68-FM-289

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 68-FM-289

December 6, 1968

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APOLLO 8

MISSION PLANNING BRIEFINGS

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MISSION PLANNING AND ANALYSIS DIVISION

MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

(NASA-TM-X-69843) APOLLO 8 MISSION PLANNING BRIEFINGS (NASA) 80 p

N74-70863

Unclas
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MSC INTERNAL NOTE NO. 68-FM-289

PROJECT APOLLO

APOLLO 8 MISSION PLANNING BRIEFINGS

By Mission Planning and Analysis Division

December 6, 1968

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

Approved: _____
John P. Mayer, Chief
Mission Planning and Analysis Division

FOREWORD

This document is comprised of slides used for Apollo 8 mission planning briefings, and is presented for general information. All or portions of these were presented at the following briefings:

Apollo 8 Status to Dr. Mueller, October 28, 1968

Apollo 8 Executive Meeting, November 10, 1968

Apollo 8 Briefing to North American Rockwell, November 13, 1968

Apollo 8 Flight Readiness Review, November 19, 1968

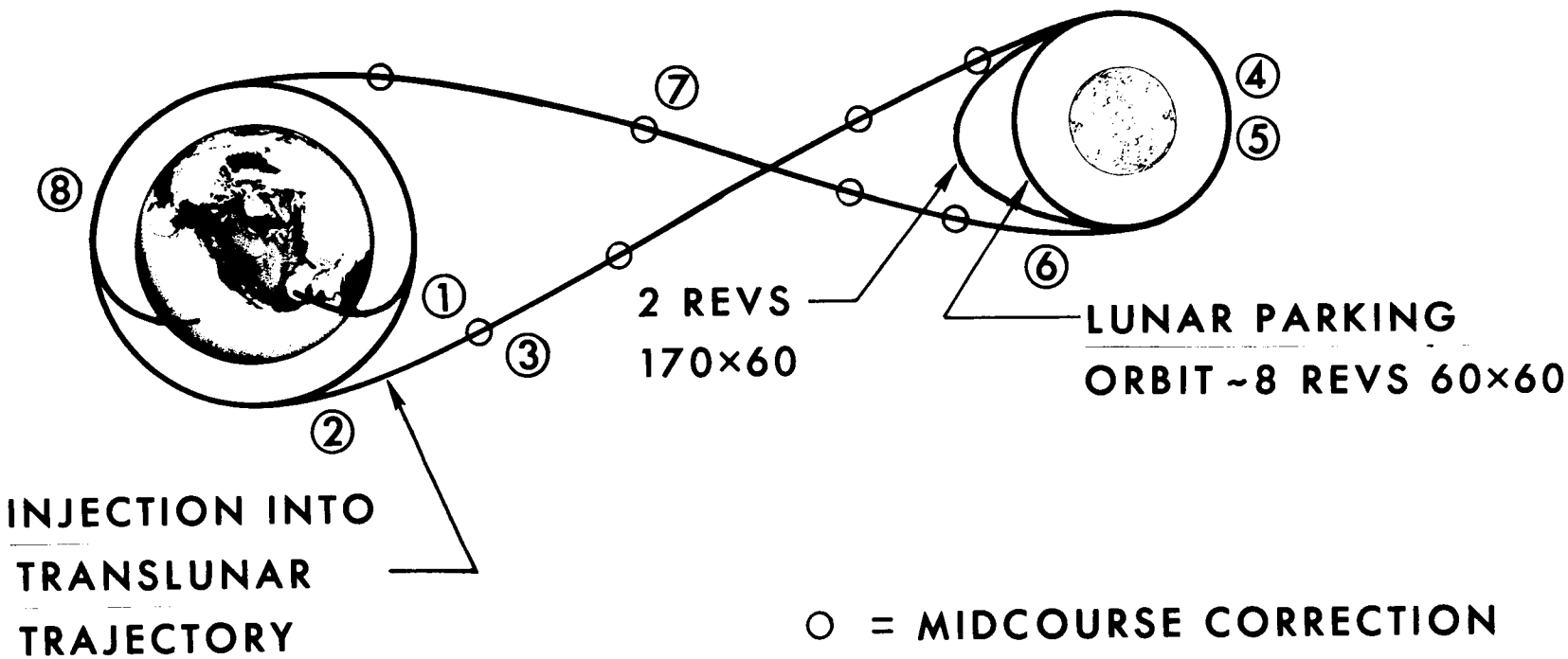
Apollo 8 Briefing to Goddard Space Flight Center, November 25, 1968

No explanation of the material is given; however, information can be obtained from William J. Bennett of the Mission Planning Support office at extension 4091.

MISSION DESIGN CONCEPTS

1. DAYLIGHT LAUNCH
2. BASIC FREE-RETURN TRAJECTORY
3. TRANSLUNAR MIDCOURSE RETAINS RCS CAPABILITY FOR ACCEPTABLE EARTH LANDING
4. TWO BURN LOI
5. MINIMIZE LUNAR ORBIT TIME
6. MINIMIZE RETURN TIME
7. TRANSEARTH MIDCOURSE FOR ENTRY CORRIDOR
8. SHORT RANGE NON-SKIP ENTRY TRAJECTORY

MISSION PROFILE

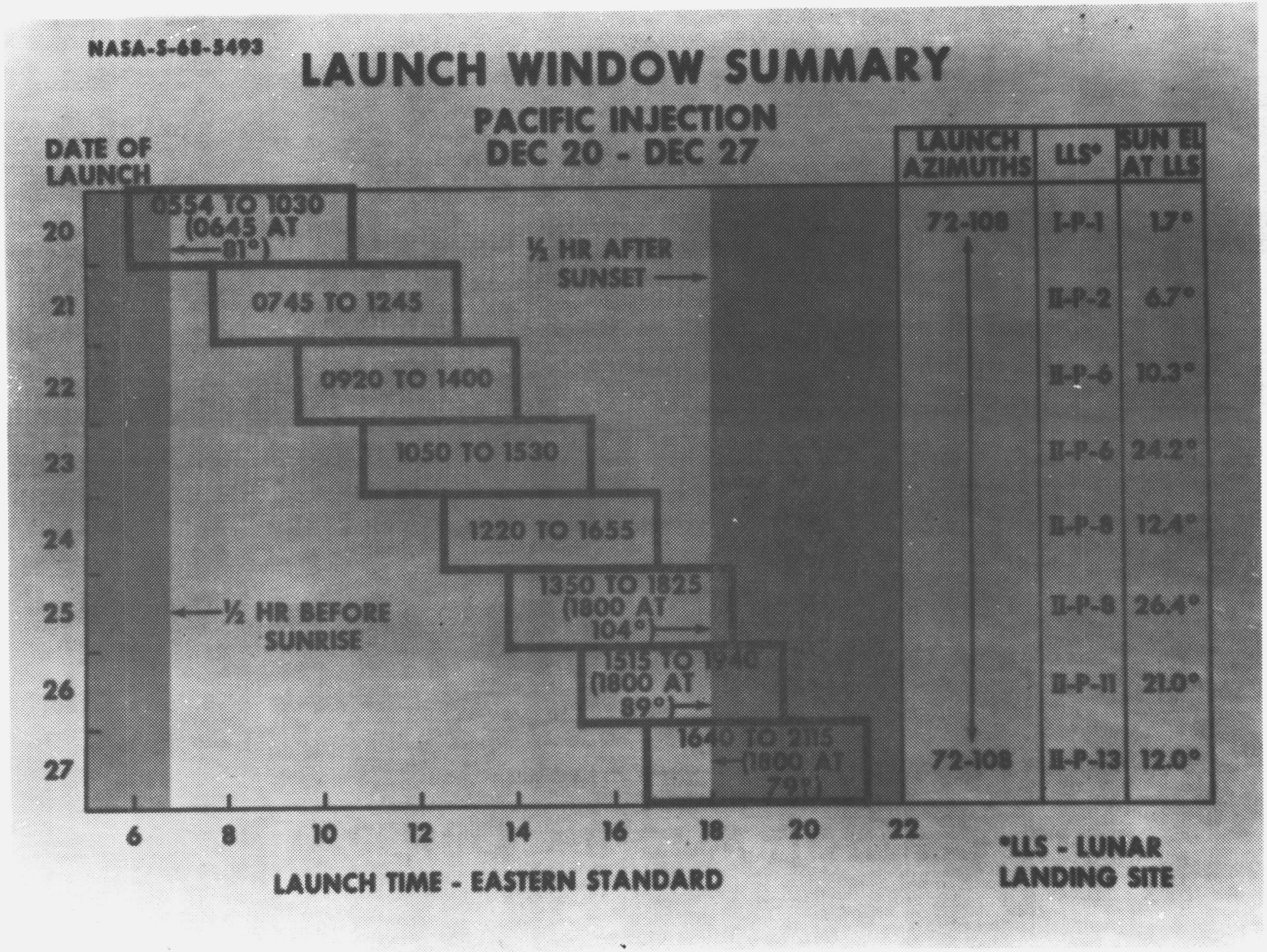


MISSION SUMMARY
DEC 21

EARTH PARKING ORBIT COAST TIME	$2^H\ 39^M\ {}^{+3^M}_{-31^M}$
TRANSLUNAR INJECTION BURN DURATION	$311.5^S\ +1.8^S$
TRANSLUNAR FLIGHT TIME	$65^H\ {}^{+9^H}_{-1^H}$
TOTAL FREE-RETURN CIRCUMLUNAR FLIGHT TIME	$130^H\ 37^M\ {}^{+17^H}_{-1^H}$
LOI(1) BURN DURATION	$246^S\ {}^{+2^S}_{-10^S}$
LOI(1) ΔV	2991 FPS $^{+30\ \text{FPS}}_{-138\ \text{FPS}}$
LOI(2) BURN DURATION	9.7^S
LOI(2) ΔV	138.5 FPS
TRANSEARTH INJECTION BURN DURATION	$206.4^S \pm 35^S$
TRANSEARTH INJECTION BURN ΔV	3531.7 FPS ±500 FPS
TRANSEARTH FLIGHT TIME	$58^H\ {}^{+9^H}_{-2^H}$
TOTAL MISSION TIME	$6^D\ 4^H\ {}^{+1^D}_{-4^H}$

LAUNCH WINDOW GUIDELINES

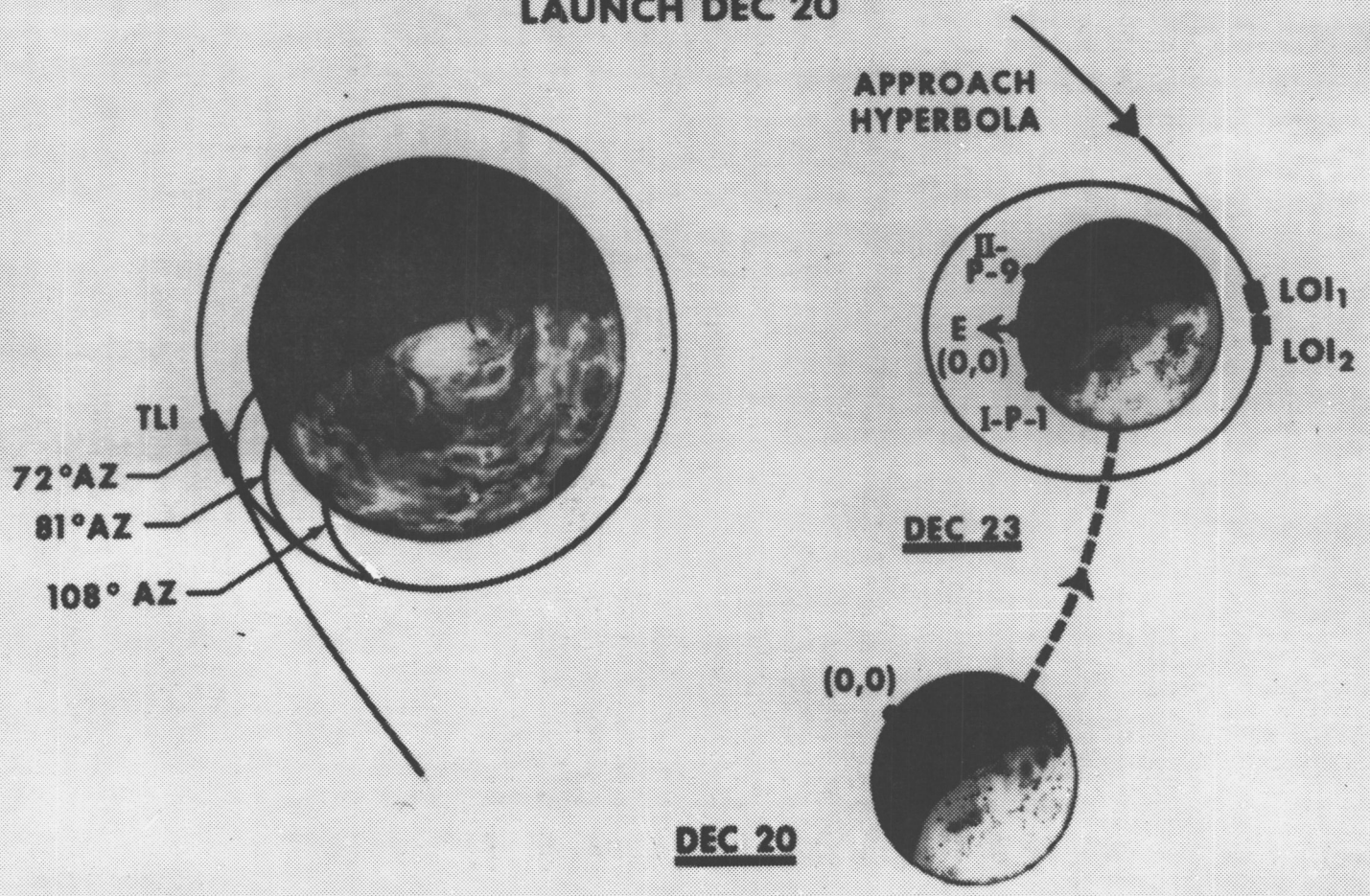
- DAYLIGHT LAUNCH ON CONSECUTIVE DAYS
- FREE-RETURN
- APPROXIMATE "G" TYPE LIGHTING IN APOLLO ZONE
- 72° - 108° LAUNCH AZIMUTH RANGE
- TWO INJECTION OPPORTUNITIES:
    - 1ST ON 2ND REV
    - 2ND ON 3RD REV


NASA-S-68-3493
LAUNCH WINDOW SUMMARY
PACIFIC INJECTION
DEC 20 - DEC 27
DATE OF LAUNCH
20
21
22
23
24
25
26
27
0554 TO 1030 (0645 AT 81°)
0745 TO 1245
0920 TO 1400
1050 TO 1530
1220 TO 1655
1350 TO 1825 (1800 AT 104°)
1515 TO 1940 (1800 AT 89°)
1640 TO 2115 (1800 AT 79°)
½ HR AFTER SUNSET
½ HR BEFORE SUNRISE
6
8
10
12
14
16
18
20
22
LAUNCH TIME - EASTERN STANDARD
LAUNCH AZIMUTHS
72-108
72-108
LLS*
I-P-1
II-P-2
II-P-6
II-P-6
II-P-9
II-P-9
II-P-11
II-P-13
SUN EL AT LLS
1.7°
6.7°
10.3°
24.2°
12.4°
26.4°
21.0°
12.0°
*LLS - LUNAR LANDING SITE

NASA-S-68-5423

DECEMBER WINDOW LIGHTING

LAUNCH DEC 20

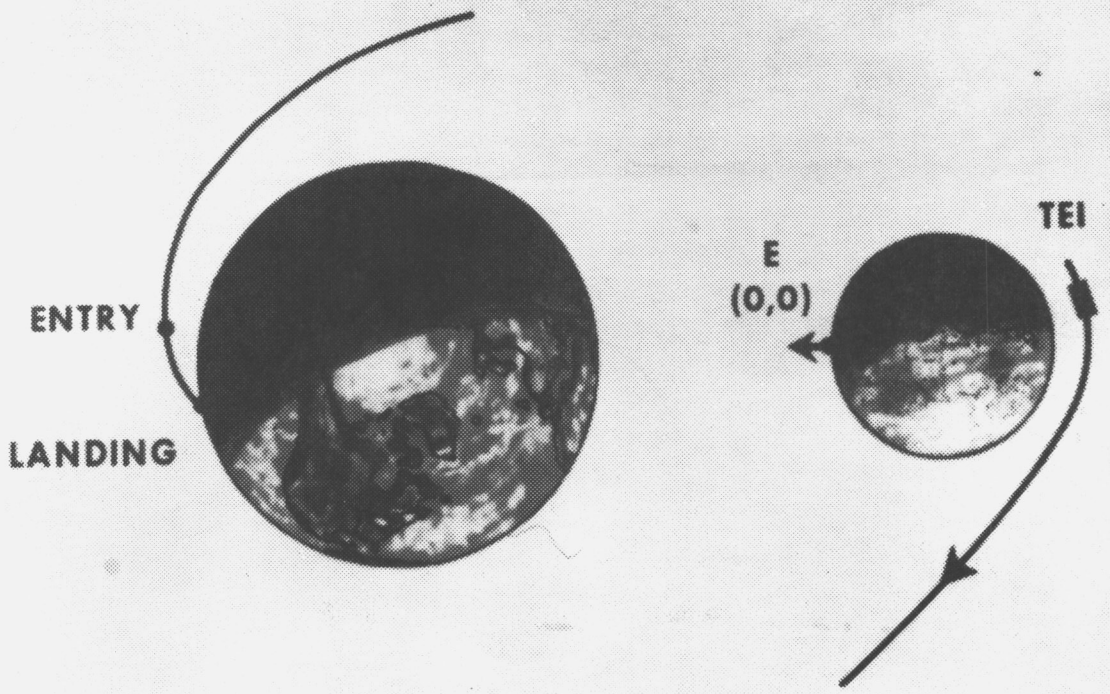


NASA-S-68-5432

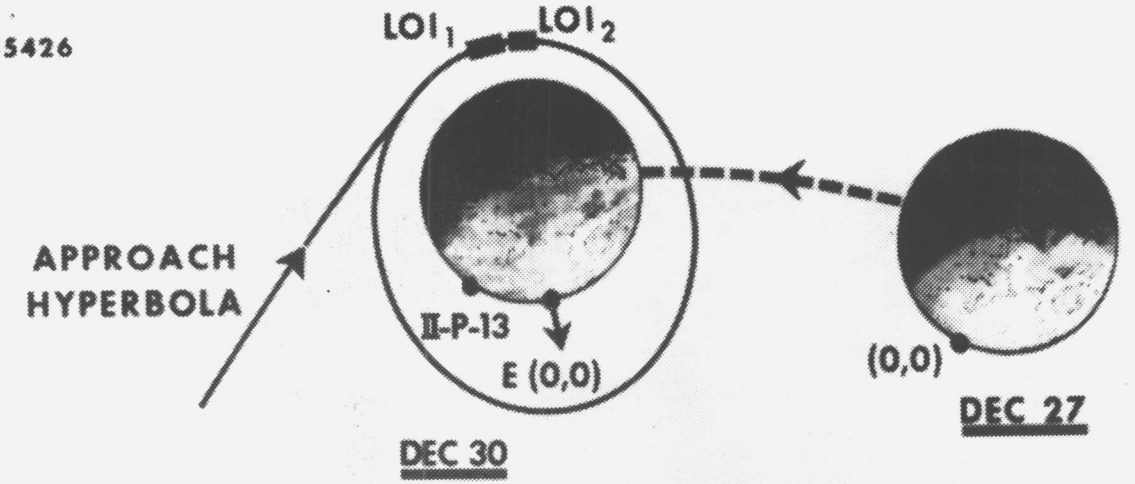
DECEMBER WINDOW
RETURN LIGHTING CONDITIONS

LANDING DEC 27, 1968

(LAUNCH DEC 20, 1968)

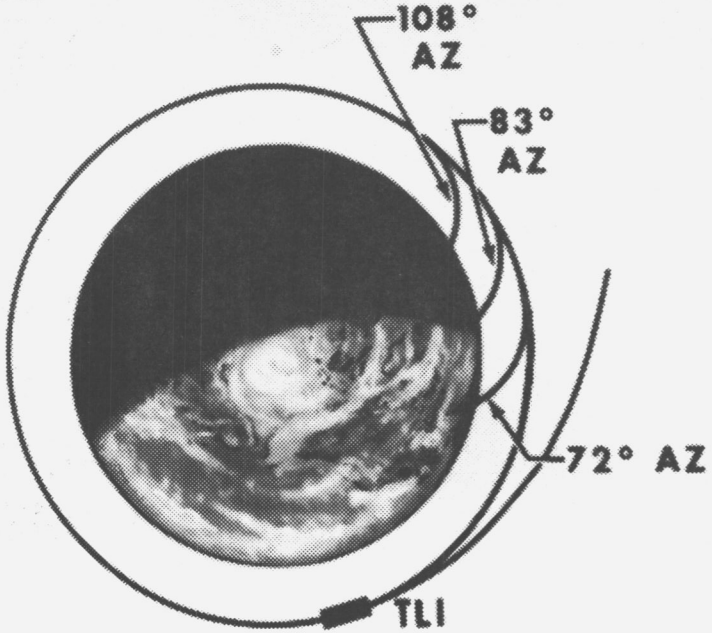


NASA-S-68-5426



DECEMBER WINDOW LIGHTING

LAUNCH DEC 27

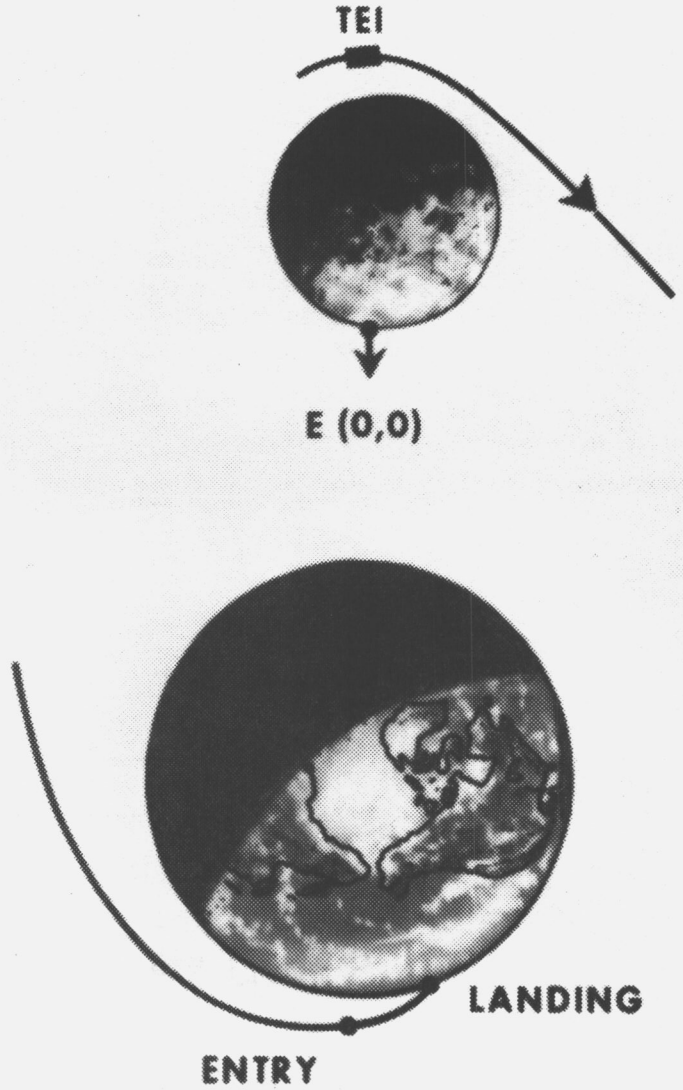


NASA-S-68-5433

DECEMBER WINDOW RETURN LIGHTING CONDITIONS

LANDING JAN 3, 1969

(LAUNCH DEC 27, 1968)

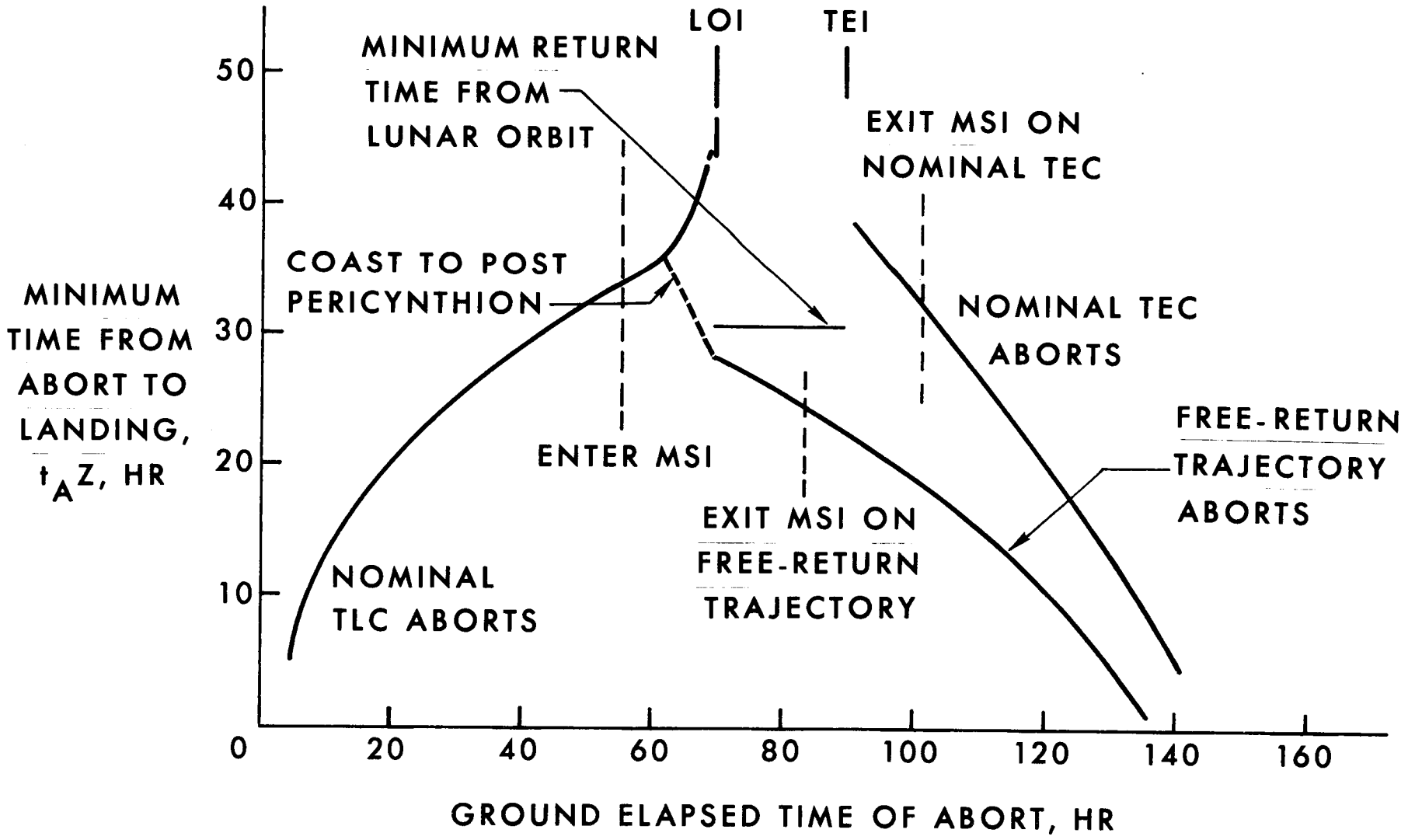


EARTH PARKING ORBIT COAST TIMES

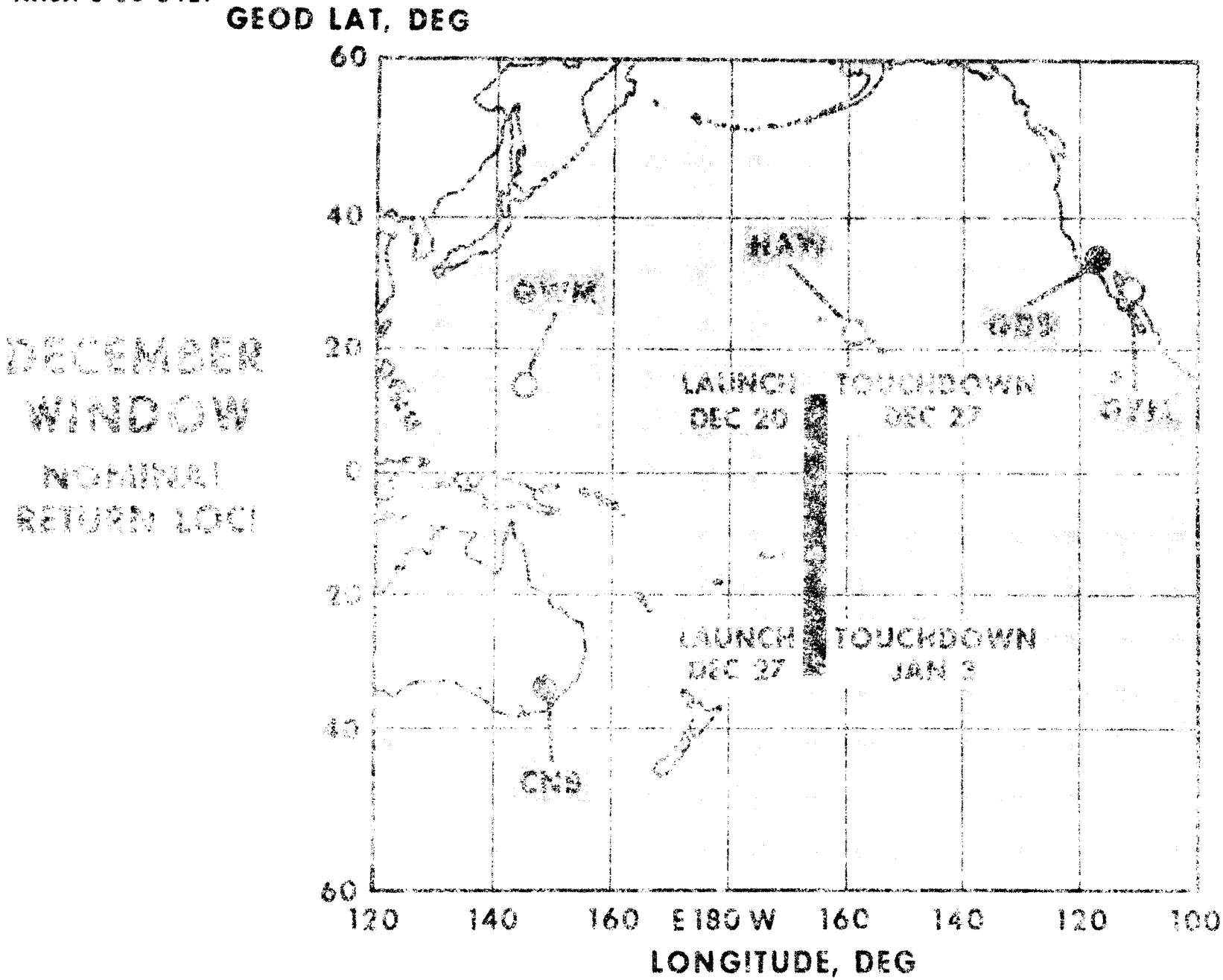
DEC 20 →	DEC 27
2 HR : 42 MIN	2 HR : 22 MIN
↓	↓
2 HR : 28 MIN	2 HR : 07 MIN

MPAD 4571 S

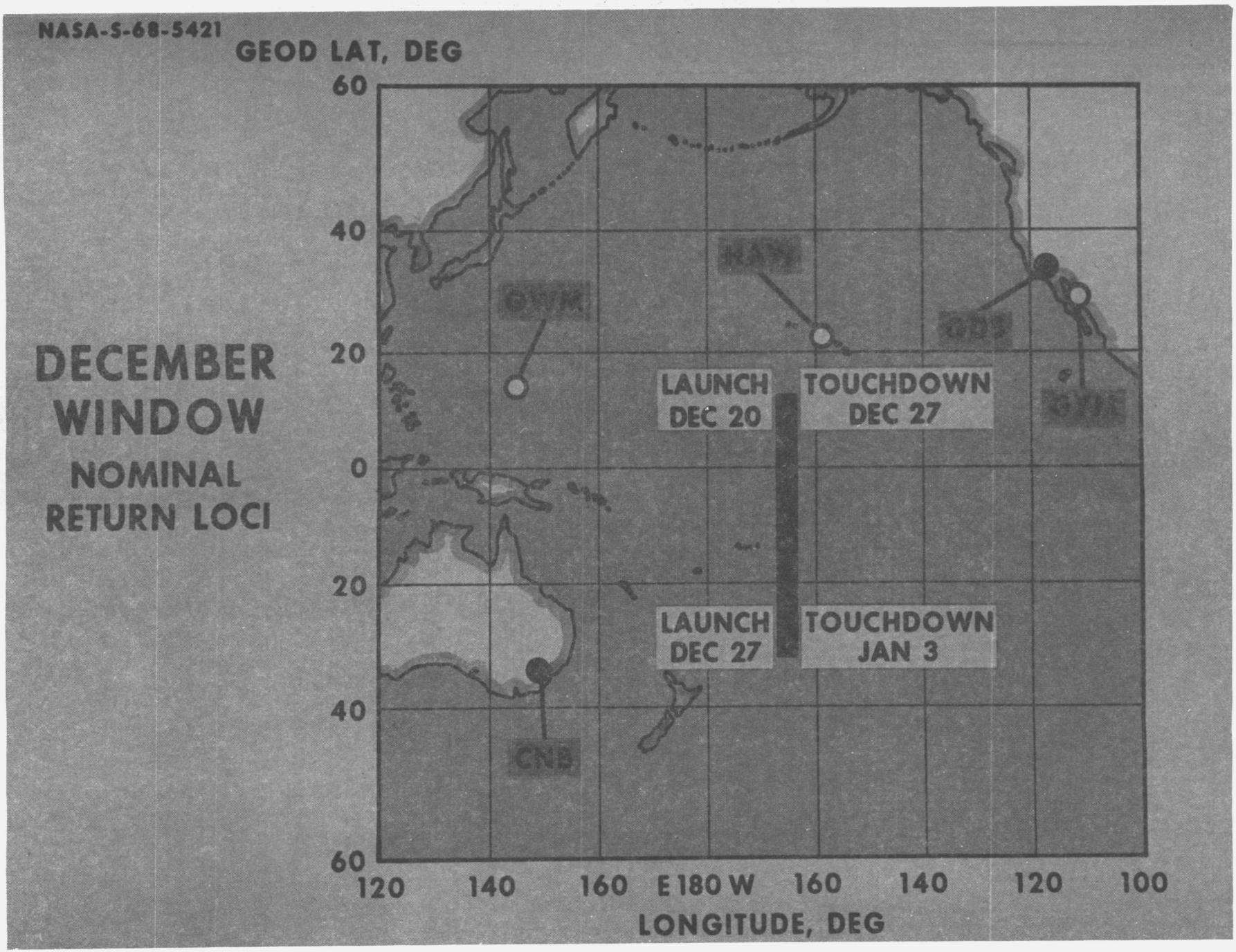
TYPICAL MINIMUM RETURN TIMES DURING A LUNAR MISSION



NASA-S-68-5421

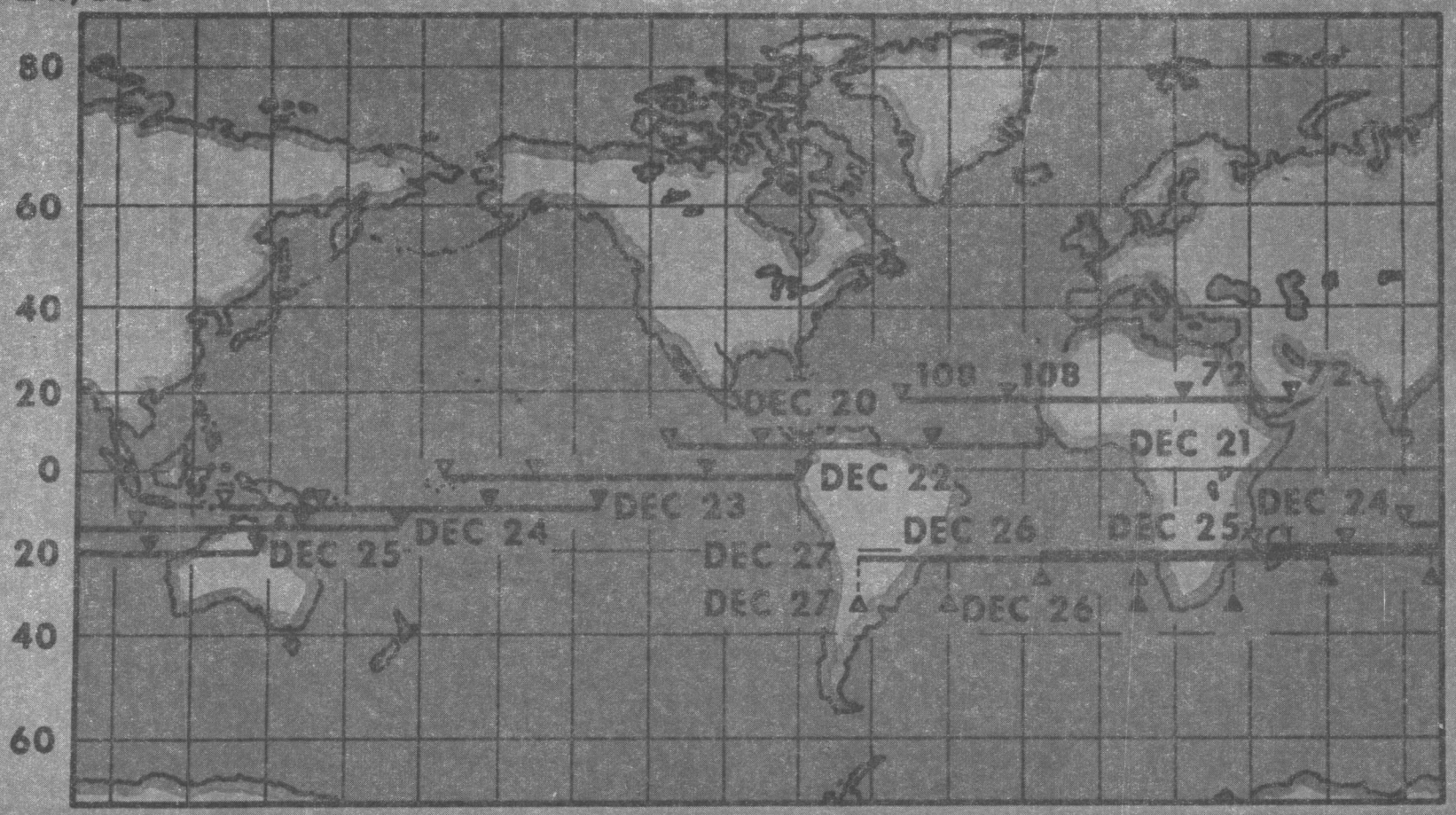


NASA-S-68-5421



NASA-S-68-5430

DECEMBER WINDOW
FREE RETURN LANDING LOCI

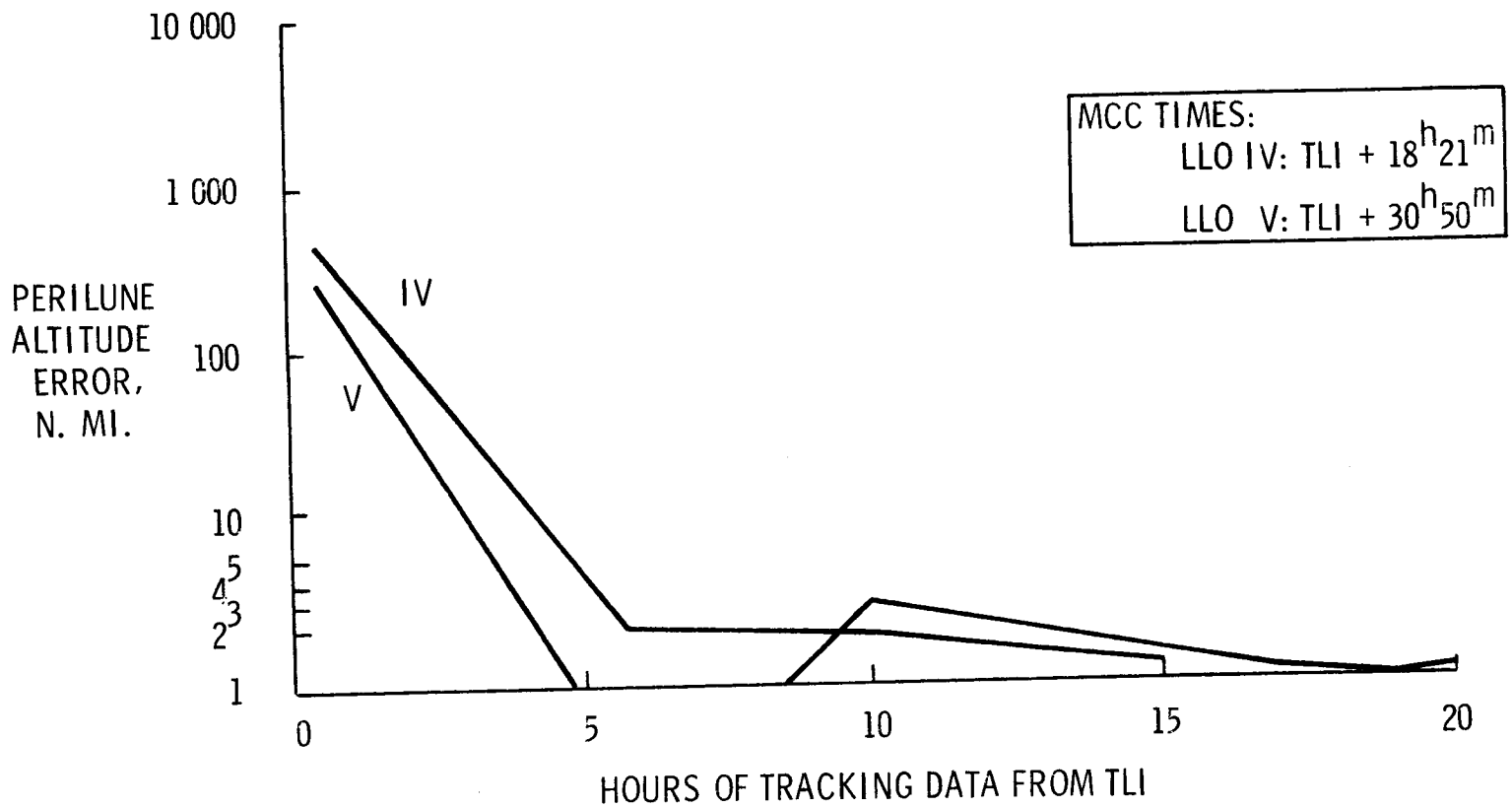


▼ FIRST OPPORTUNITY

▼ SECOND OPPORTUNITY

LUNAR APPROACH PERILUNE ALTITUDE DETERMINATION ERRORS

PRE-MIDCOURSE



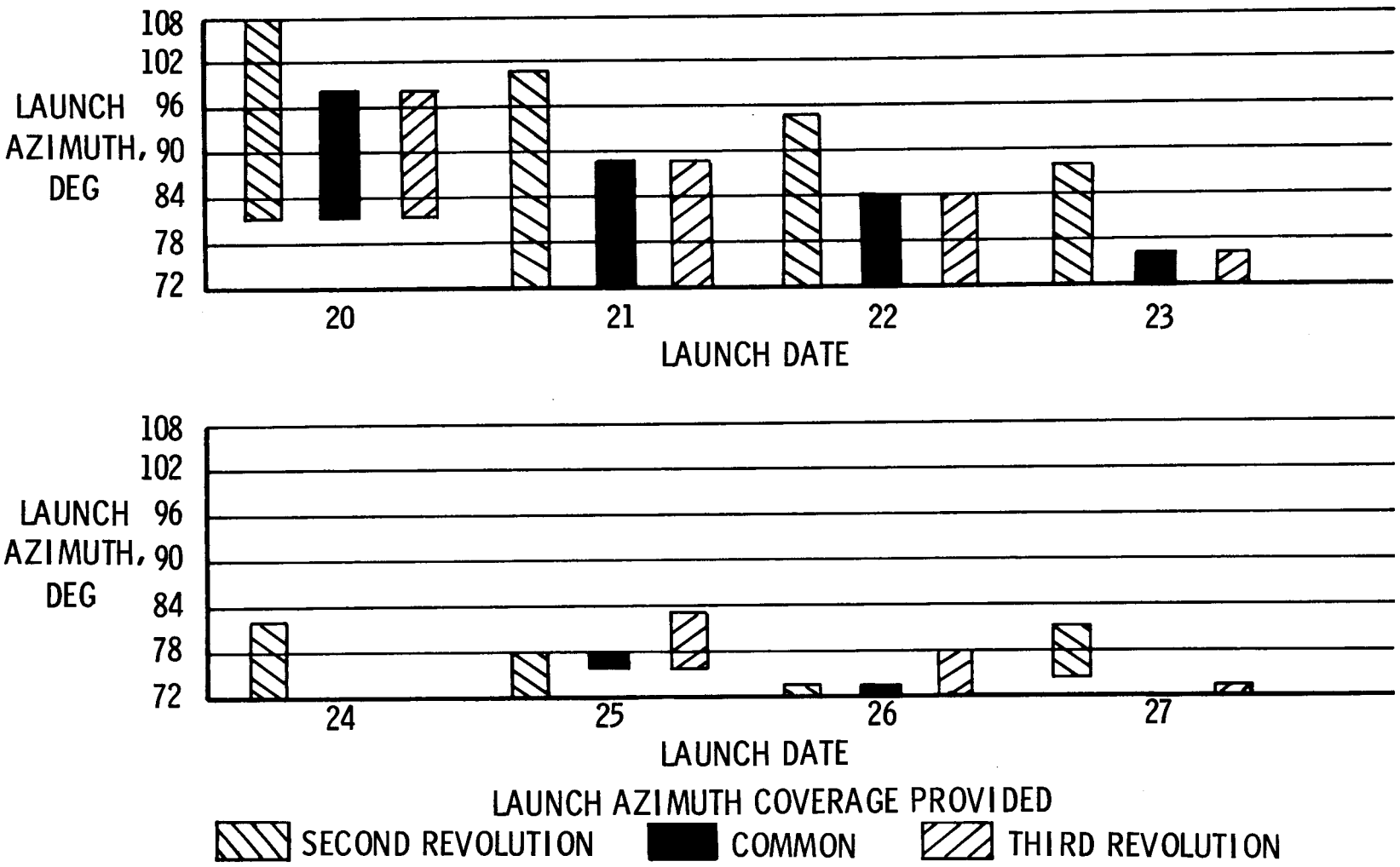
TRANSLUNAR INJECTION

- FREE-RETURN CIRCUMLUNAR
- PERILUNE ALTITUDE $\approx$ 60 N. MI.
- RETURN PERIGEE ALTITUDE $\approx$ 20 N. MI.
- RETURN INCLINATION $< 50°$
- LANDING POINT NOT CONTROLLED

TRANSLUNAR INJECTION SHIP PLACEMENT GUIDELINES

- COVERAGE OPTIMIZED FOR LAST TWO MINUTES OF THE PREIGNITION SEQUENCE
- SHIPS POSITIONED TO COVER THE OPENING OF THE WINDOW FOR FIRST INJECTION OPPORTUNITY AND TO MAXIMUM COVERAGE OVER THE 36° LAUNCH AZIMUTH RANGE
- ASSUMED CRUISING SPEED - 12 KNOTS
- COVERAGE BASED ON MINIMUM ELEVATION ANGLE OF 0°

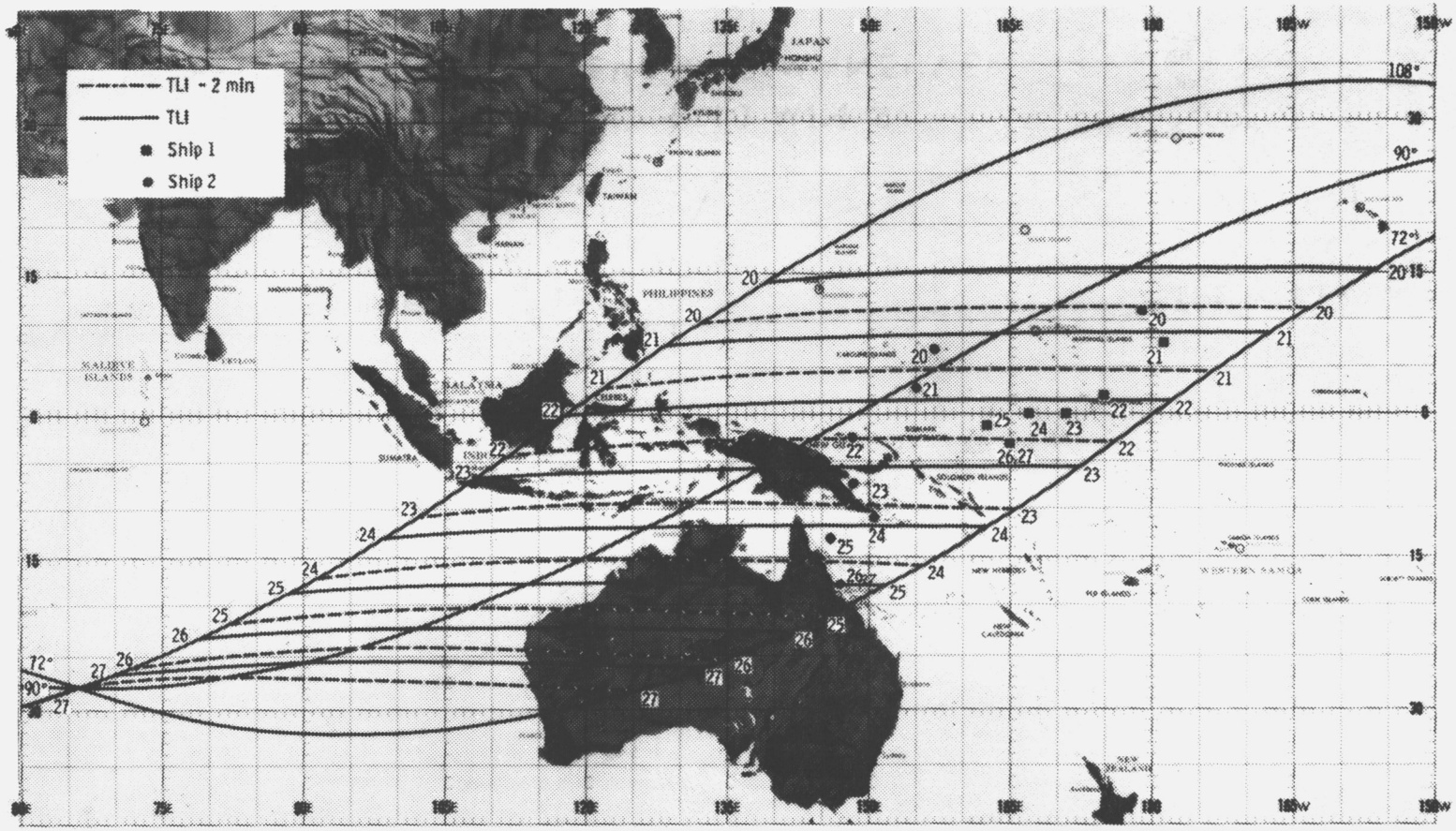
TRANSLUNAR INJECTION TRACKING SHIP COVERAGE FOR DECEMBER 1968 LAUNCH WINDOW



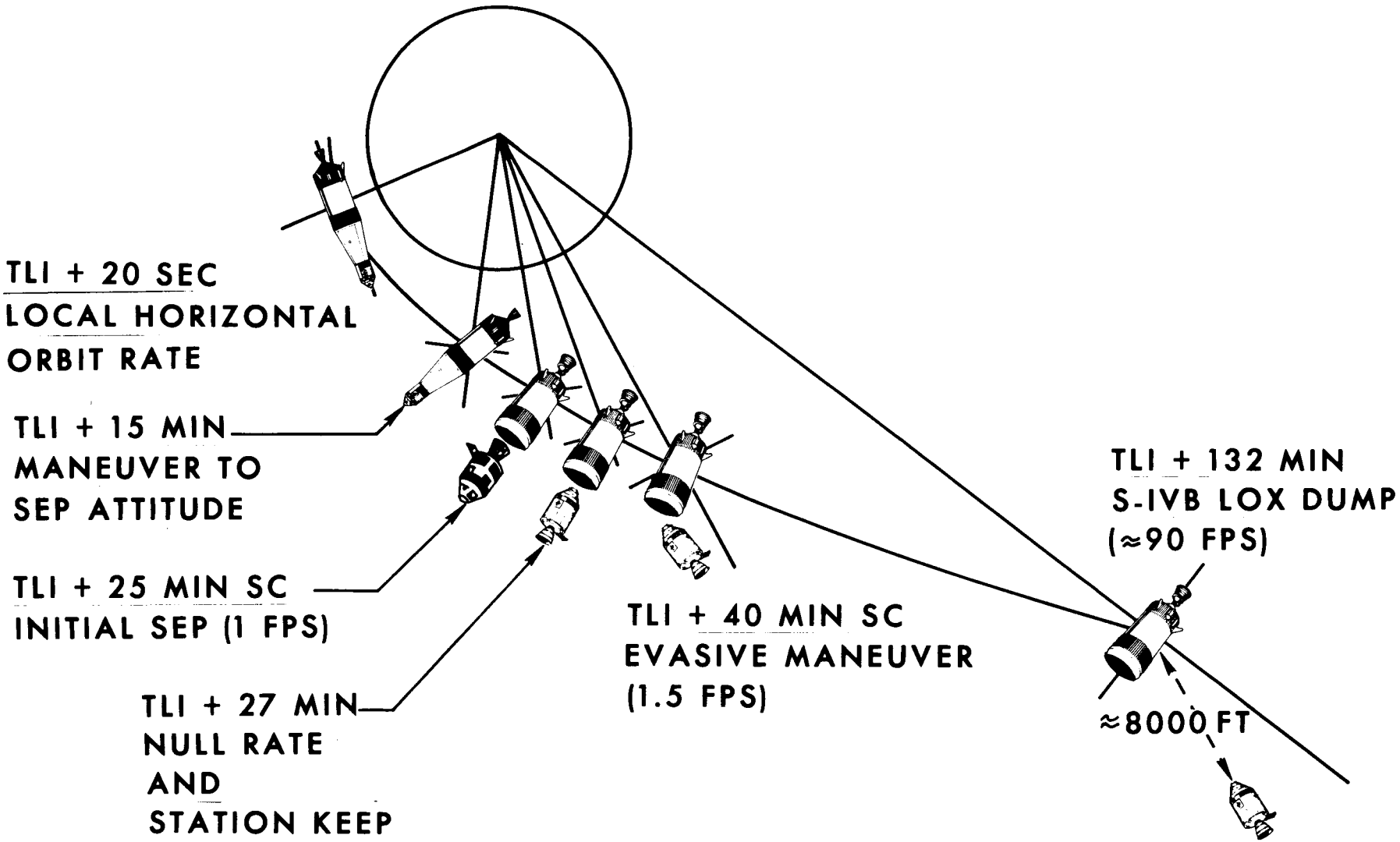
TRANSLUNAR INJECTION TRACKING SHIP COVERAGE FOR DECEMBER 1968 LAUNCH WINDOW (CONCLUDED)

	AZIMUTHS COVERED, DEG		LAUNCH WINDOW DURATION FOR AZIMUTHS COVERED, HR:MIN	
LAUNCH DATE	SECOND REV	THIRD REV	SECOND REV	THIRD REV
20 DEC	81-108	81-98	3:55	2:06
21 DEC	72-101	72-89	3:45	2:00
22 DEC	72-95	72-84	3:00	1:27
23 DEC	72-88	72-76	2:07	0:36
24 DEC	72-82	-----	1:23	----
25 DEC	72-78	76-83	0:52	1:04
26 DEC	72-73	72-78	0:10	1:00
27 DEC	74-81	72-73	1:18	0:10

TRANSLUNAR INJECTION TRACKING SHIP LOCATIONS FOR THE DECEMBER 1968 LAUNCH WINDOW



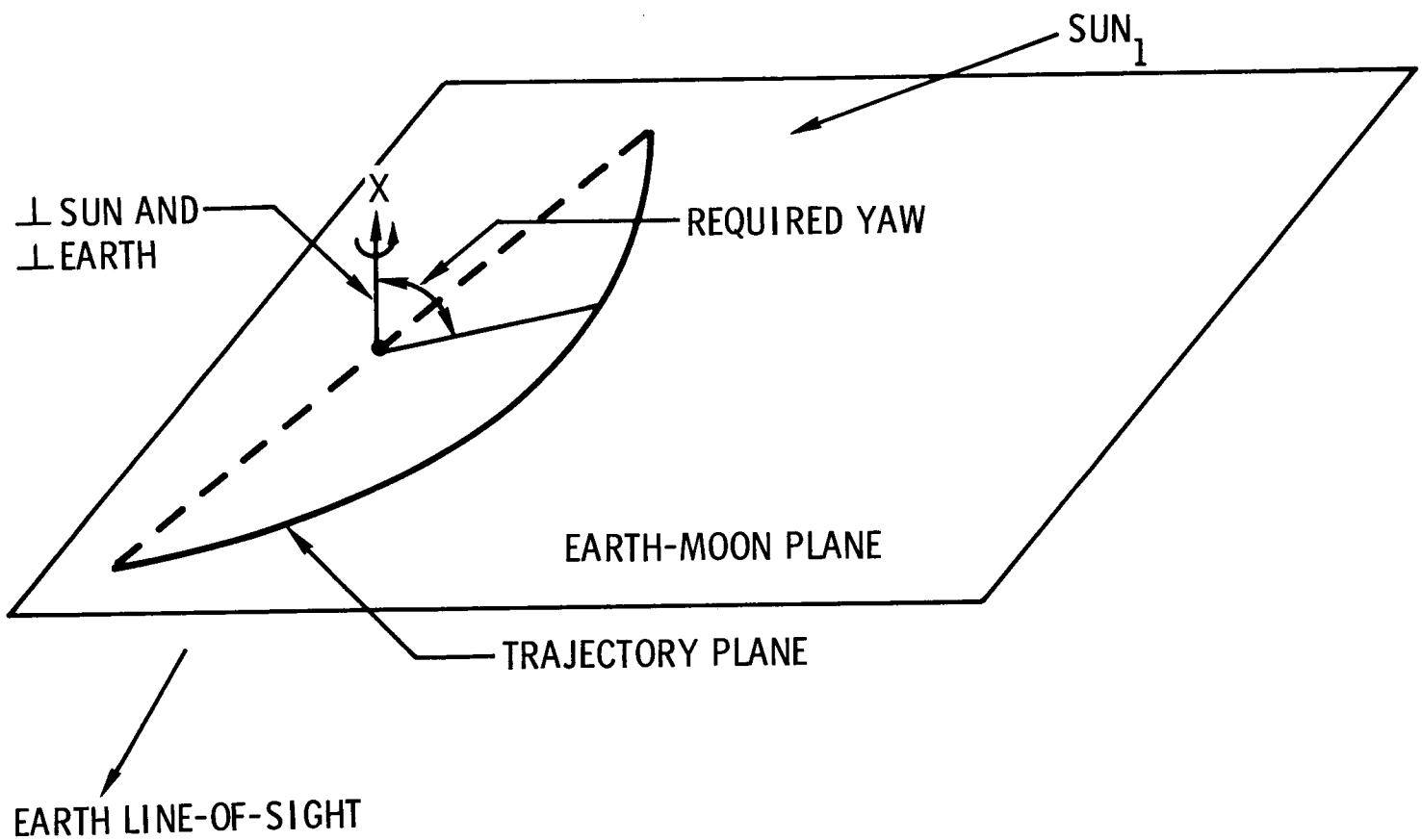
POST TLI TIMELINE



THERMAL CONTROL ATTITUDES

- BARBEQUE-ROLL 1 TO 2 REVS/HR ABOUT X-BODY AXIS
- X-BODY AXIS $\perp$ TO SUN - SC LINE
- X-BODY AXIS AS NEAR $\perp$ TO EARTH - SC LINE AS POSSIBLE WITHOUT NEARING GIMBAL LOCK
- ATTITUDE HELD WITH RCS DEADBAND CONTROL

OUT-OF-PLANE ALIGNMENT OPTIMUM FOR COMMUNICATIONS AND THERMAL CONTROL



TRANSLUNAR & FREE-RETURN SUMMARY FOR DECEMBER

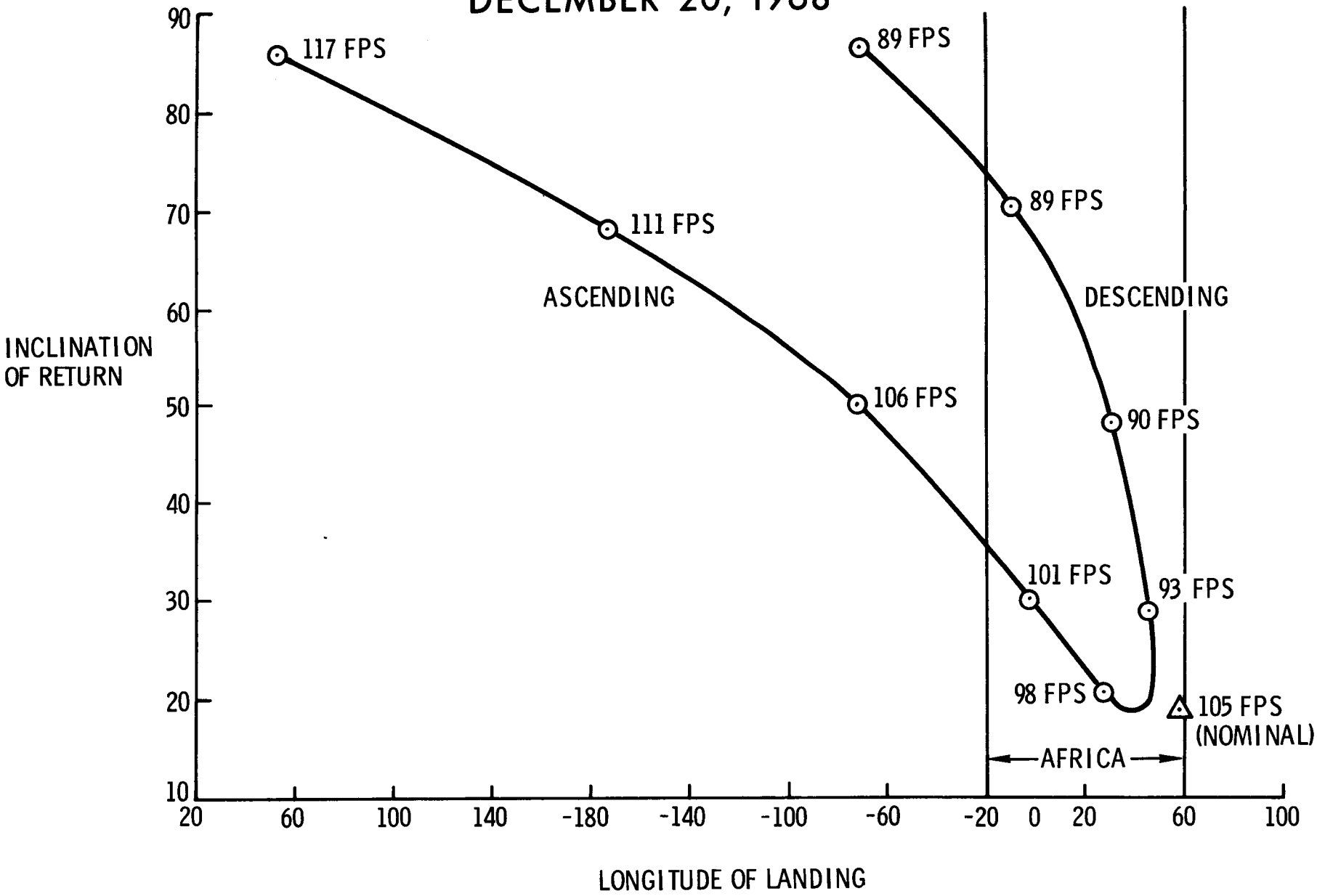
	20 →	23 →	27
TRANSLUNAR FLIGHT TIME, HR:MIN	63 : 52 ↓ 64 : 34	→	73 : 31 ↓ 73 : 50
TOTAL FREE-RETURN FLIGHT TIME, HR:MIN	129 : 55 ↓ 130 : 37	→	147 : 20 ↓ 147 : 29
FREE-RETURN INCLINATION, DEG	17 ↓ 19	→ 28 ↓ 31 →	24 ↓ 25

TRANSLUNAR MIDCOURSE CORRECTION PHILOSOPHY

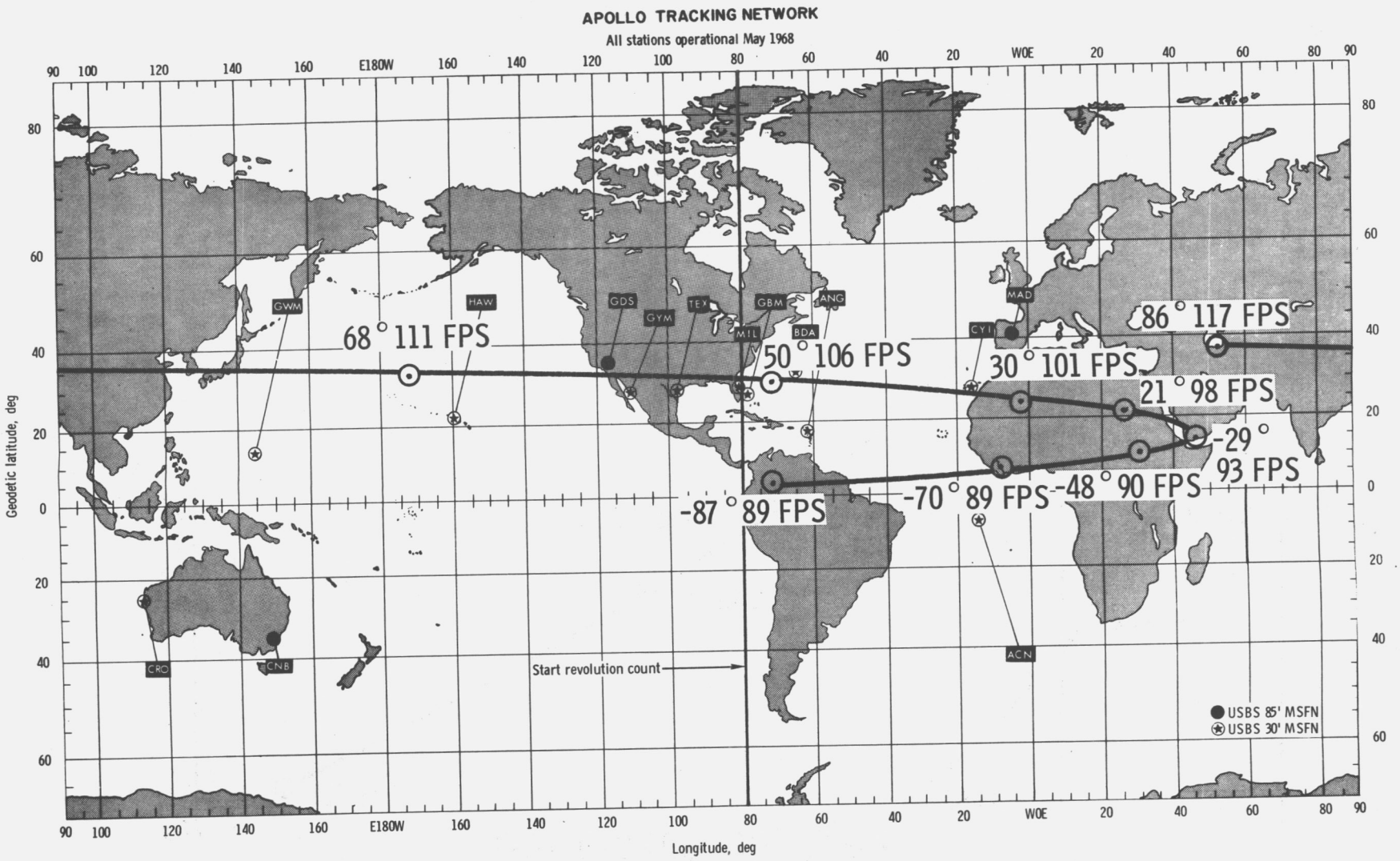
- MAINTAIN SM/RCS FREE-RETURN CAPABILITY
- MAINTAIN CLEAR PERILUNE
- KEEP LUNAR APPROACH DISPERSIONS WITHIN LOI TARGETING CAPABILITY
- MCC TIMES COMPATIBLE WITH CREW WORK/REST CYCLE IF PRACTICAL

MPAD 4539 S (IU)

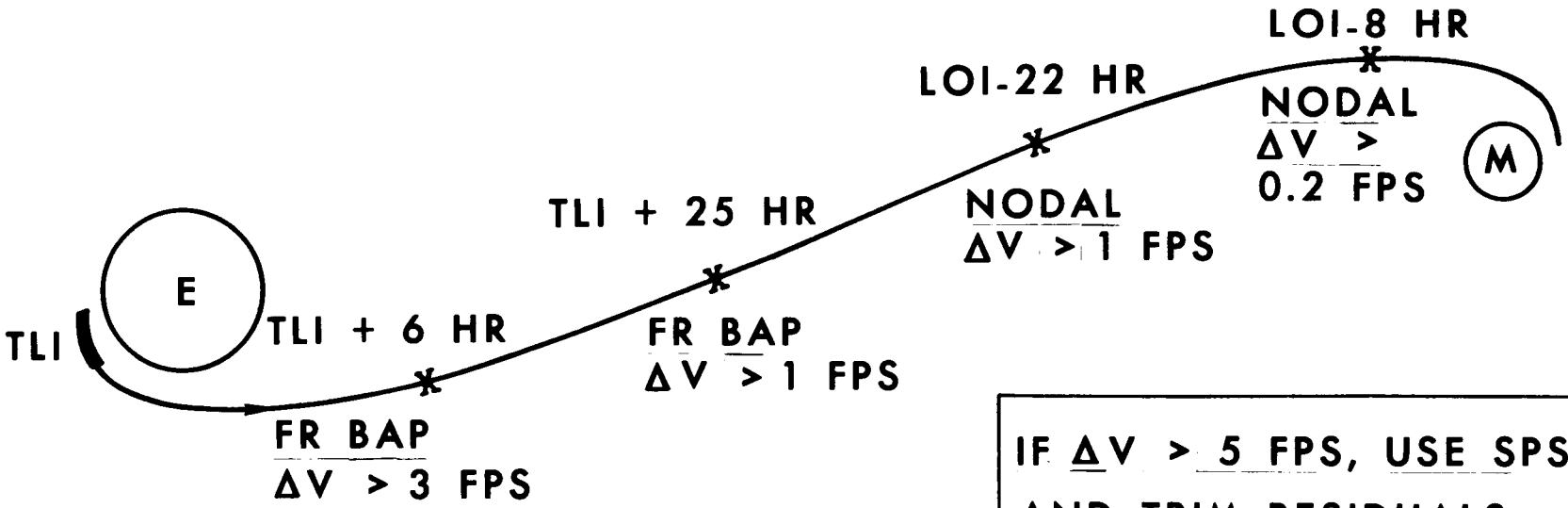
4 SIGMA TLI DISPERSION
DECEMBER 20, 1968



4 SIGMA TLI DISPERSION , DECEMBER 20, 1968

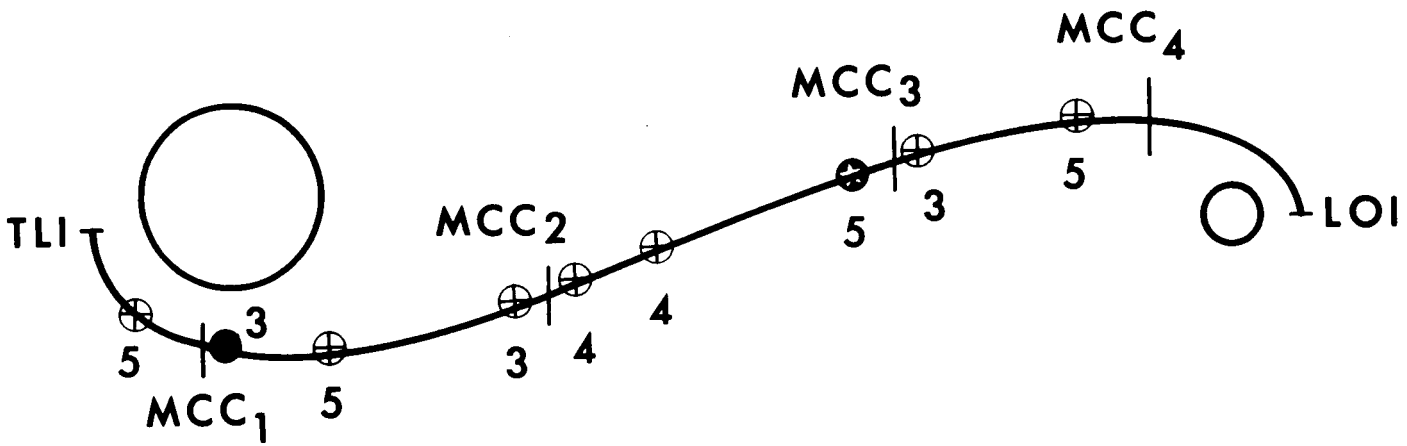


TRANSLUNAR MIDCOURSE CORRECTION STRATEGY



IF ΔV > 5 FPS, USE SPS AND TRIM RESIDUALS

APOLLO 8 TRANSLUNAR NAVIGATION SCHEDULE



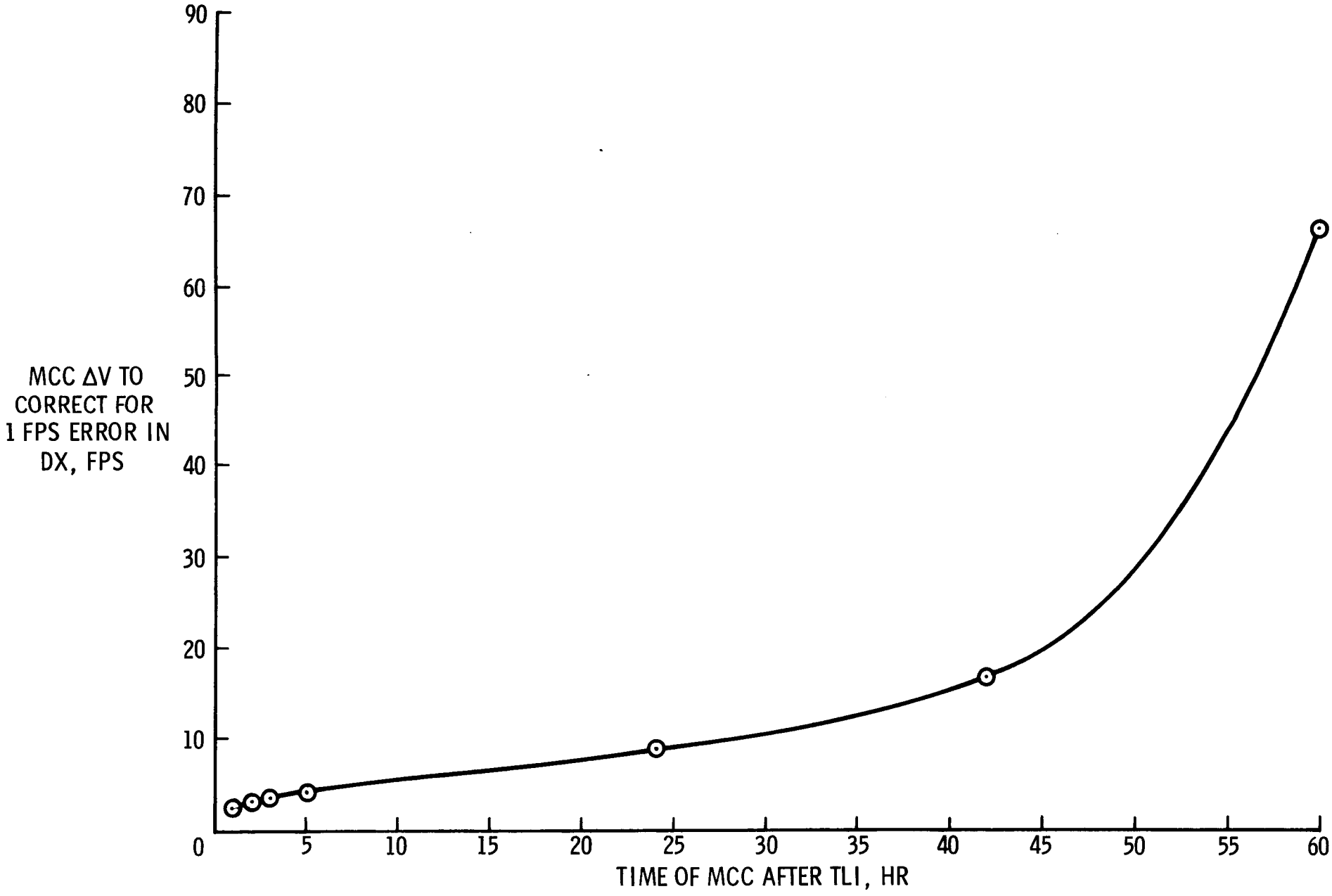
● STAR EARTH LANDMARK SIGHTINGS

⊕ STAR EARTH HORIZON SIGHTINGS

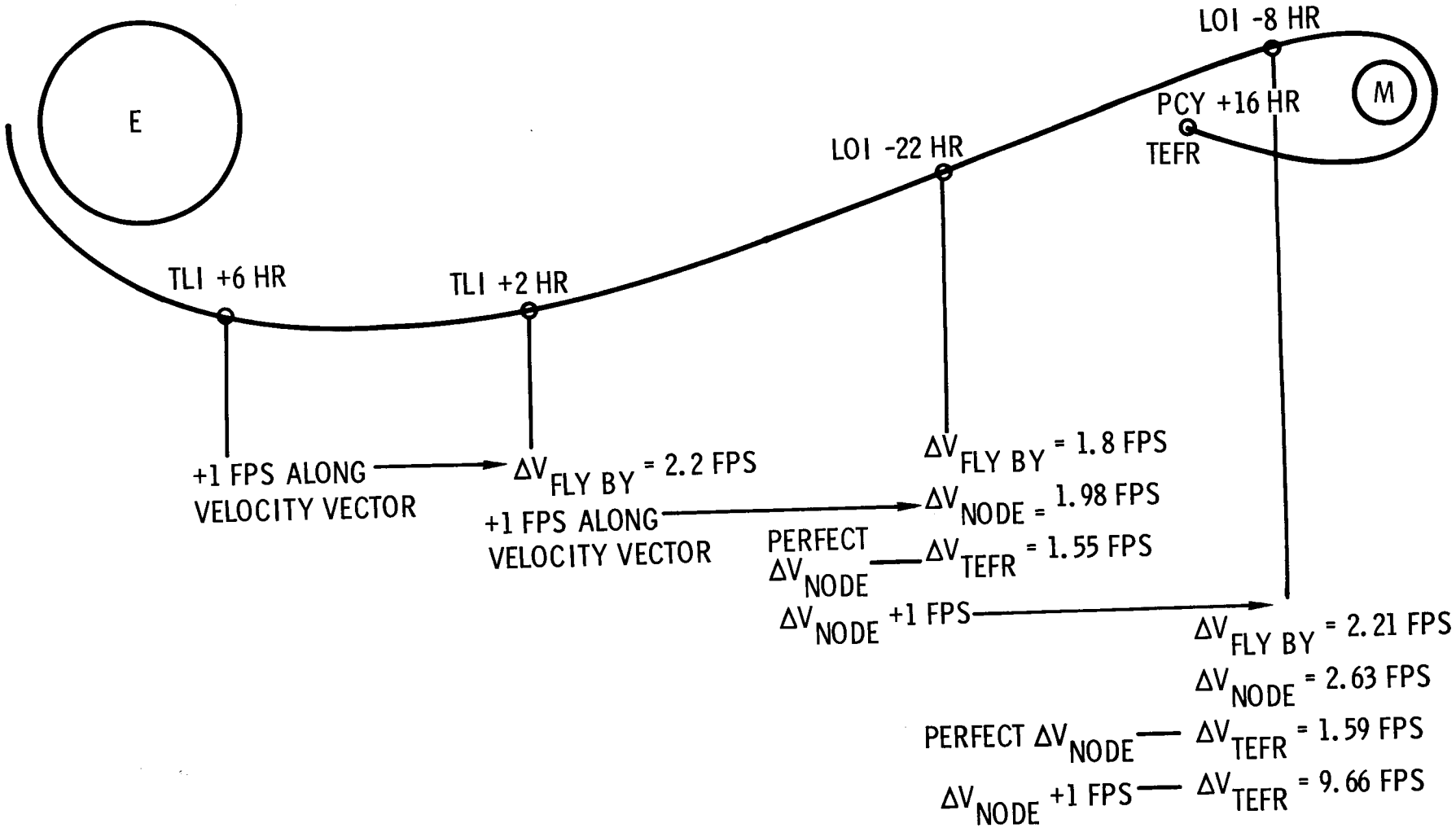
✪ STAR LUNAR HORIZON SIGHTINGS

NUMBER = NUMBER OF SIGHTINGS - SIGHTING DEFINED AS 3 MARKS

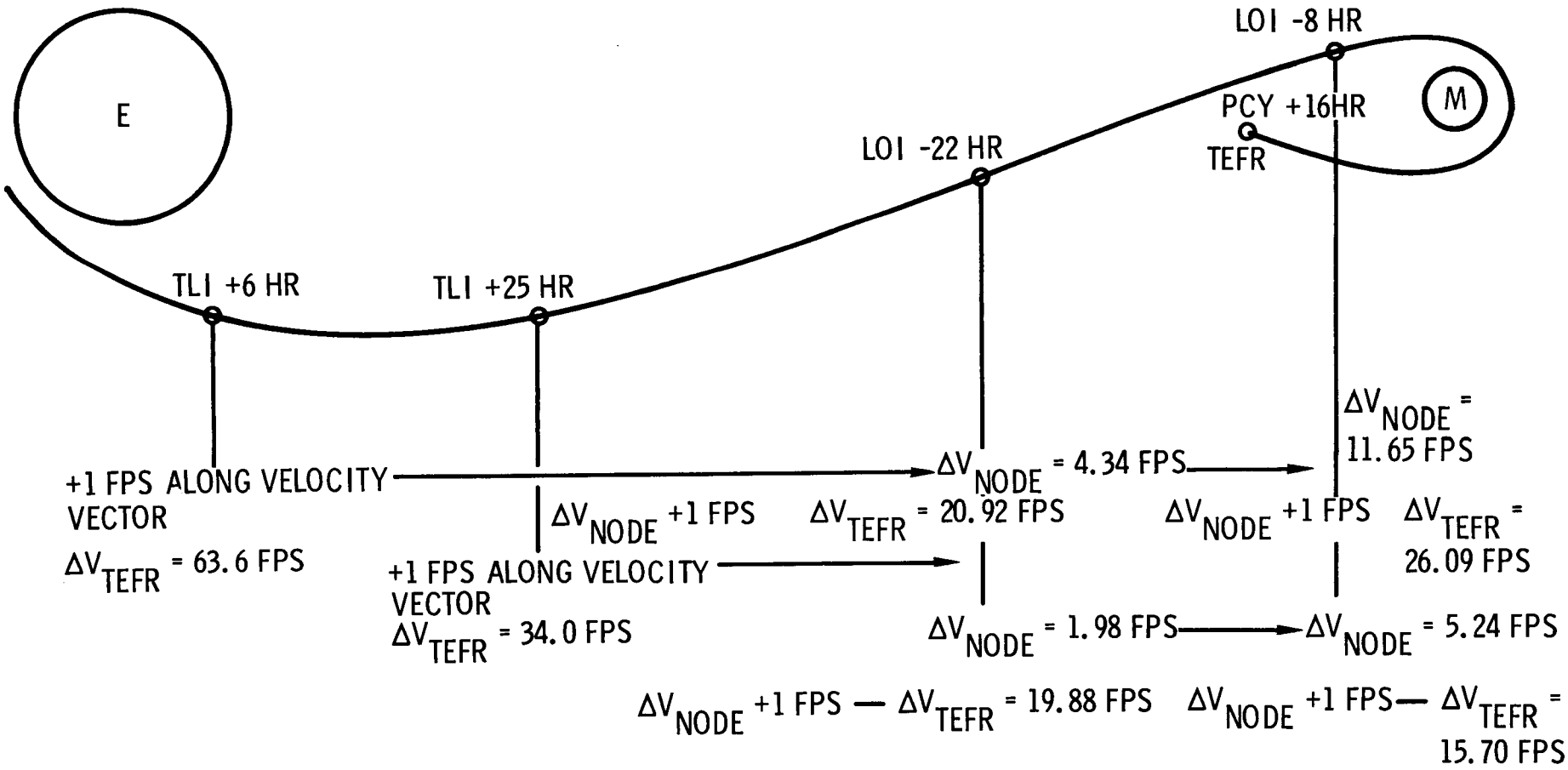
TRANSLUNAR MCC ΔV GROWTH



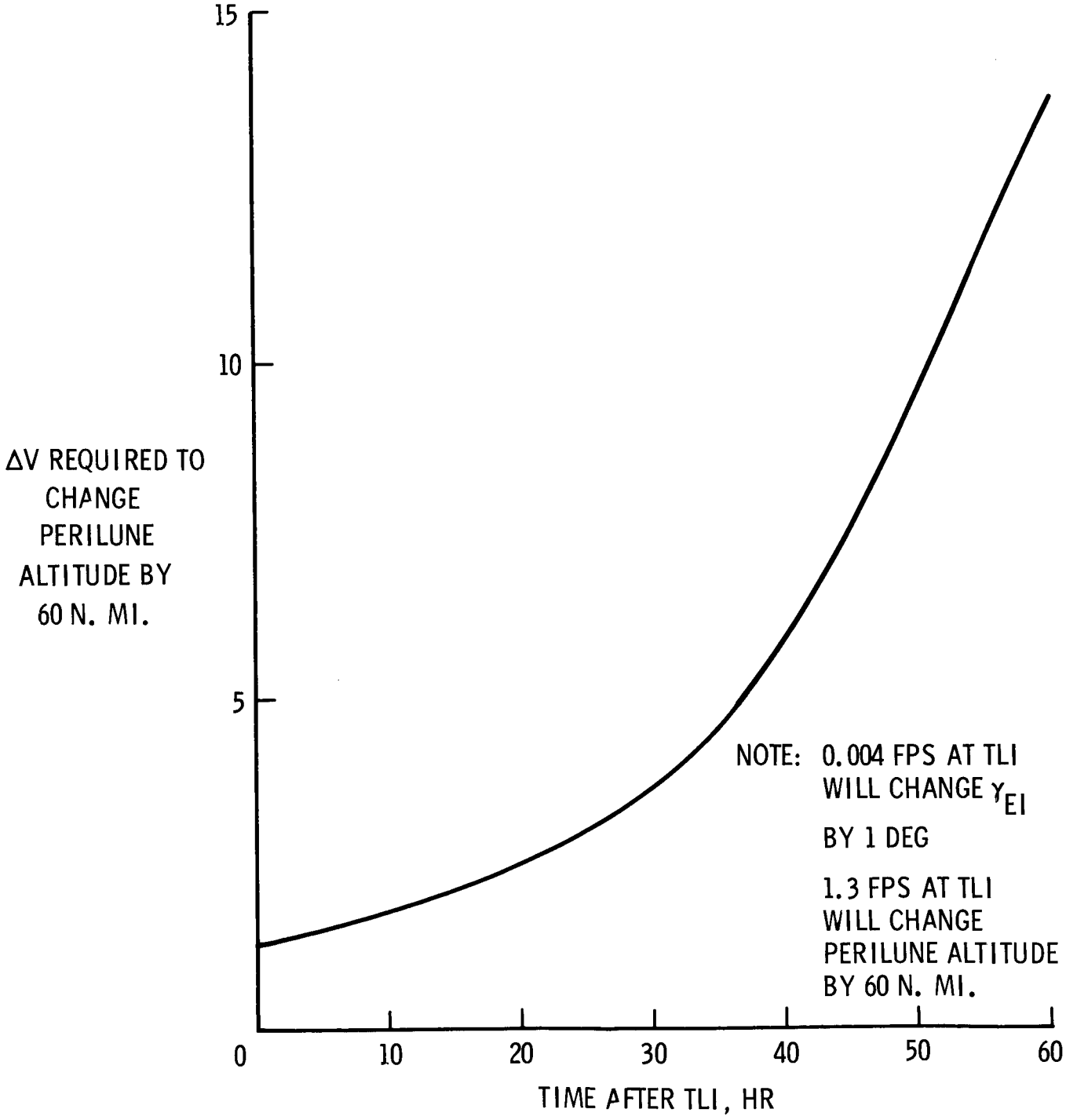
ERROR OF 1 FPS ENCOUNTERED AT PLANNED MIDCOURSE MANEUVERS FOR APOLLO 8



TRANSLUNAR MCC ΔV SENSITIVITIES



TRANSLUNAR ΔV ERROR REQUIRED TO LOWER PERILUNE ALTITUDE 60 N. MI.



PERILUNE ALTITUDE ERROR AFTER LOI DUE TO TRANSLUNAR NAVIGATION

LLO	APPROACH PERILUNE ALTITUDE, N. MI.			TRACKING INTERRUPTED LOI -
	PREDICTED	ACHEIVED	Δ	
I	N. A.	N. A.	N. A.	12^h30^m
II	536.8	535.1	-1.7	14^h25^m
III	269.6	270.8	+1.2	19^h27^m
IV	1971.1	1970.0	-1.1	13^h31^m
V	364.8	362.5	-2.3	17^h00^m

IN-FLIGHT ACTIVITIES FOR APOLLO 8

- INDEPENDENT DATA SOURCES
  - MSFN DOPPLER
  - MSFN RANGE
  - MSFN STATION SWITCHING (INCLUDING WINGS)
  - SPACECRAFT OPTICS
- INDEPENDENT PROCESSORS
  - SPACECRAFT COMPUTER
  - RTCC ORBIT DETERMINATION PROGRAM FOR MSFN
  - RTACF PROGRAM FOR MSFN AND SPACECRAFT OPTICS
- ADDITIONAL RTCC CONSOLE MANNED BY PERSONNEL WITH REAL TIME EXPERIENCE FROM PREVIOUS LUNAR MISSIONS

PRE-APOLLO 8 MSFN ACTIVITIES

- EARTH ORBIT - USBS VS C-BAND
  - APOLLO 4: MAX 7000 FT, 2.5 FPS
    MIN 500 FT, 0.1 FPS
  - APOLLO 5: MAX 244 FT, 0.5 FPS
    MIN 72 FT, 0.1 FPS
  - APOLLO 6: MAX 800 FT, 0.3 FPS
    MIN 200 FT, 0.1 FPS
- TRANSLUNAR
  - LUNAR ORBITER V DOPPLER RESIDUALS FROM 9 SITES

MEAN (CPS)	43.8	.01 → .28	.12	ANWG
σ (CPS)	0.11	.04 → .12	.24	

- LUNAR ORBIT
  - 3 REVOLUTIONS LUNAR ORBITER III
  - DSN SOLUTION VS MSFN SOLUTION
    - 525 FT
    - 0.1 FPS

LUNAR ORBITER LOI PERFORMANCE

LLO	Ω, DEG		ω, DEG		i, DEG		APO. ALT., N. MI.	
	DES.	ACH.	DES.	ACH.	DES.	ACH.	DES.	ACH.
I	325.7	326.0	180.8	180.2	12.04	12.18	998.9	1007.3
II	341.8	341.7	162.1	161.6	11.94	11.97	998.9	1010.5
III	311.7	309.7	176.2	178.5	21.05	20.61	998.9	972.6
IV	131.0	131.0	1.49	1.15	85.51	85.49	3299.8	3301.8
V	117.9	117.8	1.35	1.55	85.05	85.01	3267.0	3255.3

RTCC ORBIT DETERMINATION PROGRAM DEVELOPMENT AND VERIFICATION

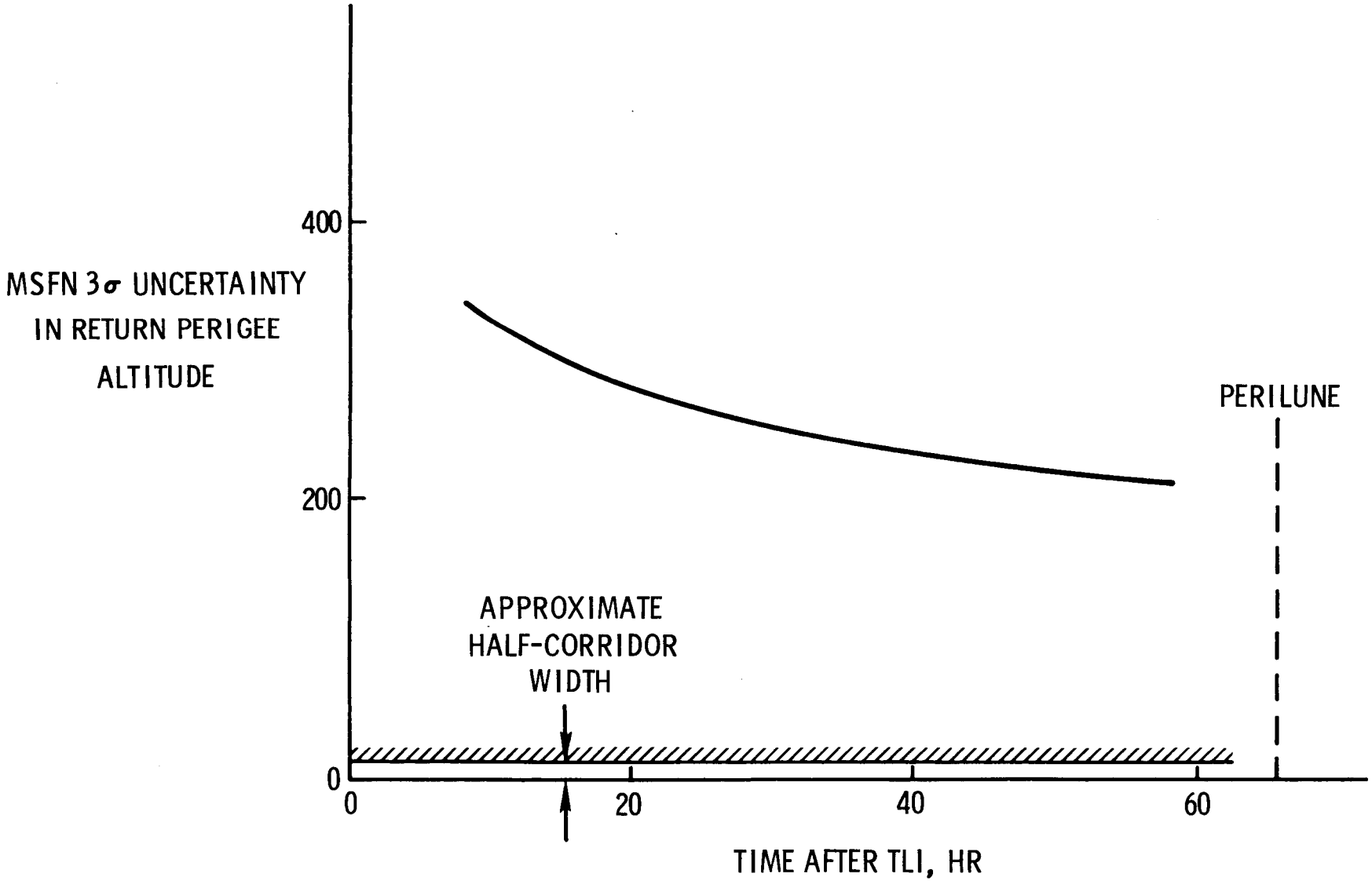
- BASIC UNITS COMPARED WITH JPL PROGRAM
  - 12 HRS INTEGRATION IN LUNAR ORBIT WITH AGREEMENT TO 10 METERS AND 0.02 METERS/SEC
  - 47 HRS INTEGRATION IN TRANSLUNAR COAST WITH AGREEMENT TO 100 METERS AND 0.2 METERS/SEC
- RTCC PROGRAM COMPARED TO JPL PROGRAM
  - JPL PROGRAM PROCESSED 28 HRS POST MANEUVER DATA FOR TRANSLUNAR BET
  - RTCC PROGRAM PROCESSED 9 HRS AT MID-POINT OF 28 HRS SPAN
  - BOTH SOLUTIONS USED TO PREDICT PERILUNE WITH AGREEMENT OF:
    - ΔH_p - 0.341 N. MI.
    - ΔV - 0.406 FPS

LUNAR ORBITER LOI PERFORMANCE

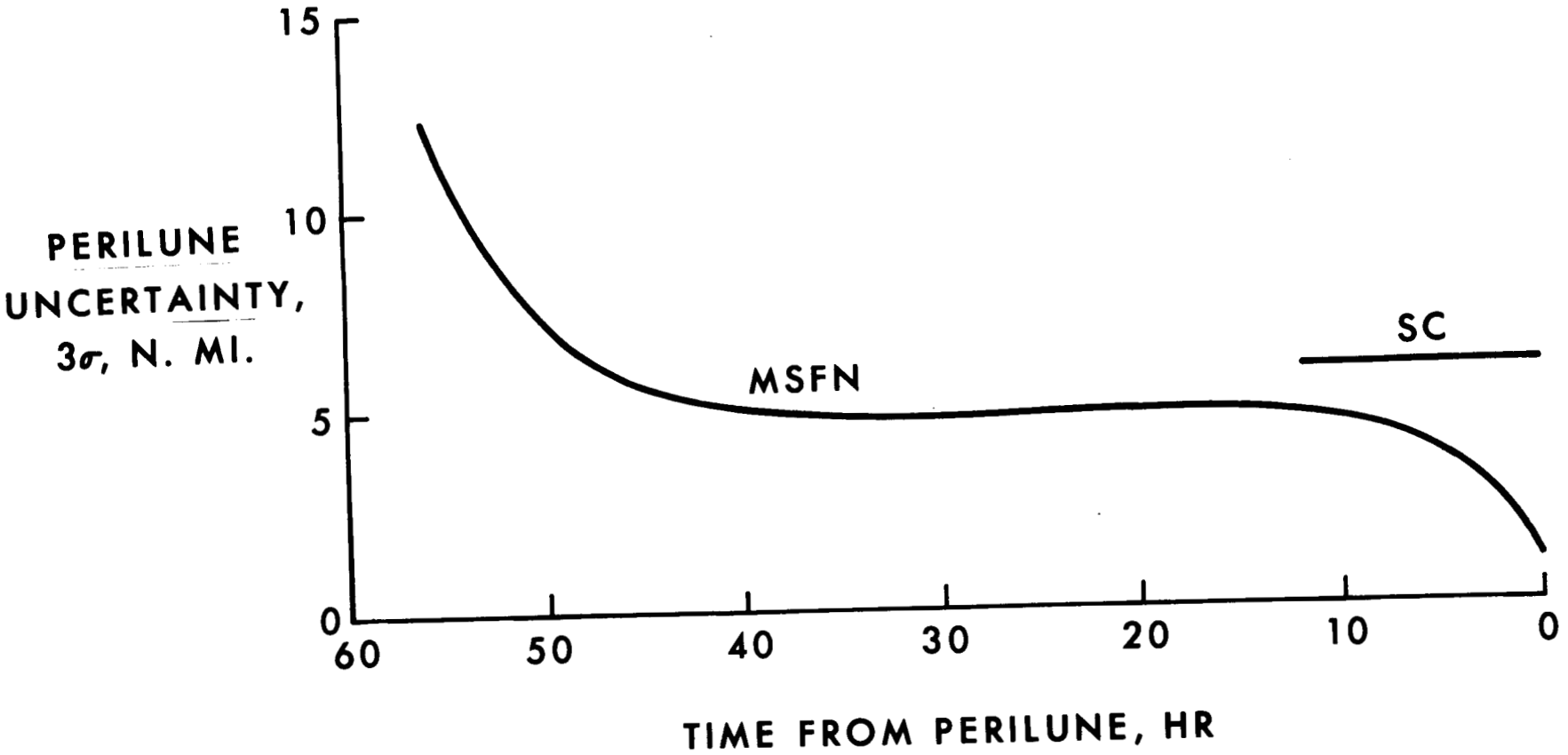
LLO	INITIAL ORBIT PERILUNE ALTITUDE, N. MI.		
	TARGETED*	ACHEIVED	Δ
I	107.8	102.0	-5.8
II	109.1	106.0	-3.1
III	115.1	113.4	-1.7
IV	1456.5	1459.5	+3.0
V	108.8	105.5	-3.3

*AFTER MIDCOURSE CORRECTION

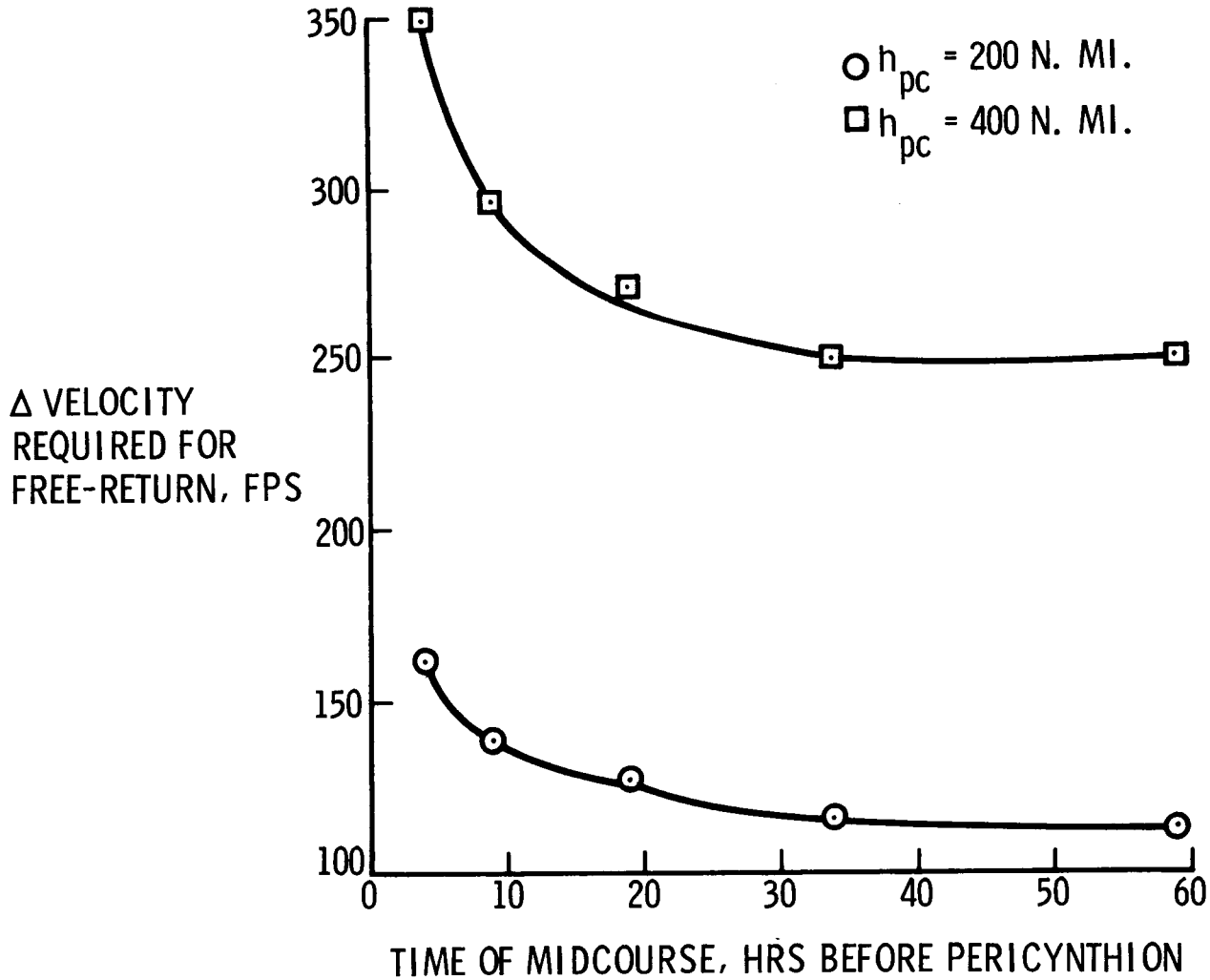
FREE RETURN PERIGEE ALTITUDE UNCERTAINTY



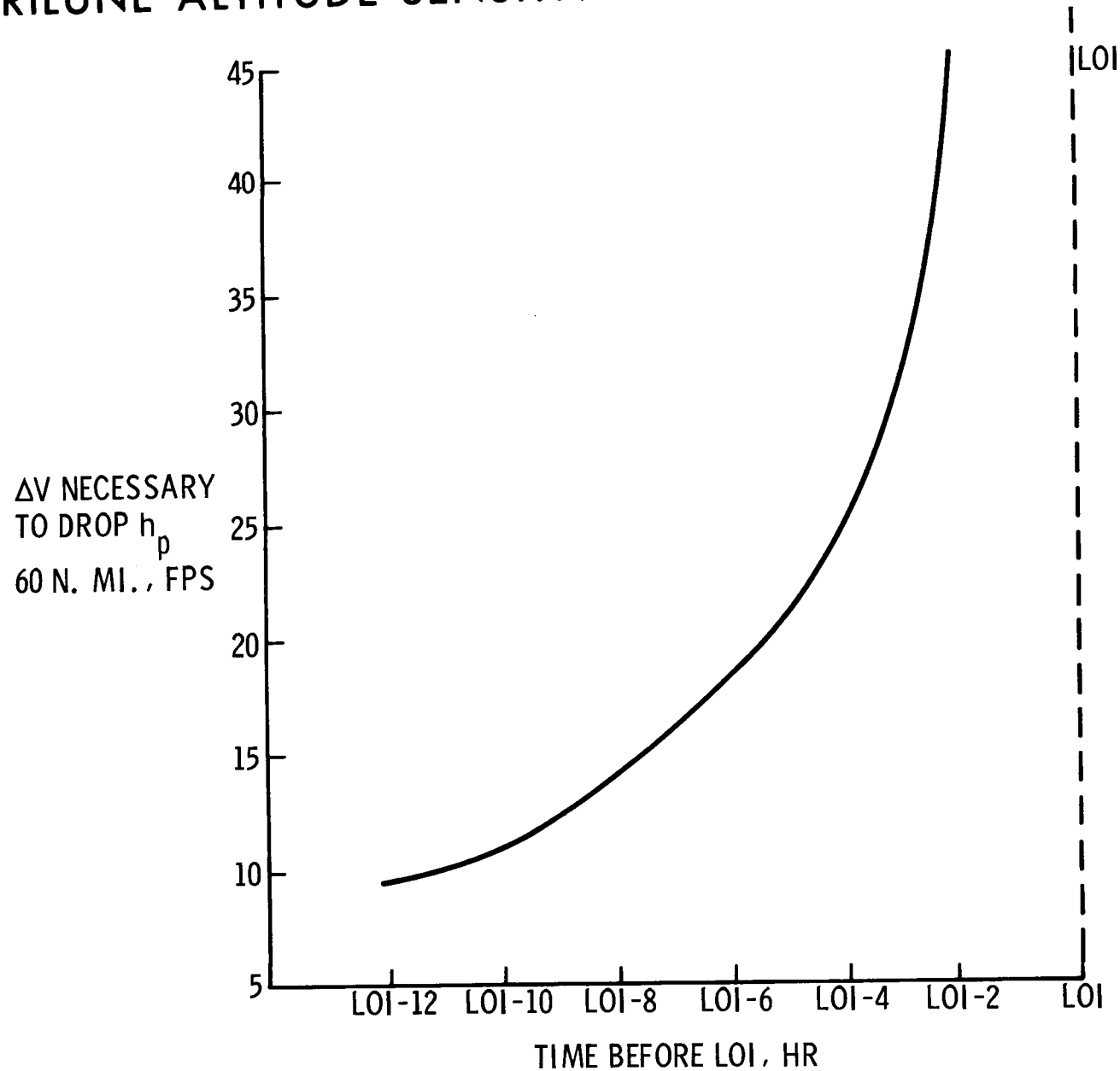
PERILUNE PREDICTION ACCURACY (3σ) FOR APOLLO 8



ΔV MCC REQUIRED TO RAISE hp FOR FREE-RETURN FLY-BY



PERILUNE ALTITUDE SENSITIVITY TO VELOCITY ERRORS



LUNAR ORBIT SELECTION GUIDELINES

- PASSAGE OVER ORBITER PHOTOGRAPHED LANDMARKS IN APOLLO ZONE
- LIGHTING AS NEAR TO "G" REQUIREMENT AS PRACTICAL
- MAXIMUM PRACTICAL INCLINATION FOR MSFN CHECK
- MINIMUM PRACTICAL FREE-RETURN INCLINATION
- REASONABLE SC PERFORMANCE REQUIREMENTS

LUNAR ORBIT SUMMARY - DEC

	20	21	22	23	24	25	26	27
LUNAR ORBIT TARGET SITE	I-P-1 (43.3°)	II-P-2 (34.0°)	II-P-6 (23.7°)	II-P-6	II-P-8 (-1.4°)	II-P-8	II-P-11 (-19.9°)	II-P-13 (-41.9°)
SUN ELEVATION AT SITE PASS (DEG)	1.8 ↓ 5.1	6.6 ↓ 10.0	10.0 ↓ 13.4	24.0 ↓ 27.3	12 ↓ 15	26 ↓ 29	20 ↓ 23	12 ↓ 15
APPROACH AZIMUTH AT SITE (DEG)	-78 →						-78	-82
INCLINATION (DEG)	12 →						12	8

LUNAR ORBIT INSERTION

- TWO-STAGE:
  - LOI(1)→60 × 170 WITH PLANE CHANGE
  - LOI(2)→60 × 60 IN PLANE
- FIXED ATTITUDE BURNS

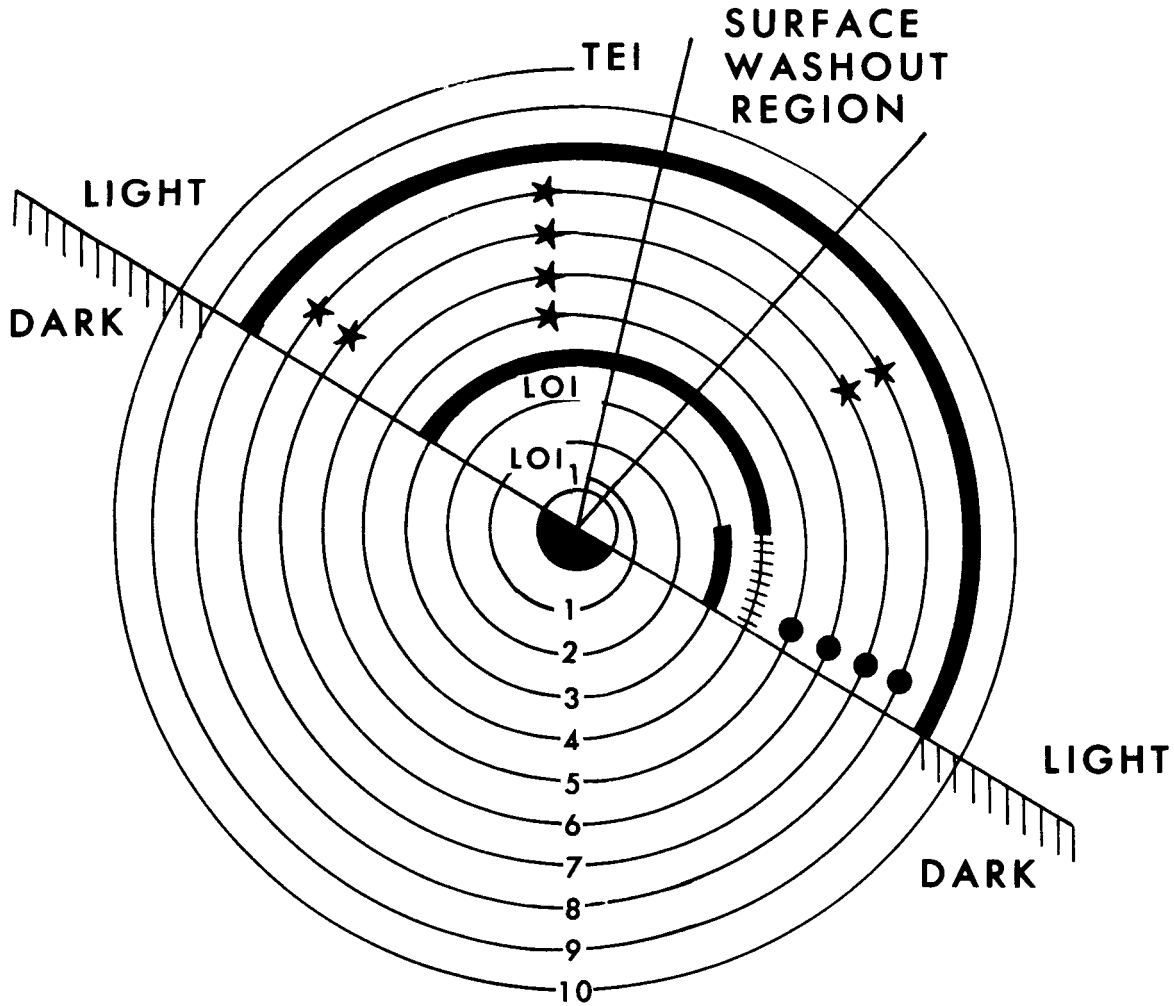
LOI(1) ΔV SUMMARY FOR DECEMBER

DEC 20 →	DEC 27
2991 FPS ↓ 3021 FPS →	2857 FPS ↓ 2889 FPS

APOLLO 8 LUNAR ORBIT ACTIVITIES

- MSFN TRACKING
- SPACECRAFT SIGHTINGS ON LUNAR LANDMARKS
- EVALUATION OF LANDMARK IDENTIFICATION AT LOW SUN ELEVATIONS
- PHOTOGRAPHY OF APPROACH TO TERMINATOR FOR CREW TRAINING
- VERTICAL AND OBLIQUE STEREO PHOTOGRAPHY FOR MAPPING
- TELEVISION
- SCIENTIFIC AND GENERAL PHOTOGRAPHY

LUNAR ORBIT SC NAVIGATION FOR APOLLO 8



● LANDMARK TRACKING FOR LM DESCENT TARGETING

✶ UNKNOWN LANDMARK TRACKING

LIGHTING EVALUATION

PHOTOGRAPHY

KEY

- ● SPACECRAFT SIGHTINGS ON KNOWN LANDMARK
  - ● SAME LANDMARK IN REVS 5, 6, 7 AND 8
  - ● SUN ELEVATION OF 5°, 6°, 7° AND 8°
  - ● POST-FLIGHT EVALUATION OF NAVIGATION FOR LM DESCENT
    - ● MSFN + SC DATA IN REV 5 PROPAGATED TO REV 7
    - ● MSFN + SC DATA IN REV 6 PROPAGATED TO REV 8
- ★ SPACECRAFT SIGHTINGS ON UNKOWN LANDMARKS
  - ● SAME LANDMARK IN EACH REV AS SELECTED BY CREW
  - ● POST-FLIGHT SOLVING FOR LOCATION PROVIDES EVALUATION OF MSFN NAVIGATION ACCURACY
  - ● SERVE AS CONTROL POINTS FOR STEREO PHOTOGRAPHY REDUCTION

KEY (CONCLUDED)

HHHH SPACECRAFT OBSERVATION OF GROUND TRACK

- ORBIT RATE MANEUVER
- FIXED OPTICS ATTITUDE
- EVALUATION BY CREW OF LANDMARK IDENTIFICATION AT LOW SUN ELEVATIONS
- SUN ELEVATION VARIES AT 3°/MIN

▬ TRAINING PHOTOGRAPHY IN REV 3

- SEQUENCING CAMERA RECORDS APPROACH TO TERMINATOR
- USED FOR CREW TRAINING FOR FUTURE MISSIONS

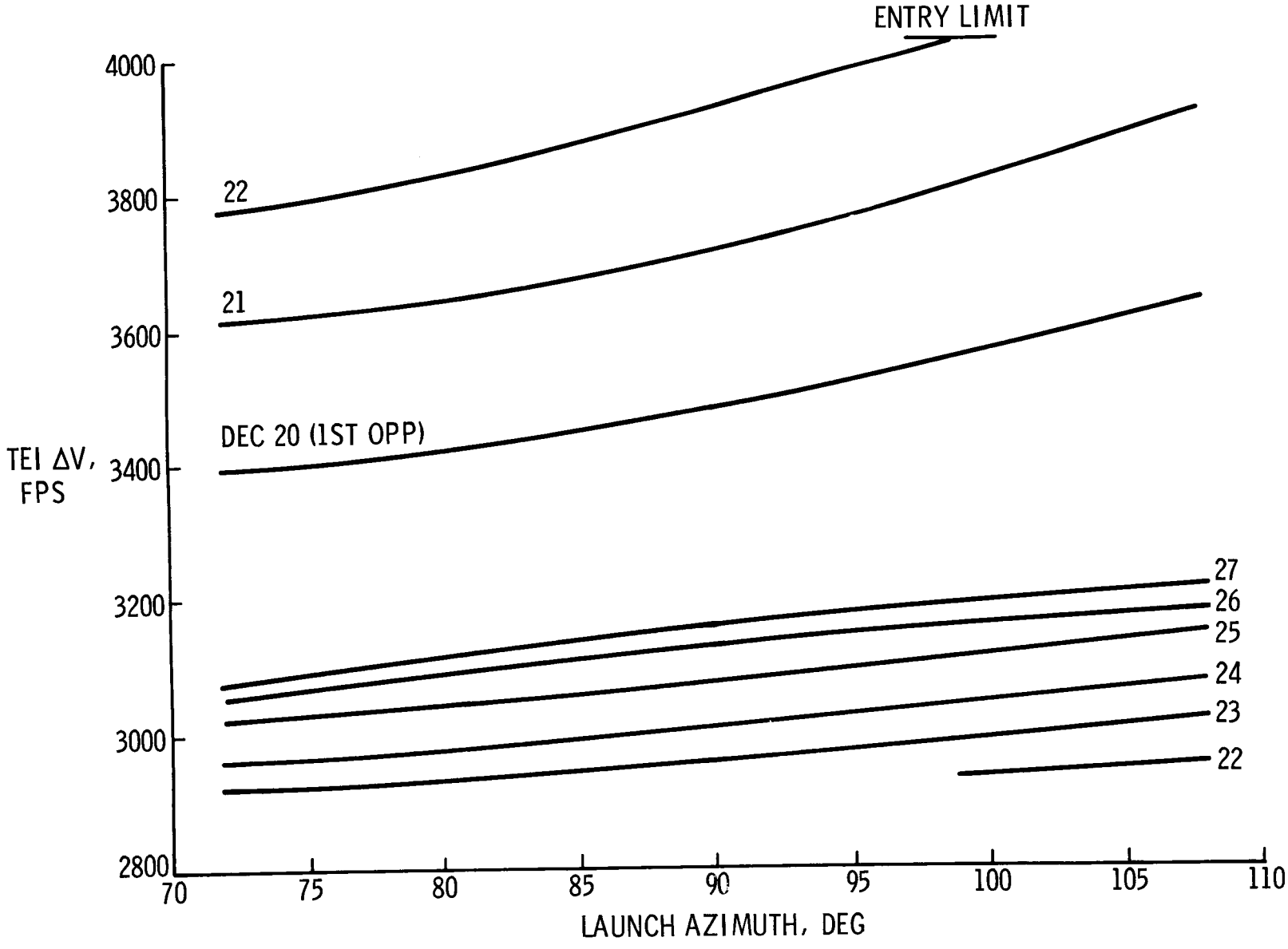
▬ STEREO PHOTOGRAPHY IN REVS 4 AND 9

- USED FOR LUNAR MAP IMPROVEMENT
- REPLACED BY KNOWN LANDMARK SIGHTING AT 9° IN REV 9 IF REV 5 SIGHTINGS ARE UNSUCCESSFUL

TRANSEARTH INJECTION

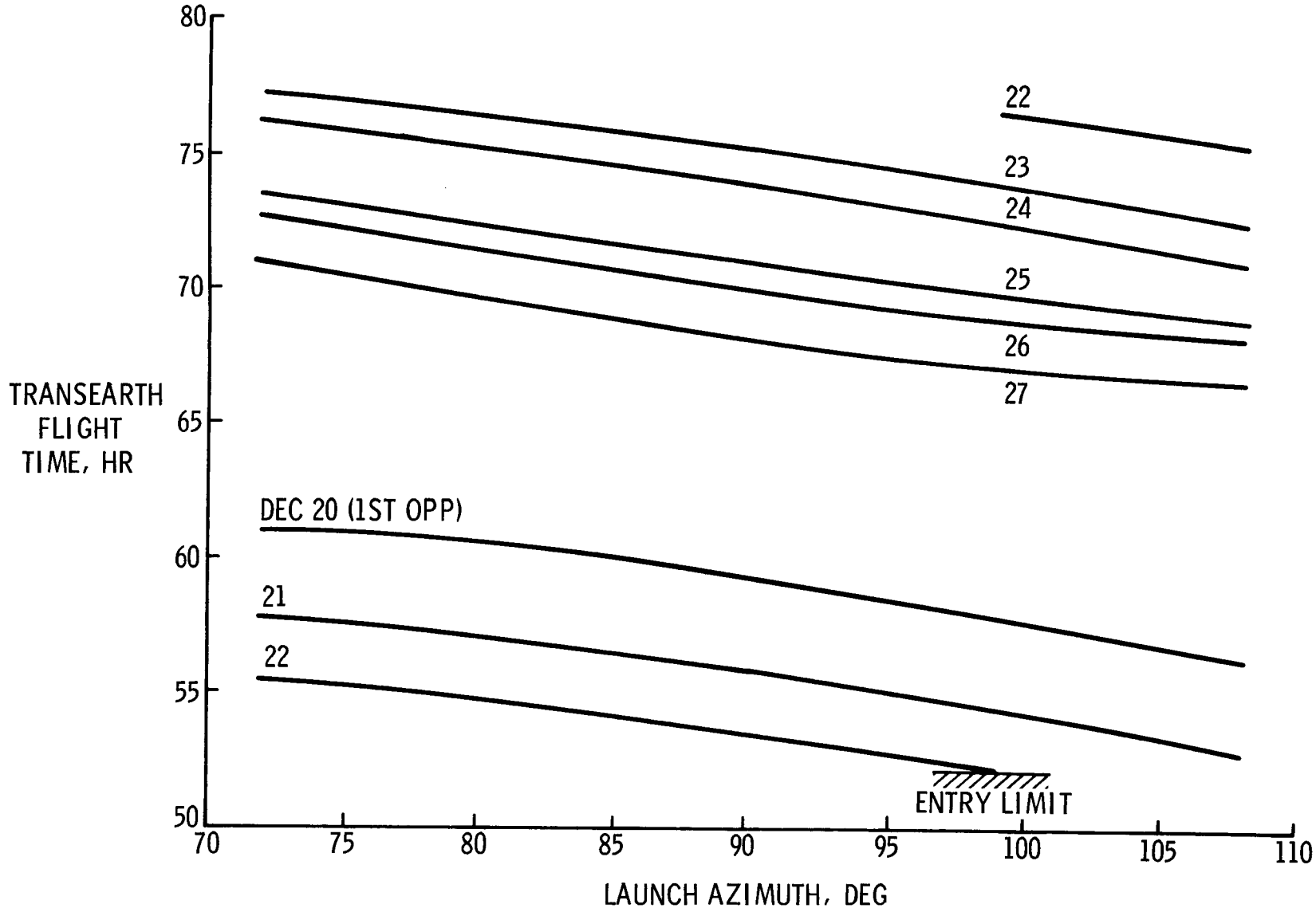
- NOMINALLY EXECUTED AFTER 10 REVS
- TARGETED LANDING LONGITUDE = 165°W
- LANDING LATITUDE NOT DIRECTLY CONTROLLED
- TARGETED ENTRY PATH ANGLE $\approx$-6.5°
- RETURN TIME ASAP W/O EXCEEDING V_{ENTRY} = 36 323 FPS
- RETURN INCLINATION <40°
- FIXED ATTITUDE BURN

TRANSEARTH INJECTION ΔV AS A FUNCTION OF LAUNCH AZIMUTH FOR DEC



MPAD 4544 S (IU)

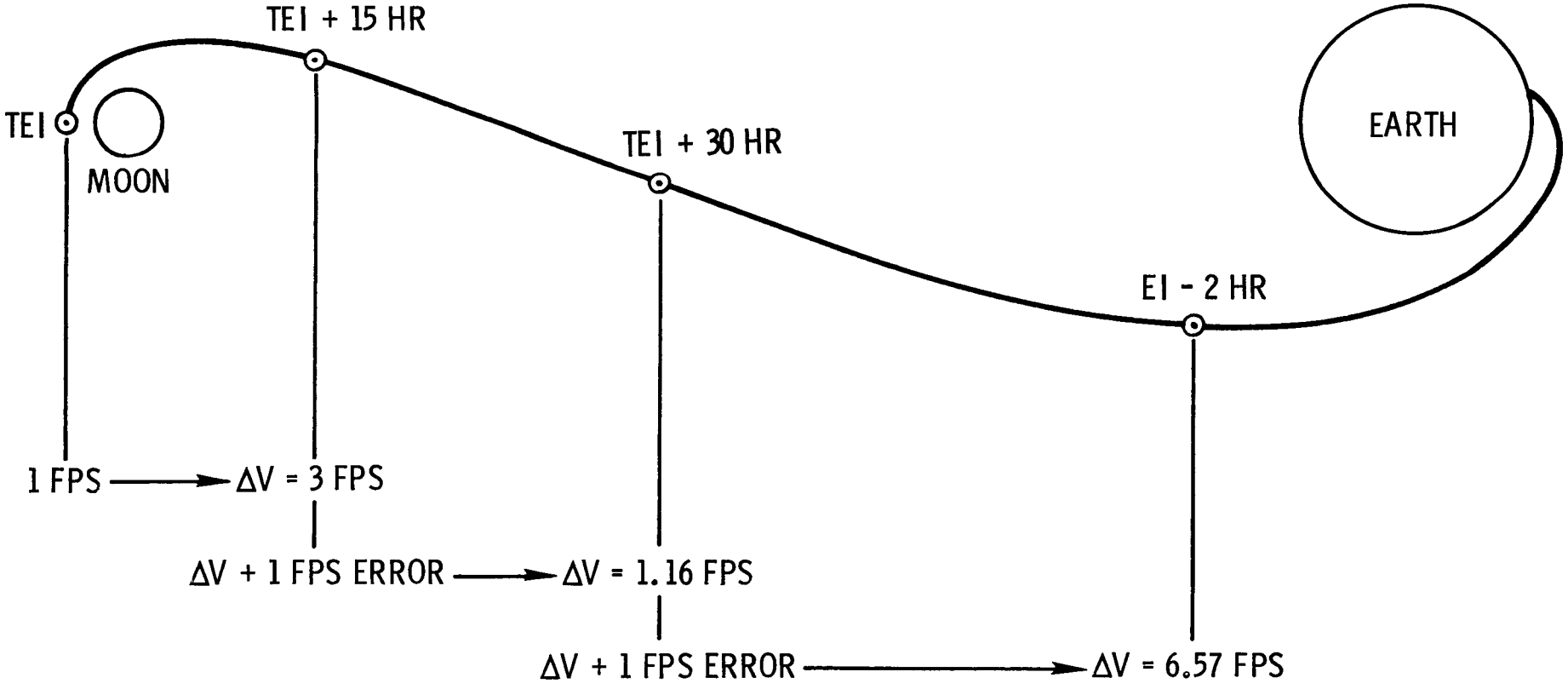
VARIATION IN TRANSEARTH FLIGHT TIME FOR DECEMBER LAUNCH WINDOW



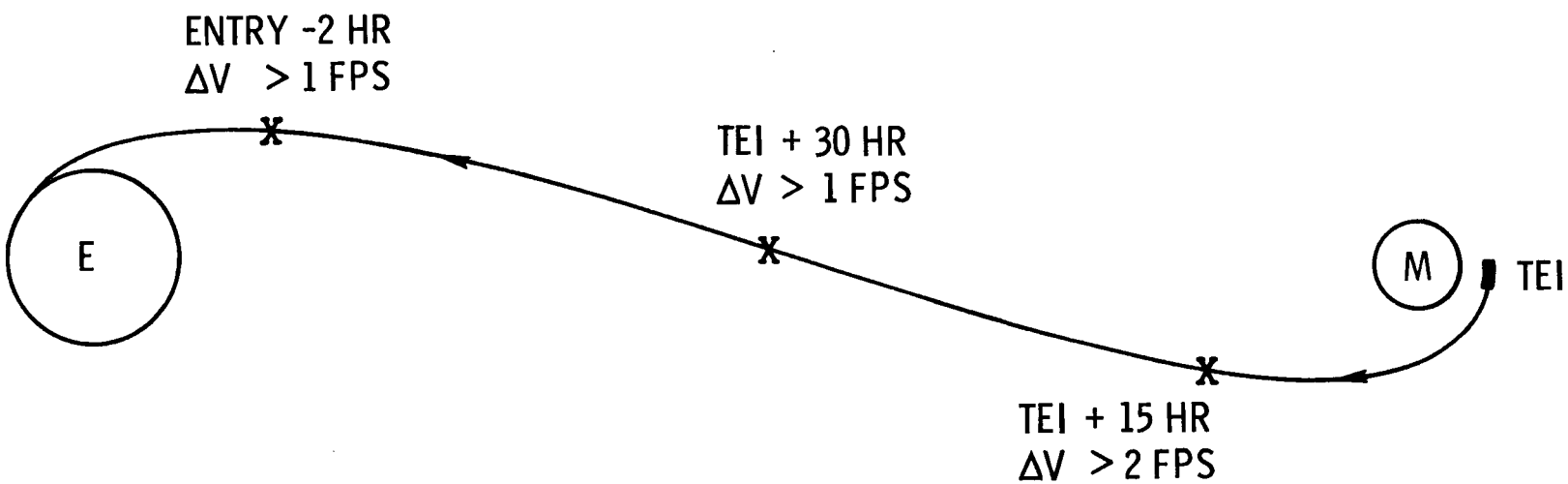
TRANSEARTH MIDCOURSE CORRECTION PHILOSOPHY

- 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 MCC ΔV SENSITIVITIES

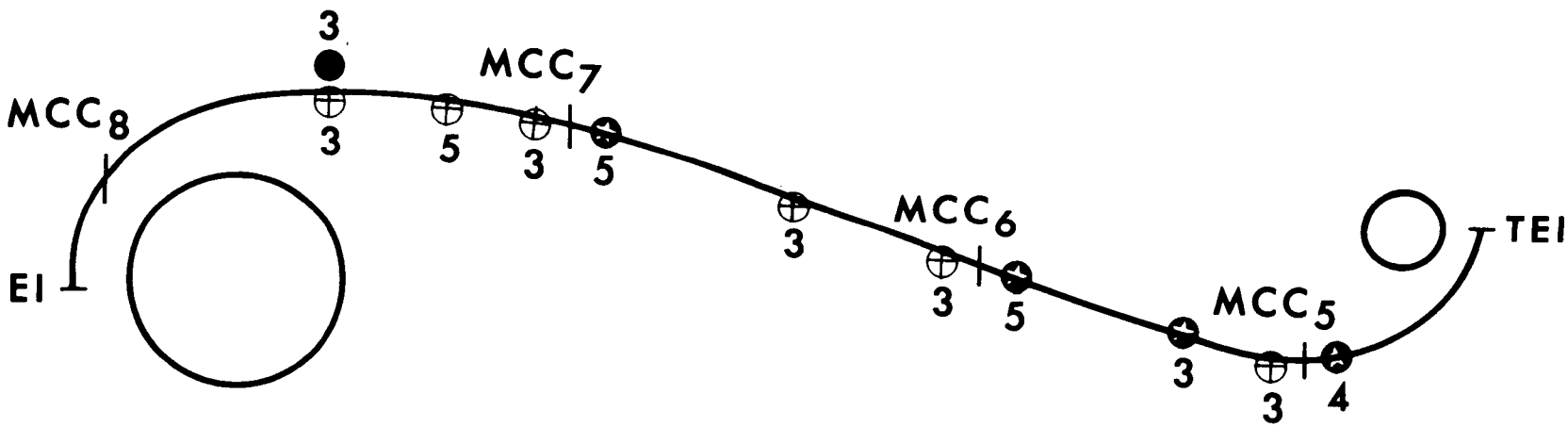


TRANSEARTH MIDCOURSE CORRECTION STRATEGY



IF ΔV > 12 FPS, USE SPS AND TRIM RESIDUALS

APOLLO 8 TRANSEARTH NAVIGATION SCHEDULE



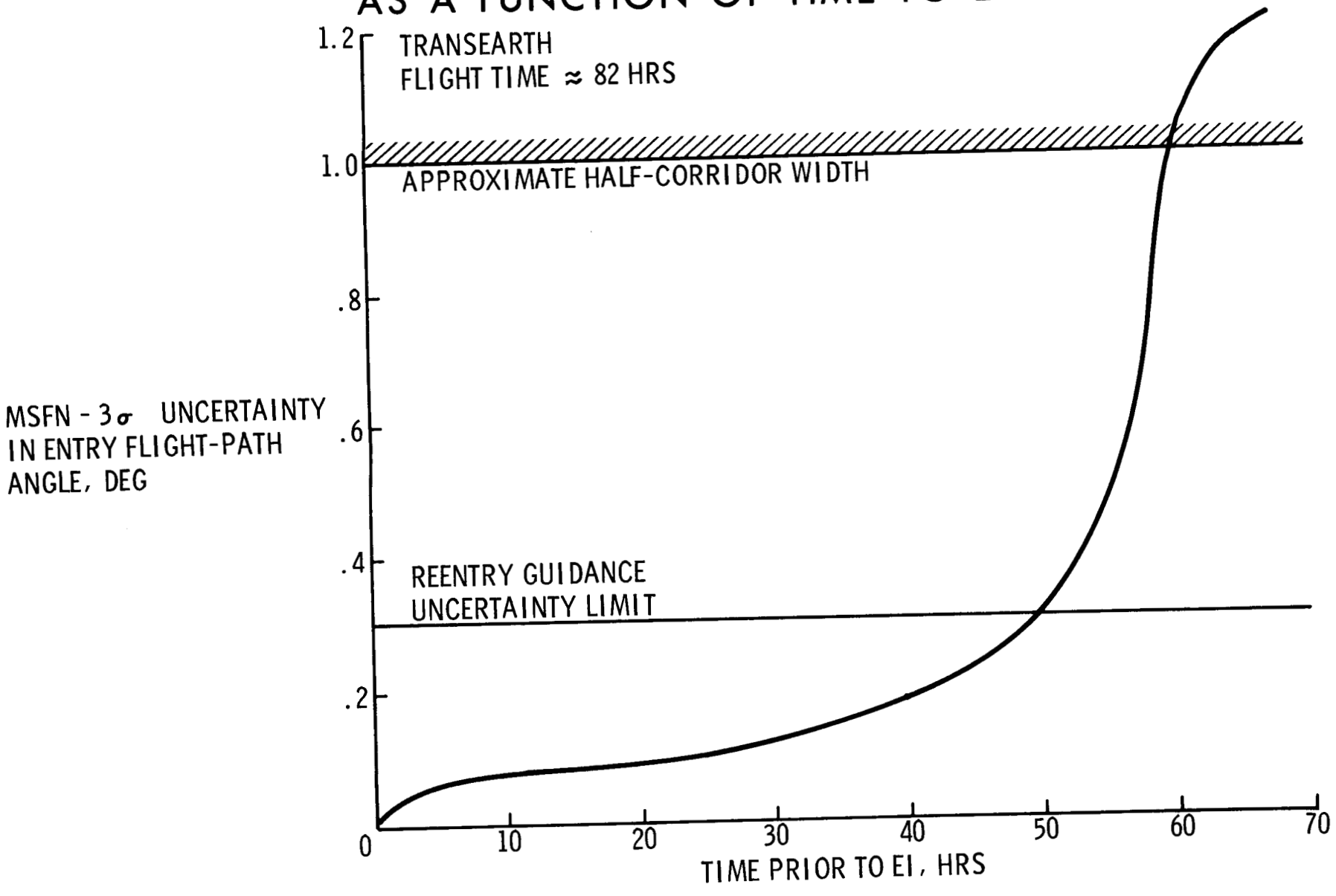
● STAR EARTH LANDMARK SIGHTINGS

⊕ STAR EARTH HORIZON SIGHTINGS

✪ STAR LUNAR HORIZON SIGHTINGS

NUMBER = NUMBER OF SIGHTINGS - SIGHTING DEFINED AS 3 MARKS

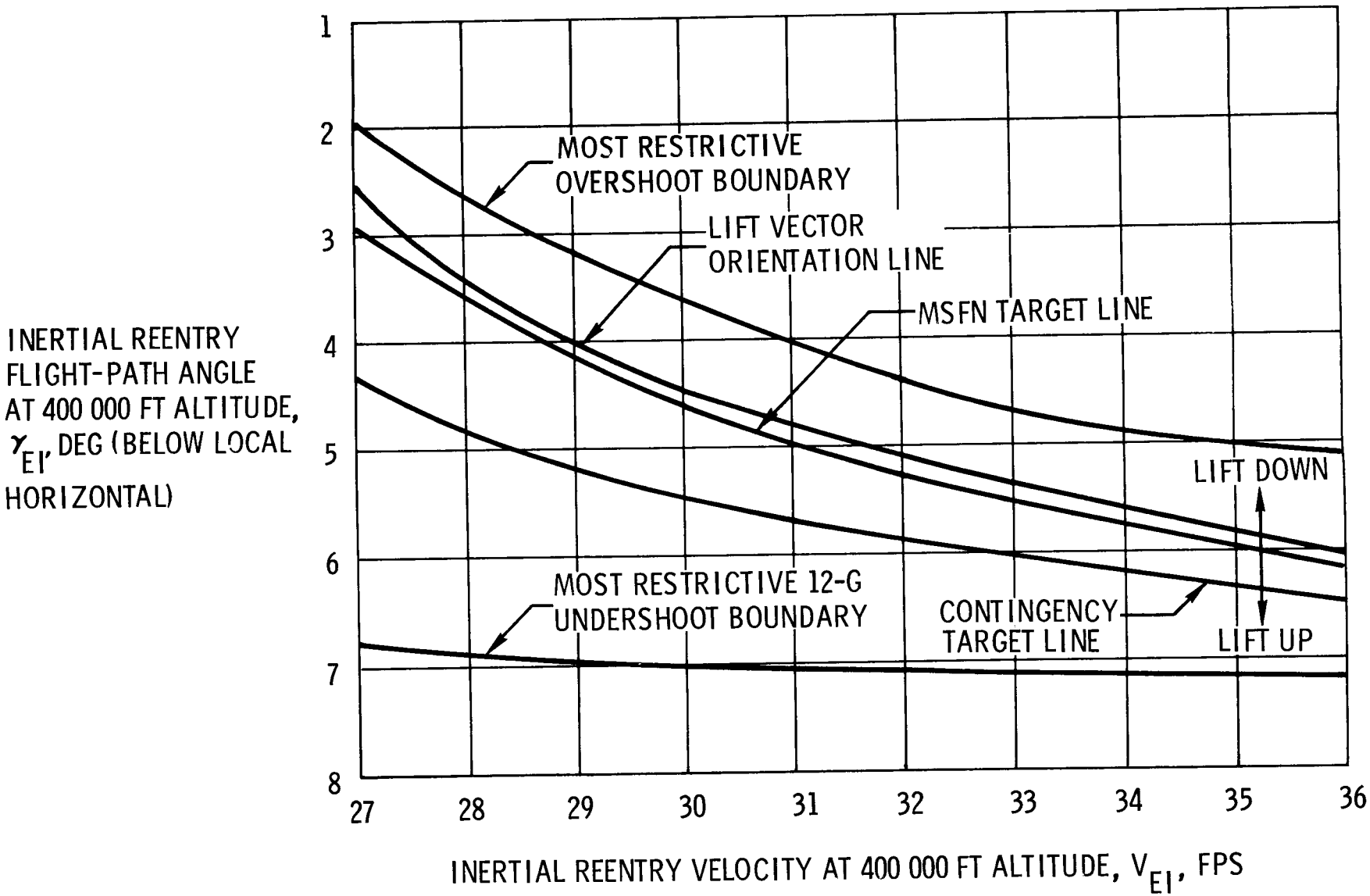
MSFN - 3σ FLIGHT-PATH UNCERTAINTY AS A FUNCTION OF TIME TO EI



ENTRY

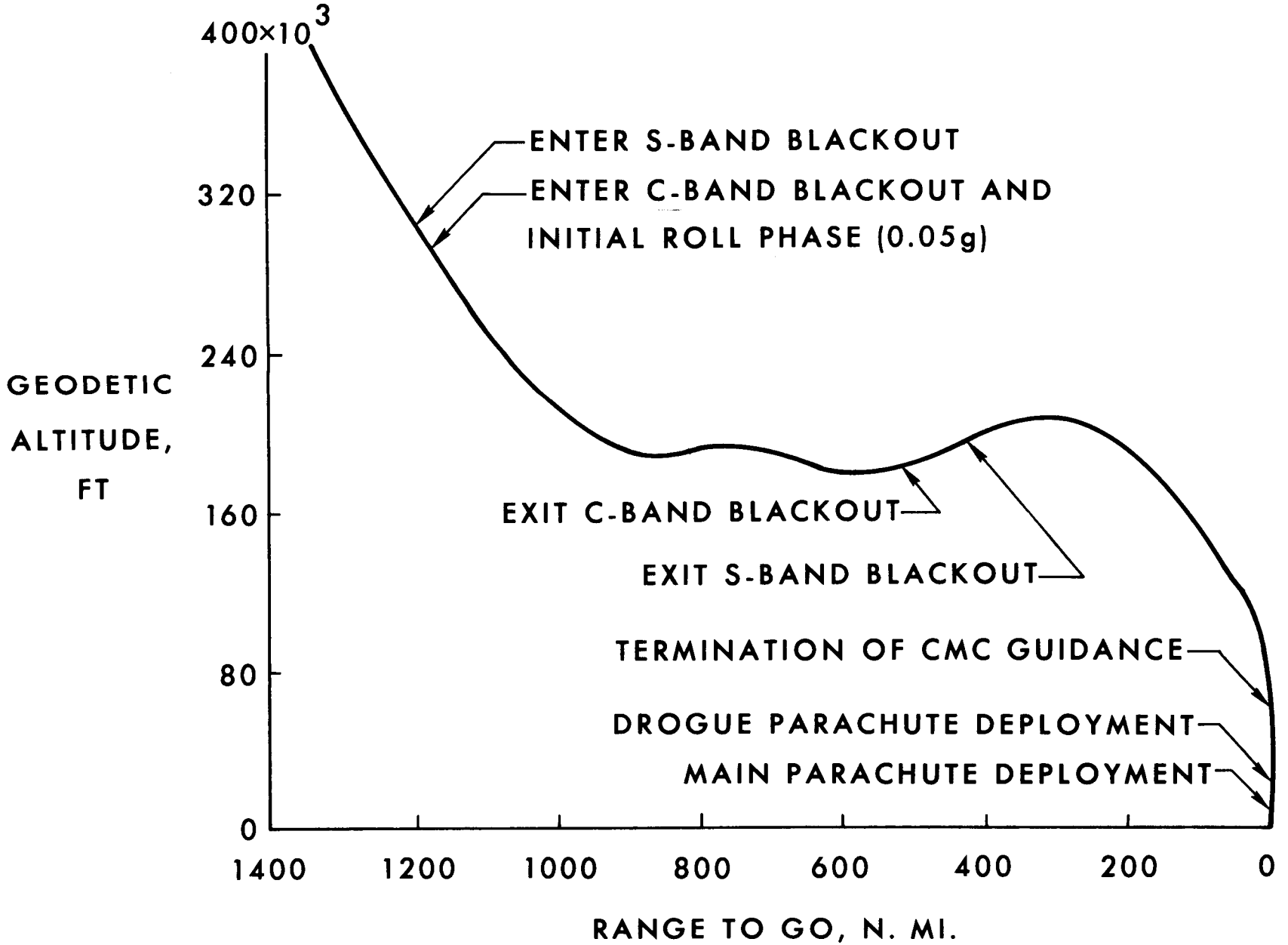
- ENTRY RANGE CAPABILITY-1200 TO 2500 N. MI.
- NOMINAL ENTRY RANGE-1350 N. MI.
- SHORT RANGE SELECTED FOR NOMINAL MISSION BECAUSE:
  - RANGE FROM ENTRY TO LANDING CAN BE SAME FOR PRIMARY AND BACKUP CONTROL MODES
  - PRIMARY MODE EASIER TO MONITOR WITH SHORT RANGE
- WEATHER AVOIDANCE, WITHIN ONE DAY PRIOR TO ENTRY, IS ACHIEVED USING ENTRY RANGING CAPABILITY TO 2500 N. MI.
- UP TO ONE DAY PRIOR TO REENTRY USE PROPULSION SYSTEM TO CHANGE LANDING POINT

REENTRY CORRIDOR C' MISSION

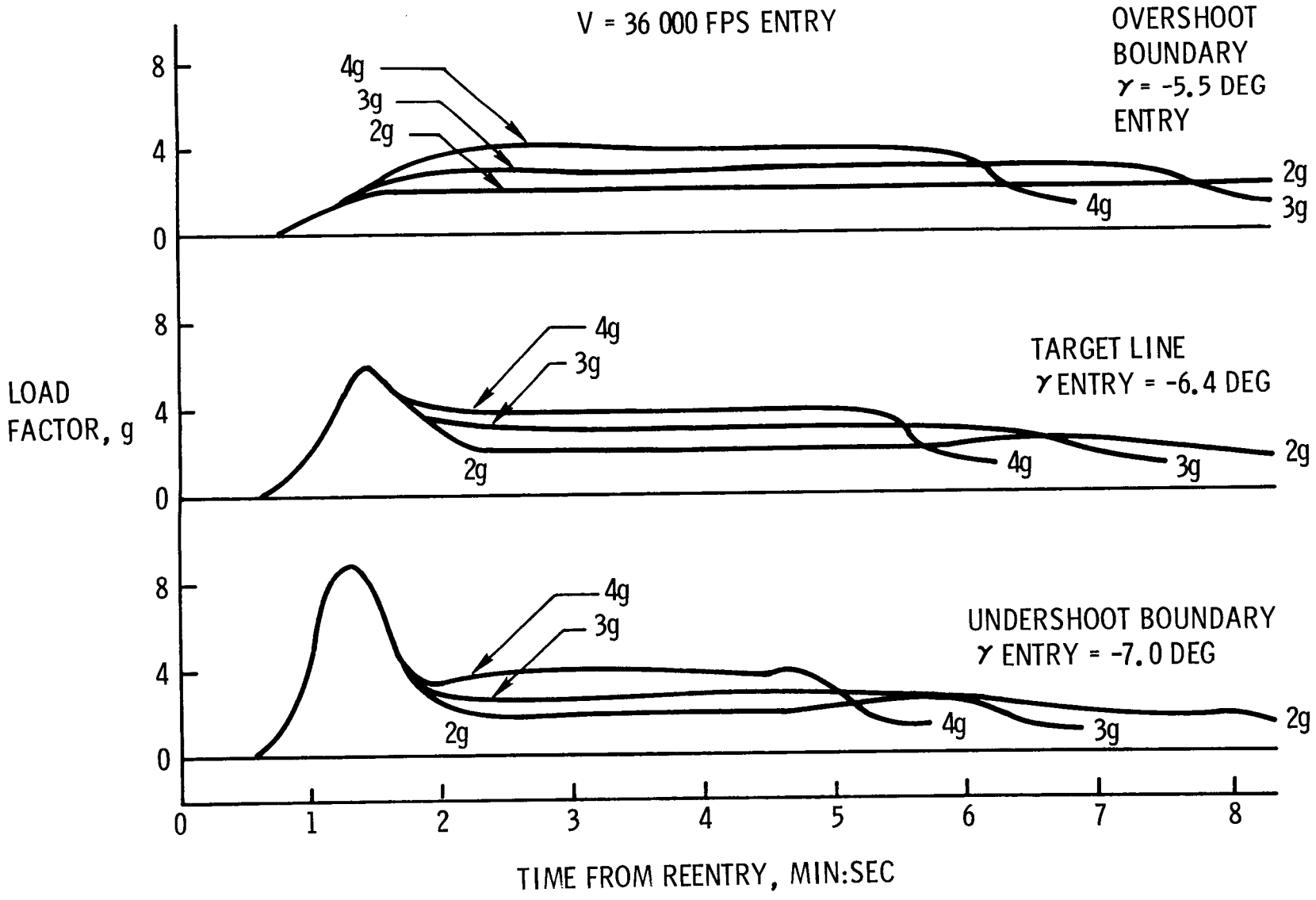


MPAD 4514 S

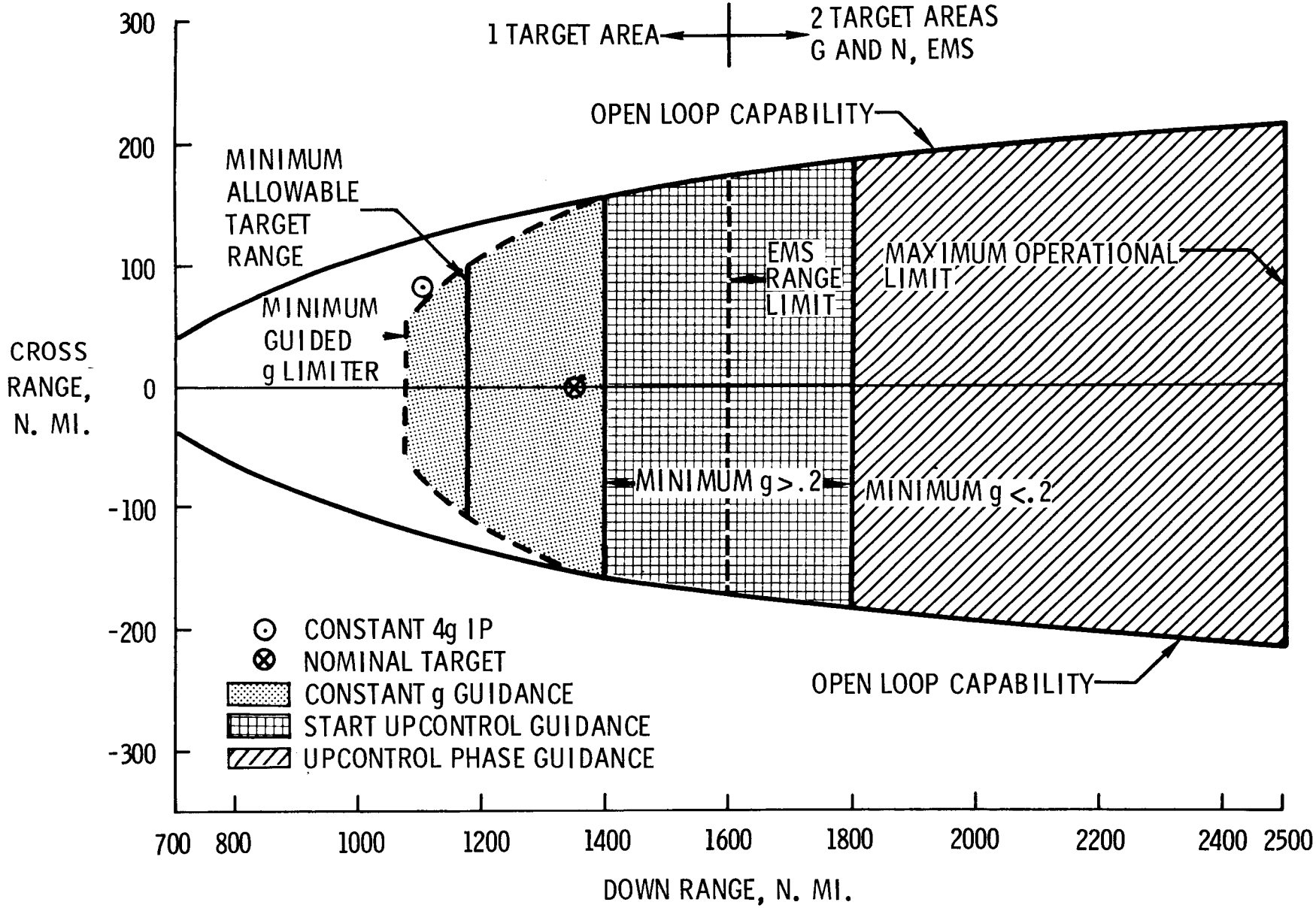
GEODETIC ALTITUDE VERSUS RANGE TO GO



LOAD FACTOR TIME HISTORIES USING THE CONSTANT g CONTROL MODE



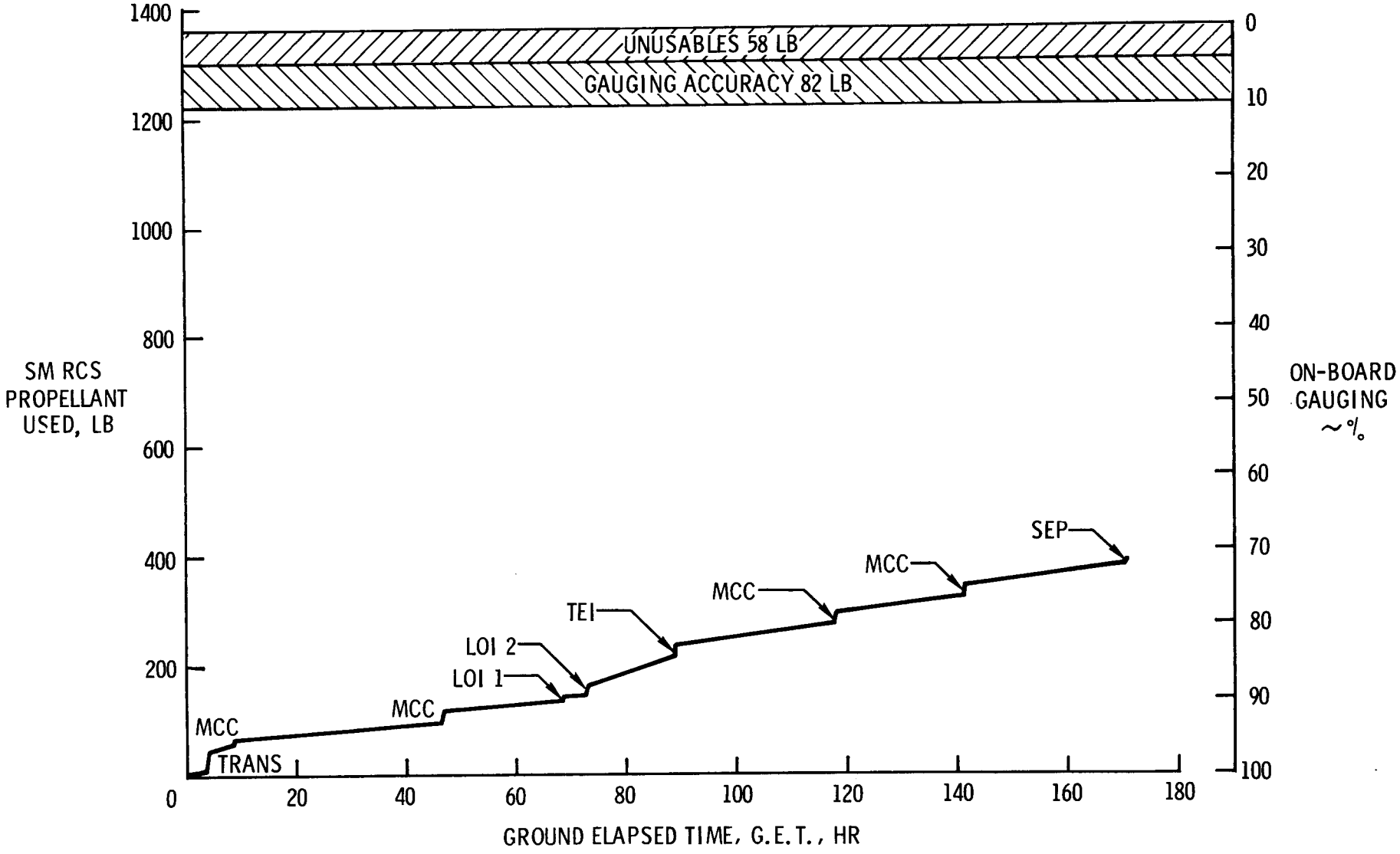
COLOSSUS GUIDANCE CAPABILITY



RECOMMENDED CONTROL PROCEDURES

ENTRY TECHNIQUE	ENTRY MODE	METHOD UTILIZED TO FLY
● PRIMARY	GNCS	AUTOMATIC
● BACKUP	EMS	● UTILIZE IF GNCS FAILED PRIOR TO OR DURING ENTRY
		● MAINTAIN CONSTANT G TO V = 25 500 FPS-AT 25 500 FPS UTILIZE EMS RANGE LINES TO RANGE TO PLANNED LANDING AREA
● SECONDARY	CONSTANT G	● UTILIZE IF GNCS AND EMS FAILED
		● FLY CONSTANT G BY MANUAL LIFT VECTOR CONTROL AND MONITORING G-METER

APOLLO 8 SM/RCS CONSUMABLES SUMMARY



PRELIMINARY NON-NOMINAL SPS ΔV BUDGET

● DISPERSIONS	
● 3σ TRANSLUNAR MCC	110 FPS
● 3σ LOI (1) AND LOI (2)	50 FPS
TOTAL (RSS)	120 FPS
● CONTINGENCIES	
● RETURN ASAP TO ATLANTIC	0 TO 520 FPS (MISSION DEPENDENT)
● MOVE LANDING PT LONG 20° AT EI -24 HR TO AVOID WEATHER	600 FPS
● LOSS AT GNCS IN LUNAR ORBIT, I.E. RETURN WITH SCS	120 FPS
TOTAL (RSS)	625 TO 800 FPS (MISSION DEPENDENT)

END OF MISSION SUMMARY - DECEMBER

	20	21	22	23 → 27	
TOTAL MISSION TIME, DAY:HR	6:04 ↓ 6:00	6:04 ↓ 5:23	5:23 ↓ 6:22	7:02 ↓ 6:22	7:00 ↓ 6:19
NOMINAL SPS PROP. RESERVE, LB	8800 ↓ 7721	8282 ↓ 6784	6790 ↓ 10227	10453 ↓ 9907	10161 ↓ 9520
NOMINAL SPS ΔV RESERVE, LB	3471 ↓ 3130	3292 ↓ 2845	2847 ↓ 3912	3970 ↓ 3804	3881 ↓ 3684
NOMINAL SPS ΔV RESERVE MINUS DISPERSIONS/CONT., FPS	2726 ↓ 2385	2547 ↓ 2100	2102 ↓ 3132	3190 ↓ 2974	3050 ↓ 2764

ALTERNATE MISSIONS

- CIRCUMLUNAR
- HIGH APOGEE EARTH ORBITAL–
  22 000 - 60 000 N. MI.
- LOW APOGEE EARTH ORBITAL

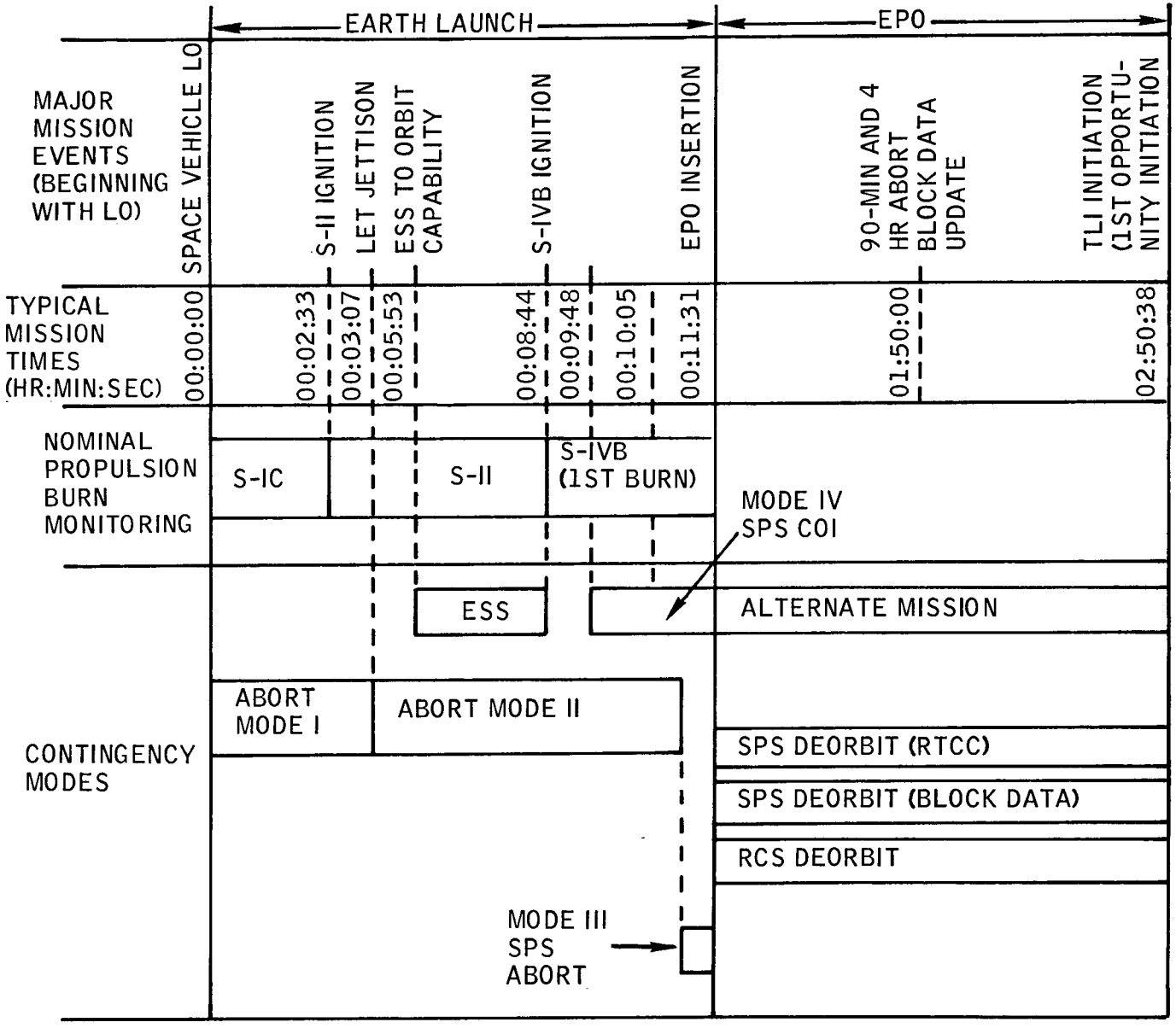
ALTERNATE MISSION
TRAJECTORY RELATED GROUND RULES

- CONSISTENT WITH CURRENT SC, CREW, RTCC, AND OPERATIONAL CONSTRAINTS
- NO ADDITIONAL CREW TRAINING
- ADHERE TO NOMINAL MISSION TIMELINE
- REQUIRED LARGE SPS MANEUVERS WITHIN MSFN COVERAGE
- SM RCS DEORBIT CAPABILITY MAINTAINED
- ABORT RETURN REDUCED WITH EACH MANEUVER
- DAYLIGHT LANDING IN WATER NEAR NOMINAL RECOVERY AREAS

APOLLO 8 ALTERNATE MISSIONS

	LAUNCH	EARTH ORBIT	TLI	TLC
11 DAY LOW EARTH ORBIT	COI > 900 FPS	NO	NO	NO
11 DAY EARTH ORBIT MISSION WITH HIGH APOGEE	COI < 900 FPS $h_a = 4000$ N. MI.	NO S-IVB REIGNITION $h_a = 4000$ N. MI.	AT TLI TERMINATION $100 \leq h_a \leq 60\,000$ h_a CHANGED TO $4000 \leq h_a \leq 22\,000$	NO
LUNAR MISSION	S-IVB EARLY STAGING NOMINAL TLI GUIDED CUT-OFF	NO	AT TLI TERMINATION $h_a \geq 60\,000$ LUNAR ORBIT	CIRCUMLUNAR

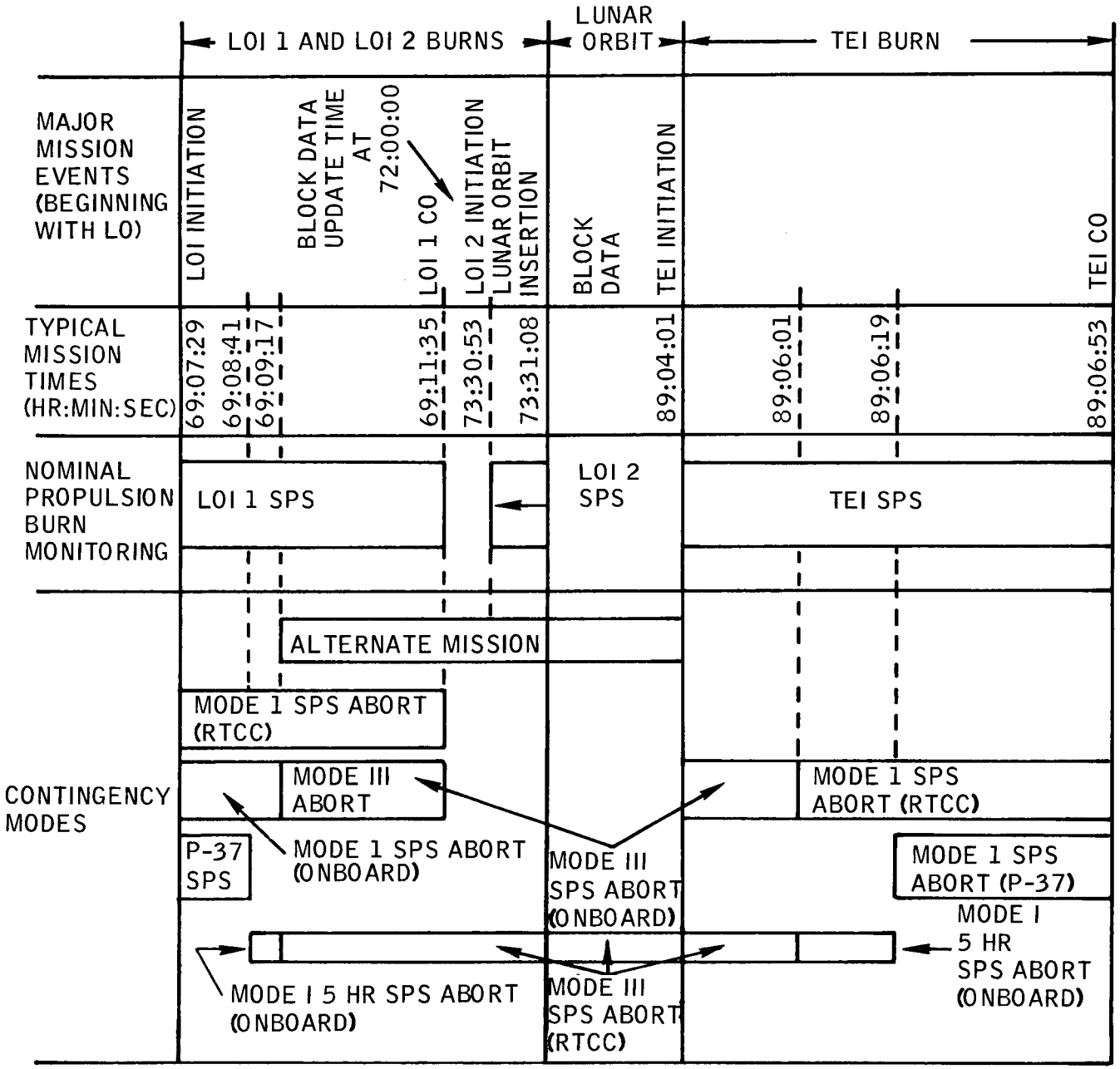
APOLLO 8 CONTINGENCIES



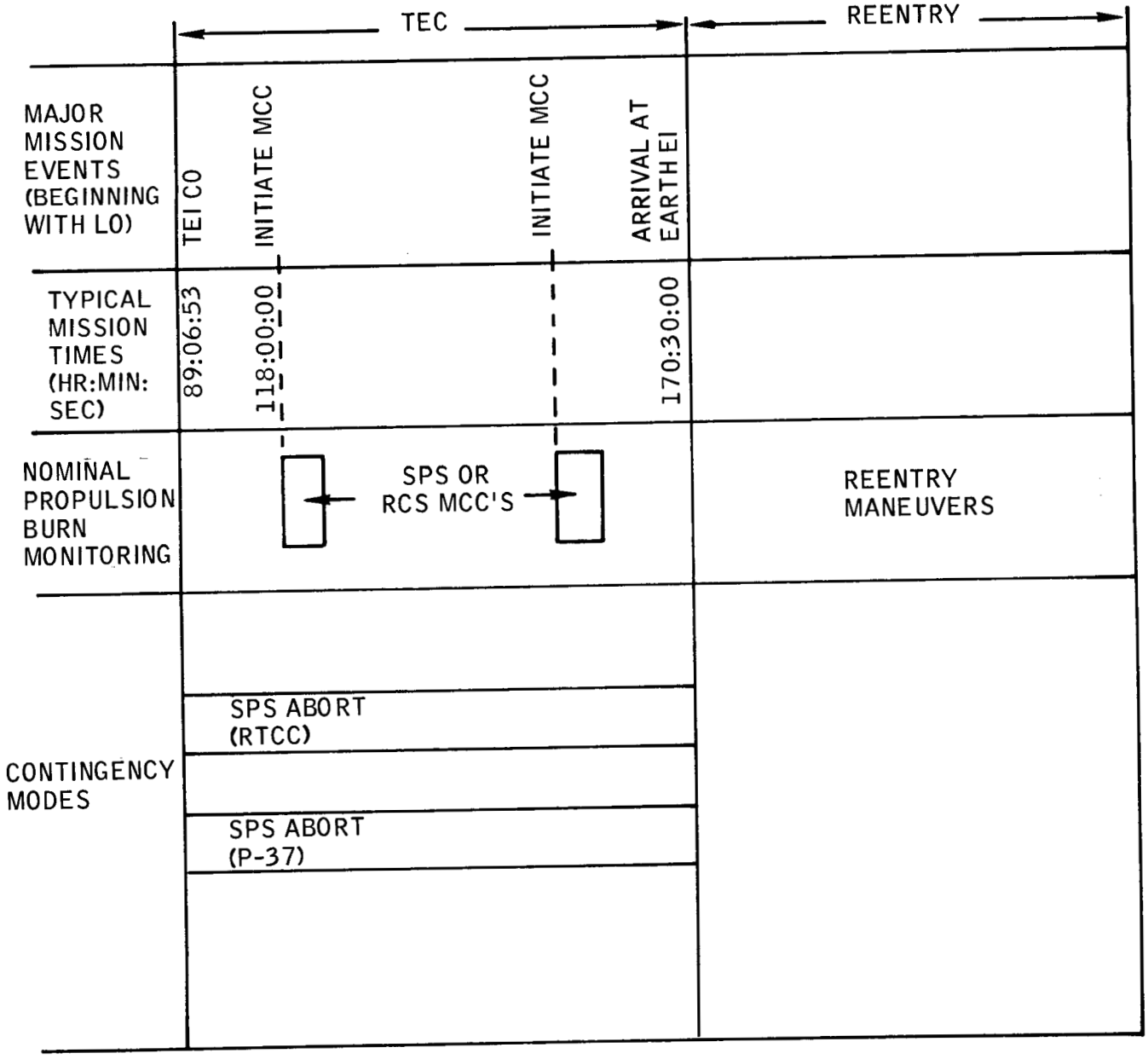
APOLLO 8 CONTINGENCIES (CONTINUED)

	TLI BURN	TLC
MAJOR MISSION EVENTS (BEGINNING WITH LO)	TLI INITIATION (1ST OPPORTUNITY INITIATION TLI CO	CSM SEPARATION, GO/NO-GO 90 MIN ABORT 90 MIN AND 4 HR BLOCK DATA UPDATE TLC ABORT BLOCK DATA UPDATE TIMES LOI INITIATIONN
TYPICAL MISSION TIMES (HR:MIN:SEC)	02:50:38 02:55:55	03:20:43 03:55:55 05:00:00 12:00:00 25:00:00 35:00:00 44:00:00 51:00:00 69:07:29
NOMINAL PROPULSION BURN MONITORING	S-IVB (2ND BURN)	SPS OR RCS MCC'S
CONTINGENCY MODES	ALTERNATE MISSION	ALTERNATE MISSION
	SPS ABORT (RTCC)	SPS ABORT (RTCC)
		SPS ABORT (BLOCK DATA)
	90 MINUTES SPS ABORT (RTCC OR BLOCK DATA)	
	10 MIN SPS ABORT (ONBOARD)	RCS ABORT (RTCC)

APOLLO 8 CONTINGENCIES (CONTINUED)



APOLLO 8 CONTINGENCIES (CONCLUDED)



MISSION CONTROL CENTER COMPUTER PROGRAM
MAJOR FUNCTIONAL CAPABILITIES

- COMPLETE EARTH ORBIT RENDEZVOUS CAPABILITY (SAME AS D PROGRAM)
- SIMULATE AND MONITOR S-IVB TRANSLUNAR INJECTION MANEUVER
- PLAN, TARGET, SIMULATE, AND MONITOR:
  - MIDCOURSE CORRECTION MANEUVERS AND MANEUVER PLANNING INCLUDING:
    - RETURN TO NOMINAL MISSION
    - FREE RETURN, FIXED LUNAR ORBIT ORIENTATION
    - FREE RETURN, LUNAR FLYBY, NOMINAL PERICYNTHION HEIGHT
    - FREE RETURN, LUNAR FLYBY, SPECIFIED PERICYNTHION HEIGHT
  - LUNAR ORBIT INSERTION MANEUVERS
  - LUNAR ORBIT ADJUSTMENT MANEUVERS

MISSION CONTROL CENTER COMPUTER PROGRAM MAJOR FUNCTIONAL CAPABILITIES (CONCLUDED)

- PLAN, TARGET, SIMULATE, AND MONITOR:
  - TRANSEARTH INJECTION MANEUVERS
  - TRANSEARTH CORRECTION AND REENTRY MANEUVERS
  - RETURN TO EARTH ABORT MANEUVERS (ALL MISSION PHASES)
- PROVIDE LANDMARK ACQUISITION DATA
- PROVIDE INFORMATION FOR POINTING OPTICS TO EARTH, MOON, AND STARS
- PROVIDE PLATFORM ALIGNMENT DATA
- ORBIT DETERMINATION FOR ALL PHASES OF MISSION (WITH 2-AND 3-WAY USB DOPPLER DATA)
- PROVIDE AEROMEDICAL DATA PROCESSING (AS PLANNED FOR D MISSION)

STATUS: FORMAL TESTING COMPLETE DECEMBER 9, 1968

PROGRAMS HAVE SUPPORTED ALL CONTROL CENTER ACTIVITIES EXCELLENTLY SINCE OCTOBER 15, 1968

ON-BOARD COMPUTER PROGRAM MAJOR FUNCTIONAL CAPABILITIES

- LAUNCH MONITORING
- TRANSLUNAR INJECTION MANEUVER MONITORING
- EXECUTE AND MONITOR:
  - MIDCOURSE CORRECTION MANEUVERS
  - LUNAR ORBIT INSERTION MANEUVERS
- PLAN, TARGET AND MONITOR
  - TRANSEARTH INJECTION MANEUVERS
- CREW CHARTS AND BLOCK DATA
- REENTRY GUIDANCE
- PLATFORM ALIGNMENT WITH STAR SIGHTINGS
- NAVIGATION
  - STAR/HORIZON SIGHTINGS
  - LUNAR LANDMARK TRACKING

STATUS: FLIGHT ROPES DELIVERED OCTOBER 14, 1968

SIT PERFORMED OCTOBER 29, 1968

SFRR AND CARR CONCLUDED SATISFACTORILY NOVEMBER 8, 1968