NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 05183

*LM RENDEZVOUS PROCEDURES

J-2 & J-3 MISSIONS

FINAL

DECEMBER 29, 1971

INDEXING DATA

DATE	OPR	#	T	PGM	SUBJECT	SIGNATOR	LOC
12-29-71	MSC	05183	R	APO	* Apollo 16 & Apollo 17	Grega	080-44B

MANNED SPACECRAFT CENTER

HOUSTON, TEXAS

LIST OF ACRONYMS AND ABBREVIATIONS

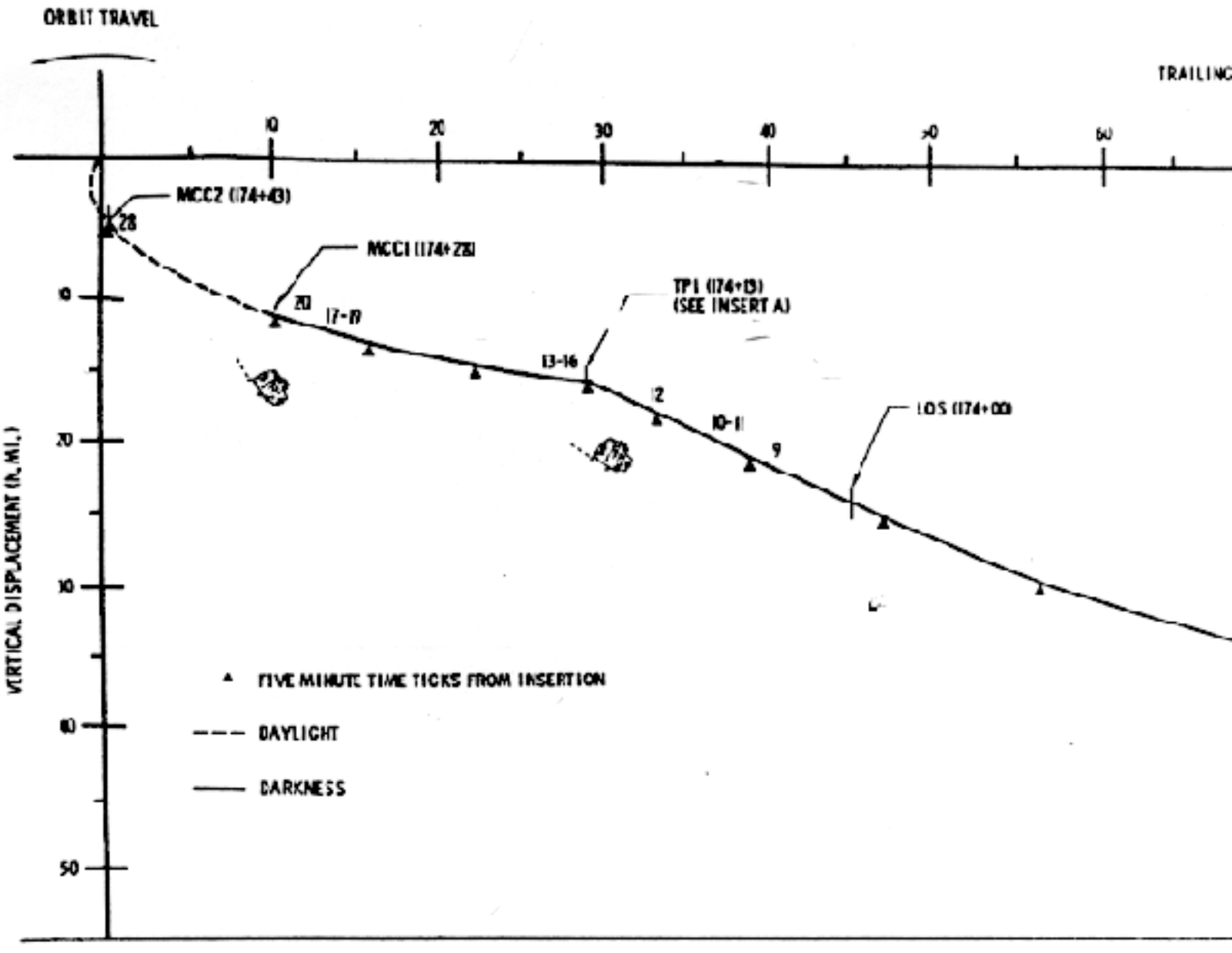
ACQ	Acquisition
ADJ	Adjust
AGS	Abort Guidance System
ALT	Altitude
ANT	Antenna
AOH	Apollo Operations Handbook
AOS	Acquisition of Signal
AOT	Alignment Optical Telescope
APS	Ascent Propulsion System
ASC	Ascent
ATT	Attitude
AZ	Azimuth
BAT	Battery
BT	Burn Time
CALIB	Calibration
CB	Circuit Breaker
CDH	Constant Delta Height
CDR	Commander
CDU	Coupling Data Unit
CEX	Color External (S0358)
CM	Command Module
CMC	Command Module Computer
CMD	Command Module Commander's Position
CMP	Command Module Pilot
COAS	Crew Optical Alignment Sight
COMM	Communications
CSI	Concentric Sequence Initiation
CSM	Command and Service Module
CT	Cease Tracking
DAP	Digital Autopilot
DB	Deadband
DEDA	Data Entry and Display Assembly
DEG	Degrees
DES	Descent
DET	Digital Event Timer
DH	Delta Height
DOI	Descent Orbit Insertion
DPS	Descent Propulsion System
DSKY	Display and Keyboard
DV	Delta Velocity
DWN	Down
E	Erasable or enter
ED	Explosive Device
EMS	Entry Monitor System
ENG	Engine
ET	Event Timer
EXT	External
FDAI	Flight Director Attitude Indicator
F/S	Frames Per Second

f	f-Stop
FPS	Feet Per Second
FT	Feet
FWD	Forward
GDC	Gyro Display Coupler
GET	Ground Elapsed Time
GETI	Ground Elapsed Time of Ignition
GMBL	Gimbal
GND	Ground (Mission Control)
HA	Apogee Altitude
HAM	Height Adjust Maneuver
HGA	High-Gain Antenna
HI	High (Switch position)
HOR	Horizon
HORIZ	Horizontal
HP	Perigee Altitude
HR	Hour(s)
HTR	Heater
ICDU	Inertial Coupling Data Unit
IMU	Inertial Measurement Unit
INS	Insertion
IT	Initiate Tracking
LGC	LM Guidance Computer
LM	Lunar Module
LMP	Lunar Module Pilot
LOI	Lunar Orbit Injection
LOS	Loss of Signal or Loss of Sight
LPD	Landing Point Designator
LR	Landing Radar
LV	Launch Vehicle
MAG	Magazine (camera)
MAN	Manual
MCC	Midcourse Correction
MCC1	First Midcourse Correction
MCC2	Second Midcourse Correction
MCC-H	Mission Control Center - Houston
MGA	Middle Gimbal Angle
MIN	Minimum or Minutes(s)
MNVR	Maneuver
MSFN	Manned Space Flight Network
NAV	Navigation
NM	Nautical miles
OMNI	Omnidirectional Antenna
ORDEAL	Orbit Rate Display Earth and Lunar
OVHD	Overhead
P	Pitch or Program
PAD	Voice Update
PB	Pushbutton

PC	Plane Change
PDI	Powered Descent Initiation
PGNS	Primary Guidance, Navigation, and Control System
PHS	Phasing
PIPA	Pulse Integrating Pendulous Accelerometers
PLM	LM Pitch Angle
PRESS	Pressure
PRO	Proceed
PROG	Program
PROP	Propellant
QTY	Quantity
R	Range
RCS	Reaction Control System
RDOT	Range Rate
RDR	Radar
REFSMMAT	Reference Stable Member Matrix
RHC	Rotation Hand Controller
RNDZ	Rendezvous
RR	Rendezvous Radar
S-BD	S-BAND
SC	Spacecraft
SEP	Separation
SHFT	Shaft
SM	Service Module
SXT	Sextant
SYNC	Synchronize
TEMP	Temperature
TFI	Time from Ignition
TGT	Target
THC	Translation Hand Controller
THETA	Angle Between SC +X Axis and Local Horizontal
TIG	Time of Ignition
TLM	Telemetry
TPF	Terminal Phase Finalization
TPI	Terminal Phase Initiation
TPM	Terminal Phase Midcourse
TRANSL	Translation
TRUN	Trunnion
TTCA	Translation Thrust Control Assembly
VG	Velocity to be Gained
VHF	Very High Frequency
(XX:XX)	Indicates GET from Liftoff in Hours:Minutes
(XXX:XX:XX)	Indicates GET from Liftoff in Hours:Minutes:Seconds
(XXX,XXX/XXX,XXX)	(ORDEAL/Inertial) Angles (Roll, Pitch, Yaw)
(XX,XX,XX)	Local Vertical Delta V's

Tracking Stations

ANG	Antigua Near Space Support Station
BDA	Bermuda Near Space Support Station
CRO	Carnarvon Near Space Support Station
CYI	Canary Near Space Support Station
GYM	Guaymas Near Space Support Station
HSK	Honeysuckle Deep Space Support Station
HTV	Huntsville Near Space Support Station
MAD	Madrid Deep Space Support Station
MER	Mercury Near Space Support Ship
MIL	MILA Near Space Support Station
RED	Redstone Near Space Support Ship
TEX	Corpus Christi Near Space Support Station
VAN	Vanguard Near Space Support Ship

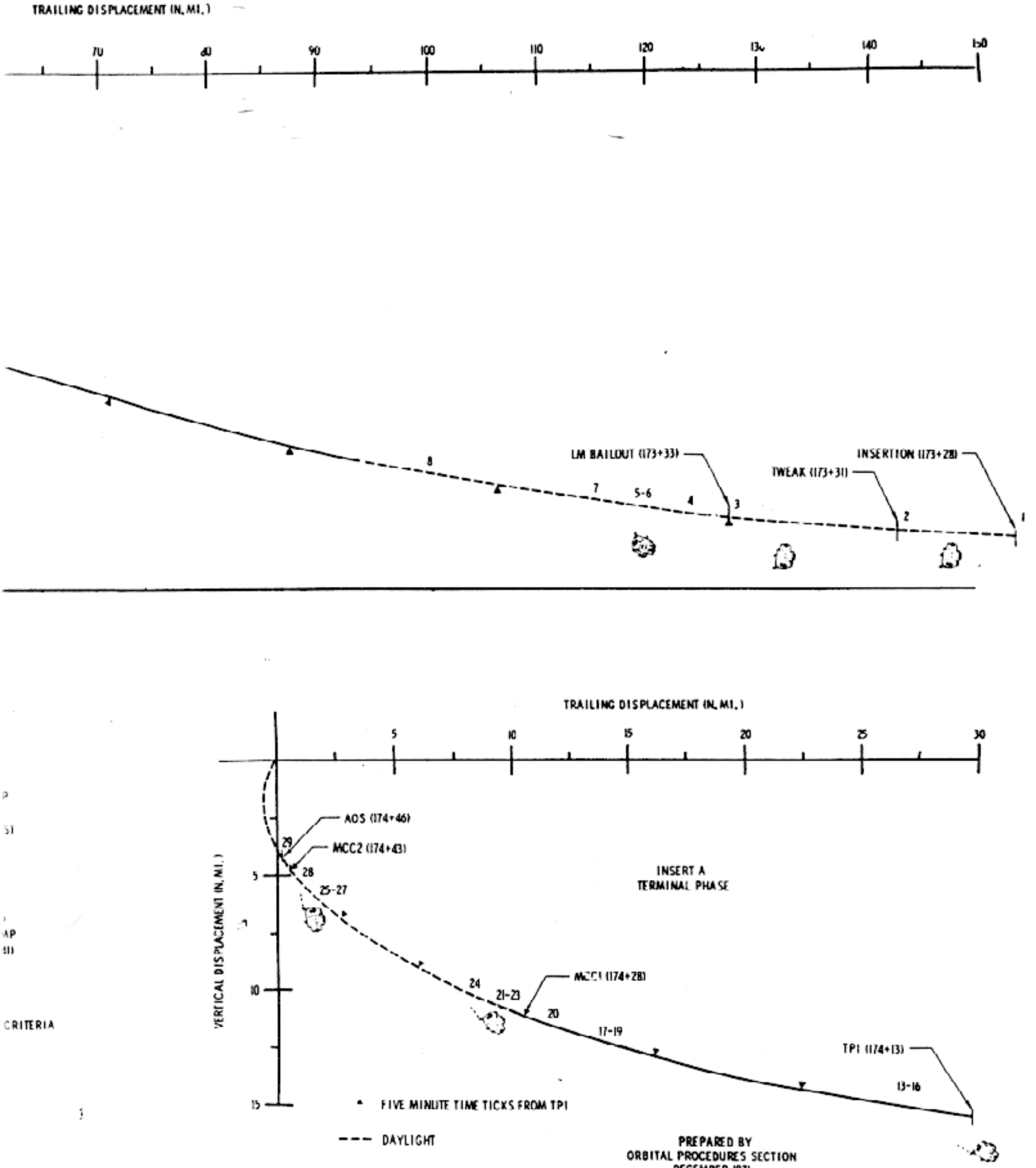


LM MAJOR EVENTS

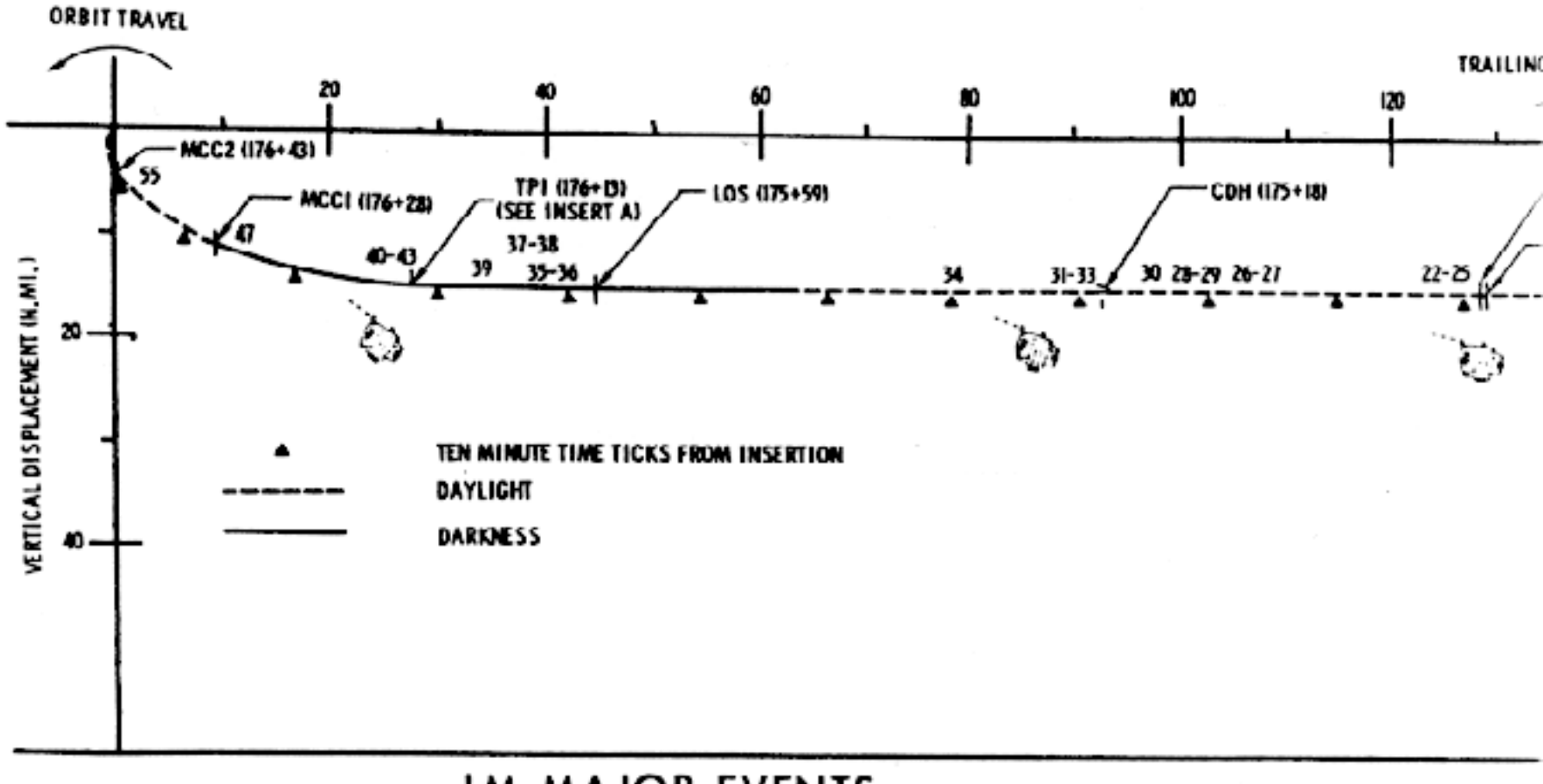
	GROUND ELAPSED TIME	EVENT
1.	173+28	INSERTION
2.	173+31	TWEAK BURN
3.	173+33	LM BAILOUT
4.	173+34	INITIATE RR NAVIGATION (P20)
5.	173+35	PGNS TARGET TPI (P34)
6.	173+35	AGS UPDATE AND ALIGN *
7.	173+36	INITIATE AGS RADAR UPDATES
8.	173+40	CSM BAILOUT
9.	174+02	TERMINATE AGS RADAR UPDATES
10.	174+05	TERMINATE RR NAVIGATION
11.	174+05	PGNS FINAL TPI COMPUTATION
12.	174+08	TPI THRUSTING MANEUVER (P42)
13.	174+15	TARGET MCC1 (PGNS P35 AND AGS)
14.	174+15	RESET W-MATRIX (V67)
15.	174+15	RESUME RR NAVIGATION
16.	174+15	RESUME AGS RADAR UPDATES
17.	174+25	TERMINATE RR NAVIGATION
18.	174+25	TERMINATE AGS RADAR UPDATES
19.	174+25	PGNS AND AGS FINAL MCC1 COMP
20.	174+27	MCC1 THRUSTING MANEUVER
21.	174+29	TARGET MCC2 (PGNS P35 AND AGS)
22.	174+29	REINITIALIZE W-MATRIX (V93)
23.	174+29	RESUME RR NAVIGATION
24.	174+30	RESUME AGS RADAR UPDATES
25.	174+40	TERMINATE RR NAVIGATION
26.	174+40	TERMINATE AGS RADAR UPDATES
27.	174+40	PGNS AND AGS FINAL MCC2 COMP
28.	174+42	MCC2 THRUSTING MANEUVER (P41)
29.	174+46	BRAKING (P47)

*ONLY IF AGS DISAGREES WITH CRITERIA

FIGURE 2-1
J-2 & J-3 MISSION RENDEZVOUS
CSM-CENTERED RELATIVE MOTION


TRAILING DISPLACEMENT (N. MI.)
70
80
90
100
110
120
130
140
150
LM BAILOUT (173+33)
INSERTION (173+28)
TWEAK (173+31)
8
7
5-6
4
3
2
1
TRAILING DISPLACEMENT (N. MI.)
5
10
15
20
25
30
AOS (174+46)
MCC2 (174+43)
29
28
25-27
INSERT A
TERMINAL PHASE
VERTICAL DISPLACEMENT (N. MI.)
5
10
15
MCC1 (174+28)
24
21-23
20
17-19
TPI (174+13)
13-16
FIVE MINUTE TIME TICKS FROM TPI
DAYLIGHT
DARKNESS
PREPARED BY
ORBITAL PROCEDURES SECTION
DECEMBER 1971

2-3, 2-4

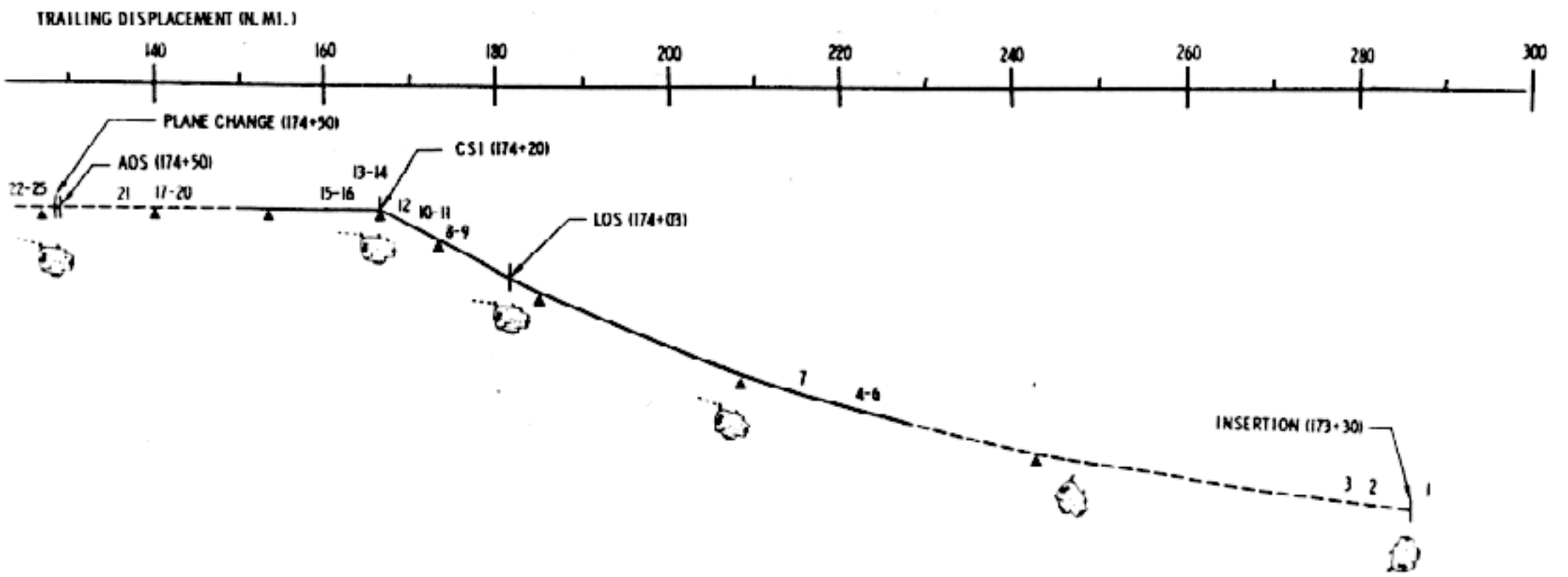


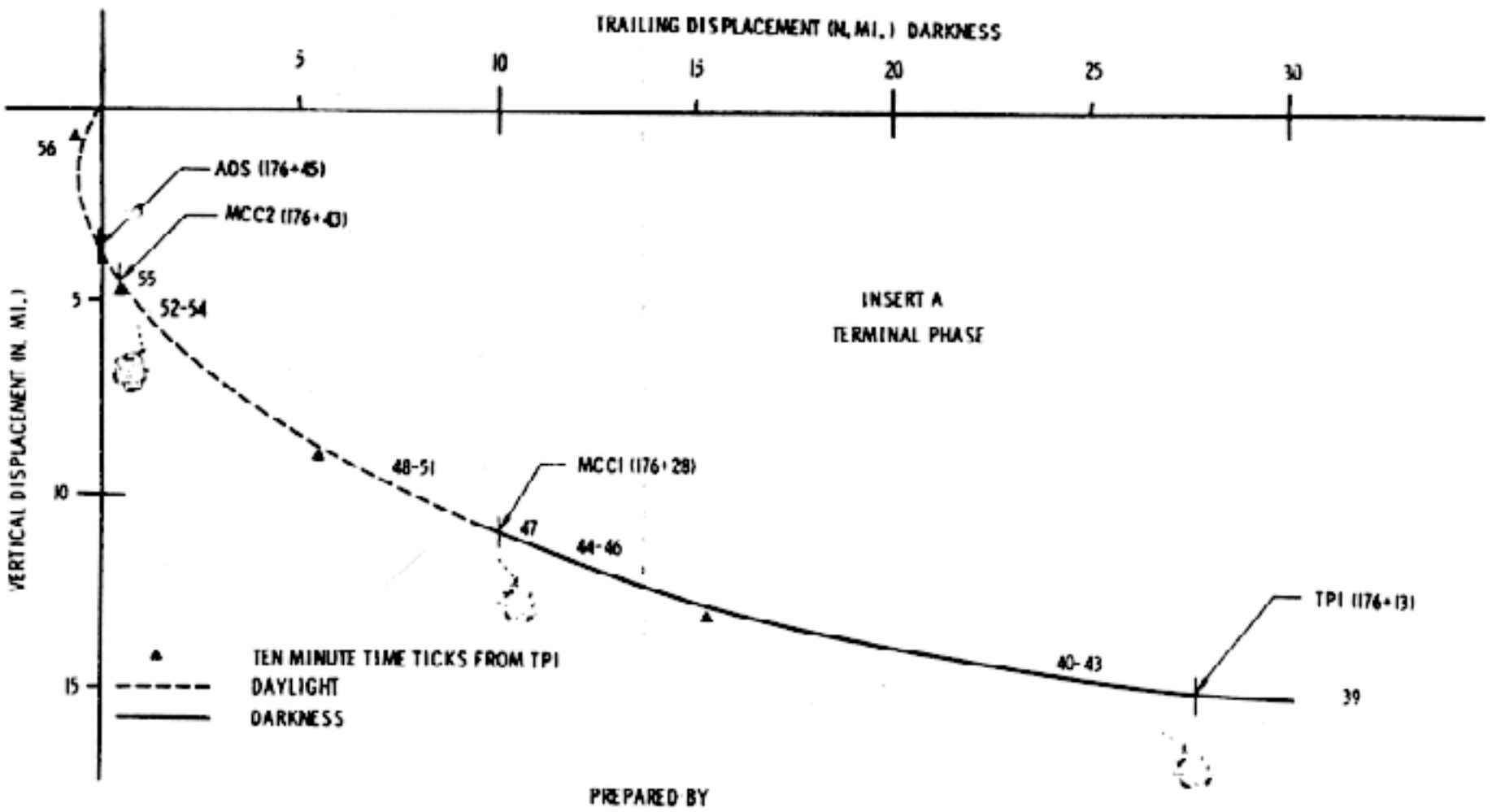
LM MAJOR EVENTS

	GROUND ELAPSED TIME	EVENT
1.	173+30	INSERTION
2.	173+32	AGS TARGET CSI
3.	173+33	IMU REFSMMAT ALIGN (P52)
4.	173+46	INITIATE RR NAVIGATION (P20)
5.	173+46	PGNS TARGET CSI (P32)
6.	173+46	AGS UPDATE AND ALIGN *
7.	173+48	INITIATE AGS RADAR UPDATES
8.	174+10	TERMINATE RR NAVIGATION (23 MARKS)
9.	174+10	PGNS FINAL CSI COMP
10.	174+11	TERMINATE AGS RADAR UPDATES (9 UPDATES)
11.	174+12	AGS FINAL CSI COMP
12.	174+13	CSI THRUSTING MANEUVER (P40/41)
13.	174+21	TARGET CDH (PGNS P33 AND AGS)
14.	174+21	INITIALIZE W-MATRIX
15.	174+23	RESUME RR NAVIGATION
16.	174+24	RESUME AGS RADAR UPDATES
17.	174+38	TERMINATE RR NAVIGATION (17 MARKS)
18.	174+39	TERMINATE AGS RADAR UPDATES (7 UPDATES)
19.	174+40	EXTERNAL ΔV FOR PLANE CHANGE (P30)
20.	174+40	OBTAIN CSM Y DOT FOR PLANE CHANGE
21.	174+42	RCS PLANE CHANGE MANEUVER (P41)
22.	174+50	TARGET CDH (PGNS P33 AND AGS)
23.	174+50	RESUME RR NAVIGATION
24.	174+50	REINITIALIZE W-MATRIX (V93)
25.	174+50	RESUME AGS RADAR UPDATES
26.	175+08	TERMINATE RR NAVIGATION (15 MARKS)
27.	175+08	PGNS FINAL CDH COMP
28.	175+09	TERMINATE AGS RADAR UPDATES (7 UPDATES)
29.	175+10	AGS FINAL CDH COMP
30.	175+12	CDH THRUSTING MANEUVER (P40/41/42)
31.	175+20	TARGET TPI (PGNS P34 AND AGS)
32.	175+20	REINITIALIZE W-MATRIX (V93)
33.	175+20	RESUME RR NAVIGATION
34.	175+30	RESUME AGS RADAR UPDATES
35.	176+02	TERMINATE RR NAVIGATION (24 MARKS)
36.	176+02	PGNS FINAL TPI COMP
37.	176+03	TERMINATE AGS RADAR UPDATES (12 UPDATES)
38.	176+03	AGS FINAL TPI SEARCH COMP
39.	176+07	TPI THRUSTING MANEUVER (P41)
40.	176+13	TARGET MCC1 (PGNS P35 AND AGS)
41.	176+13	REINITIALIZE W-MATRIX (V93)
42.	176+14	RESUME RR NAVIGATION
43.	176+14	RESUME AGS RADAR UPDATES
44.	176+24	TERMINATE RR NAVIGATION (9 MARKS)
45.	176+24	TERMINATE AGS RADAR UPDATES (6 UPDATES)
46.	176+24	PGNS AND AGS FINAL MCC1 COMP
47.	176+26	MCC1 THRUSTING MANEUVER (P41)
48.	176+28	TARGET MCC2 (PGNS P35 AND AGS)
49.	176+28	REINITIALIZE W-MATRIX (V93)
50.	176+28	RESUME RR NAVIGATION
51.	176+29	RESUME AGS RADAR UPDATES
52.	176+39	TERMINATE RR NAVIGATION (9 MARKS)
53.	176+39	TERMINATE AGS RADAR UPDATES (6 UPDATES)
54.	176+39	PGNS AND AGS FINAL MCC2 COMP
55.	176+41	MCC2 THRUSTING MANEUVER (P41)
56.	176+45	BRAKING (P47)

*ONLY IF AGS DISAGREES WITH

FIGURE 2-2
J-2 & J-3 MISSION COELLIPTIC RENDEZVOUS CSM-CENTERED RELATIVE MOTION





PREPARED BY
ORBITAL PROCEDURES SECTION
DECEMBER 1971

MISSIONS J-2 & J-3
DIRECT RENDEZVOUS
ATTITUDE TIME HISTORY FOR THE LM

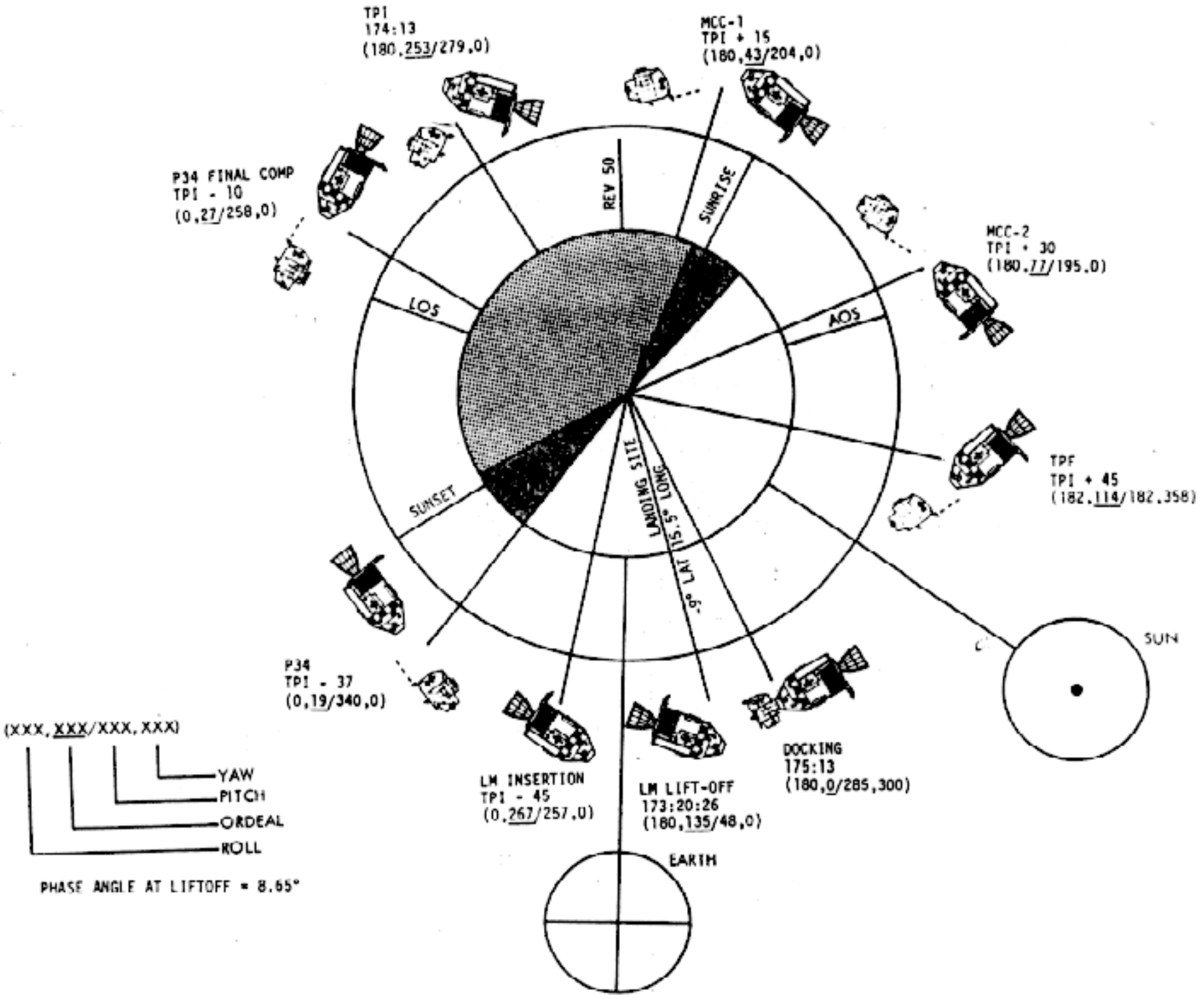
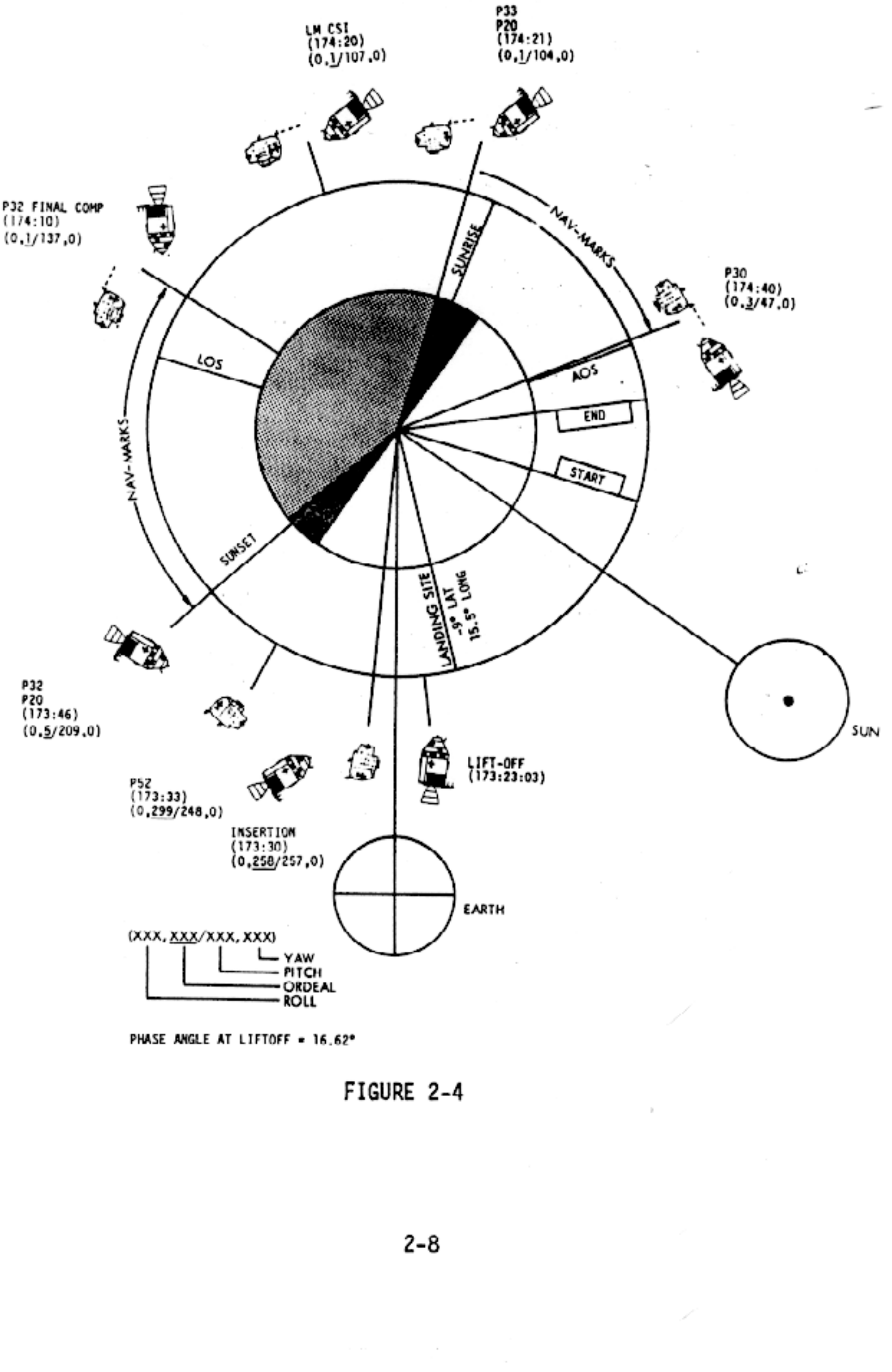


FIGURE 2-3

MISSIONS J-2 & J-3
COELLIPTIC RENDEZVOUS
ATTITUDE TIME HISTORY FOR THE LM



PHASE ANGLE AT LIFTOFF = 16.62°

FIGURE 2-4

MISSIONS J-2 & J-3
COELLIPTIC RENDEZVOUS
ATTITUDE TIME HISTORY FOR THE LM

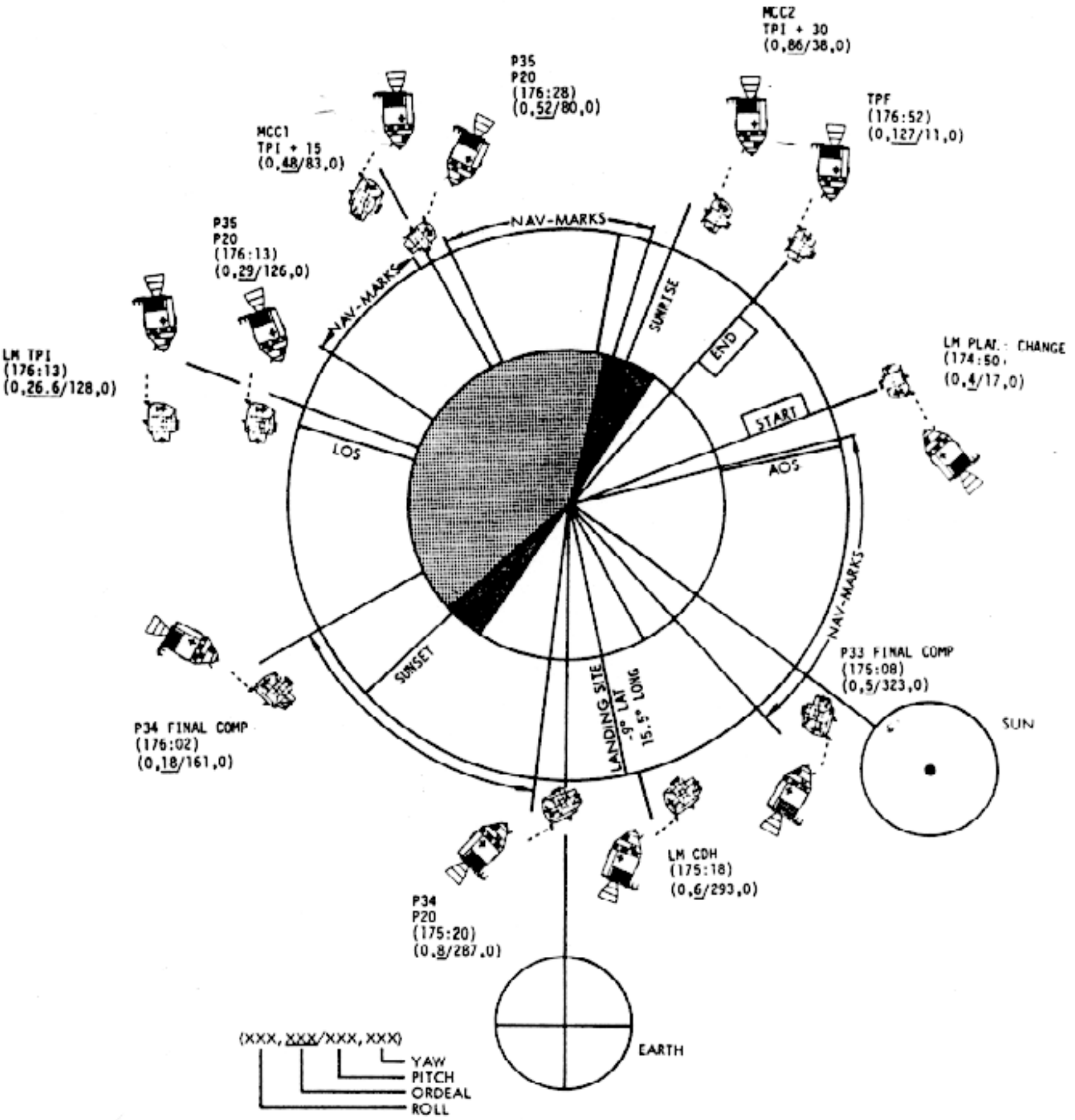


FIGURE 2-5

TIME	RANGE	RDOT
L0+5	140	1660
L0+6	152	813
L0+7	155	-175
INS	155	-449
1+00	151	-446
2+00	146	-442
3+00	142	-438
4+00	138	-433
5+00	133	-428
6+00	129	-422
7+00	125	-416
8+00	121	-409
9+00	117	-402
10+00	113	-395

INSERTION 173:27:41

V82
V76
AGS MODE CONT-ATT HOLD
RR MODE-LGC
RATE/ERR MON(2)-RNDZ RDR *
SHFT/TRUN ±5
RATE SCALE 5°/SEC
RNG/ALT MON-RNG/RNG RT
*VHF ANT-FWD *
*400+2 Z-AXIS STEER *
*410+4 TPI EXEC *
*616+00005 ULLAGE *
*623+0 *
*COPY AGS DATA *
AUDIO MODE(2)-ICS/PTT *
✓INV 2, CB INV 1-OPEN *
CB(11) & (16) ED: LOGIC PWR-OPEN
CB(11) ECS CABIN FAN1-CLOSE
+1 GO/NO-GO FOR TWEAK

ATT CONT-PULSE
MODE CONT-AUTO

P47 FDAI (0,257,0)
*404+0, 405+0, 406+0 *
*MONITOR 470, 471, 472 *

+3 TWEAK 173:30:41

ΔV'S

P47 FDAI (0,242,0) OR 10° OHW
*404+0, 405+0, 406+0 *
*MONITOR 470, 471, 472 *

40 LN BAILOUT @ L.O.+12:10

TIG	173:32:41	
ΔVX	41.6	

P20, AUTO MNVR
V80, MAX N49(2.00,12.0)
P34 TGT TPI

RR-AUTO TRACK

*VERIFY PGNS WITH MSFN *
*V47, 414+1, 400+3 *
*400+2 Z-AXIS STEER *
*417+1 (✓417+0) *
*411+1 START AUTO(19,18) *
*310R SET DET *
*303R @ TPI *
V82
V83 SET ORDEAL (35NM)
*317R, 440R, 277R *

V48, 12012
LM WT_____

33 CSM BAILOUT GET P76 PAD

*EXT LTG-TRACK *

30 CHART R/RDOT

27 RDOT ↕R

M=15, V32

24 RDOT ↕R
*COMPARE CMC,AGS,VHF/RR *
*POLAR PLOT @ 90 NM *

21 RDOT ↕R

18 RDOT ↕R
*CHECK RCS, EPS, ECS *

SS

LOS

15 RDOT ↕R
*514+0 *
*515+4 YAW STEER VEC *
*516+0 *

*MATCH INDICATED ANGLES *
*TRACK MODE-SLEW *
*S-BD ANT-AFT *
SET P _____ (+127) *
Y _____ (-50) *
*BIOMED-OFF, PCM-HI *
*UPLINK SQUELCH-ENABLE *

12 RDOT ↕R

10 CHART R/RDOT/0
9 RDOT ↕R
8 PRO-FINAL COMP

*411+0 STOP AUTO *
6 *COMPARE CMC, AGS *
CHECK TIG OF CSM
*✓DET & APS BURN CARD *
P42 N86
PERFORM YAW/ROLL MANEUVER
*404+0, 405+0, 406+0 *
*623+1 *
*400+1 GUID STEER *
5 *410+5 *
*500R_____

ATT CONT-MODE CONT

1:00 AGS MODE CONT-AUTO
:30 ABORT STAGE PB-PUSH
:10 MANUAL ULLAGE
:05 PRO
:00 TPI 174:12:41
ABORT STAGE PB-RESET
NO IGNITION
ENG ARM-ASC
MANUAL START
MANUAL STOP 3 SEC
ENG ARM-OFF
NULL RESIDUALS

```
0  TPI 174:12:41
   V76, AGS MODE CONT-ATT HOLD
   P35 TGT MCC 1          ATT CONT-PULSE
   MAX N49(0.80,5.0)       MODE CONT-AUTO
   V67 (+02000,+00020,+00005)
      *400+0                    *
      *523+0                    *
      *417+1 (√621+0)           *
      *411+1 START AUTO(13,12)  *
2                                  ⇕R
      *410+4 TPI EXEC           *
      *373+TPI TIME +15 MIN     *
      *307+028.00               *
4                          RDOT ⇕R
6                          RDOT ⇕R
8                          RDOT ⇕R
9  CHART θ                     *
10                         RDOT ⇕R
12 PRO FINAL COMP          RDOT ⇕R
13 CHART R/RDOT/θ
      *411+0 STOP AUTO          *
                 370R TOTAL VEL MCC1
                 371R ΔV TPF
      *404+0, 405+0, 406+0      *
   P41, V77
14    *410+5                 ATT CONT-
      *502R ______            MODE CONT
:05   *472R/502R                *A/H
15 MCC1
   NULL RESIDUALS
```

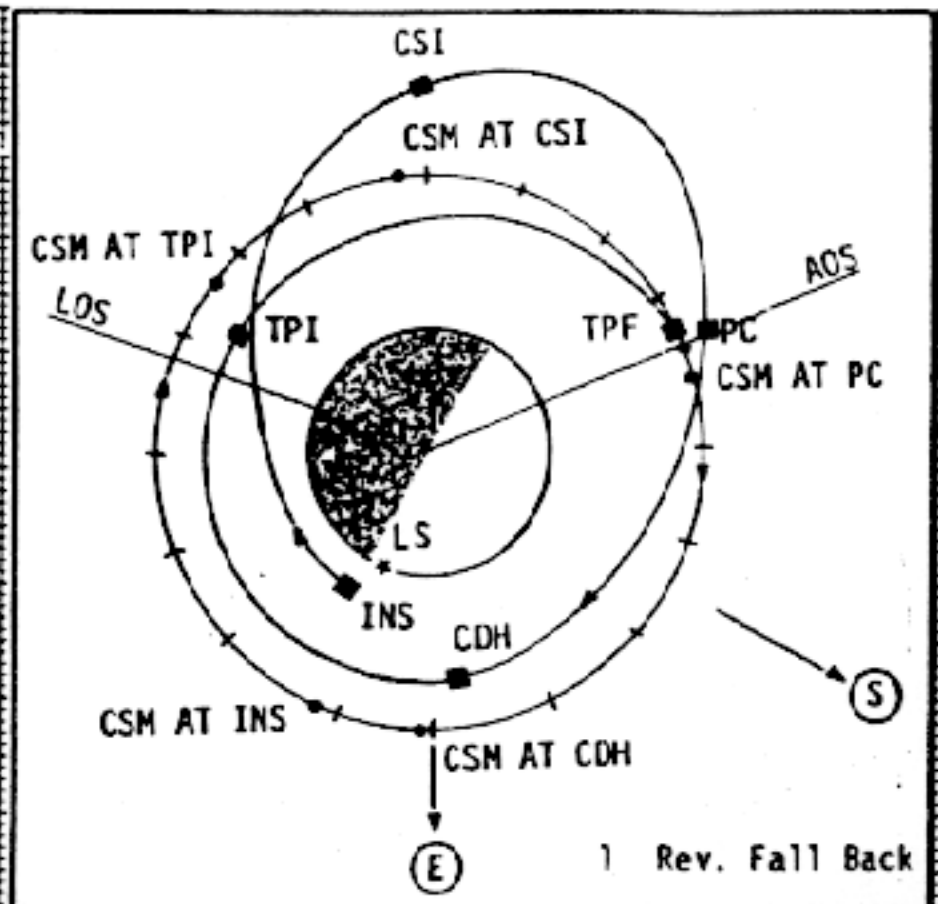
SR

```
   V76
   P35 TGT MCC 2          ATT CONT-PULSE
   V93                     MODE CONT-AUTO
      *VERIFY PGNS (PCM-HI)     *
      *V47, 414+1, 400+3        *
      *411+1 START AUTO         *
      *EXT LTG-OFF              *
17                                 ⇕R
      *410+4 TPI EXEC           *
      *373+TPI TIME +30 MIN     *
      *307+013.00               *
19                         RDOT ⇕R
21                         RDOT ⇕R
23                         RDOT ⇕R
24 CHART θ                     *
25                         RDOT ⇕R
27 PRO-FINAL COMP          RDOT ⇕R
28 CHART R/RDOT/θ
      *411+0 STOP AUTO          *
                 370R TOTAL VEL MCC2
                 371R ΔV TPF
      *404+0, 405+0, 406+0      *
   P41, V77
29    *410+5                 ATT CONT-
      *502R ______            MODE CONT
:05   *472R/502R                *A/H
30 MCC2
   NULL RESIDUALS
```

AOS

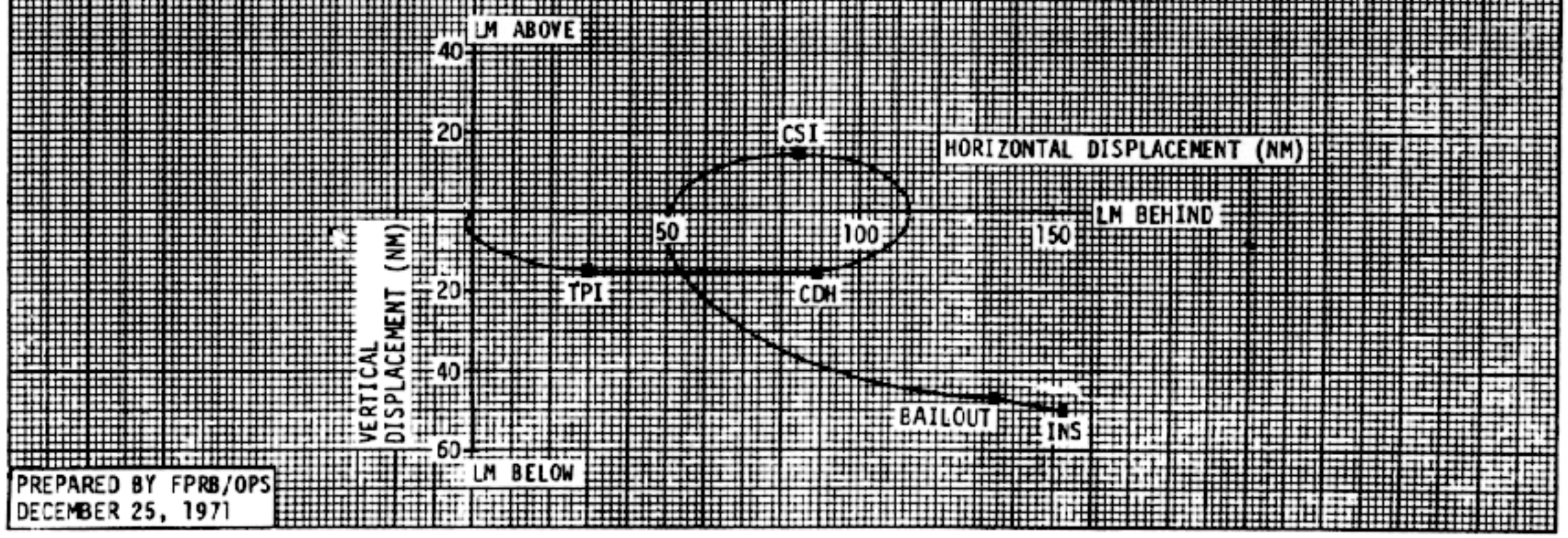
```
   P00
   V48, 11002
   P47, V63
      *404+0, 405+0, 406+0      *
      *S-BD ANT-AFT,VERIFY COMM*
      *√S-BD P ____ (+127)      *
            Y ____ (-50)        *
      *S-BD ANT-SLEW (>3.0)     *
      *TRACK MODE-AUTO          *
      *BIOMED-LEFT, PCM-HI      *
      *UPLINK SQUELCH-OFF       *
   TPI BURN REPORT
40 INITIATE BRAKING
      30 FPS - 6000 FT
      20 FPS - 3000 FT
      10 FPS - 1500 FT
       5 FPS -  600 FT
      *SETUP CAMERA FOR         *
      *  DOCKING:               *
      *LM3/DAC/10/CEX-ULC       *
      *  (T8,1/250,6) 1FPS      *
      * .25 MAG(0), (4MIN)      *
   V34, P00
   V76                    ATT CONT-PULSE
   MANEUVER/PICTURES OF SIMBAY
55 INITIATE DOCKING
   COAS TO OVHD WINDOW
      *EXT LTG-DOCK             *
   SHFT/TRUN ±50                *
   V41N72 (+000,+320)
   CB RR(2)-OPEN, V44
   FDAI LV(180,285,300)
   V77                    ATT CONT-
65 CONTACT                 MODE CONT
   CONFIRM CAPTURE FROM CSM
   MODE CONT (BOTH)-OFF
```

EVENT	GET TIG
INS	
BAILOUT	
CSI	
PC	
CDH	
TPI	

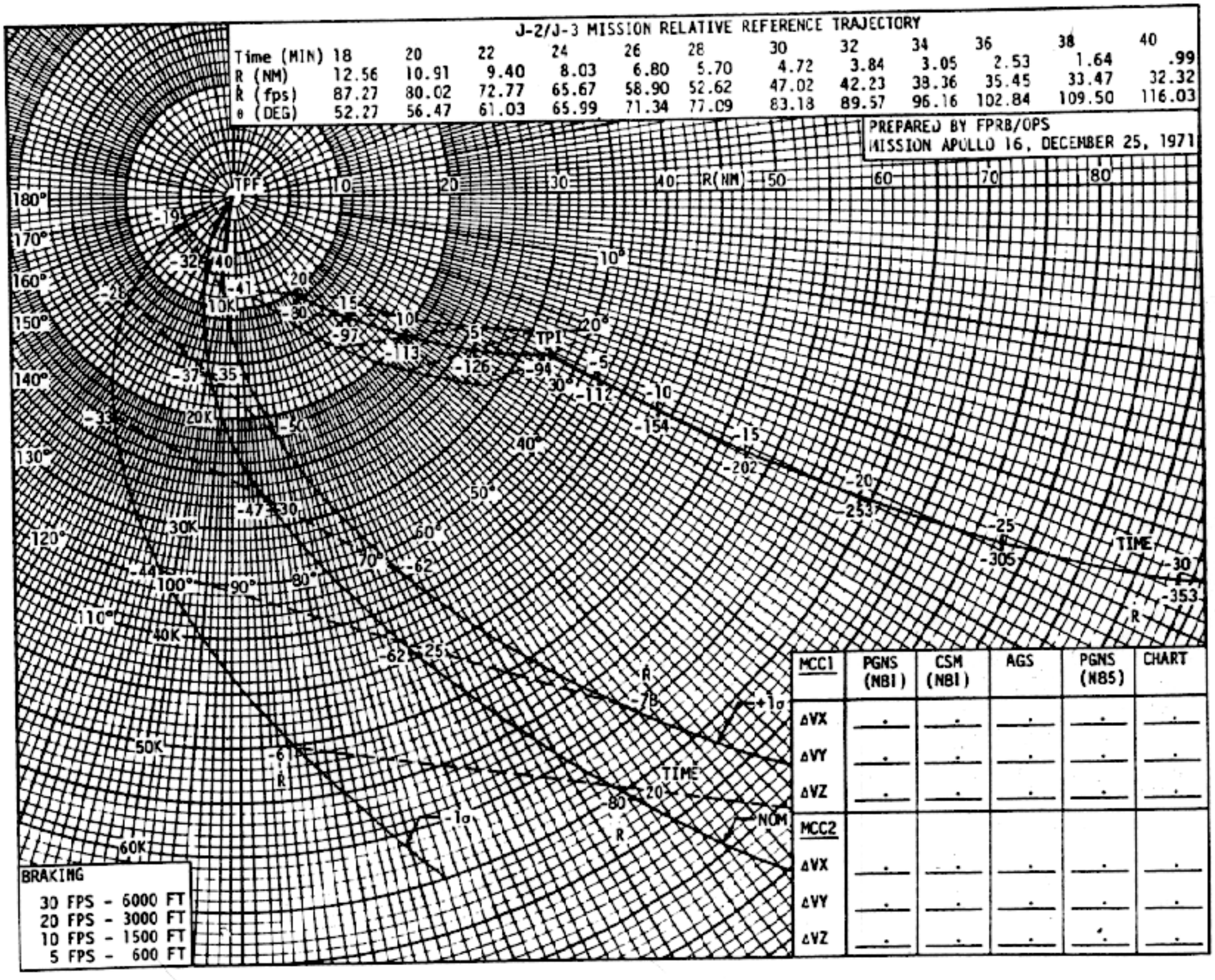


APOLLO 16/17 MISSIONS
INERTIAL AND RELATIVE PLOTS

BAILOUT



PREPARED BY FPRB/OPS
DECEMBER 25, 1971


J-2/J-3 MISSION RELATIVE REFERENCE TRAJECTORY
Time (MIN) 18 20 22 24 26 28 30 32 34 36 38 40
R (NM) 12.56 10.91 9.40 8.03 6.80 5.70 4.72 3.84 3.05 2.53 1.64 .99
Ṙ (fps) 87.27 80.02 72.77 65.67 58.90 52.62 47.02 42.23 38.36 35.45 33.47 32.32
θ (DEG) 52.27 56.47 61.03 65.99 71.34 77.09 83.18 89.57 96.16 102.84 109.50 116.03
PREPARED BY FPRB/OPS
MISSION APOLLO 16, DECEMBER 25, 1971
TPF
TPI
R(NM)
TIME
BRAKING
30 FPS - 6000 FT
20 FPS - 3000 FT
10 FPS - 1500 FT
5 FPS - 600 FT
MCC1 PGNS (NBI) CSM (NBI) AGS PGNS (N85) CHART
ΔVX
ΔVY
ΔVZ
MCC2
ΔVX
ΔVY
ΔVZ

11/29/71 Final

PDI SUMMARY DATA

PAGE	ABORT	INS			BOOST	HAM	CSI		CDH			TPI	AIM		
	TIME PDI+	TIME PDI+	N76	HA/HINS	TIME INS+	TIME INS+	TIME INS+	ΔVX	TIME INS+	ΔVX	ΔVZ	TIME PDI+	TIME PDI+	ΔVX	ΔVZ
A-1	NO 1+12	NA	NA	NA	NA	NA	1+00+00*	47.3	2+02+17*	-119.5	-61.5	2+47+13	12+00	102.3	-50.0
A-2	1+00	2+06	5655.2	137.0/54848.	NA	NA	0+55+00	50.2	1+57+16	-120.1	-42.5	2+45+48	NA	NA	NA
	2+00	3+60	5649.9	135.8/60016.				48.2	1+57+11	-117.6	-39.1				
	3+00	5+42	5645.8	132.4/60018.				47.7	1+57+01	-113.1	-33.1				
	4+00	7+19	5638.9	126.9/60023.				47.4	1+56+45	-106.0	-24.6				
	5+00	8+50	5629.2	119.2/60030.				47.3	1+56+24	-96.2	-13.5				
	6+00	10+14	5616.6	109.2/60039.				47.4	1+55+57	-83.8	-.5				
	7+00	12+29	5596.3	96.4/65421.				45.9	1+55+22	-67.1	14.2				
A-3	8+00	14+30	5570.0	79.4/71108.				44.4	1+54+36	-44.8	30.7				
	9+00	16+07	5545.5	62.5/73870.				43.7	1+53+50	-22.2	43.7				
	10+00	17+15	5528.9	49.4/72124.				43.9	1+53+15	-4.2	51.3				
	11+00	18+19	5515.8	37.2/66754.				44.9	1+52+41	13.0	56.2				
A-4	12+00	19+23	5550.3	59.6/61690.	50+00	1+50+00	2+40+00	38.0	3+38+45	-19.5	-22.5	4+44+37	NA	NA	NA
	13+00	20+26	5541.5	52.4/60251.				39.9	3+38+29	-11.3	-5.5				
	14+00	21+26	5534.0	45.9/60250.				40.6	3+38+15	-4.5	6.7				
	15+00	22+25	5526.4	41.4/60248.				41.2	3+38+02	2.5	17.9				
	16+00	23+25	5518.7	35.9/60246.				41.6	3+37+48	9.7	28.1				
	17+00	24+24	5511.1	30.5/60244.				41.7	3+37+33	17.1	37.3				
A-5	T2-1	7+21a	5510.6	29.9/60235.	50+00	3+50+00	4+40+00	36.6	5+37+21	22.8	54.4	6+43+32	NA	NA	NA
A-6	NO 2+12	NA	NA	NA	1+07+00*	2+07+00*	3+07+00*	38.1	4+09+43*	-132.3	-2.9	4+49+31	12+00	113.4	-50.0
A-7	1+00	2+07	5667.2	146.5/54190.	1+00+00	2+00+00	3+00+00	40.9	4+02+43	-132.4	-9.6	4+49+28	NA	NA	NA
	2+00	4+01	5661.7	145.4/60016.				38.6	4+02+38	-130.1	-7.1				
	3+00	5+43	5659.6	143.7/60019.				38.0	4+02+32	-127.4	-1.6				
	4+00	7+20	5656.3	141.0/60024.				37.5	4+02+24	-123.6	6.5				
	5+00	8+51	5651.6	137.2/60031.				37.0	4+02+13	-118.5	16.8				
	6+00	10+16	5645.7	132.3/60040.				36.6	4+01+59	-112.1	29.4				
A-8	7+00	12+34	5657.2	145.0/65661.	NA	NA	0+55+00	43.6	1+57+30	-125.6	-52.7	2+50+39	NA	NA	NA
	8+00	14+35	5632.3	128.1/71266.				43.2	1+56+46	-105.9	-26.7				
	9+00	16+11	5609.3	111.3/73944.				43.3	1+56+01	-85.6	-4.0				
	10+00	17+19	5593.8	98.2/72172.				44.1	1+55+27	-69.3	11.3				
A-9	11+00	18+22	5581.8	86.0/66795.				45.6	1+54+54	-53.7	23.6				
	12+00	19+24	5569.6	74.0/61708.				46.8	1+54+22	-37.9	34.4				
	13+00	20+26	5551.7	59.9/60253.				47.2	1+53+44	-19.0	44.4				
A-10	14+00	21+26	5536.9	49.0/60250.				47.0	1+53+14	-4.0	50.6				
	15+00	22+25	5521.8	38.1/60245.				46.8	1+52+45	11.3	55.0				
A-4	T2-2	7+21a	5510.6	29.9/60235.	50+00	1+50+00	2+40+00	42.2	3+37+31	17.6	38.5	4+49+13	NA	NA	NA

a INDICATES TIME IS REFERENCED TO LIFT-OFF.

* INDICATES TIME IS REFERENCED TO PDI.

RANGE AND RANGE RATE AT INS AND 10 MINUTES PRIOR TO SUBSEQUENT BURNS

PAGE	ABORT TIME PDI+	INS RANGE	INS RANGE RATE	BOOST RANGE	BOOST RANGE RATE	HAM RANGE	HAM RANGE RATE	CSI RANGE	CSI RANGE RATE	CDH RANGE	CDH RANGE RATE
A-1	NO 1+12	NA	NA	NA	NA	NA	NA	195.4	-525.2	99.6	-106.3
A-2	01+00	162.1	561.6	NA	NA	NA	NA	179.8	-527.6	103.7	-122.8
	02+00	158.7	547.2					174.8	-516.3	99.6	-122.9
	03+00	144.8	528.5					160.5	-492.4	98.6	-128.8
	04+00	120.1	495.5					136.9	-448.9	97.2	-136.6
	05+00	85.1	418.1					103.0	-375.8	96.5	-135.8
	06+00	50.4	97.8					59.6	-232.0	94.5	-148.9
	07+00	73.4	-426.0					32.1	231.3	93.9	-156.5
A-3	08+00	147.4	-469.2					83.1	196.4	93.1	-166.7
	09+00	222.7	-447.7					142.4	58.1	92.7	-176.2
	10+00	281.8	-425.6					188.1	-48.8	91.0	-180.0
	11+00	333.9	-404.8					227.5	-143.9	91.2	-186.2
A-4	12+00	385.9	-430.2	309.5	30.4	232.7	-386.6	102.4	-7.5	94.2	-98.0
	13+00	435.4	-416.9	355.5	-10.7	255.9	-390.9	126.2	-37.1	93.8	-109.5
	14+00	485.6	-403.2	402.0	-53.2	279.3	-393.2	149.9	-68.9	94.1	-119.6
	15+00	535.5	-389.2	448.0	-96.3	302.6	-393.6	173.1	-102.6	92.8	-129.6
	16+00	585.2	-375.2	493.3	-139.8	326.1	-391.7	195.9	-138.4	91.4	-138.0
	17+00	634.4	-361.1	538.1	-183.9	349.5	-388.0	218.2	-176.2	89.8	-144.7
A-5	T2-1	981.5	-307.3	893.6	-196.3	360.6	-352.5	243.0	-204.5	87.0	-173.0
A-6	NO 2+12	NA	NA	386.9	-731.7	157.4	466.4	196.3	-620.9	100.0	-162.0
A-7	01+00	386.0	620.3	378.4	-721.1	147.5	479.7	197.5	-615.2	101.5	-163.2
	02+00	383.1	606.3	373.4	-710.2	148.3	469.2	194.5	-607.8	98.3	-149.1
	03+00	369.2	596.5	358.1	-698.2	141.1	466.0	184.4	-593.6	97.0	-168.3
	04+00	343.7	585.6	332.5	-676.9	129.7	465.2	170.3	-571.4	96.7	-163.6
	05+00	305.2	572.2	295.0	-645.6	112.4	464.4	150.2	-537.0	94.8	-173.9
	06+00	252.0	554.2	244.1	-600.6	89.3	457.6	124.3	-483.9	92.1	-185.8
A-8	07+00	183.6	548.1	NA	NA	NA	NA	193.5	-547.0	100.9	-122.4
	08+00	105.2	466.5					121.5	-418.4	99.3	-133.1
	09+00	50.3	99.6					59.4	-229.5	97.6	-142.8
	10+00	65.8	-397.9					31.2	166.6	95.1	-155.6
A-9	11+00	109.4	-469.7					53.5	265.6	92.9	-163.6
	12+00	159.2	-468.3					92.0	173.7	92.1	-167.3
	13+00	208.0	-453.8					130.3	81.8	91.3	-172.1
A-10	14+00	258.5	-435.2					169.3	-11.3	89.0	-175.3
	15+00	309.1	-415.0					207.7	-105.4	88.2	-180.8
A-4	T2-2	651.5	-358.0	554.3	-193.3	360.9	-387.7	229.2	-184.7	95.6	-155.0

60 INSERTION

V82
SS AGS MODE CONT-ATT HOLD
SHFT/TRUN ±5
RATE SCALE 5°/SEC
RNG/ALT MON-RNG/RNG RT
ATT CONT-PULSE
MODE CONT-AUTO
*VHF ANT-FWD *
*EXT LTG-TRACK *
*SEQUENCE CAMERA-OFF *
*400+2 *
*616+00005 ULLAGE *
*623+0 *
*RATE/ERR MON-RNDZ RDR *
AUDIO MODE(2)-ICS/PTT *
✓INV 2, CB INV 1-OPEN *
CB(11) & (16) ED: LOGIC PWR-OPEN
CB PGNS LDG RDR-OPEN
CB RR(2)-CLOSE

V48, 1 (2) 1002

V41N72 (+000, +283)
CB RR(2)-OPEN, V44
RATE/ERR MON-LDG RDR/CMPTR
P52 OPT 3
CB AOT LAMP-CLOSE
AOT DETENT F/0°
V76
1st STAR _____
2nd STAR _____
N05 ANG DIFF
PRO
N93 TORQUING ANG
X _____
Y _____
Z _____
PRO N25(R1=14) GET
PRO N25(R1=15)
PRO TO PICAPAIR
DETENT CL
CB AOT LAMP-OPEN

LOS

40 V34
P00
*VERIFY PGNS WITH MSFN *
*V47, 414+1, 400+3 *
*400+2 *

V48, 1 (2) 2022

*MATCH INDICATED ANGLES *
*TRACK MODE-SLEW *
*S-BD ANT-AFT *
SET P _____ *
Y _____ *
*BIOMED-OFF, PCM-HI *
*UPLINK SQUELCH-ENABLE *

20

10 *VERIFY PGNS (PCM-HI) *
*V47, 414+1, 400+3 *
*400+2 *

SR *EXT LTG-OFF *

ΔVX = +10.0 (HORZ)
P30
N33 TIG BOOST (INS + ΔT)
*373 + _____ TIG BOOST *

P41, V77
V48, 12022 (IF STAGING @ BOOST)
*404+0, 405+0, 406+0 *
*400+1 GUID STEER
ATT CONT-MODE CONT *
5 *410+5 LOAD ΔV
*500R _____

:05 *500R *A/H
STAGE AT BOOST IGNITION
0 BOOST

60 BOOST

P00
V82
V76
*400+2 Z-AXIS STEER
*416+1 1/2 PERIOD
*410+1 TGT CSI
*373+_____ TIG CSI
*275+_____ TIG TPI
*605+00777 COT
*310R SET DET (-60 MIN)
*402R_____ ΔH

ATT CONT-PULSE
MODE CONT-AUTO

50

AOS
S-BD ANT-FWD, VERIFY COMM
*/S-BD P _____
Y _____
*S-BD ANT-SLEW (>3.0)
*TRACK MODE-AUTO
*BIOMED-LEFT, PCM-HI
*UPLINK SQUELCH-OFF

40

V48, 12012
(IF R <400)
CB RR(2)-CLOSE
RATE/ERR MON-RNDZ RDR
RR MODE-LGC
P20, AUTO MNVR
V80, MAX N49(2.00,12.0)

RR-AUTO TRACK

P32, TGT CSI
N11 TIG CSI (INS + ΔT)
N37 TIG TPI (PDI + ΔT)
*VERIFY PGNS WITH MSFN
*V47, 414+1, 400+3
*400+2 Z-AXIS STEER
*417+1 (/417+0)
*411+1 START AUTO(19,19)

V83 SET ORDEAL
*317R, 440R, 277R
*COMPARE VHF/RR

36 RDOT ↕R

33 RDOT ↕R

30 RDOT ↕R

27 RDOT ↕R

M=10,V32

24 RDOT ↕R

21 RDOT ↕R

18 RDOT ↕R
*CHECK RCS, EPS, ECS

15 RDOT ↕R
V90

12 RDOT ↕R
*402R _____

10 PRO-FINAL COMP
*411+0 STOP AUTO
*USE HAM CHART
*COMPARE CMC HAM

V83, SET ORDEAL
*317R, 440R, 277R

P30
N33 TIG HAM (INS + ΔT)
*373+_____ TIG HAM

P41, V77, N86
*400+1 GUID STEER
5 *410+5 LOAD ΔV
*370R _____ TOT ΔV
*500R _____

ATT CONT-MODE CONT

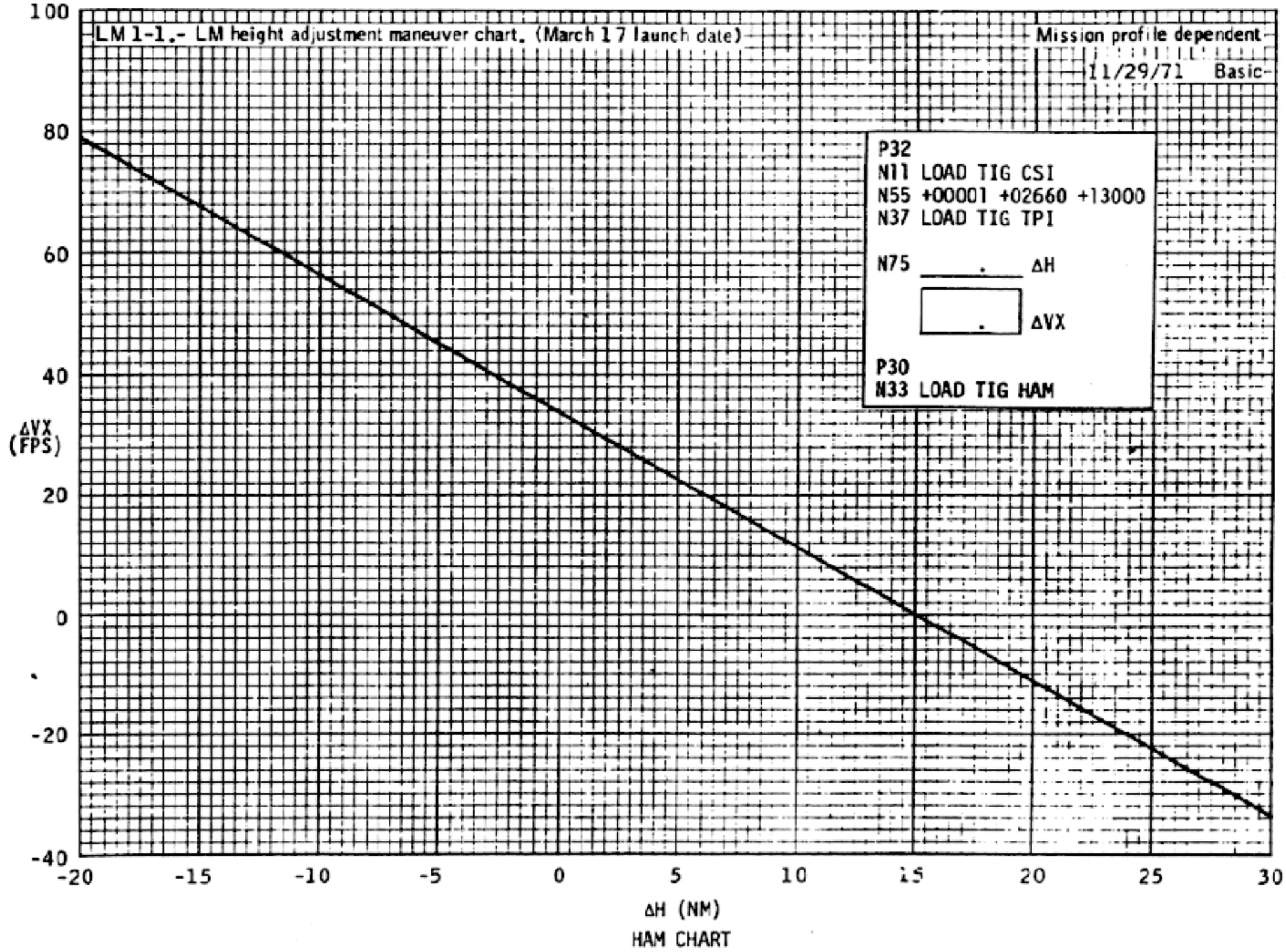
:05 *500R *A/H

0 HAM

P00
V82

LM 1-1.- LM height adjustment maneuver chart. (March 17 launch date)

Mission profile dependent
11/29/71 Basic



HAM CHART

TIME	RANGE	RDOT
INS	286	-454
1+00	281	-450
2+00	277	-445
3+00	272	-440
4+00	268	-434
5+00	264	-428
6+00	259	-421
7+00	255	-413
8+00	251	-405
9+00	247	-397
10+00	243	-388

NOM COELLIPTIC/ONE REV ABORTS

INSERTION

V82
AGS MODE CONT-ATT HOLD — ATT CONT-PULSE
RR MODE-LGC — MODE CONT-AUTO
SHFT/TRUN ±5
RATE SCALE 5°/SEC
RNG/ALT MON-RNG/RNG RT
*VHF ANT-FWD *
*SEQUENCE CAMERA-OFF *
*616+00005 ULLAGE *
*605+00777 COT *
*RATE/ERR MON-RNDZ RDR *
AUDIO MODE(2)-ICS/PTT *
/INV 2, CB INV 1-OPEN *
CB(11) & (16) ED: LOGIC PWR-OPEN
CB(11) ECS CABIN FAN1-CLOSE
CB RR(2)-CLOSE

*400+2 Z-AXIS STEER *
*507+0 Z-AXIS TRACT *
*623+0 *
*410+1 TGT CSI *
*373+_____ TIG CSI *
*275+_____ TIG TPI *
*416+1 1/2 PERIOD *
*310R SET DET *
*COPY AGS DATA(450R) *

INS/HAM THRU CSI

V48, 11002
V41N72 (+000, +283) — RR-AUTO TRACK
CB RR(2)-OPEN, V44
RATE/ERR MON-LDG RDR/CMPTR
P52 OPT 3
CB AOT LAMP-CLOSE
AOT DETENT F/0°
V76
1st STAR ANTARES (33)
2nd STAR SPICA (26) — 417+1 ⟨R
45
42 — RDOT ⟨R
39 — RDOT ⟨R
N05 ANG DIFF
PRO
N93 TORQUING ANG
X_____
Y_____
Z_____
PRO N25(R1=14) GET
PRO N25(R1=15)
PRO TO PICAPAIR
DETENT CL
CB AOT LAMP-OPEN
SS *EXT LTG-TRACK *
36 V34 — RDOT ⟨R
V48, 12012
CB RR(2)-CLOSE
RATE/ERR MON-RNDZ RDR
P20, AUTO MNVR
V80, MAX N49(2.00,12.0)
P32, TGT CSI
*VERIFY PGNS WITH MSFN *
*V47, 414+1, 400+3 *
*400+2 *
*417+1 (√417+0,621+0) *
45 *411+1 START AUTO(19,19) *
V83 SET ORDEAL (35NM)
*317R, 440R, 277R *
33 — RDOT ⟨R

MISSION APOLLO 16, DECEMBER 25, 1971

30 CHART RDOT — RDOT ⟨R
27 — RDOT ⟨R
24 — RDOT ⟨R
M=10, V32
21 — RDOT ⟨R
20 CHART RDOT
*COMPARE CMC,AGS,VHF/RR *
*MATCH INDICATED ANGLES *
*TRACK MODE-SLEW *
*S-BD ANT-AFT *
SET P _____ (-7) *
Y _____ (+22) *
*BIOMED-OFF, PCM-HI *
*UPLINK SQUELCH-ENABLE *
18 — RDOT ⟨R
*CHECK RCS, EPS, ECS *
15 — RDOT ⟨R
V90 OBTAIN CMC LM YDOT
12 — RDOT ⟨R
10 CHART R/RDOT *
PRO-FINAL COMP
N81 LOAD CMC LM YDOT(IF>5fps)
9 — RDOT ⟨R
N13 CDH TIG TO CSM
*411+0 STOP AUTO *
*COPY AGS DATA *
CB(11) ECS CABIN FAN1-OPEN
V83 SET ORDEAL
*317R, 440R, 277R *
P41, V77, N85
5 *410+5 — ATT CONT-MODE CONT
*370R _____ TOT ΔV
*ΔV's TO CSM *
:05 *500R/502R *A/H
:00 CSI
NULL RESIDUALS

LOS

RDOT1	F1	RDOT2	F2	RDOT3	F3	R3	F4
-240.0	47.3	-140.0	45.2	-70.0	-27.6	120.0	-15.2
-241.0	48.4	-141.0	43.4	-71.0	-26.6	121.0	-15.5
-242.0	49.4	-142.0	41.6	-72.0	-25.6	122.0	-15.7
-243.0	50.5	-143.0	39.8	-73.0	-24.5	123.0	-15.9
-244.0	51.5	-144.0	37.9	-74.0	-23.5	124.0	-16.1
-245.0	52.5	-145.0	36.1	-75.0	-22.5	125.0	-16.3
-246.0	53.6	-146.0	34.3	-76.0	-21.4	126.0	-16.5
-247.0	54.6	-147.0	32.4	-77.0	-20.4	127.0	-16.7
-248.0	55.7	-148.0	30.6	-78.0	-19.4	128.0	-16.9
-249.0	56.7	-149.0	28.7	-79.0	-18.3	129.0	-17.1
-250.0	57.8	-150.0	26.9	-80.0	-17.3	130.0	-17.3
-251.0	58.8	-151.0	25.1	-81.0	-16.3	131.0	-17.5
-252.0	59.9	-152.0	23.2	-82.0	-15.2	132.0	-17.7
-253.0	60.9	-153.0	21.4	-83.0	-14.2	133.0	-17.9
-254.0	62.0	-154.0	18.6	-84.0	-13.1	134.0	-18.1
-255.0	63.0	-155.0	17.7	-85.0	-12.1	135.0	-18.4
-256.0	64.1	-156.0	15.9	-86.0	-11.1	136.0	-18.6
-257.0	65.1	-157.0	14.0	-87.0	-10.0	137.0	-18.8
-258.0	66.2	-158.0	12.2	-88.0	-9.0	138.0	-19.0
-259.0	67.2	-159.0	10.3	-89.0	-8.0	139.0	-19.2
-260.0	68.3	-160.0	8.5	-90.0	-6.9	140.0	-19.4
-261.0	69.3	-161.0	6.6	-91.0	-5.9	141.0	-19.6
-262.0	70.4	-162.0	4.8	-92.0	-4.8	142.0	-19.8
-263.0	71.4	-163.0	3.0	-93.0	-3.8	143.0	-20.0
-264.0	72.5	-164.0	1.1	-94.0	-2.8	144.0	-20.2
-265.0	73.5	-165.0	-.7	-95.0	-1.7	145.0	-20.5
-266.0	74.6	-166.0	-2.6	-96.0	-.7	146.0	-20.7
-267.0	75.7	-167.0	-4.4	-97.0	.4	147.0	-20.9
-268.0	76.7	-168.0	-6.3	-98.0	1.4	148.0	-21.1
-269.0	77.8	-169.0	-8.1	-99.0	2.4	149.0	-21.3
-270.0	78.8	-170.0	-10.0	-100.0	3.5	150.0	-21.5
-271.0	79.9	-171.0	-11.9	-101.0	4.5	151.0	-21.7
-272.0	81.0	-172.0	-13.7	-102.0	5.6	152.0	-21.9
-273.0	82.0	-173.0	-15.6	-103.0	6.6	153.0	-22.1
-274.0	83.1	-174.0	-17.4	-104.0	7.7	154.0	-22.4
-275.0	84.2	-175.0	-19.3	-105.0	8.7	155.0	-22.6
-276.0	85.2	-176.0	-21.1	-106.0	9.7	156.0	-22.8
-277.0	86.3	-177.0	-23.0	-107.0	10.8	157.0	-23.0
-278.0	87.4	-178.0	-24.9	-108.0	11.8	158.0	-23.2
-279.0	88.4	-179.0	-26.7	-109.0	12.9	159.0	-23.4
-280.0	89.5	-180.0	-28.6	-110.0	13.9	160.0	-23.6
-281.0	90.6	-181.0	-30.4	-111.0	15.0	161.0	-23.8

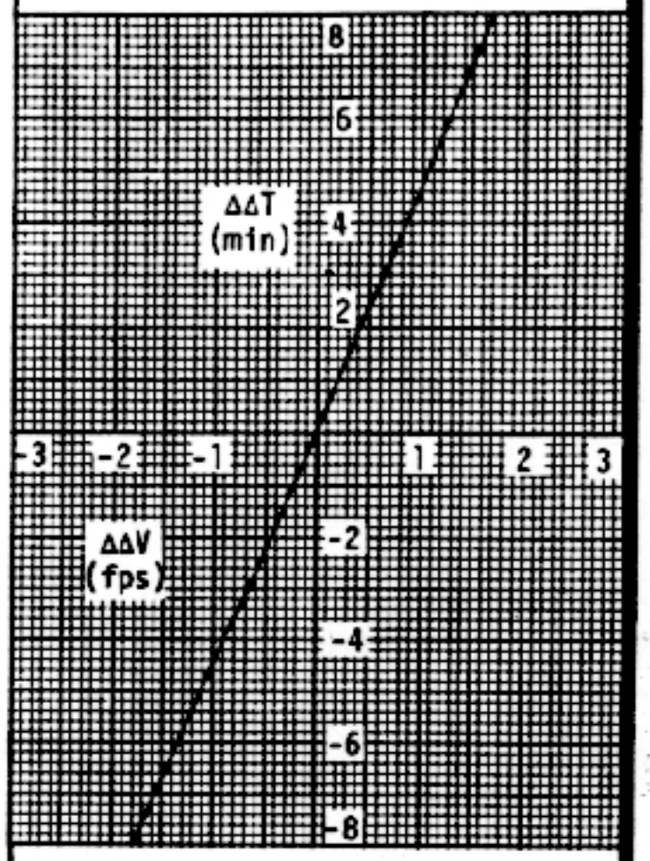
CSI BACKUP TABLE
NOMINAL ASCENT

TIME (Min)		NOMINAL DSKY>TM
-30 R1	_____	(-283.3)-1.4
-20 R2	_____	(-173.9) -.9
-10 R3	_____	(- 94.0) -.5
-10 R3	_____	(154.1)
F1	_____	(93.0)
+F2	_____	(-17.3)
	_____	(75.7)
+F3	_____	(-2.8)
	_____	(72.9)
+F4	_____	(- 22.4)
	_____	(50.5)
+ΔΔVCSI	_____	(0.0)
ΔVCSI	[ ]	(50.5)

PREPARED BY FPRB/OPS
APRIL 19, 1971

RDOT1	F1	RDOT2	F2	RDOT 3	F3	R3	F4
-282.0	91.6	-182.0	-32.3	-112.0	16.0	162.0	-24.0
-283.0	92.7	-183.0	-34.2	-113.0	17.0	163.0	-24.2
-284.0	93.8	-184.0	-36.0	-114.0	18.1	164.0	-24.5
-285.0	94.8	-185.0	-37.9	-115.0	19.1	165.0	-24.7
-286.0	95.9	-186.0	-39.8	-116.0	20.2	166.0	-24.9
-287.0	97.0	-187.0	-41.6	-117.0	21.2	167.0	-25.1
-288.0	98.1	-188.0	-43.5	-118.0	22.3	168.0	-25.3
-289.0	99.2	-189.0	-45.4	-119.0	23.3	169.0	-25.5
-290.0	100.2	-190.0	-47.2	-120.0	24.4	170.0	-25.7
-291.0	101.3	-191.0	-49.1	-121.0	25.4	171.0	-25.9
-292.0	102.4	-192.0	-51.0	-122.0	26.5	172.0	-26.1
-293.0	103.5	-193.0	-52.9	-123.0	27.5	173.0	-26.3
-294.0	104.6	-194.0	-54.7	-124.0	28.6	174.0	-26.5
-295.0	105.6	-195.0	-56.6	-125.0	29.6	175.0	-26.7
-296.0	106.7	-196.0	-58.5	-126.0	30.7	176.0	-26.9
-297.0	107.8	-197.0	-60.4	-127.0	31.7	177.0	-27.1
-298.0	108.9	-198.0	-62.2	-128.0	32.8	178.0	-27.3
-299.0	110.0	-199.0	-64.1	-129.0	33.8	179.0	-27.5
-300.0	111.1	-200.0	-66.0	-130.0	34.9	180.0	-27.7
-301.0	112.2	-201.0	-67.9	-131.0	35.9	181.0	-27.9
-302.0	113.2	-202.0	-69.8	-132.0	37.0	182.0	-28.1
-303.0	114.3	-203.0	-71.6	-133.0	38.0	183.0	-28.3
-304.0	115.4	-204.0	-73.5	-134.0	39.1	184.0	-28.5
-305.0	116.5	-205.0	-75.4	-135.0	40.1	185.0	-28.7
-306.0	117.6	-206.0	-77.3	-136.0	41.2	186.0	-28.9
-307.0	118.7	-207.0	-79.2	-137.0	42.2	187.0	-29.1
-308.0	119.8	-208.0	-81.1	-138.0	43.3	188.0	-29.3
-309.0	120.9	-209.0	-83.0	-139.0	44.3	189.0	-29.5
-310.0	122.0	-210.0	-84.9	-140.0	45.4	190.0	-29.7
-311.0	123.1	-211.0	-86.8	-141.0	46.4	191.0	-29.9
-312.0	124.2	-212.0	-88.7	-142.0	47.5	192.0	-30.1
-313.0	125.3	-213.0	-90.5	-143.0	48.5	193.0	-30.3
-314.0	126.4	-214.0	-92.4	-144.0	49.6	194.0	-30.5
-315.0	127.5	-215.0	-94.3	-145.0	50.7	195.0	-30.7
-316.0	128.6	-216.0	-96.2	-146.0	51.7	196.0	-30.9
-317.0	129.7	-217.0	-98.1	-147.0	52.8	197.0	-31.0
-318.0	130.8	-218.0	-100.0	-148.0	53.8	198.0	-31.2
-319.0	131.9	-219.0	-101.9	-149.0	54.9	199.0	-31.4
-320.0	133.0	-220.0	-103.8	-150.0	55.9	200.0	-31.6
-321.0	134.1	-221.0	-105.7	-151.0	57.0	201.0	-31.8
-322.0	135.3	-222.0	-107.7	-152.0	58.1	202.0	-32.0
-323.0	136.4	-223.0	-109.6	-153.0	59.1	203.0	-32.2

CSI BACKUP TABLE
NOMINAL ASCENT



TIG TPI ___:___:___

- TIG CSI ___:___:___

ΔT ___:___:___

- NOM ΔT 1: 36:58

ΔΔT ___:___

ΔΔVCSI

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RDOT	X1	Z1	X2	Z2	X3	Z3
-50.0	67.3	254.8	-17.2	-193.9	-50.2	-60.7
-51.0	67.6	253.9	-17.5	-191.8	-50.3	-62.0
-52.0	68.0	253.0	-17.8	-189.6	-50.3	-63.2
-53.0	68.3	252.0	-18.2	-187.5	-50.3	-64.4
-54.0	68.7	251.1	-18.5	-185.4	-50.3	-65.6
-55.0	69.0	250.2	-18.9	-183.2	-50.3	-66.8
-56.0	69.4	249.3	-19.2	-181.1	-50.3	-68.0
-57.0	69.7	248.3	-19.5	-179.0	-50.3	-69.2
-58.0	70.1	247.4	-19.9	-176.8	-50.3	-70.5
-59.0	70.4	246.5	-20.2	-174.7	-50.3	-71.7
-60.0	70.8	245.6	-20.5	-172.5	-50.4	-72.9
-61.0	71.1	244.6	-20.9	-170.4	-50.4	-74.1
-62.0	71.5	243.7	-21.2	-168.3	-50.4	-75.3
-63.0	71.8	242.8	-21.6	-166.1	-50.4	-76.5
-64.0	72.2	241.9	-21.9	-164.0	-50.4	-77.7
-65.0	72.5	240.9	-22.2	-161.8	-50.4	-78.9
-66.0	72.9	240.0	-22.6	-159.7	-50.4	-80.2
-67.0	73.2	239.1	-22.9	-157.5	-50.5	-81.4
-68.0	73.6	238.1	-23.2	-155.4	-50.5	-82.6
-69.0	73.9	237.2	-23.6	-153.2	-50.5	-83.8
-70.0	74.3	236.3	-23.9	-151.1	-50.5	-85.0
-71.0	74.6	235.3	-24.3	-149.0	-50.5	-86.2
-72.0	75.0	234.4	-24.6	-146.8	-50.5	-87.4
-73.0	75.3	233.5	-24.9	-144.7	-50.6	-88.6
-74.0	75.7	232.5	-25.3	-142.5	-50.6	-89.8
-75.0	76.0	231.6	-25.6	-140.4	-50.6	-91.1
-76.0	76.4	230.6	-25.9	-138.2	-50.6	-92.3
-77.0	76.7	229.7	-26.3	-136.1	-50.6	-93.5
-78.0	77.1	228.8	-26.6	-133.9	-50.6	-94.7
-79.0	77.4	227.8	-26.9	-131.8	-50.7	-95.9
-80.0	77.8	226.9	-27.3	-129.6	-50.7	-97.1
-81.0	78.1	225.9	-27.6	-127.5	-50.7	-98.3
-82.0	78.5	225.0	-27.9	-125.3	-50.7	-99.5
-83.0	78.8	224.1	-28.3	-123.2	-50.7	-100.7
-84.0	79.2	223.1	-28.6	-121.0	-50.8	-102.0
-85.0	79.5	222.2	-28.9	-118.9	-50.8	-103.2
-86.0	79.9	221.2	-29.3	-116.7	-50.8	-104.4
-87.0	80.2	220.3	-29.6	-114.6	-50.8	-105.6
-88.0	80.6	219.3	-29.9	-112.4	-50.8	-106.8
-89.0	80.9	218.4	-30.3	-110.2	-50.9	-108.0
-90.0	81.3	217.4	-30.6	-108.1	-50.9	-109.2
-91.0	81.6	216.5	-30.9	-105.9	-50.9	-110.4
-92.0	82.0	215.5	-31.3	-103.8	-50.9	-111.6
-93.0	82.3	214.6	-31.6	-101.6	-50.9	-112.9

CDH BACKUP TABLE
NOMINAL ASCENT

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RDOT	X1	Z1	X2	Z2	X3	Z3
-93.0	82.3	214.6	-31.6	-101.6	-50.9	-112.9
-94.0	82.7	213.6	-31.9	-99.5	-51.0	-114.1
-95.0	83.0	212.7	-32.3	-97.3	-51.0	-115.3
-96.0	83.4	211.7	-32.6	-95.1	-51.0	-116.5
-97.0	83.7	210.8	-32.9	-93.0	-51.0	-117.7
-98.0	84.1	209.8	-33.3	-90.8	-51.0	-118.9
-99.0	84.5	208.9	-33.6	-88.7	-51.1	-120.1
-100.0	84.8	207.9	-33.9	-86.5	-51.1	-121.3
-101.0	85.2	207.0	-34.2	-84.3	-51.1	-122.5
-102.0	85.5	206.0	-34.6	-82.2	-51.1	-123.7
-103.0	85.9	205.1	-34.9	-80.0	-51.2	-125.0
-104.0	86.2	204.1	-35.2	-77.8	-51.2	-126.2
-105.0	86.6	203.1	-35.6	-75.7	-51.2	-127.4
-106.0	86.9	202.2	-35.9	-73.5	-51.2	-128.6
-107.0	87.3	201.2	-36.2	-71.4	-51.3	-129.8
-108.0	87.6	200.3	-36.6	-69.2	-51.3	-131.0
-109.0	88.0	199.3	-36.9	-67.0	-51.3	-132.2
-110.0	88.3	198.3	-37.2	-64.9	-51.3	-133.4
-111.0	88.7	197.4	-37.5	-62.7	-51.4	-134.6
-112.0	89.1	196.4	-37.9	-60.5	-51.4	-135.8
-113.0	89.4	195.5	-38.2	-58.4	-51.4	-137.0
-114.0	89.8	194.5	-38.5	-56.2	-51.4	-138.3
-115.0	90.1	193.5	-38.9	-54.0	-51.5	-139.5
-116.0	90.5	192.6	-39.2	-51.8	-51.5	-140.7
-117.0	90.8	191.6	-39.5	-49.7	-51.5	-141.9
-118.0	91.2	190.6	-39.8	-47.5	-51.6	-143.1
-119.0	91.5	189.7	-40.2	-45.3	-51.6	-144.3
-120.0	91.9	188.7	-40.5	-43.2	-51.6	-145.5
-121.0	92.2	187.7	-40.8	-41.0	-51.6	-146.7
-122.0	92.6	186.8	-41.2	-38.8	-51.7	-147.9
-123.0	93.0	185.8	-41.5	-36.6	-51.7	-149.1
-124.0	93.3	184.8	-41.8	-34.5	-51.7	-150.3
-125.0	93.7	183.8	-42.1	-32.3	-51.7	-151.5
-126.0	94.0	182.9	-42.5	-30.1	-51.8	-152.8
-127.0	94.4	181.9	-42.8	-27.9	-51.8	-154.0
-128.0	94.7	180.9	-43.1	-25.8	-51.8	-155.2
-129.0	95.1	180.0	-43.4	-23.6	-51.9	-156.4
-130.0	95.4	179.0	-43.8	-21.4	-51.9	-157.6
-131.0	95.8	178.0	-44.1	-19.2	-51.9	-158.8
-132.0	96.2	177.0	-44.4	-17.1	-52.0	-160.0
-133.0	96.5	176.0	-44.7	-14.9	-52.0	-161.2
-134.0	96.9	175.1	-45.1	-12.7	-52.0	-162.4
-135.0	97.2	174.1	-45.4	-10.5	-52.1	-163.6
-136.0	97.6	173.1	-45.7	-8.3	-52.1	-164.8

CDH BACKUP TABLE
NOMINAL ASCENT

TIME (MIN)		NOMINAL	DSKY>TM
-36	R1	(-118.0)	-.6
-23	R2	(-118.0)	-.6
-10	R3	(-118.0)	-.6
ΔVX:	X1	(91.2)	
	+X2	(- 39.8)	
		(51.4)	
	+X3	(- 51.6)	
	ΔVX(LV)	(- 0.2)	
ΔVZ:	Z1	(190.6)	
	+Z2	(- 47.5)	
		(143.1)	
	+Z3	(-143.1)	
	ΔVZ(LV)	(0.0)	

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