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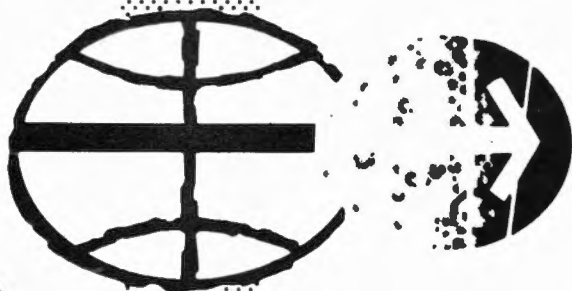
MSC INTERNAL NOTE NO. 05183

LM RENDEZVOUS PROCEDURES

J-2 & J-3 MISSIONS

FINAL
REVISION 1

MARCH 16, 1972



MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

LM RENDEZVOUS PROCEDURES
J-2 AND J-3 MISSIONS
AS-511/CSM-113/LM-11
AS-512/CSM-114/LM-12
16 MARCH 1972

REVISION 1

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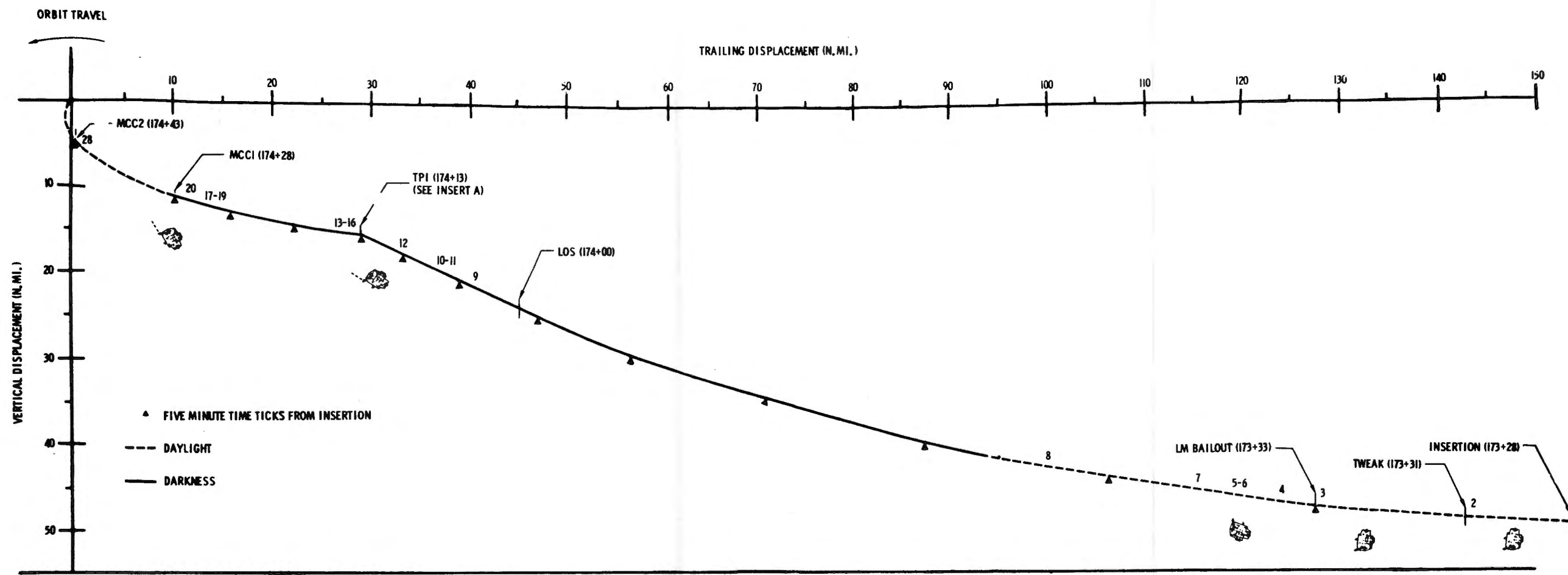
ACKNOWLEDGMENTS

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The HAM chart, CSI bias chart and PDI summary data were prepared by the Mission Planning and Analysis Division.

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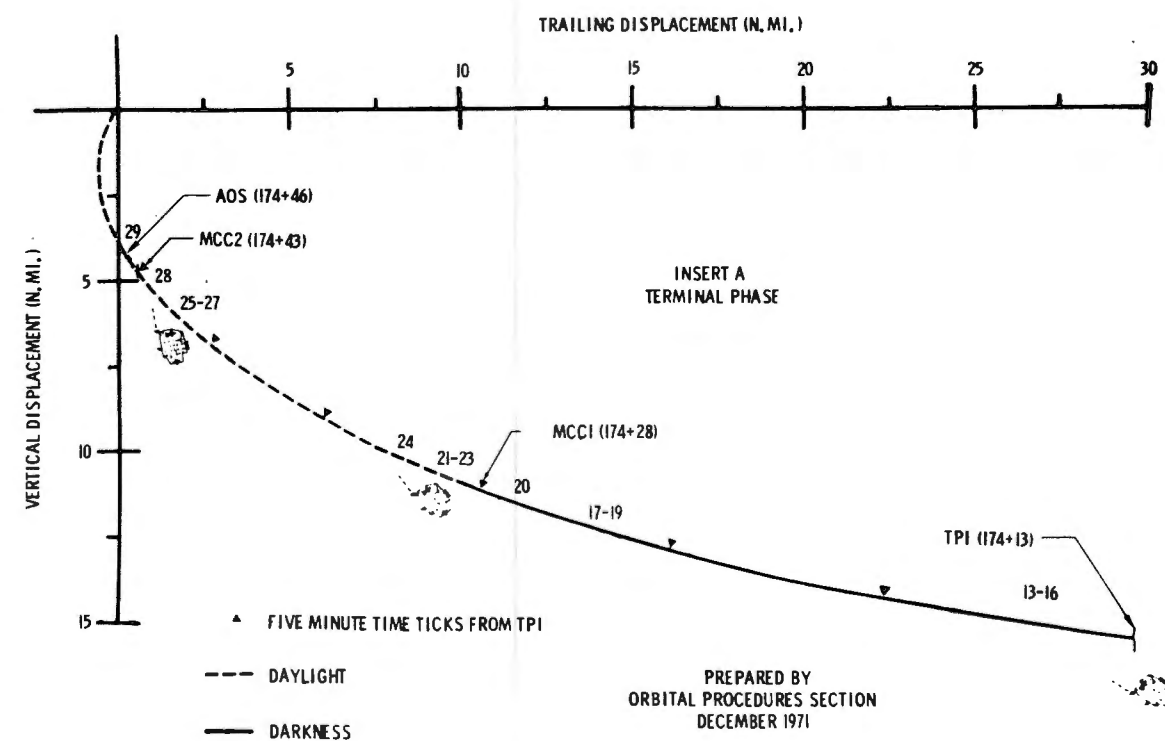


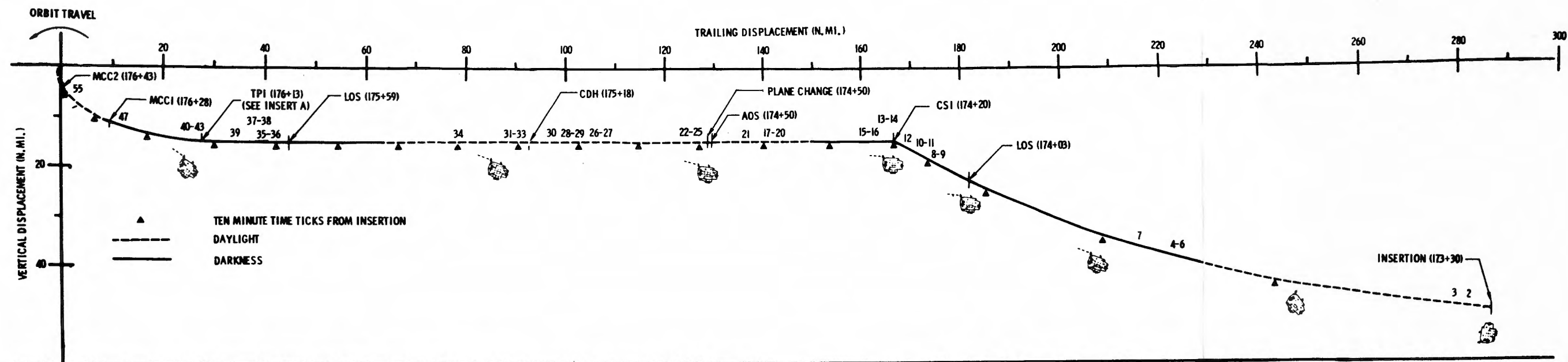
LM MAJOR EVENTS

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

*ONLY IF AGS DISAGREES WITH CRITERIA

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



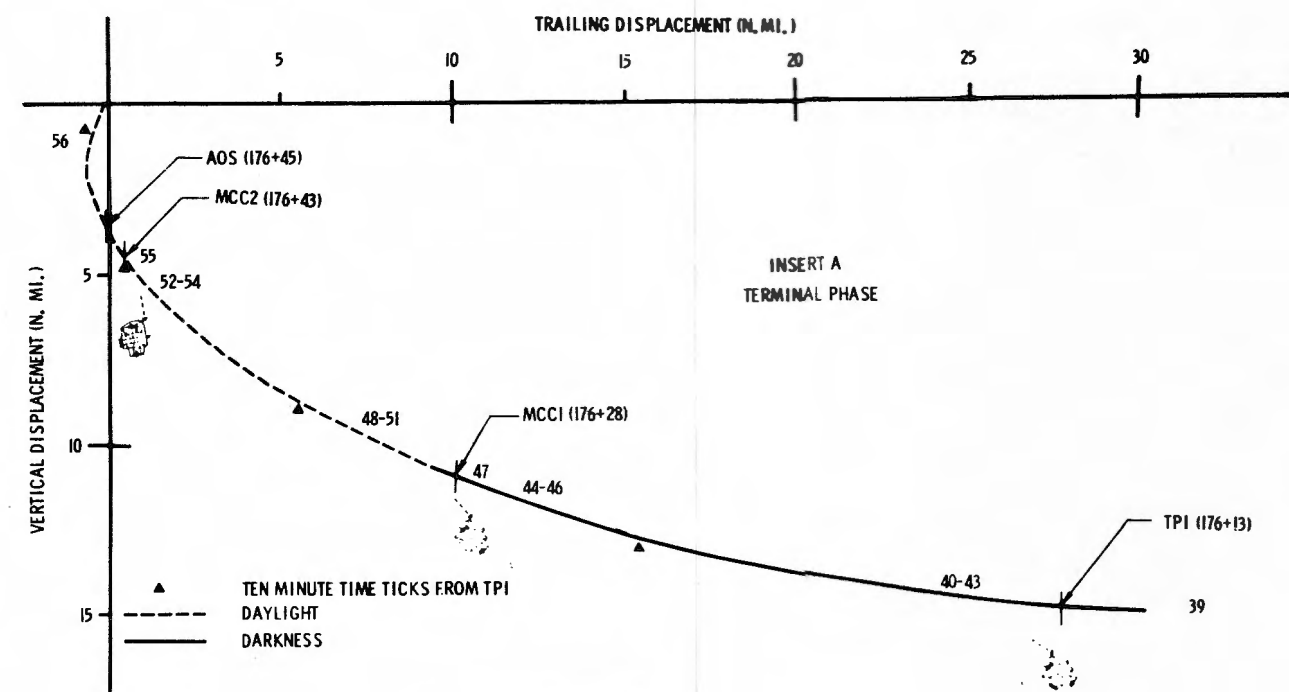


LM MAJOR EVENTS

GROUND ELAPSED TIME	EVENT	GROUND ELAPSED TIME	EVENT
1. 173+30	INSERTION	29. 175+10	AGS FINAL CDH COMP
2. 173+32	AGS TARGET CS1	30. 175+12	CDH THRUSTING MANEUVER (P4I)
3. 173+33	IMU REFSMMAT ALIGN (P52)	31. 175+20	TARGET TPI (PGNS P34 AND AGS)
4. 173+46	INITIATE RR NAVIGATION (P20)	32. 175+20	REINITIALIZE W-MATRIX (V93)
5. 173+46	PGNS TARGET CS1 (P32)	33. 175+20	RESUME RR NAVIGATION
6. 173+46	AGS UPDATE AND ALIGN *	34. 175+30	RESUME AGS RADAR UPDATES
7. 173+48	INITIATE AGS RADAR UPDATES	35. 176+02	TERMINATE RR NAVIGATION (24 MARKS)
8. 174+10	TERMINATE RR NAVIGATION (23 MARKS)	36. 176+02	PGNS FINAL TPI COMP
9. 174+10	PGNS FINAL CS1 COMP	37. 176+03	TERMINATE AGS RADAR UPDATES (12 UPDATES)
10. 174+11	TERMINATE AGS RADAR UPDATES (9 UPDATES)	38. 176+03	AGS FINAL TPI SEARCH COMP
11. 174+12	AGS FINAL CS1 COMP	39. 176+07	TPI THRUSTING MANEUVER (P4I)
12. 174+13	CS1 THRUSTING MANEUVER (P4I)	40. 176+13	TARGET MCC1 (PGNS P35 AND AGS)
13. 174+21	TARGET CDH (PGNS P33 AND AGS)	41. 176+13	REINITIALIZE W-MATRIX (V93)
14. 174+21	INITIALIZE W-MATRIX	42. 176+14	RESUME RR NAVIGATION
15. 174+23	RESUME RR NAVIGATION	43. 176+14	RESUME AGS RADAR UPDATES
16. 174+24	RESUME AGS RADAR UPDATES	44. 176+24	TERMINATE RR NAVIGATION (9 MARKS)
17. 174+38	TERMINATE RR NAVIGATION (17 MARKS)	45. 176+24	TERMINATE AGS RADAR UPDATES (6 UPDATES)
18. 174+39	TERMINATE AGS RADAR UPDATES (7 UPDATES)	46. 176+24	PGNS AND AGS FINAL MCC1 COMP
19. 174+40	EXTERNAL ΔV FOR PLANE CHANGE (P30)	47. 176+26	MCC1 THRUSTING MANEUVER (P4I)
20. 174+40	OBTAIN CSM Y DOT FOR PLANE CHANGE	48. 176+28	TARGET MCC2 (PGNS P35 AND AGS)
21. 174+42	RCS PLANE CHANGE MANEUVER (P4I)	49. 176+28	REINITIALIZE W-MATRIX (V93)
22. 174+50	TARGET CDH (PGNS P33 AND AGS)	50. 176+28	RESUME RR NAVIGATION
23. 174+50	RESUME RR NAVIGATION	51. 176+29	RESUME AGS RADAR UPDATES
24. 174+50	REINITIALIZE W-MATRIX (V93)	52. 176+39	TERMINATE RR NAVIGATION (9 MARKS)
25. 174+50	RESUME AGS RADAR UPDATES	53. 176+39	TERMINATE AGS RADAR UPDATES (6 UPDATES)
26. 175+08	TERMINATE RR NAVIGATION (15 MARKS)	54. 176+39	PGNS AND AGS FINAL MCC2 COMP
27. 175+08	PGNS FINAL CDH COMP	55. 176+41	MCC2 THRUSTING MANEUVER (P4I)
28. 175+09	TERMINATE AGS RADAR UPDATES (7 UPDATES)	56. 176+45	BRAKING (P47)

*ONLY IF AGS DISAGREES WITH CRITERIA

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

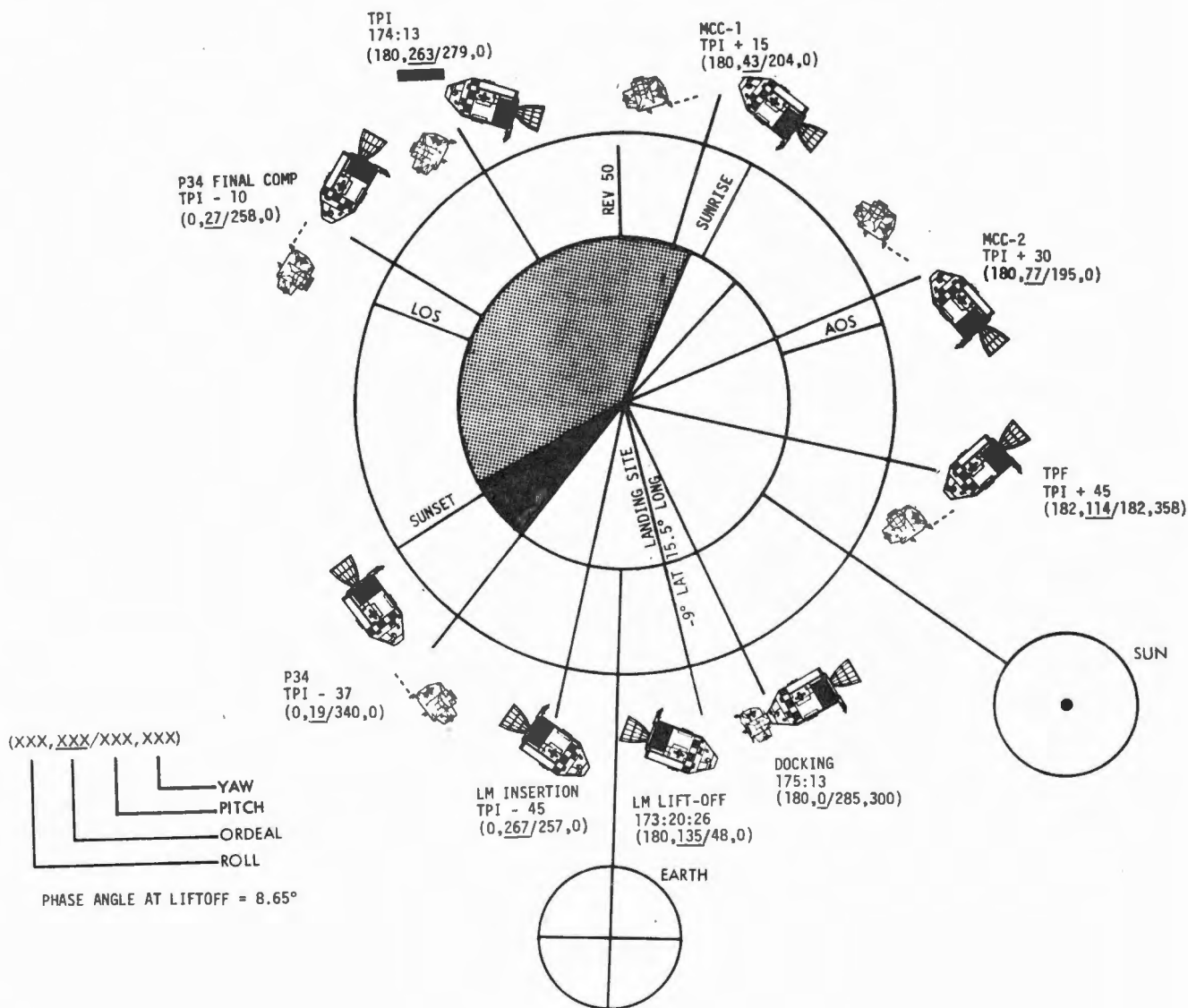
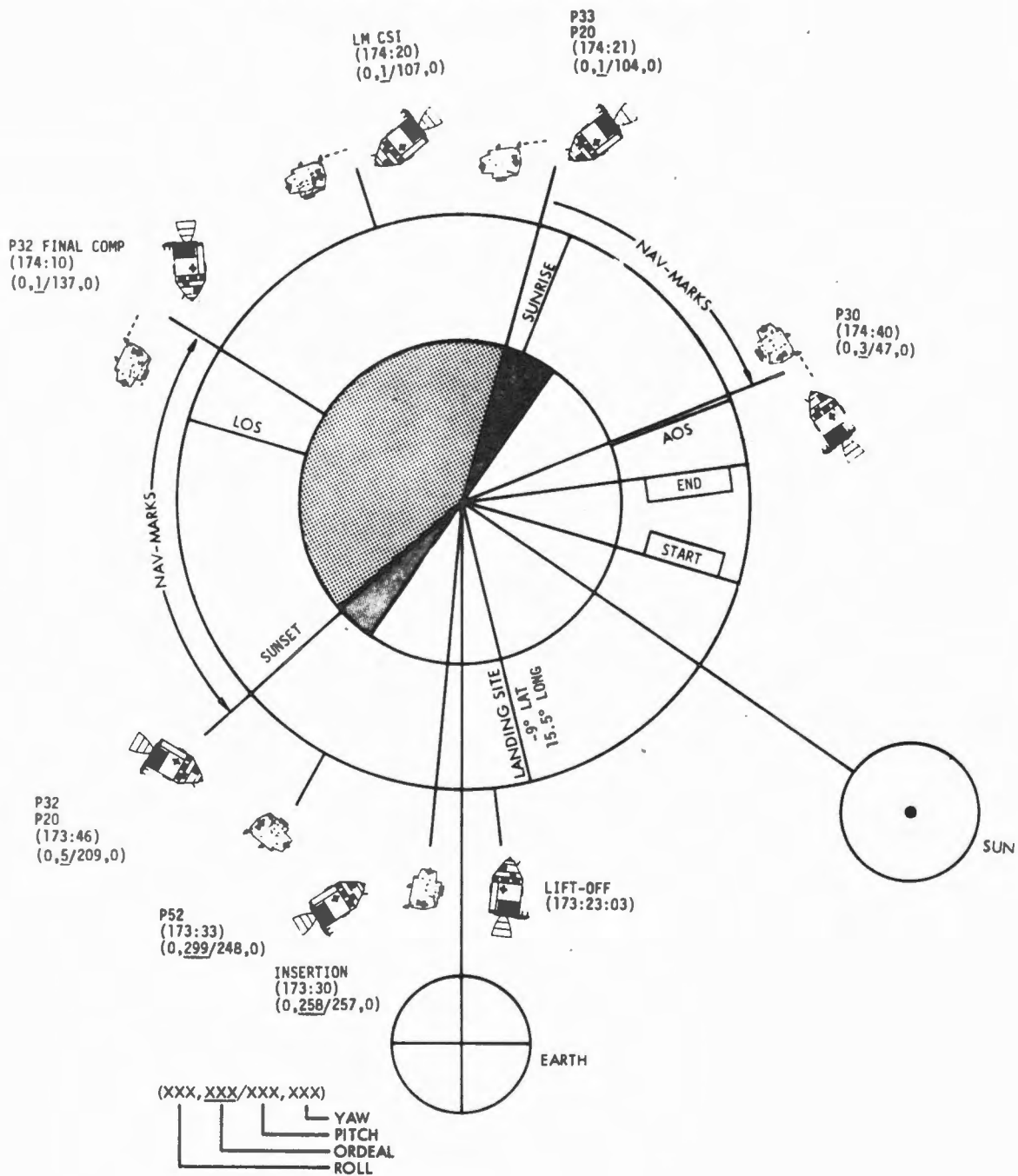


FIGURE 2-3

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



PHASE ANGLE AT LIFTOFF = 16.62°

FIGURE 2-4

3.0 DISCUSSION OF MAJOR EVENTS

3.1 LM Active Aborts

All particular abort cases that could occur during powered descent may be divided into two groups depending on whether, after aborting, the LM subsequently inserts behind or in front of the CSM. If the LM inserts into less than a 60 n mi orbit, the ensuing rendezvous is called a Catch-up, and if it inserts into higher than a 60 n mi orbit, the rendezvous is called a Fall-back.

These two groups may in turn be further subdivided depending on how far behind or ahead the LM inserts. In particular, the subgroup depends on the number of LM revolutions that elapse before the nominal post CDH conditions are obtained.

All two revolution cases involve the use of a Boost burn and HAM burn before the nominal CSI, CDH, and TPI sequence. The Boost burn is used to ensure that the pericynthion altitude of the LM insertion orbit will be above some minimum acceptable limit.

The burn is canned as follows:

Magnitude:	10 fps
Direction:	+X local horizontal
Time:	INSERTION + 50 min.

The HAM burn is used to ensure that the conditions following CDH will be the same as in the nominal rendezvous case ($\Delta H = 15$ n mi). The burn is defined as follows:

Magnitude:	Variable (see HAM Chart)
Direction:	$\pm X$ local horizontal
Time:	INSERTION + 1:50 (hr:min)

All one revolution abort cases are similar to the nominal coelliptic rendezvous as regards the number of burns required and their chronological sequencing. The magnitude of the CDH burn however, will usually be significantly different between aborts.

Using the above classification scheme, Apollo 16 and 17 LM active aborts may be further divided as follows:

3.1.1 A One Revolution Catch-up

- a) $\sim 9 < \text{PDI } 1 \leq 10:16$
- b) $\sim 14 \leq \text{PDI } 2 \leq 15:30$

3.1.2 A Two Revolution Catch-up

- a) $10:16 < \text{PDI } 1 \leq 17:30$
- b) $\text{T2-2 (PDI } 2 + 21:44 \text{ min:sec)}$

3.1.3 A Three Revolution Catch-up

- a) $\text{T2-1 (PDI } 1 + 24:17 \text{ min:sec)}$

3.1.4 A One Revolution Fall-back

- a) $\sim 1 < \text{PDI } 1 \leq 9$
- b) $\sim 6:20 < \text{PDI } 2 < 14$
- c) $\text{NO PDI } 1 + 12$

3.1.5 A Two Revolution Fall-back

- a) $\text{NO PDI } 2 + 12$
- b) $\sim 1 \leq \text{PDI } 2 \leq 6:20$

The assumptions used in developing the rendezvous procedures for these abort cases are as follows:

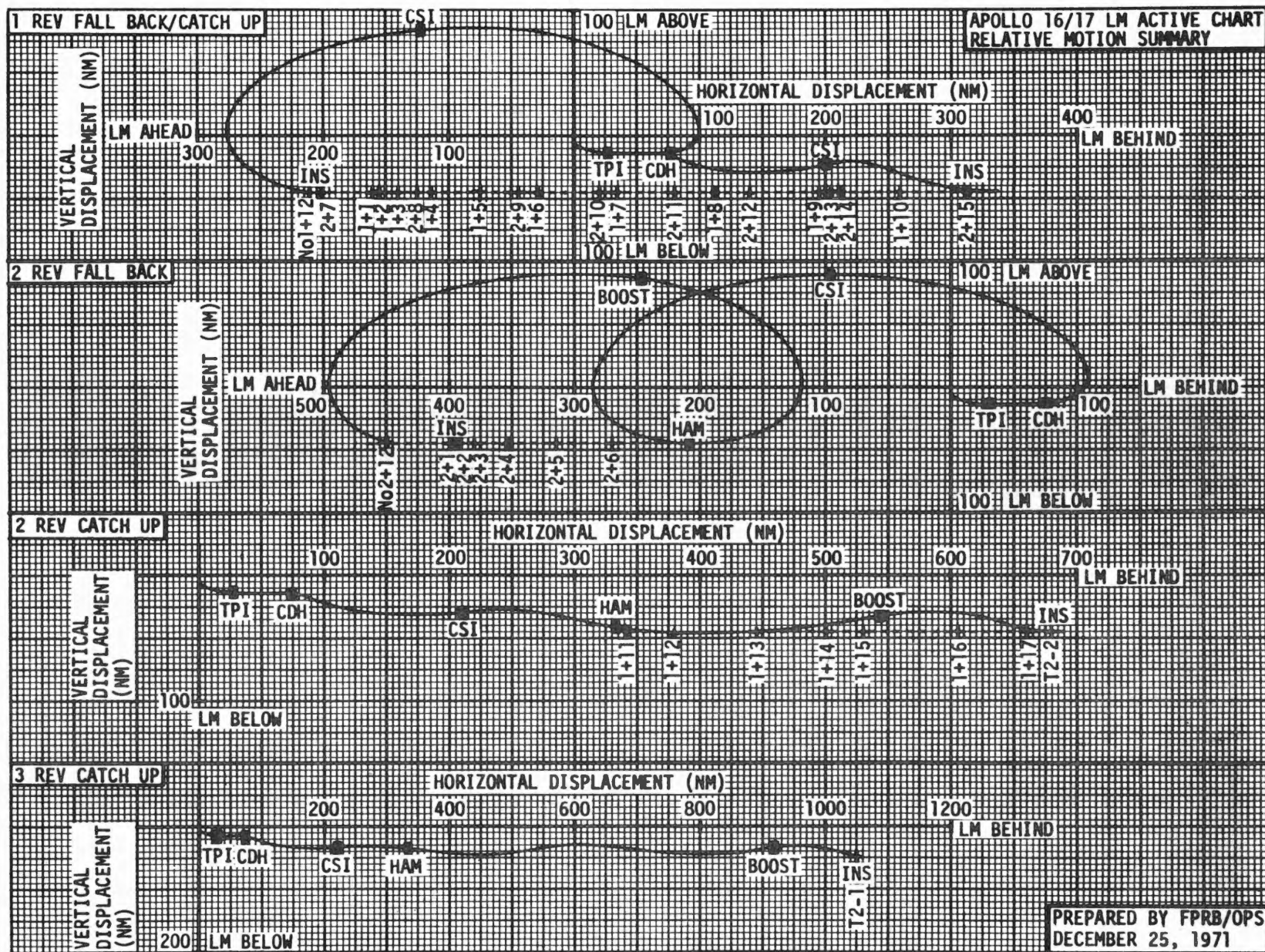
- a) The DPS will not be staged until TPI for the NO PDI 1 or 2 + 12 abort cases unless the DPS engine cannot be fired.
- b) The DPS will not be staged until CSI for the PDI 1 or 2 early abort cases.
- c) There will be no plane change required for the NO PDI 1 or 2 + 12 abort cases.

See Figure 3-1 for a summary of the relative motion plots for the above mentioned cases.

3.2 Abort Initiate Maneuver (AIM) Burn

For the NO PDI 1 or 2 + 12 abort cases, Program P30 will be loaded with the targeting parameters for the AIM burn which will be accomplished in either P40 or P42 depending upon whether or not the DPS is available for the burn. Just prior to entering the burn program, the AGS will be updated and aligned to the PGNS. If the DPS is inoperative, then the DAP will be configured to the ascent stage, staging will be performed, and the AIM burn will be accomplished with the APS engine. For the staged configuration, rendezvous for the NO PDI 1 + 12 abort case will follow the nominal coelliptic procedures for a one revolution; the NO PDI 2 + 12 abort case will follow the two revolution procedures established for the PDI 2 early aborts.

FIGURE 3-1



3.3 Boost Burn

Following the AIM burn or orbit insertion for the PDI 1 (12-17), PDI 2 (1-6), T2-1 or T2-2 aborts, the LM commander will perform an IMU realign to REFSMMAT (P52) to remove any alignment errors that may affect subsequent rendezvous navigation.

Following the alignment, the AGS is updated and aligned to the PGNS. At Boost minus 9 minutes, Program P30 is loaded with the canned +10 FPS delta V and the burn is then accomplished in P41.

3.4 Height Adjust Maneuver (HAM BURN)

As soon after the Boost burn as possible, when the range to the CSM is less than 400 n mi., the digital autopilot is configured to the burn deadband (1.0°), Program P20 is called, and an automatic pitch maneuver is initiated to the preferred track attitude. A period of rendezvous radar marking and AGS updates will then take place until 10 minutes prior to the burn, at which time a final comp will be done to obtain delta H, which is used in conjunction with the HAM chart to find the required targeting for the HAM burn. In order to assure the HAM Chart solution is correct, a comparison is made of the LGC and CMC solutions using the CSI Bias Chart. The targeting is then loaded into Program P30 and P41 is called. The AGS is then targeted in external delta V and the burn is executed as a +X translation.

3.5 Concentric Sequence Initiation (CSI)

Following the AIM burn for the NO PDI 1 +12 abort; the HAM burn; or orbit insertion for the PDI 1 (1-11), PDI 2 (7-15) or the nominal coelliptic rendezvous; MCC-H will uplink to the CSM the LM telemetry state vector. After entering darkness, the LM commander will perform an IMU realign to REFSMMAT (P52) to remove any additional alignment errors that may affect subsequent rendezvous navigation.

The digital autopilot is configured to wide deadband, Program P20 is called, and an automatic pitch maneuver is initiated to the preferred track attitude. At 173:46*, CSI targeting parameters are loaded in the PGNS. A period of rendezvous radar marking and AGS updates will then take place for 173:48 to 174:11. Upon completion of tracking the LM will obtain an out-of-plane component of the CSI delta V. The CSM's estimate of out-of-plane velocity with sextant is alleged to be better than the LM's estimate.

* All of the times presented here for the coelliptic rendezvous are referenced to the Apollo 16 nominal coelliptic sequence and are based upon a lunar lift-off time of 173:23:03 and insertion time of 173:30.

At approximately 174:13 the LM will voice its CSI solution to the CSM and the AGS is targeted in external delta V with its CSI solution to be executed. Program P40 or P41 will then be called depending upon whether or not the DPS is attached. For those cases where the burn will be executed with Z-axis thrusting, the pitch maneuver will be bypassed. All other cases will require a maneuver to the burn attitude. For the PDI 1 or 2 (1-5) abort cases, the DPS will be staged at the initiation of the burn. The CSI burn occurs nominally at 174:20. After verification of the LM CSI burn, the CSM will incorporate the LM burn parameters in its CMC LM state vector.

3.6 Constant Delta Height and Plane Change (CDH)

At 174:21 approximately two minutes after the LM CSI burn, the W-matrix will be set to 2000,20,5 and the LM targeting parameters are loaded in both the PGNS and AGS for the CDH maneuver. The out-of-plane velocity will then be computed and voiced to the LM from the CSM. Program P30 is loaded with the targeting parameters for the LM Plane Change (PC) maneuver which will be accomplished in Program P41, 30 minutes prior to the CDH maneuver. Following the PC burn, the target delta V parameters are voiced to the CSM and incorporated into the CMC LM state vector. At 174:50, targeting parameters are loaded in both the PGNS and AGS for the CDH burn which nominally occurs at 175:18. Ten minutes prior to CDH TIG, a chart solution is calculated and five minutes later, the AGS is targeted in external delta V with its CDH solution to be executed. The thrust program called for the CDH burn will be either P40, 41 or 42 depending upon whether the burn will be done with the DPS, RCS, or APS engines. The APS engine is selected for those aborts where the DPS is staged and the VG is greater than 40 FPS. For those cases where the burn is accomplished by the DPS or APS, the rendezvous radar will lose lock and will require a vehicle maneuver at the initiation of TPI navigation.

3.7 Terminal Phase Initiation (TPI) for the Coelliptic Rendezvous

Radar tracking is initiated after the CDH maneuver and updating of the LGC continued. At 175:20, approximately two minutes after the LM CDH burn, targeting parameters are loaded in both the PGNS and AGS for the TPI maneuver which will be targeted for a node at intercept. Backup measurements are made at the appropriate times. The AGS is targeted in external delta V with its TPI solution to be executed. The RCS Thrust Program, P41, is called at 176:07 and the burn attitude is normally bypassed since the LM is burning along the plus Z-axis with the thrust

direction established by resolving all delta V components into the third register. For those cases where the DPS will be staged, the burn is accomplished along the +X axis and staging occurs at the onset of the burn.

3.8 Terminal Phase Initiation (TPI) for the Direct Rendezvous

Following orbit insertion, Program P47 is called to monitor the TWEAK burn which occurs at 173:31. If a LM bailout is required, then the bailout burn is performed at 173:33 and rendezvous is continued as a nominal coelliptic sequence.

The LM is then maneuvered to the tracking attitude and Program P20 is called to initiate rendezvous radar tracking. The AGS is then updated and aligned to the PGNS only if required, followed by a period of radar tracking and backup AGS radar updating. At 174:08 the APS Thrust Program P42 is called and the LM is maneuvered to the burn attitude. The AGS is then targeted in external delta V with its TPI solution to be executed at the nominal burn time of 174:13.

3.9 Midcourse Corrections

Immediately after TPI, the Midcourse Prethrust Program, P35, will be called and radar tracking reinitiated. Backup measurements are made and midcourse correction chart solutions obtained. The MCC1 burn will nominally be performed at TPI plus 15 minutes. If MCC1 is to be executed, Program P41 will be called and the burn attitude maneuver bypassed since the plus Z-axis will remain boresighted to the CSM until docking.

Following MCC1, Program P35 will be called and targeted for MCC2 at TPI plus 30 minutes and executed identically to MCC1.

3.10 Braking

In preparation for braking, the DAP is configured to narrow dead-band (0.3°). Program P20 is terminated at 18,000 feet but the radar is kept in auto track to provide radar range and range rate displayed on the tapemeter. Average "G" is called by Program P47 prior to braking, and attitude hold is selected. The braking schedule followed is presented in Section 4.

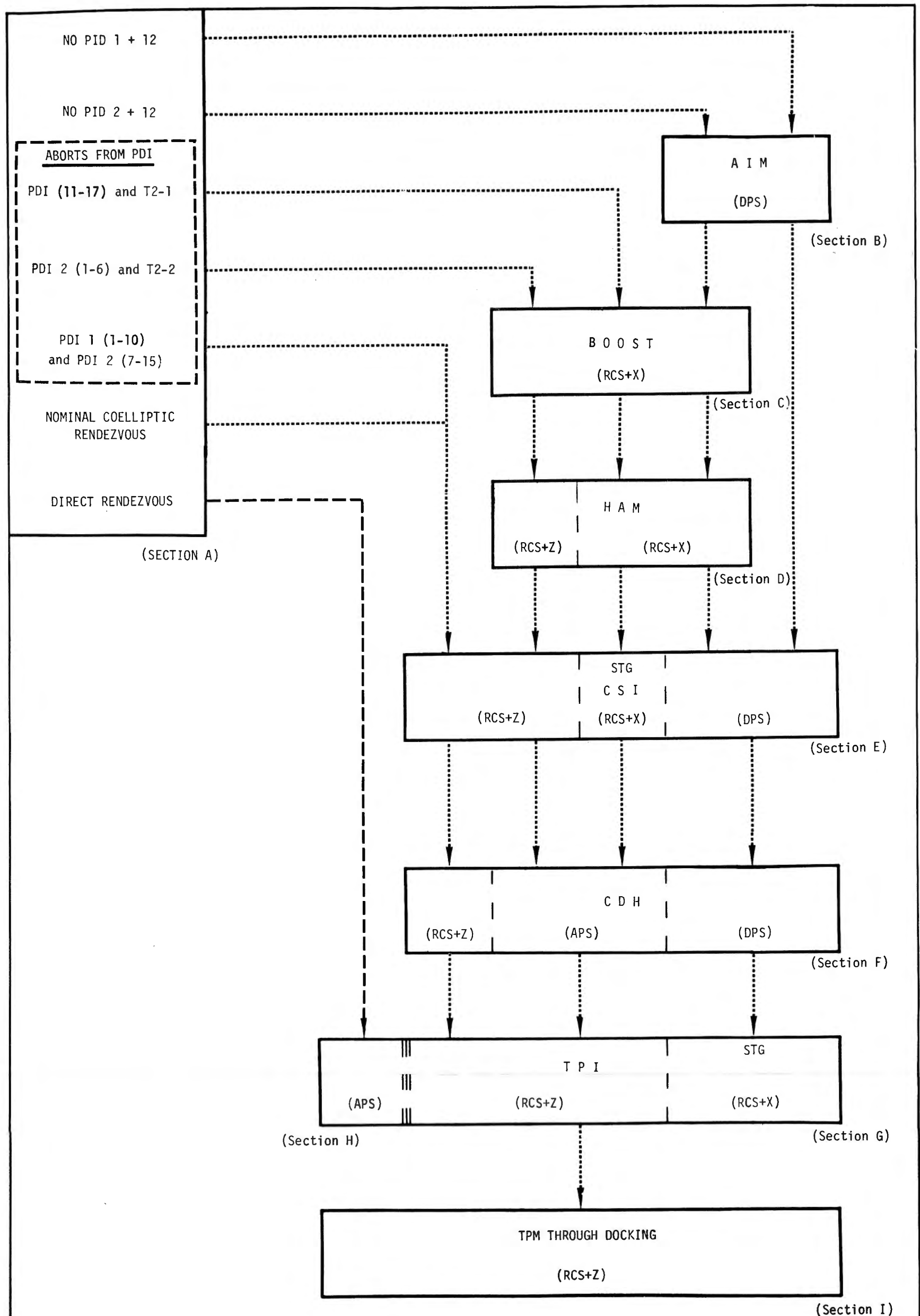


FIGURE 4-1
PROCEDURES SEQUENCE

* P R O C E D U R E I N I T I A T I O N *

 * NO PDI 1 OR 2 PLUS 12 ABORT *

* * ASSUMPTIONS AT PDI POINT * *

NOMINAL PGNS (AGS IN FOLLOW-UP)	PGNS FAILURE (AGS IN CONTROL)
1 RNDZ RDR NOT LOCKED ON	*
2 LGC IN P63	PGNS FAIL BEFORE PDI
3 PROPER DAP LOAD (22112)	
4 AGS TARGETING	
*410+0 ORBIT INSERTION	*
*507+0 Z-AXIS BORESIGHT	*
*400+1 GUIDANCE STEERING	*
5 SWITCH CONFIGURATIONS	
ABORT PB - RESET	*
ABORT/STAGE PB - RESET	*
AGS MODE CONT - AUTO	*
ACA/4 JET - ENABLE (CDR)	*
ACA/4 JET - ENABLE (LMP)	*
ACA PROP SW - ENABLE	*
ATT CONT (3) - MODE	*
ATTITUDE MON - PGNS (CDR)	ATTITUDE MON - AGS (CDR)
ATTITUDE MON - AGS (LMP)	*
AUDIO VHF A - T/R	*
AUDIO VHF B - RCV	*
BAL CPL - ON	*
CB AC BUS A RR - OPEN	*
CB LR - CLOSE	*
CB/PGNS IMU OPR - CLOSE	*
CB PGNS RNDZ RDR - OPEN	*
DEADBAND - MIN	*
DES ENG CMD OVRD - ON	*
ENG ARM - DES	*
ENG STOP PB - RESET	*
GUID CONTROL - PGNS	GUID CONT - AGS
MASTER ARM - ON (+5 SEC OFF)	*
MODE SEL - PGNS	MODE SEL - AGS

SWITCH CONFIGURATIONS (CONTINUED)

PGNS MODE CONT - AUTO
 PRPLNT QTY MON - DES 1
 RR MODE - SLEW
 RANGE ALT MON - ALT/ALT RT
 RATE ERR MON - CMPTR (CDR AND LMP)
 RATE SCALE - 25 DEG/SEC
 SHFT/TRUN - +- 5 DEG
 SLEW RATE - LO
 THROT/JET - THROT (CDR AND LMP)
 TTCA TRANSL - ENABLE (CDR)
 TTCA TRANSL - ENABLE (LMP)
 VHF A XMTR - VOICE
 VHF B RCVR - ON

PGNS MODE CONT - ATT HOLD

*
 *
 *
 *
 *
 *
 *
 *
 *
 *
 *

6 DESCENT STAGE TO BE SEPARATED AT TPI

* * * CONFIGURATION PROCEDURES FOR THE AIM BURN * * *

NOMINAL PGNS
 (AGS IN FOLLOW-UP)

PGNS FAILURE
 (AGS IN CONTROL)

AGS MODE CONT - ATT HOLD
 DES ENG CMD OVRD - OFF
 RATE SCALE - 5 DEG/SEC
 THROT/JET - JET (LMP)

*
 *
 *
 *

 * CONTINUE NO PDI 1 OR 2 + 12 ABORT PROCEDURES ON PAGE B 1 *

 * AIM BURN PROCEDURES WITH FAILED DPS (APS BURN) *

KEY V37E42E (APS THRUSTING)

F 05 09 01706 LM NOT STAGED
 PRO
 F 50 18 FDAI ANGLES (REQUEST MNVR)
 PRO (AUTO MNVR)
 F 50 18 FDAI ANGLES (MNVR COMPLETE)
 ENTR (BYPASS MNVR)
 06 40 TFI VG DELTA VM

KEY N86E

06 86 DELTA V'S - LV

-5 *616+00005 ULLAGE COUNTER LIMIT *
 *410+5 EXTERNAL DELTA V *
 (LOAD SOLUTION TO BE EXECUTED) *
 *450 451 452 LOAD *

CB AELD (2) - CLOSE *
 THROT/JET - JET (CDR) *
 PRPLNT QTY MON - OFF *

T R A N S I T I O N
AT -1:00 AGS MODE CONT - AUTO



ATT CONT(3) - PULSE
 AGS MODE CONT - AUTO
 NULL ERR SIG WITH PULSE
 ATT CONT(3) - MODE

VERIFY SWITCHES PER BURN CARD *

*500R _____ DELTA VX *

TRANSMIT DELTA V'S TO CSM *
 SYNC COUNTDOWN *

-1:00 AGS MODE CONT - AUTO
 MASTER ARM SW - ON *

-:30 ABORT STAGE PB - PUSH *

ENG ARM - ASCENT *

-:10 MANUAL ULLAGE *

STAGE - FIRF *

-:05 F 99 40 ENGINE-ON ENABLE
 PRO

06 40 TFI VG DELTA VM

-:00.0 ENGINE START (AIM BURN)

06 40 TFC VG DELTA VM

MONITOR THRUST

+ :05 ENG ARM - OFF *

MASTER ARM - OFF *

WHEN VG = 0

ABORT STAGE PB - RESET *

ENGINE SHUTDOWN

F 16 40 TFC VG DELTA VM
 PRO

F 16 85 DELTA V'S - BODY

AGS MODE CONT - ATT HOLD

NULL DELTA V'S

VERIFY AGS RESIDUALS *

*500R _____ 501R _____ 502R _____ *

DELTA VX DELTA VY DELTA VZ *

VERIFY PGNS RESIDUALS

AIM(N85)

DELTA VX(LM) _____

DELTA VY(LM) _____

DELTA VZ(LM) _____

PRO

F 37 BB

KEY 00E (P00)

STAGE - RESET *
CB (11) + (16) ED. LOGIC PWR - OPEN *
CABIN REPRESS - CLOSE *
PRESS REG A AND B - EGRESS *
SUIT GAS DIVERter - EGRESS *
CABIN GAS RETURN - EGRESS *

KEY V82E (ORBIT PARAMETERS)

F 04 12 00002 00001

PRO

F 16 44 HA HP TFF

*315R _____ HA

*403R _____ HP

PRO

* CONTINUE NO PDI 1 + 12 ABORT PROCEDURES ON PAGE E 1 *

* CONTINUE NO PDI 2 + 12 ABORT PROCEDURES ON PAGE C 1 *

RATE ERR MON - LDG RDR/CMPTR (CDR)

KEY V37E52E (IMU REALIGN)

F 04 06 00001 00003

CB HEATER AOT - CLOSE

CB AOT LAMP - CLOSE

AOT DETENT - FORWARD

KEY V76E (PGNS PULSE)

PRO

F 50 25 00015 SELECT STAR ACQUISITION MODE

ENTR (TO MANUALLY ACQUIRE)

F 01 70 002DE LOAD 1ST STAR

PRO

F 50 18 FDAI ANGLES (REQUEST MNVR)

PRO (AUTO MNVR)

F 50 18 FDAI ANGLES (MNVR COMPLETE)

ENTR (BYPASS MNVR)

F 01 71 002DE

PGNS MODE CONT - ATT HOLD

PRO

F 54 71 MARK 1ST STAR

PRO

F 01 70 002DE LOAD 2ND STAR

PRO

PGNS MODE CONT - AUTO

F 50 18 FDAI ANGLES (REQUEST MNVR)

PRO (AUTO MNVR)

F 50 18 FDAI ANGLES (MNVR COMPLETE)

ENTR (BYPASS MNVR)

F 01 71 002DE

PGNS MODE CONT-ATT HOLD

PRO

F 54 71 MARK 2ND STAR

PRO

F 06 05 STAR ANGLE DIFFERENCE _____

PRO

F 06 93 GYRO TORQUE ANGLES _____

PRO TO TORQUE / KEY V32E NOT TO TORQUE
F 50 25 00014
PRO
F 50 25 00015 SELECT STAR ACQUISITION MODE

PRO (PICAPAR)
F 01 70 002DE CHECK STAR
PRO

PGNS MODE CONT - AUTO
F 50 18 FDAI ANGLES (REQUEST MNVR)
PRO (AUTO MNVR)
F 50 18 FDAI ANGLES (MNVR COMPLETE)

ENTR (BYPASS MNVR)
F 01 71 002DE

VERIFY ALIGNMENT VIA AOT

DETENT CL
CB AOT LAMP - OPEN

-40 KEY V34E (TERMINATE)
F 37 BB

KEY 00E (P00)

```
*****
* THE FOLLOWING WILL BE PERFORMED ONLY IF *
* REQUIRED *
* *
* *411R +0 (VERIFY NO AUTO UPDATE) *
* *
* KEY V47E (INITIALIZE AGS) *
* F 06 16 GET OF AGS 0 TIME *
* TELEMETRY PCM SW - HI *
* *414+1 UPDATE AGS *
* PRO *
* 06 16 UPDATE IN PROGRESS *
* *414R (00000 COMPLETE) *
* F 50 16 UPDATE COMPLETE *
* PRO *
* *
* *400+3 AGS ALIGN *
* *400R (00000 COMPLETE) *
* *400+2 Z-AXIS STEERING *
*****
```

 * C S I B U R N *

NOMINAL PGNS
 (AGS IN FOLLOW-UP)

PGNS FAILURE
 (AGS IN CONTROL)

 * IF THE AGS AND PGNS AGREE WITHIN 10 FPS, *
 * TRIM TO LESS THAN 2 FPS (AGS, TRIM X-AXIS *
 * ONLY) AND STANDBY FOR TWEAK PARAMETERS *
 * FOR A BURN AT INSERTION + 3 MINUTES. *

AGS MODE CONT-ATT HOLD
 AUDIO MODE - ICS/PTT *
 CB (11) ECS CABIN FAN1 - CLOSE *
 INV 2 CB - CLOSE *
 INV 1 CB - OPEN *
 RATE ERR MON - RNDZ RDR (LMP) *
 RR MODE - LGC *
 SELECT INV 2 *
 SEQUENCE CAMERA - OFF *
 VHF ANT - FWD *
 X POINTER (BOTH) - LO MULT *

 * ASC ONLY *

 *
 * CB (11) + (16) ED. LOGIC PWR - OPEN *
 *
 * *616+00005 ULLAGE COUNTER LIMIT *
 *

*623+0 Z-AXIS PARALLEL TO CSM ORBIT *
 *275+XXXX.X TPI TIME *
 *416+1 (ONE-HALF ORBITAL PERIOD) *
 *605+00777 COT LOS TO CSM *

 * C S I B U R N *

NOMINAL PGNS
 (AGS IN FOLLOW-UP)

PGNS FAILURE
 (AGS IN CONTROL)

*373+XXXX.X CSI TIME	*
*400+2 Z-AXIS STEERING	*
*410+1 CSI ROUTINE	*

*310R TIME TO CSI	*
RESET DET	*
*450R _____ DELTA VX(LV) - CSI	*
*402R _____ DELTA H	*
*372R _____ TIME CSI/CDM	*
*263R _____ OUT-OF-PLANE VEL AT CSI	*

KEY V48E (LOAD DAP)

ATT CONT (3) - PULSE

 * DPS ATTACHED *

 *
 * F 04 46 21002 AGS MODE CONT - AUTO *
 PRO
 F 06 47 LMWT CMWT PULSE TO NULL AGS ERRORS
 * KEY V34E (TERMINATE) *
 *

 * ASC ONLY *

 *
 * F 04 46 11002 AGS MODE CONT - AUTO *
 PRO
 F 06 47 LMWT CMWT PULSE TO NULL AGS ERRORS
 * PRO *
 *

POINT Z-AXIS TOWARDS CSM

RR MODE - AUTO TRACK

*417+1 (RDR FILTER INIT)

TRANSITION

*417+1 RDR FLTR INIT ATT CONT (3) - PULSE AGS MODE CONT - AUTO RR MODE - AUTO TRACK
--



KEY V41N72E (COARSE ALIGN RR)
F 21 73 +000.00TRUN +283.00SHFT
F 04 12 00006 00002 (CONTINUOUS DESIGNATE)
PRO
41 BB (COARSE ALIGN VERB)

KEY V16N72E
16 72 MONITOR TRUN/SHFT ANGLES

CB PGNS RR - OPEN
CB AC BUS A RR - OPEN
KEY V44E (TERMINATE RR DESIGNATE)

RATE ERR MON - LDG RDR/CMPTR (CDR)

KEY V37E52E (OPTIONAL IMU REALIGN)
F 04 06 00001 00003

CB HEATER AOT - CLOSE
CB AOT LAMP - CLOSE

KEY V76E (PGNS PULSE)
PRO
F 50 25 00015 SELECT STAR ACQUISITION MODE
ENTR (TO MANUALLY ACQUIRE)

F 01 70 002DE LOAD 1ST STAR

	PRO	
F 50 18	FDAI ANGLES (REQUEST MNVR)	
	PRO (AUTO MNVR)	
F 50 18	FDAI ANGLES (MNVR COMPLETE)	
	ENTR (BYPASS MNVR)	
-45	F 01 71 002DE	BORESIGHT ON CSM *415+1 *316+XXX.XX RANGE
	PGNS MODE CONT - ATT HOLD	
	EXT LTG - TRACK	*
	PRO	
F 54 71	MARK 1ST STAR	
	PRO	
F 01 70	002DE LOAD 2ND STAR	
-42	SUNSET	*415+1 (NO BORESIGHT) *503-XXXX.X RANGE RATE BORESIGHT ON CSM *415+1 *316+XXX.XX RANGE
	PRO	
	PGNS MODE CONT - AUTO	
F 50 18	FDAI ANGLES (REQUEST MNVR)	
	PRO (AUTO MNVR)	
F 50 18	FDAI ANGLES (MNVR COMPLETE)	
	ENTR (BYPASS MNVR)	
F 01 71	002DE	
	PGNS MODE CONT-ATT HOLD	
-39	F 54 71 MARK 2ND STAR	*415+1 (NO BORESIGHT) *503-XXXX.X RANGE RATE BORESIGHT ON CSM *415+1 *316+XXX.XX RANGE
	PRO	
F 06 05	STAR ANGLE DIFFERENCE _____	
	PRO	
F 06 93	GYRO TORQUE ANGLES _____	

* IF ANY GYRO TORQUING ANGLE INDICATES GYRO DRIFT *

* GREATER THAN 1.5 DEG PER HOUR, THE PGNS HAS *

* FAILED. USE AGS FOR RNDZ WITH CSM TARGETING. *

* IF ANY GYRO TORQUING ANGLE INDICATES GYRO DRIFT *

* GREATER THAN 0.075 DEG PER HOUR, UPDATE GYRO *

* DRIFT COMPENSATION AND PROCEED. *

*

* IF P52 IS NOT COMPLETE BY CSI -32, TERMINATE P52 *

* AND INITIATE PRE-COI ACTIVITIES. *

PRO
F 06 81 DELTA V'S - LV (CSI)
CSI(N81)

DELTA VX(LV) _____ (NOM)

DELTA VY(LV) _____ (NOM 0.0)

DELTA VZ(LV) _____ (NOM 0.0)

(COMPARE CMC, AGS, VHF AND RR)

PRO
F 06 82 DELTA V'S - LV (CDH)
CDH(N82)

DELTA VX(LV) _____ (NOM)

DELTA VY(LV) _____ (NOM 0.0)

DELTA VZ(LV) _____ (NOM)

PRO
F 16 45 MKS TFI -00001

-21 *415+1 (NO BORESIGHT)
*503-XXXX.X RANGE RATE
BORESIGHT ON CSM
*415+1
*316+XXX.XX RANGE

-20* COPY 2ND RDOT FOR CSI BU *

-18 *415+1 (NO BORESIGHT)
*503-XXXX.X RANGE RATE
BORESIGHT ON CSM
*415+1
*316+XXX.XX RANGE

-17 TEMP/PRESS MON SEL - OXID MANF *
A AND B PRESS 175-188 PSI *
TEMP/PRESS MON SEL - FUEL MANF *
A AND B PRESS 175-188 PSI *
TEMP/PRESS MON SEL - PRPLNT *
A AND B TEMP IND 40 TO 100 DEG F *
A AND B PRESS IND 178-188 PSI *

TEMP/PRESS MON SEL - HE *

A AND B PRESS IND _____ PSIA *

A QUANTITY IND _____ PERCENT REMAINING *

B QUANTITY IND _____ PERCENT REMAINING *

TEMP MON SEL RCS QUAD 1, 4, 2, 3 *

(GREATER THAN OR EQUAL TO 120 DEG F) *

* NO PDI 1 OR 2 + 12 ABORTS * *

***** *

* *

* PROP SYS TEMPS/PRESS - NOR *

* THROT/JET - THROT (CDR) *

* MAN THROT - CDR *

* THROT - MIN *

* *

-15

KEY V90E (OUT-OF-PLANE) *415+1 (NO BORESIGHT)

*503-XXXX.X RANGE RATE

F 06 16 _____:____:____TIG CSI BORESIGHT ON CSM

PRO *415+1

F 06 90 Y YDOT PSI *316+XXX.XX RANGE

N90 CSM

YDOT _____

*263R _____OUT-OF-PLANE VELOCITY AT CSI *

PRO

F 16 45 MKS TFI -00001

-12

*415+1 (NO BORESIGHT)

*503-XXXX.X RANGE RATE

BORESIGHT ON CSM

*415+1

*316+XXX.XX RANGE

-10*

COPY RANGE AND 3RD RDOT FOR CSI BU *

COMPUTE CSI BU *

PRO (FINAL COMP)

F 06 75 DELTA H DELTA T CSI/CDH DELTA T CDH/TPI

KEY N13E

F 06 13 TIG CDH

-54

BORESIGHT ON CSM

*415+1

*316+XXXX.X RANGE

PRO
F 16 45 MKS TFI -00001

KEY V32E (MARKS = 7)

F 06 75 DELTA H CDH DELTA T CDH/TPI DELTA T TPI/TPI
PRO

F 06 81 DELTA V CDH - LV
CDH(N81)

DELTA VX(LV) _____ (NOM)

DELTA VY(LV) _____ (NOM 0.0)

DELTA VZ(LV) _____ (NOM)

-51

PRO
F 16 45 MKS TFI -00001

*415+1 (NO BORESIGHT)

*503-XXXX.X RANGE RATE

BORESIGHT ON CSM

*415+1

*316+XXX.XX RANGE

KEY V90E (OUT-OF-PLANE)

____ : ____ : ____ TIG CDH
-30:00 TIME FROM CDH

F 06 16 ____ : ____ : ____ LOAD TIG PLANE CHANGE

PRO
F 06 90 Y YDOT PSI
N90 CSM

-48

YDOT _____

*415+1 (NO BORESIGHT)

*503-XXXX.X RANGE RATE

BORESIGHT ON CSM

*415+1

*316+XXX.XX RANGE

PRO
F 16 45 MKS TFI -00001

COMPARE CMC, AGS, VHF AND RR

*

SUNRISE

-45

*415+1 (NO BORESIGHT)

*503-XXXX.X RANGE RATE

BORESIGHT ON CSM

*415+1

*316+XXX.XX RANGE

F 3

KEY V32E (MARKS = 15)

F 06 75 DELTA H CDH DELTA T CDH/TPI DELTA T TPI/TPI
PRO

F 06 81 DELTA V CDH - LV
CDH(N81)

DELTA VX(LV) _____

DELTA VY(LV) _____

DELTA VZ(LV) _____

(COMPARE WITH CSM SOLUTION)

-42

PRO
F 16 45 MKS TFI -00001

*415+1 (NO BORESIGHT)
*503-XXXX.X RANGE RATE
BORESIGHT ON CSM
*415+1
*316+XXX.XX RANGE

-39

*411+0 STOP AUTO UPDATES

*415+1 (NO BORESIGHT)
*503-XXXX.X RANGE RATE
BORESIGHT ON CSM
*415+1
*316+XXX.XX RANGE

* PLANE CHANGE TARGETING *

* CONTINUE NO PDI 1 OR 2 + 12 ABORT PROCEDURES ON PAGE F 8 *

KEY V34E (TERMINATE) (FOR PC ONLY)
F 37 BB

KEY 30E (EXTERNAL DELTA V) (FOR PC ONLY)

_____:_____:_____:TIG CDH
-30:00 TIME FROM CDH

F 06 33 ____:____:_____:LOAD TIG PLANE CHANGE

*373+XXXX.X LOAD TIG PLANE CHANGE *

PRO
F 06 81 DELTA V'S - LV

KEY V90E (OUT-OF-PLANE)

F 06 16 ____:____:____ TIG PLANE CHANGE

PRO
F 06 90 Y YDOT PSI
 N90 CSM

YDOT _____

*263R _____ OUT-OF-PLANE VELOCITY AT PC *

PRO
F 06 81 DELTA V'S - LV

COPY YDOT FROM CSM AND LOAD NEGATIVE IN R2
FOR PLANE CHANGE IF YDOT GREATER THAN 2FPS

CDH(N81)

DELTA VX(LV) _____ 0.0

DELTA VY(LV) _____ (NOM 0.0)

DELTA VZ(LV) _____ 0.0

PRO
F 06 42 HA HP DELTA V
PRO
F 16 45 MKS TFI MGA

PRO
F 37 BB

-36* COPY 1ST RDOT FOR CDH BU

*

*415+1 (NO BORESIGHT)
*503-XXXX.X RANGE RATE
BORESIGHT ON CSM
*415+1
*316+XXX.XX RANGE

KEY 41E (RCS THRUSTING)

F 50 18 FDAI ANGLES (REQUEST MNVR)
KEY V77E (RATE CMD)
ENTR (BYPASS MNVR)
16 85 DELTA V'S-BODY

F 5

KEY V06N86E
06 86 DELTA V'S - LV

*410+5 EXTERNAL DELTA V

*
*263R _____ OUT-OF-PLANE
LOAD SOLUTION TO BE
EXECUTED INTO 451
(IF AGS, LOAD MAGNITUDE
AND SIGN OF LOC 263)
(IF CSM, LOAD MAGNITUDE
AND OPPOSITE SIGN)

*450+0 451-YDOT 452+0
(LOAD CSM -YDOT)

KEY RELEASE
16 85 DELTA V'S - BODY

*
NULL ERR SIG WITH PULSE
ATT CONT(3) - MODE

T R A N S I T I O N
AT -1:00 AGS MODE CONT - AUTO



*270R _____ OUT-OF-PLANE VELOCITY

*501R _____ DELTA VY

-30:35

DSKY BLANKS FOR 5 SEC

*
*
AGS MODE CONT - ATT HOLD

T R A N S I T I O N
AGS MODE CONT - AUTO AGS MODE CONT - ATT HOLD



-30:05

#270R OUT-OF-PLANE
#501R DELTA VY

•

F 37 BB

✱

KEY 33E (CDH PRE -THRUST)

F 06 13 ____:____:____ LOAD TIG CDH

ATT CONT(3) - PULSE
AGS MODE CONT - AUTO

*373+XXXX.X CDH TIG

*410+2 CDH ROUTINE

•

* CONTINUE ON PAGE F 9

```
*****
* NO PDI 1 OR 2 + 12 ABORTS *
*****
*
* A PLANE CHANGE BURN SHOULD NOT BE REQUIRED FOR EITHER THE
* NO PDI 1 OR 2 + 12 ABORT CASES.
```

```
(AOS OF MSFN)
S-BAND ANT - FWD
VERIFY COMM
CHECK S-BAND P = __, Y = __
S-BAND ANT - SLEW
TRACK MODE - AUTO
BIOMED - LEFT
TELEMETRY PCM SW - HI
UPLINK SQUELCH - OFF
```

```
*****
* REPORT CSI BURN TO MSFN *
*****
```

-36* COPY 1ST RDOT FOR CDH BU

```
*415+1 (NO BORESIGHT)
*503-XXXX.X RANGE RATE
BORESIGHT ON CSM
*415+1
*316+XXX.XX RANGE
```

-33

```
*415+1 (NO BORESIGHT)
*503-XXXX.X RANGE RATE
BORESIGHT ON CSM
*415+1
*316+XXX.XX RANGE
```

-30

```
*415+1 (NO BORESIGHT)
*503-XXXX.X RANGE RATE
BORESIGHT ON CSM
*415+1
*316+XXX.XX RANGE
```

 * NO PDI 1 OR 2 + 12 ABORTS (DPS BURN) *

*
 * RATE ERR MON - CMPTR *
 *

-6 KEY 40E (DPS THRUSTING)

F 50 18 FDAI ANGLES (REQUEST MNVR)
 PRO (AUTO MNVR)
 F 50 18 FDAI ANGLES (MNVR COMPLETE)
 ENTR (BYPASS MNVR)
 06 40 TFI VG DELTA VM

KEY N86E
 06 86 DELTA V'S - LV

AGS(N86) CHART

DELTA VX(LV)	_____	_____
DELTA VY(LV)	_____	_____
DELTA VZ(LV)	_____	_____

-5 *400+1 GUIDANCE STEERING *
 *410+5 EXTERNAL DELTA V *

*450 451 452 LOAD

TRANSMIT DELTA V'S TO
 CSM AND SYNC COUNTDOWN

KEY RELEASE
 06 40 TFI VG DELTA VM

NULL ERR SIG WITH PULSE

ATT CONT(3) - MODE

T R A N S I T I O N
AT -1:00 AGS MODE CONT - AUTO



DESCENT REGS 1 AND 2 CLOSED *
 VERIFY SWITCHES PER BURN CARD *
 THROT/JET - THROT *
 THROT - MIN *
 THROT CONT SW - MAN *
 MAN THROT - CDR *

*500R _____ DELTA VX *

	TRANSMIT DELTA V'S TO CSM	*
	SYNC COUNTDOWN	*
-1:00	AGS MODE CONT - AUTO	
-1:35	DSKY BLANKS FOR 5 SEC	
-1:30	ENG ARM - DESCENT	*
-1:20	ABORT PB - PUSH	*
-1:07.5	MONITOR ULLAGE	MANUAL ULLAGE (LMP)
-1:05 F 99 40	ENGINE-ON ENABLE	
	PRO	
06 40	TFI VG DELTA VM	
-1:00.0	ENGINE START (CDH BURN)	
06 40	TFC VG DELTA VM	MONITOR THRUST
+1:05	ENG ARM - OFF	*
+1:15	THROTTLE UP TO 40 PERCENT	
	WHEN VG = 0	*
	ENG STOP PB - PUSH	*
	ENGINE SHUTDOWN	
F 16 40	TFC VG DELTA VM	
	ABORT PB - RESET	*
	ENG STOP PB - RESET	*
	PRO	
F 16 85	DELTA V'S - BODY	
	PRPLNT QTY MON - OFF	*
	AGS MODE CONT - ATT HOLD	*
	THROT/JET - JET	*
	*616+00005 ULLAGE COUNTER LIMIT	*
	RATE ERR MON - RNDZ RDR	
	TTCA TRANSL - DISABLE (LMP)	

 * TPI BURN FOR COELLIPTIC RENDEZVOUS *

NOMINAL PGNS
 (AGS IN FOLLOW-UP)

PGNS FAILURE
 (AGS IN CONTROL)

KEY V76E (PGNS PULSE)

KEY 34E (TPI)

ATT CONT(3) - PULSE

KEY V93E (REINIT W MATRIX)

 * IF CDH WAS AN X-AXIS BURN *

 *
 * *400+2 Z-AXIS STEERING *
 *
 F 50 18 FDAI ANGLES (REQUEST MNVR)
 PRO (AUTO MNVR)
 F 50 18 FDAI ANGLES (MNVR COMPLETE)
 ENTR (BYPASS MNVR)
 *
 *

F 06 37 ____ : ____ : ____ LOAD TIG TPI NULL ERR SIG WITH PULSE
 PRO
 F 06 55 +00000 +026.60E +130.00 OMEGAT RR MODE - AUTO TRACK
 PRO
 F 16 45 MKS TFI -00001

*417+1 (RADAR FILTER INITIALIZED) *

*621R ____ CHECK RADAR MARK COUNTER

RESET DET

KEY V82E (ORBIT PARAMETERS)
 F 04 12 00002 00001 *315R ____ HA
 PRO
 F 16 44 HA HP TFF *403R ____ HP
 PRO
 F 16 45 MKS TFI -00001

-51

*410+3 TPI SEARCH ROUTINE *
 *307+043.00 DELTA T TRANSFER *
 *310+050.00 TFI TPI *
 *303R _____ THETA 50 MIN FROM NOW *
 (IF 303 IS LESS THAN 26.6 DEG, INCREASE 310) *
 (IF GREATER THAN 26.6 DEG, DECREASE 310) *
 *410+4 (WHEN 303 = 26.6 DEG) *

*310R _____ TFI TPI
 RESET DET

*450R _____ DELTA VX(LV) *
 *451R _____ DELTA VY(LV) *
 *452R _____ DELTA VZ(LV) *
 *370R _____ DELTA V TPI *
 *371R _____ DELTA V TPI + DELTA V TPF *
 *411+1 START AUTO RADAR UPDATES

T R A N S I T I O N
*411+0 STOP AUTO U/D ATT CONT(3) - PULSE AGS MODE CONT - AUTO RR MODE - AUTO TRACK



-42

BORESIGHT ON CSM
 *415+1
 *316+XXX.XX RANGE

-39

KEY V32E (MARKS = 7)
 F 06 37 _____:_____:_____TIG TPI
 PRO
 F 06 58 HP DELTA V TPI DELTA V TPF

*415+1 (NO BORESIGHT)
 *503-XXXX.X RANGE RATE
 BORESIGHT ON CSM
 *415+1
 *316+XXX.XX RANGE

PRO
F 06 81 DELTA V'S - LV TPI(N81)

DELTA VX(LV) _____ (NOM)
DELTA VY(LV) _____ (NOM)
DELTA VZ(LV) _____ (NOM)

PRO
F 16 45 MKS TFI -00001

(COMPARE TPI TIME)

-36 *415+1 (NO BORESIGHT)
*503-XXXX.X RANGE RATE
BORESIGHT ON CSM
*415+1
*316+XXX.XX RANGE

-33 *415+1 (NO BORESIGHT)
*503-XXXX.X RANGE RATE
BORESIGHT ON CSM
*415+1
*316+XXX.XX RANGE

-30 *415+1 (NO BORESIGHT)
*503-XXXX.X RANGE RATE
BORESIGHT ON CSM
*415+1
*316+XXX.XX RANGE

-27 *415+1 (NO BORESIGHT)
*503-XXXX.X RANGE RATE
BORESIGHT ON CSM
*415+1
*316+XXX.XX RANGE

SUNSET

*410+3 TPI SEARCH ROUTINE *
*310+026.00 TFI TPI *

*303R _____ THETA 26 MIN FROM NOW *
(IF 303 IS LESS THAN 26.6 DEG, INCREASE 310) *
(IF GREATER THAN 26.6 DEG, DECREASE 310) *
*410+4 (WHEN 303 = 26.6 DEG) *

*310R _____ TFI TPI

RESET DET

G 3

-24

KEY V32E (MARKS = 15)

F 06 37 : : TIG TPI

PRO

F 06 58 HP DELTA V TPI DELTA V TPF

PRO

F 06 81 DELTA V'S - LV

TPI(N81)

DELTA VX(LV) (NOM)

DELTA VY(LV) (NOM)

DELTA VZ(LV) (NOM)

(COMPARE CMC, AGS, VHF AND RR)

-21

PRO

F 16 45 MKS TFI -00001

*415+1 (NO BORESIGHT)
*503-XXXX.X RANGE RATE
BORESIGHT ON CSM
*415+1
*316+XXX.XX RANGE

*415+1 (NO BORESIGHT)
*503-XXXX.X RANGE RATE
BORESIGHT ON CSM
*415+1
*316+XXX.XX RANGE

-18

*415+1 (NO BORESIGHT)
*503-XXXX.X RANGE RATE
BORESIGHT ON CSM
*415+1
*316+XXX.XX RANGE

-17

TEMP/PRESS MON SEL - OXID MANF *
A AND B PRESS 175-188 PSI *
TEMP/PRESS MON SEL - FUEL MANF *
A AND B PRESS 175-188 PSI *
TEMP/PRESS MON SEL - PRPLNT *
A AND B TEMP IND 40 TO 100 DEG F *
A AND B PRESS IND 178-188 PSI *
TEMP/PRESS MON SEL - HE *

A AND B PRESS IND _____ PSIA *

A QUANTITY IND _____ PERCENT REMAINING *

B QUANTITY IND _____ PERCENT REMAINING *
TEMP MON SEL RCS QUAD 1, 4, 2, 3 *
(GREATER THAN OR EQUAL TO 120 DEG F) *

SUIT/CABIN PRESS - NOR *
GLYCOL TEMP/PRESS - NOR *
O2/H2O QUANTITY - NOMINAL *

KEY V90E (OPTIONAL OUT-OF-PLANE)

F 06 16 ____:____:____TIG TPI

PRO

F 06 90 Y YDOT PSI
N90 CSM

YDOT _____

PRO

F 16 45 MKS TFI -00001

-15

*415+1 (NO BORESIGHT)
*503-XXXX.X RANGE RATE
BORESIGHT ON CSM
*415+1
*316+XXX.XX RANGE

*370R _____ DELTA V TPI *

*371R _____ DELTA V TPI + DELTA V TPF *

-12

*415+1 (NO BORESIGHT)
*503-XXXX.X RANGE RATE
BORESIGHT ON CSM
*415+1
*316+XXX.XX RANGE

```
*****
* THE FOLLOWING WILL BE PERFORMED ONLY IF *
* REQUIRED *
* *
* *411+0 STOP AUTO UPDATES *
* *
* KEY V47E (INITIALIZE AGS) *
* F 06 16 GET OF AGS 0 TIME *
* TELEMETRY PCM SW - HI *
* *414+1 UPDATE AGS *
* PRO *
* 06 16 UPDATE IN PROGRESS *
* *414R (00000 COMPLETE) *
* F 50 16 UPDATE COMPLETE *
* PRO *
* F 16 45 MKS TFI -00001 *
* *
* *400+3 AGS ALIGN *
* *400R (00000 COMPLETE) *
* *400+2 Z-AXIS STEERING *
*****
```

G

5

```

(LOS OF MSFN) *
MATCH INDICATED ANGLES *
TRACK MODE - SLEW *
SET P = -13, Y = +17 *
S-BAND ANT - AFT *
BIOMED - OFF *
OMNI - FORWARD *
TELEMETRY PCM SW - HI *
UPLINK SQUELCH - ENABLE *

```

-10

PRO (FINAL COMP)

F 06 37 ____:____:____ TIG TPI

TRANSMIT TIG OF TPI TO CSM

PRO

F 06 58 HP DELTA V TPI DELTA V TPF

PRO

F 06 81 DELTA V'S - LV

TPI(N81) AGS(45X)

DELTA VX(LV) _____ (NOM)

DELTA VY(LV) _____ (NOM)

DELTA VZ(LV) _____ (NOM)

COPY VX(LV), VY(LV), AND VZ(LV) FROM CCM

```

*****
* COMPARE LGC (TPI) (OR CMC TIG (TPI) IF CMC *
* SOLUTION IS USED) AGAINST NOMINAL. IF *
* TIG (TPI) IS EARLIER THAN NOMINAL - 8 MINS. *
* RECYCLE P34 USING TIME OPTION WITH TIG (TPI) = *
* TIG (TPI) - 8 MINUTES, OTHERWISE PROCEED. *
*****

```

PRO

F 16 45 MKS TFI MGA

RESET DET

COMPARE THE RR WITH VHF

COMPUTE THE CHECK LIMIT AS FOLLOWS:

LIMIT = 0.01RANGE (NM) + 0.5
(WHERE THE MINIMUM LIMIT IS 1 NM)

 * IF THE RR RANGE AGREES WITH THE VHF RANGE WITHIN *
 * THE ABOVE LIMIT, PERFORM THE FOLLOWING CHECKS. *
 * IF NOT, DETERMINE THE FAILED SYSTEM WITH MSFN, *
 * AND USE THE VALID SOLUTION. *

 * THE NOMINAL BURN SOLUTION PRIORITY IS: *
 * PGNS, AGS, GNCS, AND CHARTS *
 * THE 3 SIGMA COMPARISON LIMITS ON VX(LV), VY(LV), *
 * AND VZ(LV) ARE 3, 7, AND 9 FPS RESPECTIVELY. *
 * THESE CHECK LIMITS WILL BE USED TO DETERMINE IF *
 * THE NOMINAL BURN PRIORITY WILL BE FOLLOWED. *

PRO

F 37 BB

-9*

*277R COPY TGT LOS ANGLE

SET ORDEAL

*415+1 (NO BORESIGHT)
 *503-XXXX.X RANGE RATE
 BORESIGHT ON CSM
 *415+1
 *316+XXX.XX RANGE

*411+0 STOP AUTO UPDATES
 *410+3 TPI SEARCH ROUTINE
 *310+008.00 TFI TPI

*303R _____ THETA 08 MIN FROM NOW *
 (IF 303 IS LESS THAN 26.6 DEG, INCREASE 310) *
 (IF GREATER THAN 26.6 DEG, DECREASE 310) *
 *410+4 (WHEN 303 = 26.6 DEG) *

*310R _____ TFI TPI

RESET DET

*450R _____ DELTA VX(LV) *

*451R _____ DELTA VY(LV) *

*452R _____ DELTA VZ(LV) *

*370R _____ DELTA V TPI

*371R _____ DELTA V TPI + DELTA V TPF

 * CONTINUE NO PDI 1 OR 2 + 12 ABORT PROCEDURES ON PAGE G 10 *

*373+XXXX.X LOAD TIG TPI	*373R_____TIG TPI
ADD 15 MIN AND RECORD FOR MCC1	*
ADD 30 MIN FOR MCC2	*
*507+1 THRUST ALONG Z-BODY AXIS	*
*410+5 EXTERNAL DELTA V	*
*450 451 452 LOAD	

NULL ERR SIG WITH PULSE
ATT CONT(3) - MODE

 * TPI BURN FOR DIRECT RENDEZVOUS *

NOMINAL PGNS
 (AGS IN FOLLOW-UP)

PGNS FAILURE
 (AGS IN CONTROL)

 * IF THE AGS AND PGNS AGREE WITHIN 10 FPS, *
 * TRIM TO LESS THAN 10 FPS (AGS TRIM X-AXIS *
 * ONLY) AND STANDBY FOR BURN PARAMETERS FOR *
 * A TWEAK AT INSERTION + 3 MINUTES OR BAIL- *
 * OUT AT INSERTION + 5 MINUTES. *
 * *
 * THE TWEAK LIMITS ARE: *
 * GREATER THAN 5 FPS IN PLANE *
 * GREATER THAN 10 FPS OUT-OF-PLANE *
 * *
 * TRIM ALL TWEAKS TO LESS THAN 0.2 FPS *

KEY V76E (PGNS PULSE)

AGS MODE CONT - ATT HOLD
 AUDIO MODE - ICS/PTT
 CB (11) + (16) ED. LOGIC PWR - OPEN
 CB (11) ECS CABIN FAN1 - CLOSE
 INV 2 CB - CLOSE
 INV 1 CB - OPEN
 SELECT INV 2
 RATE ERR MON - RNDZ RDR (CDR AND LMP)
 RATE SCALE - 5 DEG/SEC
 SHFT/TRUN - +-5 DEG
 VHF ANT - FWD

*400+2 Z-AXIS STEERING
 *410+4 TPI EXECUTE
 *616+00005 ULLAGE COUNTER LIMIT
 *623+0 Z-AXIS PARALLEL TO CSM ORBIT

*303R _____ THETA AT TPI

*370R _____ DELTA V TPI

*371R _____ DELTA V TPI + DELTA V TPF

*402R _____ PREDICTED HP (TPI)

```

*****
* IF THE TWEAK BURN IS GREATER THAN 60 FPS RSS, THE *
* OUT-OF-PLANE ATTITUDE IS GREATER THAN 0.5 DEG, *
* OR HP IS LESS THAN 5 NM, THEN PERFORM LM BAILOUT *
* PROCEDURES AT TPI - 40 MINUTES. *
*****

```

```

*****
-44 * GO / NO GO FOR TWEAK *
*****

```

```

SUIT/CABIN PRESS - NOR *
GLYCOL TEMP/PRESS - NOR *
O2/H2O QUANTITY - NOMINAL *
PRESS REG A AND B - CABIN *
CABIN REPRESS - CLOSE *
CABIN GAS RETURN - AUTO *
SUIT GAS DIVERter - PUSH/CABIN *
DOFF HELMET AND GLOVES *

```

```

*****
* TWEAK *
*****
*
* CHECK FDAI = 0, 257, 0

```

RECORD (_ _ _)

KEY V37E47E (AVE G)
F 16 83 DELTA V'S

```

*404+0 405+0 406+0 *
(MONITOR 470 471 472) *

```

```

-43 BURN VG'S AS REQUIRED *

```

```

PRO
* F 37 BB
*
*****

```

```

*****
* BAILOUT *
*****
*
* CHECK FDAI = 0, 242, 0
*
RECORD ( _ _ _ )

```

* BAILOUT (CONTINUED) *

*
* KEY V37E47E (AVG G)
* F 16 83 DELTA V'S

*404+0 405+0 406+0 *
(MONITOR 470 471 472) *

-40 BURN VG'S AS REQUIRED *

PRO
F 37 BB

KEY 00E (P00)

KEY V82E (ORBIT PARAMETERS)
F 04 12 00002 00001
PRO
F 16 44 HA HP TFF

*315R _____ HA *

*403R _____ HP *

PRO

* CONTINUE BAILOUT PROCEDURES ON PAGE E 2 *

EXT LTG - TRACK *

KEY 20E (ACQUIRE RADAR)

F 50 18 FDAI ANGLES (REQUEST MNVR)

PRO (AUTO MNVR)
F 50 18 FDAI ANGLES (MNVR COMPLETE)

ENTR (BYPASS MNVR)
NO TRK LT - OFF
F 50 72 RR TRUN/SHFT
VERIFY RR LOCK-ON AND DATA

PRO
DSKY BLANKS

KEY V80E (UPDATE LM SV)

ATT CONT (3) - PULSE

NULL AGS ATT ERRORS

POINT Z-AXIS TOWARDS CSM
SLEW ANT TO 0.0 ON FDAI
VERIFY MAX SIGNAL STRENGTH

RR MODE - AUTO TRACK
NO TRACK LT - OFF

T R A N S I T I O N

ATT CONT(3) - PULSE
AGS MODE CONT - AUTO
RR MODE - AUTO TRACK



* TPI TARGETING *

*373+XXXX.X TPI TIME
*307+043.00 DELTA T TRNSFR
*310R TIME TO TPI

SET DET

*303R _____THETA AT TPI

*370R _____DELTA V TPI

*371R _____DELTA V TPI + TPF

KEY V37E34E (TPI)

F 06 37 _____ : _____ : _____ LOAD TIG TPI FROM DATA PAD
 (NOM)
 PRO
F 06 55 +00000 +00000E +130.00 OMEGAT
 PRO
F 16 45 MKS TFI -00001

* THE FOLLOWING WILL BE PERFORMED ONLY IF *
* REQUIRED *
* *411R +0 (VERIFY NO AUTO UPDATE) *
* *
* KEY V47E (INITIALIZE AGS) *
* F 06 16 GET OF AGS 0 TIME *
* TELEMETRY PCM SW - HI *
* *414+1 UPDATE AGS *
* PRO *
* 06 16 UPDATE IN PROGRESS *
* *414R (00000 COMPLETE) *
* F 50 16 UPDATE COMPLETE *
* PRO *
* F 16 45 MKS TFI -00001 *
* *
* *400+3 AGS ALIGN *
* *400R (00000 COMPLETE) *
* *400+2 Z-AXIS STEERING *

*417+1 (RADAR FILTER INITIALIZED) *
 *417R +0 (VERIFY INITIALIZATION) *
 *411+1 START AUTO RADAR UPDATES

*310R TIME TO TPI

RESET DET

*303R _____ THETA AT TPI

KEY V82E (ORBIT PARAMETERS)

F 04 12 00002 00001

PRO

F 16 44 HA HP TFF

*315R _____ HA

*403R _____ HP

PRO

F 16 45 MKS TFI -00001

KEY V83E (RENDEZVOUS PARAMETERS)

F 16 54 R RDOT THETA

SET ORDEAL

*317R _____ RANGE (XXX.XX) *

*440R _____ RANGE RATE *

*277R _____ LOS ANGLE *

SET ORDEAL

PRO

F 16 45 MKS TFI -00001

KEY V48E (LOAD DAP)

F 04 46 12012

PRO

F 06 47 LMWT CMWT

PRO

F 16 45 MKS TFI -00001

 * PERFORM CSM BAILOUT PROCEDURES IF REQUIRED, AND *
 * COPY P76 PAD. *

SUNSET

-30*

COPY R, RDOT FOR TPI BU

*

BORESIGHT ON CSM

*415+1

*316+XXX.XX RANGE

-27

*415+1 (NO BORESIGHT)

*503-XXXX.X RANGE RATE

BORESIGHT ON CSM

*415+1

*316+XXX.XX RANGE

```
*****
*          OPTIONAL RECYCLE          *
*          KEY V32E (MARKS = 15)     *
*                                     *
* F 06 55 +00000_____E +130.00 OMEGAT *
*          PRO                        *
* F 06 58 HP DELTA V TPI DELTA V TPF  *
*          PRO                        *
* F 06 81 DELTA V'S - LV              *
*                                     *
*                                     *
*          DELTA VX (LV) _____ *
*                                     *
*          DELTA VY (LV) _____ *
*                                     *
*          DELTA VZ (LV) _____ *
*                                     *
*          (COMPARE CMC, AGS, VHF, RR) *
*                                     *
*          PRO                        *
* F 16 45 MKS TFI -00001             *
*****
```

-24

*415+1 (NO BORESIGHT)

*503-XXXX.X RANGE RATE

BORESIGHT ON CSM

*415+1

*316+XXX.XX RANGE

-21

*415+1 (NO BORESIGHT)

*503-XXXX.X RANGE RATE

BORESIGHT ON CSM

*415+1

*316+XXX.XX RANGE

*303R _____ THETA AT TPI

*373R _____ TIG TPI

ADD 15 MIN AND RECORD
FOR MCC1
ADD 30 MIN FOR MCC2

*370R _____ DELTA V TPI

COMPARE AGS DELTA V WITH
CHARTS AND CSM

*371R _____ DELTA V TPI +
DELTA V TPF

COMPARE THE RR WITH VHF

COMPUTE THE CHECK LIMIT AS FOLLOWS:

LIMIT = $0.01 \text{ RANGE (NM)} + 0.5$
(WHERE THE MINIMUM LIMIT IS 1 NM)

* IF THE RR RANGE AGREES WITH THE VHF RANGE WITHIN *
* THE ABOVE LIMIT, PERFORM THE FOLLOWING CHECKS. *
* IF NOT, DETERMINE THE FAILED SYSTEM WITH MSFN, *
* AND USE THE VALID SOLUTION. *

* THE NOMINAL BURN SOLUTION PRIORITY IS: *
* PGNS, AGS, GNCS *
* THE 3 SIGMA COMPARISON LIMITS ON VX(LV), VY(LV), *
* AND VZ(LV) ARE 3, 7 AND 9 FPS RESPECTIVELY. *
* THESE CHECK LIMITS WILL BE USED TO DETERMINE IF *
* THE NOMINAL BURN PRIORITY WILL BE FOLLOWED. *

*310R _____ TFI TPI

RESET DET

*370R _____ DELTA V TPI

*371R _____ DELTA V TPI + DELTA V TPF

*402R _____ PREDICTED HP (TPI) *

COPY CSM TPI SOLUTION AND SYNC COUNTDOWN *

*310R TIME TO TPI.

RESET DET
VERIFY SWITCHES PER BURN CARD

PRO
F 37 BB

KEY 42E (APS THRUSTING)
F 50 18 FDAI ANGLES (REQUEST MNVR)

* P E R F O R M Y A W / R O L L M A N E U V E R *

ENTR (BYPASS MNVR)
06 40 TFI VG DELTA VM

KEY N86E
06 86 DELTA V'S - LV

(N86) CHART

DELTA VX(LV)	_____	_____
DELTA VY(LV)	_____	_____
DELTA VZ(LV)	_____	_____

*404+0 405+0 406+0 *
(MONITOR 470 471 472) *

*623+1 Z-AXIS PARALLEL TO UNIT VECTOR PLANE *
*400+1 GUIDANCE STEERING *
*410+5 EXTERNAL DELTA V *
*450 451 452 LOAD

NULL ERR SIG WITH PULSE

ATT CONT(3) - MODE

KEY RELEASE
06 40 TFI VG DELTA VM



*500R _____ DELTA VX (NOM)) *

H 10

* TPM THROUGH DOCKING *

PGNS FAILURE
(AGS IN CONTROL)

* MCC1 TARGETING *

KEY V76E (PGNS PULSE)

```

* DIRECT RENDEZVOUS *
*****
*
* *****
*  *  OPTIONAL YAW/ROLL MANEUVER TO HEADS UP POSITION  *
*****

```

*400+2 Z-AXIS STEERING
*623+0 Z-AXIS PARALLEL TO CSM ORBIT

RATE ERR MON - RNDZ RDR

KEY 35E (TPM PRE-THRUST)

```
F 50 18 FDAI ANGLES (REQUEST MNVR)
PRO (AUTO MNVR)
F 50 18 FDAI ANGLES (MNVR COMPLETE)
ENTR (BYPASS MNVR)
F 50 72 RR TRUN/SHFT
PRO
F 16 45 MKS TFI -00001
```

KEY V67E (RESET W MATRIX)
F 06 99 +02000 +00020 +00005
PRO

* IF TPI WAS A Z-AXIS BURN *

*
* *507+0 Z-AXIS BORESIGHT *
*

KEY 35E (TPM PRE-THRUST)

*
* KEY V93E (REINIT W MATRIX) *
*

* NO PDI 1 OR 2 + 12 ABORTS *

*
* *400+2 Z-AXIS STEERING *
*

RATE ERR MON - RNDZ RDR

KEY 35E (TPM PRE-THRUST)

KEY V93E (REINIT W MATRIX)

F 50 18 FDAI ANGLES (REQUEST MNVR)
PRO (AUTO MNVR)
F 50 18 FDAI ANGLES (MNVR COMPLETE)
ENTR (BYPASS MNVR)
F 50 72 RR TRUN/SHFT
PRO

*
*

F 16 45 MKS TFI -00001

ATT CONT(3) - PULSE
AGS MODE CONT - AUTO

NULL ERR SIG WITH PULSE

RR MODE - AUTO TRACK

*417+1 (RADAR FILTER INITIALIZED)

*621R _____ CHECK RADAR MARK COUNTER
*411+1 START AUTO RADAR UPDATES

TRANSITION

#411+0 STOP AUTO U/D
ATT CONT(3) - PULSE
AGS MODE CONT - AUTO
RR MODE - AUTO TRACK

+2

BORESIGHT ON CSM
*415+1
*316+XXXX.X RANGE

*410+4 TPI EXECUTE
*373+XXXX.X TPI TIME + 15 MIN
*307+028.00 TIME, IGNITION TO RENDEZVOUS

+4

*415+1 (NO BORESIGHT)
*503-XXXX.X RANGE RATE
BORESIGHT ON CSM
*415+1
*316+XXX.XX RANGE

+6

*415+1 (NO BORESIGHT)
*503-XXXX.X RANGE RATE
BORESIGHT ON CSM
*415+1
*316+XXX.XX RANGE

+8

*415+1 (NO BORESIGHT)
*503-XXXX.X RANGE RATE
BORESIGHT ON CSM
*415+1
*316+XXX.XX RANGE

+9*

*277R COPY TGT LOS ANGLE

*370R_____ DELTA V TPI
*371R_____ DELTA V TPI + TPF

+10

*415+1 (NO BORESIGHT)
*503-XXXX.X RANGE RATE
BORESIGHT ON CSM
*415+1
*316+XXX.XX RANGE

+12 PRO (COMPUTE MCC FOR TPI + 15) *415+1 (NO BORESIGHT)
 F 06 81 DELTA V'S - LV *503-XXXX.X RANGE RATE
 BORESIGHT ON CSM
 *415+1
 MCC1(N81) *316+XXX.XX RANGE

DELTA VX(LV) _____ (NOM 0.0)
 DELTA VY(LV) _____ (NOM 0.0)
 DELTA VZ(LV) _____ (NOM 0.0)

PRO
 F 16 45 MKS TFI MGA

+13* *277R COPY TGT LOS ANGLE *
 *411+0 STOP AUTO UPDATES
 COPY R, RDOT FROM TM AND COMPUTE MCC1 BU *
 *370R _____ DELTA V TPI *
 *371R _____ DELTA V TPI + DELTA V TPF *
 *404+0 405+0 406+0 *
 (MONITOR 470 471 472) *

PRO
 F 37 BB

KEY 41E (RCs THRUSTING)
 F 50 18 FDAI ANGLES (REQUEST MNVR)
 KEY V77E (RATE CMD)
 ENTR (BYPASS MNVR)
 16 85 DELTA V'S - BODY

KEY V06N86E
 06 86 DELTA V'S - LV

+14 *410+5 EXTERNAL DELTA V *
 (LOAD SOLUTION TO BE EXECUTED)
 *450 451 452 LOAD NULL ERR SIG WITH PULSE
 ATT CONT(3) - MODE

KEY RELEASE
 16 85 DELTA V'S - BODY

TIME	RANGE	RDOT
L0+5	142	1652
L0+6	154	802
L0+7	157	-191
INS	156	-447
1+00	152	-444
2+00	148	-440
3+00	143	-436
4+00	139	-432
5+00	135	-426
6+00	130	-421
7+00	126	-415
8+00	122	-408
9+00	118	-401
10+00	114	-394

INSERTION 171:52:23

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

*373+0159.3 TIG TPI

*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

P47 FDAI (0,257,0)

*404+0, 405+0, 406+0

*MONITOR 470, 471, 472

+3 TWEAK 171:55:23

ΔV'S

INSERTION THRU TPI

P47 FDAI (0,242,0) OR 10° OHW

*404+0, 405+0, 406+0 *

*MONITOR 470, 471, 472 *

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

TIG 171:57:23

ΔVX 41.0

*EXT LTG-TRACK *

P20, AUTO MNVR

V80, MAX N49(2.00,12.0)

P34 TGT TPI

*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

35 CSM BAILOUT GET P76 PAD

30 CHART R/RDOT

27

M=15, V32

24

*COMPARE CMC, AGS, VHF/RR *

*POLAR PLOT @ 90 NM *

21

18

*CHECK RCS, EPS, ECS *

MISSION APOLLO 16, FEBRUARY 29, 1972

15

*514+0 *

*515+4 YAW STEER VEC *

*516+0 *

*MATCH INDICATED ANGLES *

*TRACK MODE-SLEW *

*S-BD ANT-AFT *

SET P _____ (+125) *

Y _____ (-55) *

*BIOMED-OFF, PCM-HI *

*UPLINK SQUELCH-ENABLE *

12

10 CHART R/RDOT/θ

9

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

1:00 AGS MODE CONT-AUTO

:30 ABORT STAGE PB-PUSH

:10 MANUAL ULLAGE

:05 PRO

:00 TPI 172:39:23

ABORT STAGE PB-RESET

NO IGNITION

ENG ARM-ASC

MANUAL START

MANUAL STOP 3 SEC

ENG ARM-OFF

NULL RESIDUALS

0 TPI 172:39:23
 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 *
 *623+0 *
 *417+1 (✓621+0) *
 411+1 START AUTO(13,12) [] SR
 2 *410+4 TPI EXEC * [R]
 *373+TPI TIME +15 MIN *
 *307+028.00 *
 4 RDOT [R]
 6 RDOT [R]
 8 RDOT [R]
 9 CHART 0 *
 10 RDOT [R]
 12 PRO FINAL COMP RDOT [R]
 13 CHART R/RDOT/0
 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

TPI THRU DOCKING

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 *410+4 TPI EXEC * [R]
 *373+TPI TIME +30 MIN *
 *307+013.00 *
 19 RDOT [R]
 21 RDOT [R]
 23 RDOT [R]
 24 CHART 0 *
 25 RDOT [R]
 27 PRO-FINAL COMP RDOT [R]
 28 CHART R/RDOT/0
 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

MISSION APOLLO 16, FEBRUARY 29, 1972

P00
 V48, 11002
 P47, V63
 *404+0, 405+0, 406+0 *
 S-BD ANT-AFT, VERIFY COMM
 */S-BD P (+125) *
 Y (-55) *
 *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,RCS
 55 INITIATE DOCKING
 COAS TO OVHD WINDOW
 *EXT LTG-DOCK *
 SHFT/TRUN ±50 *
 V41N72 (+000,+320)
 CB RR(2)-OPEN, V44
 FDAI (180,282,300)
 V77 ATT CONT-
 65 CONTACT MODE CONT
 CONFIRM CAPTURE FROM CSM
 MODE CONT (BOTH)-OFF

3/6/72 Final

PDI SUMMARY DATA

PAGE	ABORT	INS			BOOST	HAM	CSI		CDH			TPI	AIM		
		TIME PDI+	N76	HA/HINS			TIME INS+	ΔVX	TIME INS+	ΔVX	ΔVZ		TIME PDI+	ΔVX	ΔVZ
A-1	NO 1+12	NA	NA	NA	NA	NA	1+00+00*	46.4	2+02+17*	-121.0	-62.7	2+48+42	12+00	102.3	-50.0
A-2	1+00	2+05	5655.2	137.3/55316.	NA	NA	0+55+00	50.2	1+57+17	-120.3	-42.9	2+47+19	NA	NA	NA
	2+00	3+59	5650.3	136.1/60016.	↓	↓	↓	48.2	1+57+12	-117.9	-39.6	↓	↓	↓	↓
	3+00	5+41	5646.3	132.8/60018.	↓	↓	↓	47.7	1+57+02	-113.5	-33.7	↓	↓	↓	↓
	4+00	7+18	5639.3	127.2/60023.	↓	↓	↓	47.5	1+56+46	-106.2	-24.9	↓	↓	↓	↓
	5+00	8+49	5629.8	119.6/60030.	↓	↓	↓	47.3	1+56+25	-96.8	-14.2	↓	↓	↓	↓
	6+00	10+13	5617.2	109.6/60038.	↓	↓	↓	47.5	1+55+59	-84.3	-1.1	↓	↓	↓	↓
	7+00	12+27	5597.2	97.0/65209.	↓	↓	↓	46.0	1+55+24	-67.8	13.6	↓	↓	↓	↓
A-3	8+00	14+29	5570.9	80.0/70999.	↓	↓	↓	44.5	1+54+38	-45.6	30.2	↓	↓	↓	↓
	9+00	16+06	5546.2	63.2/74096.	↓	↓	↓	43.7	1+53+52	-23.0	43.4	↓	↓	↓	↓
	10+00	17+15	5529.7	49.9/71992.	↓	↓	↓	44.0	1+53+16	-4.7	51.0	↓	↓	↓	↓
A-4	11+00	18+20	5554.2	65.7/67668.	50+00	1+50+00	2+40+00	35.3	3+38+59	-26.1	-37.3	4+46+08	NA	NA	NA
	12+00	19+23	5550.5	59.9/62010.	↓	↓	↓	38.0	3+38+46	-19.8	-23.2	↓	↓	↓	↓
	13+00	20+26	5541.9	52.7/60244.	↓	↓	↓	39.9	3+38+29	-11.5	-6.1	↓	↓	↓	↓
	14+00	21+26	5534.3	47.2/60242.	↓	↓	↓	40.7	3+38+16	-4.8	6.2	↓	↓	↓	↓
	15+00	22+25	5526.7	41.7/60241.	↓	↓	↓	41.2	3+38+02	2.2	17.4	↓	↓	↓	↓
	16+00	23+25	5519.1	36.2/60239.	↓	↓	↓	41.6	3+37+48	9.4	27.7	↓	↓	↓	↓
	17+00	24+24	5511.5	30.8/60238.	↓	↓	↓	41.8	3+37+34	16.9	36.9	↓	↓	↓	↓
A-5	T2-1	7+22n	5510.4	29.8/60154.	50+00	3+50+00	4+40+00	36.5	5+37+20	23.0	54.4	6+44+52	NA	NA	NA
A-6	NO 2+12	NA	NA	NA	1+07+00*	2+07+00*	3+07+00*	39.3	4+09+42*	-129.6	2.0	4+50+48	12+00	112.0	-50.0
A-7	1+00	2+07	5666.7	146.3/54651.	1+00+00	2+00+00	3+00+00	40.9	4+02+43	-132.1	-9.3	4+50+55	NA	NA	NA
	2+00	4+00	5661.5	145.2/60017.	↓	↓	↓	38.7	4+02+38	-129.9	-6.8	↓	↓	↓	↓
	3+00	5+43	5659.5	143.6/60019.	↓	↓	↓	38.1	4+02+32	-127.2	-1.4	↓	↓	↓	↓
	4+00	7+19	5656.2	140.9/60024.	↓	↓	↓	37.5	4+02+24	-123.4	6.7	↓	↓	↓	↓
	5+00	8+50	5651.5	137.1/60031.	↓	↓	↓	37.2	4+02+13	-118.2	17.3	↓	↓	↓	↓
	6+00	10+15	5645.6	132.3/60039.	↓	↓	↓	36.7	4+01+59	-112.0	29.4	↓	↓	↓	↓
A-8	7+00	12+32	5657.3	145.0/65451.	NA	NA	0+55+00	43.7	1+57+30	-125.5	-52.6	2+52+06	NA	NA	NA
	8+00	14+33	5632.3	128.0/71163.	↓	↓	↓	43.3	1+56+46	-105.7	-26.5	↓	↓	↓	↓
	9+00	16+10	5609.0	111.2/74179.	↓	↓	↓	43.3	1+56+01	-85.4	-4.0	↓	↓	↓	↓
	10+00	17+19	5593.7	98.0/72050.	↓	↓	↓	44.2	1+55+26	-68.9	11.5	↓	↓	↓	↓
A-9	11+00	18+22	5581.0	85.9/67701.	↓	↓	↓	45.4	1+54+54	-53.4	23.9	↓	↓	↓	↓
	12+00	19+24	5569.4	74.0/62035.	↓	↓	↓	46.8	1+54+22	-37.8	34.3	↓	↓	↓	↓
	13+00	20+26	5551.4	59.7/60246.	↓	↓	↓	47.2	1+53+43	-18.6	44.5	↓	↓	↓	↓
A-10	14+00	21+26	5536.6	48.8/60243.	↓	↓	↓	47.1	1+53+14	-3.6	50.7	↓	↓	↓	↓
	15+00	22+25	5521.5	37.9/60240.	↓	↓	↓	46.8	1+52+44	11.7	55.1	↓	↓	↓	↓
A-4	T2-2	7+22n	5510.4	29.8/60154.	50+00	1+50+00	2+40+00	42.0	3+37+31	17.9	38.9	4+50+52	NA	NA	NA

n 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

3/1/72

PAGE	ABORT	INS		BOOST		HAM		CSI		CDH	
	TIME PDI+	RANGE	RANGE RATE	RANGE	RANGE RATE	RANGE	RANGE RATE	RANGE	RANGE RATE	RANGE	RANGE RATE
A-1	NO 1+12	NA	NA	NA	NA	NA	NA	193.3	-526.5	104.3	-109.6
A-2	01+00	160.9	559.5	NA	NA	NA	NA	178.2	-526.3	105.3	-123.0
	02+00	157.5	545.2	↓	↓	↓	↓	173.2	-514.9	101.2	-123.1
	03+00	143.7	526.8	↓	↓	↓	↓	159.1	-491.3	100.4	-129.1
	04+00	119.0	493.6	↓	↓	↓	↓	135.5	-447.3	101.5	-112.0
	05+00	84.1	414.6	↓	↓	↓	↓	101.6	-373.1	98.5	-136.3
	06+00	49.9	85.5	↓	↓	↓	↓	58.4	-224.1	96.7	-149.7
	07+00	74.4	-428.8	↓	↓	↓	↓	33.2	243.6	96.4	-157.6
A-3	08+00	149.9	-468.5	↓	↓	↓	↓	86.2	196.7	96.1	-168.7
	09+00	224.5	-446.9	↓	↓	↓	↓	145.0	60.2	94.1	-176.6
	10+00	283.6	-424.8	↓	↓	↓	↓	190.7	-46.0	94.4	-182.2
A-4	11+00	335.5	-443.0	263.0	75.6	212.3	-378.0	81.5	24.3	99.3	-88.2
	12+00	387.7	-429.2	311.8	32.1	236.2	-385.3	106.5	-6.0	98.7	-101.2
	13+00	437.3	-415.9	357.9	-9.7	258.9	-390.0	131.1	-57.9	97.5	-111.8
	14+00	487.5	-402.0	404.2	-52.8	282.0	-392.2	153.0	-68.3	96.0	-121.2
	15+00	537.5	-388.0	450.1	-96.4	305.0	-392.3	175.9	-102.6	95.4	-130.6
	16+00	587.1	-374.0	495.3	-140.6	328.1	-390.4	198.2	-139.0	93.4	-138.2
	17+00	636.3	-359.8	540.0	-185.3	351.2	-386.7	220.1	-177.4	92.3	-149.4
A-5	T2-1	983.5	-305.9	895.9	-197.7	362.6	-350.9	245.2	-206.3	84.5	-154.7
A-6	NO 2+12	NA	NA	381.6	-726.1	158.0	468.2	195.2	-618.9	95.9	-160.2
A-7	01+00	381.1	618.1	373.0	-718.7	143.8	479.3	193.2	-611.4	103.9	-165.2
	02+00	378.2	604.0	368.1	-707.7	144.6	468.7	190.2	-603.0	99.1	-163.7
	03+00	364.3	594.8	352.8	-695.9	137.3	465.8	180.2	-588.6	101.1	-158.2
	04+00	338.8	583.8	327.3	-674.3	126.0	464.8	166.2	-565.8	99.2	-165.6
	05+00	300.2	570.2	289.8	-642.7	108.7	463.4	146.2	-530.3	97.3	-175.8
	06+00	247.0	551.9	238.9	-597.2	85.8	455.0	120.4	-475.0	96.4	-178.8
A-8	07+00	178.7	544.3	NA	NA	NA	NA	188.6	-540.8	102.7	-123.9
	08+00	99.5	455.1	↓	↓	↓	↓	115.8	-406.9	101.2	-135.0
	09+00	48.7	40.3	↓	↓	↓	↓	55.2	-203.7	98.1	-152.8
	10+00	69.8	-414.7	↓	↓	↓	↓	32.1	211.8	97.1	-156.9
A-9	11+00	114.4	-470.5	↓	↓	↓	↓	58.2	260.1	94.6	-164.5
	12+00	164.5	-466.4	↓	↓	↓	↓	97.0	166.5	92.1	-168.9
	13+00	213.5	-451.3	↓	↓	↓	↓	135.3	74.9	91.6	-171.7
A-10	14+00	264.0	-432.4	↓	↓	↓	↓	174.2	-18.6	90.7	-175.7
	15+00	314.6	-412.2	↓	↓	↓	↓	212.5	-112.5	88.3	-175.1
A-4	T2-2	654.0	-356.5	556.8	-194.8	363.0	-386.3	231.6	-185.9	93.2	-141.3

60 INSERTION

SS V82
 AGS MODE CONT-ATT HOLD
 SHFT/TRUN ± 5
 RATE SCALE 5°/SEC
 RNG/ALT MON-RNG/RNG RT
 *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/CMPT
 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

ATT CONT-
 PULSE
 MODE CONT-
 AUTO

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 *

30

20

INSERTION THRU BOOST

MISSION APOLLO 16, FEBRUARY 29, 1972

20

18

*CHECK RCS, EPS, ECS *

10

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

SR

*EXT LTG-OFF *

 $\Delta V_X = +10.0$ (HORZ)

P30

N33 TIG BOOST (INS + ΔT)

*373 + TIG BOOST *

IF STAGING @ BOOST

V48, 12022, PRO, V34

P4T, V77

*404+0, 405+0, 406+0 *

*400+1 GUID STEER

*410+5 LOAD ΔV

*500R

ATT CONT-
 MODE CONT

:05

*500R

*A/H

STAGE AT BOOST IGNITION

O BOOST

BOOST THRU HAM

MISSION APOLLO 16, NOVEMBER 7, 1971

60 BOOST

P00
V82
V76ATT CONT-
PULSE
MODE CONT-
AUTO

*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 *

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

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 (7417+0) *]
 [*411+1 START AUTO(19,19) *]

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

36

R

33

RDOT R

30

RDOT R

27

RDOT R

M=10, V32

24

RDOT R

21

RDOT R

18

*CHECK RCS, EPS, ECS *

RDOT R

15

V90

RDOT R

12

*402R *

RDOT R

10 PRO-FINAL COMP

*411+0 STOP AUTO *
 *USE HAM CHART *
 *COMPARE CMC HAM *

R

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

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

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

ATT CONT-
MODE CONT

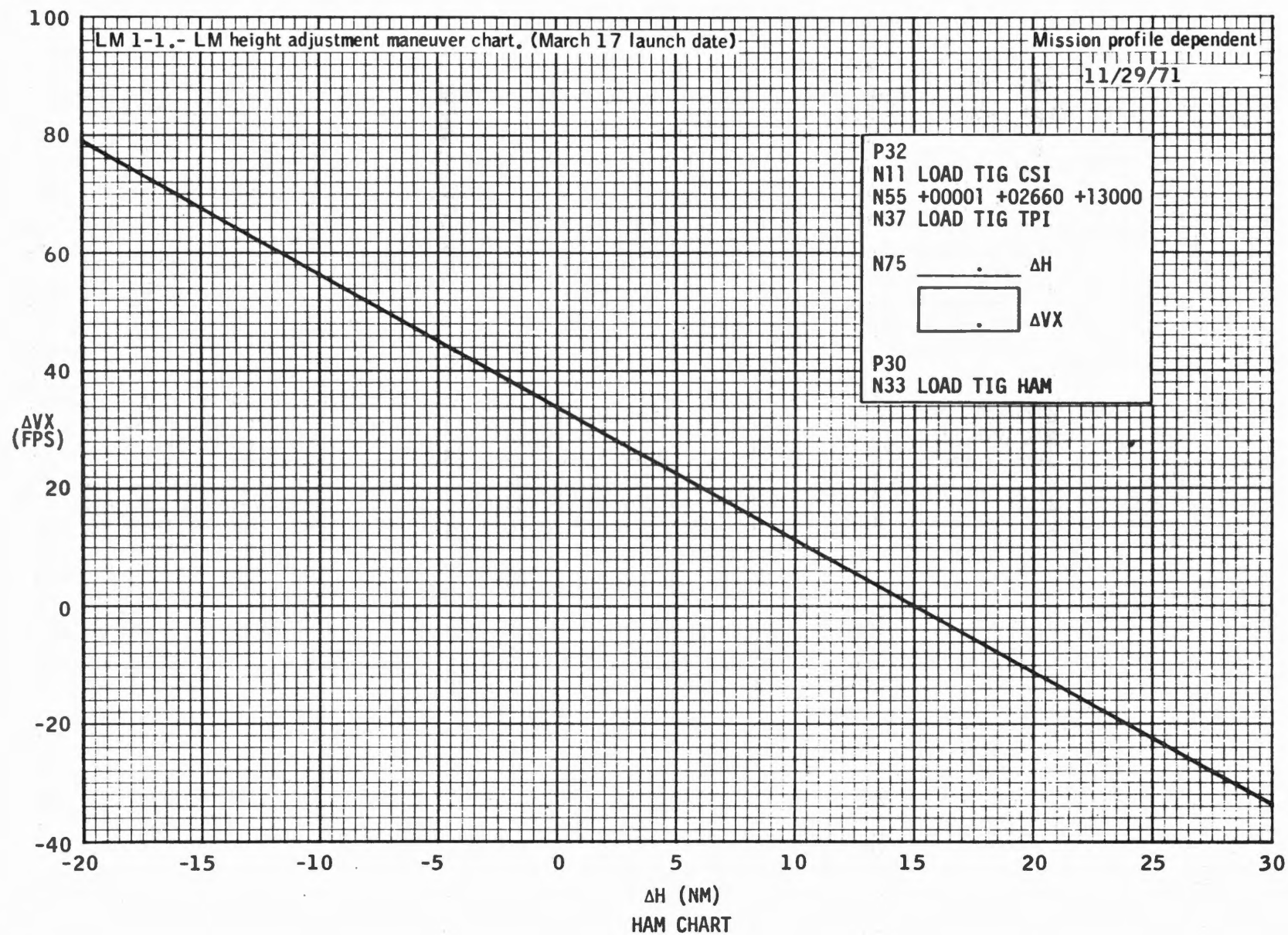
:05 *500R

A/H

O HAM

P00
V82

5-11



TIME	RANGE	RDOT
INS	282	-453
1+00	278	-449
2+00	273	-444
3+00	269	-439
4+00	264	-433
5+00	260	-427
6+00	256	-420
7+00	252	-413
8+00	248	-405
9+00	244	-397
10+00	240	-389

NOM COELLIPTIC/ONE REV ABORTS

INSERTION

V82

AGS MODE CONT-ATT HOLD

RR MODE-LGC

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 TRACK

*623+0

*410+1 TGT CSI

*373+ TIG CSI

*275+ TIG TPI

*416+1 T/2 PERIOD

*310R SET DET

*COPY AGS DATA(450R)

INS/HAM THRU CSI

V48, 11002

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 NUNKI (37)

2nd STAR SPICA (26)

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

*EXT LTG-TRACK

PRO N25(R1=14) GET

PRO N25(R1=15)

PRO TO PICAPAIR

DETENT CL

CB AOT LAMP-OPEN

*EXT LTG-TRACK

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)

*411+1 START AUTO(19,19)

V83 SET ORDEAL (35NM)

*317R, 440R, 277R

V48, 11002

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 NUNKI (37)

2nd STAR SPICA (26)

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

*EXT LTG-TRACK

PRO N25(R1=14) GET

PRO N25(R1=15)

PRO TO PICAPAIR

DETENT CL

CB AOT LAMP-OPEN

*EXT LTG-TRACK

PRO N25(R1=14) GET

PRO N25(R1=15)

PRO TO PICAPAIR

DETENT CL

CB AOT LAMP-OPEN

*EXT LTG-TRACK

PRO N25(R1=14) GET

PRO N25(R1=15)

PRO TO PICAPAIR

DETENT CL

CB AOT LAMP-OPEN

*EXT LTG-TRACK

PRO N25(R1=14) GET

PRO N25(R1=15)

PRO TO PICAPAIR

DETENT CL

CB AOT LAMP-OPEN

*EXT LTG-TRACK

PRO N25(R1=14) GET

PRO N25(R1=15)

PRO TO PICAPAIR

DETENT CL

CB AOT LAMP-OPEN

*EXT LTG-TRACK

PRO N25(R1=14) GET

PRO N25(R1=15)

PRO TO PICAPAIR

DETENT CL

CB AOT LAMP-OPEN

*EXT LTG-TRACK

PRO N25(R1=14) GET

PRO N25(R1=15)

PRO TO PICAPAIR

DETENT CL

CB AOT LAMP-OPEN

*EXT LTG-TRACK

PRO N25(R1=14) GET

PRO N25(R1=15)

PRO TO PICAPAIR

DETENT CL

CB AOT LAMP-OPEN

*EXT LTG-TRACK

PRO N25(R1=14) GET

PRO N25(R1=15)

PRO TO PICAPAIR

DETENT CL

CB AOT LAMP-OPEN

*EXT LTG-TRACK

PRO N25(R1=14) GET

PRO N25(R1=15)

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CB AOT LAMP-OPEN

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CB AOT LAMP-OPEN

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PRO N25(R1=15)

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DETENT CL

CB AOT LAMP-OPEN

*EXT LTG-TRACK

PRO N25(R1=14) GET

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CB AOT LAMP-OPEN

*EXT LTG-TRACK

PRO N25(R1=14) GET

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DETENT CL

CB AOT LAMP-OPEN

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PRO N25(R1=14) GET

PRO N25(R1=15)

PRO TO PICAPAIR

DETENT CL

CB AOT LAMP-OPEN

*EXT LTG-TRACK

PRO N25(R1=14) GET

PRO N25(R1=15)

PRO TO PICAPAIR

DETENT CL

CB AOT LAMP-OPEN

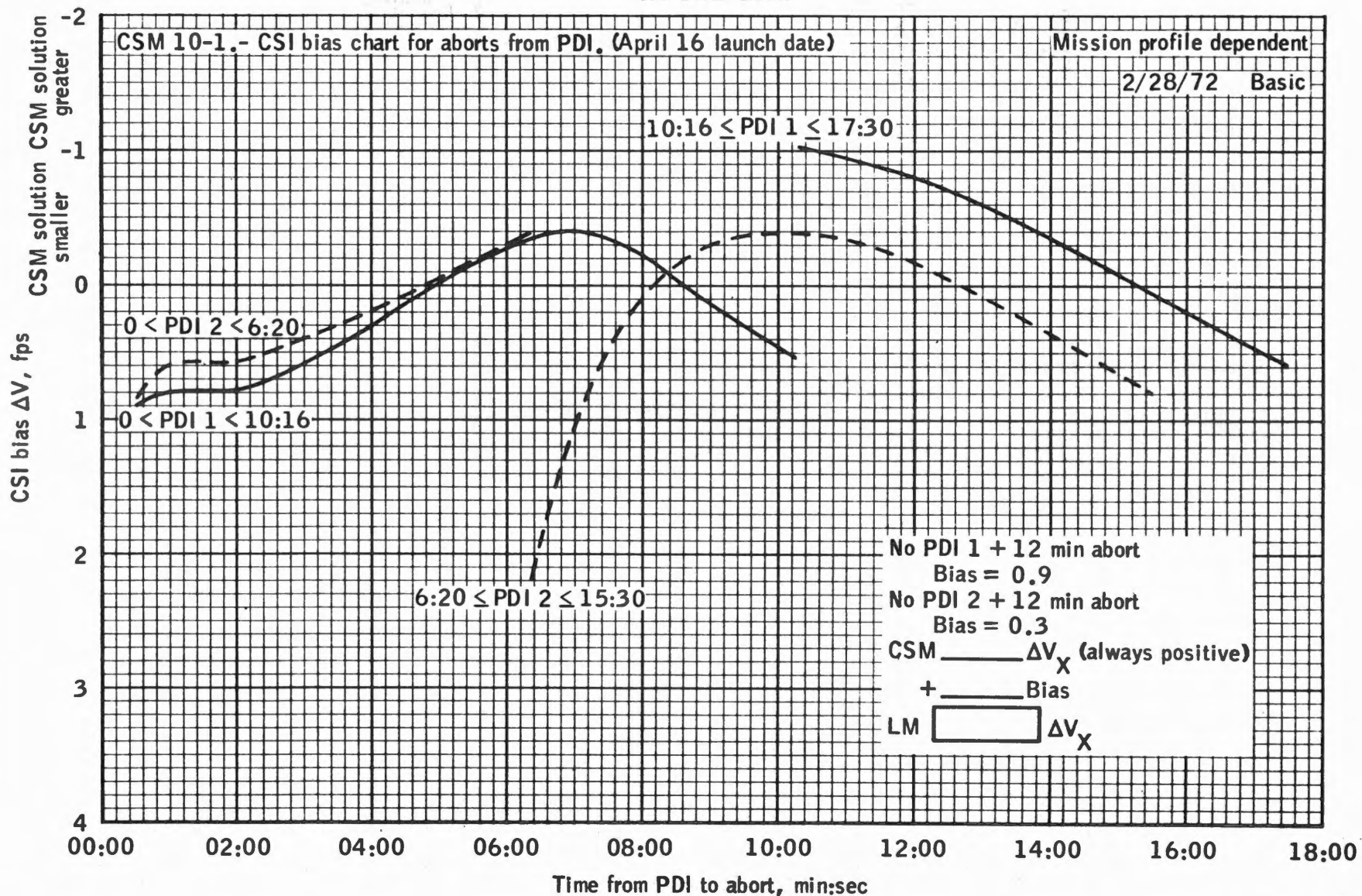
*EXT LTG-TRACK

PRO N25(R1=14) GET

PRO N25(R1=15)

CSI BIAS CHART

5-13



SR

58 CSI
 V76
 P33 TGT CDH
 MAX N49(0.80,5.0)
 V67 (+02000,+00020,+00005)
 ATT CONT-PULSE
 MODE CONT-AUTO
 *417+1 (✓621+0) *
 *410+2 TGT CDH *
 *373R TM CDH *
 *310R SET DET *
 *COPY AGS DATA *
 55 *411+1 START AUTO(19,19)*
 V82
 V83 SET ORDEAL (45NM)
 *317R, 440R, 277R *
 54
 51 M=7, V32
 48 V90, LOAD CDH-30
 *COMPARE CMC,AGS,VHF/RR *
 45
 M=15, V32
 42

CSI THRU CDH

39 V34, P30 (PC ONLY) RDOT }R
 38 *411+0 STOP AUTO *
 V90 LOAD CDH-30
 OBTAIN CMC LM YDOT
 36 CHART RDOT RDOT }R
 P41, V77
 *373+ TIG PC
 35 *410+5 LOAD ΔV ATT CONT-
 *263R MODE CONT
 *501R *
 :05 *270R/501R A/H
 30 PLANE CHANGE
 AOS
 S-BD ANT-FWD,VERIFY COMM
 */S-BD P (-7) *
 Y (+22) *
 *S-BD ANT-SLEW (>3.0) *
 *TRACK MODE-AUTO *
 *BIOMED-LEFT, PCM-HI *
 *UPLINK SQUELCH-OFF *
 CSI BURN REPORT
 TIG,ΔV'S, RESIDUALS
 V76
 P33 TGT CDH ATT CONT-PULSE
 V93 MODE CONT-AUTO
 *VERIFY PGNS WITH MSFN *
 *V47, 414+1, 400+3 *
 *400+2 Z-AXIS STEER *
 *410+2 TGT CDH *
 *373+ TIG CDH IF PC *
 *451+0 YDOT *
 *COPY AGS DATA *
 28 *411+1 START AUTO *
 27

MISSION APOLLO 16, FEBRUARY 29, 1972

24 RDOT }R
 23 CHART RDOT
 21 RDOT }R
 M=7, V32
 *COMPARE CMC,AGS,VHF/RR *
 18 RDOT }R
 *CHECK RCS, EPS, ECS *
 15 RDOT }R
 V90 OBTAIN CMC LM YDOT
 12 RDOT }R
 10 CHART RDOT *
 PRO-FINAL COMP
 N81 LOAD CMC LM YDOT
 9 RDOT }R
 *411+0 STOP AUTO *
 *VERIFY PGNS (PCM-HI) *
 *V47, 414+1, 400+3 *
 *400+2 Z-AXIS STEER *
 *COPY AGS DATA *
 V83, SET ORDEAL *
 *317R, 440R, 277R *
 P41, V77, N86
 (LARGE ΔV USE APS OR DPS)
 5 *410+5 ATT CONT-
 *370R TOT ΔV MODE CONT
 *500R *
 *502R *
 :05 *500R/502R A/H
 :00 CDH
 NULL RESIDUALS

CDH THRU TPI

MISSION APOLLO 16, FEBRUARY 29, 1972

5-15

53 CDH
V76
P34 TGT TPI ATT CONT-PULSE
MAX N49(0.80,5.0) MODE CONT-AUTO
V93
*417+1 (/621+0) *
*SET DET *
V82
*410+3 TPI SRCH *
*310+TIME TO TPI *
*303R @ TPI *
*410+4 (When 303=26.6) *
43 *411+1 START AUTO(19,19)*
*POLAR PLOT @ 75 NM *
31OR
42 }R
39 M=7, V32 RDOT }R
*COMPARE TPI TIME *
36 RDOT }R
33 RDOT }R
30 RDOT }R
27 RDOT }R
SS *MONITOR 303R @ TPI AND *
*RETARGET IF REQ *
*COPY AGS DATA *
24 RDOT }R
M=15, V32
*COMPARE CMC, AGS, VHF/RR *
*VOICE LM TPI TIME *
* TO CSM *
21 RDOT }R
18 RDOT }R
*CHECK RCS, EPS, ECS *

15 RDOT }R
*MATCH INDICATED ANGLES *
*TRACK MODE-SLEW *
*S-BD ANT-AFT *
SET P (+236) *
Y (+51) *
*BIOMED-OFF, PCM-HI *
*UPLINK SQUELCH-ENABLE *
12 RDOT }R
*VERIFY PGNS (PCM-HI) *
*411+0 STOP AUTO *
*V47, 414+1, 400+3 *
*400+2 Z-AXIS STEER *
10 PRO-FINAL COMP
TIG TO CSM
*SET DET *
9 CHART @ RDOT }R
*411+0 STOP AUTO *
*410+3 *
*310+TIME TO TPI *
*303R @ TPI *
*410+4 (WHEN 303=26.6) *
*310R / WITH DET *
*COPY AGS DATA *
5 CHART R/RDOT/@
P41, V77, N86
*404+0, 405+0, 406+0 *
4 *410+5 LOAD ΔV & TIG *
*507+1 THR Z-AXIS ATT CONT-
*502R MODE CONT
05 *472R/502R *A/H
00 TPI
NULL RESIDUALS

0 TPI
V76
*507+0 Z-AXIS TRACK *
P35 TGT MCC 1 ATT CONT-PULSE
MAX N49(0.80,5.0) MODE CONT-AUTO
V93
*417+1 (/621+0) *
*411+1 START AUTO(13,12) *
2 *410+4 TPI EXEC *
*373+TPI TIME +15 MIN *
*307+028.00 *
4 RDOT }R
6 RDOT }R
8 RDOT }R
9 CHART 0 *
10 RDOT }R
12 PRO FINAL COMP RDOT }R
13 CHART R/RDOT/0
*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

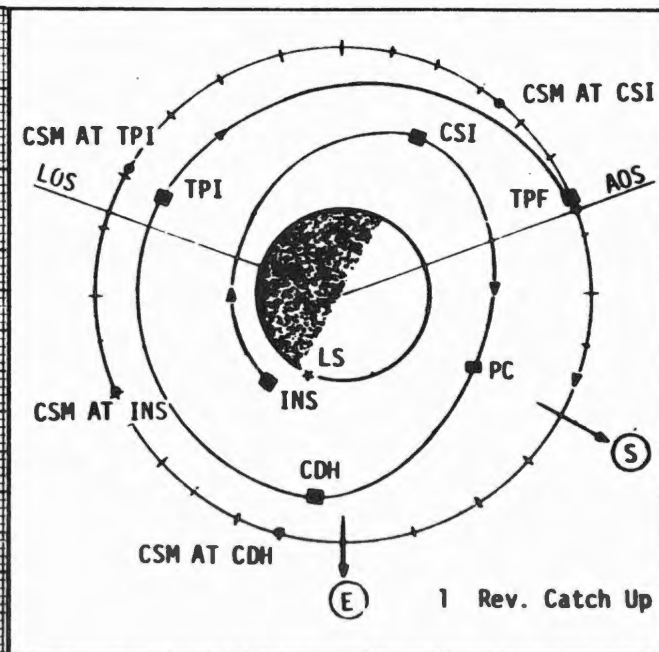
TPI THRU DOCKING

V76
P35 TGT MCC 2 ATT CONT-PULSE
V93 MODE CONT-AUTO
*VERIFY PGNS (PCM-HI) *
*V47,414+1,400+3 *
*400+2 Z-AXIS STEER *
*411+1 START AUTO *
17 *410+4 TPI EXEC *
*373+TPI TIME +30 MIN *
*307+013.00 *
*EXT LTG-OFF *
19 RDOT }R
21 RDOT }R
23 RDOT }R
24 CHART 0 *
25 RDOT }R
27 PRO-FINAL COMP RDOT }R
28 CHART R/RDOT/0
*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

MISSION APOLLO 16, FEBRUARY 29, 1972

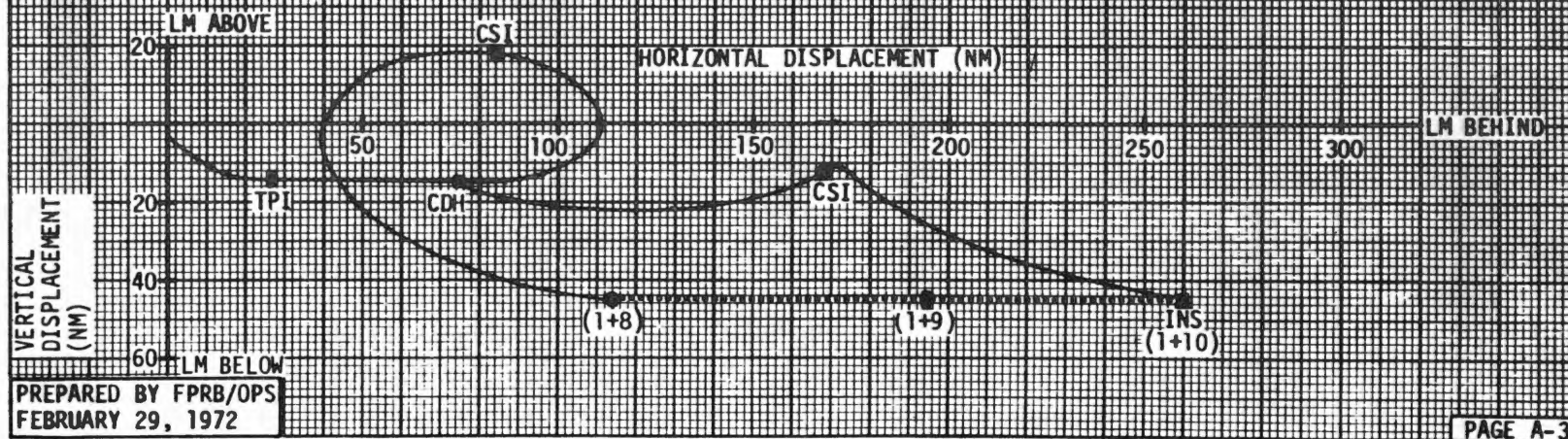
CB(11) ECS CABIN FAN1-CLOSE
P00
V48, 11002
P47, V63
*404+0, 405+0, 406+0 *
TPI BURN REPORT
40 INITIATE BRAKING
30 FPS - 6000 FT
20 FPS - 3000 FT
10 FPS - 1500 FT
5 FPS - 600 FT
*SETUP CAMERA FOR *
* DOCKING: *
*LM3/DAC/10/CEX-ULC *
* (T8,1/250,6) 1FPS *
* .25 MAG(0), (4MIN) *
V34, P00
V76 ATT CONT-PULSE
MANEUVER/PICTURES OF SIMBAY,RCS
55 INITIATE DOCKING
COAS TO OVHD WINDOW
*EXT LTG-DOCK *
SHFT/TRUN ±50 *
V41N72 (+000,+320)
CB RR(2)-OPEN, V44
S-BD ANT-FWD,VERIFY COMM
*/S-BD P (+236) *
Y (+51) *
*S-BD ANT-SLEW (>3.0) *
*TRACK MODE-AUTO *
*BIOMED-LEFT, PCM-HI *
*UPLINK SQUELCH-OFF *
FDAI (180,290,300)
V77 ATT CONT-
65 CONTACT MODE CONT
CONFIRM CAPTURE FROM CSM
MODE CONT (BOTH)-OFF
POST DOCKING PROCEDURES

EVENT	GET TIG
INS	
CSI	
PC	
CDH	
TPI	

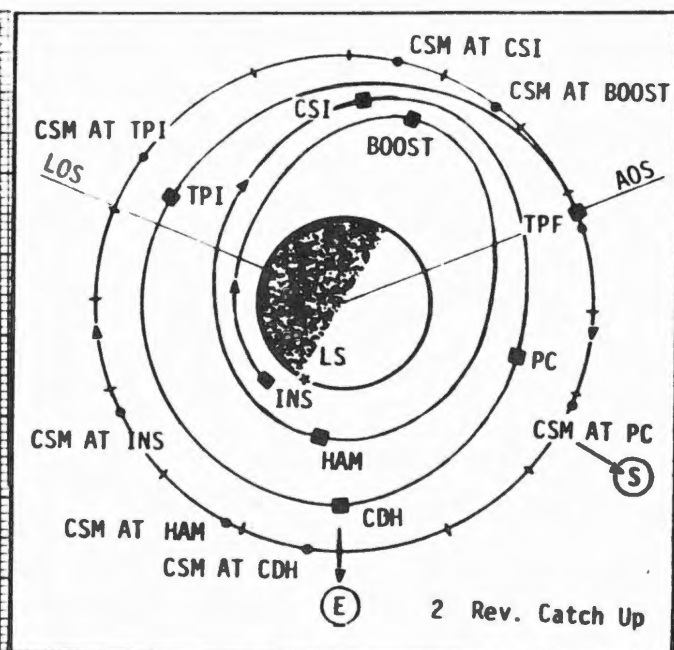


APOLLO 16/17 MISSIONS
INERTIAL AND RELATIVE PLOTS

$$8 \leq \text{PDI} \leq 10$$



EVENT	GET TIG
INS	
BOOST	
HAM	
CSI	
PC	
CDH	
TPI	



APOLLO 16/17 MISSIONS
INERTIAL AND RELATIVE PLOTS
1. $11 < \text{PDI} \leq 17$
2. T2-2

VERTICAL
DISPLACEMENT (NM)

LM AHEAD

LM ABOVE

HORIZONTAL DISPLACEMENT (NM)

LM BEHIND

LM BELOW

PREPARED BY FPRB/OPS
FEBRUARY 29, 1972

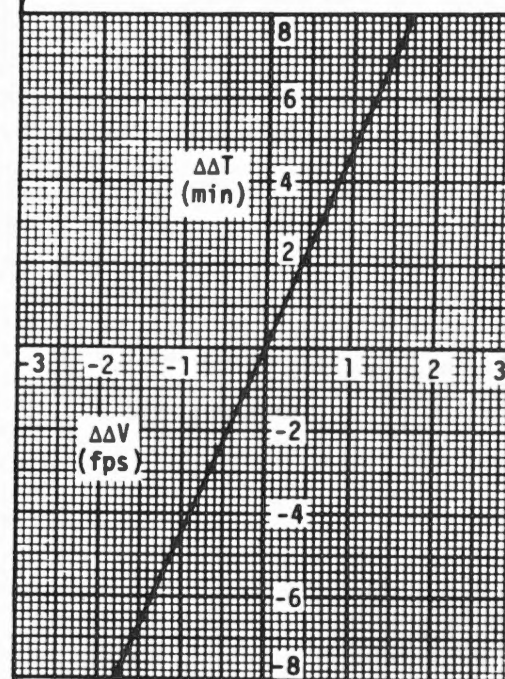
PAGE A-4

RDOT1	F1	RDOT2	F2	RDOT3	F3	R3	F4	CSI BACKUP TABLE NOMINAL ASCENT	
-240.0	47.3	-140.0	45.2	-70.0	-27.6	120.0	-15.2	TIME	NOMINAL
-241.0	48.4	-141.0	43.4	-71.0	-26.6	121.0	-15.5	(Min)	
-242.0	49.4	-142.0	41.6	-72.0	-25.6	122.0	-15.7		DSKY>TM
-243.0	50.5	-143.0	39.8	-73.0	-24.5	123.0	-15.9	-30 R1	(-283.3) -1.4
-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	-20 R2	(-173.9) -.9
-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	-10 R3	(- 94.0) -.5
-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	-10 R3	(154.1)
-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	F1	(93.0)
-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	+F2	(-17.3)
-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		(75.7)
-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	+F3	(-2.8)
-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		(72.9)
-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	+F4	(- 22.4)
-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		(50.5)
-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	+ΔΔVCSI	(0.0)
-266.0	74.6	-166.0	-2.6	-96.0	-.7	146.0	-20.7	ΔVCSI	(50.5)
-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		

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

$\Delta \Delta T$ ____:____

$\Delta \Delta VCSI$

PREPARED BY FPRB/OPS
APRIL 19, 1971

DIRECT ASCENT TPI BACKUP TABLE TWEAK

R1	V1	R1	V1	R1	V2	R1	V2	R1	V2	CSM A+P	V3
40.	343.0	90.	860.5	-412.	-82.0	-362.	-117.8	-312.	-164.1	95.	-467.0
41.	844.2	91.	860.4	-411.	-82.7	-361.	-118.6	-311.	-165.2	96.	-469.7
42.	345.3	92.	860.2	-410.	-83.3	-360.	-119.4	-310.	-166.3	97.	-472.1
43.	846.4	93.	860.1	-409.	-84.0	-359.	-120.2	-309.	-167.4	98.	-474.4
44.	847.4	94.	859.9	-408.	-84.7	-358.	-121.0	-308.	-168.5	99.	-476.5
45.	848.4	95.	859.8	-407.	-85.3	-357.	-121.8	-307.	-169.7	100.	-478.4
46.	849.3	96.	859.7	-406.	-86.0	-356.	-122.6	-306.	-170.8	101.	-480.2
47.	850.2	97.	859.5	-405.	-86.7	-355.	-123.4	-305.	-171.9	102.	-481.8
48.	851.0	98.	859.4	-404.	-87.3	-354.	-124.3	-304.	-173.1	103.	-483.3
49.	851.9	99.	859.3	-403.	-88.0	-353.	-125.1	-303.	-174.2	104.	-484.6
50.	352.6	100.	859.1	-402.	-88.7	-352.	-125.9	-302.	-175.4	105.	-485.7
51.	853.4	101.	859.0	-401.	-89.4	-351.	-126.8	-301.	-176.6	106.	-486.8
52.	854.0	102.	858.9	-400.	-90.0	-350.	-127.6	-300.	-177.7	107.	-487.7
53.	854.7	103.	858.8	-399.	-90.7	-349.	-128.5	-299.	-178.9	108.	-488.5
54.	855.3	104.	858.6	-398.	-91.4	-348.	-129.3	-298.	-180.1	109.	-489.2
55.	855.9	105.	858.5	-397.	-92.1	-347.	-130.2	-297.	-181.3	110.	-489.7
56.	856.4	106.	858.4	-396.	-92.8	-346.	-131.1	-296.	-182.5	111.	-490.2
57.	857.0	107.	858.4	-395.	-93.5	-345.	-131.9	-295.	-183.7	112.	-490.6
58.	857.4	108.	858.3	-394.	-94.2	-344.	-132.8	-294.	-185.0	113.	-490.9
59.	857.9	109.	858.2	-393.	-94.9	-343.	-133.7	-293.	-186.2	114.	-491.0
60.	858.3	110.	858.2	-392.	-95.6	-342.	-134.6	-292.	-187.5	115.	-491.2
61.	858.7	111.	858.1	-391.	-96.3	-341.	-135.5	-291.	-188.7	116.	-491.2
62.	859.0	112.	858.1	-390.	-97.0	-340.	-136.4	-290.	-190.0	117.	-491.2
63.	859.4	113.	858.1	-389.	-97.7	-339.	-137.3	-289.	-191.3	118.	-491.1
64.	859.7	114.	858.1	-388.	-98.4	-338.	-138.2	-288.	-192.5	119.	-490.9
65.	859.9	115.	858.1	-387.	-99.1	-337.	-139.1	-287.	-193.8	120.	-490.7
66.	860.2	116.	858.1	-386.	-99.8	-336.	-140.0	-286.	-195.1	121.	-490.5
67.	860.4	117.	858.2	-385.	-100.5	-335.	-141.0	-285.	-196.4	122.	-490.2
68.	860.6	118.	858.3	-384.	-101.2	-334.	-141.9	-284.	-197.8	123.	-489.9
69.	860.8	119.	858.3	-383.	-101.9	-333.	-142.8	-283.	-199.1	124.	-489.6
70.	860.9	120.	858.4	-382.	-102.6	-332.	-143.8	-282.	-200.4	125.	-489.2
71.	861.1	121.	858.6	-381.	-103.4	-331.	-144.7	-281.	-201.8	126.	-488.8
72.	861.2	122.	858.7	-380.	-104.1	-330.	-145.7	-280.	-203.1	127.	-488.4
73.	861.2	123.	858.9	-379.	-104.8	-329.	-146.7	-279.	-204.5	128.	-488.1
74.	861.3	124.	859.1	-378.	-105.6	-328.	-147.6	-278.	-205.9	129.	-487.7
75.	861.4	125.	859.3	-377.	-106.3	-327.	-148.6	-277.	-207.3	130.	-487.3
76.	861.4	126.	859.6	-376.	-107.0	-326.	-149.6	-276.	-208.6	131.	-486.9
77.	861.4	127.	859.9	-375.	-107.8	-325.	-150.6	-275.	-210.1	132.	-486.6
78.	861.4	128.	860.2	-374.	-108.5	-324.	-151.6	-274.	-211.5	133.	-486.3
79.	861.4	129.	860.5	-373.	-109.3	-323.	-152.6	-273.	-212.9	134.	-486.0
80.	861.4	130.	860.8	-372.	-110.0	-322.	-153.6	-272.	-214.3	135.	-485.8
81.	861.3	131.	861.2	-371.	-110.8	-321.	-154.6	-271.	-215.8	136.	-485.6
82.	861.3	132.	861.7	-370.	-111.5	-320.	-155.7	-270.	-217.2	137.	-485.5
83.	861.2	133.	862.1	-369.	-112.3	-319.	-156.7	-269.	-218.7	138.	-485.4
84.	861.1	134.	862.6	-368.	-113.1	-318.	-157.7	-268.	-220.2	139.	-485.4
85.	861.0	135.	863.1	-367.	-113.8	-317.	-158.8	-267.	-221.7	140.	-485.4
86.	860.9	136.	863.7	-366.	-114.6	-316.	-159.8	-266.	-223.2	141.	-485.5
87.	860.8	137.	864.2	-365.	-115.4	-315.	-160.9	-265.	-224.7	142.	-485.7
88.	860.7	138.	864.9	-364.	-116.2	-314.	-162.0	-264.	-226.2	143.	-486.0
89.	860.6	139.	865.5	-363.	-117.0	-313.	-163.0	-263.	-227.7	144.	-486.4

TPI LOGGING

TIME	TM DATA	NOMINAL
TPI - 30:00	R1 _____ (88.8)	
	R1 _____ (-335.6)	
	CSM A+P _____ (119.8)	
TPI - 10:00	R2 _____ (42.2)	
	R2 _____ (-139.1)	
	02 _____ (26.5)	
	N81	
F+/A-	D+/U-	
H1 _____ (179.7)	V1 _____ (860.6)	
H2 _____ (-107.9)	V2 _____ (-140.4)	
ΔVX _____ (71.8)	_____ (120.2)	
	V3 _____ (-490.8)	
	_____ (229.4)	
	V4 _____ (-66.8)	
	_____ (162.6)	
	V5 _____ (-48.2)	
	_____ (114.4)	
	V6 _____ (-108.1)	
	ΔVZ _____ (6.3)	

PREPARED BY FPRB/OPS
March 21, 1972

DIRECT ASCENT TPI BACKUP TABLE TWEAK

R2	V4	R2	V5	H1	R2	V5	H1	G2	V6	H2	G2	V6	H2
13.	-41.6	-230.	-20.0	170.9	-130.	-49.6	180.2	14.00	-18.8	-90.1	26.50	-103.1	-107.9
14.	-43.8	-228.	-21.1	171.2	-128.	-49.9	180.3	14.25	-20.2	-90.8	26.75	-103.9	-108.1
15.	-45.8	-226.	-22.1	171.5	-126.	-50.2	180.3	14.50	-21.6	-91.5	27.00	-111.7	-108.3
16.	-47.7	-224.	-23.1	171.8	-124.	-50.5	180.4	14.75	-23.0	-92.2	27.25	-113.5	-108.5
17.	-49.5	-222.	-24.1	172.2	-122.	-50.8	180.5	15.00	-24.5	-92.8	27.50	-115.3	-108.6
18.	-51.2	-220.	-25.1	172.4	-120.	-51.2	180.6	15.25	-26.0	-93.5	27.75	-117.1	-108.8
19.	-52.8	-218.	-26.1	172.7	-118.	-51.5	180.6	15.50	-27.5	-94.1	28.00	-118.8	-109.0
20.	-54.2	-216.	-27.0	173.0	-116.	-51.8	180.7	15.75	-29.0	-94.7	28.25	-120.5	-109.2
21.	-55.6	-214.	-27.9	173.3	-114.	-52.1	180.8	16.00	-30.6	-95.2	28.50	-122.2	-109.4
22.	-56.8	-212.	-28.7	173.6	-112.	-52.4	180.9	16.25	-32.2	-95.8	28.75	-123.9	-109.6
23.	-58.0	-210.	-29.6	173.8	-110.	-52.7	180.9	16.50	-33.8	-96.3	29.00	-125.6	-109.8
24.	-59.1	-208.	-30.4	174.1	-108.	-53.0	181.0	16.75	-35.5	-96.8	29.25	-127.2	-110.1
25.	-60.0	-206.	-31.2	174.3	-106.	-53.3	181.1	17.00	-37.2	-97.3	29.50	-128.8	-110.3
26.	-60.9	-204.	-32.0	174.6	-104.	-53.7	181.1	17.25	-38.9	-97.8	29.75	-130.4	-110.5
27.	-61.7	-202.	-32.7	174.8	-102.	-54.0	181.2	17.50	-40.6	-98.3	30.00	-132.0	-110.7
28.	-62.5	-200.	-33.5	175.0	-100.	-54.3	181.3	17.75	-42.3	-98.7	30.25	-133.5	-111.0
29.	-63.1	-198.	-34.2	175.3	-98.	-54.7	181.3	18.00	-44.0	-99.1	30.50	-135.1	-111.2
30.	-63.7	-196.	-34.9	175.5	-96.	-55.0	181.4	18.25	-45.8	-99.6	30.75	-136.5	-111.5
31.	-64.2	-194.	-35.6	175.7	-94.	-55.4	181.5	18.50	-47.6	-100.0	31.00	-138.0	-111.8
32.	-64.7	-192.	-36.2	175.9	-92.	-55.7	181.5	18.75	-49.4	-100.4	31.25	-139.4	-112.0
33.	-65.1	-190.	-36.8	176.1	-90.	-56.1	181.6	19.00	-51.2	-100.7	31.50	-140.8	-112.3
34.	-65.4	-188.	-37.4	176.3	-88.	-56.5	181.7	19.25	-53.0	-101.1	31.75	-142.2	-112.6
35.	-65.8	-186.	-38.0	176.5	-86.	-56.9	181.7	19.50	-54.9	-101.4	32.00	-143.5	-112.9
36.	-66.0	-184.	-38.6	176.7	-84.	-57.3	181.8	19.75	-56.7	-101.8	32.25	-144.8	-113.2
37.	-66.2	-182.	-39.2	176.9	-82.	-57.7	181.9	20.00	-58.6	-102.1	32.50	-146.1	-113.6
38.	-66.4	-180.	-39.7	177.1	-80.	-58.1	181.9	20.25	-60.5	-102.4	32.75	-147.3	-113.9
39.	-66.5	-178.	-40.3	177.2	-78.	-58.5	182.0	20.50	-62.4	-102.7	33.00	-148.5	-114.3
40.	-66.6	-176.	-40.8	177.4	-76.	-59.0	182.1	20.75	-64.3	-103.0	33.25	-149.7	-114.6
41.	-66.7	-174.	-41.3	177.6	-74.	-59.4	182.1	21.00	-66.2	-103.3	33.50	-150.8	-115.0
42.	-66.8	-172.	-41.7	177.7	-72.	-59.9	182.2	21.25	-68.1	-103.6	33.75	-151.9	-115.4
43.	-66.8	-170.	-42.2	177.9	-70.	-60.4	182.3	21.50	-70.0	-103.8	34.00	-152.9	-115.8
44.	-66.8	-168.	-42.7	178.0	-68.	-60.9	182.3	21.75	-71.9	-104.1	34.25	-153.9	-116.3
45.	-66.9	-166.	-43.1	178.2	-66.	-61.4	182.4	22.00	-73.8	-104.3	34.50	-154.8	-116.7
46.	-66.9	-164.	-43.6	178.3	-64.	-61.9	182.5	22.25	-75.8	-104.6	34.75	-155.8	-117.2
47.	-66.9	-162.	-44.0	178.4	-62.	-62.5	182.6	22.50	-77.7	-104.8	35.00	-156.6	-117.6
48.	-66.9	-160.	-44.4	178.6	-60.	-63.0	182.6	22.75	-79.6	-105.0	35.25	-157.4	-118.1
49.	-66.9	-158.	-44.8	178.7	-58.	-63.6	182.7	23.00	-81.6	-105.2	35.50	-158.2	-118.6
50.	-66.9	-156.	-45.2	178.8	-56.	-64.2	182.8	23.25	-83.5	-105.4	35.75	-159.0	-119.2
51.	-66.9	-154.	-45.6	178.9	-54.	-64.8	182.9	23.50	-85.4	-105.7	36.00	-159.6	-119.7
52.	-67.0	-152.	-45.9	179.1	-52.	-65.4	183.0	23.75	-87.3	-105.9	36.25	-160.3	-120.3
53.	-67.0	-150.	-46.3	179.2	-50.	-66.1	183.1	24.00	-89.3	-106.1	36.50	-160.9	-120.8
54.	-67.1	-148.	-46.7	179.3	-48.	-66.7	183.1	24.25	-91.2	-106.3	36.75	-161.4	-121.4
55.	-67.2	-146.	-47.0	179.4	-46.	-67.4	183.2	24.50	-93.1	-106.4	37.00	-161.9	-122.1
56.	-67.4	-144.	-47.3	179.5	-44.	-68.1	183.3	24.75	-95.0	-106.6	37.25	-162.3	-122.7
57.	-67.6	-142.	-47.7	179.6	-42.	-68.9	183.4	25.00	-96.9	-106.8	37.50	-162.7	-123.4
58.	-67.8	-140.	-48.0	179.7	-40.	-69.6	183.5	25.25	-98.8	-107.0	37.75	-163.0	-124.1
59.	-68.1	-138.	-48.3	179.8	-38.	-70.4	183.6	25.50	-100.7	-107.2	38.00	-163.3	-124.8
60.	-68.4	-136.	-48.7	179.9	-36.	-71.2	183.7	25.75	-102.5	-107.4	38.25	-163.5	-125.5
61.	-68.7	-134.	-49.0	180.0	-34.	-72.0	183.8	26.00	-104.4	-107.5	38.50	-163.7	-126.2
62.	-69.2	-132.	-49.3	180.1	-32.	-72.8	183.9	26.25	-106.3	-107.7	38.75	-163.8	-127.0

DIRECT ASCENT TPI BACKUP TABLE

R1	V1	R1	V1	R1	V2	R1	V2	R1	V2
40.	2098.7	90.	2068.7	-410.	-9.3	-360.	-99.3	-310.	-148.5
41.	2097.3	91.	2068.6	-409.	-11.9	-359.	-100.5	-309.	-149.5
42.	2095.9	92.	2068.7	-408.	-14.4	-358.	-101.6	-308.	-150.4
43.	2094.5	93.	2068.7	-407.	-16.9	-357.	-102.8	-307.	-151.4
44.	2093.2	94.	2068.7	-406.	-19.4	-356.	-103.9	-306.	-152.4
45.	2092.0	95.	2068.7	-405.	-21.8	-355.	-105.1	-305.	-153.4
46.	2090.7	96.	2068.8	-404.	-24.2	-354.	-106.2	-304.	-154.4
47.	2089.6	97.	2068.8	-403.	-26.5	-353.	-107.3	-303.	-155.5
48.	2088.4	98.	2068.9	-402.	-28.8	-352.	-108.4	-302.	-156.5
49.	2087.3	99.	2069.0	-401.	-31.1	-351.	-109.5	-301.	-157.5
50.	2086.2	100.	2069.0	-400.	-33.3	-350.	-110.5	-300.	-158.6
51.	2085.2	101.	2069.1	-399.	-35.6	-349.	-111.6	-299.	-159.7
52.	2084.2	102.	2069.2	-398.	-37.7	-348.	-112.6	-298.	-160.7
53.	2083.3	103.	2069.3	-397.	-39.9	-347.	-113.6	-297.	-161.8
54.	2082.4	104.	2069.4	-396.	-42.0	-346.	-114.7	-296.	-162.9
55.	2081.5	105.	2069.5	-395.	-44.0	-345.	-115.7	-295.	-164.0
56.	2080.7	106.	2069.6	-394.	-46.1	-344.	-116.7	-294.	-165.2
57.	2079.9	107.	2069.7	-393.	-48.1	-343.	-117.7	-293.	-166.3
58.	2079.1	108.	2069.8	-392.	-50.1	-342.	-118.6	-292.	-167.5
59.	2078.4	109.	2069.9	-391.	-52.0	-341.	-119.6	-291.	-168.6
60.	2077.7	110.	2070.0	-390.	-53.9	-340.	-120.6	-290.	-169.8
61.	2077.0	111.	2070.1	-389.	-55.8	-339.	-121.6	-289.	-171.0
62.	2076.3	112.	2070.2	-388.	-57.6	-338.	-122.5	-288.	-172.3
63.	2075.7	113.	2070.3	-387.	-59.5	-337.	-123.5	-287.	-173.5
64.	2075.2	114.	2070.4	-386.	-61.3	-336.	-124.4	-286.	-174.8
65.	2074.6	115.	2070.5	-385.	-63.0	-335.	-125.3	-285.	-176.0
66.	2074.1	116.	2070.6	-384.	-64.8	-334.	-126.3	-284.	-177.3
67.	2073.6	117.	2070.7	-383.	-66.5	-333.	-127.2	-283.	-178.7
68.	2073.1	118.	2070.8	-382.	-68.2	-332.	-128.1	-282.	-180.0
69.	2072.7	119.	2070.9	-381.	-69.8	-331.	-129.1	-281.	-181.3
70.	2072.3	120.	2070.9	-380.	-71.4	-330.	-130.0	-280.	-182.7
71.	2071.9	121.	2071.0	-379.	-73.0	-329.	-130.9	-279.	-184.1
72.	2071.6	122.	2071.1	-378.	-74.6	-328.	-131.8	-278.	-185.5
73.	2071.2	123.	2071.1	-377.	-76.2	-327.	-132.7	-277.	-187.0
74.	2070.9	124.	2071.1	-376.	-77.7	-326.	-133.6	-276.	-188.4
75.	2070.6	125.	2071.2	-375.	-79.2	-325.	-134.5	-275.	-189.9
76.	2070.4	126.	2071.2	-374.	-80.7	-324.	-135.5	-274.	-191.4
77.	2070.1	127.	2071.2	-373.	-82.2	-323.	-136.4	-273.	-193.0
78.	2069.9	128.	2071.2	-372.	-83.6	-322.	-137.3	-272.	-194.5
79.	2069.7	129.	2071.2	-371.	-85.0	-321.	-138.2	-271.	-196.1
80.	2069.5	130.	2071.1	-370.	-86.4	-320.	-139.1	-270.	-197.7
81.	2069.4	131.	2071.1	-369.	-87.8	-319.	-140.0	-269.	-199.3
82.	2069.2	132.	2071.0	-368.	-89.1	-318.	-141.0	-268.	-201.0
83.	2069.1	133.	2070.9	-367.	-90.5	-317.	-141.9	-267.	-202.7
84.	2069.0	134.	2070.8	-366.	-91.8	-316.	-142.8	-266.	-204.4
85.	2068.9	135.	2070.7	-365.	-93.1	-315.	-143.8	-265.	-206.1
86.	2068.8	136.	2070.6	-374.	-94.4	-314.	-144.7	-264.	-207.9
87.	2068.8	137.	2070.5	-363.	-95.6	-313.	-145.6	-263.	-209.7
88.	2068.7	138.	2070.3	-362.	-96.8	-312.	-146.6	-262.	-211.5
89.	2068.7	139.	2070.1	-361.	-98.1	-311.	-147.5	-261.	-213.4

TPI LOGGING

TIME	TM DATA	NOMINAL
TPI - 30:00	R1 _____ (88.8)	
	R1 _____ (-335.6)	
	CSM A+P _____ (119.8)	
TPI - 10:00	R2 _____ (42.2)	
	R2 _____ (-139.1)	
	02 _____ (26.5)	
F+/A-	D+/U-	
H1 _____ (230.7)	V1 _____ (2068.7)	
H2 _____ (-159.1)	V2 _____ (-124.8)	
ΔVX _____ (71.6)	_____ (1943.9)	

	V3 _____ (-485.1)	
	_____ (1458.8)	

	V4 _____ (-48.5)	
	_____ (1410.3)	

	V5 _____ (-64.3)	
	_____ (1346.0)	

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	ΔVZ _____ (8.7)	

DIRECT ASCENT TPI BACKUP TABLE

CSM A+P	V3	R2	V4	R2	V4	R2	V5	H1	R2	V5	H1	R2	V5	H1
95.	-290.9	1.	-21.2	51.	-48.8	-303.	-96.3	155.3	-203.	-25.0	219.3	-103.	-109.2	230.7
96.	-298.7	2.	-22.3	52.	-48.7	-301.	-93.0	157.3	-201.	-25.4	219.9	-101.	-112.1	230.6
97.	-306.5	3.	-23.4	53.	-48.6	-299.	-89.8	159.3	-199.	-25.8	220.6	-99.	-115.0	230.5
98.	-314.4	4.	-24.5	54.	-48.4	-297.	-85.6	161.2	-197.	-26.3	221.2	-97.	-118.0	230.4
99.	-322.2	5.	-25.6	55.	-48.2	-295.	-83.6	163.1	-195.	-26.8	221.7	-95.	-121.0	230.2
100.	-330.0	6.	-26.6	56.	-48.0	-293.	-80.6	165.0	-193.	-27.4	222.3	-93.	-124.0	230.1
101.	-337.8	7.	-27.7	57.	-47.8	-291.	-77.7	166.8	-191.	-28.0	222.8	-91.	-127.1	229.9
102.	-345.7	8.	-28.7	58.	-47.5	-289.	-74.9	168.6	-189.	-28.7	223.4	-89.	-130.2	229.8
103.	-353.5	9.	-29.7	59.	-47.2	-287.	-72.2	170.3	-187.	-29.5	223.9	-87.	-133.4	229.6
104.	-361.3	10.	-30.6	60.	-46.9	-285.	-69.5	172.1	-185.	-30.3	224.4	-85.	-136.6	229.5
105.	-369.2	11.	-31.5	61.	-46.6	-283.	-67.0	173.8	-183.	-31.2	224.8	-83.	-139.8	229.3
106.	-377.0	12.	-32.5	62.	-46.2	-281.	-64.5	175.4	-181.	-32.1	225.3	-81.	-143.1	229.1
107.	-384.8	13.	-33.3	63.	-45.8	-279.	-62.1	177.1	-179.	-33.1	225.7	-79.	-146.4	228.9
108.	-392.7	14.	-34.2	64.	-45.3	-277.	-59.7	178.7	-177.	-34.2	226.1	-77.	-149.7	228.7
109.	-400.5	15.	-35.1	65.	-44.9	-275.	-57.5	180.3	-175.	-35.3	226.5	-75.	-153.1	228.5
110.	-408.3	16.	-35.9	66.	-44.4	-273.	-55.3	181.8	-173.	-36.5	226.9	-73.	-156.5	228.3
111.	-416.2	17.	-36.7	67.	-43.9	-271.	-53.2	183.4	-171.	-37.7	227.2	-71.	-159.9	228.1
112.	-424.0	18.	-37.4	68.	-43.3	-269.	-51.2	184.8	-169.	-39.0	227.6	-69.	-163.4	227.9
113.	-431.8	19.	-38.2	69.	-42.7	-267.	-49.3	186.3	-167.	-40.3	227.9	-67.	-166.9	227.7
114.	-439.6	20.	-38.9	70.	-42.1	-265.	-47.4	187.7	-165.	-41.7	228.2	-65.	-170.4	227.5
115.	-447.5	21.	-39.6	71.	-41.5	-263.	-45.6	189.1	-163.	-43.2	228.5	-63.	-174.0	227.2
116.	-455.3	22.	-40.3	72.	-40.8	-261.	-43.9	190.5	-161.	-44.6	228.8	-61.	-177.6	227.0
117.	-463.1	23.	-40.9	73.	-40.1	-259.	-42.3	191.9	-159.	-46.2	229.0	-59.	-181.2	226.8
118.	-470.9	24.	-41.5	74.	-39.4	-257.	-40.7	193.2	-157.	-47.8	229.3	-57.	-184.9	226.5
119.	-478.7	25.	-42.1	75.	-38.7	-255.	-39.2	194.5	-155.	-49.4	229.5	-55.	-188.6	226.3
120.	-486.6	26.	-42.7	76.	-37.9	-253.	-37.8	195.8	-153.	-51.2	229.7	-53.	-192.3	226.0
121.	-494.4	27.	-43.3	77.	-37.1	-251.	-36.4	197.0	-151.	-52.9	229.9	-51.	-196.0	225.8
122.	-502.2	28.	-43.8	78.	-36.2	-249.	-35.2	198.2	-149.	-54.7	230.1	-49.	-199.8	225.5
123.	-510.0	29.	-44.3	79.	-35.4	-247.	-34.0	199.4	-147.	-56.6	230.2	-47.	-203.6	225.3
124.	-517.8	30.	-44.8	80.	-34.5	-245.	-32.8	200.6	-145.	-58.5	230.4	-45.	-207.5	225.0
125.	-525.6	31.	-45.2	81.	-33.5	-243.	-31.8	201.7	-143.	-60.4	230.5	-43.	-211.3	224.8
126.	-533.3	32.	-45.6	82.	-32.6	-241.	-30.8	202.8	-141.	-62.4	230.6	-41.	-215.2	224.5
127.	-541.1	33.	-46.0	83.	-31.6	-239.	-29.9	203.9	-139.	-64.5	230.8	-49.	-219.1	224.2
128.	-548.9	34.	-46.4	84.	-30.6	-237.	-29.1	205.0	-137.	-66.6	230.8	-37.	-223.0	224.0
129.	-556.7	35.	-46.8	85.	-29.5	-235.	-28.3	206.0	-135.	-68.7	230.9	-35.	-227.0	223.7
130.	-564.4	36.	-47.1	86.	-28.4	-233.	-27.6	207.0	-133.	-70.9	231.0	-33.	-231.0	223.4
131.	-572.2	37.	-47.4	87.	-27.3	-231.	-26.9	208.0	-131.	-73.2	231.1	-31.	-235.0	223.2
132.	-579.9	38.	-47.7	88.	-26.2	-229.	-26.4	208.9	-129.	-75.5	231.1	-29.	-239.0	222.9
133.	-587.7	39.	-47.9	89.	-25.0	-227.	-25.9	209.9	-127.	-77.8	231.1	-27.	-243.1	222.6
134.	-595.4	40.	-48.1	90.	-23.8	-225.	-25.5	210.8	-125.	-80.2	231.2	-25.	-247.2	222.4
135.	-603.2	41.	-48.3	91.	-22.6	-223.	-25.1	211.7	-123.	-82.6	231.2	-23.	-251.3	222.1
136.	-610.9	42.	-48.5	92.	-21.3	-221.	-24.8	212.5	-121.	-85.1	231.2	-21.	-255.4	221.8
137.	-618.6	43.	-48.6	93.	-20.0	-219.	-24.6	213.4	-119.	-87.6	231.2	-19.	-259.6	221.6
138.	-626.3	44.	-48.7	94.	-18.7	-217.	-24.4	214.2	-117.	-90.1	231.1	-17.	-263.7	221.3
139.	-634.0	45.	-48.8	95.	-17.3	-215.	-24.3	215.0	-115.	-92.7	231.1	-15.	-267.9	221.0
140.	-641.7	46.	-48.9	96.	-16.0	-213.	-24.3	215.8	-113.	-95.4	231.1	-13.	-272.1	220.8
141.	-649.4	47.	-48.9	97.	-14.5	-211.	-24.3	216.5	-111.	-98.1	231.0	-11.	-276.4	220.5
142.	-657.0	48.	-48.9	98.	-13.1	-209.	-24.4	217.2	-109.	-100.8	230.9	-9.	-280.6	220.3
143.	-664.7	49.	-48.9	99.	-11.6	-207.	-24.5	217.9	-107.	-103.5	230.9	-7.	-284.9	220.0
144.	-672.4	50.	-48.9	100.	-10.1	-205.	-24.8	218.6	-105.	-106.4	230.8	-5.	-289.2	219.8

DIRECT ASCENT TPI BACKUP TABLE

R2	V5	H1	02	V6	H2	02	V6	H2	02	V6	H2	02	V6	H2
-7.	-284.9	220.0	-22.50	-4.4	-2.7	2.50	-964.9	-117.5	27.50	-1345.2	-159.9	52.50	-1449.4	-174.8
-5.	-289.2	219.8	-22.00	-31.3	-6.0	3.00	-977.2	-118.9	28.00	-1349.0	-160.4	53.00	-1450.8	-175.1
-3.	-293.5	219.5	-21.50	-57.8	-9.2	3.50	-989.2	-120.3	28.50	-1352.6	-160.8	53.50	-1452.1	-175.4
-1.	-297.8	219.3	-21.00	-83.9	-12.4	4.00	-1001.1	-121.6	29.00	-1356.2	-161.2	54.00	-1453.5	-175.8
1.	-302.2	219.0	-20.50	-109.7	-15.6	4.50	-1012.7	-123.0	29.50	-1359.7	-161.5	54.50	-1454.9	-176.1
3.	-306.5	218.8	-20.00	-135.2	-18.7	5.00	-1024.0	-124.2	30.00	-1363.0	-161.9	55.00	-1456.4	-176.5
5.	-310.9	218.5	-19.50	-160.4	-21.7	5.50	-1035.2	-125.5	30.50	-1366.3	-162.3	55.50	-1457.8	-176.9
7.	-315.3	218.3	-19.00	-185.1	-24.8	6.00	-1046.1	-126.8	31.00	-1369.5	-162.7	56.00	-1459.3	-177.2
9.	-319.7	218.1	-18.50	-209.6	-27.7	6.50	-1056.9	-128.0	31.50	-1372.5	-163.0	56.50	-1460.8	-177.6
11.	-324.1	217.8	-18.00	-233.7	-30.7	7.00	-1067.4	-129.2	32.00	-1375.5	-163.3	57.00	-1462.3	-178.0
13.	-328.6	217.6	-17.50	-257.5	-33.6	7.50	-1077.7	-130.3	32.50	-1378.4	-163.7	57.50	-1463.9	-178.4
15.	-333.0	217.4	-17.00	-281.0	-36.4	8.00	-1087.8	-131.5	33.00	-1381.2	-164.0	58.00	-1465.5	-178.8
17.	-337.5	217.2	-16.50	-304.1	-39.2	8.50	-1097.6	-132.6	33.50	-1383.9	-164.3	58.50	-1467.2	-179.2
19.	-342.0	217.0	-16.00	-326.9	-42.0	9.00	-1107.3	-133.7	34.00	-1386.6	-164.6	59.00	-1468.8	-179.7
21.	-346.5	216.8	-15.50	-349.4	-44.7	9.50	-1116.8	-134.7	34.50	-1389.1	-164.9	59.50	-1470.6	-180.1
23.	-351.0	216.6	-15.00	-371.6	-47.4	10.00	-1126.1	-135.8	35.00	-1391.6	-165.3	60.00	-1472.3	-180.6
25.	-355.5	216.4	-14.50	-393.4	-50.0	10.50	-1135.2	-136.8	35.50	-1394.0	-165.5	60.50	-1474.2	-181.0
27.	-360.0	216.2	-14.00	-415.0	-52.6	11.00	-1144.1	-137.8	36.00	-1396.4	-165.8	61.00	-1476.0	-181.5
29.	-364.6	216.1	-13.50	-436.2	-55.2	11.50	-1152.8	-138.8	36.50	-1398.6	-166.1	61.50	-1477.9	-182.0
31.	-369.1	215.9	-13.00	-457.1	-57.7	12.00	-1161.3	-139.7	37.00	-1400.8	-166.4	62.00	-1479.9	-182.5
33.	-373.7	215.7	-12.50	-477.7	-60.1	12.50	-1169.6	-140.6	37.50	-1403.0	-166.7	62.50	-1482.0	-183.0
35.	-378.3	215.6	-12.00	-498.0	-62.6	13.00	-1177.8	-141.5	38.00	-1405.1	-167.0	63.00	-1484.0	-183.6
37.	-382.9	215.4	-11.50	-518.0	-65.0	13.50	-1185.7	-142.4	38.50	-1407.1	-167.2	63.50	-1486.2	-184.1
39.	-387.5	215.3	-11.00	-537.7	-67.3	14.00	-1193.5	-143.3	39.00	-1409.0	-167.5	64.00	-1488.4	-184.7
41.	-392.1	215.2	-10.50	-557.1	-69.6	14.50	-1201.1	-144.1	39.50	-1410.9	-167.8	64.50	-1490.7	-185.3
43.	-396.7	215.1	-10.00	-576.2	-71.9	15.00	-1208.6	-145.0	40.00	-1412.8	-168.0	65.00	-1493.1	-185.9
45.	-401.3	214.9	-9.50	-595.0	-74.2	15.50	-1215.8	-145.8	40.50	-1414.6	-168.3	65.50	-1495.5	-186.5
47.	-405.9	214.8	-9.00	-613.5	-76.4	16.00	-1222.9	-146.5	41.00	-1416.4	-168.5	66.00	-1498.0	-187.1
49.	-410.5	214.7	-8.50	-631.8	-78.5	16.50	-1229.9	-147.3	41.50	-1418.1	-168.8	66.50	-1500.6	-187.8
51.	-415.2	214.7	-8.00	-649.7	-80.7	17.00	-1236.6	-148.0	42.00	-1419.8	-169.0	67.00	-1503.2	-188.4
53.	-419.8	214.6	-7.50	-667.4	-82.7	17.50	-1243.3	-148.8	42.50	-1421.4	-169.3	67.50	-1506.0	-189.1
55.	-424.5	214.5	-7.00	-684.8	-84.8	18.00	-1249.7	-149.5	43.00	-1423.0	-169.5	68.00	-1508.8	-189.8
57.	-429.1	214.5	-6.50	-701.9	-86.8	18.50	-1256.0	-150.2	43.50	-1424.5	-169.8	68.50	-1511.7	-190.5
59.	-433.8	214.4	-6.00	-718.7	-88.8	19.00	-1262.1	-150.8	44.00	-1426.1	-170.1	69.00	-1514.7	-191.2
61.	-438.5	214.4	-5.50	-735.2	-90.8	19.50	-1268.1	-151.5	44.50	-1427.6	-170.3	69.50	-1517.8	-192.0
63.	-443.1	214.3	-5.00	-751.5	-92.7	20.00	-1273.9	-152.1	45.00	-1429.0	-170.6	70.00	-1521.0	-192.8
65.	-447.8	214.3	-4.50	-767.5	-94.6	20.50	-1279.6	-152.8	45.50	-1430.5	-170.8	70.50	-1524.3	-193.6
67.	-452.5	214.3	-4.00	-783.3	-96.4	21.00	-1285.2	-153.4	46.00	-1431.9	-171.1	71.00	-1527.7	-194.4
69.	-457.1	214.3	-3.50	-798.8	-98.2	21.50	-1290.6	-154.0	46.50	-1433.3	-171.3	71.50	-1531.2	-195.2
71.	-461.8	214.4	-3.00	-814.0	-100.0	22.00	-1295.8	-154.5	47.00	-1434.7	-171.6	72.00	-1534.8	-196.1
73.	-466.5	214.4	-2.50	-829.0	-101.7	22.50	-1301.0	-155.1	47.50	-1436.1	-171.9	72.50	-1538.5	-196.9
75.	-471.2	214.4	-2.00	-843.7	-103.5	23.00	-1306.0	-155.6	48.00	-1437.4	-172.2	73.00	-1542.3	-197.8
77.	-475.9	214.5	-1.50	-858.1	-105.1	23.50	-1310.8	-156.2	48.50	-1438.8	-172.4	73.50	-1546.2	-198.7
79.	-480.5	214.6	-1.00	-872.3	-106.8	24.00	-1315.5	-156.7	49.00	-1440.1	-172.7	74.00	-1550.2	-199.7
81.	-485.2	214.6	-.50	-886.3	-108.4	24.50	-1320.1	-157.2	49.50	-1441.4	-173.0	74.50	-1554.3	-200.6
83.	-489.9	214.7	0.00	-900.0	-110.0	25.00	-1324.6	-157.7	50.00	-1442.8	-173.3	75.00	-1558.6	-201.6
85.	-494.6	214.8	.50	-913.5	-111.6	25.50	-1329.0	-158.1	50.50	-1444.1	-173.6	75.50	-1563.0	-202.6
87.	-499.3	215.0	1.00	-926.7	-113.1	26.00	-1333.2	-158.6	51.00	-1445.4	-173.9	76.00	-1567.5	-203.6
89.	-503.9	215.1	1.50	-939.7	-114.6	26.50	-1337.3	-159.1	51.50	-1446.7	-174.2	76.50	-1572.1	-204.7
91.	-508.6	215.2	2.00	-952.4	-116.0	27.00	-1341.3	-159.5	52.00	-1448.1	-174.5	77.00	-1576.9	-205.8

MCC1 CHART LOGGING					
$\dot{R}_{REQ}$ _____ 103.0 R_{13} _____ 16.92 $\dot{R}_{13^-}$ _____ 103.0 θ_{13} _____ 43.87 $\Delta \dot{R}$ _____ 0.0 θ_{9^-} _____ 37.97 $\Delta \theta$ _____ 5.90					
MCC1	PGNS (N59)	CMC (N59)	AGS	PGNS (N85)	CHART
ΔVX	_____.	_____.	_____.	_____.	_____.
ΔVY	_____.	_____.	_____.	_____.	_____.
ΔVZ	_____.	_____.	_____.	_____.	_____.

MCC2 CHART LOGGING					
$\dot{R}_{REQ}$ _____ 50.2 R_{28} _____ 33.1 kFT $\dot{R}_{28^-}$ _____ 50.2 θ_{28} _____ 78.09 $\Delta \dot{R}$ _____ 0.0 θ_{24^-} _____ 66.79 $\Delta \theta$ _____ 11.30					
MCC2	PGNS (N59)	CMC (N59)	AGS	PGNS (N85)	CHART
ΔVX	_____.	_____.	_____.	_____.	_____.
ΔVY	_____.	_____.	_____.	_____.	_____.
ΔVZ	_____.	_____.	_____.	_____.	_____.

CSM CIRC

P76													
+	0	0				+	0	0				HRS (97)	N33
+	0	0	0			+	0	0	0			MIN (41)	TIG
+	0					+	0					SEC (44.50)	
												ΔVX (+69.7)	N84
												ΔVY (+0.0)	
												ΔVZ (-71.2)	
CSM HA/HP													
CMC					LGC					V82			
/					/					OPT 2			

PDI RULES

1. NO AUTO ULLAGE - BACKUP VIA +X OVERRIDE (+NO AUTO IGNITION - PDI NO-GO)
 2. NO IGN (WITH AUTO ULL) DELAY 2 SEC, THEN START PB-PUSH; THEN DES OVRD - ON AT 5 SEC
 3. T/W >1.6 AND DSKY CHANGES <18 fps/2 SEC
 4. ATT/RATE <5°/SEC
 5. ΔH IN LIMITS >10 SEC, NOT OUT OF LIMITS >60 SEC
 6. DATA GOOD AT > 6,000 ft
 7. IF NO THROTTLE DOWN BY P64 + 15 SEC - ABORT
 8. BINGO FUEL 1 MIN 31 SEC AFTER LOW LEVEL OR WHEN FUEL QTY <2% UNLESS LANDING IMMINENT
- NOTE: FOR FLASHING LR ALT OR VEL LIGHTS PRECEDED BY STEADY LR LT, CYCLE RADAR TEST SWITCH

NO PDI + 12

+	0	0				+	0	0				HRS (98)	N33
+	0	0	0			+	0	0	0			MIN (46)	TIG
+	0					+	0					SEC (11.70)	E
												ΔVX (+103.7)	N81
												ΔVY (+0.0)	LV
												ΔVZ (-47.1)	F
+						+						HA (+139.6)	N42
												HP (+9.2)	
+						+						ΔVR (+113.9)	
X	X	X				X	X	X				BT (0:39)	
X	X	X				X	X	X				R (000)	FDAI
X	X	X				X	X	X				P (273)	INER
+						+						TIG (526.2)	373
												ΔVX (+103.7)	N86
												ΔVY (+0.0)	AGS
												ΔVZ (-47.1)	
+	0	0				+	0	0				HRS (99)	N11
+	0	0	0			+	0	0	0			MIN (34)	CSI
+	0					+	0					SEC (40.80)	G
+	0	0				+	0	0				HRS (101)	N37
+	0	0	0			+	0	0	0			MIN (21)	TPI
+	0					+	0					SEC (59.60)	H
RESIDUALS													
PGNS							AGS						
						ΔVX	N85					ΔVX	500
						ΔVY						ΔVY	501
						ΔVZ						ΔVZ	502

PDI 1 ABORT CARD

PDI 1 PAD													
+	0	0				+	0	0				HRS(98)	N33
+	0	0	0			+	0	0	0			MIN(34)	PDI
+	0					+	0					SEC(40.86)	I
X	X					X	X					TGO(11:03)	N61
												X RANGE(+0.0)	
X	X	X				X	X	X				R (000)	FDAI
X	X	X				X	X	X				P (111)	AT TIG
X	X	X				X	X	X				Y (340)	
												DEDA 231	IF ROD
(0<PDI 1<10:16) ABORT PAD EARLY													
LOG INSERTION GET = _____ : _____													
+ _____ 5 5 0 0													
CSI GET = _____ : _____													
+	0	0				+	0	0				HRS(101)	N37
+	0	0	0			+	0	0	0			MIN(21)	TPI
+	0					+	0					SEC(59.60)	J
T1-1 (10:16 ≤ PDI 1 ≤ 17:30) ABORT PAD LATE													
LOG INSERTION GET = _____ : _____													
+ _____ 5 0 0 0													
BOOST GET = _____ : _____													
+ _____ 1 0 0 0 0													
HAM GET = _____ : _____													
+ _____ 5 0 0 0													
CSI GET = _____ : _____													
+	0	0				+	0	0				HRS(103)	N37
+	0	0	0			+	0	0	0			MIN(20)	TPI
+	0					+	0					SEC(47.80)	K

T2-1(PDI 1 + 24:17 :) ABORT PAD													
LOG INSERTION GET = _____ : _____													
+ _____ 5 0 0 0													
BOOST GET = _____ : _____													
+ _____ 3 0 0 0 0													
HAM GET = _____ : _____													
+ _____ 5 0 0 0													
CSI GET = _____ : _____													
+	0	0				+	0	0				HRS(98)	N33
+	0	0	0			+	0	0	0			MIN(58)	TIG
+	0					+	0					SEC(57.90)	L
+	0	0				+	0	0				HRS(105)	N37
+	0	0	0			+	0	0	0			MIN(19)	TPI
+	0					+	0					SEC(36.00)	M
N69 TARGET UPDATE													
						ΔDN RNG							
						ΔX RNG V25							
						ΔRLS							
						ΔDN RNG V21							
						ΔDN RNG V24							
						ΔX RNG							
						ΔRLS V23							
THROTTLE DOWN _____ : _____													
T3-1 (1 REV) ABORT TIME													
+	0	0				+	0	0				HRS(100)	N33
+	0	0	0			+	0	0	0			MIN(42)	TIG
+	0					+	0					SEC(48.00)	N

PDI 2 ABORT CARD

PDI 2 PAD															
+	0	0				+	0	0				HRS(100)	N33		
+	0	0	0			+	0	0	0			MIN(28)	PDI		
+	0					+	0					SEC(42.20)	I		
X	X					X	X					TGO(11:03)	N61		
												X RANGE(+0.0)			
X	X	X				X	X	X				R (000)	FDAI		
X	X	X				X	X	X				P (111)	AT TIG		
X	X	X				X	X	X				Y (340)			
												DEDA 231 IF RQD			
(0<PDI 2 < 6:20) ABORT PAD EARLY															
LOG INSERTION GET=												5 0 0 0			
+												1 0 0 0 0			
BOOST GET=												1 0 0 0 0			
+												1 0 0 0 0			
HAM GET=												1 0 0 0 0			
+												1 0 0 0 0			
CSI GET=												5 5 0 0			
+												5 5 0 0			
CSI TIG												5 5 0 0			
+	0	0				+	0	0				HRS(105)	N37		
+	0	0	0			+	0	0	0			MIN(19)	TPI		
+	0					+	0					SEC(36.00)	J		
T1-2(6:20 ≤ PDI 2 ≤ 15:30) ABORT PAD LATE															
LOG INSERTION GET=												5 5 0 0			
+												5 5 0 0			
CSI TIG												5 5 0 0			
+	0	0				+	0	0				HRS(103)	N37		
+	0	0	0			+	0	0	0			MIN(20)	TPI		
+	0					+	0					SEC(47.80)	K		

T2-2(PDI 2 + 21:44 __:__) ABORT PAD															
LOG INSERTION GET =															
+															
BOOST GET =															
+															
HAM GET =															
+															
CSI GET =															
+	0	0				+	0	0				HRS(100)	N33		
+	0	0	0			+	0	0	0			MIN(50)	TIG		
+	0					+	0					SEC(25.90)	L		
+	0	0				+	0	0				HRS(105)	N37		
+	0	0	0			+	0	0	0			MIN(19)	TPI		
+	0					+	0					SEC(36.00)	M		
N69 TARGET UPDATE															
												ΔDN RNG			
												ΔX RNG V25			
												ΔRLS			
												ΔDN RNG V21			
												ΔDN RNG			
												ΔX RNG V24			
												ΔRLS V23			
THROTTLE DOWN															
T3-2 (1 REV) ABORT TIME															
+	0	0				+	0	0				HRS (102)	N33		
+	0	0	0			+	0	0	0			MIN (41)	TIG		
+	0					+	0					SEC (24.00)	N		

5-48

*NOTE: LOAD 8 NM CROSSRANGE IF GREATER THAN 8 NM

DIRECT TPI CARD

IF TWO OF THREE SOLUTIONS AGREE,
BURN PRIORITY SOLUTION.

PRIORITY OF SOLUTION: PGNS, AGS, CMC,
CHARTS.

GUIDE VALUES: $\dot{X}=3$ fps, $\dot{Y}=7$ fps, $\dot{Z}=9$ fps

RR AGREES WITH VHF WHERE
 $\Delta R=0.01R + 0.5$ NM, ΔR IS ALWAYS ≥ 1 NM
RR DOES NOT AGREE WITH VHF,
MSFN ISOLATES FAILED SYSTEM.

APS FOR $\Delta V > 40$ fps, DPS FOR $\Delta V > 6$ fps (DPS FULL)

AGS RECOVERY FROM BAD RADAR MARKS, PAGE 9

TPI SOLUTIONS

PGNS

AGS

CMC

CHARTS

TIG	N37	373	N37
θ LOS	(+26.6) N55	303	N55
HP	(+44.0) N58	402	N58
ΔV TPI	(+72.1)	370	
ΔV TPF	(+30.8)**	371	
ΔVX	N81	450	N81* ΔVX
ΔVY		451	*
ΔVZ		452	* ΔVZ

** IF ΔV TPF > 100 fps, OR } DO TPI 2
 { 1 RCS LOST AND ΔV TPF > 55 fps } PAGE 9

*CHANGE SIGN
BIAS; ΔVX = -1.0
ΔVZ = +2.0

TPI PAD

+	0	0				+	0	0				HRS(172)	N37
+	0	0	0			+	0	0	0			MIN(39)	TPI
+	0					+	0					SEC(22.90)	
R1(+00000), R2(+000.00), R3(+130.00)												N55	
	0					0						ΔVX(+71.5)	N81
	0					0						ΔVY(+0.2)	LV
	0					0						ΔVZ(+9.4)	
+	0					+	0					R(+36.34)	N54
-	0					-	0					R(-101.1)	TPI
X	X					X	X					BT(00:03)	TIG-5

TIG	N37	373	N37
θ LOS	N55	303	N55
HP	N58	402	N58
ΔV TPI		370	
ΔV TPF**		371	
ΔVX	N81	450	N81* ΔVX
ΔVY		451	*
ΔVZ		452	* ΔVZ

RESIDUALS

PGNS

AGS

		ΔVX	N85			ΔVX	500
		ΔVY				ΔVY	501
		ΔVZ				ΔVZ	502

CSI CARD

BURN RULES

IF TWO OF THREE SOLUTIONS AGREE
BURN PRIORITY SOLUTION.

PRIORITY OF SOLUTIONS: PGNS, AGS, CMC, CHARTS.

GUIDE VALUE: $\dot{X} = 3$ fps.

RR AGREES WITH VHF WHERE

$\Delta R = 0.01R + 0.5$ NM, ΔR IS ALWAYS ≥ 1 NM

RR DOES NOT AGREE WITH VHF,

MSFN ISOLATES FAILED SYSTEM.

V90 < 5 fps - NO BURN

APS FOR $\Delta V > 40$ fps, DPS FOR $\Delta V > 6$ fps (DPS FULL)

CSI PAD

+	0	0				+	0	0				HRS(172) N11
+	0	0	0			+	0	0	0			MIN(44) CSI
+	0					+	0					SEC(30.80)
R1(+00001), R2(+026.60), R3(+130.00)												N55
+	0	0				+	0	0				HRS(174) N37
+	0	0	0			+	0	0	0			MIN(36) TPI
+	0					+	0					SEC(23.40)
	0						0					$\Delta VX(+51.3)$ N81
	0						0					$\Delta VY(+0.0)$ LV
410+1, 605+00777, 416+1, 623+0												
+						+						373(164.5)
+						+						275(276.4)
	0						0					$\Delta VX(+51.3)$ N86
	0						0					$\Delta VY(+0.0)$ AGS
	0						0					$\Delta VZ(+1.1)$

CSI SOLUTIONS

	PGNS	AGS	CMC	CHARTS
ΔH	(+15.0) N75	402		
CSI/CDH(58:30)		372		
CDH/TPI(53:23)				
ΔVX (ΔVG)	N81	370	N81*	ΔV
ΔVY		263	*	
CDH $\Delta VX(0.0)$	N82		*CHANGE SIGN BIAS; $\Delta VX = -1.0$	
CDH $\Delta VX(0.0)$				

ΔH	N75	402		
CSI/CDH		372		
CDH/TPI				
ΔVX (ΔVG)	N81	370	N81*	ΔV
ΔVY		263	*	
CDH ΔVX	N82			
CDH ΔVZ				

RESIDUALS

PGNS				AGS			
		ΔVX	N85			ΔVX	500
		ΔVY				ΔVY	501
		ΔVZ				ΔVZ	502

IF TWO OF THREE SOLUTIONS AGREE, BURN PRIORITY SOLUTION.

PRIORITY OF SOLUTION: PGNS, AGS, CMC, CHARTS.

GUIDE VALUES: X=3fps, Z=9fps

RR AGREES WITH VHF WHERE $\Delta R = 0.01 + 0.5 \text{ NM}$,
 ΔR IS ALWAYS $> 1 \text{ NM}$

RR DOES NOT AGREE WITH VHF, MSFN ISOLATES
 FAILED SYSTEM.

V90 <5fps - NO BURN

APS FOR $\Delta V > 40 \text{ fps}$, DPS FOR $\Delta V > 6 \text{ fps}$ (DPS FULL)

CDH/PLANE CHANGE CARD

CDH PAD												
+	0	0				+	0	0				HRS(173) N13
+	0	0	0			+	0	0	0			MIN(43) CDH
+	0					+	0					SEC(00.80)
	0						0					$\Delta VX(+0.0)$ N81
	0						0					$\Delta VY(+0.0)$ LV
	0						0					$\Delta VZ(+0.0)$
X	X	X				X	X	X				PLM FDAI
+						+						373(223.0)
	0						0					$\Delta VX(+0.0)$ N86
	0						0					$\Delta VY(+0.0)$ AGS
	0						0					$\Delta VZ(+0.0)$
PLANE CHANGE P30												
TIG CDH												
- 30 00 00												
TIG PC												
YDOT AND Y												
CSM(N90)				PGNS(N90)				AGS(270)				
YDOT		Y		YDOT		Y		YDOT		Y		
(-)		(-)		(-)		(-)		()		()		
(-)		(-)		(-)		(-)		()		()		

CDH SOLUTIONS				
	PGNS	AGS	CMC	CHARTS
ΔH	(+14.6)N75	402		
CDH/TPI (53:23)				
ΔT SLIP (00:00)				
ΔVX	N81	450	N81*	ΔVX
ΔVY		263	*	
ΔVZ		452	*	ΔVY
*CHANGE SIGN NO BIAS				
ΔH	N75	402		
CDH/TPI				
ΔT SLIP				
ΔVX	N81	450	N81*	ΔVX
ΔVY		263	*	
ΔVZ		452	*	ΔVY

RESIDUALS			
PGNS		AGS	
	ΔVX N85		ΔVX 500
	ΔVY		ΔVY 501
	ΔVZ		ΔVZ 502

COELLIPTIC TPI CARD

BURN RULES

IF TWO OF THREE SOLUTIONS AGREE,
BURN PRIORITY SOLUTION.

PRIORITY OF SOLUTIONS: PGNS, AGS, CMC,
CHARTS.

GUIDE VALUES: $\dot{X}=3$ fps, $\dot{Y}=7$ fps, $\dot{Z}=9$ fps

RR AGREES WITH VHF WHERE
 $\Delta R=0.01R + 0.5$ NM, ΔR IS ALWAYS ≥ 1 NM
RR DOES NOT AGREE WITH VHF,
MSFN ISOLATES FAILED SYSTEM.

IF TIG TPI > 8 min EARLY - RECYCLE P34
WITH TIG EQUAL TO NOMINAL TIG-8 min

DPS FOR $\Delta V > 6$ fps (DPS FULL)

TPI SOLUTIONS

	PGNS	AGS	CMC	CHARTS
TIG	N37	373	N37	
θ LOS	(+26.6)N55	303	N55	
HP	(+44.2)N58	402	N58	
ΔV TPI	(+24.5)	370		
ΔV TPF	(+30.8)	371		
$\Delta V X$	N81	450	N81*	$\Delta V X$
$\Delta V Y$		451	*	
$\Delta V Z$		452	*	$\Delta V Z$
*CHANGE SIGN				

TPI PAD

+	0	0				+	0	0				HRS(174) N37
+	0	0	0			+	0	0	0			MIN(36) TPI
+	0					+	0					SEC(23.40)
R1(+00000),R2(+026.60),R3(+130.00)												N55
	0						0					$\Delta V X(+21.4)N81$
	0						0					$\Delta V Y(+0.4)LV$
	0						0					$\Delta V Z(-10.7)$
+	0					+	0					R(+36.60) N54
-	0					-	0					TPI
X	X					X	X					$\dot{R}(-108.7)TIG-5$
												BT(00:22)

TIG	N37	373	N37	
θ LOS	N55	303	N55	
HP	N58	402	N58	
ΔV TPI		370		
ΔV TPF		371		
$\Delta V X$	N81	450	N81*	$\Delta V X$
$\Delta V Y$		451	*	
$\Delta V Z$		452	*	$\Delta V Z$

RESIDUALS

PGNS				AGS			
			$\Delta V X$	N85			$\Delta V X$ 500
			$\Delta V Y$				$\Delta V Y$ 501
			$\Delta V Z$				$\Delta V Z$ 502

P76/77 PADS

												PURPOSE
+	0	0				+	0	0				HRS N33
+	0	0	0			+	0	0	0			MIN TIG
+	0					+	0					SEC
												ΔVX N84/N81
												ΔVY
												ΔVZ
												PURPOSE
+	0	0				+	0	0				HRS N33
+	0	0	0			+	0	0	0			MIN TIG
+	0					+	0					SEC
												ΔVX N84/N81
												ΔVY
												ΔVZ
												PURPOSE
+	0	0				+	0	0				HRS N33
+	0	0	0			+	0	0	0			MIN TIG
+	0					+	0					SEC
												ΔVX N84/N81
												ΔVY
												ΔVZ

AGS SV PADS

						LM INSERTION + 1						PURP	LOAD
						+	5	3	3	7	3	240	
						-	1	2	8	7	2	241	
						-	1	7	5	0	5	242	
						-	1	8	3	7	8	260	
						-	4	6	9	9	6	261	
						-	2	2	6	1	9	262	
						+	0	1	1	3	0	254	414+2
						+	5	2	4	9	5	244	
						-	2	1	0	5	8	245	
						-	2	1	8	9	4	246	
						-	2	5	2	4	6	264	
						-	4	3	0	4	9	265	
						-	1	9	0	9	1	266	
						+	0	1	1	3	0	272	414+3
												PURP	LOAD
												240	
												241	
												242	
												260	
												261	
												262	
												254	414+2
												244	
												245	
												246	
												264	
												265	
												266	
												272	414+3

P30 PADS

5-55

+	0	0			+	0	0			HRS	N33
+	0	0	0		+	0	0	0		MIN	TIG
+	0				+	0				SEC	
										Δ VX	N81
										Δ VY	LV
										Δ VZ	
+					+					HA	N42
										HP	
+					+					Δ VR	
X	X	X			X	X	X			BT	
X	X	X			X	X	X			R	FDAI
X	X	X			X	X	X			P	INER
+					+					TIG	373
										Δ VX	N86
										Δ VY	AGS
										Δ VZ	
X	X	X			X	X	X			BSS	
X	X				X	X				SPA	
X	X	X			X	X	X			SXP	
RESIDUALS											
PGNS						AGS					
										Δ VX	N85
										Δ VY	
										Δ VZ	
										Δ VX	500
										Δ VY	501
										Δ VZ	502

+	0	0			+	0	0			HRS	N33
+	0	0	0		+	0	0	0		MIN	TIG
+	0				+	0				SEC	
										Δ VX	N81
										Δ VY	LV
										Δ VZ	
+					+					HA	N42
										HP	
+					+					Δ VR	
X	X	X			X	X	X			BT	
X	X	X			X	X	X			R	FDAI
X	X	X			X	X	X			P	INER
+					+					TIG	373
										Δ VX	N86
										Δ VY	AGS
										Δ VZ	
X	X	X			X	X	X			BSS	
X	X				X	X				SPA	
X	X	X			X	X	X			SXP	
RESIDUALS											
PGNS						AGS					
										Δ VX	N85
										Δ VY	
										Δ VZ	
										Δ VX	500
										Δ VY	501
										Δ VZ	502

ASCENT

CSI

+	0	0				+	0	0				HRS	N33	+	0	0				+	0	0				HRS	N11
+	0	0	0			+	0	0	0			MIN	TIG	+	0	0	0			+	0	0	0			MIN	CSI
+	0					+	0					SEC		+	0					+	0					SEC	
+						+						V(H)		R ₁ (+00001), R ₂ (+026.60), R ₃ (+130.00)								N55					
+						+						V(V)N76		+	0	0				+	0	0				HRS	N37
	0						0					*CROSSRANGE		+	0	0	0			+	0	0	0			MIN	TPI
+						+						047		+	0					+	0					SEC	
+						+						053			0						0					ΔVX	N81
+						+						224/226			0						0					ΔVY	LV
+						+						231		410+1, 605+00777, 416+1, 623+0													
+						+						465		+						+						373	
+						+						373		+						+						275	
+	0	0				+	0	0				HRS	N37		0						0					ΔVX	
+	0	0	0			+	0	0	0			MIN	TPI		0						0					ΔVY	AGS
+	0					+	0					SEC			0						0					ΔVZ	
+						+						LM WT															

*NOTE: LOAD 8 NM CROSSRANGE IF GREATER THAN 8 NM

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