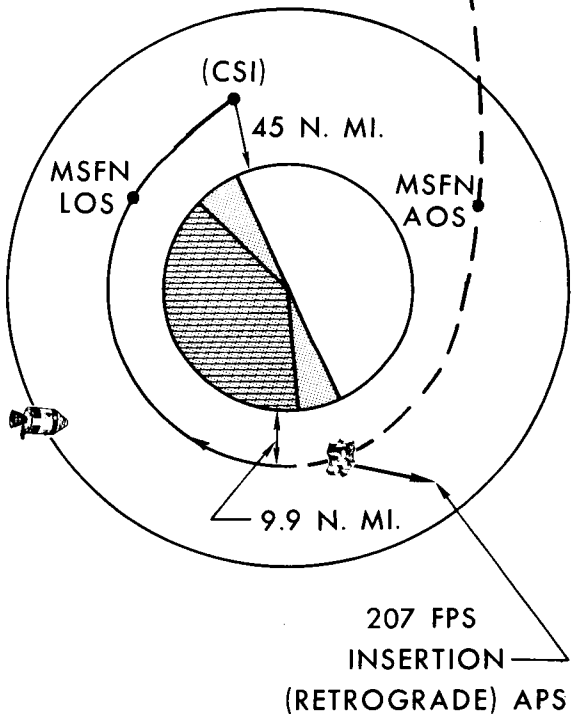


INSERTION

(RESUME G TIMELINE)

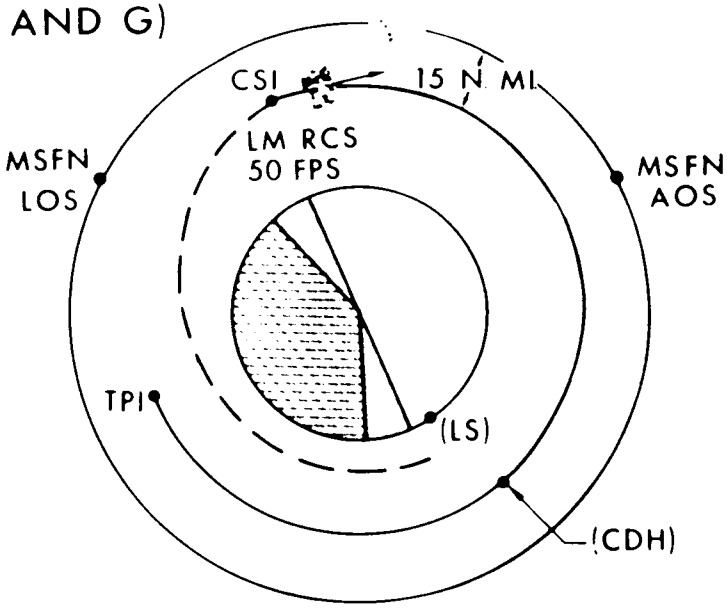
MPAD 5266 S

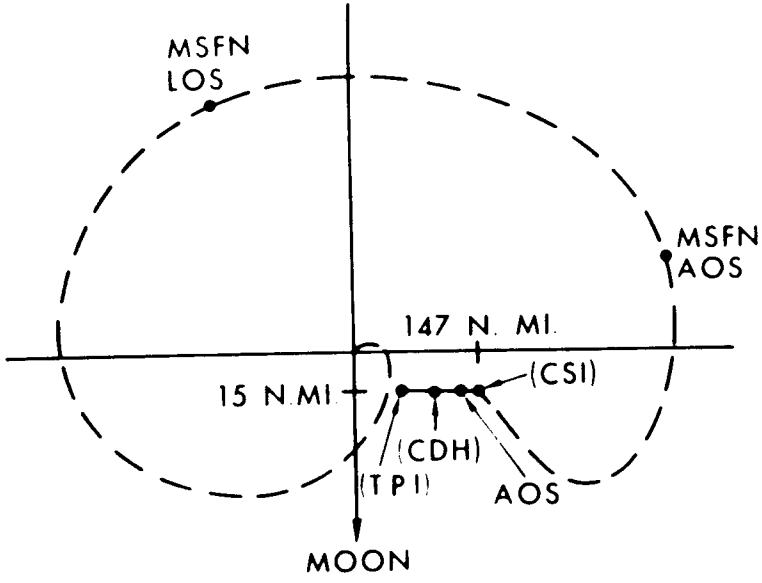




CONCENTRIC SEQUENCE INITIATION

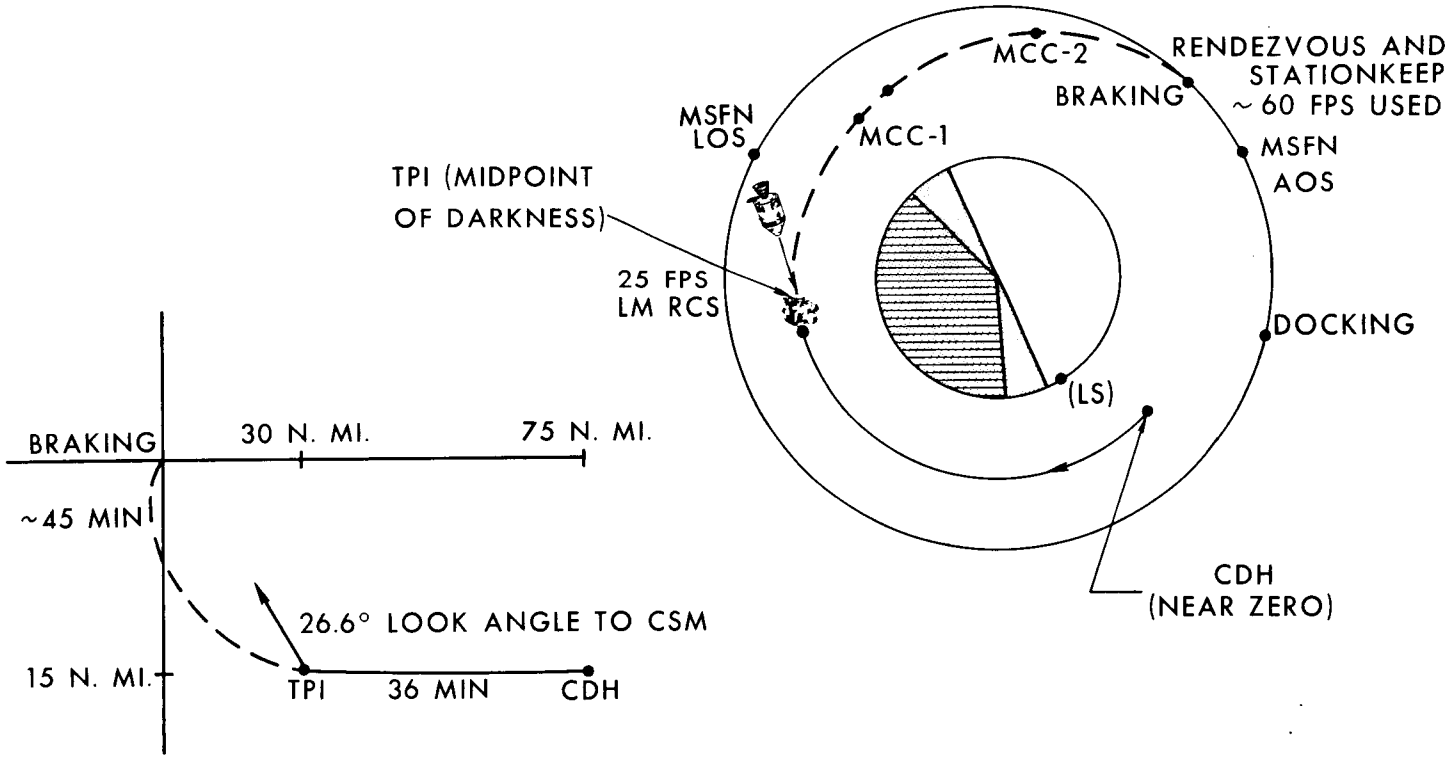
(SAME ON F AND G)





MPAD 4980 S

CONSTANT DIFFERENTIAL HEIGHT AND TERMINAL PHASE
(SAME ON F AND G)

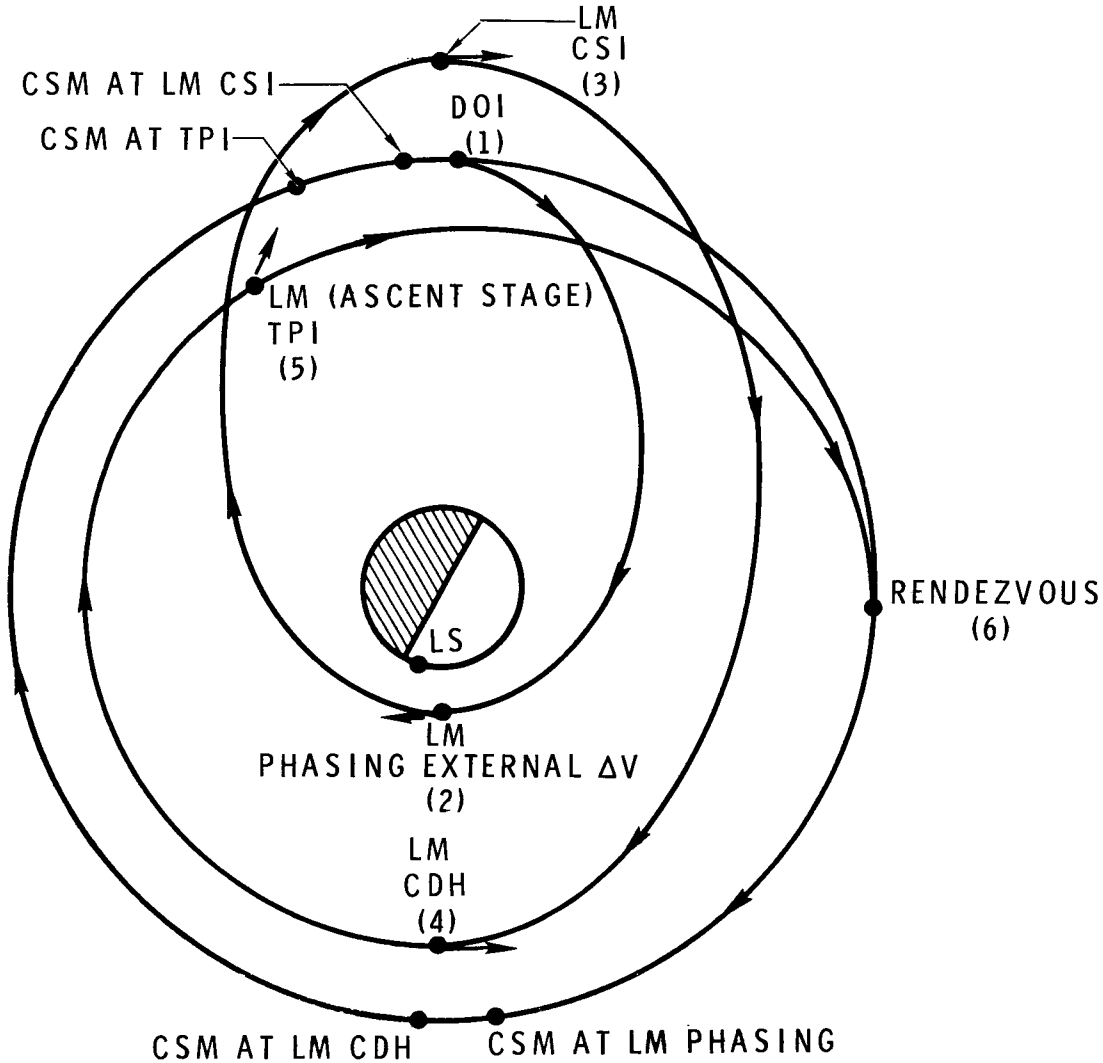


LM RENDEZVOUS SITUATIONS AND TECHNIQUES

- ABORT AFTER DOI
  - MANUAL RENDEZVOUS - PGNCS FAILURE
- ABORT AT PERILUNE
  - PHASE ADJUSTMENT CSI/CDH - DECISION TO DISCONTINUE NOMINAL MISSION
- LM COMPLETION OF RENDEZVOUS WHEN CSM ASSISTANCE IS REQUIRED
  - TERMINAL PHASE - CONSTRAINTS ON CONTINUOUS FIRING OF RCS THRUSTERS
- NOMINAL RENDEZVOUS
  - CSI/CDH

ILLUSTRATION OF PHASE ADJUSTMENT - CSI/CDH

(LM ABORT AT PERILUNE)



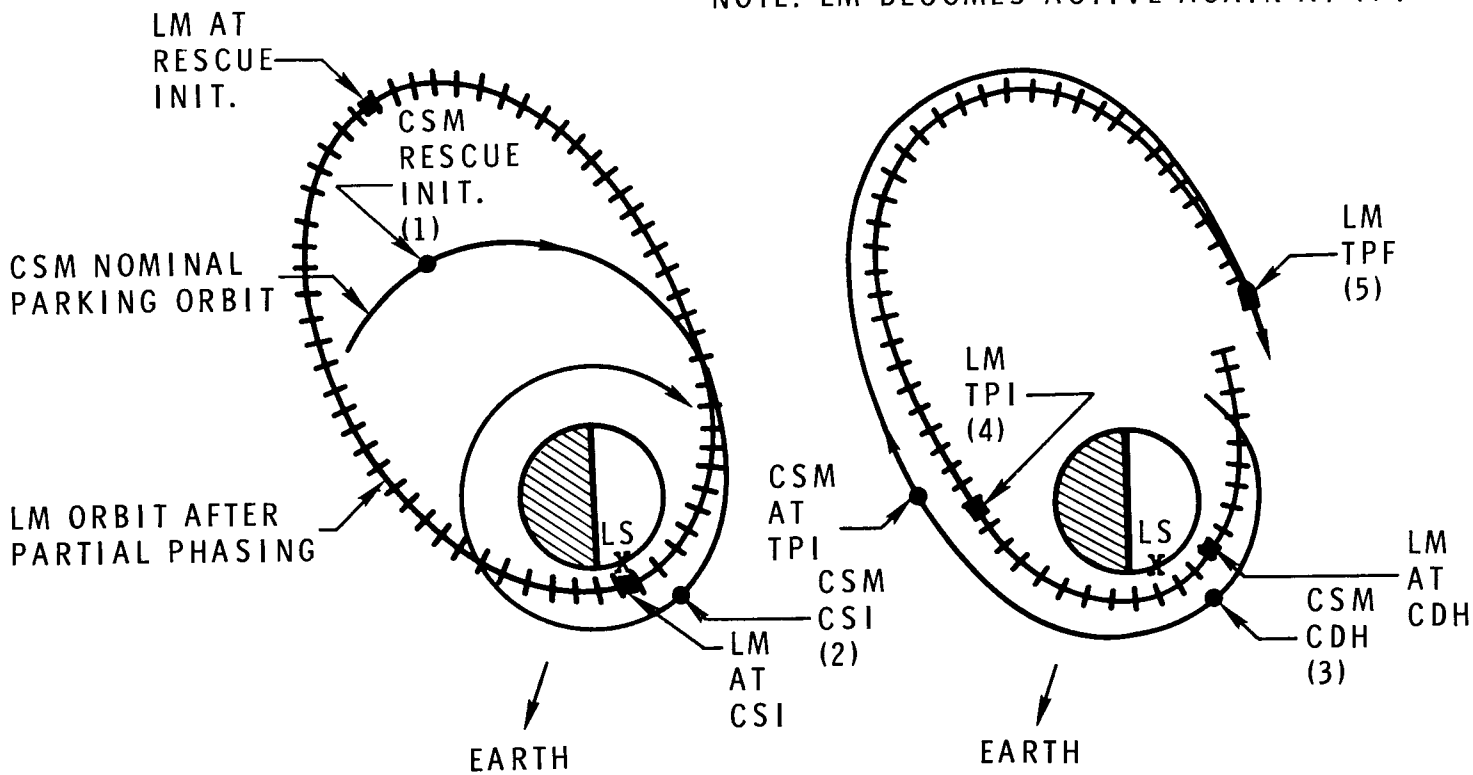
2.2 Abort and Rescue

CSM RESCUE SITUATIONS AND TECHNIQUES

- RESCUE INITIATION OCCURS 1 REV AFTER DOI
  - HEIGHT ADJUST CSI/CDH
    - LM IS SHOWN TO BE COMPLETELY PASSIVE AFTER DOI
    - BOTH THE DPS AND APS KNOWN TO HAVE FAILED PRIOR TO COMPLETION OF PHASING
- RESCUE INITIATION OCCURS 3 MIN AFTER PLANNED LM INSERTION MANEUVER
  - CSM INSERTION CSI/CDH
    - APS FAILED AT INSERTION WITHIN RCS CAPABILITY TO REMOVE THE ΔV
- RESCUE INITIATION OCCURS 2 REV AFTER DOI
  - HEIGHT ADJUST CSI/CDH
    - APS FAILED IN THE REGION WHERE LM RCS CANNOT BE USED EITHER TO COMPLETE INSERTION OR REMOVE THE ΔV
- RESCUE INITIATION OCCURS AT NOMINAL CSI TIME
  - CSI/CDH - LM COMPLETES INSERTION THEN BECOMES INACTIVE
- RESCUE INITIATION OCCURS AT NOMINAL CDH TIME
  - CDH - LM BECOMES INACTIVE AFTER CSI

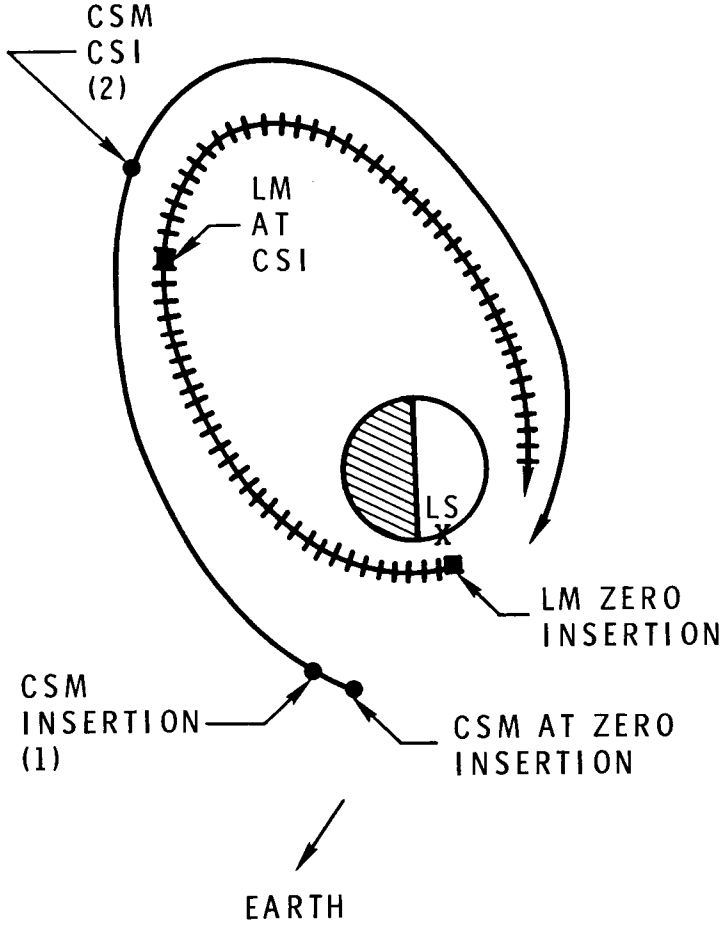
RESCUE SEQUENCE AFTER PARTIAL LM MANEUVERS

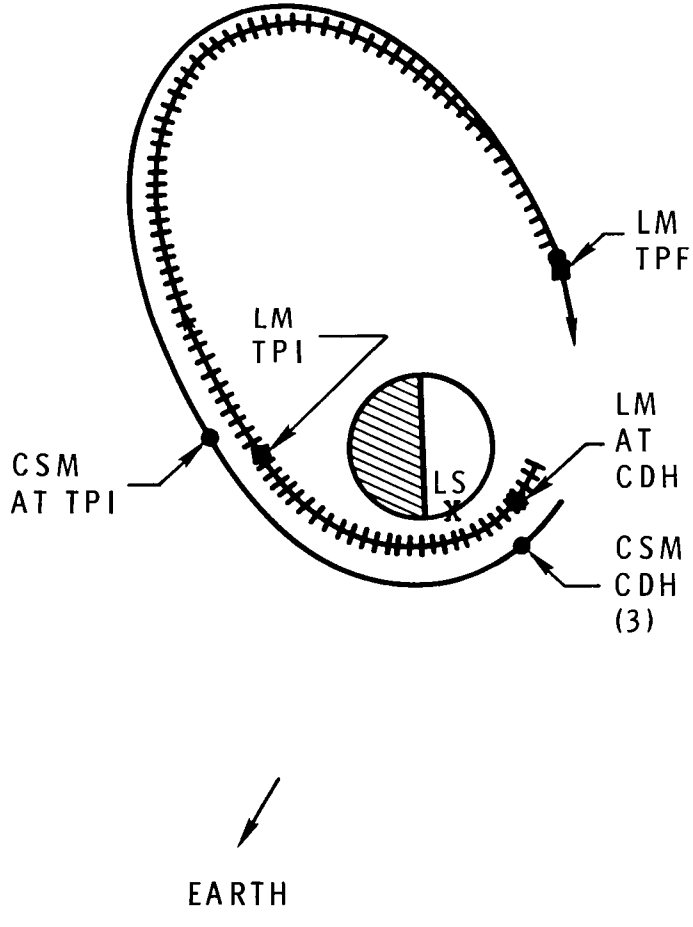
NOTE: LM BECOMES ACTIVE AGAIN AT TPI



RESCUE SEQUENCE AFTER ZERO LM INSERTION

NOTE: LM BECOMES ACTIVE AGAIN AT TPI



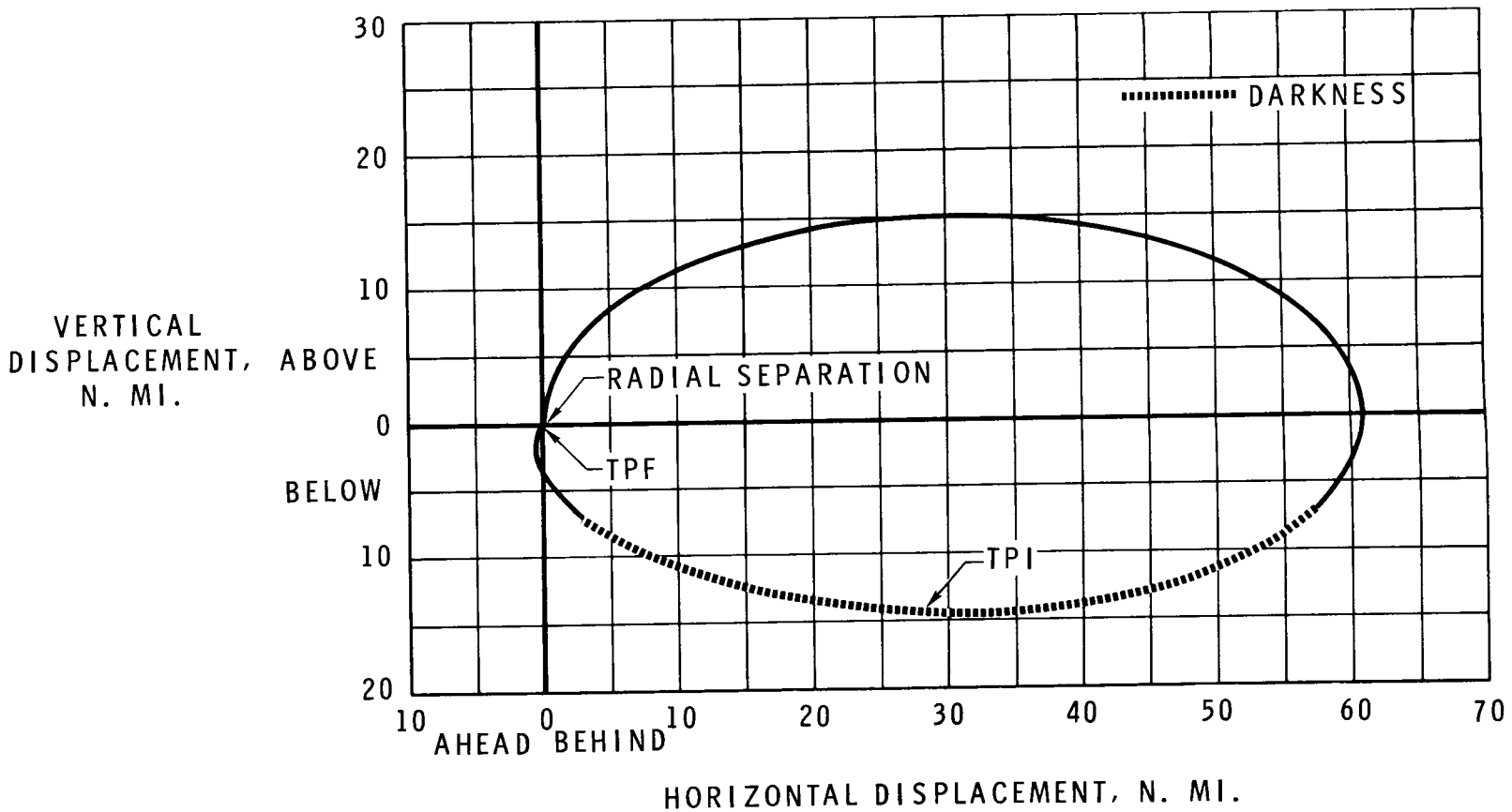


2.3 Alternate Lunar Rendezvous

POSSIBLE LUNAR RENDEZVOUS ALTERNATES

RENDEZVOUS ALTERNATE	CONTINGENCY SITUATION	DURATION OF RENDEZVOUS SEQUENCE
DPS - ONLY (1) CSM DOES BRAKING (2) STAGE AFTER CDH, LM DOES TERMINAL PHASE	(1) UNABLE TO STAGE OR APS POWER LIMITED (2) NO USABLE APS	7 1/2 HOURS (NOMINAL)
APS - ONLY MAXIMUM RANGE = 100 N. MI.	DPS INOPERATIVE	5 1/2 HOURS (LIKE PDI ABORT)
FOOTBALL MAXIMUM RANGE = 60 N. MI.	APS AND DPS IN-OPERATIVE	3 1/2 HOURS

RELATIVE MOTION ALTERNATE C, MODIFIED FOOTBALL



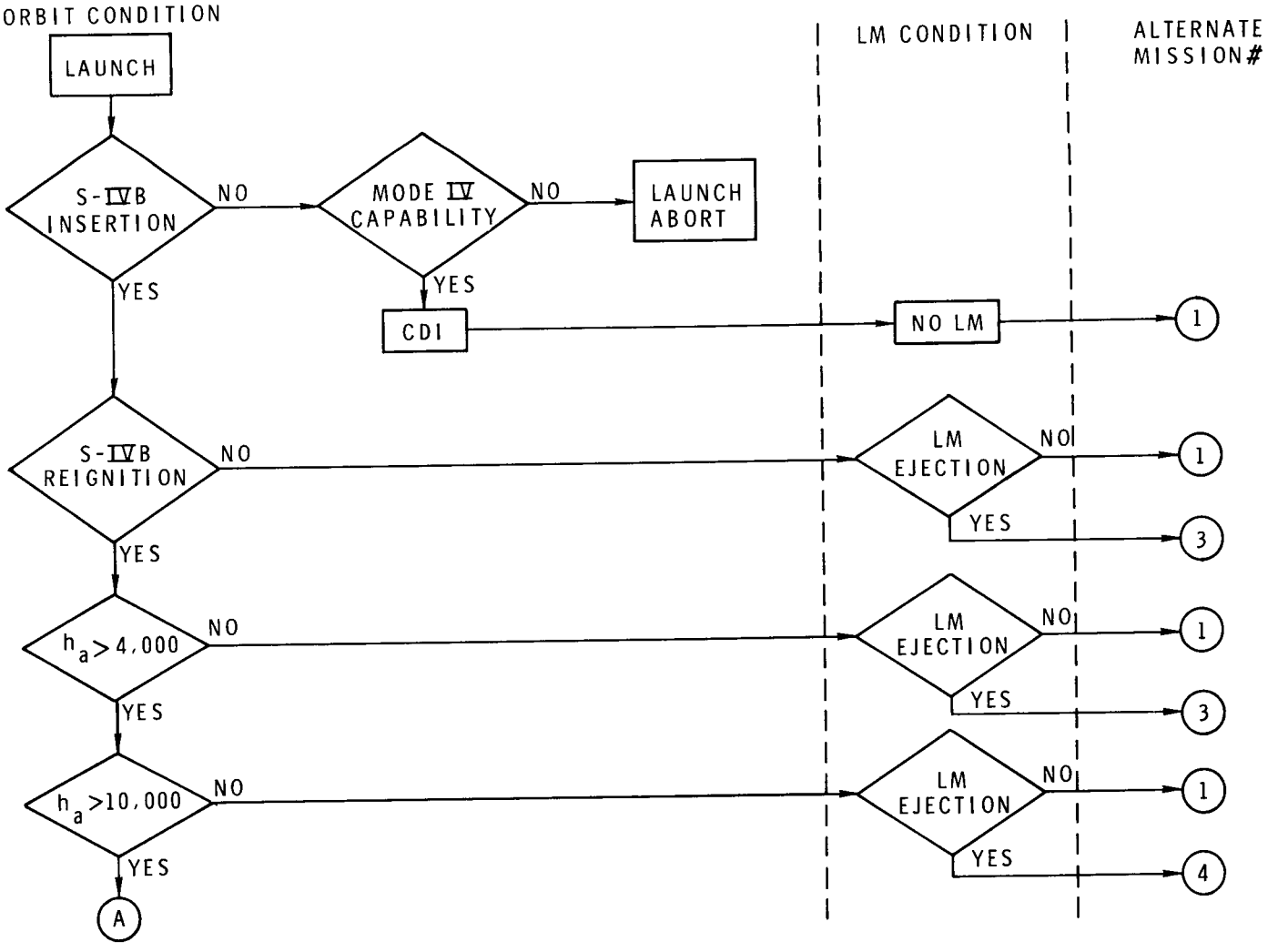
2.4 Earth Orbital Alternate Rendezvous and Earth Orbital Alternate Missions

MPAD 5279 S

ALTERNATE MISSION EARTH ORBIT GUIDELINES

- LM TESTING TAKES PRIORITY OVER CSM TESTING
- A LUNAR MISSION TIMELINE IS DESIRABLE
- NO ADDITIONAL CREW TRAINING WILL BE NECESSARY
- RCS DEORBIT CAPABILITY WILL BE MAINTAINED
- COVERAGE FOR ALL SPS AND DPS MANEUVERS IS DESIRABLE.
  COVERAGE FOR ALL LARGE LM MANEUVERS IS MANDATORY
- ALTERNATE MISSIONS WILL BE OPEN ENDED UP TO 10 DAYS

"F" EARTH ORBIT ALTERNATE MISSION FLOW CHART



ALTERNATE MISSION #1

(LOW EARTH ORBIT CSM ONLY)

- SIMULATED LOI (100-400)
- FURTHER MCC'S TO APPROXIMATE LUNAR MISSION TIMELINE
- APPROXIMATELY A 10 DAY MISSION

ALTERNATE MISSIONS #3 & 4

(LOW EARTH ORBIT WITH RENDEZVOUS)

- PHASING MANEUVER TO INSURE TRACKING FOR SECOND SIMULATED PDI MANEUVER
- SIMULATED DOI (1 HOUR PRIOR TO SIMULATED PDI)
- SIMULATED PDI
- PHASING MANEUVER TO INSURE TRACKING FOR SIMULATED LOI
- SIMULATED LOI (100-400 N. MI. ORBIT)
- TWO SPS MANEUVERS TO CIRCULARIZE AT 150 N. MI.
- LM ACTIVE RENDEZVOUS
- APS BURN TO DEPLETION (AGS CONTROLLED)
- FURTHER MCC'S TO COMPLETE LUNAR MISSION TIMELINE
- APPROXIMATELY 10 DAY MISSION

*IF TLI $h_a \leq 4000$ N. MI. MANEUVERS 4 AND 5 COULD PRECEDE 1, 2, 3

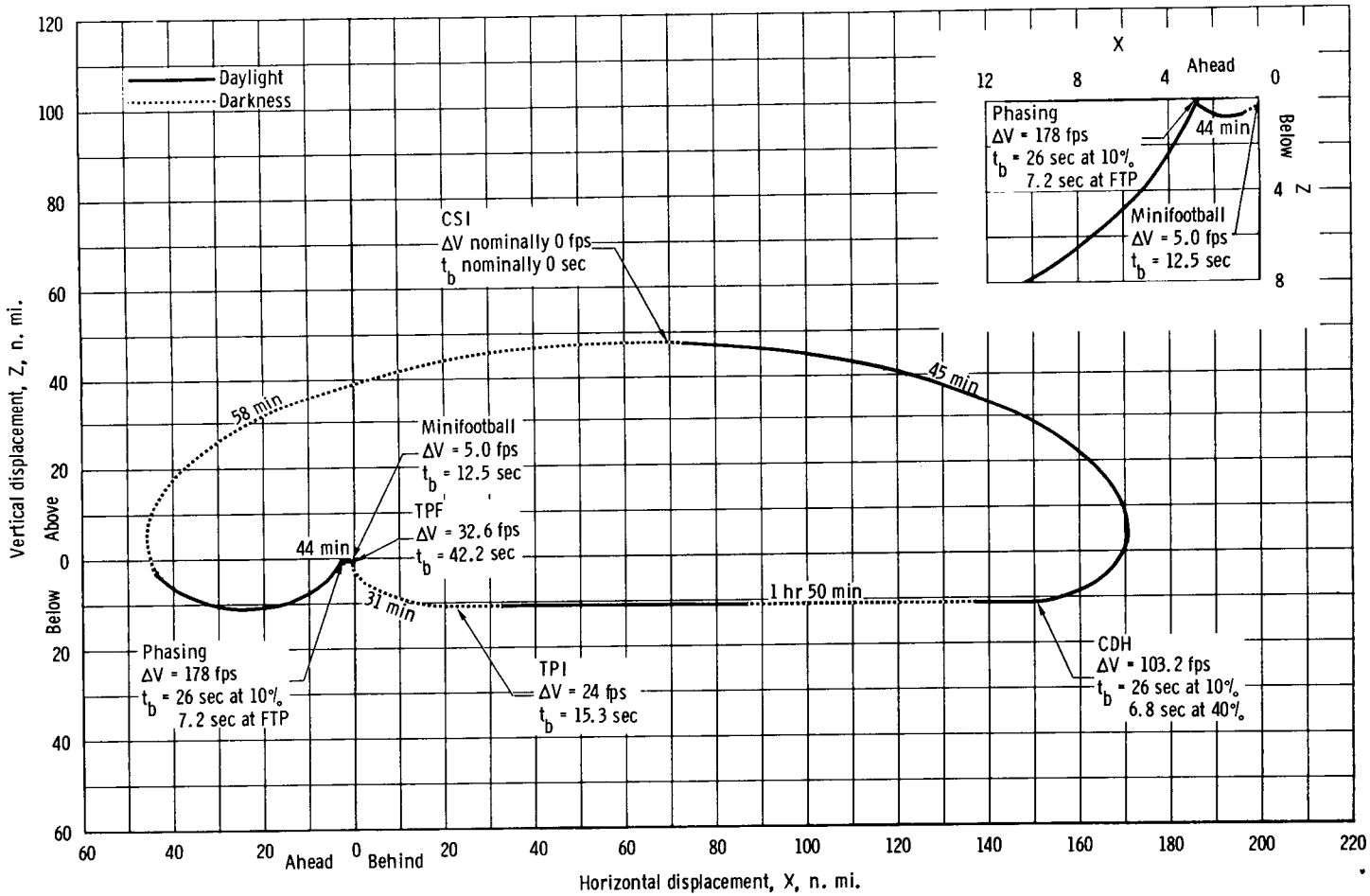
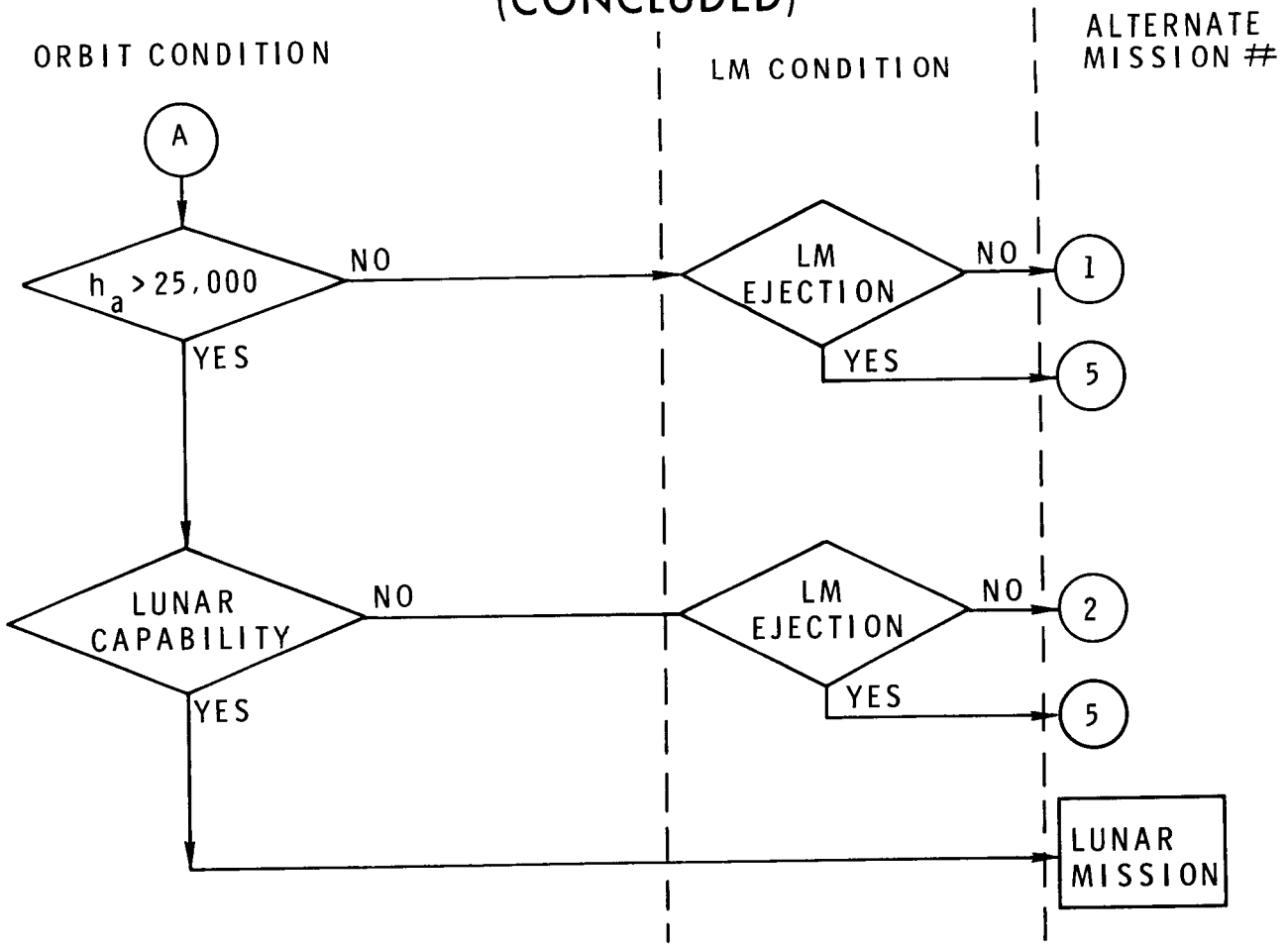


Figure 2.- Relative motion for F mission earth orbital alternate rendezvous.

"F" EARTH ORBIT ALTERNATE MISSION FLOW CHART (CONCLUDED)



ALTERNATE MISSION #5

- PHASING MANEUVER TO INSURE TRACK FOR SIMULATED LOI
- SIMULATED LOI (APPROXIMATELY SEMISYNCHRONOUS)
- PHASING MANEUVER TO INSURE TRACKING FOR PDI
- SIMULATED DOI (1 HOUR PRIOR TO SIMULATED PDI)
- SIMULATED PDI (APPROXIMATELY SEMISYNCHRONOUS)
- APS TO DEPLETION (AGS CONTROLLED)
- PHASING MANEUVER TO PUT PERIGEE OVER RECOVERY ZONE LATER (40 SECOND MANEUVER)
- SPS-(SEMISYNCHRONOUS)
- MCC'S TO COMPLETE LUNAR MISSION TIMELINE
- APPROXIMATELY A 10 DAY MISSION

ALTERNATE MISSION #2

(SEMISYNCHRONOUS WITH CSM ONLY)

- PHASING MANEUVER TO ADJUST ORBIT PERIOD TO G.E.T. SIMULATED LOI TRACK
- SIMULATED LOI (NEAR SEMISYNCHRONOUS)
- PHASING MANEUVER TO PLACE PERIGEE OVER RECOVERY ZONE AT A LATER TIME
- SPS TO SEMISYNCHRONOUS ORBIT
- FURTHER MCC'S TO APPROXIMATE LUNAR TIMELINE
- APPROXIMATELY A 10 DAY MISSION

3.0 ALTERNATE LUNAR MISSIONS

Rocky D. Duncan

LUNAR ALTERNATE MISSIONS

ALTERNATE 1

CONTINGENCY: NON NOMINAL TLI

ALTERNATE 1 A: DPS LOI

1 B: CSM ONLY -- LUNAR ORBITAL MISSION

1 C: CSM/LM FLYBY

ALTERNATE 2

CONTINGENCY: FAILURE TO PERFORM T.D. AND E

ALTERNATE 2: CSM ONLY -- LUNAR ORBITAL MISSION

ALTERNATE 3

CONTINGENCY: LM NO GO FOR RENDEZVOUS

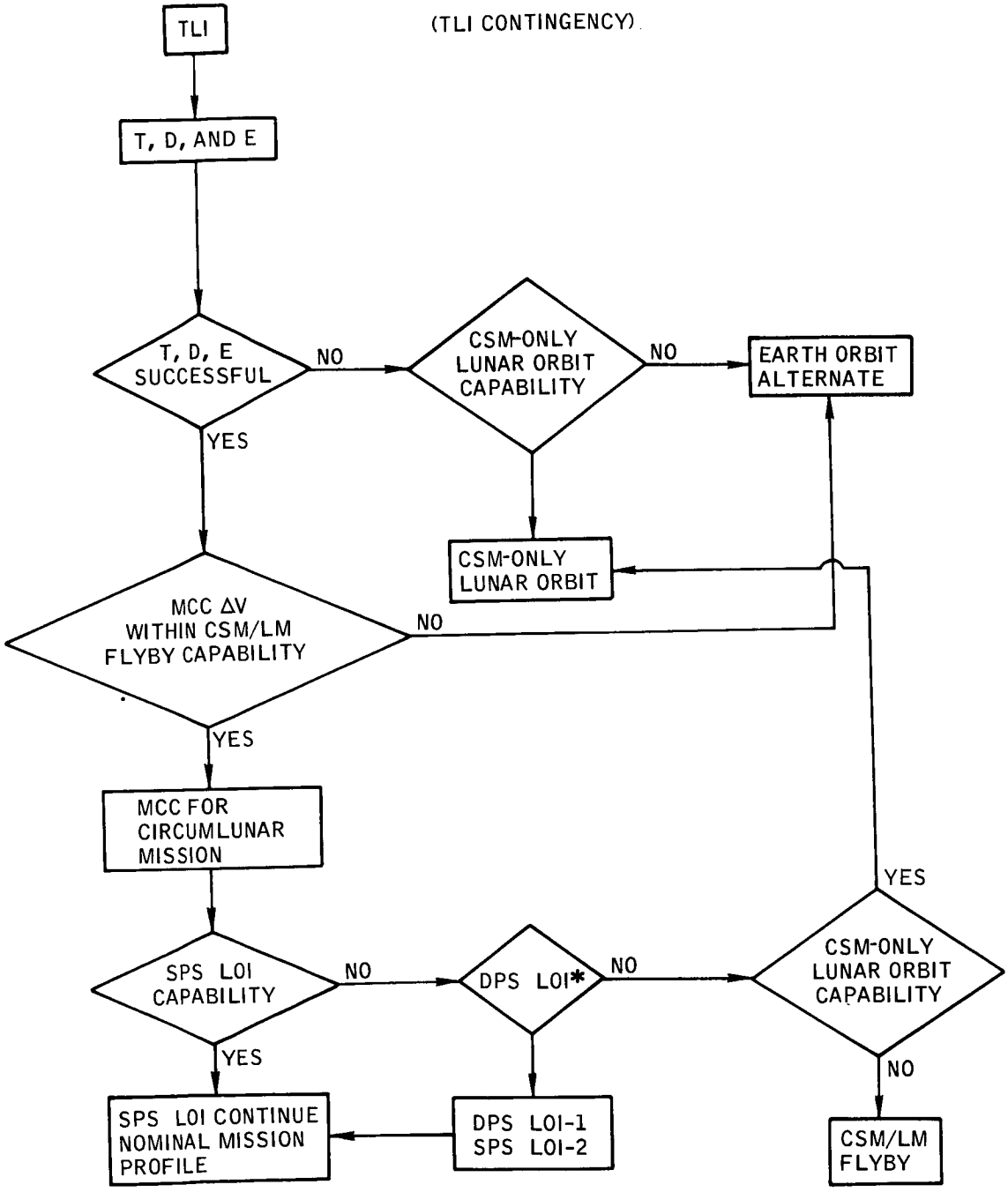
ALTERNATE 3: DPS LOI

ALTERNATE 4

CONTINGENCY: LM NO GO FOR RENDEZVOUS OR DPS TEI

ALTERNATE 4: APS BURN TO DEPLETION

DECISION LOGIC FOR LUNAR ALTERNATE MISSIONS

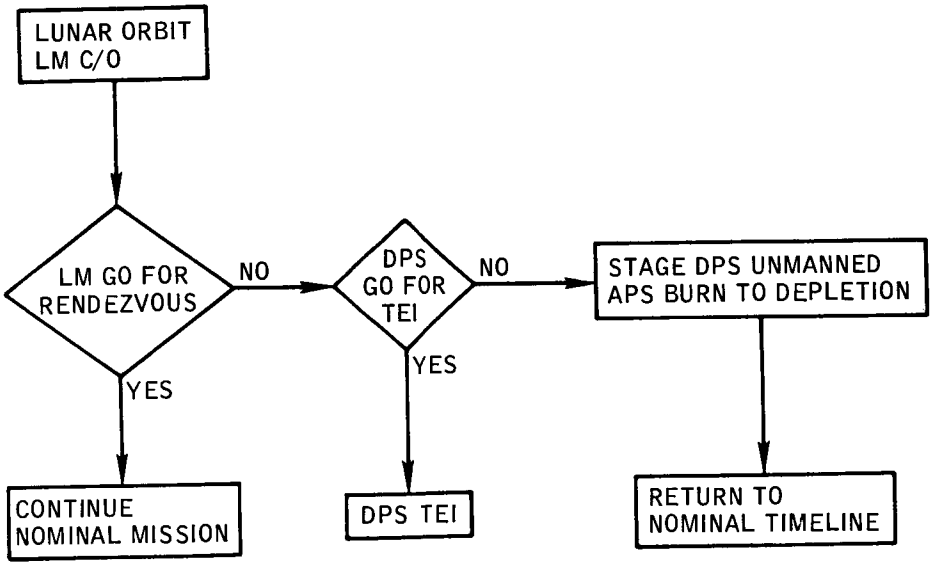


*WITHIN DEFINED GUIDELINES

MPAD 5280 S

DECISION LOGIC FOR LUNAR ALTERNATE MISSIONS (CONCLUDED)

(LUNAR ORBIT)



ALTERNATE 1-A

- DPS LOI

  1: SPS MCC PRECLUDES SPS LOI-1 LOI-2, TEI

  2: DPS LOI -- 60 BY 700 TO 60 BY 1600*

     A: SUMP TANKS MUST BE FULL

     B: LOI-2 MUST BE AT LEAST 40 SECOND SPS BURN

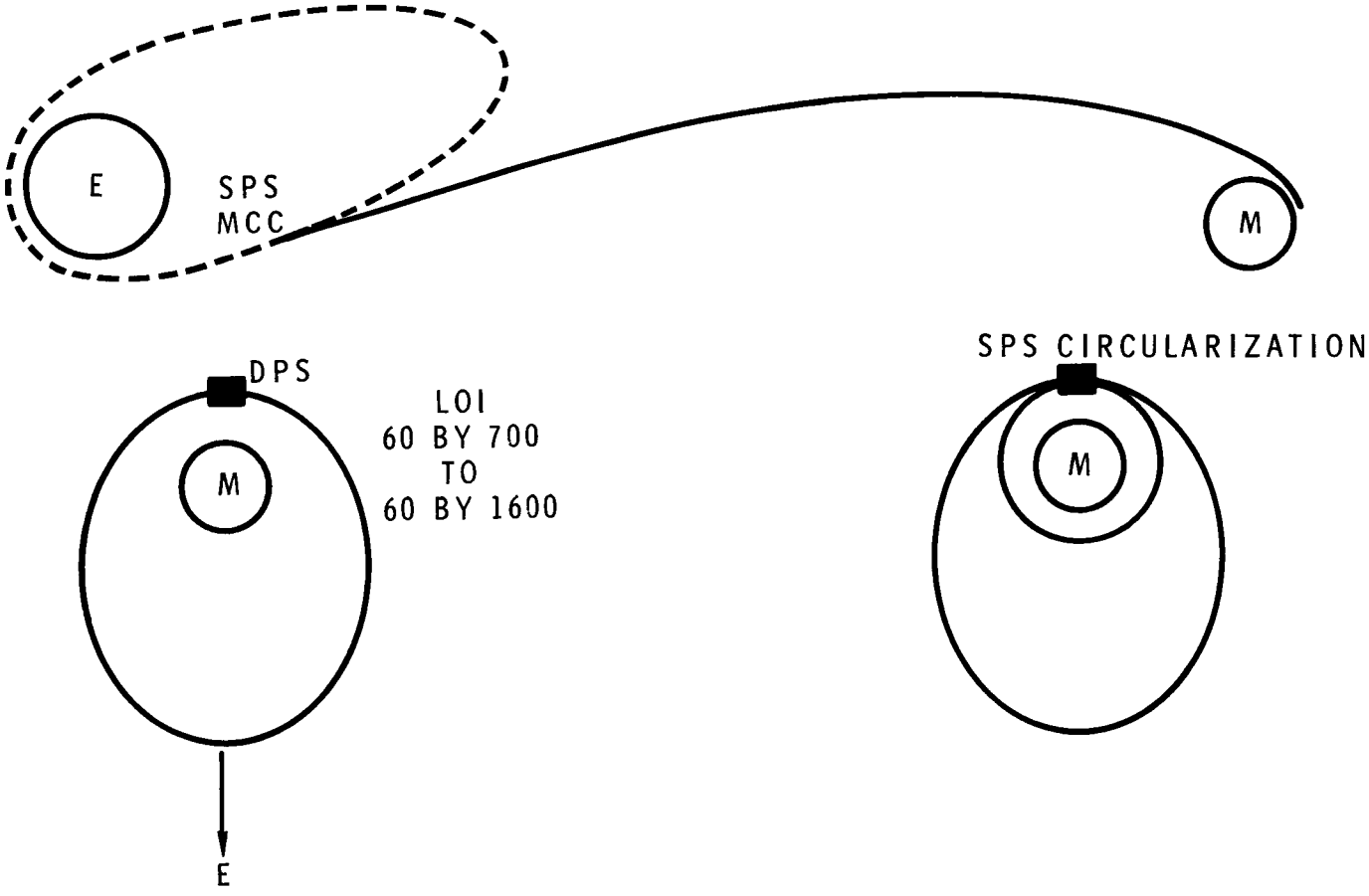
  3: SPS LOI-2

  4: RETURN TO NOMINAL MISSION PROFILE

*FUNCTION OF W_0 AT LOI; THEREFORE FUNCTION OF SIZE OF TL MCC

MPAD 5277 S(IU)

DPS LOI



ALTERNATE 1-B

- CSM ONLY LUNAR ALTERNATE
  - 1: LM TESTING TL COAST
    - NO DPS BURN
    - APS BURN TO DEPLETION
  - 2: RETURN TO NOMINAL MISSION TIMELINE

ALTERNATE 1-C

- CSM/LM FLYBY

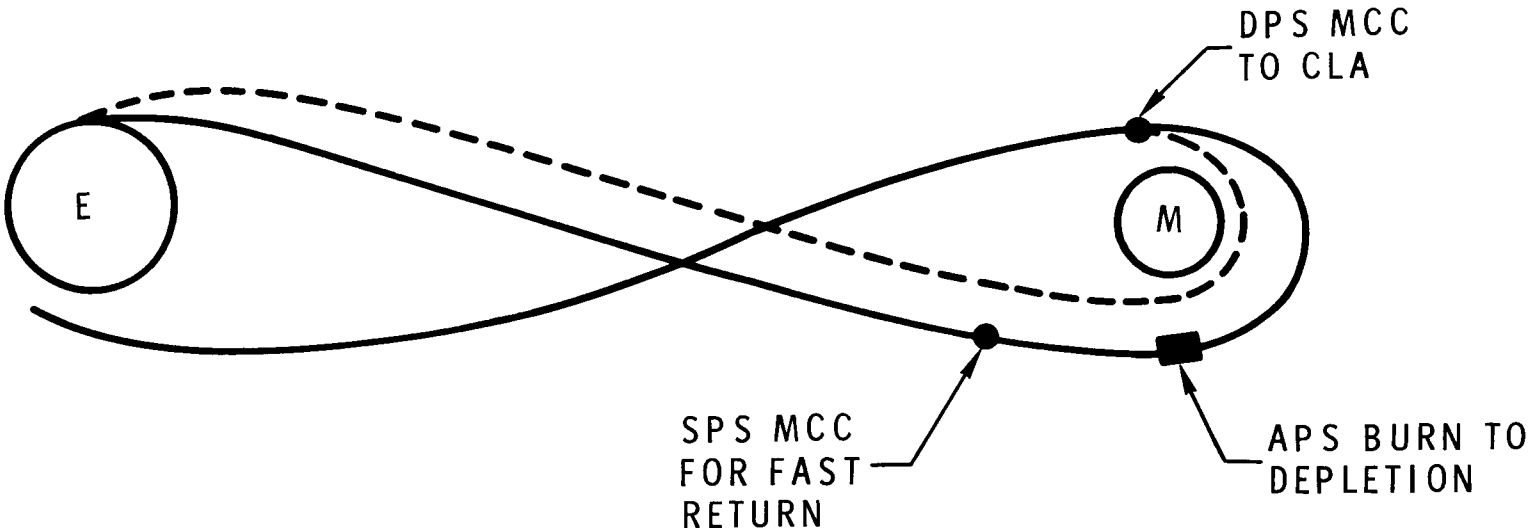
  1: DPS MCC AT LOI-5 HRS TO 65W CLA

  2: APS BURN TO DEPLETION AT PC + 2 HRS

  3: SPS MCC AT PC + 15 HRS* FOR FAST RETURN

*FUNCTION OF TRACKING REQUIRED

CSM/LM FLYBY


DPS MCC
TO CLA
E
M
SPS MCC
FOR FAST
RETURN
APS BURN TO
DEPLETION

ALTERNATE 2

- CSM ONLY -- LUNAR ORBITAL MISSION

  1: LOI DAY -- PRIMARILY PHOTOGRAPHY

  2: DOI DAY

     4 REVOLUTIONS OF LNDMK TRACKING

  3: SPS DOI INTO 60 BY 8 N. MI. FOR 3 REVOLUTIONS

  4: CIRCULARIZE AT 3RD APOGEE

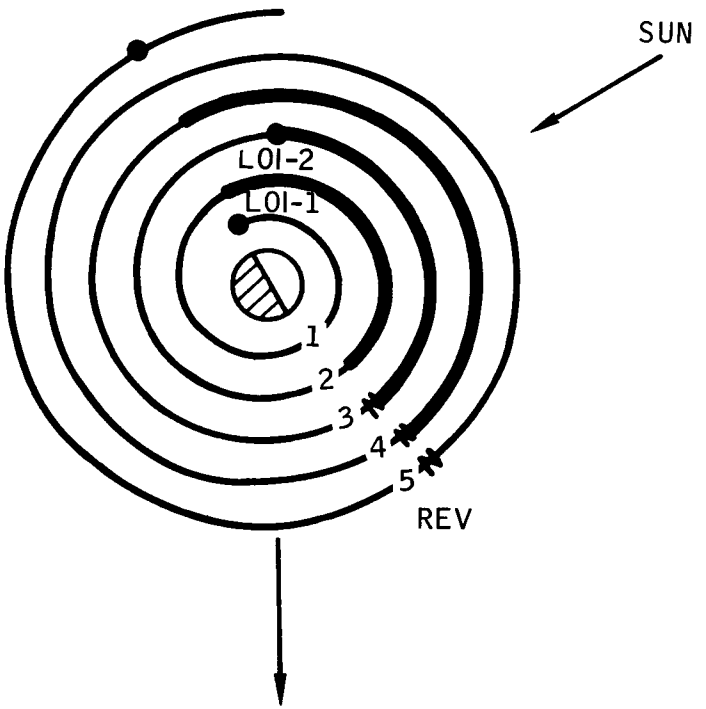
  5: RETURN TO NOMINAL MISSION TIMELINE

EVENTS SEQUENCE FOR LOI DAY

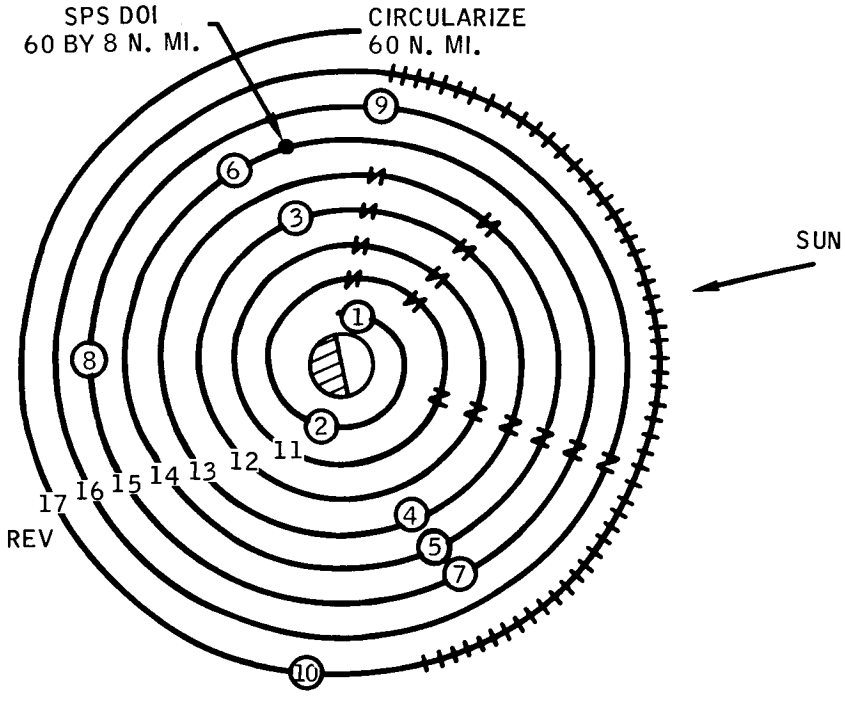
LANDMARK TRACKING

TARGET OF OPPORTUNITY PHOTOGRAPHY

LOI-1 ≈ 76 HR
LOI-2 ≈ 80.5 HR
BEGIN REST ≈ 86 HR



EVENT SEQUENCE FOR DOI DAY



LANDMARK TRACKING

VERTICAL STEREO PHOTOGRAPHY

NOMINAL TIMELINE EVENTS

EVENT	TIME, G.E.T.
1 - AWAKE AND EAT	94:00
2 - BEGIN LM CHECKOUT	95:00
3 - DOI	99:54
4 - PHASING	101:06
5 - INSERTION	103:03
6 - CSI	103:54
7 - CDH	104:52
8 - TPI	105:59
9 - DOCKING	106:40
10 - APS BURN TO DEPLETION	109:04

ALTERNATE 3

- DPS TEI

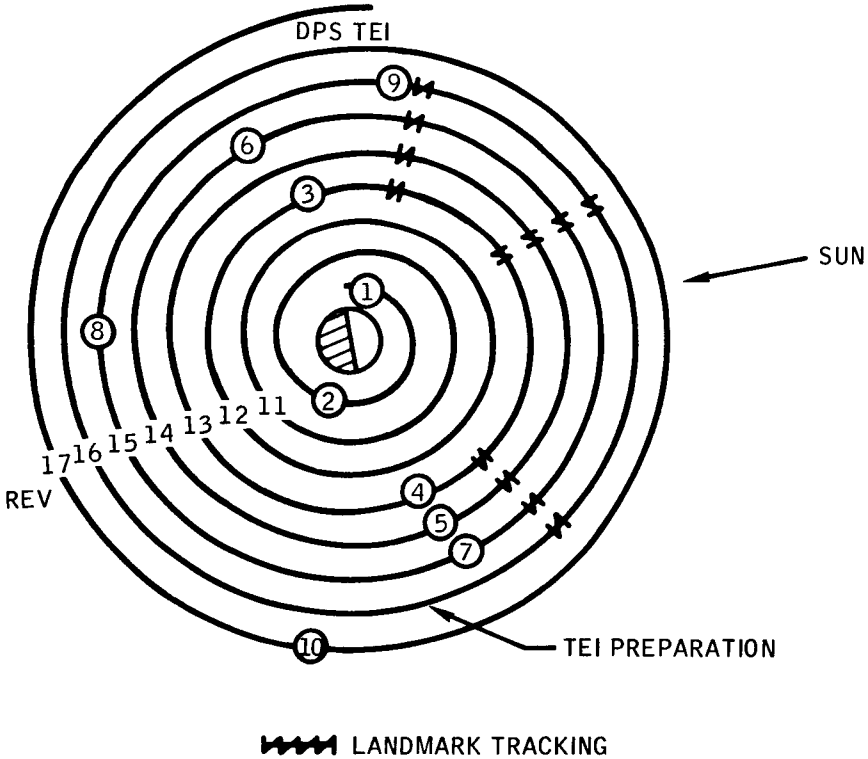
  1: TRACKING DURING PERIODS FORMALLY USED FOR RENDEZVOUS

  2: DPS TEI ≈ 2800 FPS

  3: APS BURN TO DEPLETION

  4: SPS FOR FAST RETURN

DPS TEI ON DOI DAY



NOMINAL TIMELINE EVENTS

EVENT	TIME, G.E.T.
1 - AWAKE AND EAT	94:00
2 - BEGIN LM CHECKOUT	95:00
3 - DOI	99:54
4 - PHASING	101:06
5 - INSERTION	103:03
6 - CSI	103:54
7 - CDH	104:52
8 - TPI	105:59
9 - DOCKING	106:40
10 - APS BURN TO DEPLETION	109:04

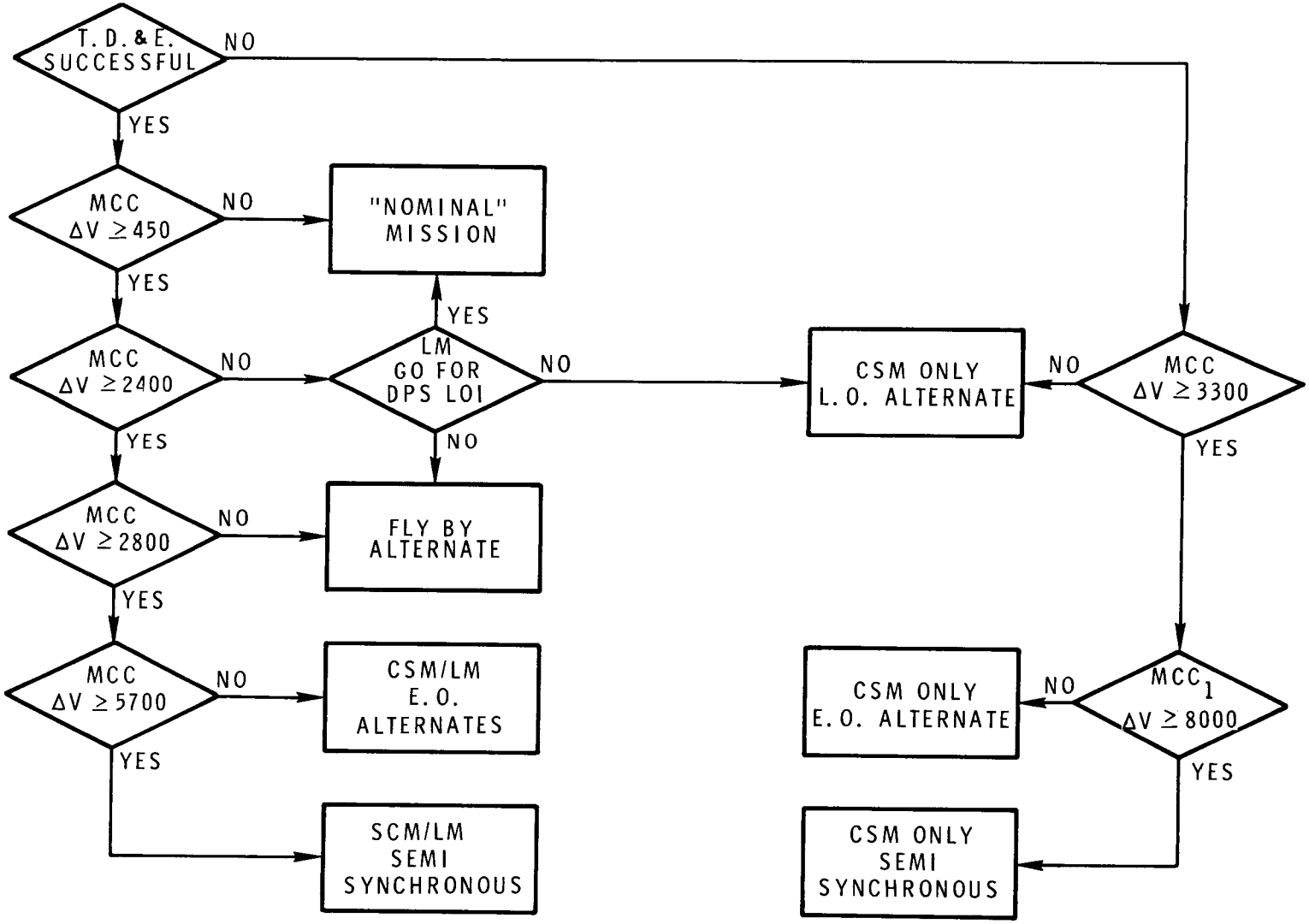
ASSUMPTIONS/CONSTRAINTS

- 550 FPS ΔV AFTER TEI ~ L.O. ALTERNATES
- 5500 FPS ΔV AFTER MCC (SPS ONLY) ~ FLYBY
- FULL SM SUMP TANKS AFTER DPS LOI
- SLOW RETURN TIMES ~ TEC
- 760 FPS ΔV FOR LM RESCUE ~ CSM/LM L.O.

NOTE: MCC ΔV (4500 FPS) ~ DPS AND SPS ΔV OF 5500 REM.

APOLLO 10 ALTERNATE MISSION LOGIC

MPAD 5288 S

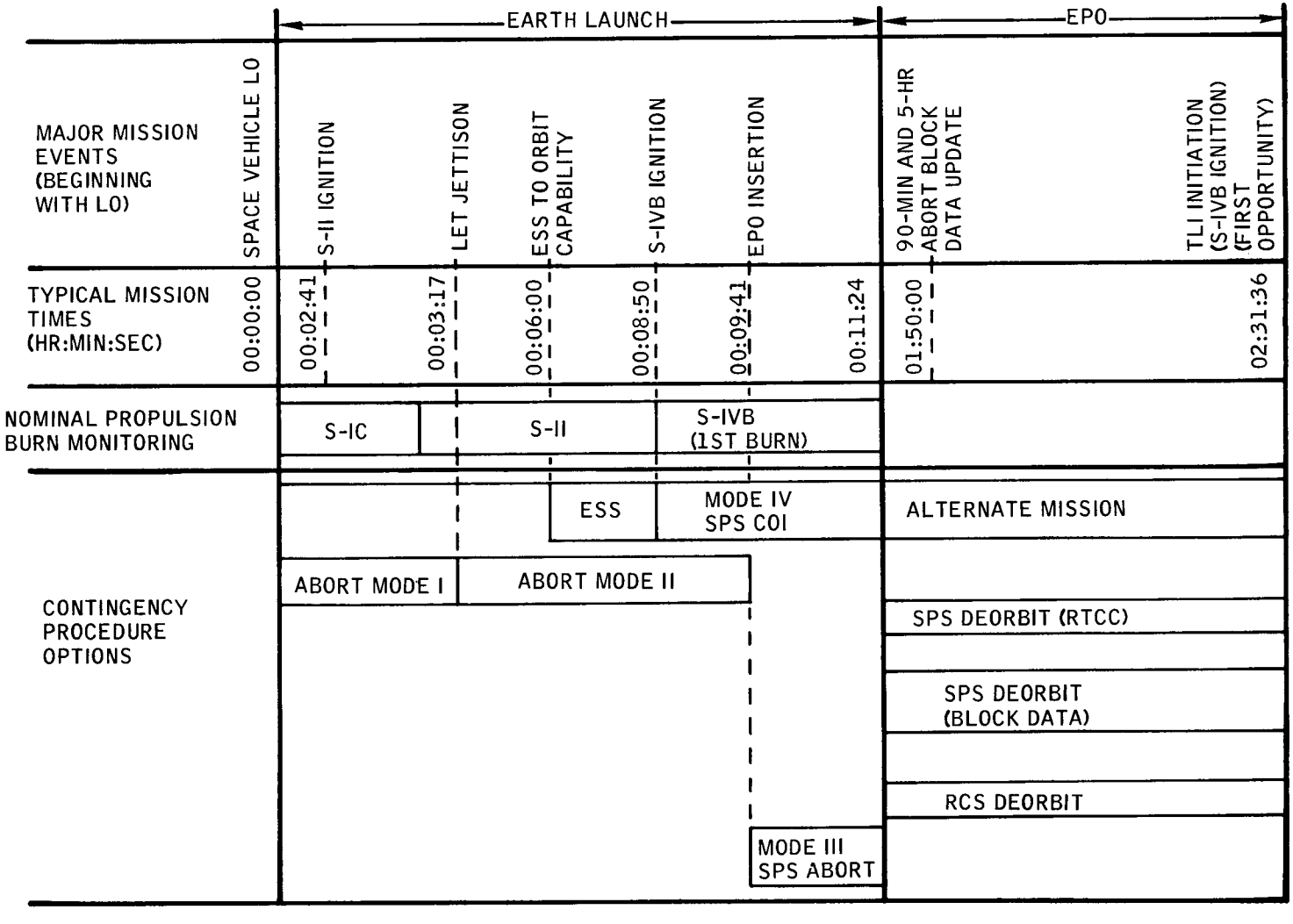


4.0 ABORTS

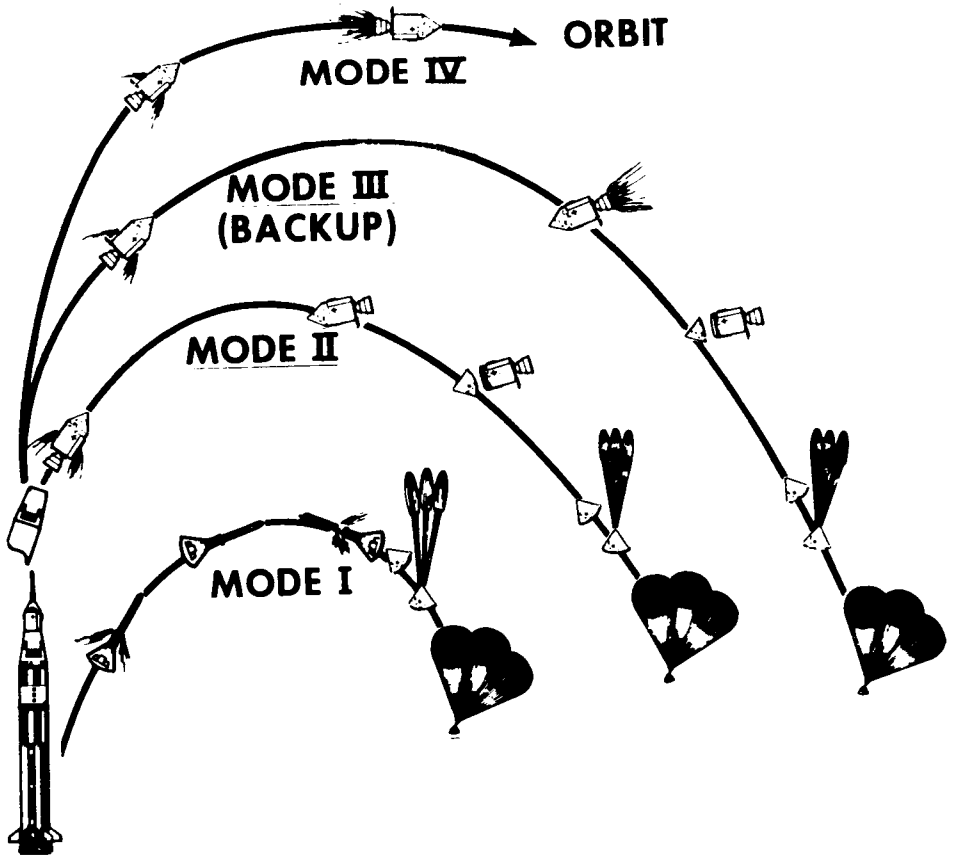
By Charles T. Hyle

MPAD 5293 S

APOLLO 10 CONTINGENCIES

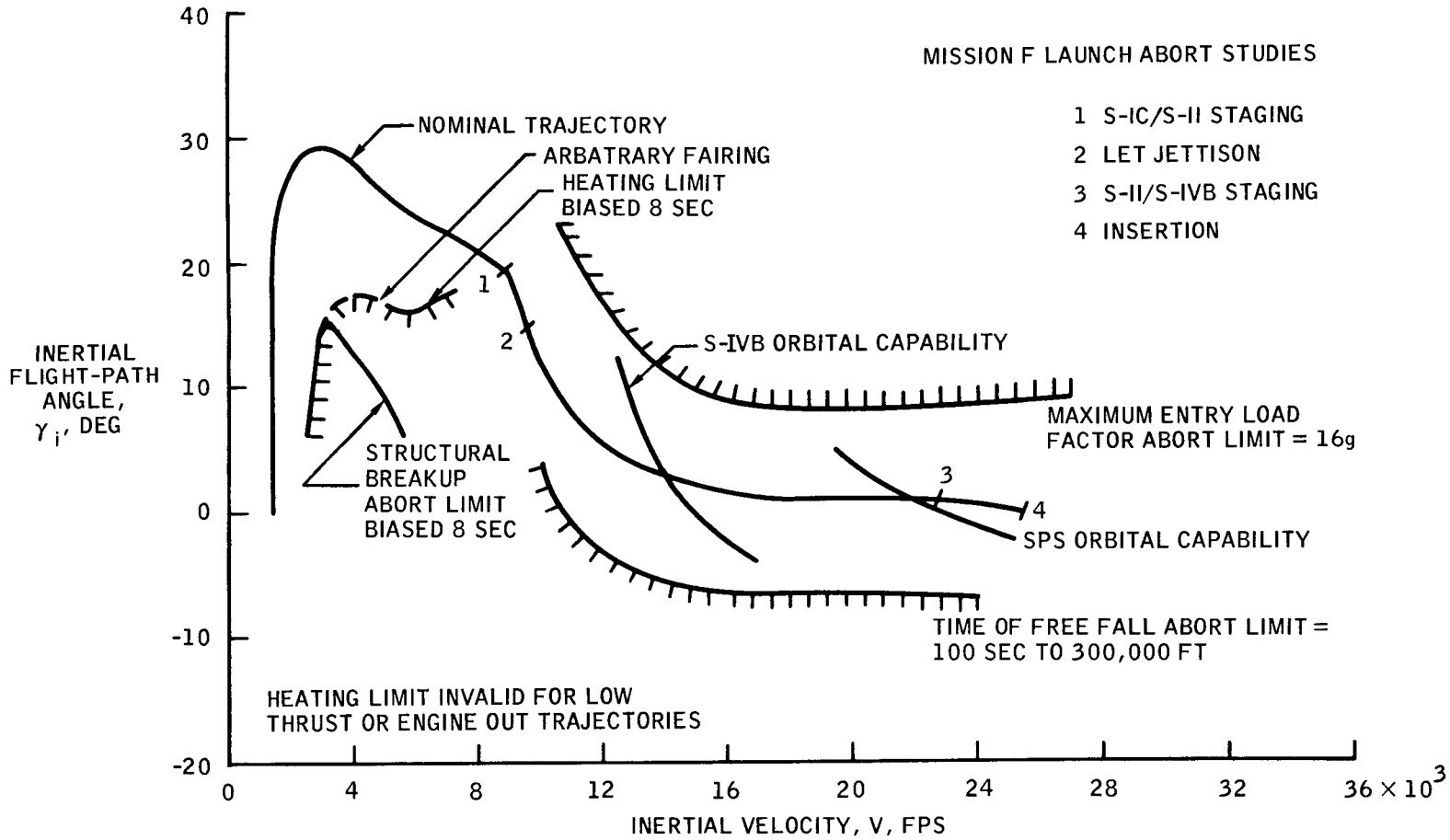


APOLLO LAUNCH ABORT MODES

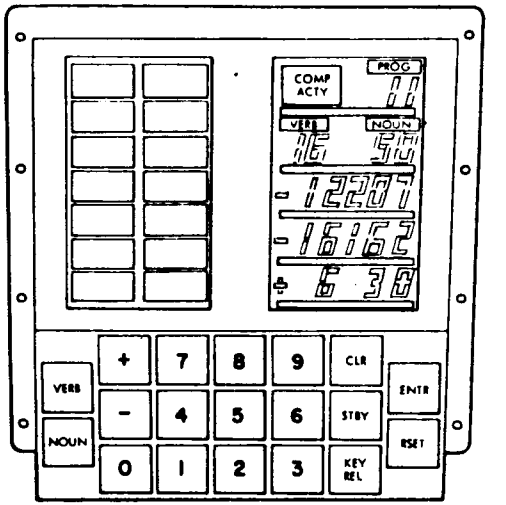


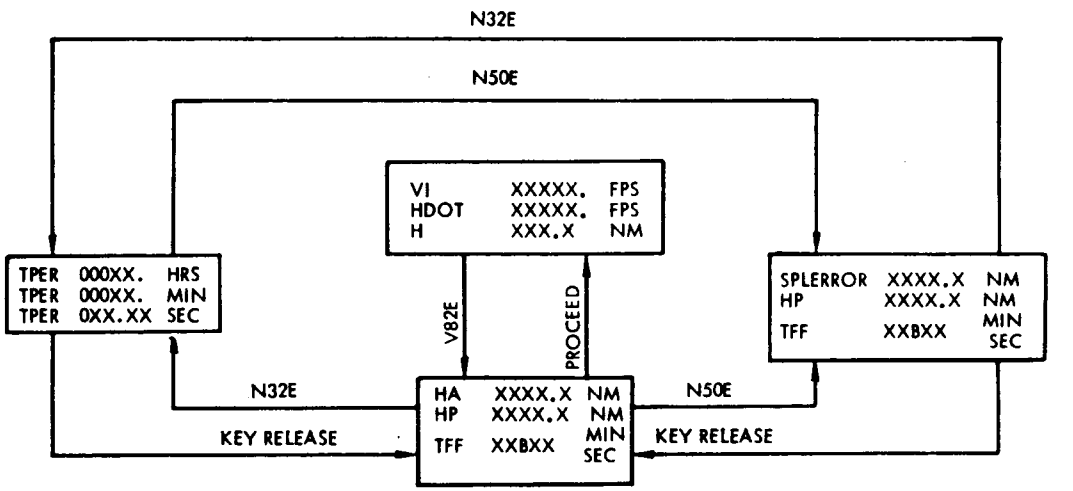
NASA/MSC/DFO
MISSION PLANNING AND ANALYSIS DIVISION
BRANCH FAB DATE 3-7-68
BY Henderson PLOT NO. MPAD 3201V

LAUNCH ABORT AND CAPABILITY LIMITS

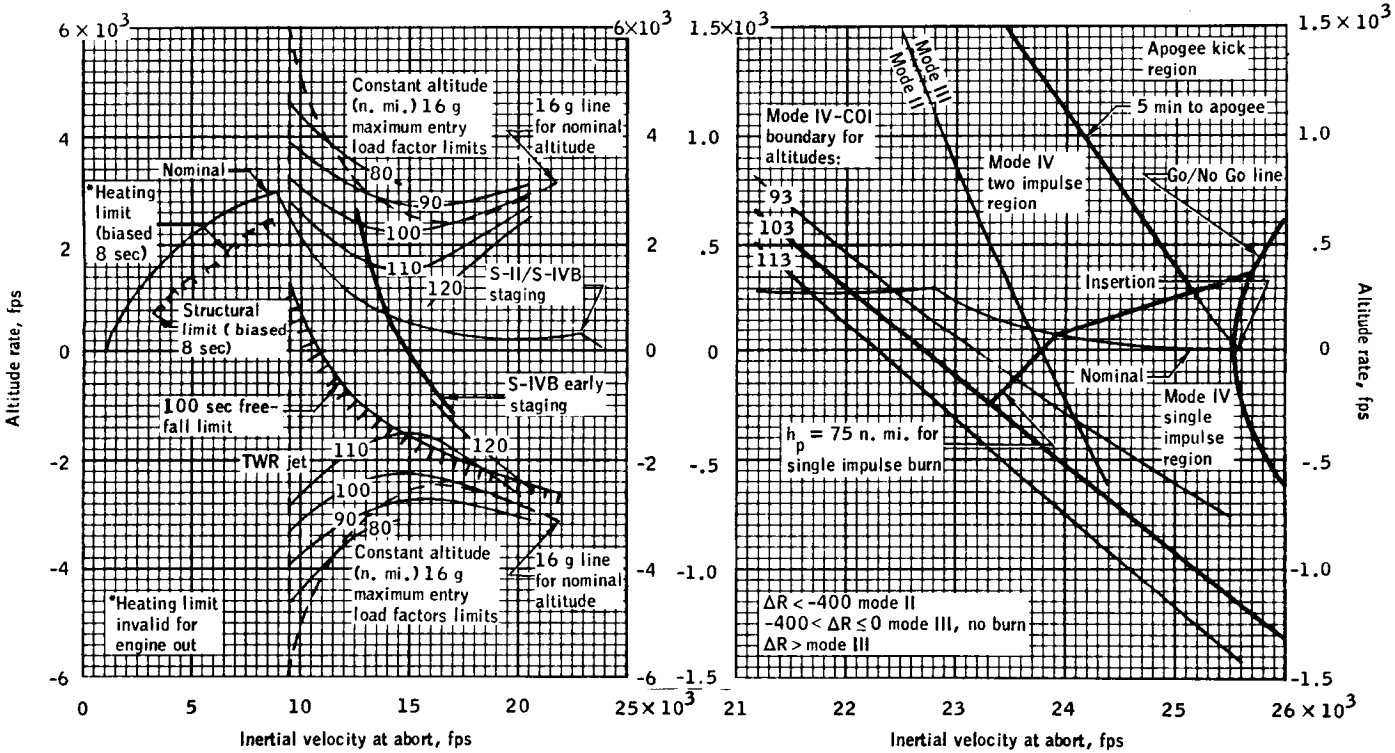


AGC DISPLAY KEYBOARD AND DISPLAY PARAMETERS





SAMPLE NO-VOICE CREW CHART FOR THE LAUNCH PHASE

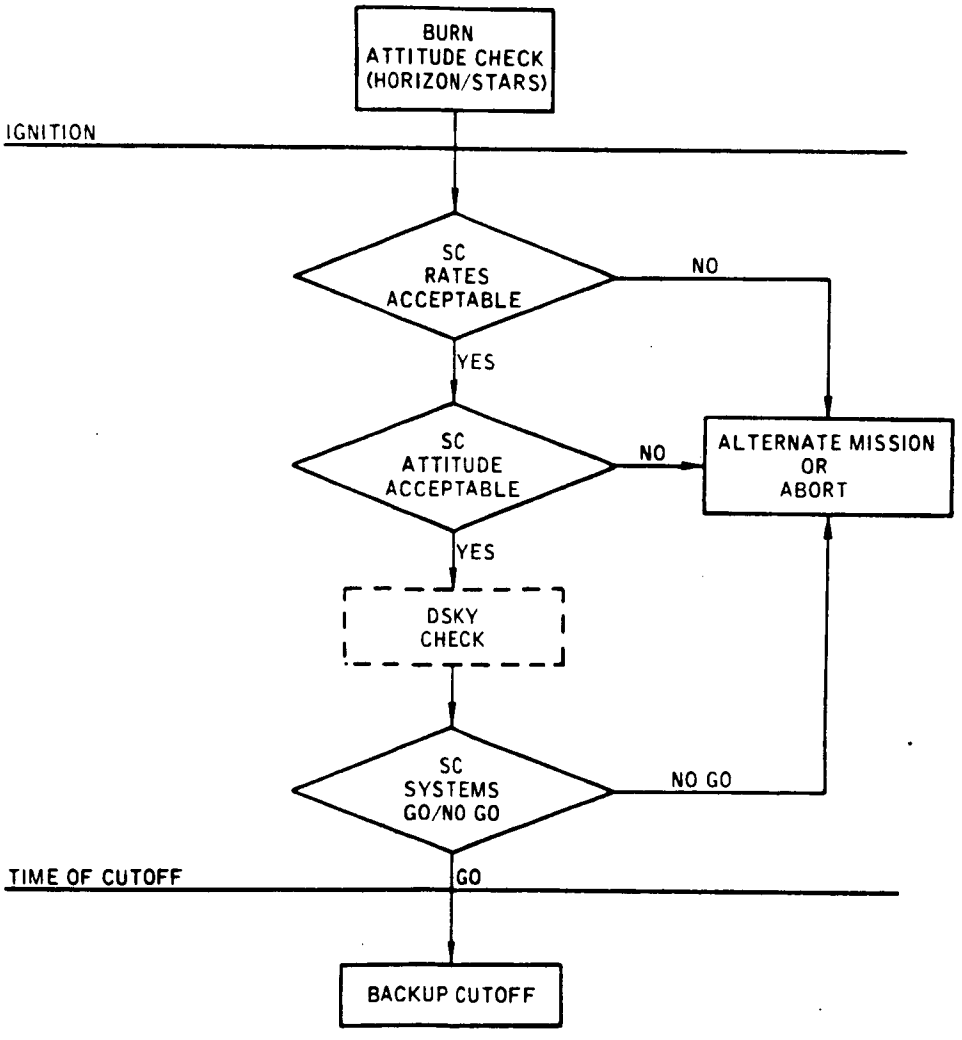


APOLLO 10 CONTINGENCIES (CONTINUED)

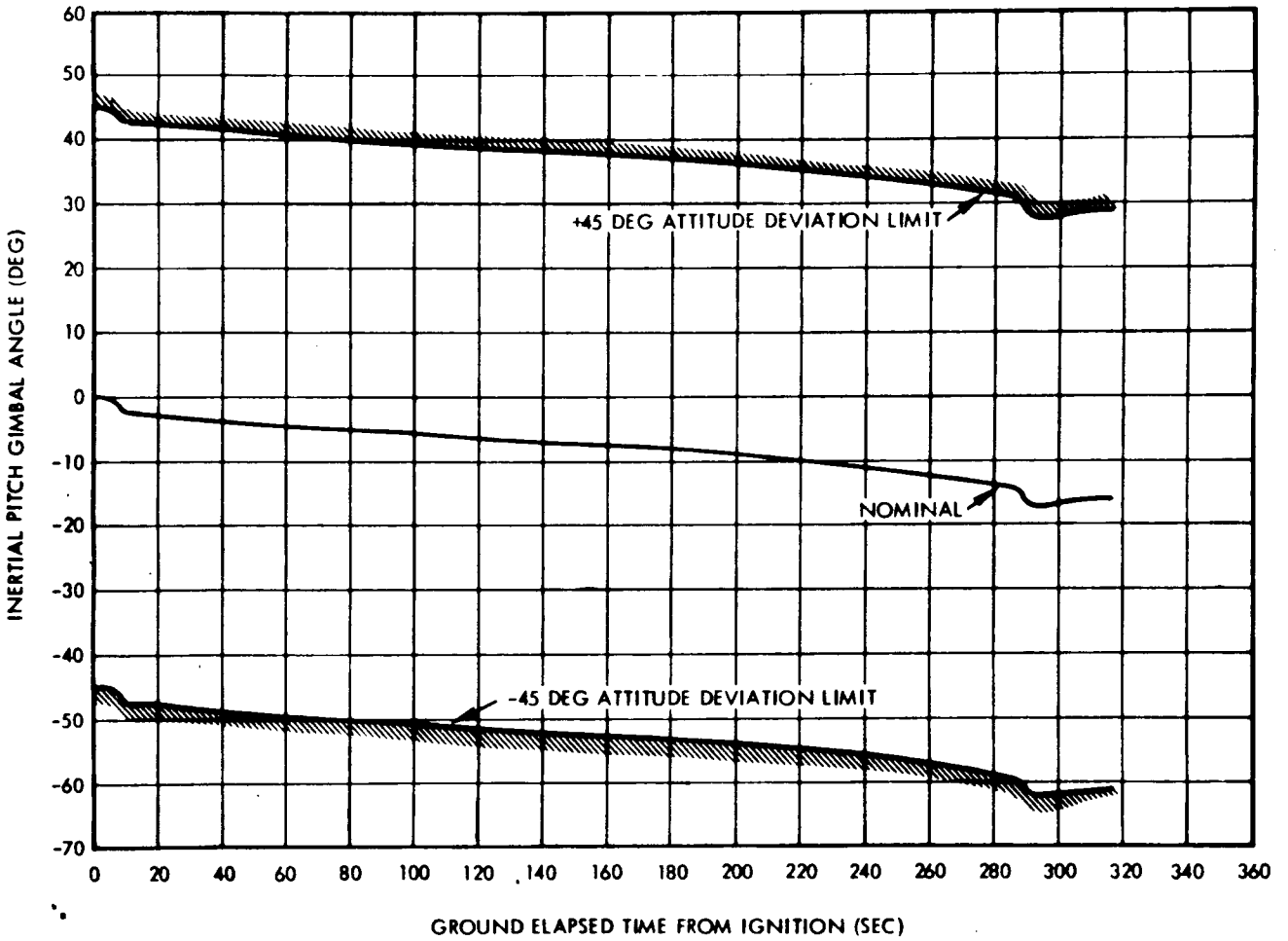
	TLI BURN	T AND D
MAJOR MISSION EVENTS (BEGINNING WITH LO)	SPACE VEHICLE LO; TLI CO (S-IVB CO)	CSM SEPARATION; LM EXTRACTION
TYPICAL MISSION TIMES (HR:MIN:SEC)	00:00:00; 02:36:43	03:01:43; 04:15:00
NOMINAL PROPULSION BURN MONITORING	S-IVB (2ND BURN)	
CONTINGENCY PROCEDURE OPTIONS	ALTERNATE MISSION	ALTERNATE MISSION
	90-MIN SPS ABORT (BLOCK DATA)	TLI + 4 HR ABORT (BLOCK DATA)
	10-MIN SPS ABORT (ONBOARD)	

MPAD 5299 S

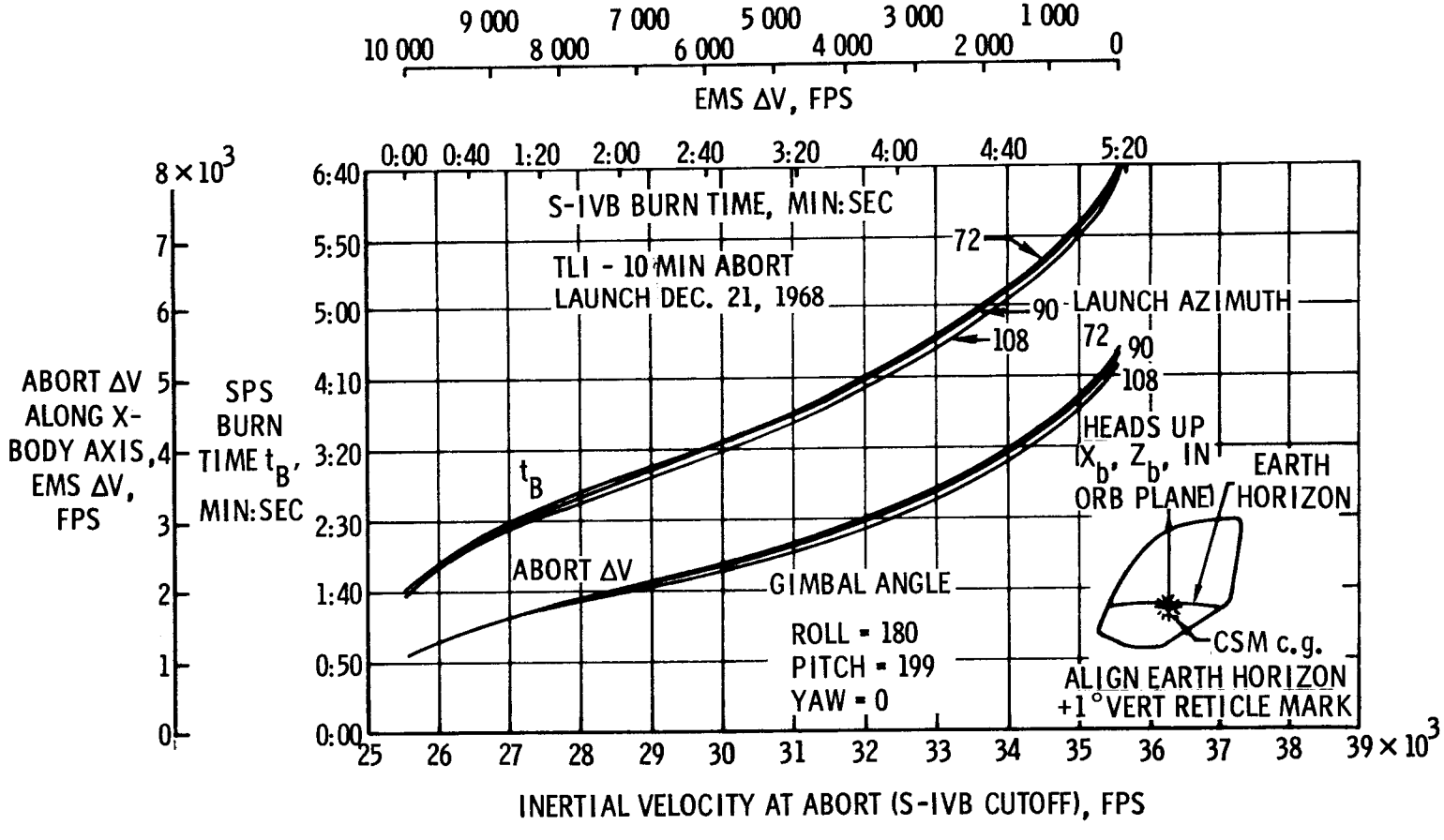
BASIC CREW MANEUVER MONITORING TECHNIQUE



TYPICAL TLI BURN MONITORING PITCH GIMBAL ANGLE CREW CHART



TLI ABORT CREW CHART



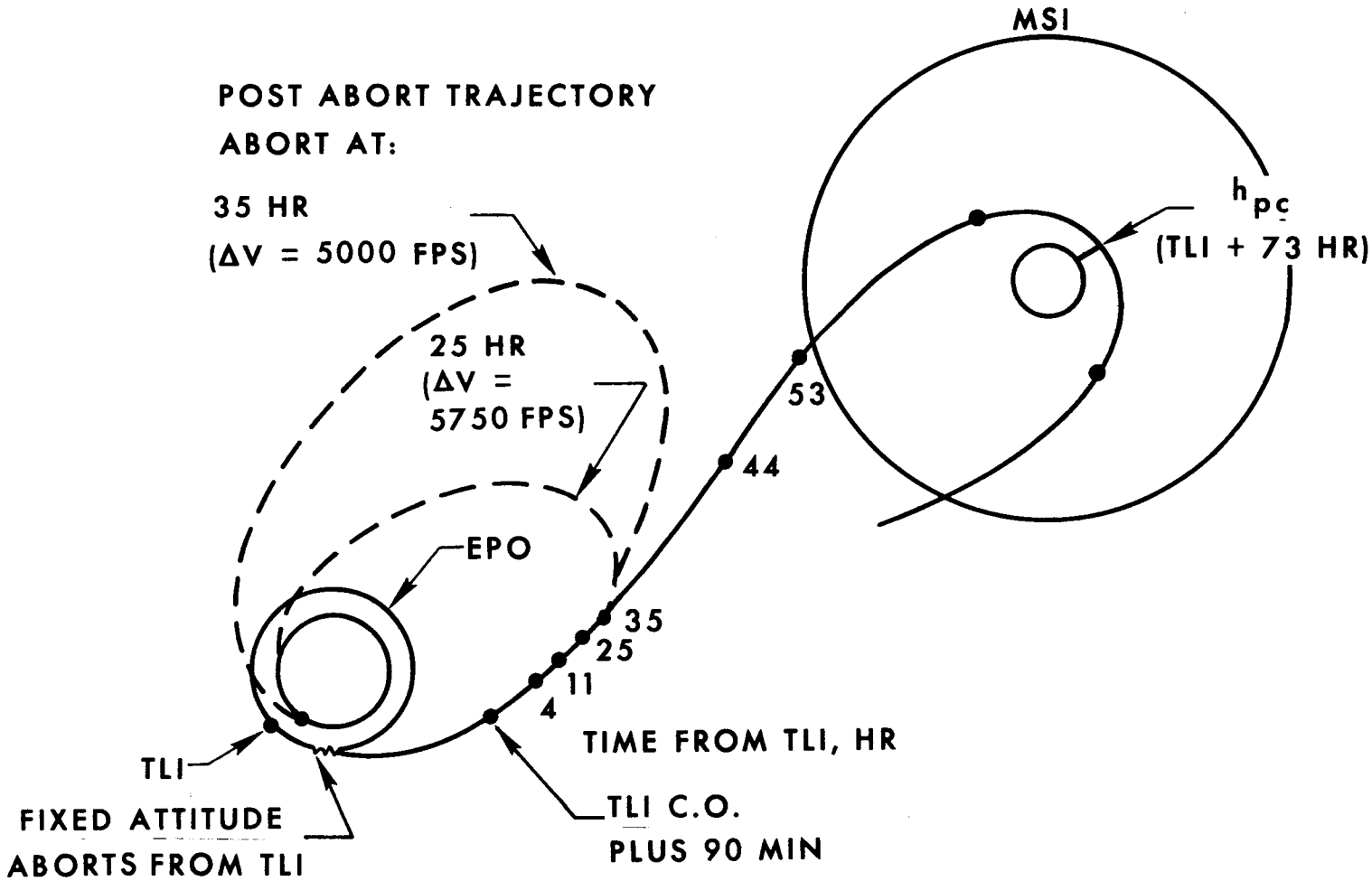
APOLLO 10 CONTINGENCIES (CONTINUED)

	TRANSLUNAR COAST			
MAJOR MISSION EVENTS (BEGINNING WITH LO)	SPACE VEHICLE LO	LOI-29 HR	LOI-20 HR	LOI-5 HR	LOI (PC)
TYPICAL MISSION TIMES (HR:MIN:SEC)	00:00:00	47:08:00	56:08:00	71:08:00	76:08:00
NOMINAL PROPULSION BURN MONITORING					
CONTINGENCY PROCEDURE OPTIONS	ALTERNATE MISSIONS				
	SPS OR RCS TO MPL-FLYBY IF 60 N. MI. $< h_F <$ 1500 N. MI. (RTCC OR BLOCK DATA)				SPS OR RCS TO PRIME CLA (RTCC OR BLOCK DATA)
	DPS OR RCS TO MPL-FLYBY IF 60 N. MI. $< h_p <$ 1500 N. MI. (RTCC OR BLOCK DATA)				DPS OR RCS TO PRIME CLA (RTCC OR BLOCK DATA)
	SPS DIRECT WITHOUT LM TO PRIME CLA (RTCC)	SPS AT PC + 2 HR TO ANY CLA (RTCC OR BLOCK DATA)			
	DPS AT PC + 2 HR TO ANY CLA (RTCC OR BLOCK DATA)				
	SPS DIRECT WITH LM TO ANY CLA (RTCC)				
	SPS DIRECT WITHOUT LM TO PRIME CLA (BLOCK DATA-P37)				

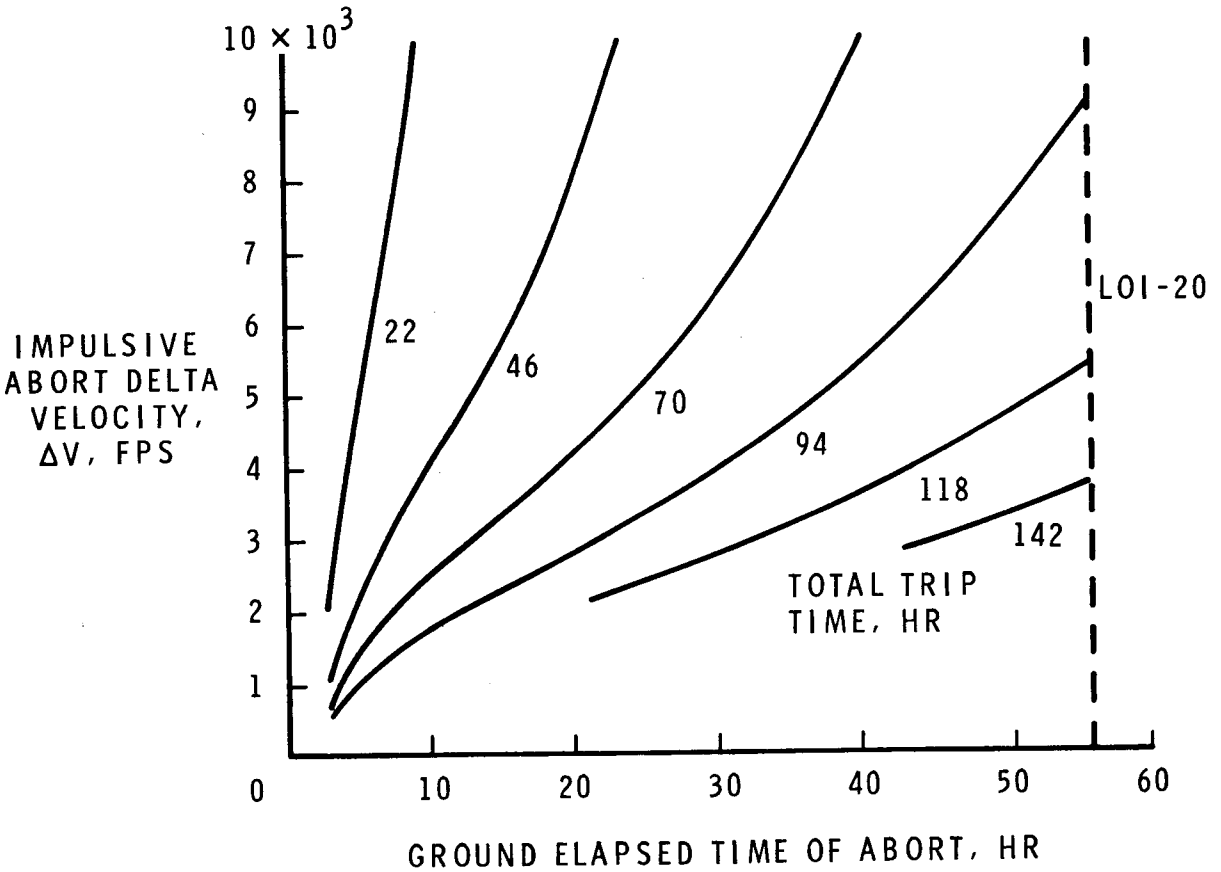
MPAD 5306 S

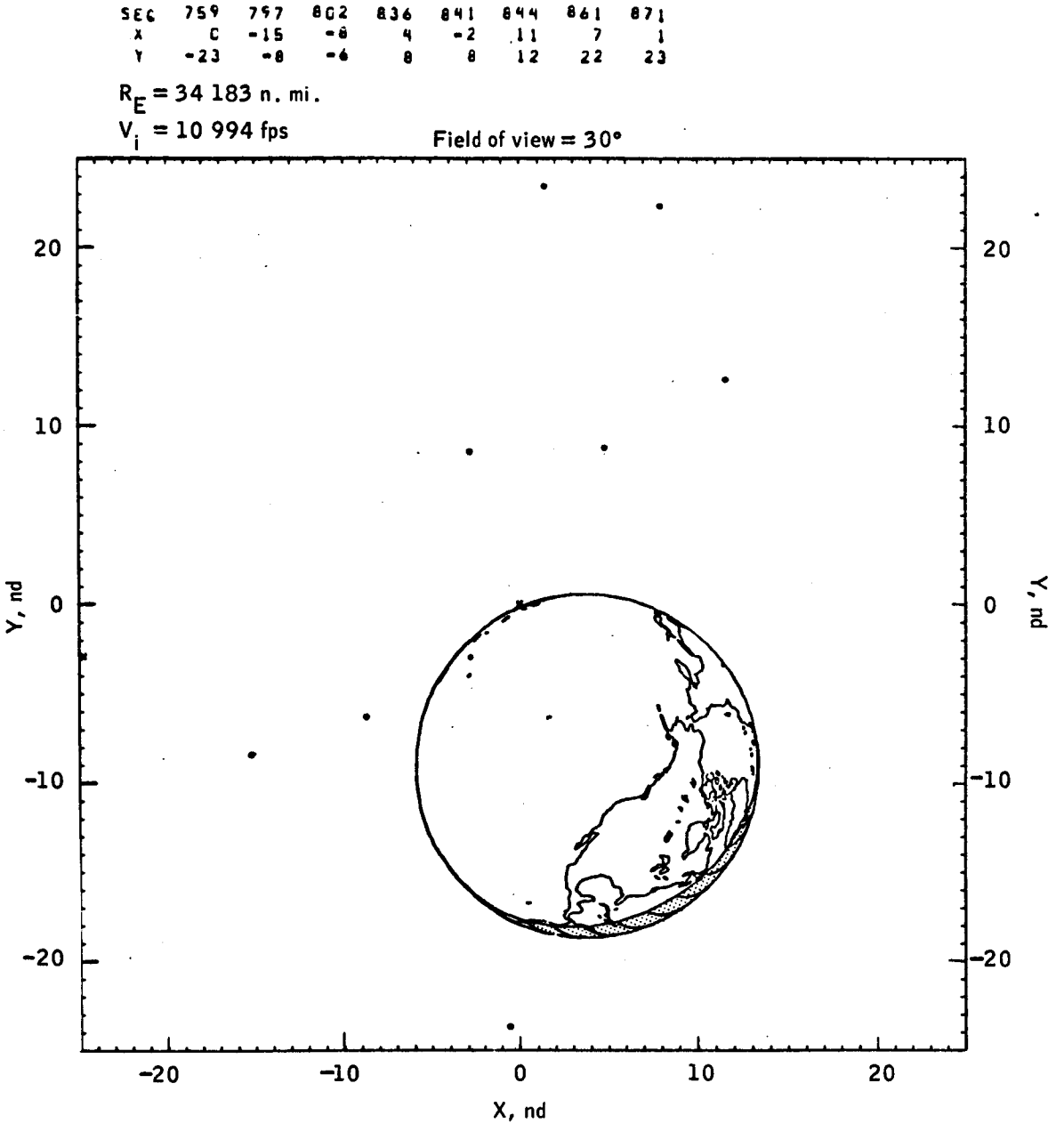
ABORT GEOMETRY DURING TLI/TLC

TIME OF ABORT MANEUVER



ABORTS TO MPL-F MISSION-LAUNCH: MAY 18, 1969 72-1

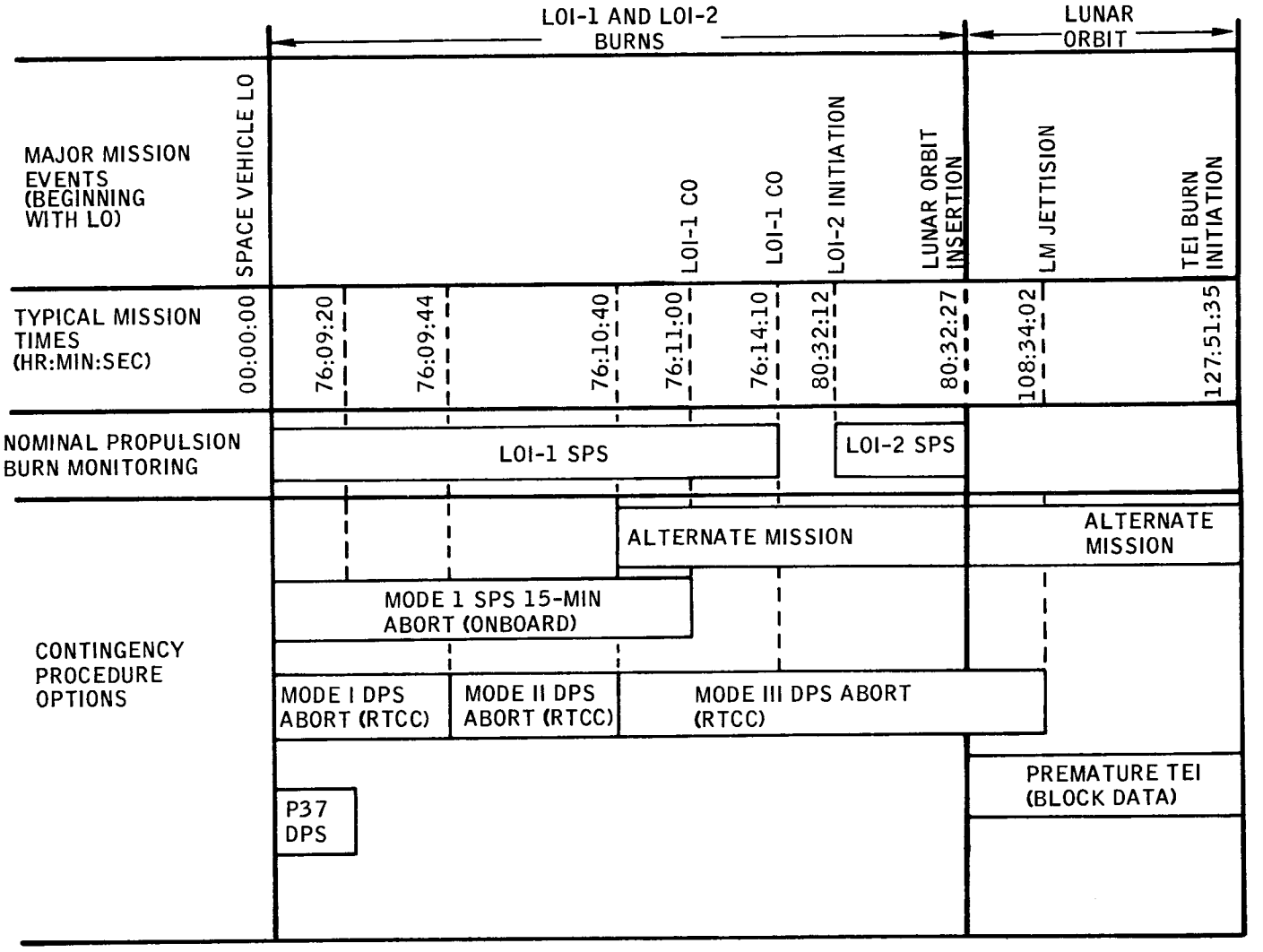




(c) Abort at TLI plus ≈ 4 hours.

Figure 1.- Continued.

APOLLO 10 CONTINGENCIES (CONTINUED)

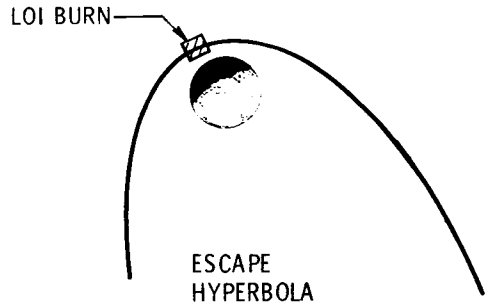
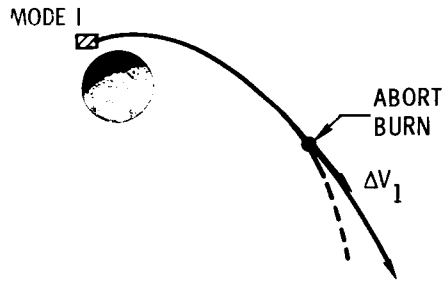
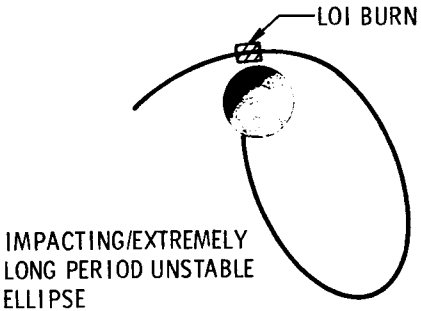
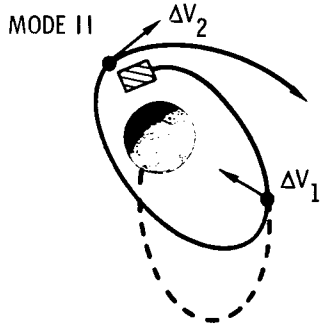
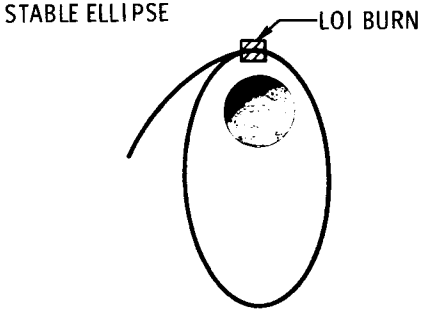
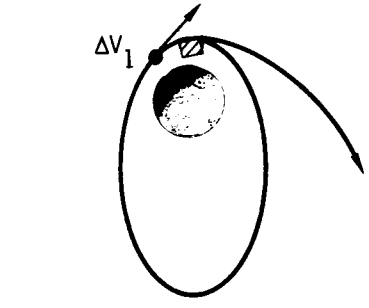


RECOMMENDED ACTION FOR PROBLEMS DURING LOI

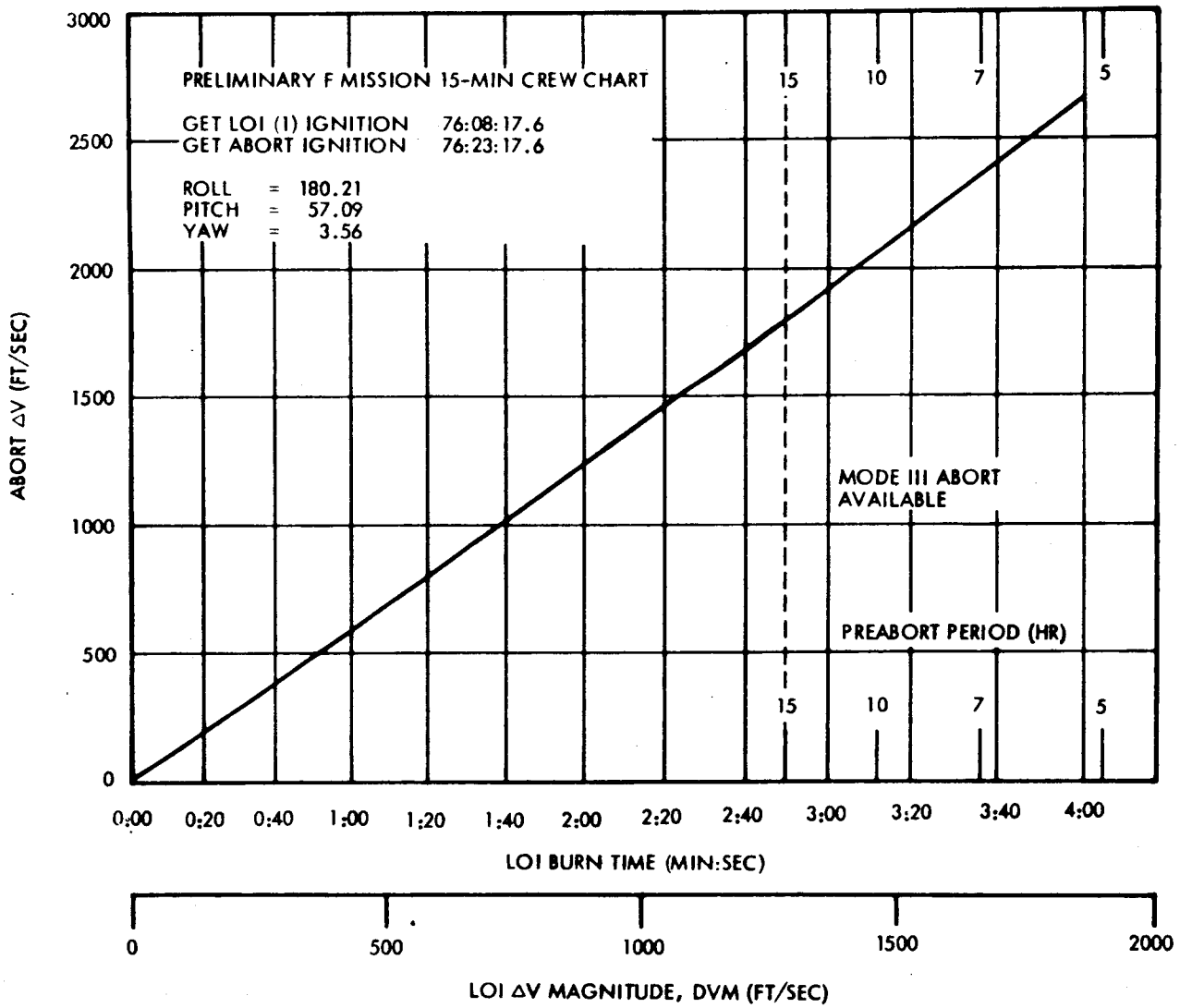
TYPE		
1	GUIDANCE AND CONTROL (IMU DRIFTS, ETC)	MANUAL TAKEOVER AT 10°/SEC OR 10° ATTITUDE DEVIATION AND COMPLETE LOI AT IGNITION ATTITUDE
2	NON-SPS (ECS ETC)	COMPLETE LOI
3	SPS (PRESS ETC)	CREW CHART ABORT SPS AT 15 MINUTES OR DPS AT PERILUNE (RTCC)
4	INADVERTANT SHUTDOWNS (CMC ETC)	DPS ABORT AFTER 2 HOURS (RTCC)

SUMMARY OF LUNAR ORBIT INSERTION ABORT MODES

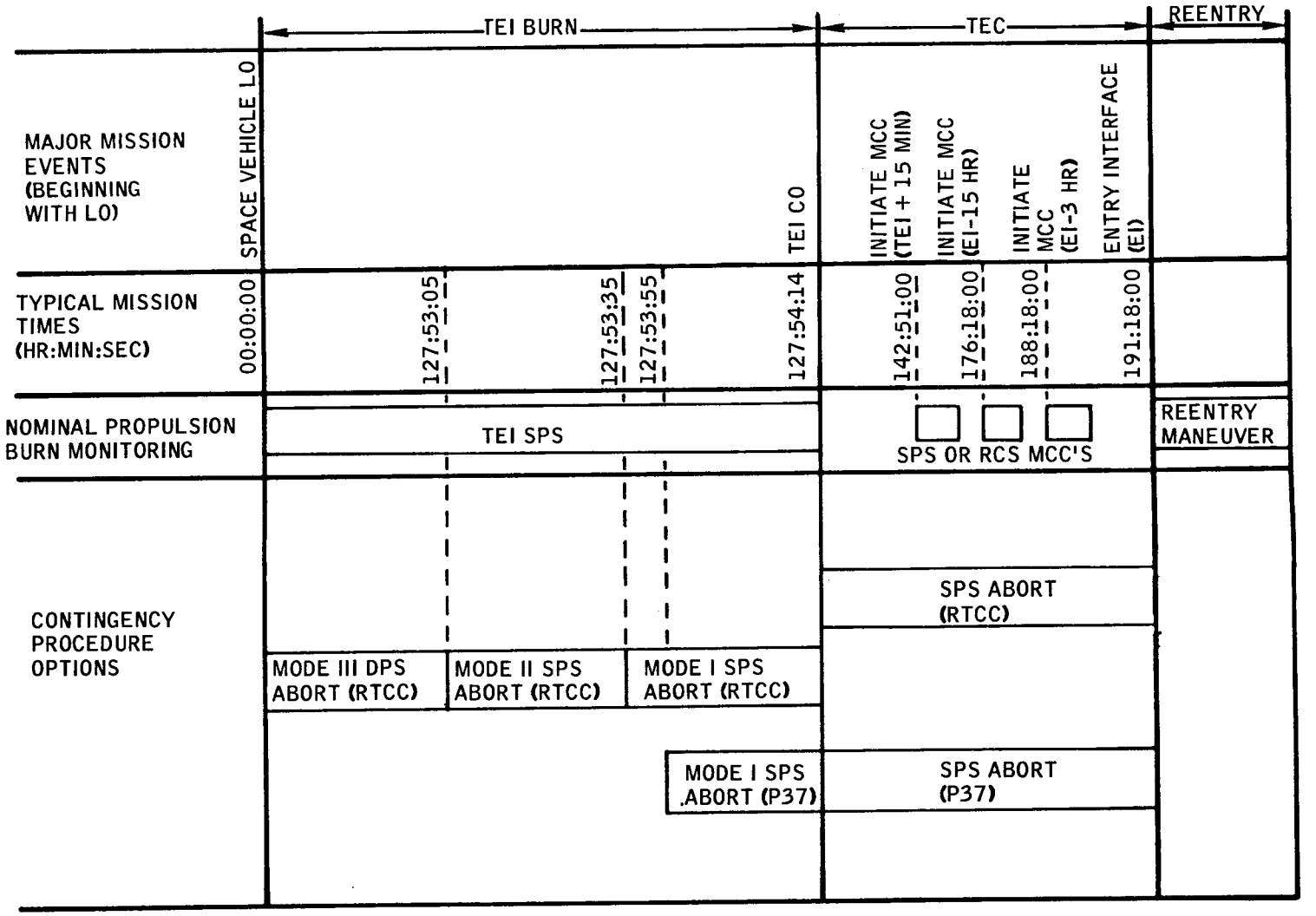
MPAD 3703 S (IU)

LOI SHUTDOWN RANGE	PREABORT TRAJECTORY	ABORT MODE
0-120 SEC		
120-180 SEC		
180-NOMINAL CUTOFF		

MODE I LOI ABORT ΔV CREW CHART MPAD 5303 S



APOLLO 10 CONTINGENCIES (CONCLUDED)



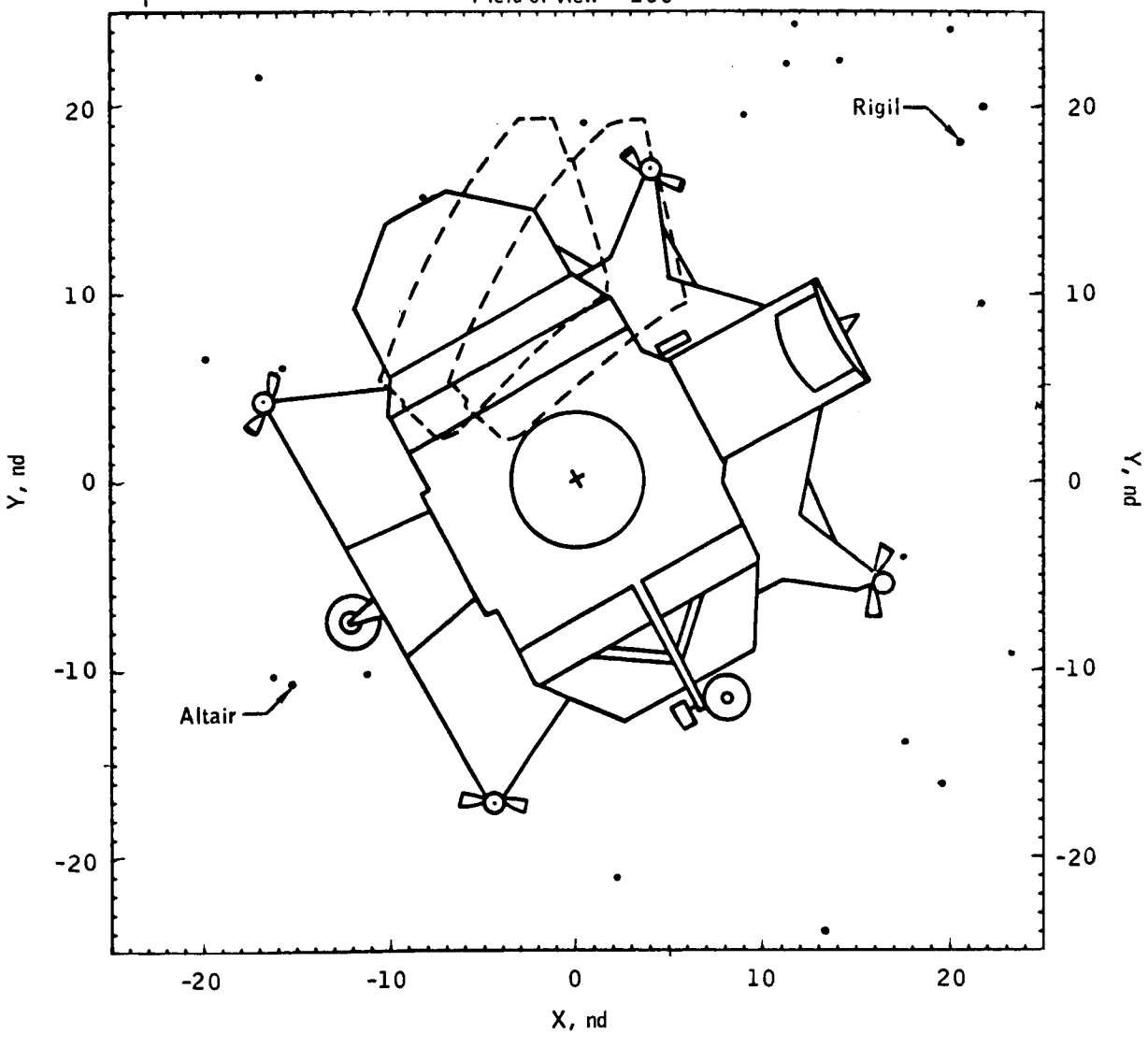
SEQ	599	617	641	643	645	660	688	700	717	753	757	795
X	20	21	11	20	14	11	9	-16	0	-8	21	-19
Y	24	20	24	18	22	22	19	21	19	15	9	6

SEQ	803	904	907	909	933	990	1001	1010	1028	1041
X	-15	-16	-15	-11	17	2	17	23	19	13
Y	6	-10	-10	-10	-3	-20	-13	-9	-15	-23

R_M = 6019 n. mi.

V_i = 4668 fps

Field of view = 100°



(b) LOI plus 2 hour abort on free-return trajectory (SPS burn, docked configuration).

Figure 2.- Continued.

5.0 CONSUMABLES SUMMARY

W. J. Bennett

CONSUMABLES SUMMARY

CONSUMABLE	PERCENTAGE OF AVAILABLE CONSUMABLE USED FOR MISSION PLANNING
CM RCS	15
SM RCS	60
SPS	
MAY 18 LAUNCH	92
MAY 17 LAUNCH	89
LM RCS	65
DPS	5
APS	100
CSM O_2	66
CSM H_2	77
LM DESCENT BATTERY	36
LM ASCENT BATTERY	73

CSM CONSUMABLES SUMMARY

SYSTEM	MISSION F	
	USAGE LB	MARGIN PERCENT
DPS PROPELLANT	830	94
APS PROPELLANT	183	93
RCS PROPELLANT	360	33
DESCENT O_2	2.8	94
DESCENT H_2O	57	82
DESCENT BATTERY AMP-HR	550	61
ASCENT O_2	1.9	56
ASCENT H_2O	37	55
ASCENT BATTERY AMP-HR	367	33

LM CONSUMABLES SUMMARY

CONSUMABLE	MISSION F	
	REQUIRED LB	MARGIN PERCENT
SPS PROPELLANT	36,700	8
RCS PROPELLANT		
SM	800	34
CM	32	85
OXYGEN	415	34
HYDROGEN	42	23
BATTERY POWER	92.6 AMP HR	23

6.0 NAVIGATION

W. J. Bennett

LUNAR ORBIT NAVIGATION HISTORY

- LUNAR ORBITER PROGRAM SHOWED THAT LACK OF KNOWLEDGE OF LUNAR GRAVITY FIELD RESULTED IN NAVIGATION INACCURACIES
- APOLLO 8 SHOWED THAT THESE INACCURACIES WERE SIGNIFICANTLY INCREASED AS ORBITAL ALTITUDE WAS DECREASED
- POSTFLIGHT ANALYSIS OF APOLLO 8 DATA HAS INDICATED THAT NAVIGATION SUPPORT OF THE LM LANDING WILL BE IMPROVED BY:
    - USE OF NEW MODEL OF GRAVITY FIELD
    - SPACECRAFT OBSERVATIONS OF LANDING SITE WITH SEXTANT
    - EMPIRICAL CORRECTIONS TO NAVIGATION DATA

NAVIGATION ACCURACIES FOR LUNAR LANDING

1σ ERRORS PROPAGATED TWO REVOLUTIONS

- REALTIME APOLLO 8 ERRORS
  - DOWNTRACK 30,000 FT
  - RADIUS 5,500 FT
- PREDICTIONS BASED ON APOLLO 8 POSTFLIGHT ANALYSIS
  - DOWNTRACK 3,000 FT
  - RADIUS 1,400 FT

NOTE: APOLLO 8 RESULTS INDICATE THAT LUNAR MAPS ARE IN ERROR BY 4,500 FT IN RADIUS AT SITE 1

NAVIGATION BENEFITS OF F MISSION

- VERIFY PREDICTIONS FROM APOLLO 8 POSTFLIGHT ANALYSIS
  - USE NEW LUNAR GRAVITY MODEL
  - COMBINE SPACECRAFT LANDMARK TRACKING DATA WITH GROUND TRACING DATA
  - EVALUATE PREDICTION ERRORS FOR VARYING ARC LENGTHS OF MSFN TRACKING DATA
  - EVALUATE TECHNIQUES FOR APPLYING EMPIRICAL CORRECTIONS TO NAVIGATION DATA
- EVALUATE PREDICTION CAPABILITIES DURING DESCENT TO 50,000 FEET
- EVALUATE LUNAR MAPS IN VICINITY OF LANDING SITE
- ACQUIRE POWERED FLIGHT TRACKING DATA FOR TESTING OF GROUND TECHNIQUES FOR MONITORING THE LM DESCENT AND ASCENT BURNS
- EVALUATE SPACECRAFT RENDEZVOUS NAVIGATION DATA WITH MAXIMUM PROPELLANT RESERVES AND CONTROLLED INITIAL CONDITIONS

7.0 DOCUMENTATION SCHEDULE

W. J. Bennett

APOLLO 10 (MISSION F) DOCUMENTATION SCHEDULE

Document	IN no.	Date, month, day, yr
Operational Trajectory		
Volume I - Trajectory Profile for May 17	69-FM-65	3/26/69
Volume II - Trajectory Listing for May 17	69-FM-66	3/10/69
Volume III - May Summary	69-FM-67	3/26/69
Volume IV - June Summary		4/18/69
Volume V - July Summary		4/20/69
TLI Ship Positioning and Coverage Data	69-FM-56	4/20/69
Attitude Time line		4/20/69
Operational Trajectory, Revision 1 - May 18		
Volume I - May 18 Profile		4/28/69
Volume II - Trajectory Parameters for May 18		4/28/69
Consumables Analysis	69-FM-76	4/07/69
Dispersion Analysis		4/21/69
Preliminary Alternate Mission Plan		
Volume I - Earth Orbital Alternates	69-FM-25	2/03/69
Volume II - Lunar Alternate Mission	69-FM-38	2/17/69
Volume III - Alternate Lunar Rendezvous	69-FM-57	3/04/69
Operational Alternate Mission Plan		
Volume I - Earth Orbital Alternates		4/20/69
Volume II - Lunar Alternate Mission	69-FM-87	4/14/69
Volume III - Alternate Mission Plan	69-FM-82	4/10/69
Preliminary LM Abort and Rescue Plan		
Volume I - Nontime-Critical Procedures	69-FM-34	2/11/69
Volume II - Time-Critical Procedures	69-FM-61	3/10/69
Operational LM Abort and Rescue Plan		
Volume I - Nontime-Critical Procedures	69-FM-84	4/18/69
Operational Abort Plan	69-FM-78	4/07/69