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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FINAL

FLIGHT PLAN
APOLLO 7

AS 205/CSM 101

SEPT 16, 1968

PREPARED BY
FLIGHT PLANNING BRANCH
FLIGHT CREW SUPPORT DIVISION

MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

SECTION II

SECTION III

SECTION IV

APOLLO AS205/CSM 101

FINAL FLIGHT PLAN

September 16, 1968

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INTRODUCTION

This document programs the AS205/CSM 101 operations and crew activities to fulfill the test objectives defined in the Mission Requirements Document SPD8-R-001 Change E, and to be compatible with the NASA Operational Trajectory 68-FM-184, dated July 31, 1968.

The Apollo 7 Flight Plan is under the configuration control of the Crew Procedures Control Board (CPCB). All proposed changes to this document that fall in the following categories should be submitted to the CPCB via a Crew Procedures Change Request:

1. Items that impose additional crew training or impact crew procedures.
2. Items that impact the accomplishment of detailed test objectives.
3. Items that result in a significant RCS or EPS budget change.
4. Items that result in moving major activities to a different activity day in the Flight Plan.
5. Items that require a change to the flight data file.

The Chief, Flight Planning Branch (FCSD) will determine what proposed changes fall in the above categories.

Mr. W. M. Anderson will act as co-ordinator for all proposed changes to the Apollo 7 Flight Plan.

ABBREVIATIONS

ARIA	Apollo Range Instrumentation Aircraft
ANG	Antigua
AOH	Apollo Operations Handbook
AOS	Acquisition of Signal
ARS	Attitude Reference System
ACN	Ascension Island
ACQ	Aquisition
ATP	Alternate Target Point
Att	Attitude
BDA	Bermuda
BT	Burn Time
BU	Backup
CAL	Pt. Arguello, California
CAM	Camera
CCU	Crewman communication umbilical
CDR	Commander
CDU	Control Data Unit
Ck	Check
CMD	Command
CMP	Command Module Pilot
CNB	Canberra
CNV	Cape Kennedy, Florida
COAS	Crew Optical Alignment Sight
CRO	Carnarvon
CSQ	USAF Coastal Sentry
CTN	Canton Island
CYI	Grand Canary Island
DAP	Digital Autopilot
db	Deadband
DET	Digital Event Timer
DSE	Data Storage Equipment
DTO	Detailed Test Objective
ECO	Engine Cut-off
EGL	Eglin AFB
EMS	Entry Monitor System
F/C	Fuel Cell
FM	Frequency modulation
FOV	Field of View
Fps	Feet per second
FQ	Flight Qualification
GBM	Grand Bahama Island
GDC	Gyro Display Coupler
GET	Ground Elapsed Time
GETI	Ground Elapsed Time of Ignition
Gly	Glycol
GNCS	Guidance Navigation Control System
GST	Goldstone California
GYM	Guaymas
HAW	Hawaii
HBR	High Bit Rate (TM)
HD	Highly Desirable
HSK	Honeysuckle
Htr	Heater
HTV	USNS Huntsville
IAW	In Accordance With
ICG	Inflight coverall garment
IRIG	Inertial Reference Integrating Gyro
IU	Instrumentation Unit
IVA	Intervehicular Activities
KNO	Kano Nigeria
kwh	Kilowatt Hour
LBR	Low Bit Rate (TM)
LEB	Lower Equipment Bay
LH	Local Horizontal
LHEB	Left-hand Equipment Bay
LLM	Lunar Landing Mission
LLOS	Landmark Line of Sight
LMP	Lunar Module Pilot

ABBREVIATIONS (Cont'd)

LOS	Line of Sight
LV	Local Vertical
LVPD	Launch Vehicle Pressure Display
MAD	Madrid Spain
MER	USNS Mercury
MCC	Midcourse correction
MDC	Main Display Console
MI	Minimum Impulse
MLA	Meritt Island
MSFN	Manned Space Flight Network
MTVC	Manual Thrust Vector Control
NCC	Corrective Combination Maneuver
NM	Nautical Miles
NOM	Nominal
NSR	Nominal Slow Rate
OSS	Optics subsystem
P	Pitch
pb	Push button
PCM	Pulse Code Modulation
PIPA	Pulsed Integrating Pendulous Accel.
PMP	Premodulation processor
PRE	Pretoria
Pref	Preferred Orientation
PRN	Pseudo-random noise
PTC	Passive Thermal Control
PUGS	Propellant Utilization and Gaging System
PWR	Power
Pxx	Programs xx
R	Roll
Rad	Radiator
RCDR	Recorder
RCV	Receiver
RED	USNS Redstone
REFSMMAT	Reference to Stable Member Matrix
Reqd	Required
RKV	USAF Rose Knot
RNDZ	Rendezvous
RR	Rendezvous Radar
RT	Real Time
RTC	Real Time Command
S/C	Spacecraft
SA	Shaft Angle
SCE	Signal Conditioning Equipment
SCS	Stabilization Control System
SCT	Scanning Telescope
SEQ	Sequence
SIMP	Simplex
SLA	Service Module LM Adapter
SLOS	Star Line-of-Sight
SR	Sunrise
SS	Sunset
Sta	Station
STBY	Standby
Sw	Switch
SXT	Sextant
T	Time
TA	Trunnion Angle
TAN	Tananarive
TBD	To Be Determined
TEX	Corpus Christi, Texas
TIG	Time of Ignition
TM	Telemetry
TPF	Terminal Phase Final
TPI	Terminal Phase Initiation
TVC	Thrust Vector Control
UCD	Urine collection device
UCTA	Urine collection transfer assembly
USBE	Unified S-band equipment

ABBREVIATIONS (cont'd)

VAN	USNS Vanguard
VG	Velocity to gain
VHF	Very High Frequency
Vlv	Valve
W/O	Without
WHS	White Sands
wrt	With Reference To
WSMR	White Sands Missile Range
WTN	USNS Watertown
XMIT	Transmit
XPNDR	Transponder
Y	Yaw

Note:

Additional abbreviations concerned with spacecraft updates are found on pages 1-9 through 1-20.

SECTION I - GENERAL

FLIGHT PLAN NOTES

A. MISSION

The AS205/CSM 101 mission ascent-to-orbit will include the S-IB boost phase and the S-IVB orbit insertion burn. The spacecraft will remain attached to the S-IVB in a 120 x 150 nautical mile orbit for two revolutions.

The CSM will separate from the S-IVB at GET of 2:55, transpose and perform a simulated docking maneuver using a docking target in the S-IVB SLA. Photographs of the S-IVB and SLA will be taken during the transposition and docking maneuvers.

After completion of the simulated docking, the SM/RCS will be used to perform an initial phasing maneuver for a rendezvous with the S-IVB. The CSM active rendezvous will be a two-impulse transfer ellipse utilizing the SPS for the coelliptic and corrective combination maneuvers. The rendezvous with the S-IVB will be completed at approximately 30 hours elapsed time. The nominal sequence of events leading to the rendezvous is shown in Figure 1-1.

Following a period of formation flying with the S-IVB, the spacecraft will separate and begin a drifting flight phase planned for nine days. This period will be devoted to evaluation of crew activities, crew/spacecraft interface, system performance, and mission support activities. The drifting flight phase will be interrupted by SPS burns as presented in Table 1-I.

The deorbit maneuver will be a GNCS controlled SPS burn. Entry will be via G&N control after DAP verification (approximately 30 seconds after 0.2g). Splashdown will occur in the Atlantic recovery area.

B. CREW

1. Crew designation is as follows:

Designation	Couch Position at Lift-off and Entry	Prime	Backup
Commander (CDR)	Left	Schirra	Stafford
Command Module Pilot (CMP)	Center	Eisele	Young
Lunar Module Pilot (LMP)	Right	Cunningham	Cernan

2. The crew will follow a 16-hour work, 8-hour rest cycle. At least one crew member will be awake at all times with the CDR and LMP scheduled for simultaneous sleep periods.

3. The pressure suits will be removed and stowed at crew option following GO/NO GO for 18-1 (GET 7:22). Suits will not normally be donned until prior to deorbit. Partial pressure suit operation will commence at crew option after the GO/NO GO for 2-1 at CRO.

4. Two full night passes are scheduled for IMU orientation, realign and system preparation prior to activities requiring the G&N. If the IMU orientation is known and unacceptable, one full night pass is scheduled for realignment. The crew work-rest has been arranged so that all crewmen are awake at least 30 minutes prior to the IMU orientation procedure for SPS burns.

5. Crew members will eat together when possible. One hour will be allocated per meal. Scheduling of additional activities will be held to a minimum during the meal periods.

6. Spacecraft maneuver rates, unless required to support mission objectives or time critical events, will generally not exceed 0.5°/sec (6 min for a 180° maneuver).

7. The crew couch position for each SPS maneuver is shown in Table 1-I.

8. An effort was made not to schedule G&N operations, i.e. alignments, tests, with one or two crewmen asleep. However, due to the major maneuver schedule and the work-rest requirements, it was not always possible to adhere to this guideline.

9. Food, exercise, crew water consumption and sleep will be logged and will be handled on the basis of negative reporting except when minimum requirements are violated.

C. INSTRUMENTATION

1. The DSE will be operated continuously in the LBR recording mode except HBR will be recorded during the following periods:

   a. Launch
   b. S-IVB/CSM separation
   c. TPI braking
   d. All SPS maneuvers
   e. CM/SM separation and entry
   f. In support of certain DTO requirements

Recorded data will generally be dumped by RTC at least once per rev.

2. The FQ recorder will be used:

   a. ≈45 sec prior to lift-off to GET ≈04:00
   b. ≈30 sec prior to G&N/MTVC burn to ≈30 sec after shutdown
   c. ≈30 sec prior to deorbit burn to ECO plus 10 sec.
   d. Prior to CM-SM sep to end of tape.

3. The six FQ instrumentation circuit breakers (panel 277) will be configured:

   a. All CLOSED when the FQ recorder is being used.
   b. CB 9 and 10 OPEN during all other periods. CB 8 permits ECS flight qualification instrumentation to be available on PCM for real time operational use.

4. The biomedical telemetry switching plan requires that the TLM INPUT BIOMED switch be repositioned to a different crewman each 8 hours. This switching plan is denoted in the timeline. The plan also requires that voice identification be given to MCC if crewmen change couches and umbilicals.

5. The spacecraft telecommunication system will be configured for optimum ground control via RTC. A typical station pass with a DSE dump via RTC, as planned by the flight control team, would include:

Station AOS:	DSE - rewind
	PCM - HBR
	S-band tape mode (FM - On)
	DSE - playback mode
At end of DSE rewind:	DSE - forward
At end of DSE dump:	DSE - rewind
Station LOS - 15 sec:	SALVO RESET 2 (returns S/C to pre-AOS comm configuration)

   If there is no DSE dump:

Station AOS:	DSE - Stop
	PCM - HBR
Station LOS - 15 sec:	SALVO RESET 2 (returns S/C to pre-AOS comm configuration)

6. The CSM will nominally be configured for transmitting HBR data during prelaunch.

D. COMMUNICATION

1. VHF Simplex A (296.8) will be the primary air/ground communication frequency for initial voice contact. However, the USBE voice mode will be powered up throughout the mission and will be used for test purposes and for backup for VHF. All duplex and simplex VHF modes will also be tested. The USB test modes and their identification are denoted in the timeline by the ground station when the mode is scheduled for test.

   VHF comm modes are as follows:

	S/C XMIT	S/C RECEIVES
Simplex A	296.8	296.8
Simplex B	259.7	259.7
Duplex A	296.8	259.7
Duplex B	259.7	296.8

2. The S-Band antenna selection to insure lock-on during SPS and RCS ΔV maneuvers is shown in Section II by the maneuver.

3. Table 1-II (page 1-8) presents the GO/NO GO areas and associtaed data. In addition Table 1-II presents the landing area block data for PTP's (Preferred Target Point) and ATP's (alternate target point). These data are voiced up approximately every 4 to 7 revs.

4. Pages 1-9 thru 1-20 present the following log data and associated abbreviations:

   a. Landing area block data (1-9)
   b. P27 manual update (1-11)
   c. Nav check (1-13)
   d. Maneuver update (1-15)
   e. Entry update (1-18)

5. GO/NO GO areas and approximate GETI are present in Table 1-II. The GO/NO GO is passed up to the crew approximately two revs prior to the GETI.

6. Once per day following activities over the US, the flight crew will make a report to the ground containing the following flight plan information:

   a. Particular flight plan items accomplished, including the rev or approximate time of accomplishment.

   b. Quantity and type of photographic film used.

7. General flight plan updates will be voiced up once per day and will contain a schedule of the coming day's activities.

8. During communications, the spacecraft will be referred to by name (i.e. Apollo 7) and the ground will be referred to as "Houston". The individual crew member callouts will be per their assigned crew position.

9. Negative reporting will be used by the flight crew in reporting completion of each checklist. The checklist will not be read by the flight crew or the ground station over air/ground during the conduct of the checklist unless specifically requested by the ground (non-nominal conditions only).

10. All onboard gage readings reported to the network will be read directly from the S/C gages and not corrected by the appropriate factors.

E. CSM SYSTEMS

1. The spacecraft lift-off and power down switch positions are no longer in the flight plan but may be found in the AOH, Vol. II.

2. Spacecraft system status checks scheduled prior to the GO/NO GO for 18-1 (GET 7:22), in addition to the normal checklist activities include:

   a. Redundant suit compressor check
   b. Main and emergency cabin regulators check
   c. Redundant H_2O accumulator check
   d. Secondary coolant loop check
   e. Fuel cell purge
   f. Inverter changeover and check
   g. VHF check all voice modes
   h. USB check all voice modes except backup down voice
   i. PIPA bias and EMS bias check
   j. CMC update for 6-4
   k. IMU alignment to 6-4 REFSMMAT
   l. Prethrust activities for 6-4 to gimbal motor check and including the SCT/star attitude check
   m. Out-the-window orientation for day and night retro
   n. Urine dump

3. Periodic spacecraft system monitoring is a continuing task and does not require real time scheduling; monitoring checks are not shown.

4. Fuel cell purging for both H_2 and O_2 are shown after the expenditure of approximately 30 kwh (See EPS Analysis, Section III).

5. An ECS redundant component check is scheduled each day.

6. One LiOH canister is scheduled for change approximately every 12 hours, starting with the removal of canister No. 1 at 10 hours GET.

7. Cabin humidity surveys (in accordance with DTO P4.4) are shown every six hours when partially suited, starting after GET 9:00, and once a day when in shirt sleeves.

8. The IMU is shown powered up approximately 15 minutes prior to an IMU orientation.

9. Potable water chlorination is shown each 24 hours starting at 12 hrs. GET. Water chlorination is scheduled approximately 2 hours prior to water being required for food reconstitution.

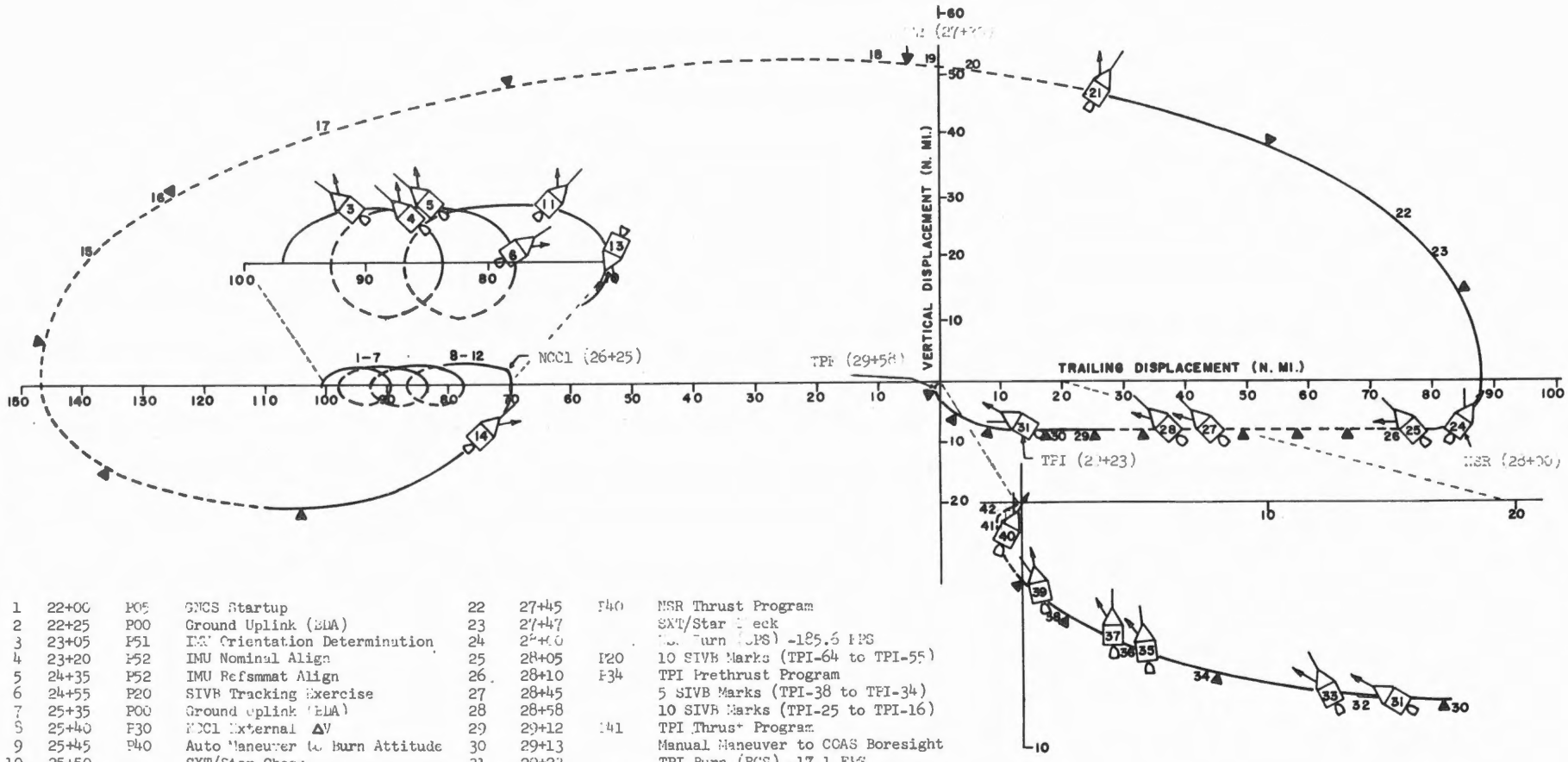
F. PROCEDURES

1. Crew procedures for the accomplishment of the system and mission operations called out in the flight plan may be found in the following documents:

    a. Apollo Operations Handbook (AOH)
    b. Abort Summary Document
    c. Rendezvous Procedures Document
    d. Reentry Procedures Document
    e. Crew checklist

2. Particular procedures for the accomplishment of the specific DTO tests are found in Section IV of this document. A reference to the applicable test procedure is also shown by the test in the timeline, Section II.

Figure 1-1. - Apollo 7 Rendezvous Profile



1	22+00	P05	GNCS Startup	22	27+45	P40	NSR Thrust Program
2	22+25	P00	Ground Uplink (BDA)	23	27+47		SXT/Star Check
3	23+05	P51	IMU Orientation Determination	24	28+00		TPF Burn (DPS) -185.6 FPS
4	23+20	P52	IMU Nominal Align	25	28+05	P20	10 SIVB Marks (TPI-64 to TPI-55)
5	24+35	P52	IMU Refsmmat Align	26	28+10	P34	TPI Prethrust Program
6	24+55	P20	SIVB Tracking Exercise	27	28+45		5 SIVB Marks (TPI-38 to TPI-34)
7	25+35	P00	Ground Uplink (BDA)	28	28+58		10 SIVB Marks (TPI-25 to TPI-16)
8	25+40	P30	NCC1 External ΔV	29	29+12	P41	TPI Thrust Program
9	25+45	P40	Auto Maneuver to Burn Attitude	30	29+13		Manual Maneuver to COAS Boresight
10	25+50		SXT/Star Check	31	29+23		TPI Burn (RCS) -17.1 FPS
11	25+55	P52	IMU Refsmmat Align	32	ASAP	P35	MCC1 Prethrust Program
12	26+10	P40	NCC1 Thrust Program	33	29+28		6 CSM Marks (TPI+5 to TPI+11)
13	26+25		NCC1 Burn (SPS) -208.6 FPS	34	29+36	P41	MCC1 Thrust Program
14	26+30	P20	SIVB Tracking Exercise	35	29+37		MCC1 Burn (RCS)
15	27+05	P00	Ground Uplink (MIL)	36	ASAP	P37	MCC2 Prethrust Program
16	27+10	P30	NCC2 External ΔV	37	29+40		2 CSM Marks (TPI+17 to TPI+18)
17	27+15	P40/P41	NCC2 Thrust Program	38	29+43	P41	MCC2 Thrust Program
18	27+30		NCC2 Burn (OMS/RCS)	39	29+44		MCC2 Burn (RCS)
19	27+32	P30	NSR External ΔV	40	AS REQD	P47	Thrust Monitor (LCC Control)
20	27+34		Manual Maneuver to Burn Attitude	41	29+58		TPF (RCS) -13 FPS
21	27+35	P52	IMU Refsmmat Align	42	30+10		Station Keeping

NOTE:

COAS LINE OF SIGHT
SXT LINE OF SIGHT
DENOTES ACTIVE LINE OF SIGHT
DAYLIGHT
NIGHT
10 MINUTES

TABLE 1-I

SPS BURN SCHEDULE

BURN NO	GETI BURN TIME DELTA V_c	LH ATTITUDE wrt orb plane	HEADS UP OR DOWN LIGHTING	ΔV (LV) ΔV REQD fps	ULLAGE ΔV fps	TVC	SPS ON/OFF	SEAT POSITION L	SEAT POSITION C	SEAT POSITION R	REMARKS
1	26:25 BT: 9.6 ΔV_c:197.7	R: 0° P: -72.2° Y: -3.3°	UP NIGHT SR-16 MIN	ΔVX: 54.8 ΔVY: -1.3 ΔVZ: 201.6 ΔV REQD: 208.6	G&N 4 Jet 15 Sec ΔV:5.8	G&N	G&N	CDR	CMP	LMP	NCC1 120/198 WT: 32400
2	28:00 BT: 8.4 ΔV_c:173.9	R: 180° P: -59.2° Y: 180°	DOWN NIGHT SR-11 MIN	ΔVX: -87.9 ΔVY: 0.36 ΔVZ: -163.8 ΔV REQD: 185.6	G&N 4 Jet 15 Sec ΔV:6.0	G&N	G&N	CDR	CMP	LMP	NSR 117/157 WT: 31732
3	91:43 BT: 5.1 ΔV_c:103.8	R: 0° P: -17.7° Y: -122°	UP DAY SS-5 MIN	ΔVX: -58.7 ΔVY: 95.7 ΔVZ: -29.2 ΔV REQD: 115.7	SCS 4 Jet 15 Sec ΔV:6.1	SCS AUTO	pb ON EMS OFF	CMP	LMP	CDR	96/155 Slosh Damping Test WT: 31035
4	120:52 BT: 0.5 ΔV_c:14.9	R: 0° P: +2.9 Y: 0°	UP DAY SR+20 MIN	ΔVX: 15 ΔVY: 0 ΔVZ: 0 ΔV REQD: 14.9	G&N 2 Jet 20 Sec ΔV:4.4	G&N	G&N	CMP	LMP	CDR	94/160 Slosh Damping Test WT: 30683
5	165:08 BT:61.5 ΔV_c:1451.6	R: 0° P: +2.4° Y: +85°	UP DAY SR+7 MIN	ΔVX: 120.0 ΔVY: 1464.1 ΔVZ: 5.0 ΔV REQD: 1465.4	G&N 2 Jet 20 Sec ΔV:4.4	G&N MTVC	G&N ON Thrust Sw OFF	CDR	CMP	LMP	97/242 PUGS Test WT: 30635
6	210:13 BT: 0.5 ΔV_c: N/A	R: 0° P: +3.0° Y: 180°	UP NIGHT SR-4 MIN	ΔVX: -17.0 ΔVY: 0 ΔVZ: 0 ΔV REQD: 16.9	G&N 2 Jet 20 Sec ΔV:5.0	G&N	G&N	CMP	LMP	CDR	91/232 WT: 26470
7	239:05 BT: 7.7 ΔV_c:188.5	R: 0° P: +87° Y: 0	UP DAY SR+12 MIN	ΔVX: 0 ΔVY: 0 ΔVZ:-203 ΔV REQD: 202.5	SCS 4 Jet 15 Sec ΔV:7.2	SCS AUTO	pb ON EMS OFF	CMP	LMP	CDR	92/228 WT: 26417
8	259:40 BT: 10.2 ΔV_c:263.8	R: 0° P: -49.3° Y: -178.9°	UP NIGHT SR-15 MIN	ΔVX: -191.2 ΔVY: 0 ΔVZ: 203 ΔV REQD: 278.3	G&N 4 Jet 15 Sec ΔV:7.5	G&N	G&N	CDR	CMP	LMP	Deorbit

TABLE 1-II

GO/NO GO AREAS

AREA	APPROX GETI Hr+Min	REV	GO/NO GO STA	REV
2-1	1+25	1	CRO	
6-4	8+58	6	GDS	5
18-1	26+50	17	MLA	15
33-1	50+45	32	MLA	30
47-1	73+20	46	MLA	44
62-1	96+52	61	MLA	59
77-1	120+35	76	MLA	74
92-1	144+15	91	MLA	89
106-1	166+22	105	MLA	103
121-1	190+33	120	MLA	108
135-1	213+50	134	MLA	132
150-1	237+10	149	MLA	147

LANDING AREA BLOCK DATA

BLK NO.	PTP GROUP	ATP GROUP	UPDATE REV	UPDATE STATION
1	2-1 to 8-3	1-B to 8-A	take on	
2	9-3 to 14-2	9-A to 14-C	7	HAW
3	15-1 to 21-4	15-C to 21-A	14	CYI
4	22-3 to 26-A	22-B to 26-C	18	ANG
5	27-2 to 32-1	27-C to 32-B	25	RED
6	33-1 to 38-3	33-4 to 38-A	31	CRO
7	39-3 to 44-1	39-A to 44-C	36	HAW
8	45-1 to 50-4	45-B to 50-B	44	CYI
9	51-3 to 56-A	51-A to 56-C	48	GWM
10	57-2 to 62-1	57-C to 62-4	55	RED
11	63-4 to 68-3	63-A to 68-A	61	CRO
12	69-A to 74-1	69-C to 74-B	66	HAW
13	75-1 to 80-4	75-B to 80-B	74	BDA
14	81-3 to 86-2	81-A to 86-C	79	HAW
15	87-2 to 92-1	87-C to 92-4	85	RED
16	93-4 to 98-3	93-A to 98-A	91	CRO
17	99-A to 104-1	99-C to 104-B	97	RED
18	105-1 to 110-3	105-B to 110-A	103	CYI
19	111-3 to 116-2	111-A to 116-C	109	HAW
20	117-1 to 122-4	117-C to 122-B	115	CYI
21	123-4 to 128-A	123-B to 128-C	121	MIL
22	129-A to 134-1	129-C to 134-B	127	GWM
23	135-1 to 140-3	135-4 to 140-A	133	CYI
24	144-3 to 146-1	141-A to 146-C	139	HAW
25	147-1 to 152-4	147-C to 152-B	145	CYI
26	153-3 to 158-A	153-B to 158-C	151	TEX
27	159-A to 164-1	159-C to 164-B	157	GWM

LANDING AREA BLOCK DATA LOG

BLOCK DATA

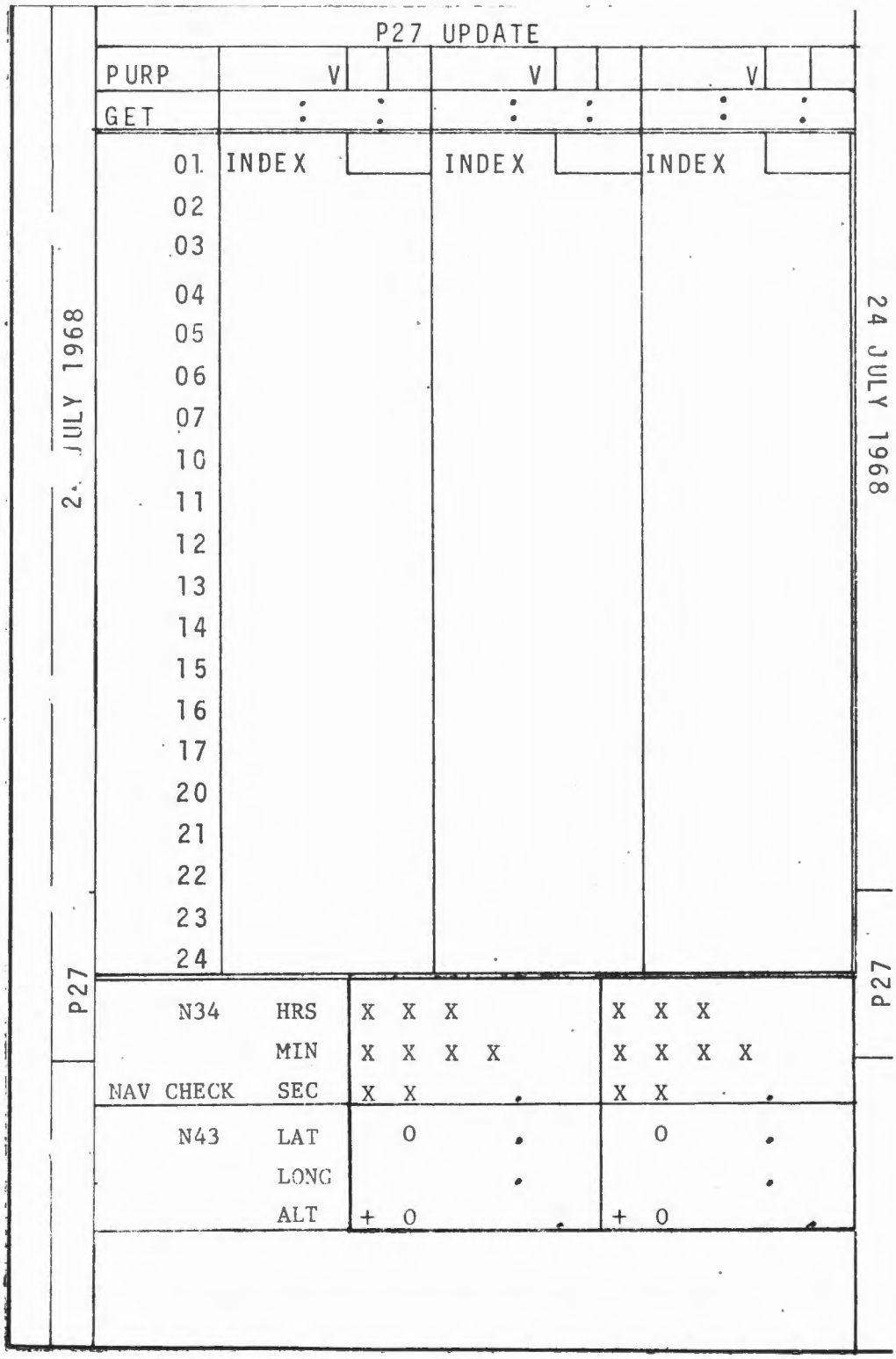
X X	X X	AREA
X X X .	X X X .	LAT
X X .	X X .	LONG
: :	: :	GETI
X X X .	X X X .	ΔV_C
X X	X X	AREA
X X X .	X X X .	LAT
X X .	X X .	LONG
: :	: :	GETI
X X X .	X X X .	ΔV_C
X X	X X	AREA
X X X .	X X X .	LAT
X X .	X X .	LONG
: :	: :	GETI
X X X .	X X X .	ΔV_C
X X	X X	AREA
X X X .	X X X .	LAT
X X .	X X .	LONG
: :	: :	GETI
X X X .	X X X .	ΔV_C
X X	X X	AREA
X X X .	X X X .	LAT
X X .	X X .	LONG
: :	: :	GETI
X X X .	X X X .	ΔV_C

REMARKS:

BLOCK DATA

AREA		RECOVERY AREA
LAT	XX.XX	LATITUDE OF TARGET POINT, DEGREES
LONG	XXX.XX	LONGITUDE OF TARGET POINT, DEGREES
GETI	XXX:XX:XX	RETRO-FIRE IGNITION TIME (HR:MIN:SEC)
ΔV_C	XXX.X	PREMANEUVER SETTING IN EMSΔV COUNTER, FPS
W_X	XXXXXXX	WEATHER CONDITIONS AT TARGET POINT (GOOD-FAIR-POOR) (INCLUDED IN REMARKS)

P27 MANUAL UPDATE LOG



P27 UPDATE				
PURP		V	V	V
GET		: :	: :	: :
01	INDEX		INDEX	INDEX
02				
03				
04				
05				
06				
07				
10				
11				
12				
13				
14				
15				
16				
17				
20				
21				
22				
23				
24				
N34	HRS	X X X	X X X	
	MIN	X X X X	X X X X	
NAV CHECK	SEC	X X .	X X .	
N43	LAT	0 .	0 .	
	LONG	.	.	
	ALT	+ 0 .	+ 0 .	

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P27

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P27

P27 UPDATE

PURP	XXX	TYPE OF DATA TO BE RECEIVED (SUCH AS: NAV - LIFT-OFF TIME)
V	XX	TYPE OF COMMAND LOAD (70 - 71 - 72 - 73)
GET	XXX:XX:XX	TIME DATA RECORDED (HR:MIN:SEC)
01	XX	INDEX NO. OF COMMAND WORDS IN LOAD (OCTAL)
02-24	XXXXX	NO. OF CORRECTION COMMAND WORDS
NAV CHECK		TO CONFIRM POINT ABOVE GROUND TRACK FOR A GIVEN TIME
T		TIME
LAT		LATITUDE
LONG		LONGITUDE
ALT		ALTITUDE

NAV CHECK UPDATE LOG

NAV CHECK

X X X X X X X X X .	X X X X X X X X X .	HRS MIN SEC	N34
0 . . + 0 .	0 . . + 0 .	LAT LONG ALT	N43
X X X X X X X X X .	X X X X X X X X X .	HRS MIN SEC	N34
0 . . + 0 .	0 . . + 0 .	LAT LONG ALT	N43
X X X X X X X X X .	X X X X X X X X X .	HRS MIN SEC	N34
0 . . + 0 .	0 . . + 0 .	LAT LONG ALT	N43
X X X X X X X X X .	X X X X X X X X X .	HRS MIN SEC	N34
0 . . + 0 .	0 . . + 0 .	LAT LONG ALT	N43
X X X X X X X X X .	X X X X X X X X X .	HRS MIN SEC	N34
0 . . + 0 .	0 . . + 0 .	LAT LONG ALT	N43

NAV CHECK

NAV CHECK

NAV CHECK

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NAVIGATION CHECK

SPACECRAFT POSITION DEFINED RELATIVE TO THE EARTH FOR A GIVEN TIME.

GET	XXX:XX:XX	TIME THAT LAT,LONG & ALT VALID (HR:MIN:SEC)
LAT	XX.XX	LATITUDE, DEGREES
LONG	XXX.XX	LONGITUDE, DEGREES
ALT	0XXX.X	ALTITUDE , UNITS N.M.

MANEUVER UPDATE LOG

MANEUVER			PURPOSE	MANEUVER
+ 0 0 .	+ 0 0 .		HRS GETI N33	
+ 0 0 0 .	+ 0 0 0 .		MIN	
+ 0 .	+ 0 .		SEC	
.	.		ΔVX N32	
.	.		ΔVY	
.	.		ΔVZ	
+ 0 .	+ 0 .		HA N42	
0 .	0 .		HP	
+ .	+ .		VC∓ΔVR-T.O.	
+	+		WGT N47	
0 0 .	0 0 .		PTRM N48	
0 0 .	0 0 .		YTRM	
X X X :	X X X :		BT(MIN:SEC)	
X X X X	X X X X		SXTS	
X X .	X X .		SFT	
X X X .	X X X .		TRN	
+ 0 0 .	+ 0 0 .		HRS N34	
+ 0 0 0 .	+ 0 0 0 .		MIN TLAT, LONG	
+ 0 .	+ 0 .		SEC	
0 .	0 .		LAT N43	
.	.		LONG	
+ 0 .	+ 0 .		ALT	
X X X	X X X		R AS	
X X X	X X X		P REQUIRED	
X X X	X X X		Y	

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MANEUVER UPDATE

PURPOSE	XXXXXX	TYPE OF MANEUVER TO BE PERFORMED
GETI		TIME OF MANEUVER IGNITION
	XXX	(HR)
	XX	(MIN)
	XX.XX	(SEC)
ΔVX	XXXX.X	EXTERNAL ΔV COMPONENTS
ΔVY	XXXX.X	(USED IN P30), FPS
ΔVZ	XXXX.X	
HA	XXX.X	PREDICTED APOGEE AND PERIGEE ALTITUDES
HP	XXX.X	AFTER MANEUVER (N.M.)
V_C	XXXX.X	PREMANEUVER SETTING IN EMS ΔV COUNTER, FPS
W_{GT}	XXXXX	TOTAL VEHICLE WEIGHT, LBS
PTRM	X.XX	SPS OFFSETS TO PLACE THRUST
YTRM	X.XX	VECTOR THRU CENTER OF GRAVITY, DEGREES
BT	X:XX	BURN DURATION OF MANEUVER (MIN:SEC)
SXTS	XX	SEXTANT STAR FOR ORIENTATION CHECK (OCTAL)
SFT	XXX.X	SEXTANT SHAFT SETTING FOR ORIENTATION CHECK, DEGREES
TRN	XX.X	SEXTANT TRUNNION SETTING FOR ORIENTATION CHECK, DEGREES

MANEUVER UPDATE (continued)

N34			TIME THAT LATITUDE, LONGITUDE AND ALTITUDE ARE VALID.
	TLAT	XXX	(HR)
	LONG	XX	(MIN)
	ALT	XX.XX	(SEC)
N43	LAT	XX.XX	LATITUDE (+ NORTH), DEGREES
	LONG	XXXX.XX	LONGITUDE (+ EAST), DEGREES
	ALT	XXX.X	ALTITUDE , UNITS
R		XXX	ROLL IGNITION GIMBAL ANGLE, DEGREES
P		XXX	PITCH IGNITION GIMBAL ANGLE, DEGREES
Y		XXX	YAW IGNITION GIMBAL ANGLE, DEGREES

ENTRY UPDATE		
X –	X –	AREA
X X –	X X –	ΔV TO
X X X	X X X	R400K
X X X	X X X	P400K
X X X	X X X	Y400K
+	+	RTGO .05G 63
+	+	V10 .05G
X X	X X	RET .05G
0	0	LAT 61
		LONG
X X	X X	RET .2G
		DRE 66
R L /	R L /	BANK AN
X X	X X	RET RB
X X	X X	RETBBO
X X	X X	RETEBO
X X	X X	RETDROG
X X X	X X X	BBA CHART
/	/	DRE UPDATE
POST BURN		
X X X	X X X	R400K
+	+	RTGO .05G 63
+	+	VIO .05G
X X	X X	RET .05G
X X	X X	RET .02G
		DRE 66
R L /	R L /	BANK AN
X X	X X	RETRB
X X	X X	RETBBO
X X	X X	RETEBO
X X	X X	RETDROG

24 JULY 1968 — ENTRY — 24 JULY 1968 — ENTRY

ENTRY UPDATE

AREA	XXX-XX	RECOVERY AREA (FIRST 3-LANDING REVOLUTION LAST 2 - RECOVERY AREA AND SUPPORT CAPABILITIES)
ΔV TO	XX.X	TAIL OFF VELOCITY READ IN EMS ΔV COUNTER, FPS
R400K	XXX	ROLL ENTRY GIMBAL ANGLE TO ASSURE CAPTURE, DEGREES
P400K	XXX	PITCH ENTRY GIMBAL ANGLE TO ASSURE CAPTURE, DEGREES
Y400K	XXX	YAW ENTRY GIMBAL ANGLE TO ASSURE CAPTURE, DEGREES
RTGO	+ XXXX.X	RANGE TO GO FROM 0.05G TO TARGET, MILES
VIO	+ XXXXX.	INERTIAL VELOCITY AT 0.05G, FPS
RET .05G	XX:XX	TIME FROM RETRO FIRE TO 0.05G (MIN:SEC)
LAT	XX:XX	LATITUDE OF TARGET POINT, DEGREES
LONG	XXXX.XX	LONGITUDE OF TARGET POINT, DEGREES
RET .2G	XX:XX	TIME FROM RETRO FIRE TO 0.2G (MIN:SEC)
BANK AN	XX/XX	BACKUP BANK ANGLE SCS TYPE ENTRY (ROLL LEFT/ROLL RIGHT),DEGREES
RETRB	XX:XX	RET TO REVERSE BACKUP BANK ANGLE (MIN:SEC)
RETBBO	XX:XX	RET TO BEGIN BLACK OUT (MIN:SEC)
RETEBO	XX:XX	RET TO END BLACK OUT (MIN:SEC)
RETDROG	XX:XX	RET TO DROGUE DEPLOY (MIN:SEC)
DRE	XXXXX.X	DOWN RANGE ERROR AT 0.2G
BBA	XXX	BACKUP BANK ANGLE, DEGREES

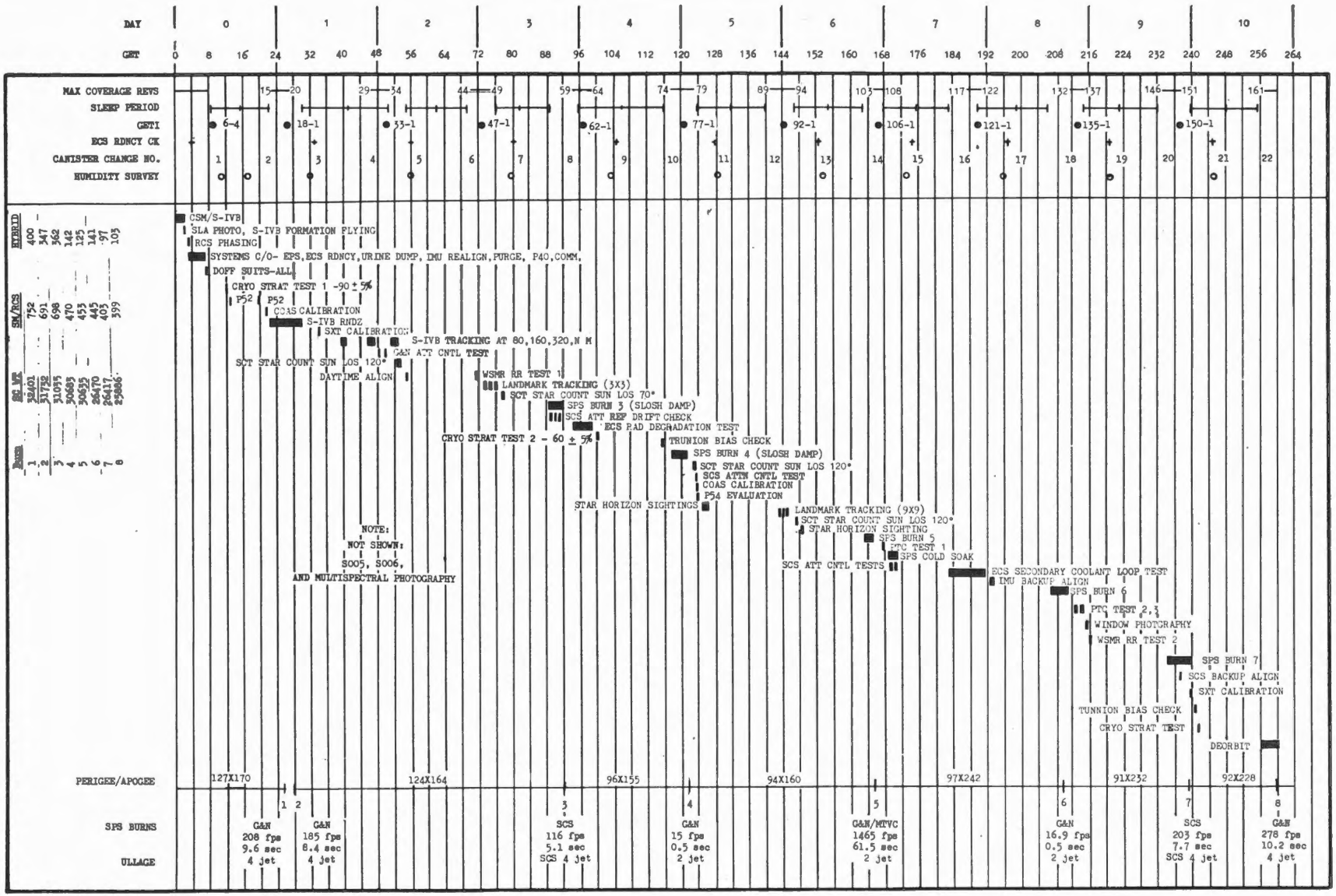
ENTRY UPDATE (CONTINUED)

POSTBURN

R 400K	XXX	ROLL ENTRY GIMBAL ANGLE TO ASSURE CAPTURE, DEGREES
RTGO .05G	+XXXX.X	RANGE TO GO FROM 0.05G TO TARGET, MILES
VIO .05G	+XXXXX.	INERTIAL VELOCITY AT 0.05G, FPS
RET .05G	XX:XX	TIME FROM RETROFIRE TO 0.05G (MIN:SEC)
RET .2G	XX:XX	TIME FROM RETROFIRE TO 0.2G (MIN:SEC)
DRE	XXXXX.X	DOWN RANGE ERROR AT 0.2G
BANK AN	XX/XX	BACKUP BANK ANGLE SCS TYPE ENTRY (ROLL LEFT/ROLL RIGHT), DEGREES
RETRB	XX:XX	RET TO REVERSE BACKUP BANK ANGLE (MIN:SEC)
RETBBO	XX:XX	RET TO BEGIN BLACKOUT (MIN:SEC)
RETEBO	XX:XX	RET TO END BLACKOUT (MIN:SEC)
RETDROG	XX:XX	RET TO DROGUE DEPLOY (MIN:SEC)

SECTION II - DETAILED TIMELINE

APOLLO 7 SUMMARY FLIGHT PLAN



FLIGHT PLAN

TIME	EVENT	REMARKS
-00:03	LCC: REPORT IGNITION	NOMINAL LIFT-OFF 1500 GMT
00:00	LCC: CDR: REPORT LIFT-OFF	CLOCK STARTS, L/O LIGHT, ENGINE LIGHTS OFF, UMBILICAL DISCONNECT, tb = 0
00:10	CDR: REPORT ROLL COMMENCE	
00:21	CDR: REPORT PITCH TRACKING	
00:38	CDR: REPORT ROLL COMPLETE	
01:01	MCC: REPORT MODE IB	PROP DUMP TO RCS CMD
01:17	MAX Q	
01:40	CDR: REPORT EDS MANUAL OFF	EDS RATE AND ENG AUTO - OFF
01:50	MCC: REPORT MARK, MODE IC	h = 100,000 ft (16.5NM)
02:10	MCC: REPORT GO/NO GO FOR STAGING	
02:12	CDR: REPORT GO/NO GO FOR STAGING	
02:23	CDR: REPORT INBOARD OUT	
02:26	CDR: REPORT OUTBOARD OUT	
02:27	CDR: REPORT STAGING	
02:31	CDR: REPORT ENGINE ON	
02:35	CDR: REPORT SCALE CHANGE	
02:46	CDR: REPORT TOWER JETT	TOWER JETTISONED @ J-2 IGNITION +15 sec

FLIGHT PLAN

TIME	EVENT	REMARKS
02:51	CDR: REPORT GUIDANCE	
03:30	MCC: REPORT TRAJECTORY GO/NO GO	
04:00	CMP: REPORT S/C GO/NO GO	
05:00	LMP: REPORT S/C GO/NO GO	
06:00	CDR: REPORT S/C GO/NO GO	
07:00	CMP: REPORT S/C GO/NO GO	
08:00	LMP: REPORT S/C GO/NO GO	
09:00	CDR: REPORT S/C GO/NO GO	
	MCC: REPORT TRAJECTORY AND CMC GO/NO GO	
	REPORT PREDICTED SECO	
09:27	MCC: REPORT MARK, MODE IV	
09:53	CDR: REPORT SECO REPORT: Hp	09:53 LH VENT OPEN PASS "B" ENABLE LH PASS VENT OPEN
	S-IVB MAINTAINS CUTOFF INERTIAL ATT FOR 20 SEC	
		09:54 PASS "A" ENABLE
SECO +20 SEC	S-IVB MANEUVERS TO LH AND INITIATES ORB RATE (HEADS DOWN)	

MISSON	EDITION	DATE	PAGE
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MSC FORM 2114C (JUL 67)

FLIGHT PLAN

TIME	EVENT	REMARKS
SECO + 40 SEC	MCC: REPORT ORBITAL GO/NO GO	
10:23	LOX VENT OPEN	
10:53	LOX VENT CLOSED	
12:40	BDA LOS:	
	INSERTION CHECKLIST	
17:41	CYI AOS	
	SELECT SIMP A (on ground cue)	SELECT S-BAND ANT D ON GROUND CUE (IF NOT SELECTED DURING LAUNCH)
	SETUP CABIN GAS ANALYZER	

FLIGHT PLAN

TIME	EVENT	REMARKS
	MCC: REPORT: [CMC LIFT-OFF TIME UPDATE GET TIME HACK ORBITAL PARAMETERS	
23:39	CYI LOS	
30:53	LH_2 VENT CLOSED	
36:24	TAN AOS	
39:00	S/C SUNSET	
43:20	TAN LOS	
53:41	CRO AOS	
	CDR INSTALL COAS	
53:43	LH_2 VENT OPEN	
	MCC: REPORT: [GO/NO GO GET S-IVB PASSIVATION INITIATE STATE VECTOR - AS REQD	
	PARTIAL SUIT OPERATION (AS DESIRED)	
59:12	CRO LOS	
1:01	CNB AOS CMP TO LEB - FINISH INSERTION CHECKLIST STOW LMP, CMP, CDR GLOVES, LIFE VESTS AND CMP HELMET - UNDER RH COUCH - STOW LMP HELMET, REMOVE	CONFIGURE H-BLAD FOR WINDOW AND SLA PHOTOGRAPHY: 70mm LENS RING SIGHT S0121 F11, 1/250
1:09	CNB LOS CAMERA BRACKET; UNDER LH COUCH - STOW CDR HELMET, REMOVE ORDEAL, TEMP STOWAGE BAGS, TISSUE DISP	CONFIGURE SEQ-CAM FOR SLA PHOTOGRAPHY 18mm LENS S0121 MOUNT IN RH WINDOW BRACKET

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MSC FORM 2114C (JUL 67)

FLIGHT PLAN

TIME	EVENT	REMARKS
	N LEB - STOW CMP TEMP STOWAGE BAG, REMOVE N FLT DATA FILE, INSTALL URINE FILTER —— N COUCHES TO DOCK ——UNSTOW & ASSEMBLE N CAMERAS, PASS CAMERAS & EXTRA FILM TO N LMP & CDR N	
1:16	N S/C SUNRISE	
1:25	HTV AOS RECORD LVPD PRIOR TO S-IVB PASSIVATION (Pg 4-5)	
1:30	SELECT P47 (prior to LOX dump)	ENABLES MSFN TO MONITOR S/C ACCEL DURING S-IVB PASSIVATION

FLIGHT PLAN

TIME	EVENT	REMARKS
01:34	S-IVB PASSIVATION	
	01:34:05 START LOX DUMP	
	01:34:15 LOX PASS VENT OPEN	
	01:34:19 LH VENT OPEN	
	01:42:05 START COLD He DUMP	
	01:44:19 LH VENT CLOSED	
	01:46:05 STOP LOX DUMP	
	01:46:33 PASS "A" DISABLE PASS "B" DISABLE	
	RECORD LVPD AFTER S-IVB PASSIVATION (Pg 4- 5)	
	APOLLO 7 REPORT: CABIN PPO_2	
01:46	MCC: UPDATE NAV STARS VISIBLE FOR P52	
01:51	VAN LOS	
	JETTISON OPTICS COVERS	
02:06	PRE AOS	
02:09	N S/C SUNSET N N P52 IMU REALIGN (OPTION 3) N (REALIGNS TO PAD REFSMMAT) N	

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MSC FORM 2114C (JUL 67)

FLIGHT PLAN

TIME	EVENT	REMARKS
02:15	MCC: N GIVE 40 min TIME HACK TO S-IVB N CSM SEP N REPORT GET S-IVB PITCH N DOWN AND INERTIAL MANEUVER N	
02:18	TAN LOS N N	
02:27	CMP: N RETURN TO COUCH FOR S-IVB TAKEOVER N AND CSM/S-IVB SEP N	
02:28	CRO AOS: N APOLLO 7: REPORT GYRO TORQUE ANGLES N	
	MCC: N REPORT GO/NO GO FOR S-IVB TAKEOVER N DEMONSTRATION N UPDATE STATE VECTOR AS REQD N	
	N PREPARE FOR S-IVB TAKEOVER – DAP LOAD N	
02:30	N INITIATE S-IVB MANUAL ATTITUDE N CONTROL DEMONSTRATION (Pg 4-8,) N	

MANEUVER	MANEUVER TIME
VERIFY CONTROL	30 SEC or LESS
-P FOR 3°	10 SEC
STOP RATE, HOLD ATT	10 SEC
+P FOR 12°	40 SEC
STOP RATE, HOLD ATT	10 SEC
-R FOR 5°	10 SEC
STOP RATE, HOLD ATT	10 SEC
+R FOR 5°	10 SEC
STOP RATE, HOLD ATT	10 SEC
-Y FOR 3°	10 SEC

S-IVB MANEUVER RATES:
R RATE 0.5°/SEC
P, Y RATE 0.3°/SEC

MISSON	AS-205/101	EDITION	FINAL	DATE	SEPTEMBER 16, 1968	PAGE	2-7

FLIGHT PLAN

TIME	EVENT	REMARKS
	MANEUVER — MANEUVER TIME STOP RATE, HOLD ATT — 10 SEC +Y FOR 3° — 10 SEC STOP RATE, HOLD ATT — 10 SEC 180 SEC	
02:33	END S-IVB MANUAL CONTROL TEST	S-IVB RETURNS TO I/U TIMELINE
	MCC: REPORT GO/NO GO FOR PYRO ARM	
02:34	CRO LOS	ARIA COVERAGE 2:34 to 2:44
02:38	INITIATE S-IVB SEP PREPARATION CHECKLIST	
02:42:50	S-IVB PITCHES DOWN 20° AND MAINTAINS ORB RATE	
02:46	S/C SUNRISE	
	PERFORM WINDOW PHOTOGRAPHY (Pg 4-9)	
02:51:05	S-IVB GOES INERTIAL	
02:54	HAW AOS	
02:55	CSM/S-IVB SEPARATION AND TRANSPOSITION	DSE HBR REQD FOR CSM/S-IVB SEP.
	INITIATE POSTSEP CHECKLIST	SEP & TRANSPOSITION SEQUENCE +X FOR 3 SEC. ΔV 1.05 FPS COAST 1 MIN 10 SEC. DISTANCE 70 FT. -X FOR 1-1/2 SEC. ΔV 0.5 FPS
	SELECT S-BAND ANT A (after pitch-over)	PITCH UP 180° @ 5°/SEC ROLL LEFT 60° @ 2°/SEC PLUS X 1-1/2 SEC

(N N N … marks alongside events from maneuver table through 02:42:50)

FLIGHT PLAN

TIME	EVENT	REMARKS
03:03	US AOS — S-IVB SIMULATED DOCKING APPROACH	
	S-IVB FORMATION FLYING AND SLA PHOTOGRAPHY (Pg 4-11)	
03:07	APOLLO 7 — REPORT: CABIN PPO_2	
	MCC: UPDATE INITIAL PHASE MANEUVER REPORT ON VOICE QUALITY DSE DUMP	
	S-IVB MANEUVERS TO RETRO ATT	
	TERMINATE FORMATION FLYING	
	P47 THRUST MONITOR	
03:20	INITIAL PHASE MANEUVER (ΔV - 7.5 fps) SLOSH DAMPING TEST (Pg 4-20)	RETROGRADE 10 MIN HBR REQD FOR SLOSH DAMPING TEST
03:24	VAN LOS	
03:30	ACN AOS — CMP TO LEB	
03:38	ACN LOS — CHECK THIRD INVERTER	RECORD INVERTER PHASE VOLTAGES
03:39	N S/C SUNSET	
	N	
	CMP: N	
	N	
	N	
	N	
	N	
	N	
	N	
	N	

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FLIGHT PLAN

4:00 — N — ECS REDUNDANT COMPONENT CHECK

CRO — N — APOLLO 7 REPORT: PYRO A,B VOLTS; BAT C VOLTAGE; INVERTER PHASE VOLTAGE

:10 — N

ARIA 4:10 to 4:18

:20 — CK PYRO CB'S - OPEN

HAW

:30 — PIPA BIAS AND EMS BIAS TEST (REPORT RESULTS)

MCC: REPORT RESULTS OF PHASING MANEUVER

:40 — TEX — APOLLO 7 REPORT: CABIN PPO_2

MCC UPDATE: STATE VECTOR; TGT LOAD; REFSMMAT; MANEUVER PAD; NAV CHECK; DAY & NIGHT RETRO TEST TIMES

:50 — URINE DUMP CHECK (REPORT RESULTS)

P30 EXTERNAL ΔV

ANG

5:00

5:00 — SET PREFERRED ORIENTATION FLAG -76 Bit 4

EMS ΔV TEST

ACN

:10 — N — P52 IMU REALIGN (Option 1-Preferred)

PRE — N

:20 — N

TAN — N

:30 — N

N

CRO — N

:40 — N

N

ARIA 5:43 to 5:52

P40 CSM-SPS THRUSTING (to check of gimbal angles)

:50 — H_2 PURGE HTR - ON

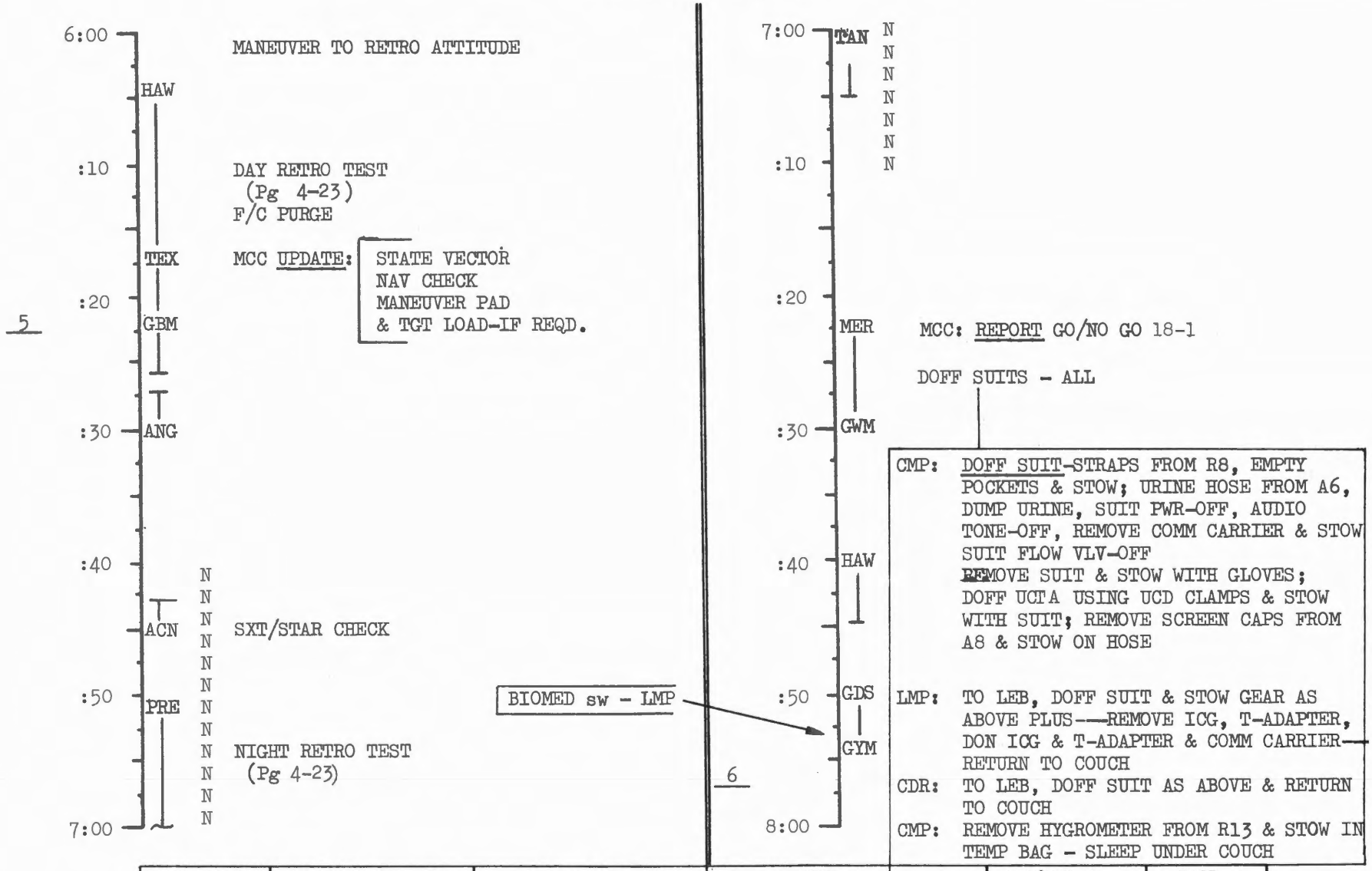
GWM

6:00

MISSION	EDITION	DATE	TIME	DAY/REV	PAGE
AS-205/101	FINAL	SEPTEMBER 16, 1968	4:00 - 6:00		2-10

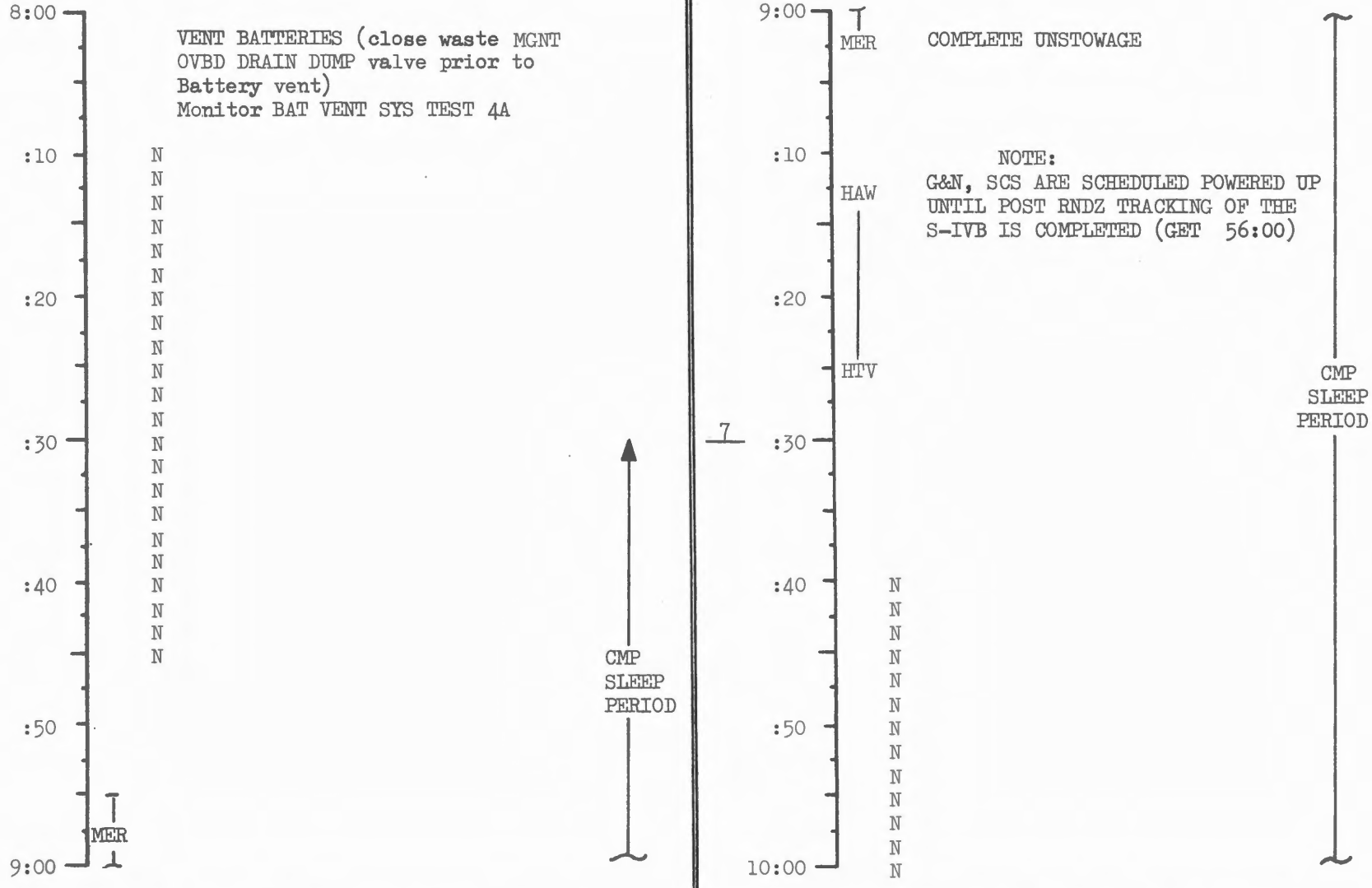
MSC FORM 1186 (SEP 67) FLIGHT PLANNING BRANCH

FLIGHT PLAN



MISSION	EDITION	DATE	TIME	DAY/REV	PAGE
AS-205/101	FINAL	SEPTEMBER 16, 1968	6:00 - 8:00		2-11

FLIGHT PLAN



MISSION	EDITION	DATE	TIME	DAY/REV	PAGE
AS-205/101	FINAL	SEPTEMBER 16, 1968	8:00 - 10:00		2-12

MSC FORM 1186 (SEP 67) FLIGHT PLANNING BRANCH

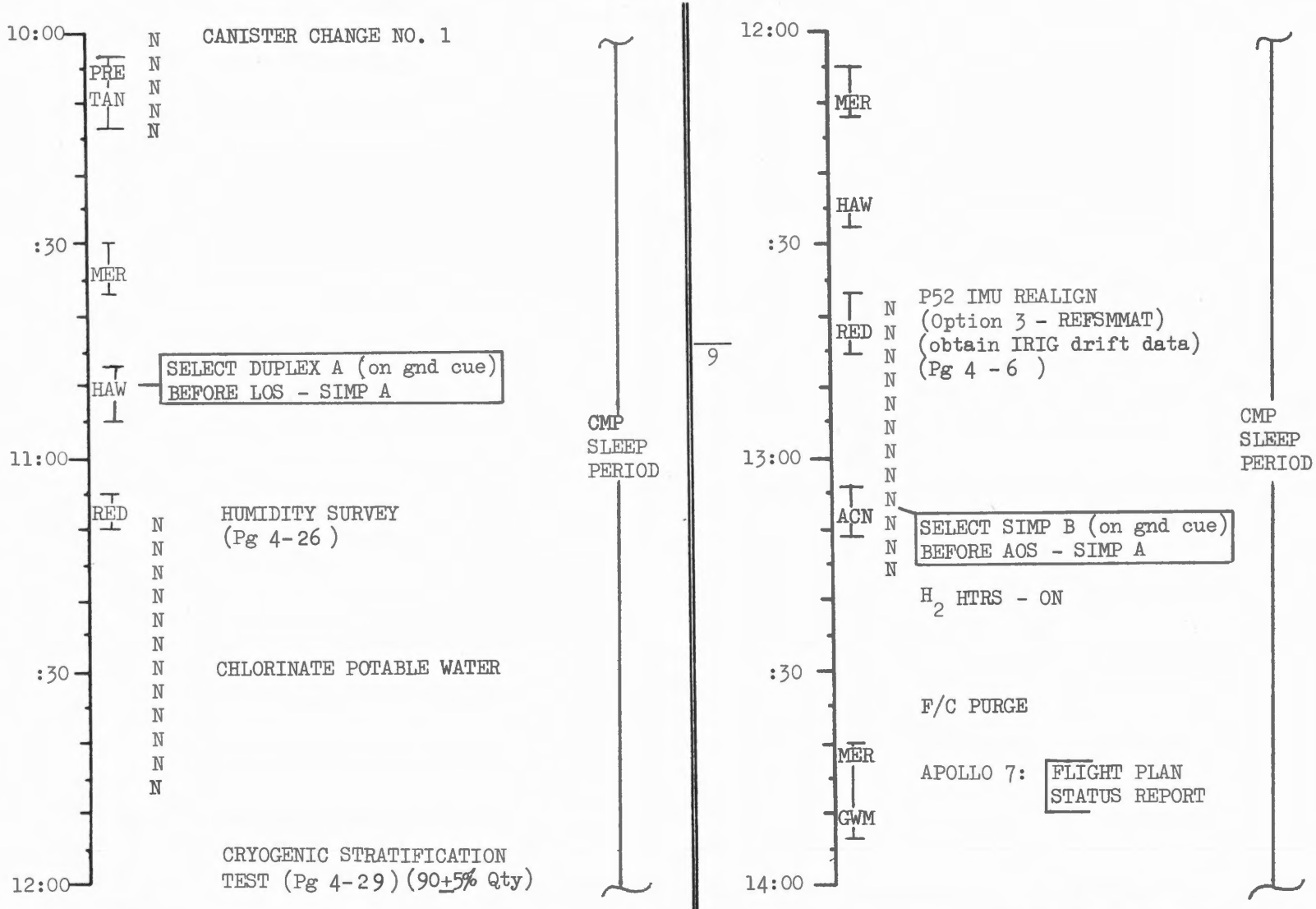
TABLE III

TYPICAL

HOUSEKEEPING CONFIGURATION

ITEM	VOLUME	NO. UNSTOWED	INFLIGHT LOCATION
16mm Camera	Vol B3	1	W/Crew or Temp Stow F 1 or 2
16mm Film Mag	Vol B3	3	In Temp Stowage-F 1 or 2 or Bag
18mm Lens	Vol B3	1	In Temp Stow
Power Cable	Vol B3	1	On Panel 227 or PL100
Mirror Rt. Angle	Vol B3	1	On Cam. or Temp Stow
70mm Hasselblad	Vol B3	1	In Temp Stow (Vol F1)
70mm Mag	Vol R13	2	In Temp Stow (Vol F1)
Ring Sight	Vol B3	1	In Temp Stow
Spotmeter	Vol B3	1	In Temp Stow or on Cam
Flt. Data File		As Req'd	In Temp Stow or in Vol R12
Tissue Dispenser		3	In Temp Stow
Helmet Stow Bag W/Helmet			Selectable
Inflt. Coveralls		3	On Crew
Window Shades			On Windows
Temp Stow Bags	U3		1 on RT Hand & LH Girth Ring
Tool Set	A1	1	On A3
CWG Adapter	A8	3	On Crew
CCU Control Head		3	On Crew
O_2 Umbilicals		3	Stowed in CM
Seq. Cam. Brt.	A8	1	Mt. on R/H Rend. Window
CCU Cable		3	On Crew
Urine Filters	R1	2	Mount on Panel
COAS & Bulb	Vol U3		LH window
Light wt headset	A8		On Crew

FLIGHT PLAN



MISSION	EDITION	DATE	TIME	DAY/REV	PAGE
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FLIGHT PLAN

14:00

10

RED N N N N N N N N N N N N

:30

ACN

CDR, LMP EAT PERIOD

CMP SLEEP PERIOD

15:00

MER

GWM

:30

11

N N N N N N N

RED

BIOMED sw - CMP

CDR LMP SLEEP PERIOD

16:00

16:00

N N N N N

CMP EAT PERIOD

:30

CDR, LMP SLEEP PERIOD

MER

GWM

17:00

N N N N N N N N N N N

HUMIDITY SURVEY (Pg 4-26)

12

RED

:30

CYI

18:00

MISSION	EDITION	DATE	TIME	DAY/REV	PAGE
AS-205/101	FINAL	SEPTEMBER 16, 1968	14:00 - 18:00	0/9-12	2-14

FLIGHT PLAN

18:00 RED

:10

:20

CDR
LMP
SLEEP
PERIOD

:30

:40 CNB N N N N N N N N N N N N N

:50

19:00 RED

13

19:00 RED N N N N N N N N N N

:10

ANG MCC: FLIGHT PLAN UPDATE

:20

:30 CYI

MAD

:40

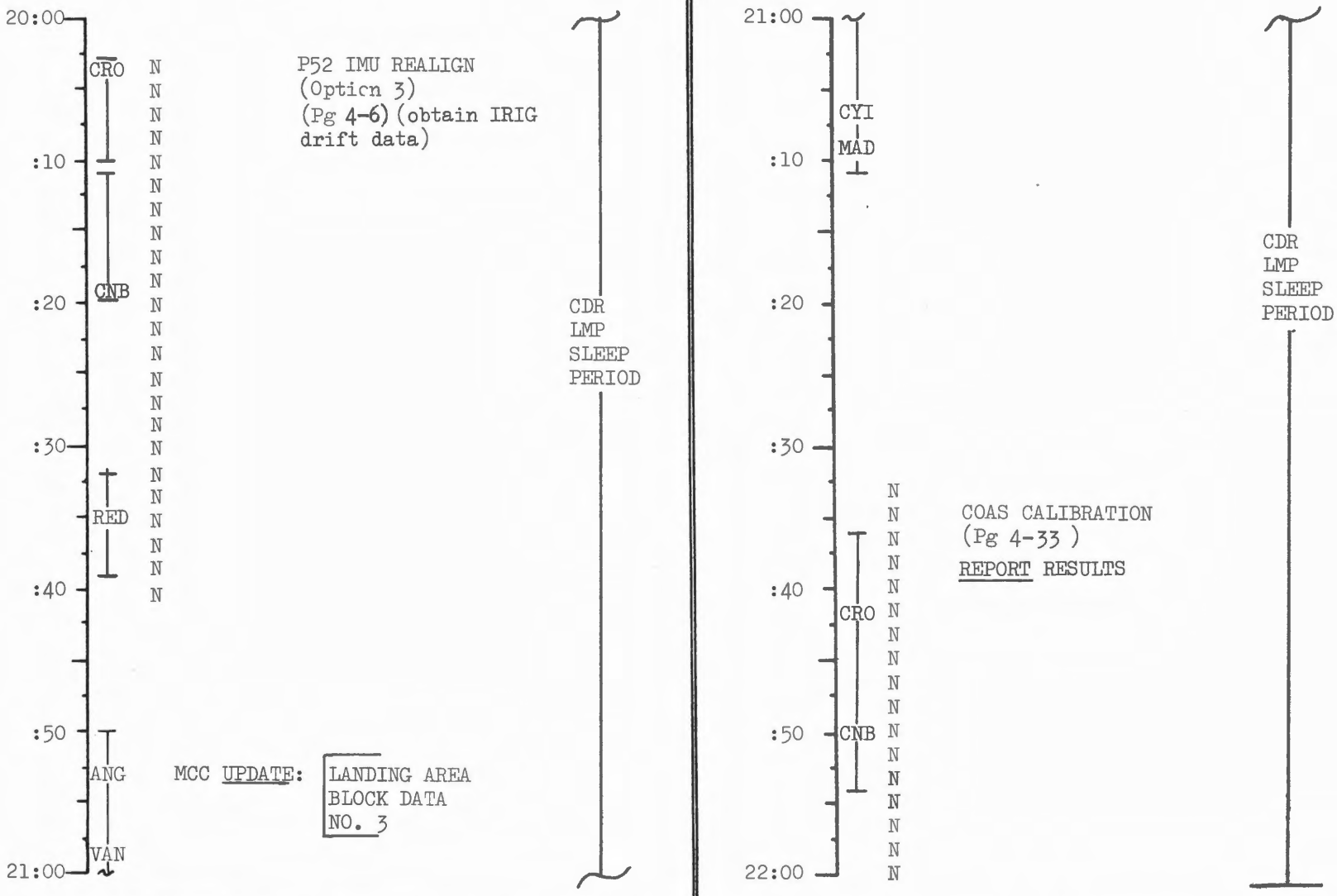
:50

20:00

CDR
LMP
SLEEP
PERIOD

MISSION	EDITION	DATE	TIME	DAY/REV	PAGE
AS-205/101	FINAL	SEPTEMBER 16, 1968	18:00 - 20:00	0/12-13	2-15

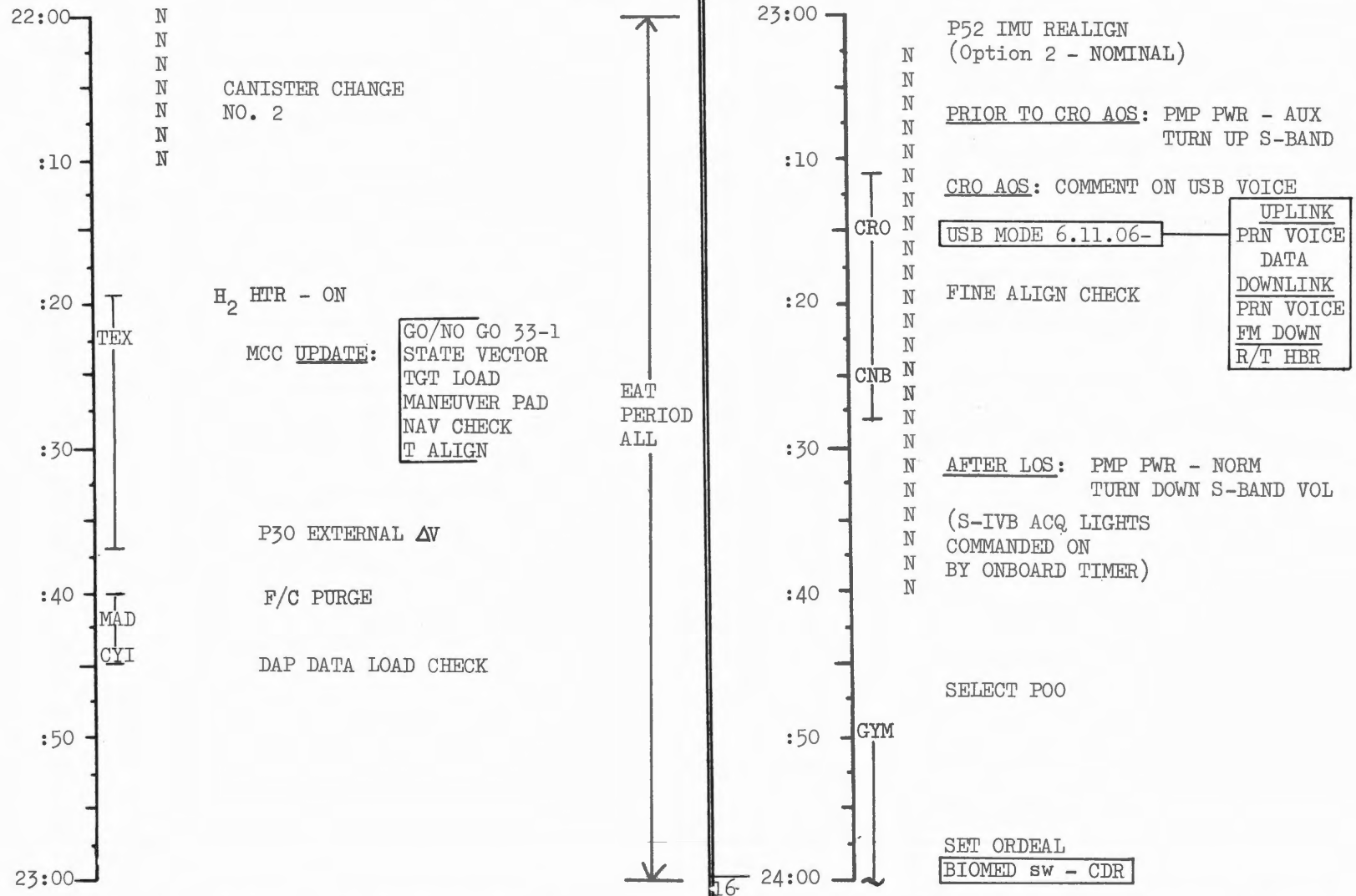
FLIGHT PLAN



MISSION	EDITION	DATE	TIME	DAY/REV	PAGE
AS-205/101	FINAL	SEPTEMBER 16, 1968	20:00 - 22:00	0/13-14	2-16

MSC FORM 1186 (SEP 67) FLIGHT PLANNING BRANCH

FLIGHT PLAN

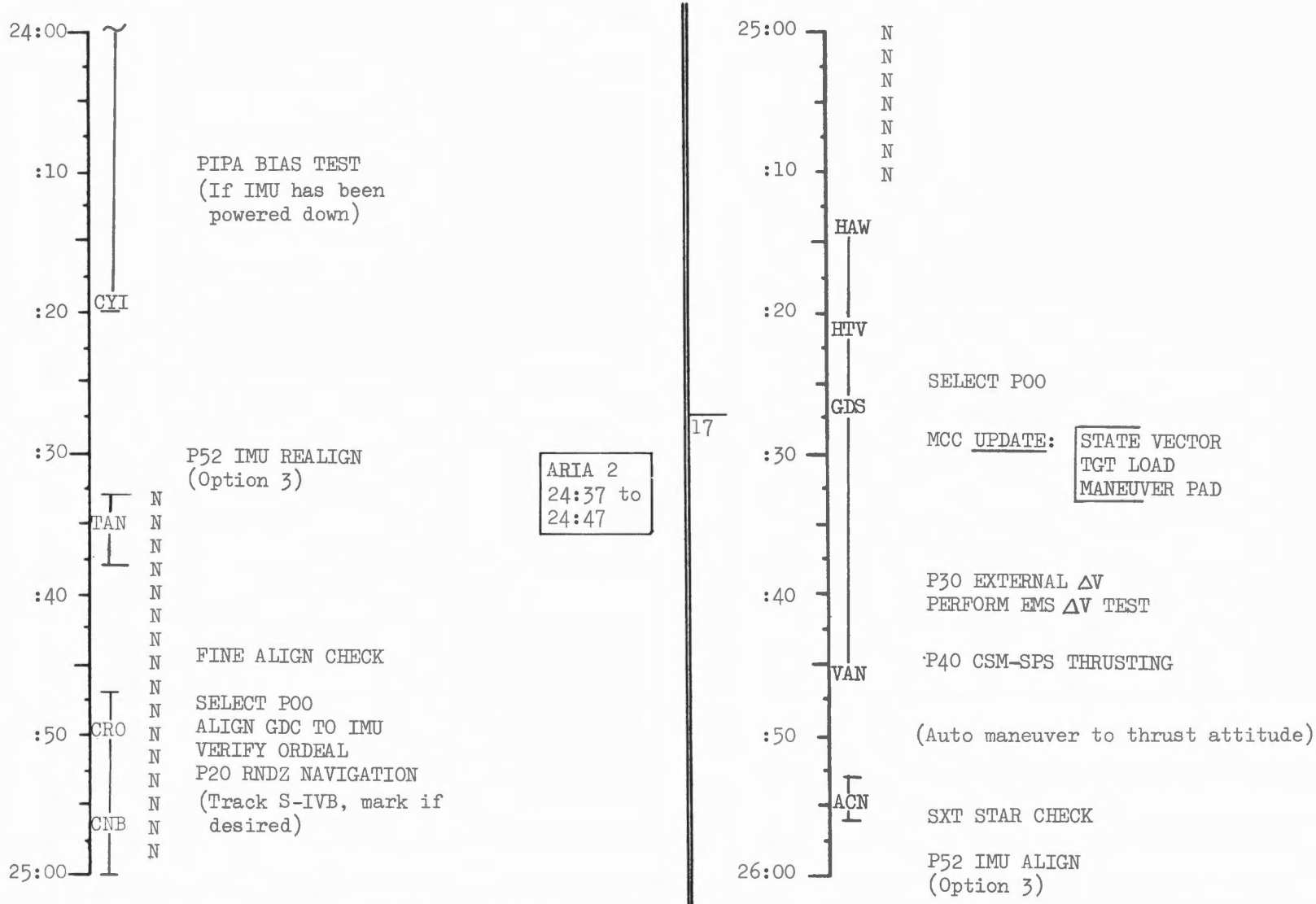


15

16

MISSION	EDITION	DATE	TIME	DAY/REV	PAGE
AS-205/101	FINAL	SEPTEMBER 16, 1968	22:00 - 24:00	0/14-16	2-17

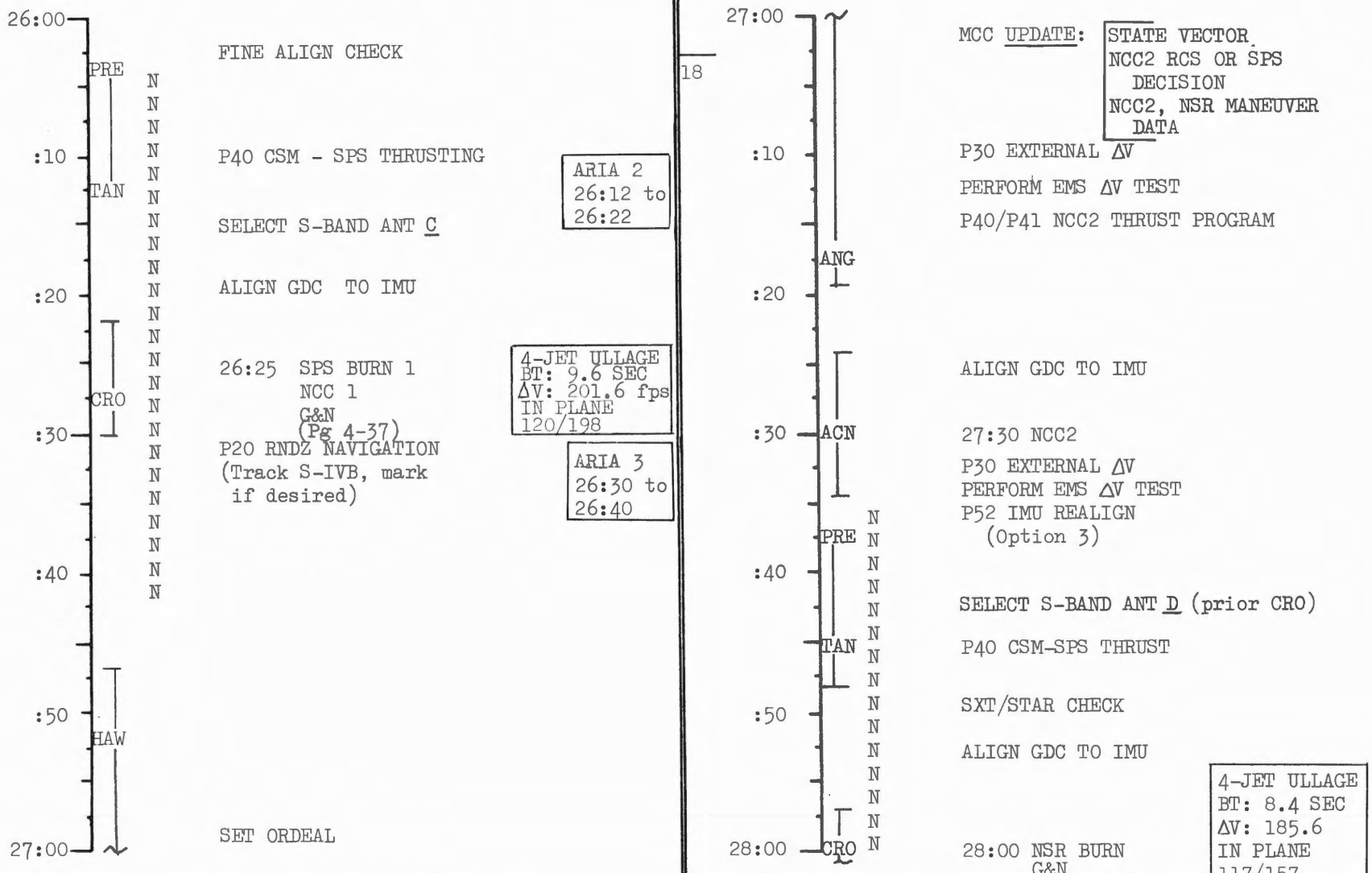
FLIGHT PLAN



MISSION	EDITION	DATE	TIME	DAY/REV	PAGE
AS-205/101	FINAL	SEPTEMBER 16, 1968	24:00 - 26:00	1/16-17	2-18

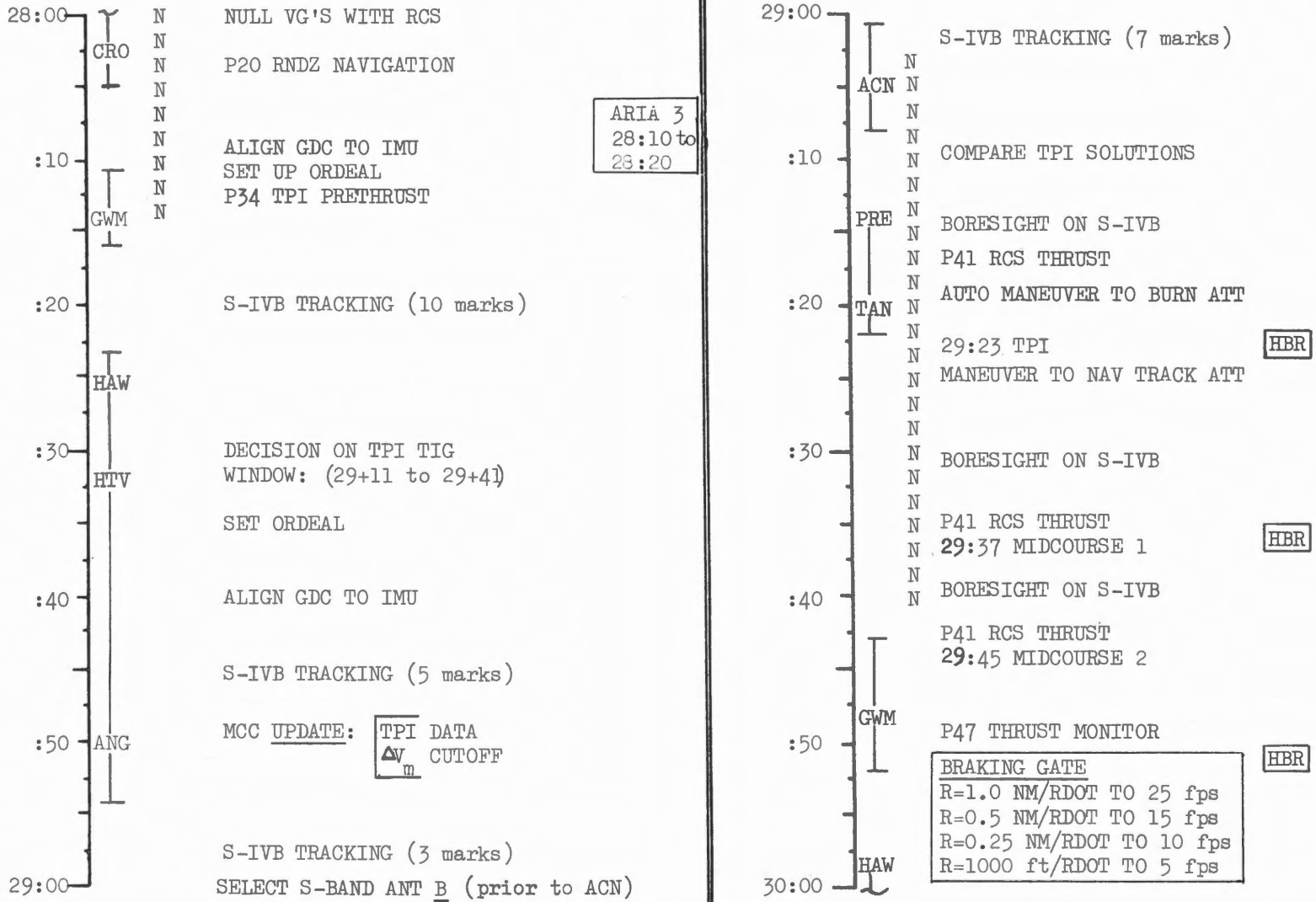
MSC FORM 1186 (SEP 67) FLIGHT PLANNING BRANCH

FLIGHT PLAN



MISSION	EDITION	DATE	TIME	DAY/REV	PAGE
AS-205/101	FINAL	SEPTEMBER 16, 1968	26:00 - 28:00	1/17-18	2-19

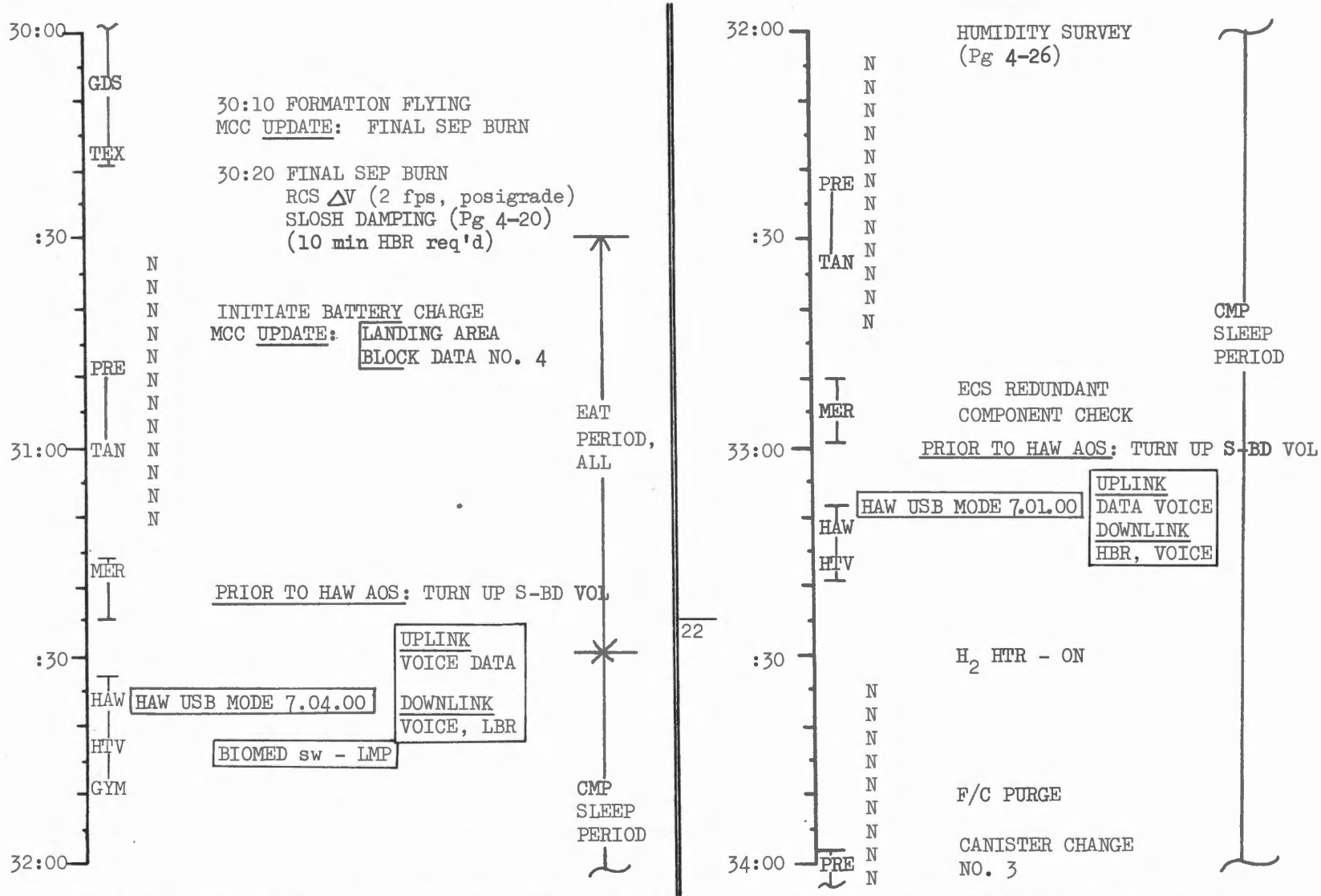
FLIGHT PLAN



MISSION	EDITION	DATE	TIME	DAY/REV	PAGE
AS-205/101	FINAL	SEPTEMBER 16, 1968	28:00 - 30:00	1/18-19	2-20

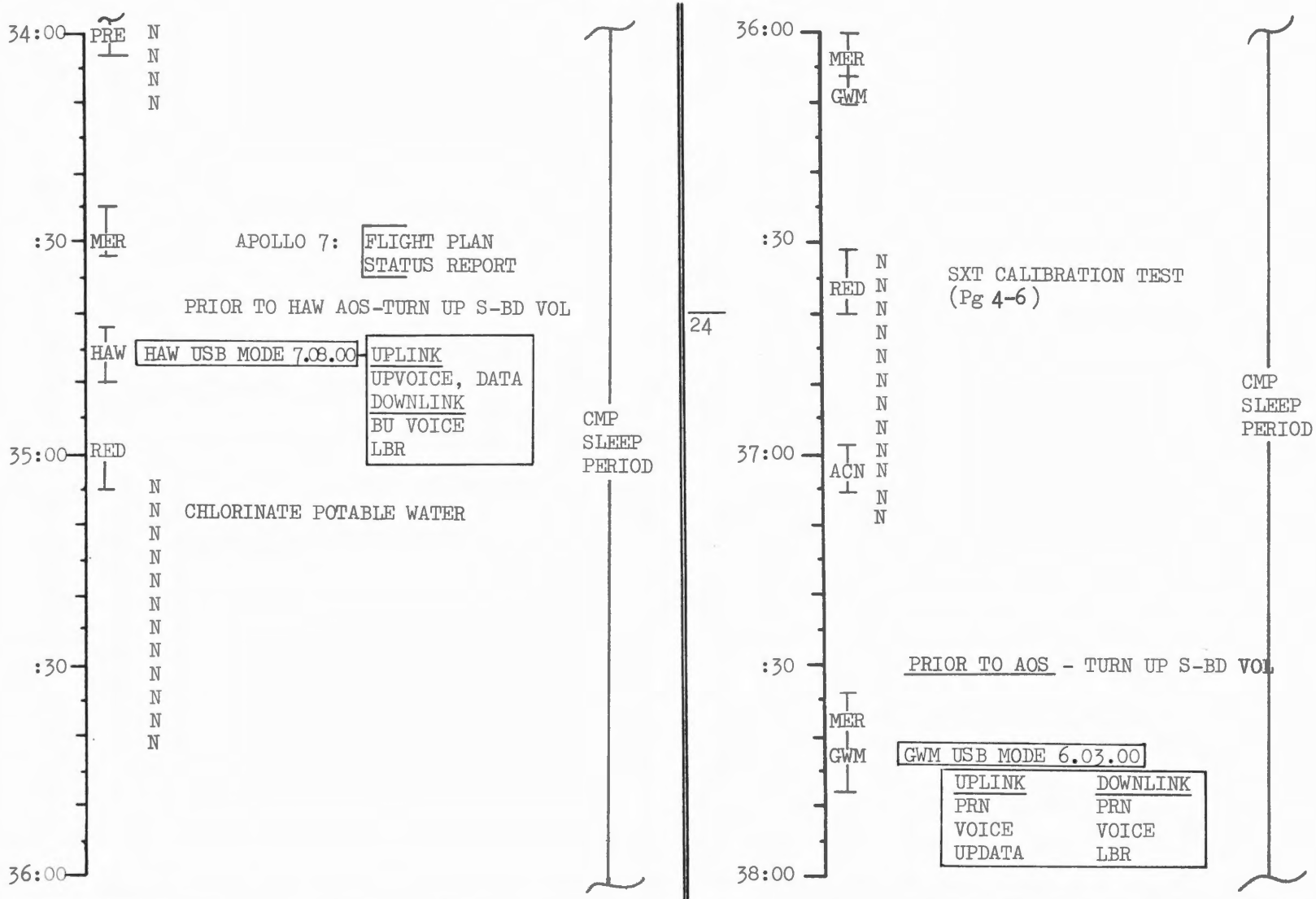
MSC FORM 1186 (SEP 67) FLIGHT PLANNING BRANCH

FLIGHT PLAN



MISSION	EDITION	DATE	TIME	DAY/REV	PAGE
AS-205/101	FINAL	SEPTEMBER 16, 1968	30:00 - 34:00	1/19-22	2-21

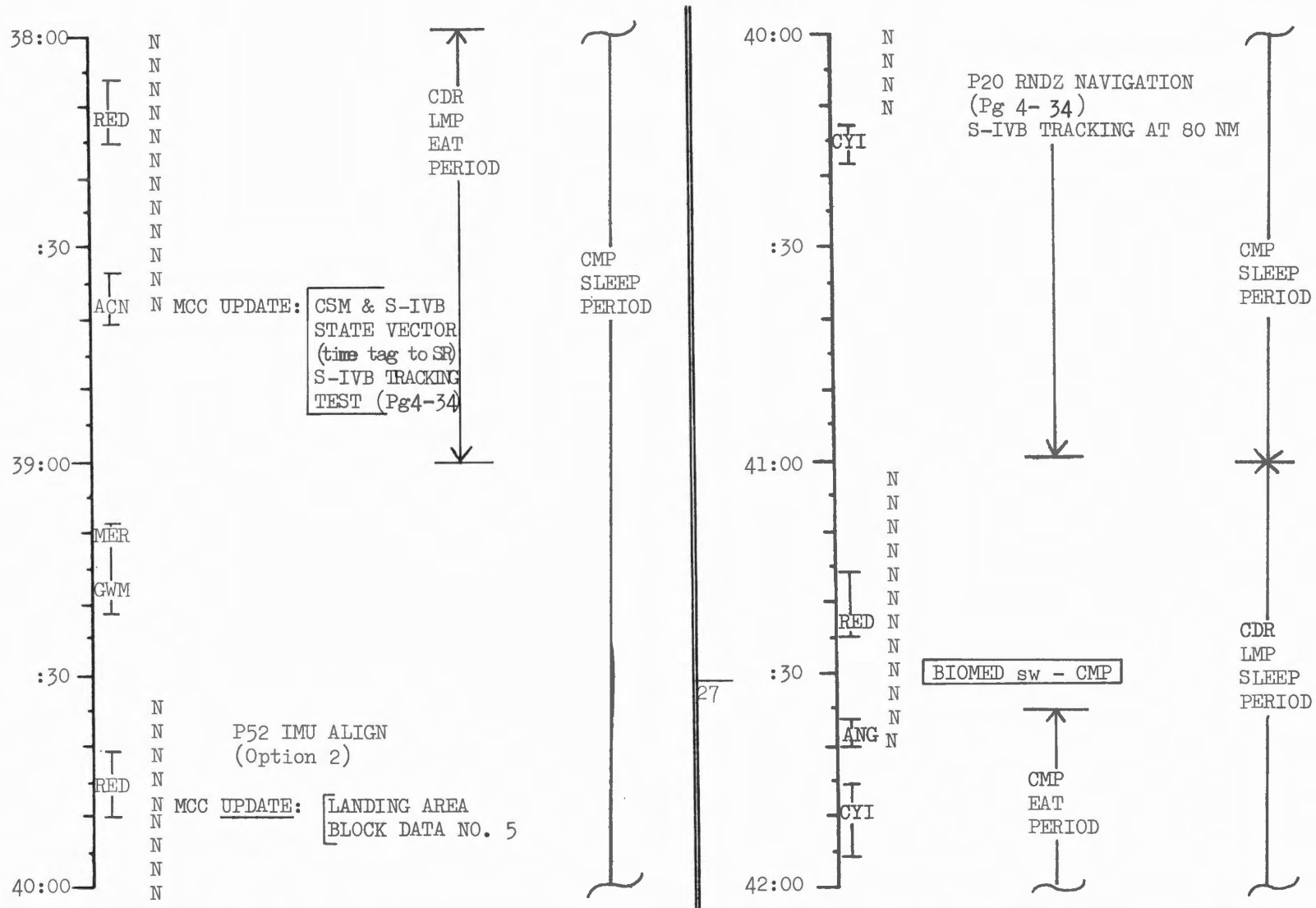
FLIGHT PLAN



MISSION	EDITION	DATE	TIME	DAY/REV	PAGE
AS-205/101	FINAL	SEPTEMBER 16, 1968	34:00 - 38:00	1/22-24	2-22

MSC FORM 1186 (SEP 67) FLIGHT PLANNING BRANCH

FLIGHT PLAN

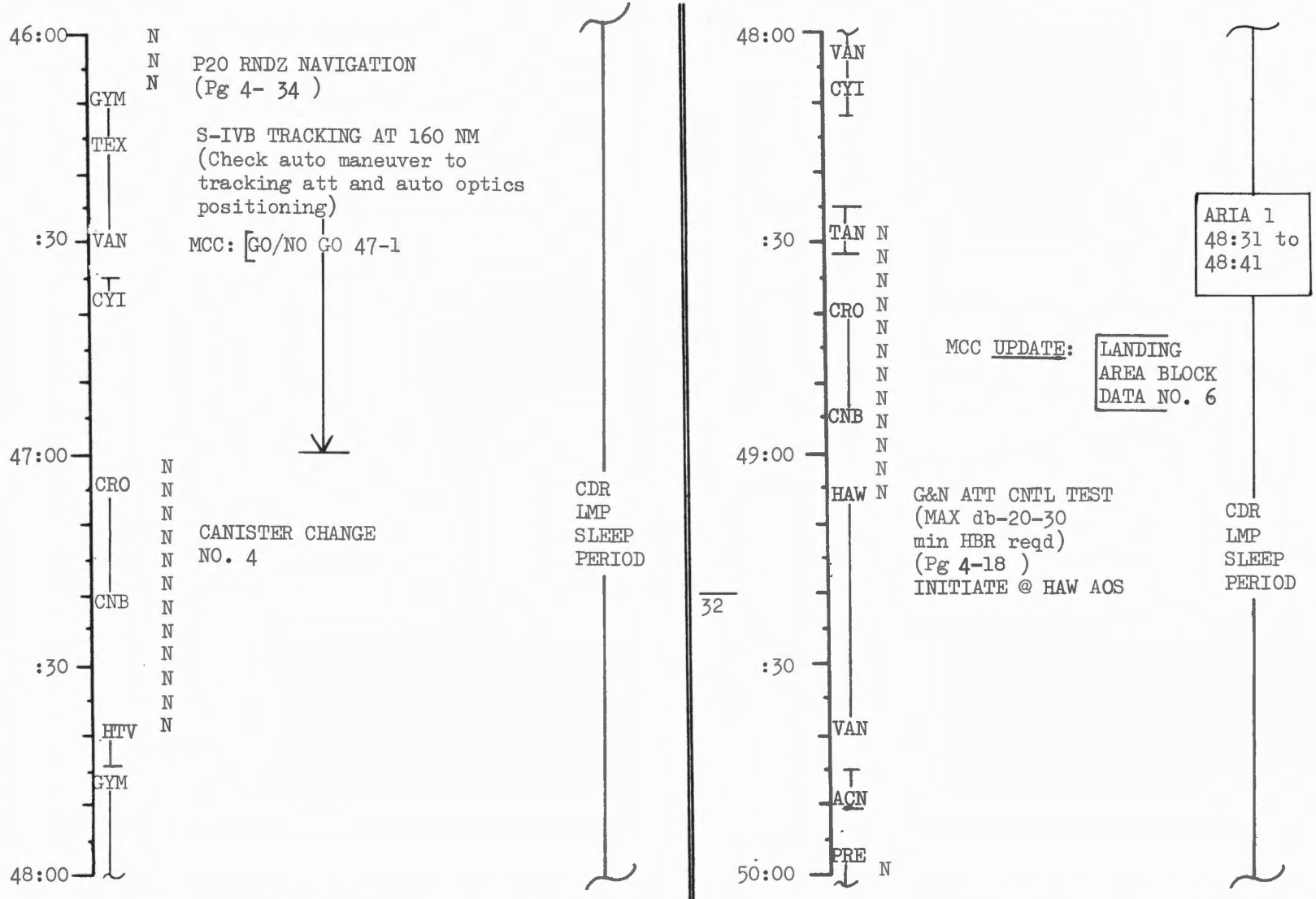


MISSION	EDITION	DATE	TIME	DAY/REV	PAGE
AS-205/101	FINAL	SEPTEMBER 16, 1968	38:00 - 42:00	1/24-27	2-23

Time	Station	Notes	Activity	Crew
42:00				CDR LMP SLEEP PERIOD
:30	CNB	N N N N N N N N N N N N		
43:00 (28)	RED			
	ANG		MCC: FLIGHT PLAN UPDATE	
	CYI MAD			
:30				
			H_2 HTRS - ON	
44:00	CRO			

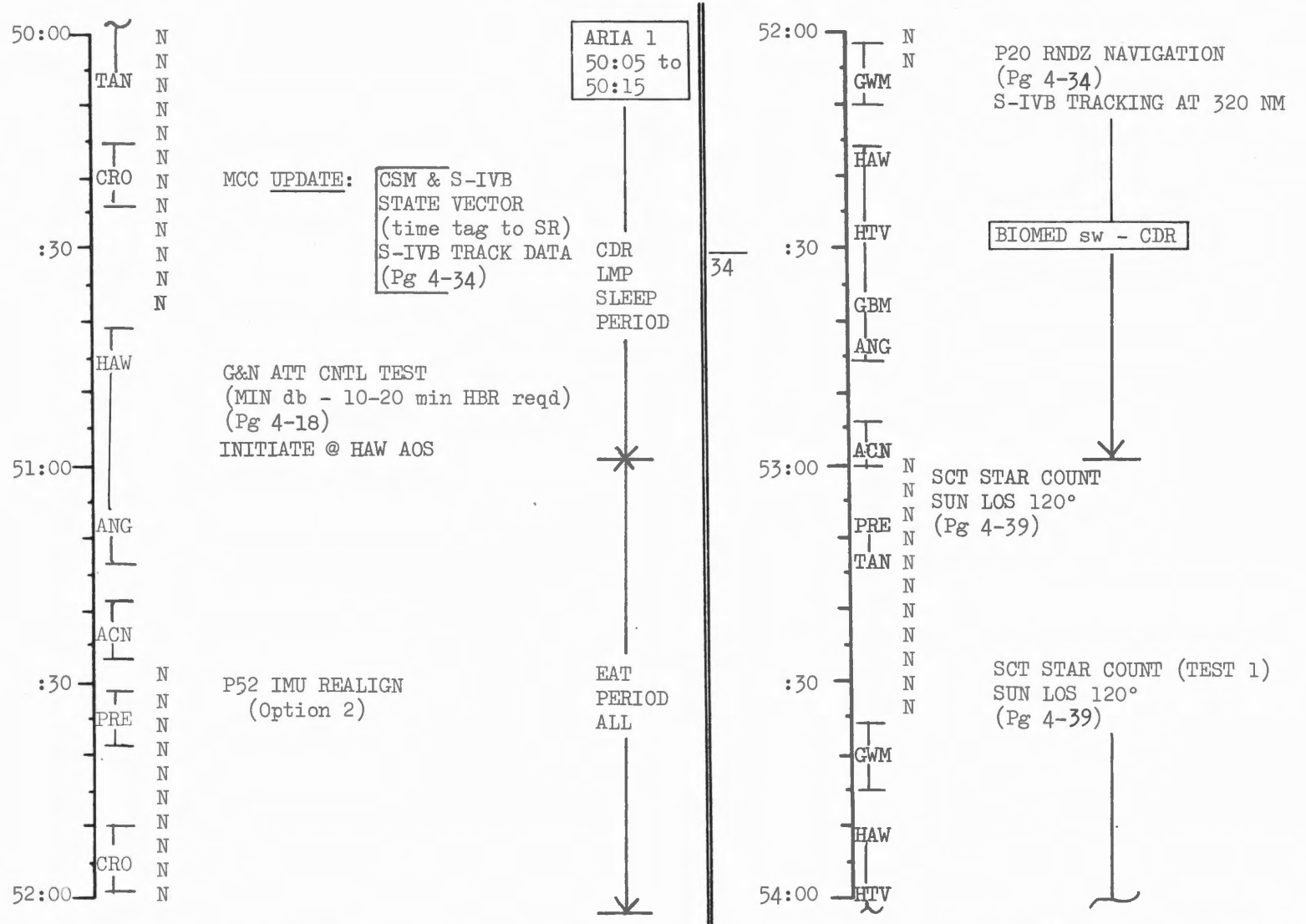
Time	Station	Notes	Activity	Crew
44:00	CRO	N N	F/C PURGE	CDR LMP SLEEP PERIOD
	CNB	N N N N N N N		
:30 (29)	RED	N N N N		
	GBM		MCC UPDATE: CSM & S-IVB STATE VECTOR (time tag to SR) S-IVB TRACK DATA (Pg 4-34)	
	VAN			
45:00	CYI MAD			
:30	CRO	N N N N N	P52 IMU REALIGN (Option 2)	
	CNB	N N N N		
46:00				

FLIGHT PLAN



MISSION	EDITION	DATE	TIME	DAY/REV	PAGE
AS-205/101	FINAL	SEPTEMBER 16, 1968	46:00 - 50:00	1-2/29-32	2-25

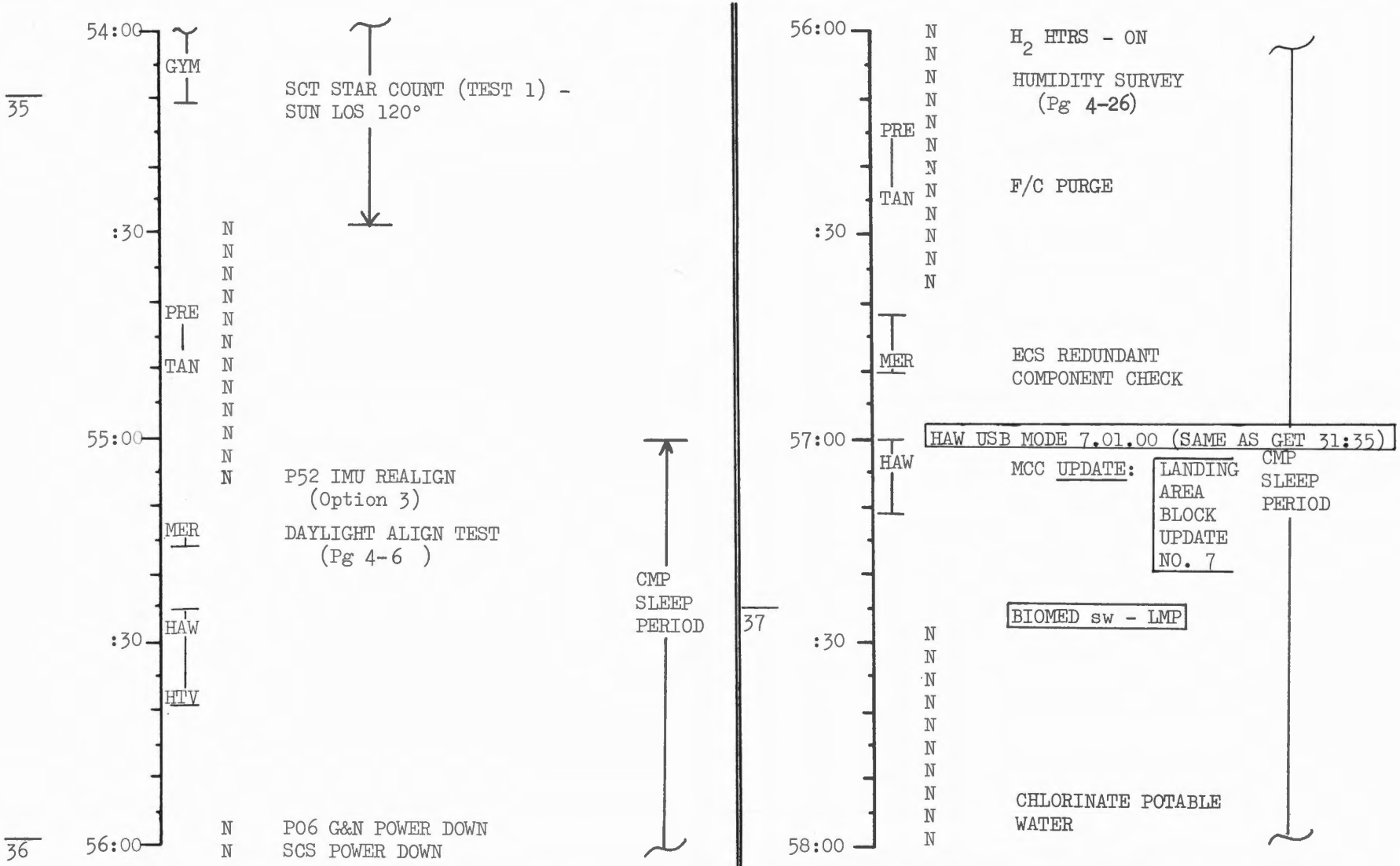
FLIGHT PLAN



MISSION	EDITION	DATE	TIME	DAY/REV	PAGE
AS-205/101	FINAL	SEPTEMBER 16, 1968	50:00 - 54:00	2/32-34	2-26

MSC FORM 1186 (SEP 67) FLIGHT PLANNING BRANCH

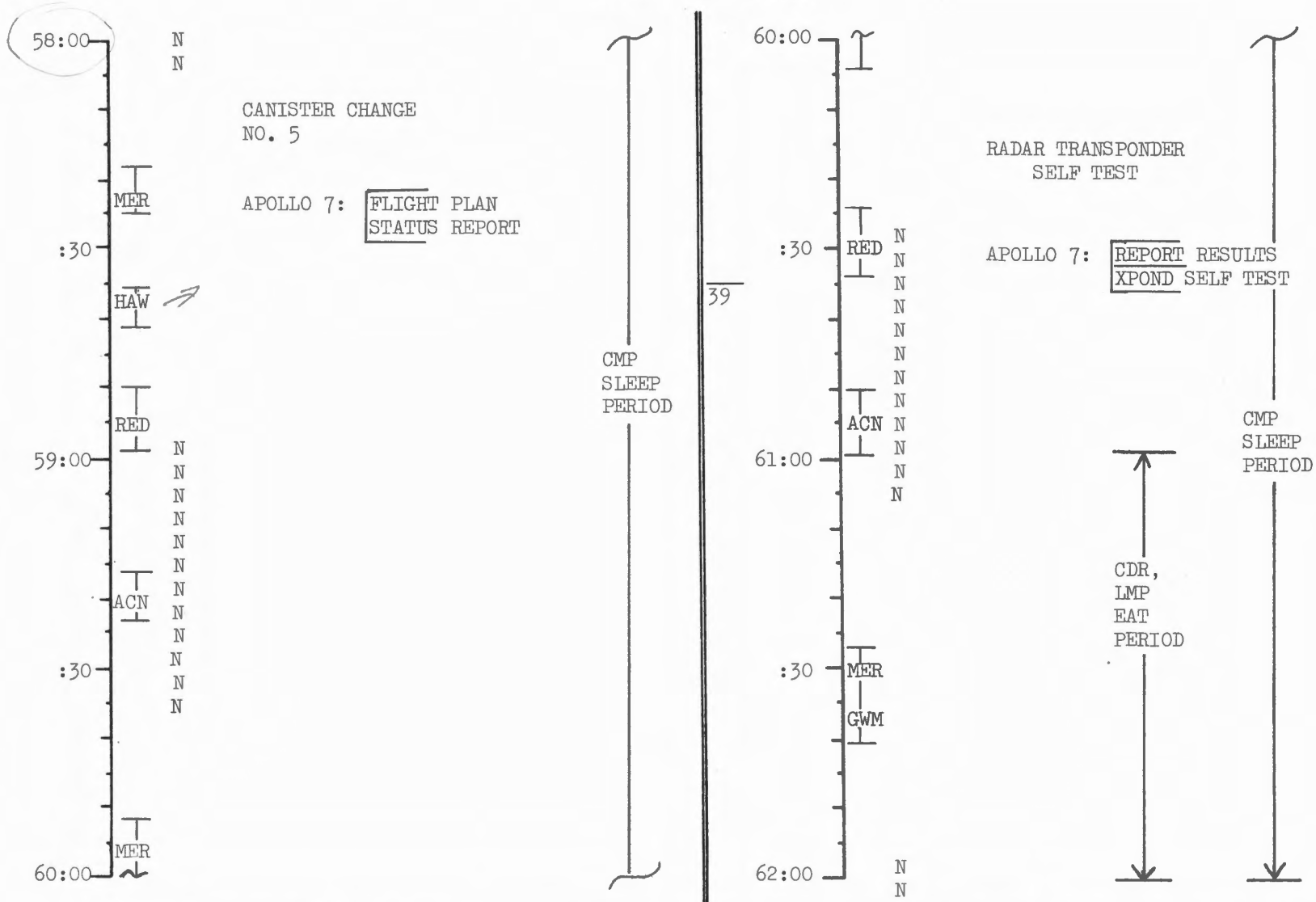
FLIGHT PLAN



MISSION	EDITION	DATE	TIME	DAY/REV	PAGE
AS-205/101	FINAL	SEPTEMBER 16, 1968	54:00 - 58:00	2/34-37	2-27

GROUND ELAPSED TIME
LIFTOFF 8.00

FLIGHT PLAN

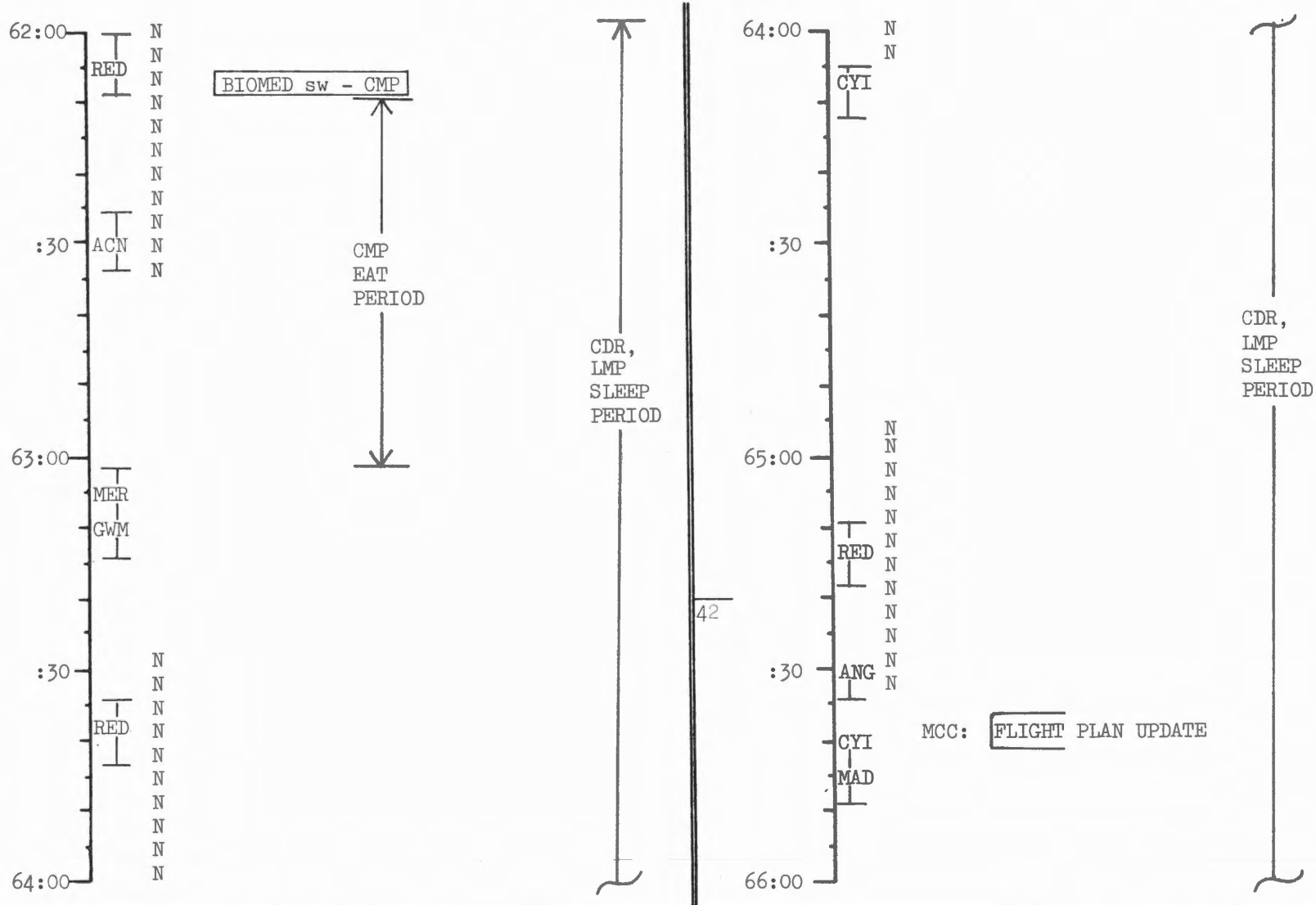


REV
38

MISSION	EDITION	DATE	TIME	DAY/REV	PAGE
AS-205/101	FINAL	SEPTEMBER 16, 1968	58:00 - 62:00	2/37-39	2-28

MSC FORM 1186 (SEP 67) FLIGHT PLANNING BRANCH

FLIGHT PLAN



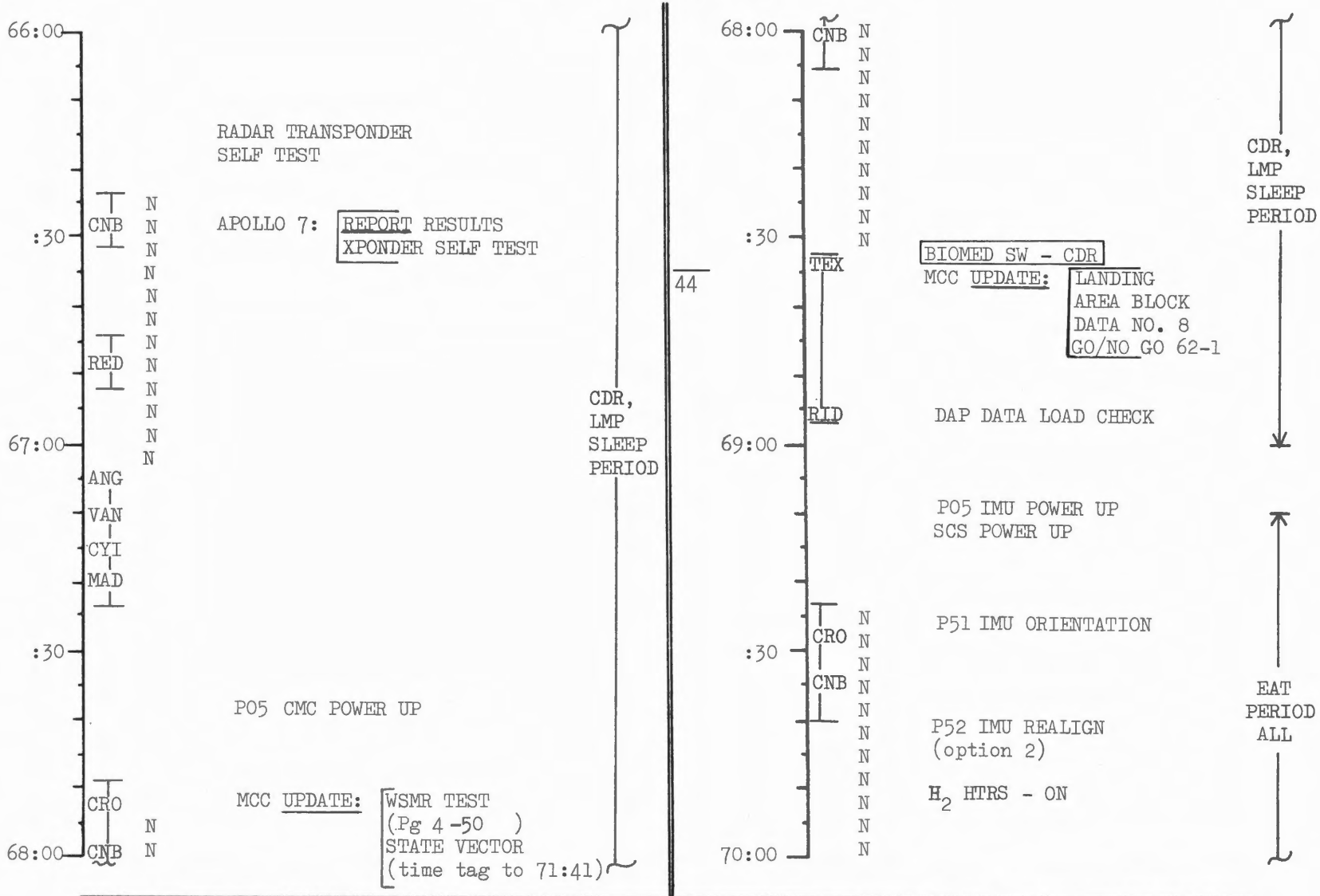
40

41

42

MISSION	EDITION	DATE	TIME	DAY/REV	PAGE
AS-205/101	FINAL	SEPTEMBER 16, 1968	62:00 - 66:00	2/39-42	2-29

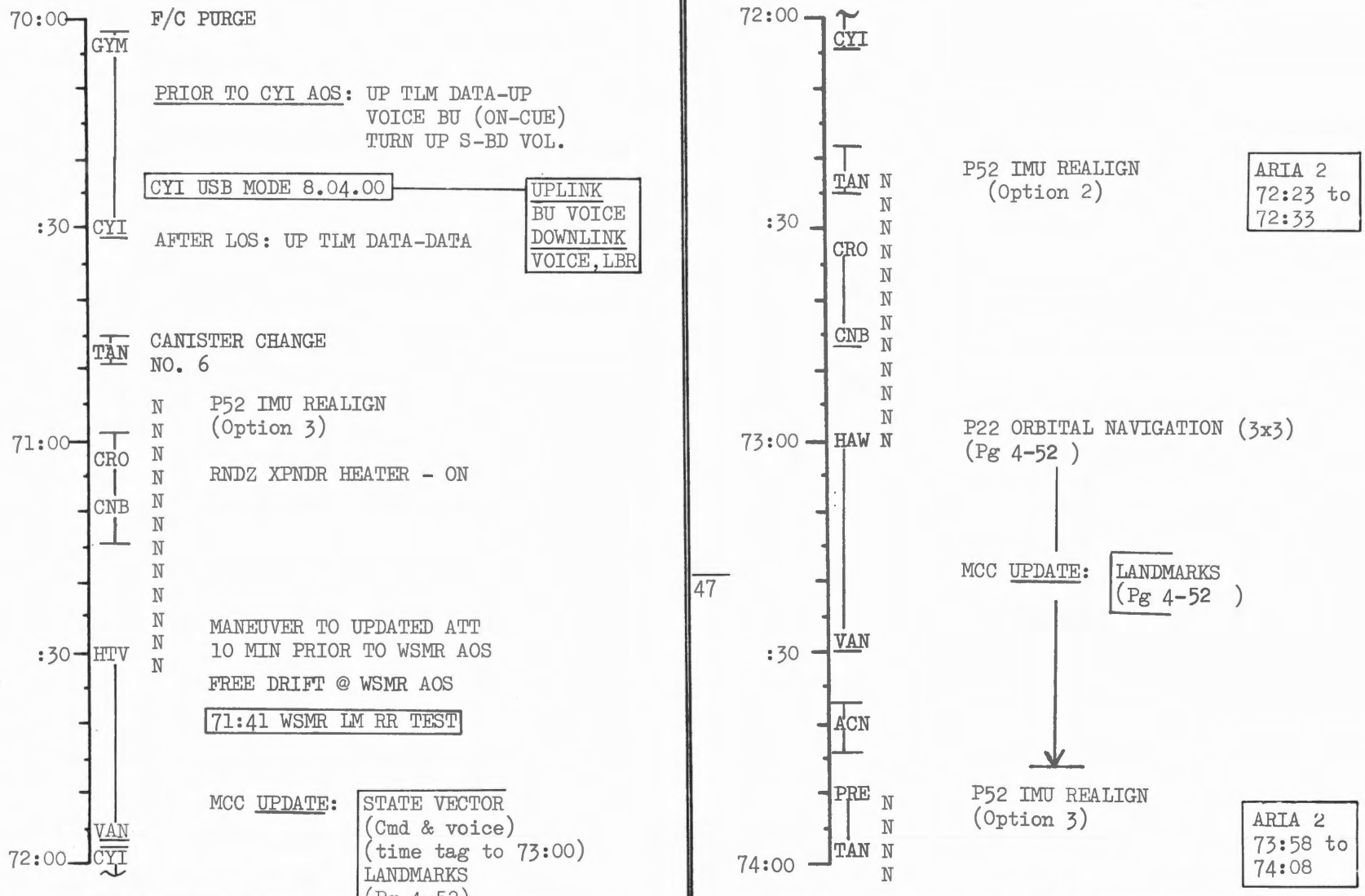
FLIGHT PLAN



MISSION	EDITION	DATE	TIME	DAY/REV	PAGE
AS-205/101	FINAL	SEPTEMBER 16, 1968	66:00 - 70:00	2/42-44	2-30

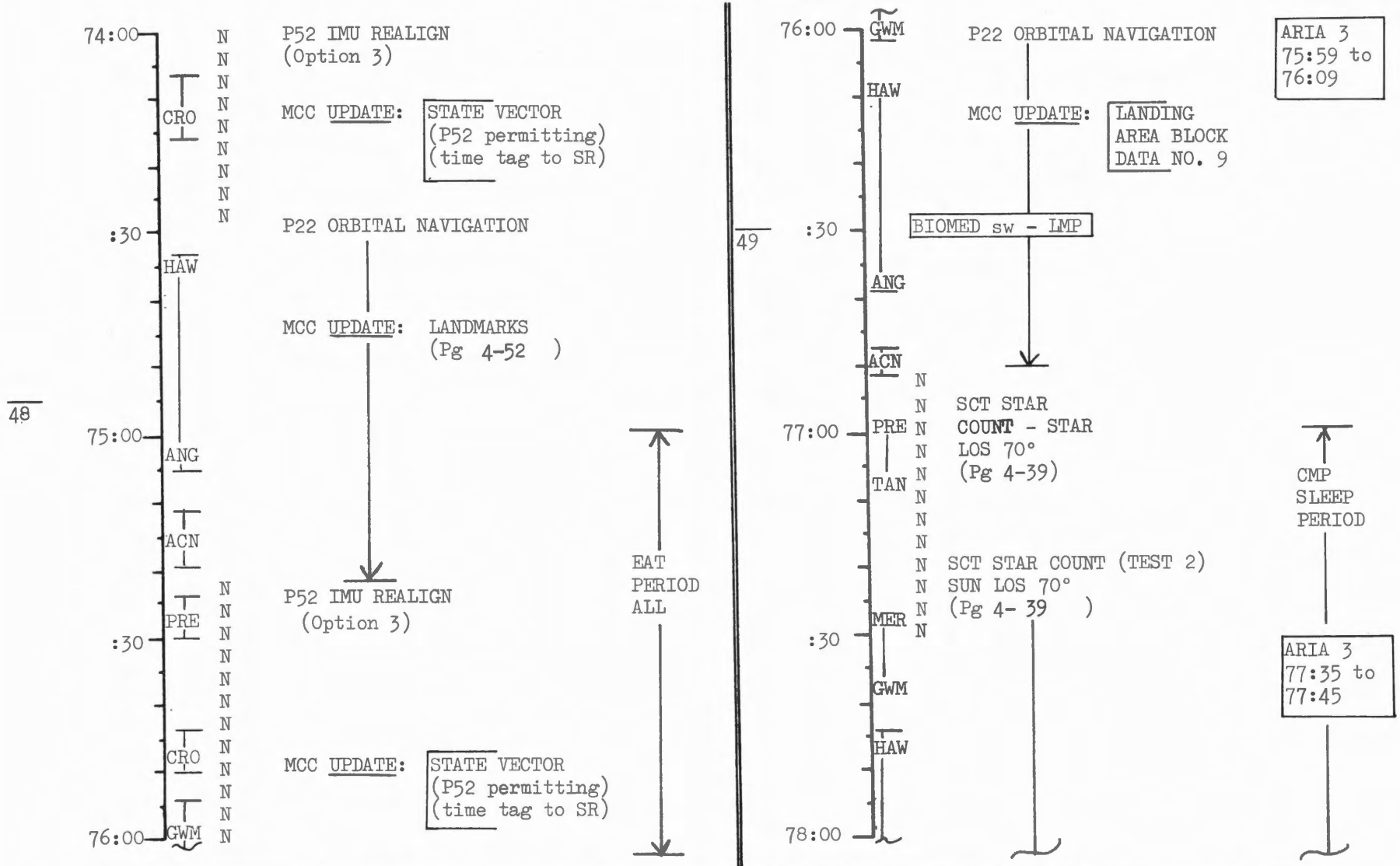
MSC FORM 1186 (SEP 67) FLIGHT PLANNING BRANCH

FLIGHT PLAN



MISSION	EDITION	DATE	TIME	DAY/REV	PAGE
AS-205/101	FINAL	SEPTEMBER 16, 1968	70:00 - 74:00	2-3/44-47	2-31

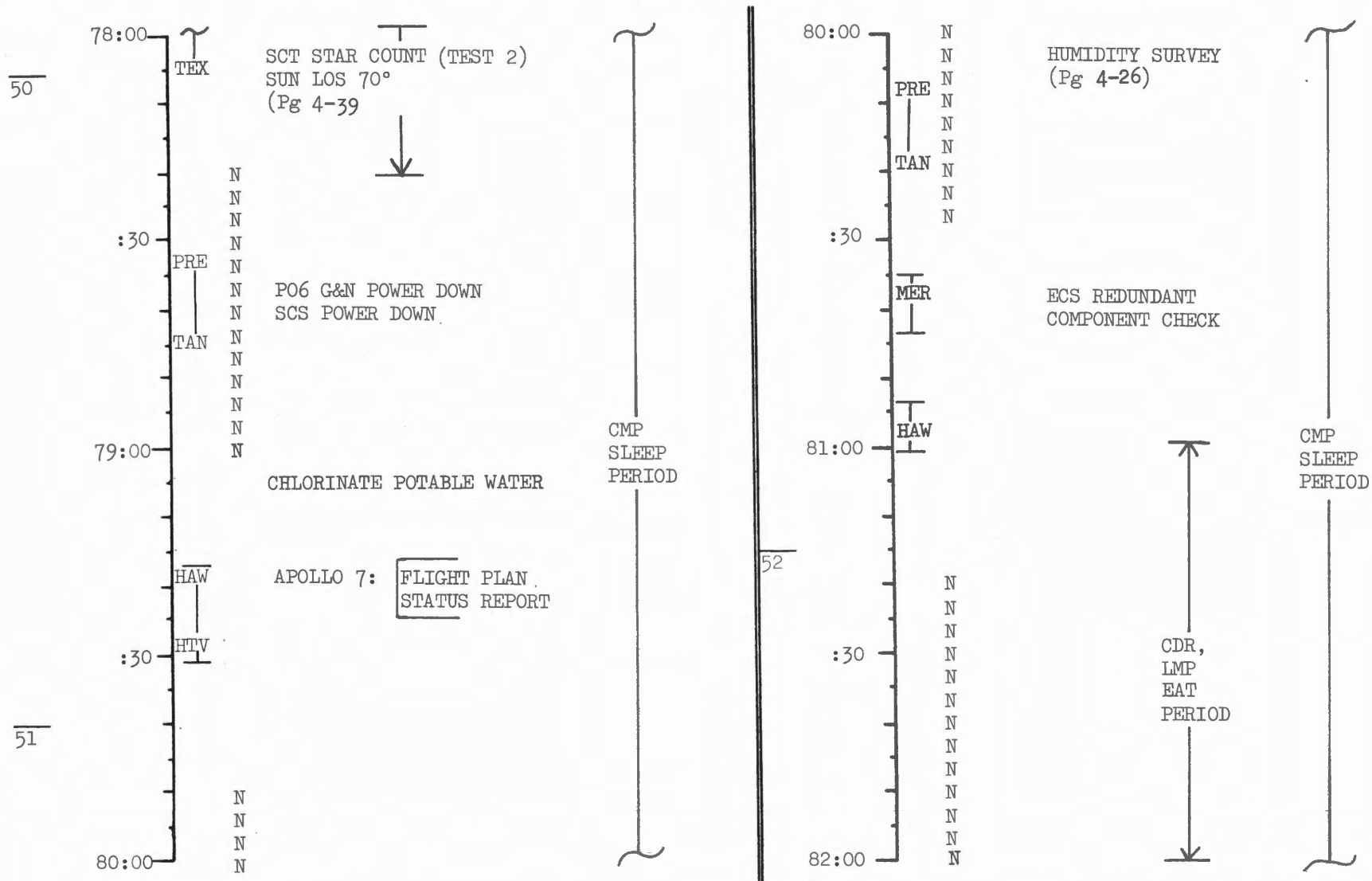
FLIGHT PLAN



MISSION	EDITION	DATE	TIME	DAY/REV	PAGE
AS-205/101	FINAL	SEPTEMBER 16, 1968	74:00 - 78:00	3/47-49	2-32

MSC FORM 1186 (SEP 67) FLIGHT PLANNING BRANCH

FLIGHT PLAN



MISSION	EDITION	DATE	TIME	DAY/REV	PAGE
AS-205/101	FINAL	SEPTEMBER 16, 1968	78:00 - 82:00	3/49-52	2-33

FLIGHT PLAN

82:00

CANISTER CHANGE
NO. 7

CMP SLEEP PERIOD

MER

:30

HAW

RED

N N N N N N N N N N N N N N

BIOMED sw - CMP

53

CDR LMP SLEEP PERIOD

83:00

ACN

CMP EAT PERIOD

:30

MER

MCC: FLIGHT PLAN UPDATE

GWM

84:00

84:00

RED

N N N N N N N N N N N N N

:30

54

CDR LMP SLEEP PERIOD

ACN

85:00

H_2 HTRS - ON

MER

F/C PURGE

:30

GWM

MCC: FLIGHT PLAN UPDATE

RED

N N N N

MCC UPDATE: LANDING AREA BLOCK DATA NO. 10

86:00

MISSION	EDITION	DATE	TIME	DAY/REV	PAGE
AS-205/101	FINAL	SEPTEMBER 16, 1968	82:00 - 86:00	3/52-54	2-34

FLIGHT PLAN

55

86:00 N N N N N N ACN N N

:30

87:00 MER GWM

POS CMS POWER UP

N N N

:30 RED N N

MCC UPDATE: STATE VECTOR / TGT LOAD / MANEUVER PAD / NAV CHECK

56

N N N N N N N N

P30 EXTERNAL ΔV

88:00 CYI N

CDR LMP SLEEP PERIOD

88:00 CYI

DAP DATA LOAD CHECK

EMS ΔV TEST

:30

P05 IMU POWER UP
SCS POWER UP

EAT PERIOD ALL

P51 IMU ORIENTATION

N N N N

P40 CSM-SPS THRUSTING

89:00 RED N N

P52 IMU REALIGN
(Option 1)

57

N N

BIOMED sw - CDR

N N N ANG VAN N N

:30 CYI

ALIGN GDC TO IMU

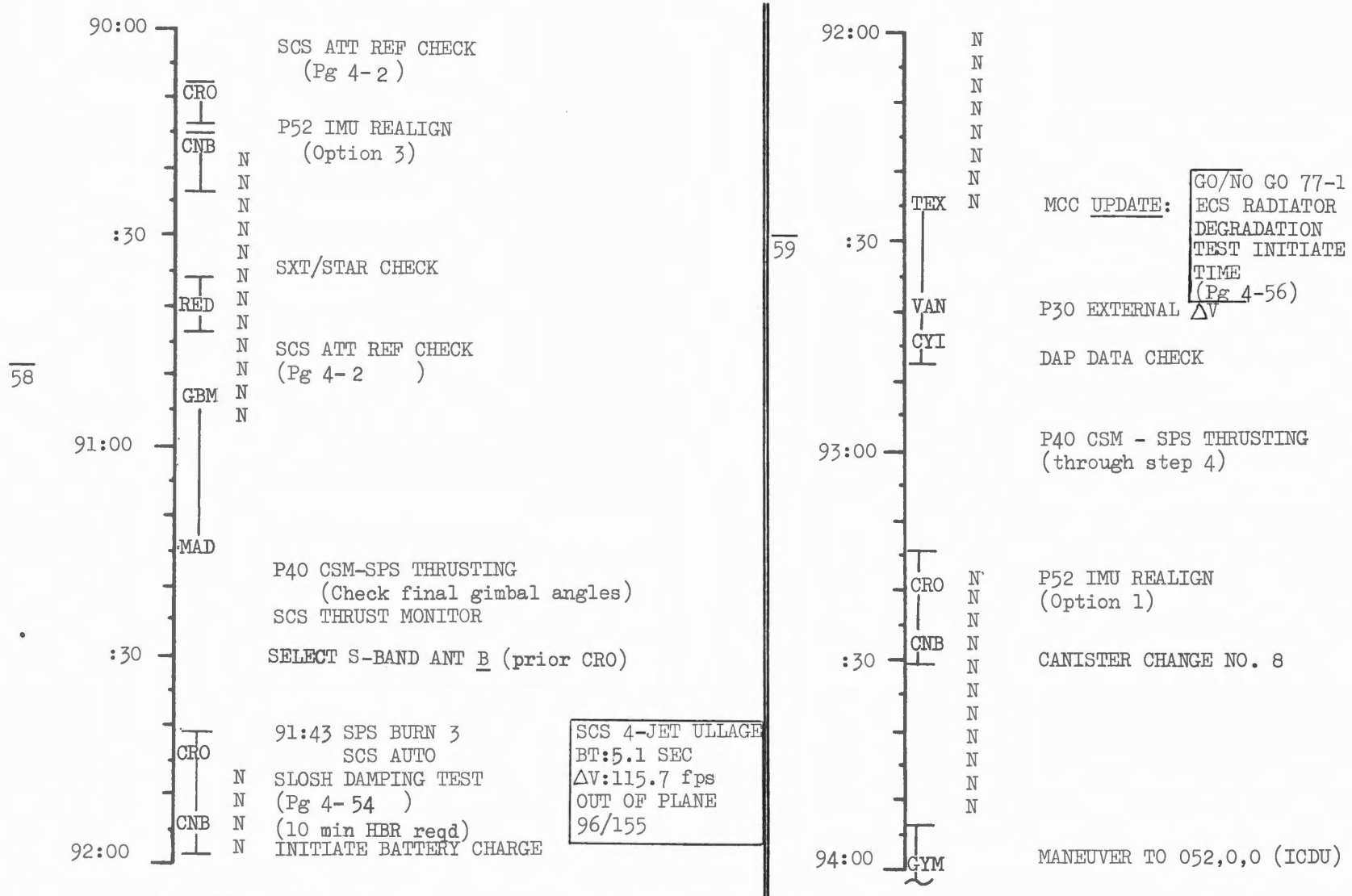
MAD

SCS ATT REF CHECK
(Pg 4-2)

90:00

MISSION	EDITION	DATE	TIME	DAY/REV	PAGE
AS-205/101	FINAL	SEPTEMBER 16, 1968	86:00 - 90:00	3/54-57	2-35

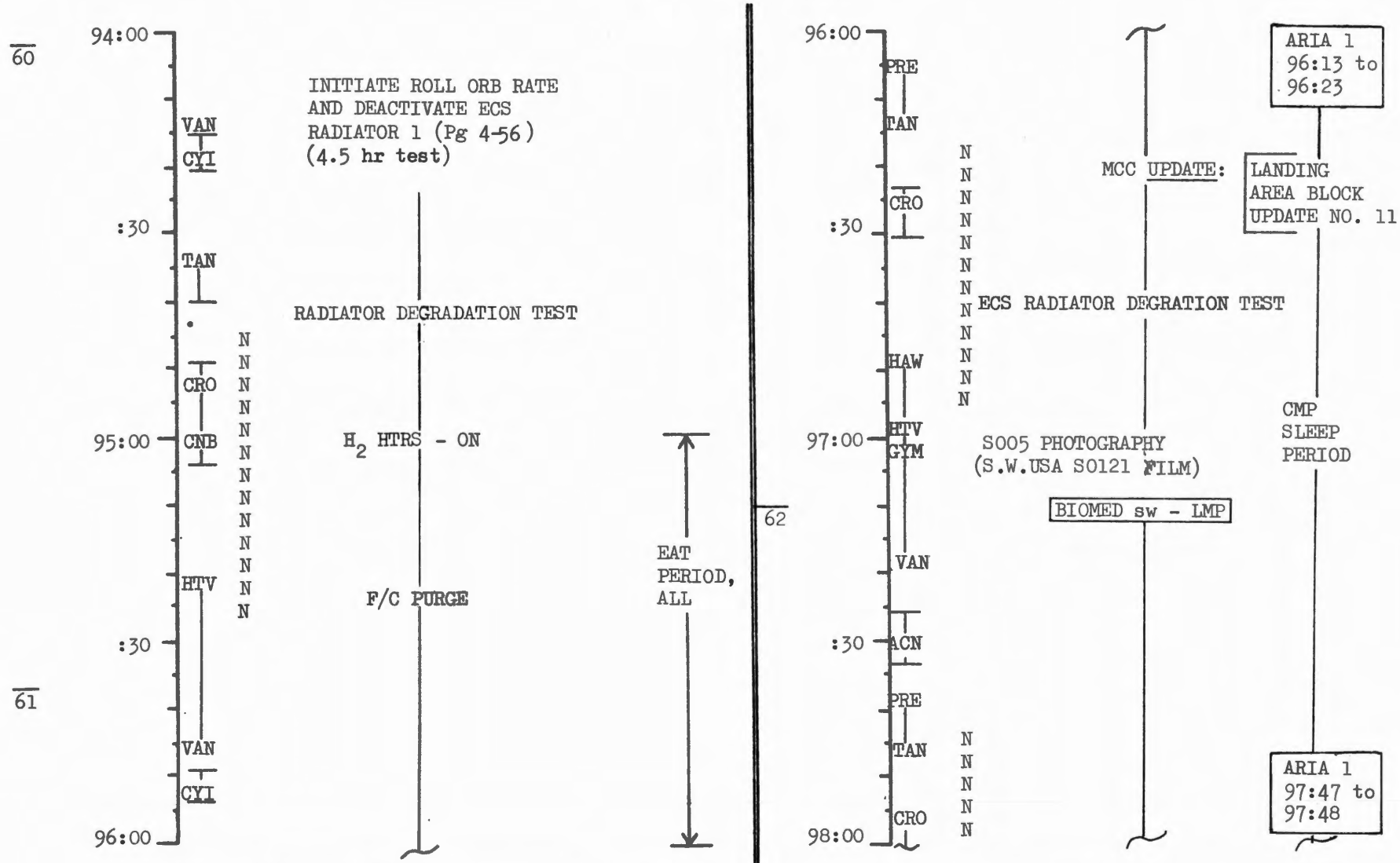
FLIGHT PLAN



MISSION	EDITION	DATE	TIME	DAY/REV	PAGE
AS-205/101	FINAL	SEPTEMBER 16, 1968	90:00 - 94:00	3/57-59	2-36

MSC FORM 1186 (SEP 67) FLIGHT PLANNING BRANCH

FLIGHT PLAN



MISSION	EDITION	DATE	TIME	DAY/REV	PAGE
AS-205/101	FINAL	SEPTEMBER 16, 1968	94:00 - 98:00	3-4/59-62	2-37

FLIGHT PLAN

98:00 — CRO

N N N N N N

PRIOR TO AOS: PMP PWR-AUX
SBD AUX PCM-KEY
TURN UP SBD VOL

GDS USB MODE 7.06.06

ON GND CUE:

SBD NORM MODE PCM-PCM
PMP PWR - NORM

UPLINK
UPVOICE
DATA
DOWNLINK
KEY
FM DWN
R/T HBR

HAW

:30

S005 PHOTOGRAPHY
(S.W. USA-S0121 FILM)

63

END ECS RADIATOR DEGRADATION TEST
RETURN TO TWO RADIATOR OPERATION

ANG

S006 PHOTOGRAPHY
(CARIBBEAN AREA)

99:00 — ACN

TEX USB MODE 7.08.00
(SAME AS GET 33.05)

CMP
SLEEP
PERIOD

PRE

N N N N N N N N N N N N

P06 G&N POWER DOWN
SCS POWER DOWN

:30

CRO

PRIOR TO AOS: PMP PWR - AUX
TURN UP SBD VOL

HAW USB MODE 7.12.06

AFTER LOS: PMP PWR-NORM

UPLINK
UPVOICE
UPDATA
DOWNLINK
VOICE
FM
R/T HBR

GWM

100:00 — HAW

64

65

100:00 — HTV

GBM

PRIOR TO GYM AOS CONFIGURE
FOR RELAY MODE
GYM VOICE RELAY MODE
AT LOS RETURN TO NORMAL COMM

DOWNLINK FOLLOWING MESSAGE FOR
EMERGENCY KEY TEST:

T- H.... I.. S... I.. S...
A.- T- E. S... T- O--- F..-.
E. M-- E. R.-.
G--. E. N-. C-.-. Y-.--
K-.- E. Y-.--

:30

PRE

N N N N N N N N N N N N N N N N N

TAN

101:00

CMP
SLEEP
PERIOD

MER

GWM

:30

H-BLAD WINDOW
PHOTOGRAPHY
(focus at infinity)
(Pg 4-9)

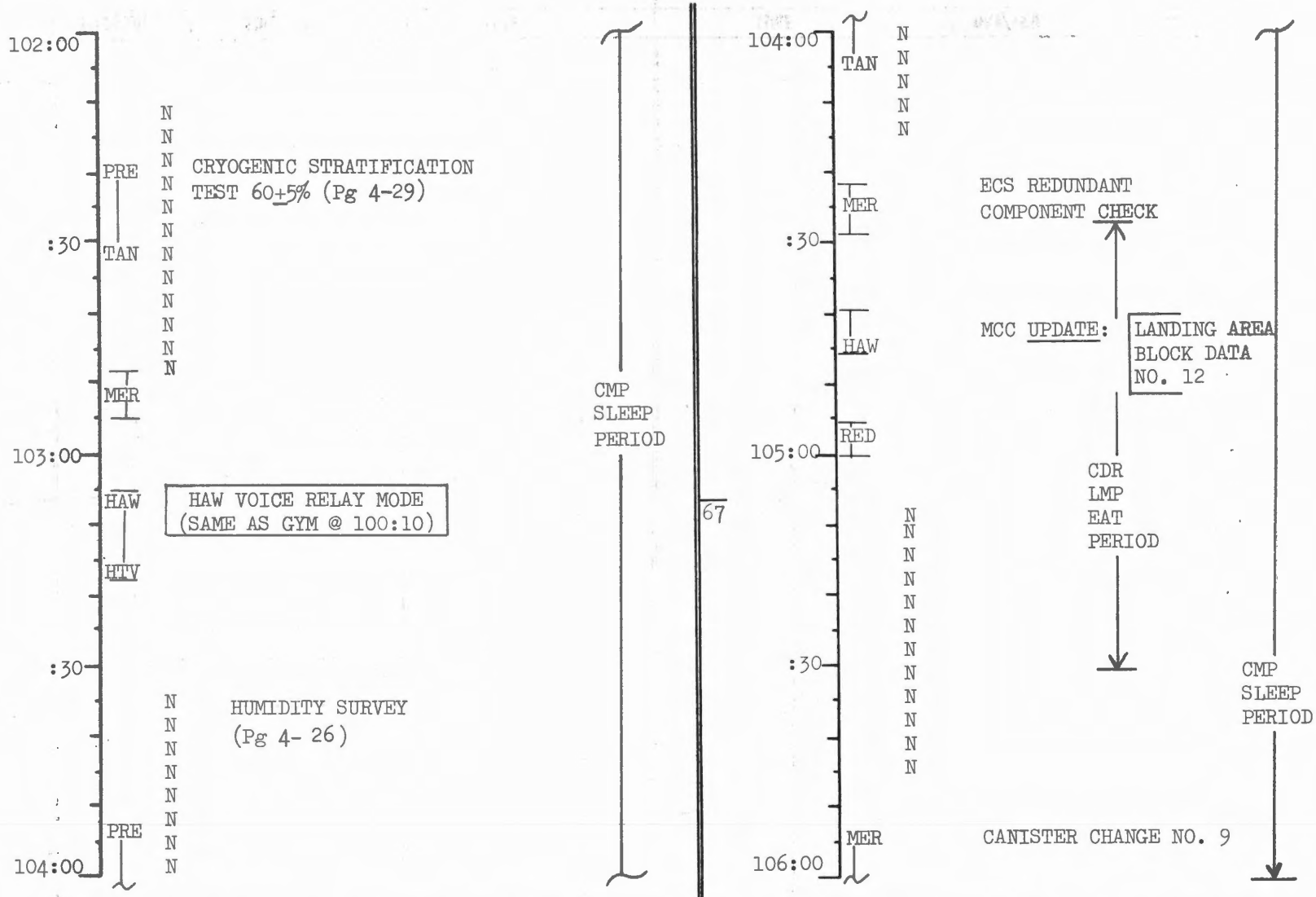
HTV

CHLORINATE POTABLE WATER

102:00

MISSION	EDITION	DATE	TIME	DAY/REV	PAGE
AS-205/101	FINAL	SEPTEMBER 16, 1968	98:00 - 102:00	4/62-65	2-38

FLIGHT PLAN



MISSION	EDITION	DATE	TIME	DAY/REV	PAGE
AS-205/101	FINAL	SEPTEMBER 16, 1968	102:00 - 106:00	4/65-67	2-39

FLIGHT PLAN

106:00 MER

:30 RED

RED USB MODE 6.11.06
(SAME AS CRO @ 23.10)

BIOMED sw - CMP

CMP
EAT
PERIOD

ACN

107:00

:30 MER

108:00

CDR,
LMP
SLEEP
PERIOD

69

70

108:00 RED

:30 ACN

109:00 MER

GWM

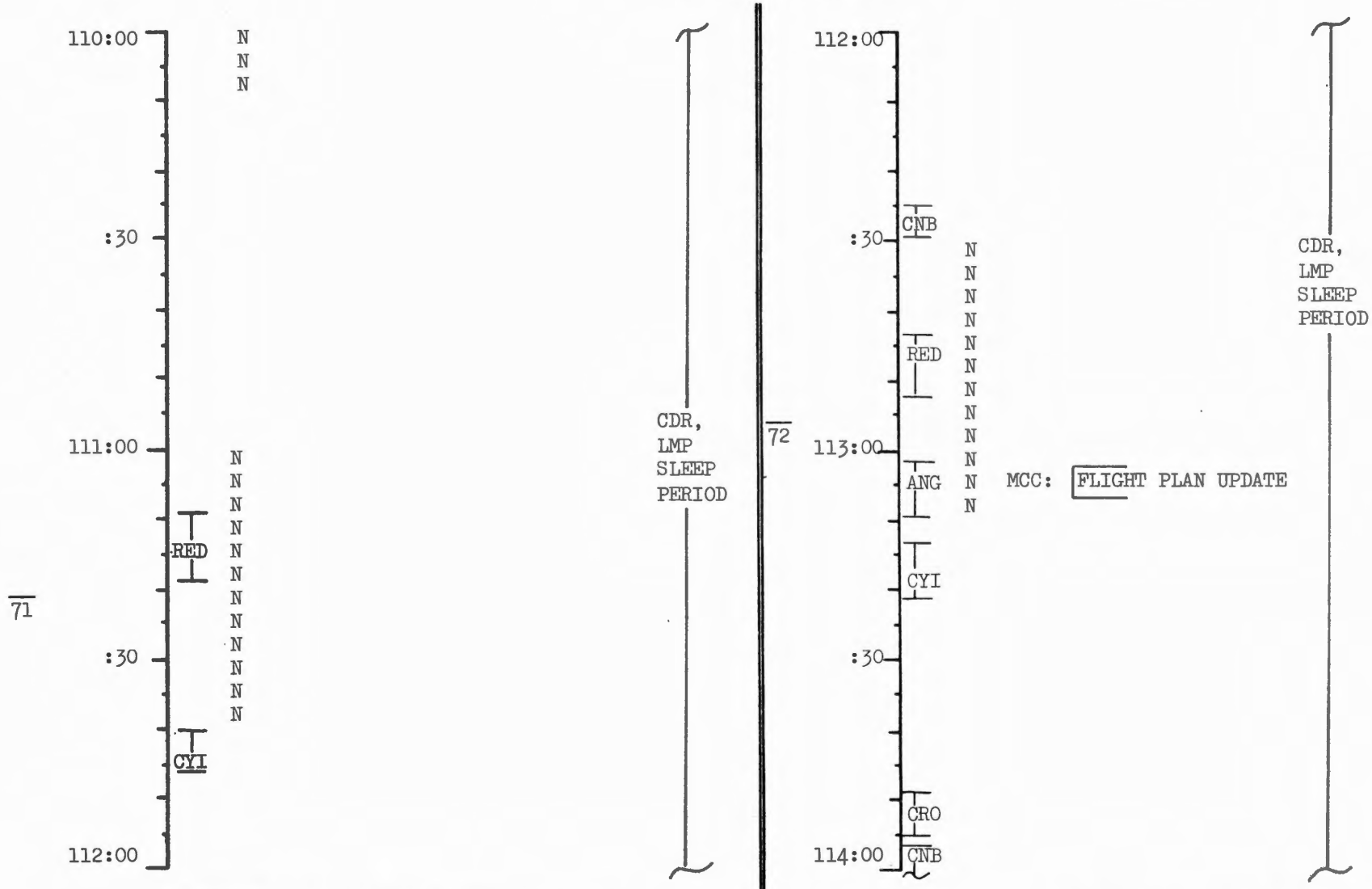
:30 RED

110:00

CDR,
LMP
SLEEP
PERIOD

MISSION	EDITION	DATE	TIME	DAY/REV	PAGE
AS-205/101	FINAL	SEPTEMBER 16, 1968	106:00 - 110:00	4/67-70	2-40

FLIGHT PLAN



MISSION	EDITION	DATE	TIME	DAY/REV	PAGE
AS-205/101	FINAL	SEPTEMBER 16, 1968	110:00 - 114:00	4/70-72	2-41

FLIGHT PLAN

114:00 CNB N N N N N N N N N N N
RED
:30
73
GBM
MAD

CDR LMP SLEEP PERIOD (114:00 - 116:00)

115:00
CRO
:30 N N N N N N N N N N
CNB
P23 (through TRUN BIAS ck) (Pg 4-58)
116:00

116:00 TEX N N

74

MCC UPDATE: GO/NO GO 92-1 LANDING AREA BLOCK DATA NO. 13

BIOMED sw - CDR

RID
:30

EAT PERIOD ALL

CRO
117:00 N N N N N N N N N N N N
CNB

P05 CMC POWER UP

:30
GYM

MCC UPDATE: STATE VECTOR TGT LOAD MANEUVER PAD NAV CHECK

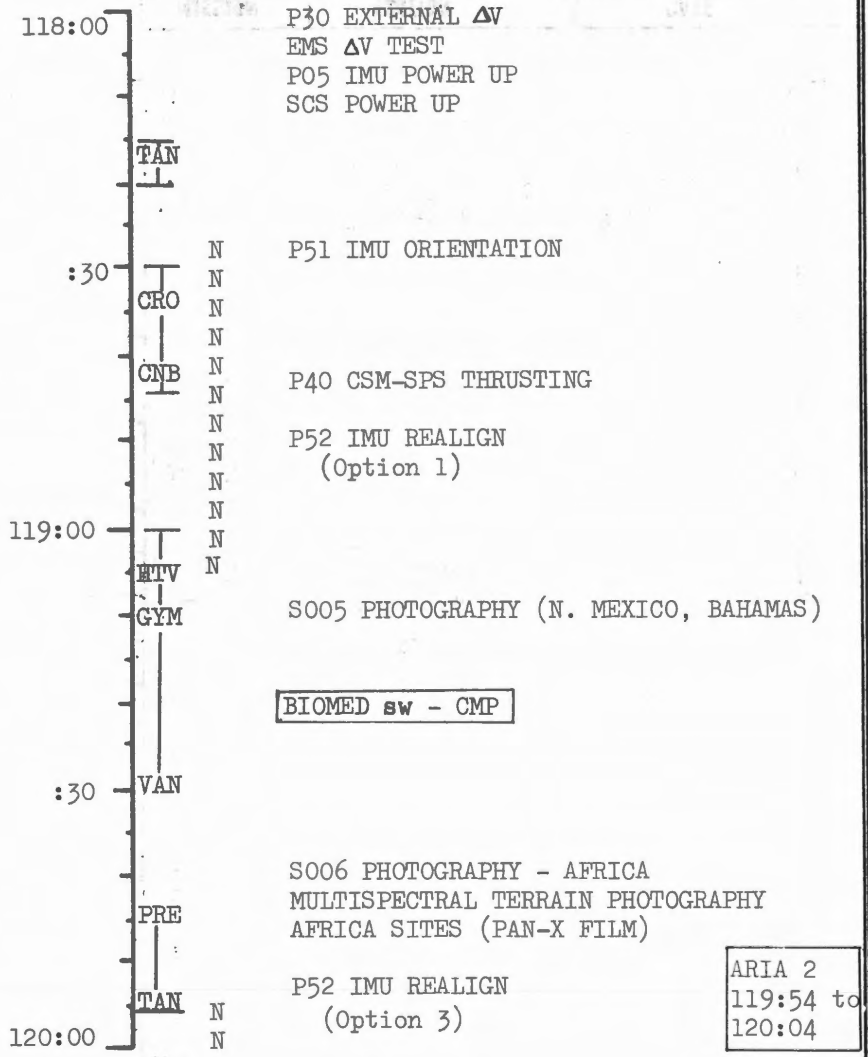
75

VAN
118:00 CYI

DAP DATA CHECK
CANISTER CHANGE NO. 10

MISSION	EDITION	DATE	TIME	DAY/REV	PAGE
AS-205/101	FINAL	SEPTEMBER 16, 1968	114:00 - 118:00	4/72-75	2-42

FLIGHT PLAN



P30 EXTERNAL ΔV
EMS ΔV TEST
P05 IMU POWER UP
SCS POWER UP

P51 IMU ORIENTATION

P40 CSM-SPS THRUSTING

P52 IMU REALIGN
(Option 1)

S005 PHOTOGRAPHY (N. MEXICO, BAHAMAS)

BIOMED sw - CMP

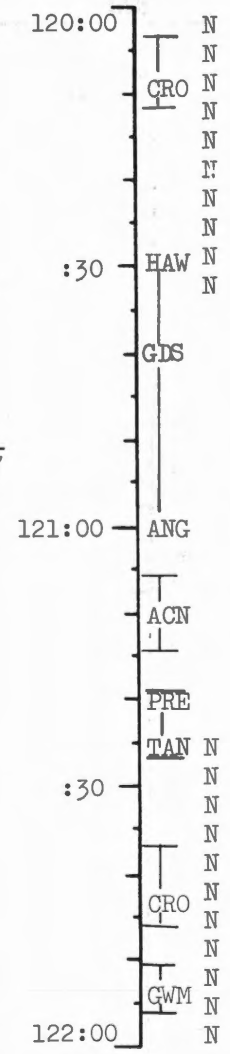
S006 PHOTOGRAPHY - AFRICA
MULTISPECTRAL TERRAIN PHOTOGRAPHY
AFRICA SITES (PAN-X FILM)

P52 IMU REALIGN
(Option 3)

ARIA 2
119:54 to
120:04

76

77



SELECT S-BAND ANT A (prior GDS)

SXT/STAR CHECK

P40 CSM-SPS THRUSTING

120:52 SPS BURN 4
G&N MIN IMP
SLOSH DAMPING TEST
(Pg 4-59)
(3 min HBR reqd)

2-JET ULLAGE
BT: 0.5 SEC
ΔV: 14.9 fps
IN PLANE
94/160

INITIATE BATTERY CHARGE

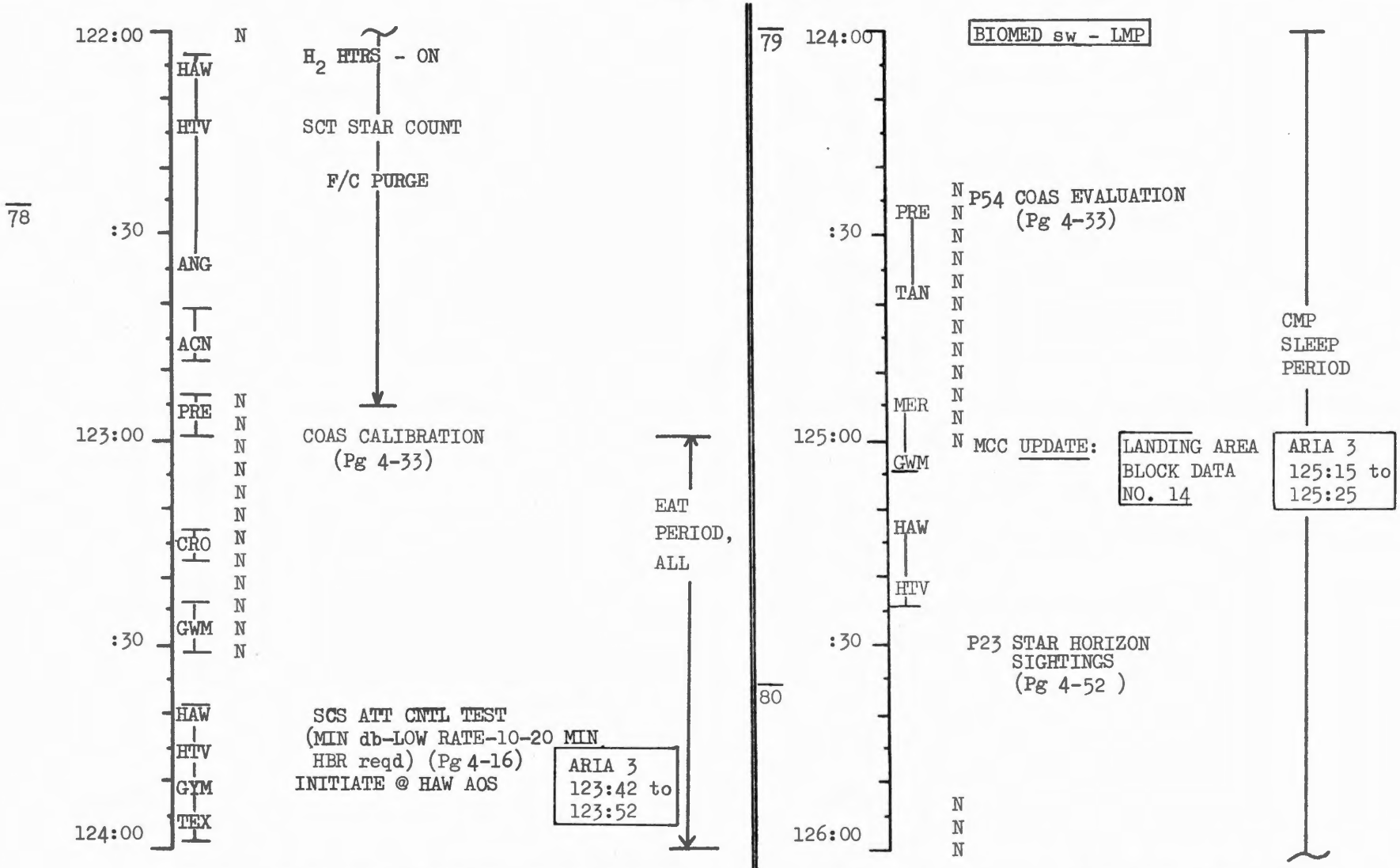
MCC UPDATE: SCT STAR COUNT TEST 3
SCT SUN
LOS 120°
(Pg 4-39)

ARIA 2
121:28 to
121:38

SCT STAR COUNT TEST 3
(SCT SUN LOS 120°
W/O WINDOW SHADES
Pg 4-39)

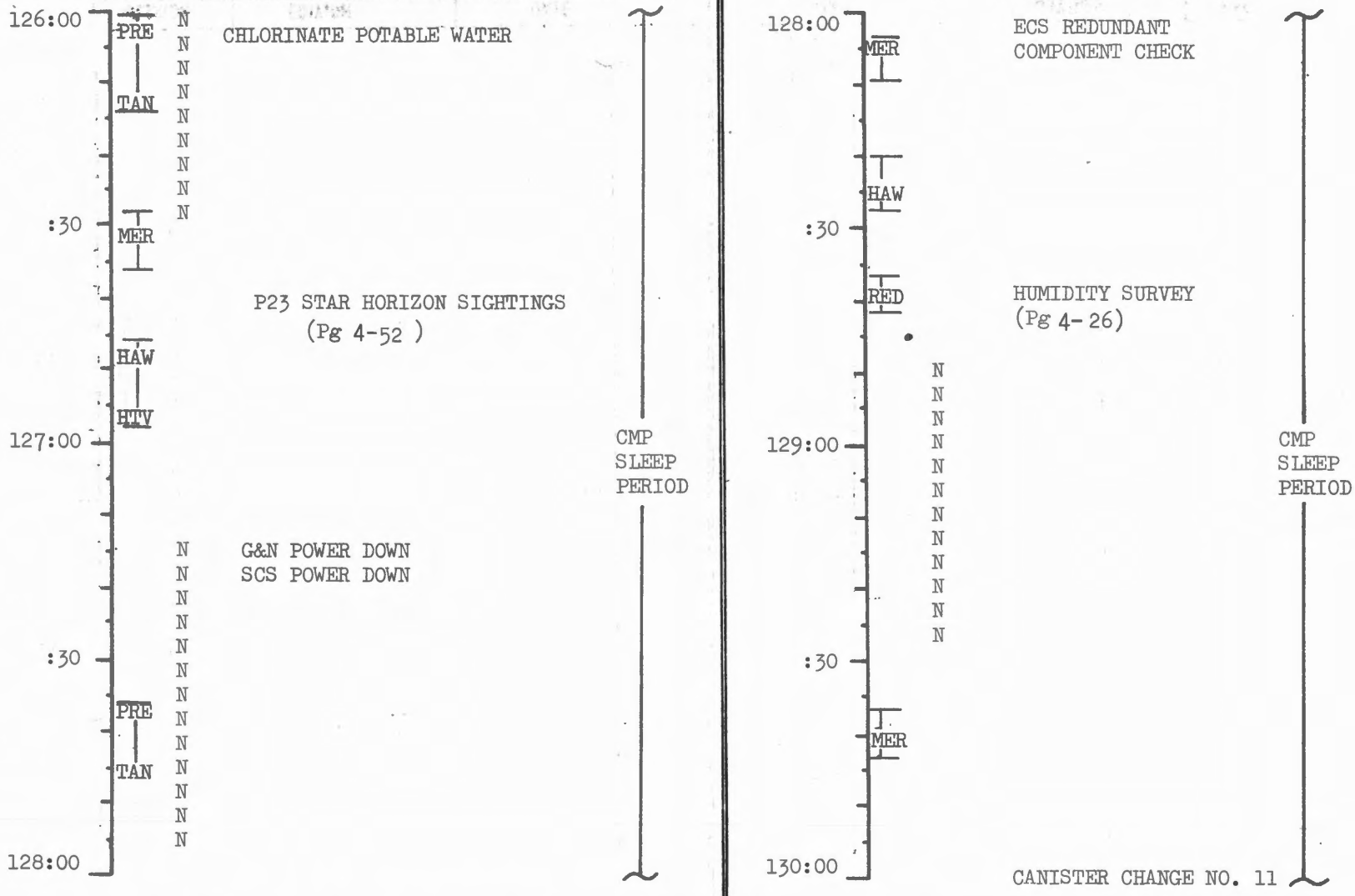
MISSION	EDITION	DATE	TIME	DAY/REV	PAGE
AS-205/101	FINAL	SEPTEMBER 16, 1968	118:00 - 122:00	4-5/75-77	2-43

FLIGHT PLAN



MISSION	EDITION	DATE	TIME	DAY/REV	PAGE
AS-205/101	FINAL	SEPTEMBER 16, 1968	122:00 - 126:00	5/77-80	2-44

FLIGHT PLAN



81

MISSION	EDITION	DATE	TIME	DAY/REV	PAGE
AS-205/101	FINAL	SEPTEMBER 16, 1968	126:00 - 130:00	5/80-82	2-45

MSC FORM 1186 (SEP 67) FLIGHT PLANNING BRANCH

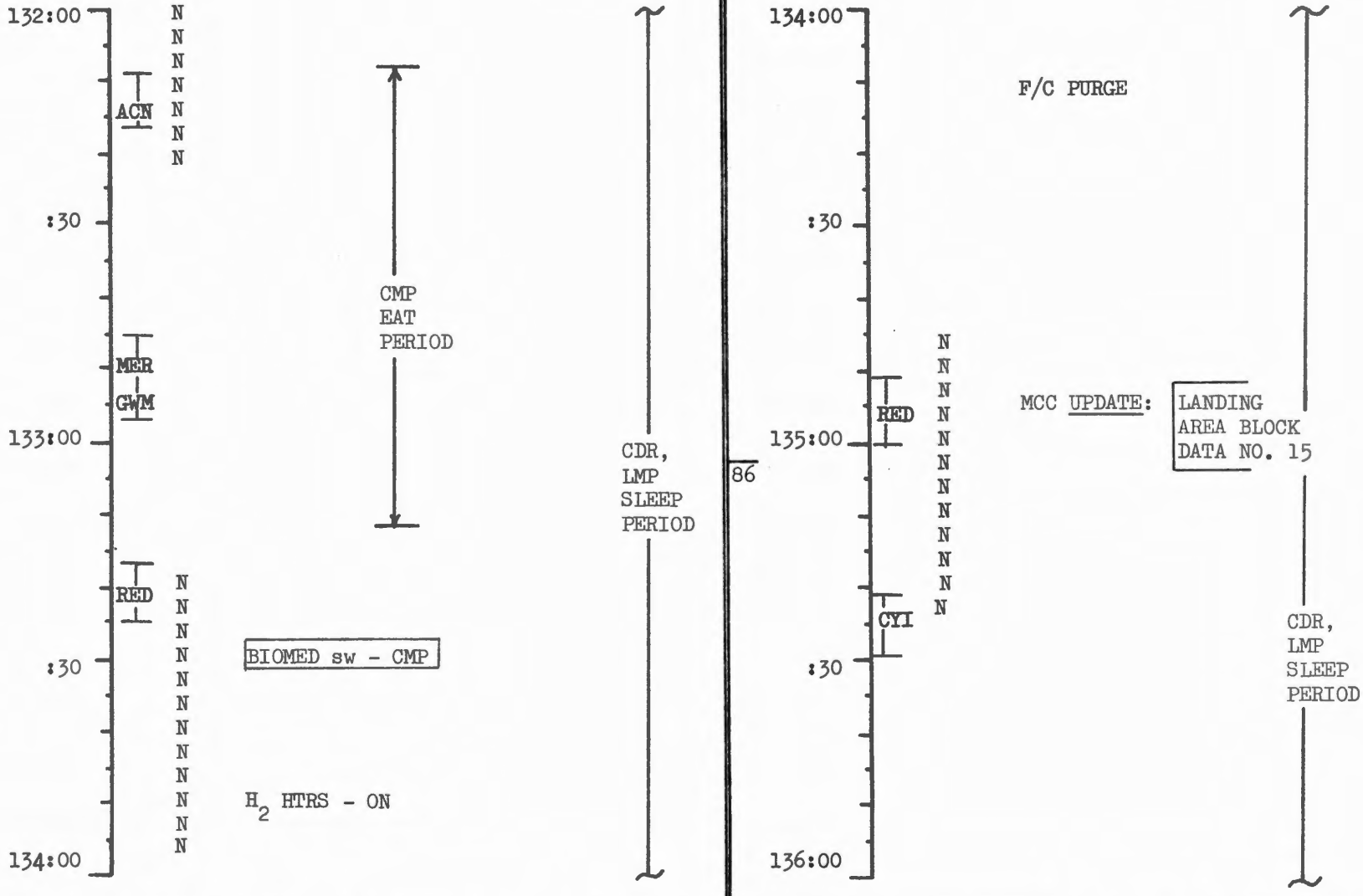
FLIGHT PLAN

Time	Crew activity / station	Notes
130:00		CMP SLEEP PERIOD (130:00 – 131:00)
:10 – :17	RED	APOLLO 7: FLIGHT PLAN STATUS REPORT
:20 – 131:00	N (night)	
:35 – :43	ACN	
83		

Time	Crew activity / station	Notes
131:00		CDR, CMP EAT PERIOD (131:00 – :53); CMP SLEEP PERIOD (131:00 – 132:00)
:11 – :23	MER, GWM	
:42 – :51	RED	
:49 – 132:00	N (night)	
84		
132:00		

MISSION	EDITION	DATE	TIME	DAY/REV	PAGE
AS-205/101	FINAL	SEPTEMBER 16, 1968	130:00 - 132:00	5/82/84	2-46

FLIGHT PLAN



85

86

MISSION	EDITION	DATE	TIME	DAY/REV	PAGE
AS-205/101	FINAL	SEPTEMBER 16, 1968	132:00 - 136:00	5/84-86	2-47

MSC FORM 1186 (SEP 67) FLIGHT PLANNING BRANCH

FLIGHT PLAN

87

136:00
CNB
N N N N N N N N N N N N
:30 RED
ANG
CYI
MCC: FLIGHT PLAN UPDATE
137:00
MAD
:30 CRO
CNB
N N N N N N
138:00

CDR, LMP SLEEP PERIOD

88

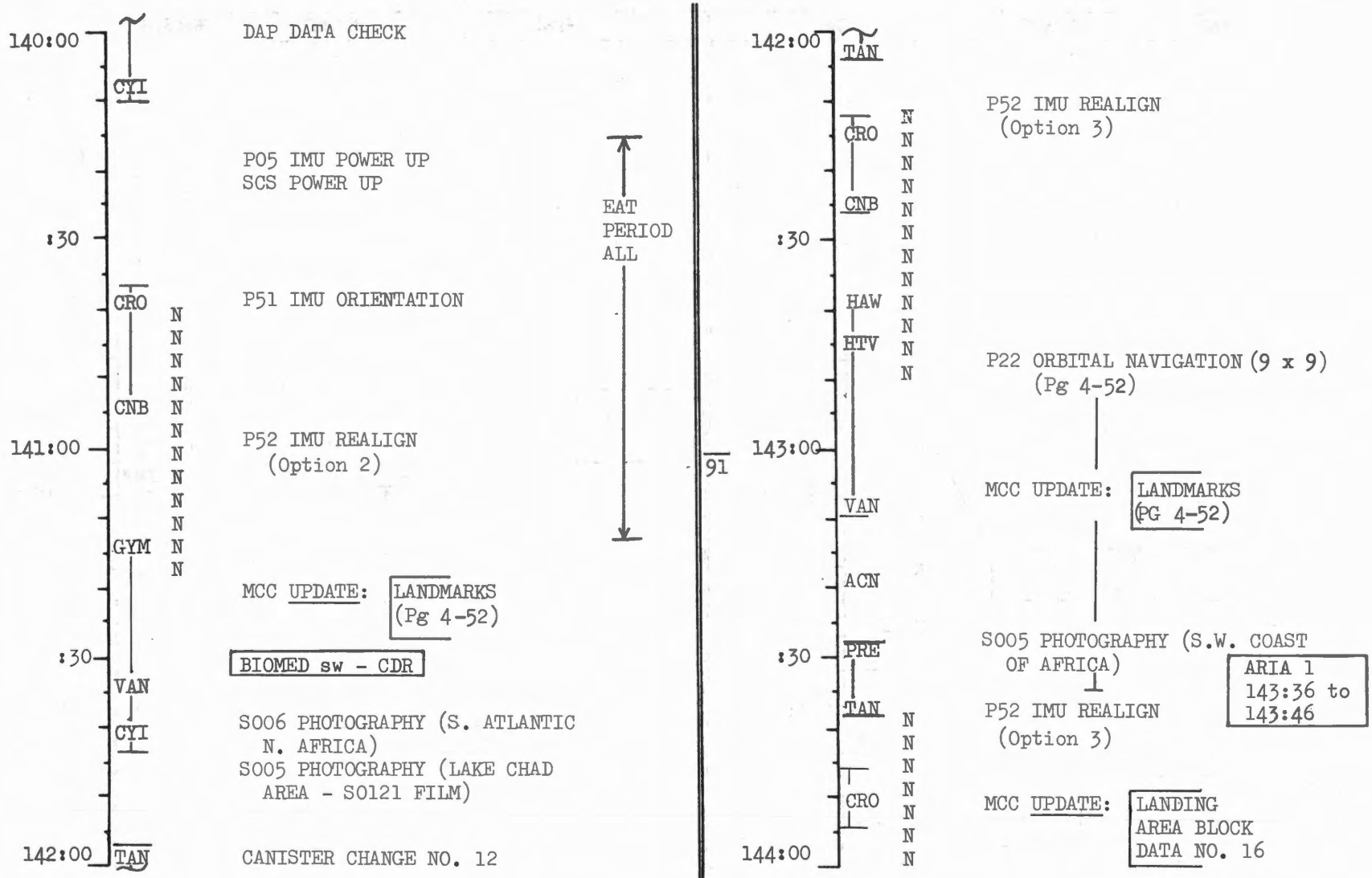
89

138:00
RED
N N N N N N
ANG
VAN
:30
CYI
139:00
CRO
CNB
N N N N N N N N N N N N
:30 P05 CMC POWER UP
TEX
MCC UPDATE: GO/NO GO 106-1
STATE VECTOR
(Cmd & Voice)
(time tag to
142:50)
W-MATRIX
(9X9)
LANDMARKS (Pg 4-52)
VAN
140:00

CDR, LMP SLEEP PERIOD

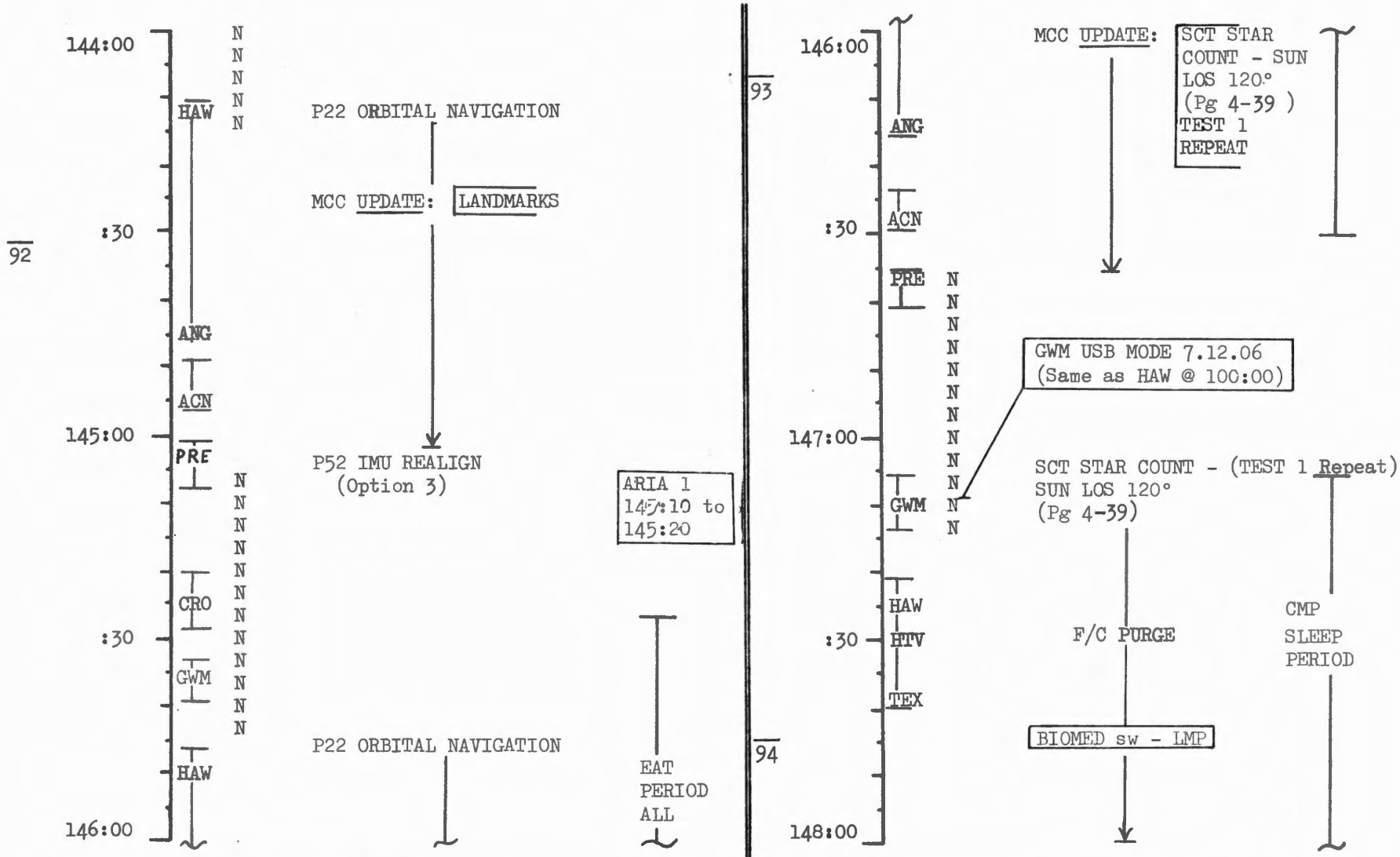
MISSION	EDITION	DATE	TIME	DAY/REV	PAGE
AS-205/101	FINAL	SEPTEMBER 16, 1968	136:00 - 140:00	5/86-89	2-48

FLIGHT PLAN



MISSION	EDITION	DATE	TIME	DAY/REV	PAGE
AS-205/101	FINAL	SEPTEMBER 16, 1968	140:00 - 144:00	5/89-91	2-49

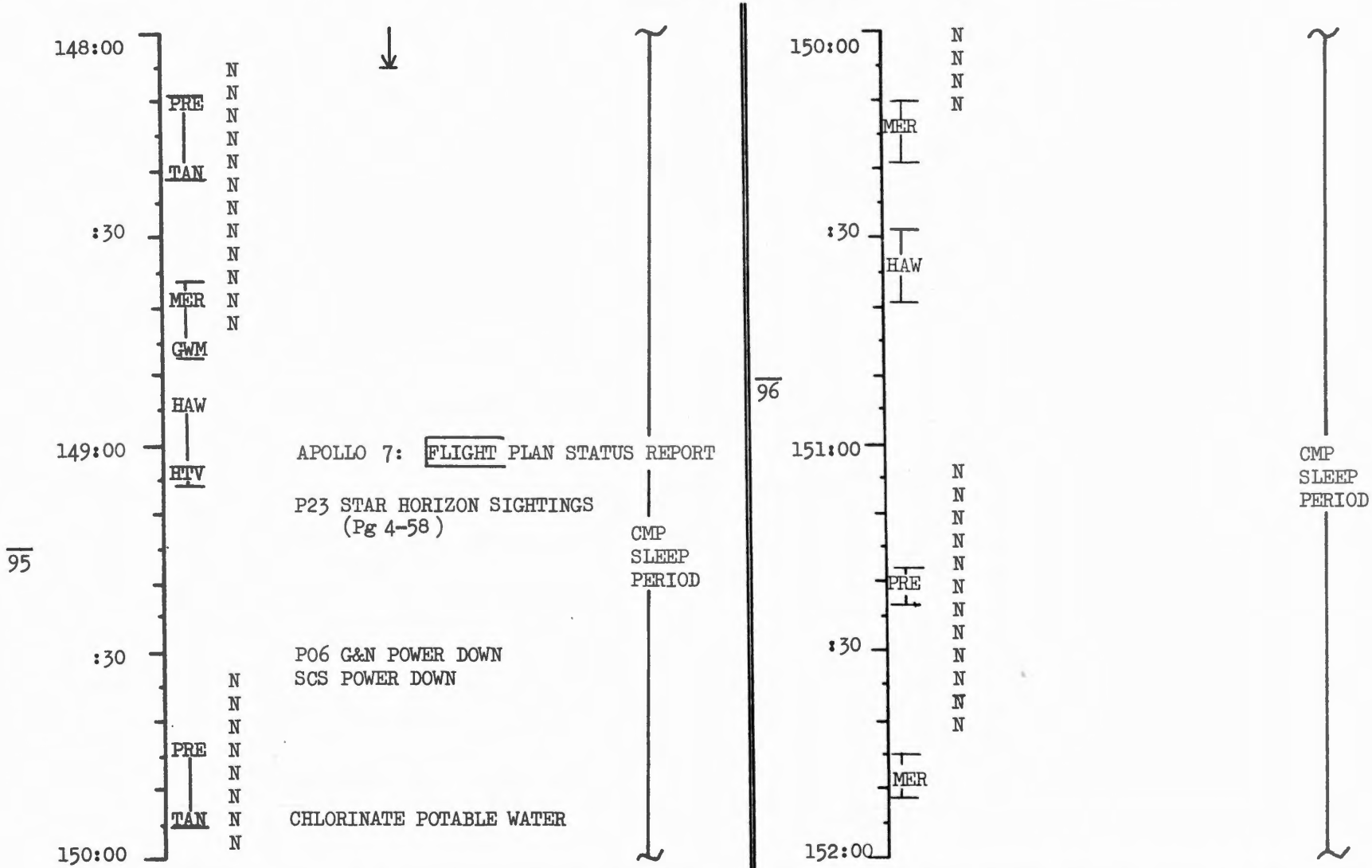
FLIGHT PLAN



MISSION	EDITION	DATE	TIME	DAY/REV	PAGE
AS-205/101	FINAL	SEPTEMBER 16, 1968	144:00 - 148:00	6/91-94	2-50

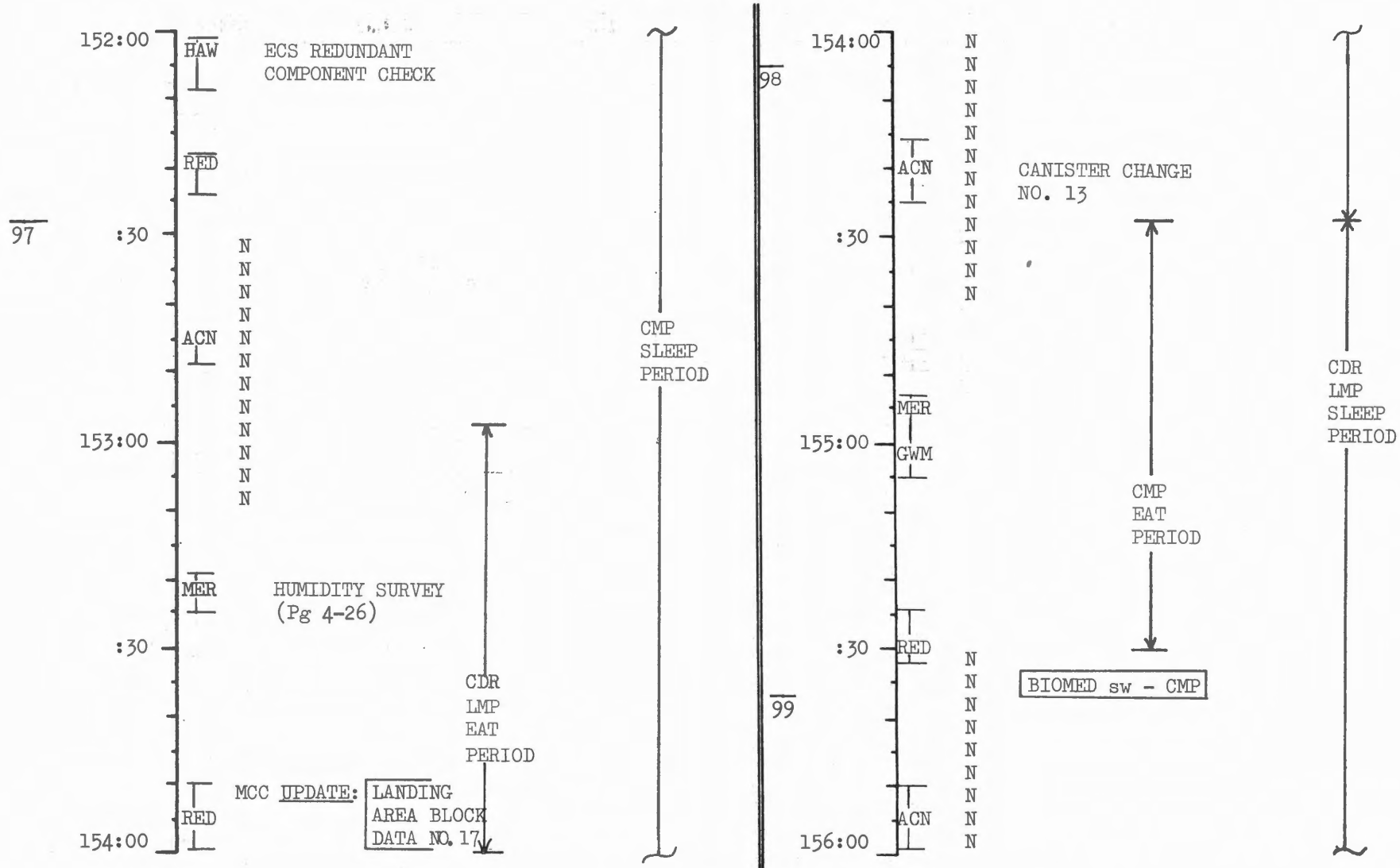
MSC FORM 1186 (SEP 67) FLIGHT PLANNING BRANCH

FLIGHT PLAN



MISSION	EDITION	DATE	TIME	DAY/REV	PAGE
AS-205/101	FINAL	SEPTEMBER 16, 1968	148:00 - 152:00	6/94-96	2-51

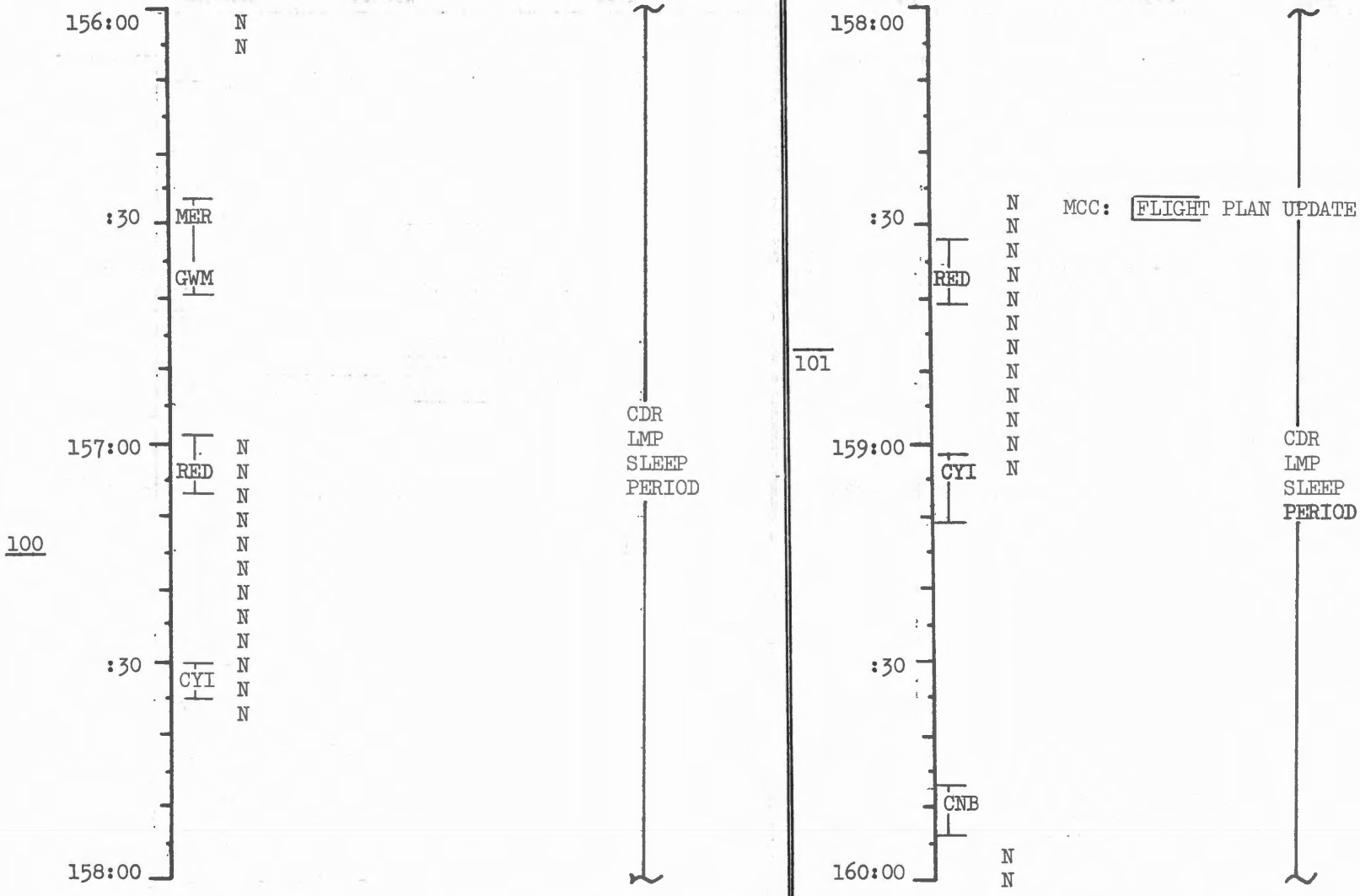
FLIGHT PLAN



MISSION	EDITION	DATE	TIME	DAY/REV	PAGE
AS-205/101	FINAL	SEPTEMBER 16, 1968	152:00 - 156:00	6/96/99	2-52

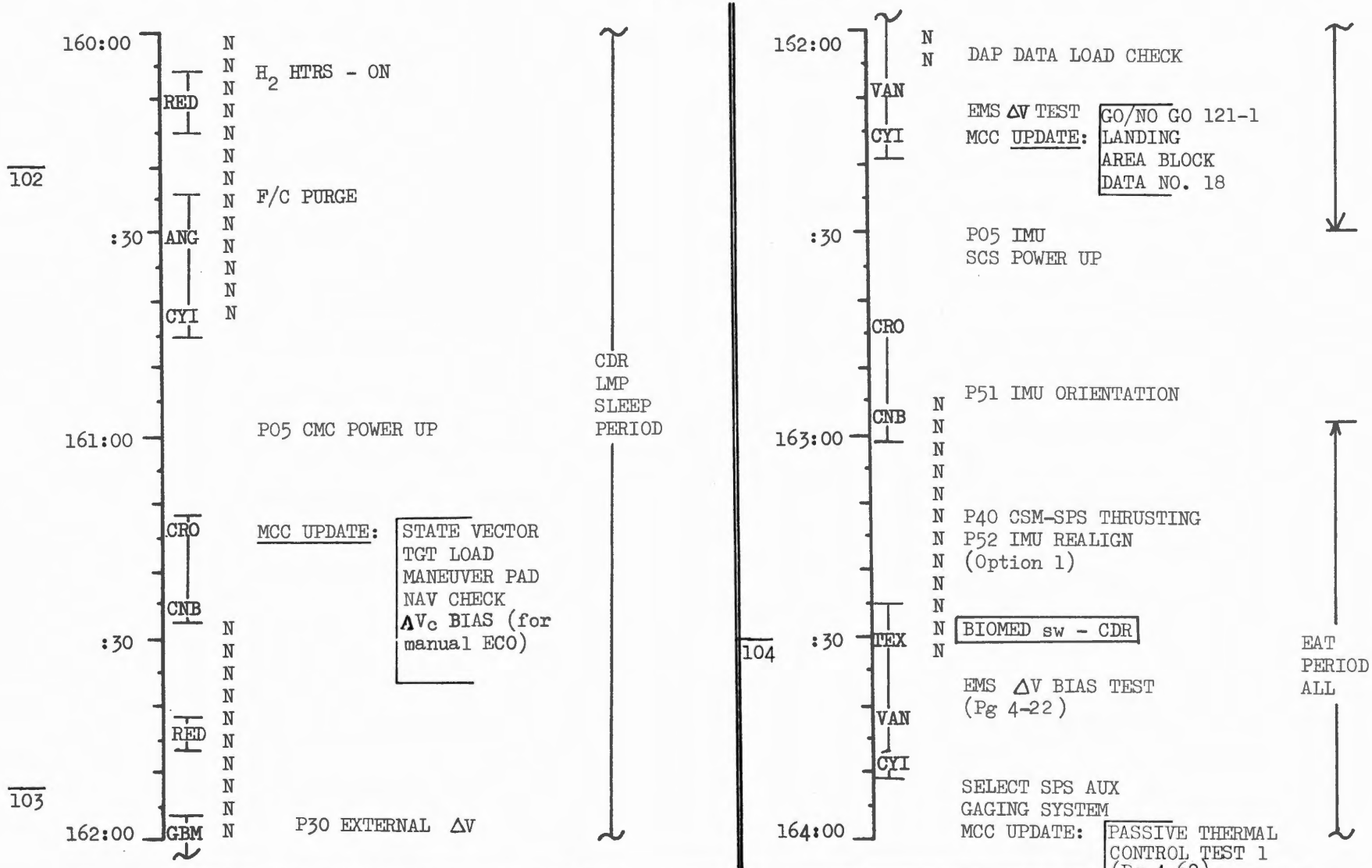
MSC FORM 1186 (SEP 67) FLIGHT PLANNING BRANCH

FLIGHT PLAN



MISSION	EDITION	DATE	TIME	DAY/REV	PAGE
AS-205/101	FINAL	SEPTEMBER 16, 1968	156:00 - 160:00	6/99-101	2-53

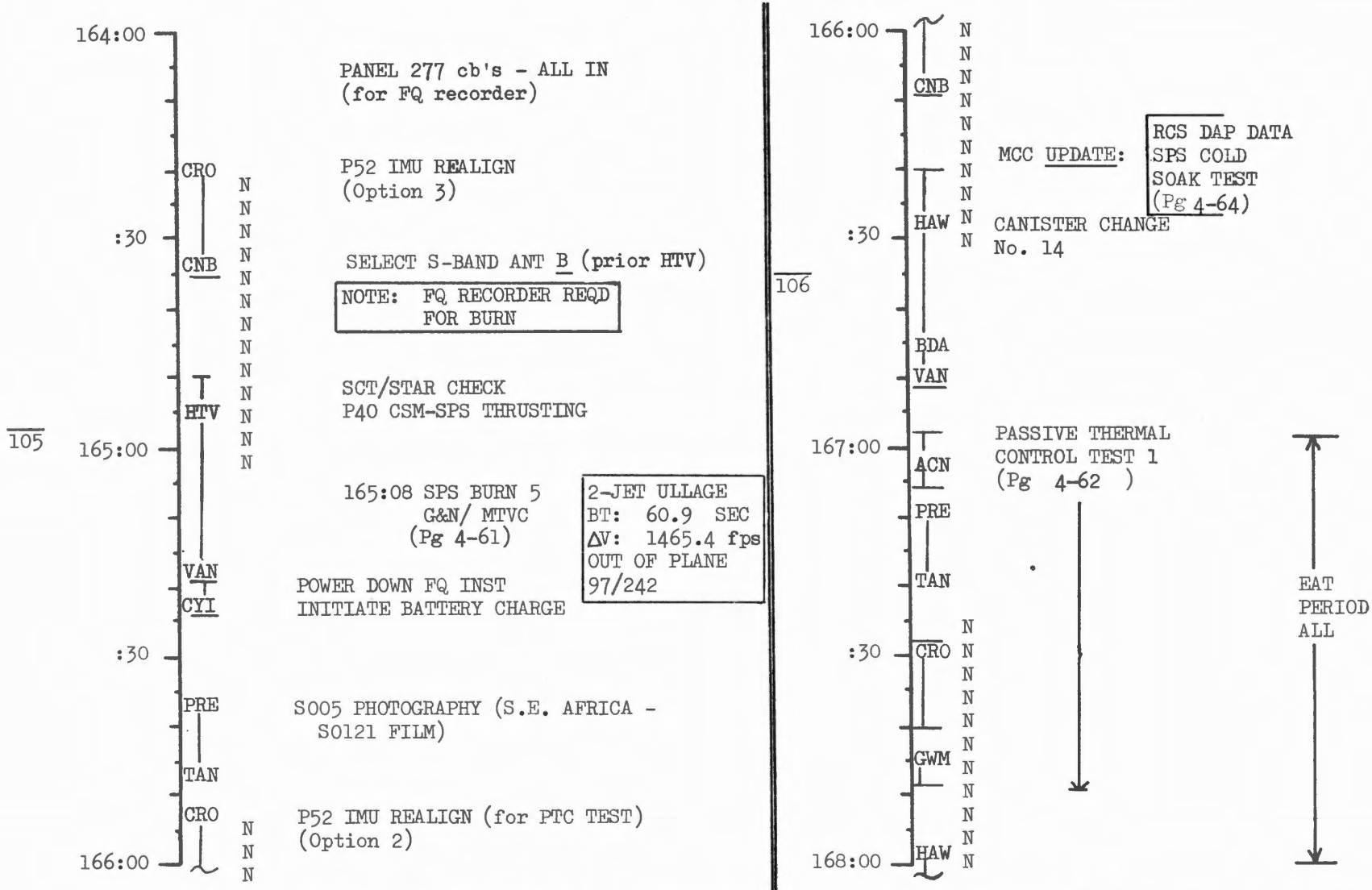
FLIGHT PLAN



MISSION	EDITION	DATE	TIME	DAY/REV	PAGE
AS-205/101	FINAL	SEPTEMBER 16, 1968	160:00 - 164:00	6/101-104	2-54

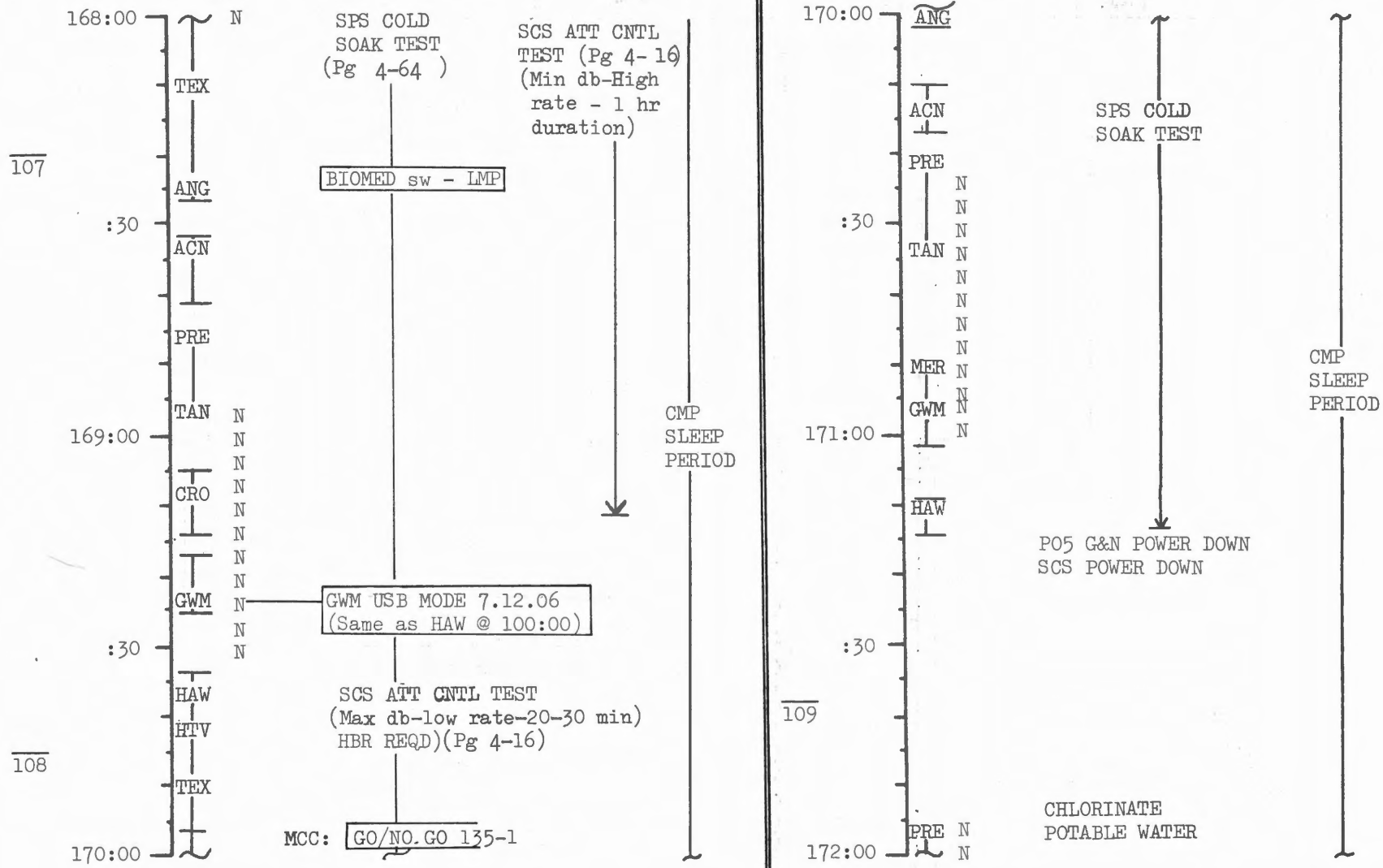
MSC FORM 1186 (SEP 67) FLIGHT PLANNING BRANCH

FLIGHT PLAN



MISSION	EDITION	DATE	TIME	DAY/REV	PAGE
AS-205/101	FINAL	SEPTEMBER 16, 1968	164:00 - 168:00	6/104-106	2-55

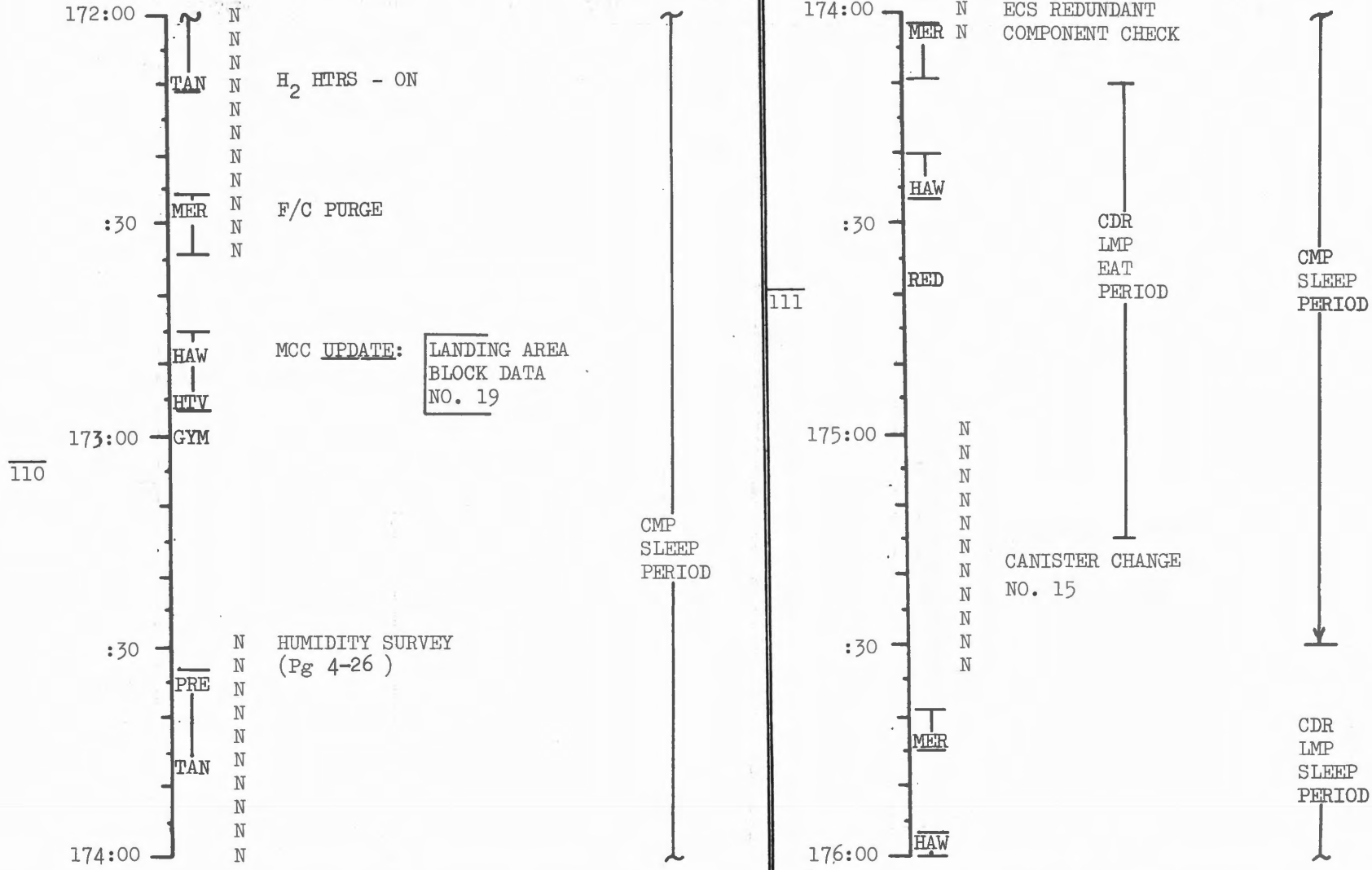
FLIGHT PLAN



MISSION	EDITION	DATE	TIME	DAY/REV	PAGE
AS-205/101	FINAL	SEPTEMBER 16, 1968	168:00 - 172:00	7/106-109	2-56

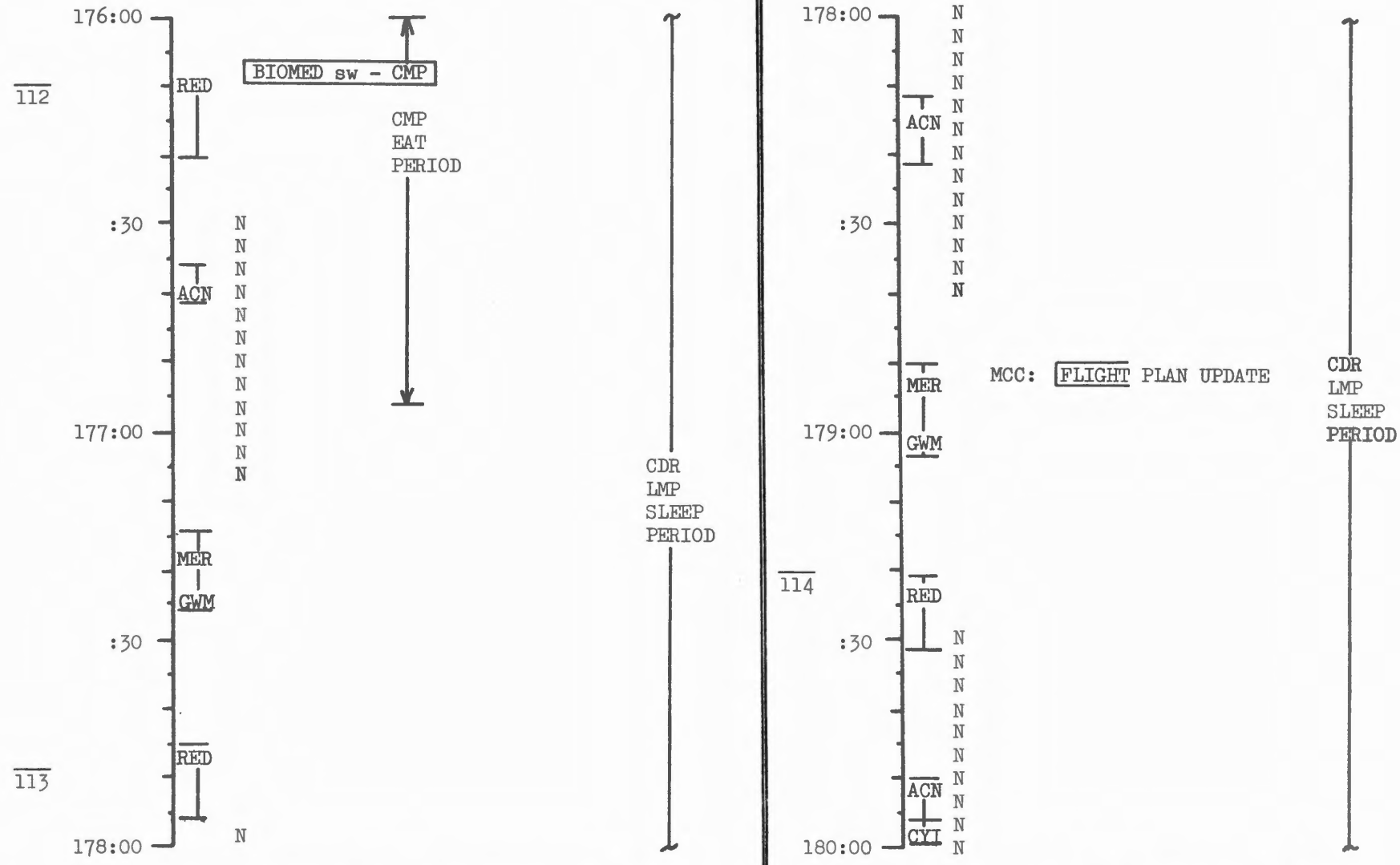
MSC FORM 1186 (SEP 67) FLIGHT PLANNING BRANCH

FLIGHT PLAN



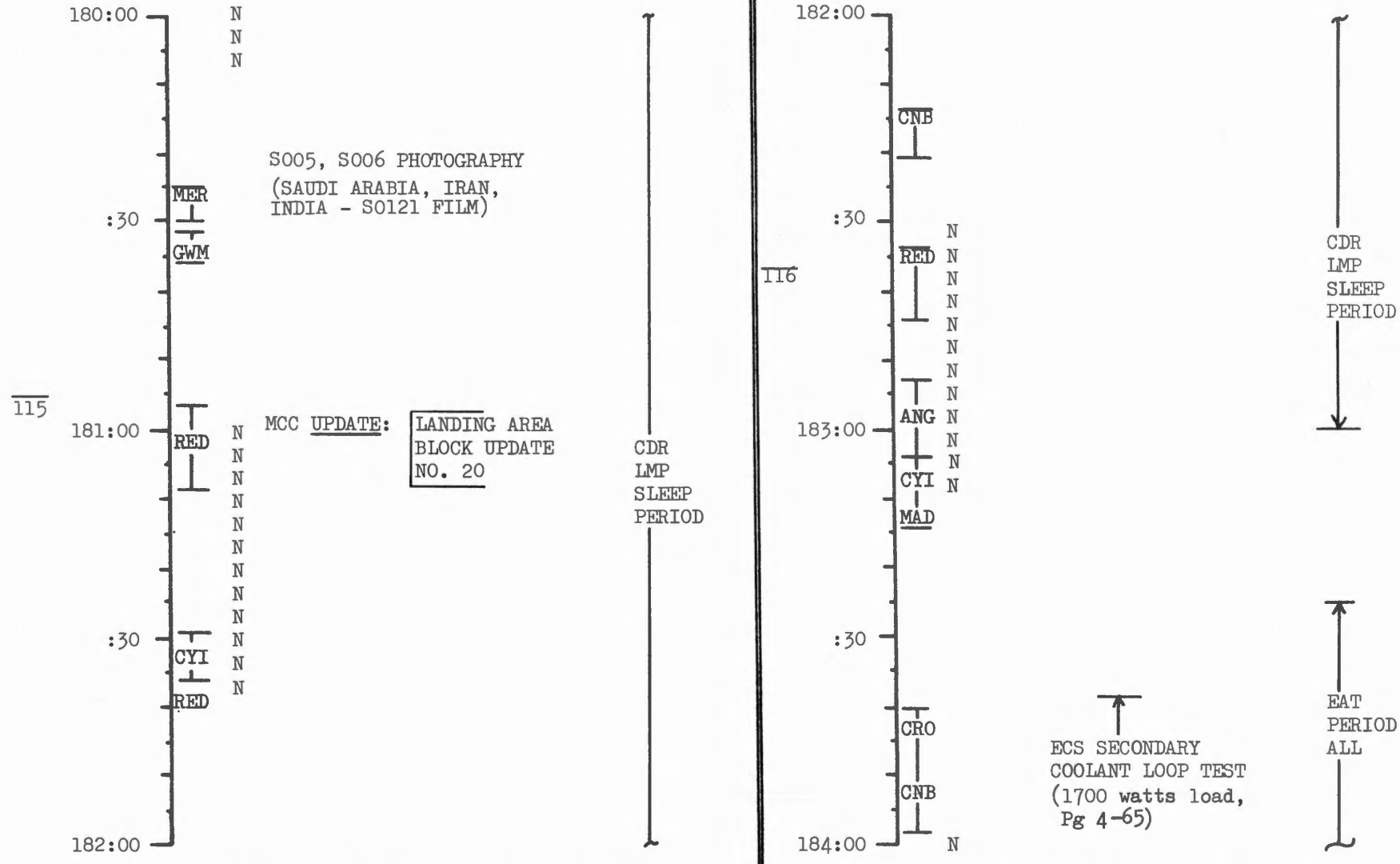
MISSION	EDITION	DATE	TIME	DAY/REV	PAGE
AS-205/101	FINAL	SEPTEMBER 16, 1968	172:00 - 176:00	7/109-111	2-57

FLIGHT PLAN



MISSION	EDITION	DATE	TIME	DAY/REV	PAGE
AS-205/101	FINAL	SEPTEMBER 16, 1968	176:00 - 180:00	7/111-114	2-58

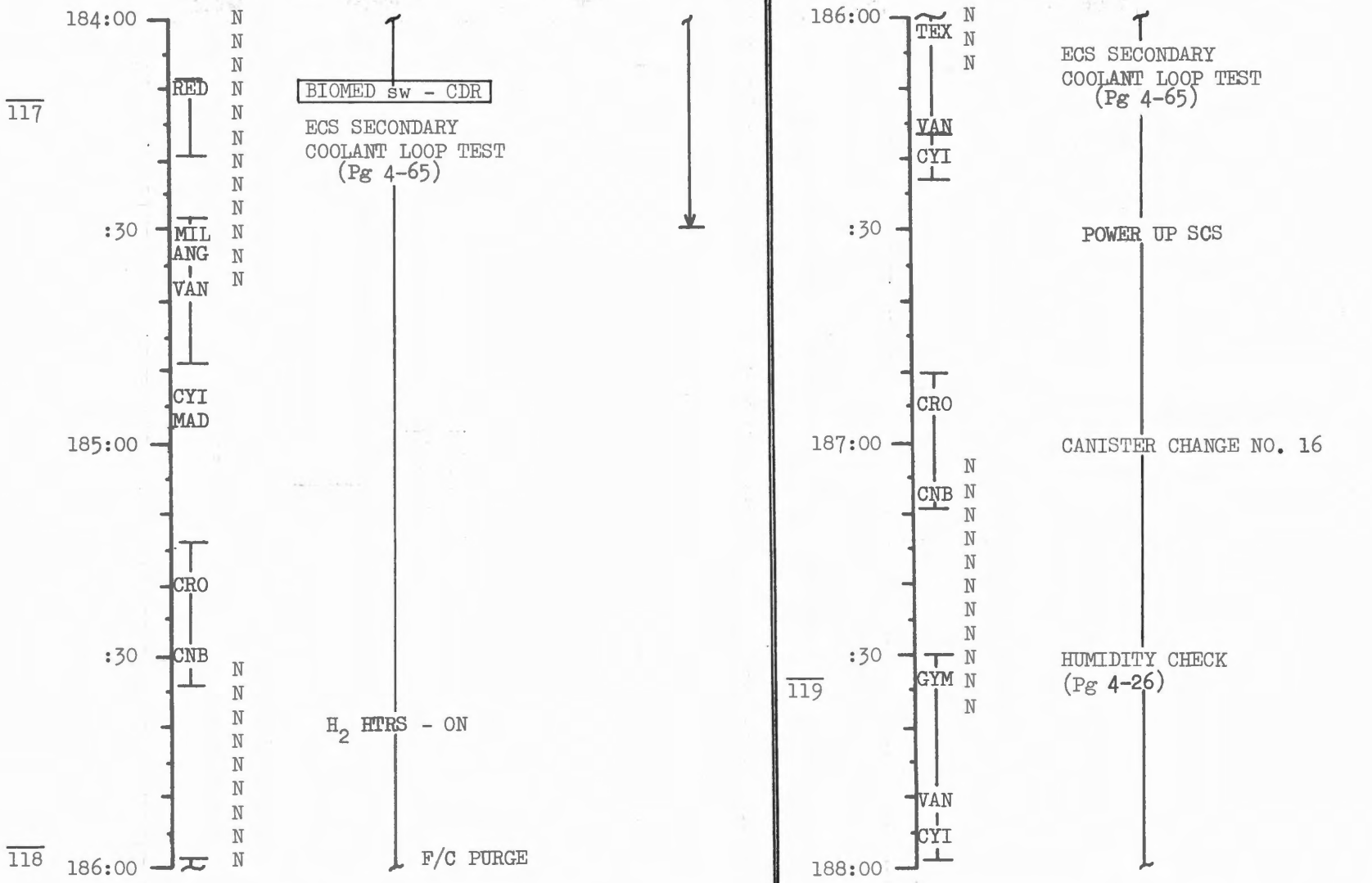
FLIGHT PLAN



MISSION	EDITION	DATE	TIME	DAY/REV	PAGE
AS-205/101	FINAL	SEPTEMBER 16, 1968	180:00 - 184:00	7/114-116	2-59

MSC FORM 1186 (SEP 67) FLIGHT PLANNING BRANCH

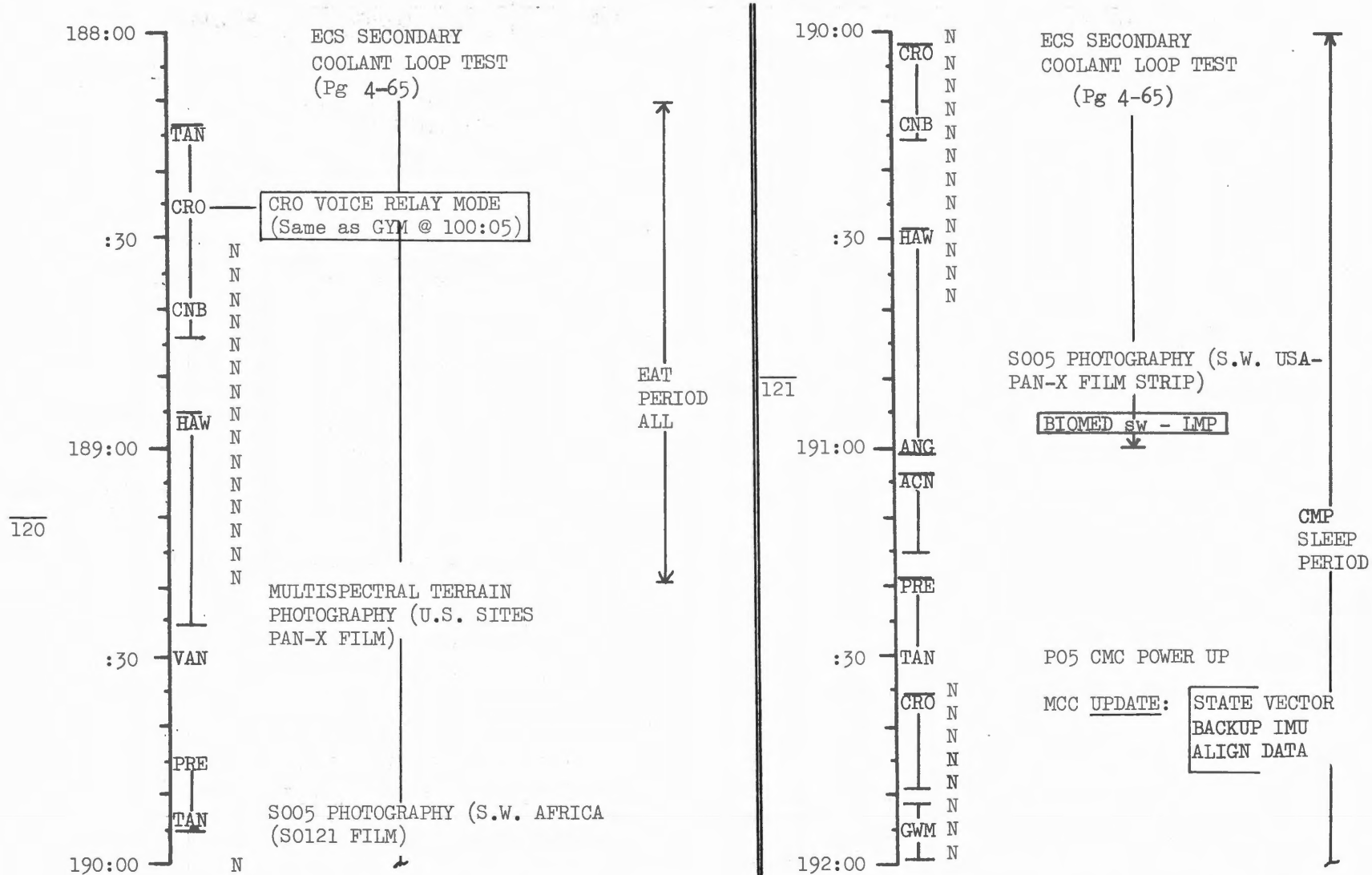
FLIGHT PLAN



MISSION	EDITION	DATE	TIME	DAY/REV	PAGE
AS-205/101	FINAL	SEPTEMBER 16, 1968	184:00 - 188:00	7/116-119	2-60

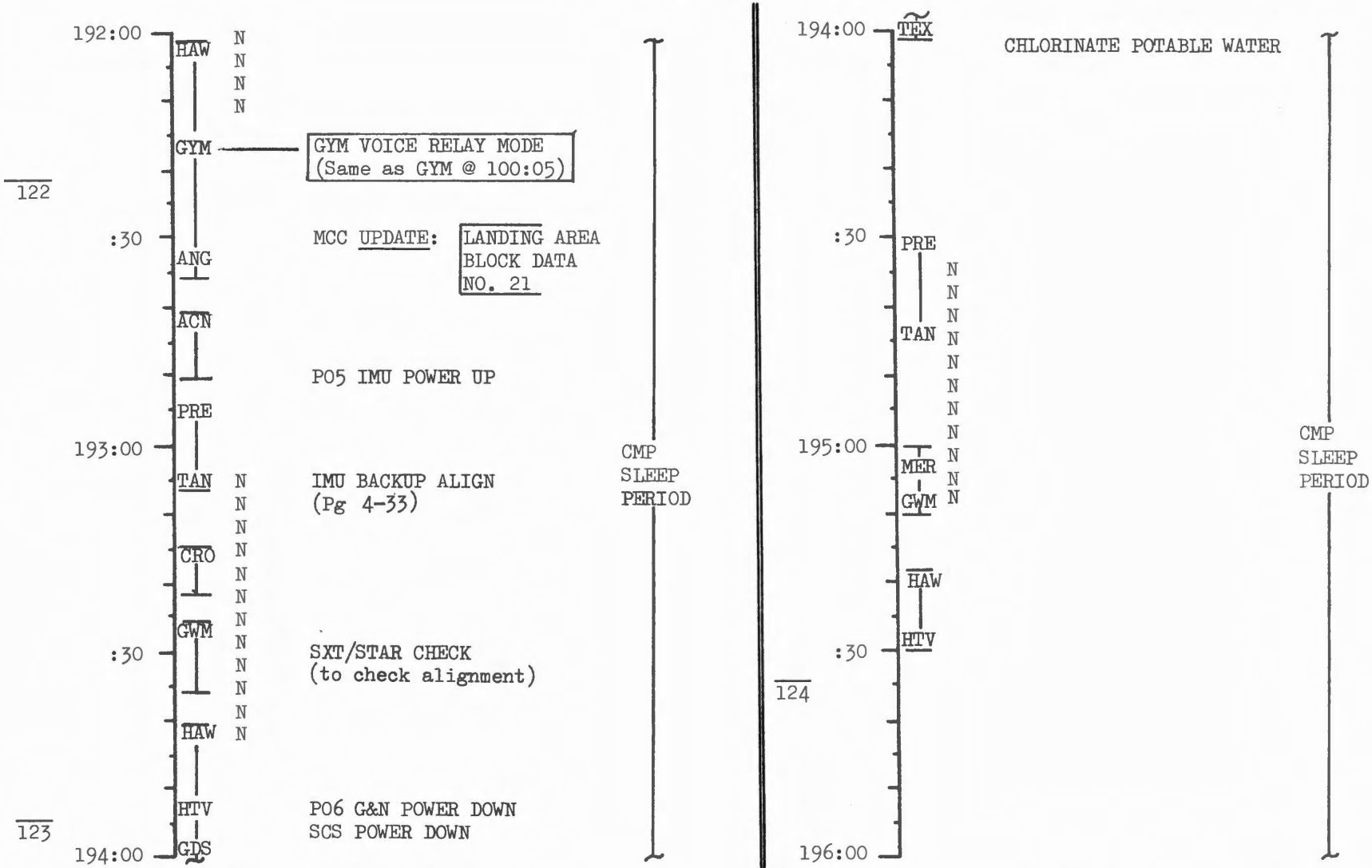
MSC FORM 1186 (SEP 67) FLIGHT PLANNING BRANCH

FLIGHT PLAN



MISSION	EDITION	DATE	TIME	DAY/REV	PAGE
AS-205/101	FINAL	SEPTEMBER 16, 1968	188:00 - 192:00	7/119-121	2-61

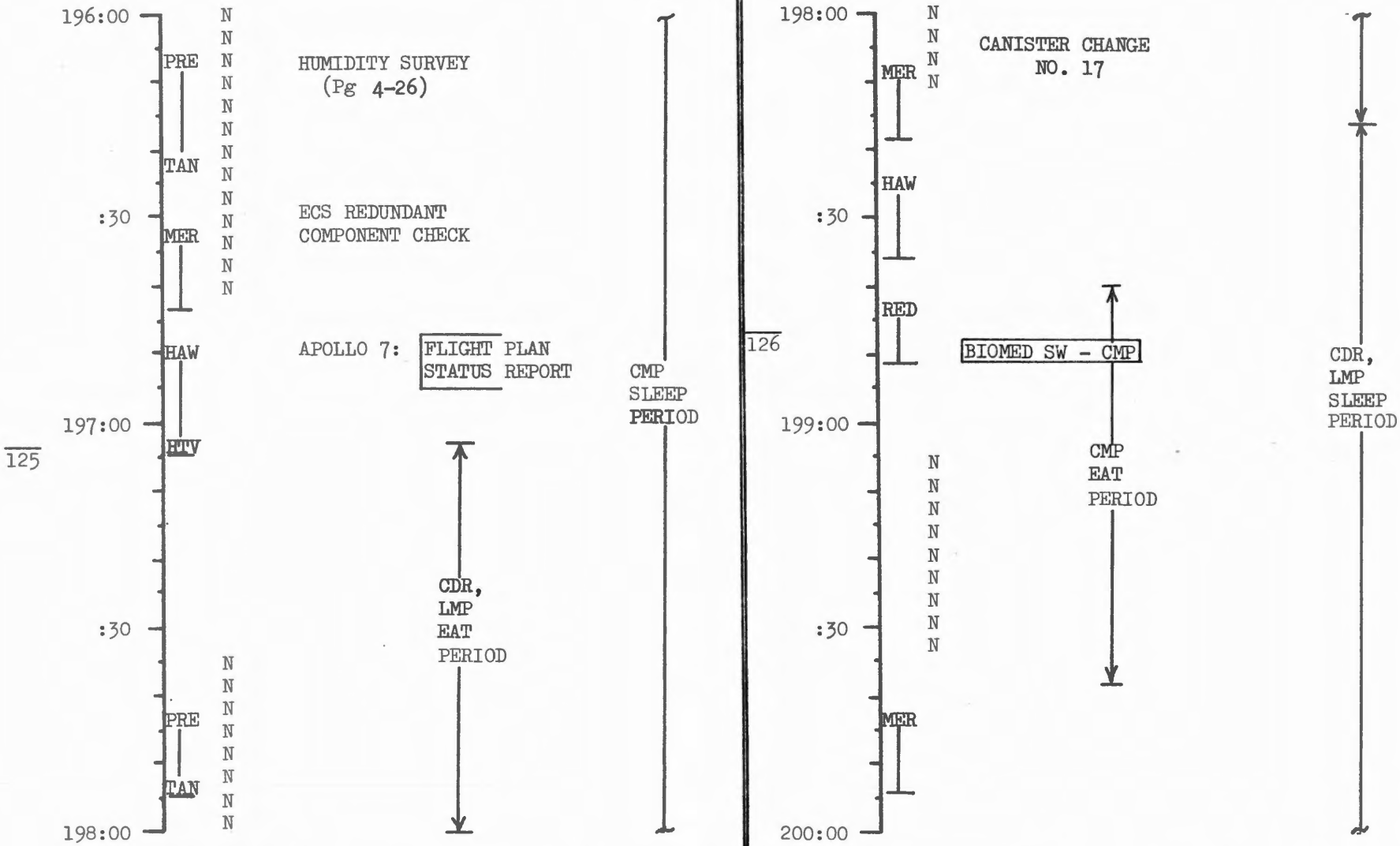
FLIGHT PLAN



MISSION	EDITION	DATE	TIME	DAY/REV	PAGE
AS-205/101	FINAL	SEPTEMBER 16, 1968	192:00 - 196:00	8/121-124	2-62

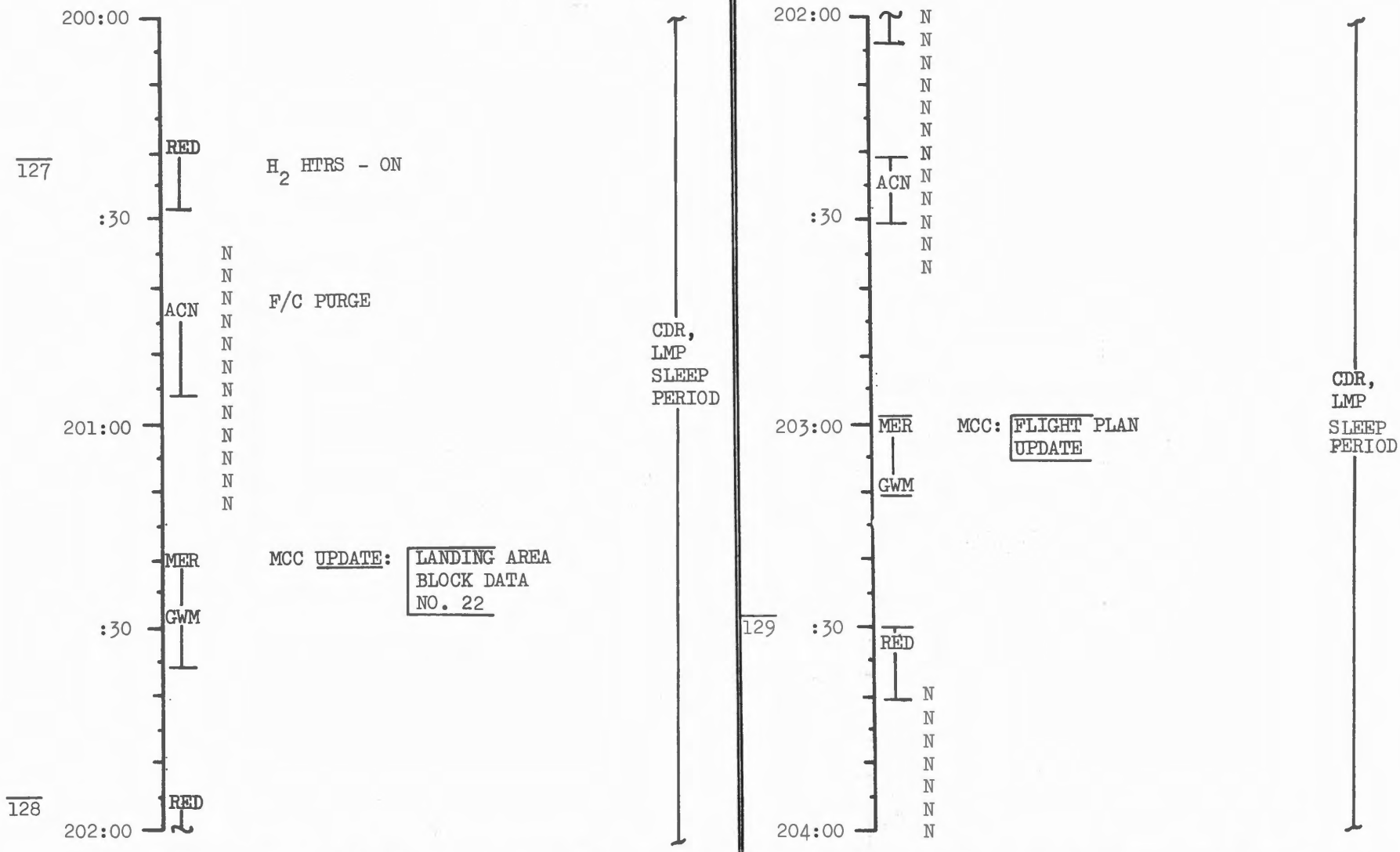
MSC FORM 1186 (SEP 67) FLIGHT PLANNING BRANCH

FLIGHT PLAN



MISSION	EDITION	DATE	TIME	DAY/REV	PAGE
AS-205/101	FINAL	SEPTEMBER 16, 1968	196:00 - 200:00	8/124-126	2-63

FLIGHT PLAN



MISSION	EDITION	DATE	TIME	DAY/REV	PAGE
AS-205/101	FINAL	SEPTEMBER 16, 1968	200:00 - 204:00	8/126-129	2-64

MSC FORM 1186 (SEP 67) FLIGHT PLANNING BRANCH

FLIGHT PLAN

204:00 CYI N N N N N

RADAR TRANSPONDER
SELF TEST

:30

CDR
LMP
SLEEP
PERIOD

205:00

130

RED N N N N N N N

APOLLO 7: REPORT RESULTS
OF XPONDER SELF TEST

P05 CMC POWER UP

:30 ANG N N N

CYI N N N

MAD

MCC UPDATE: STATE VECTOR
NAV CHECK
TGT LOAD
MANEUVER PAD

P30 EXTERNAL ΔV

206:00

206:00

EMS ΔV TEST
DAP DATA CHECK

P05 IMU POWER UP
SCS POWER UP

CNB

EAT
PERIOD

:30

131

N N N N N N N N N N N N

P51 IMU ORIENTATION

RED

BIOMED sw - CDR
P40 CSM-SPS THRUSTING

207:00

P52 IMU REALIGN
(Option 1)

BDA

MAD

:30

CRO

208:00

MISSION	EDITION	DATE	TIME	DAY/REV	PAGE
AS-205/101	FINAL	SEPTEMBER 16, 1968	205:00 - 208:00	8/129-131	2-65

FLIGHT PLAN

208:00 ~ CNB

N P52 IMU REALIGN
N (Option 3)

132 RED N

N N N N N

:30 TEX N

N MCC UPDATE: GO/NO GO 150-1 | PASSIVE THERMAL CONTROL TEST 2 (Pg 4-62)

N N N

VAN

MAD

209:00

CRO

:30

CNB

N SELECT S-BAND ANT A (prior GYM)
N N N

N SXT/STAR CHECK
N P40 CSM-SPS THRUSTING

210:00

210:00 N

133 GYM N

TEX N

N 210:13 SPS BURN 6
G&N MIN IMP
(Pg 4-67)

N

2-JET ULLAGE
BT:0.5 SEC
ΔV:16.9 fps
IN PLANE
91/232

VAN INITIATE BATTERY CHARGE

:30 CYI

MCC UPDATE: LANDING AREA BLOCK UPDATE NO. 23

CANISTER CHANGE NO. 18

211:00 CRO

CNB N P52 IMU REALIGN
N (Option 2)

H_2 HTRS - ON

N N N N N

:30 N

134 N

HTV N F/C PURGE

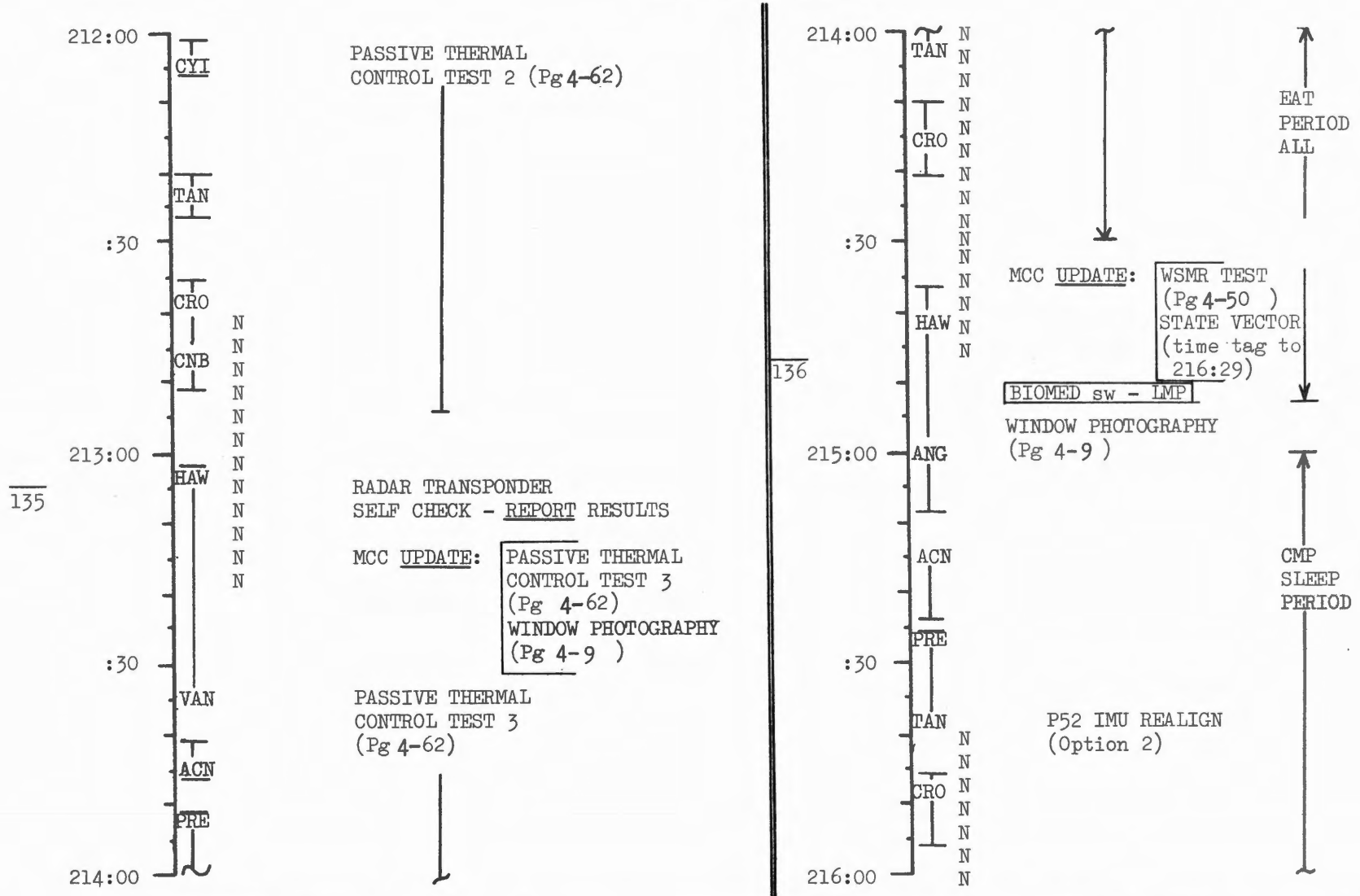
N N N

VAN

212:00

MISSION	EDITION	DATE	TIME	DAY/REV	PAGE
AS-205/101	FINAL	SEPTEMBER 16, 1968	208:00 - 212:00	8/131-134	2-66

FLIGHT PLAN



MISSION	EDITION	DATE	TIME	DAY/REV	PAGE
AS-205/101	FINAL	SEPTEMBER 16, 1968	212:00 - 216:00	8/134-136	2-67

FLIGHT PLAN

216:00 — GWM — N N N N N N

RNDZ XPNDR HEATER - ON

MANEUVER TO UPDATED ATT
10 MIN PRIOR TO WSMR AOS

HAW

FREE DRIFT @ WSMR AOS

137 :30 — HTV

216:29 WSMR LM RR TEST 2

(Pg 4-50)

GBM

ANG

ACN

SCS ATT CNTL
TEST (MAX db -
high rate - Pg 4-16)
(1+30 duration)
INITIATE @ ACN AOS

CMP
SLEEP
PERIOD

217:00 — PRE

TAN — N N N N N N N N N N N N

:30 — MER

CHLORINATE POTABLE WATER

GWM

HAW

218:00

218:00 — GYM

138

:30

PRE — N N N N N N N N N N N N N N N N

TAN

P06 G&N POWER DOWN
SCS POWER DOWN

CMP
SLEEP
PERIOD

219:00

HAW

APOLLO 7: FLIGHT PLAN
STATUS REPORT

:30 — HTV

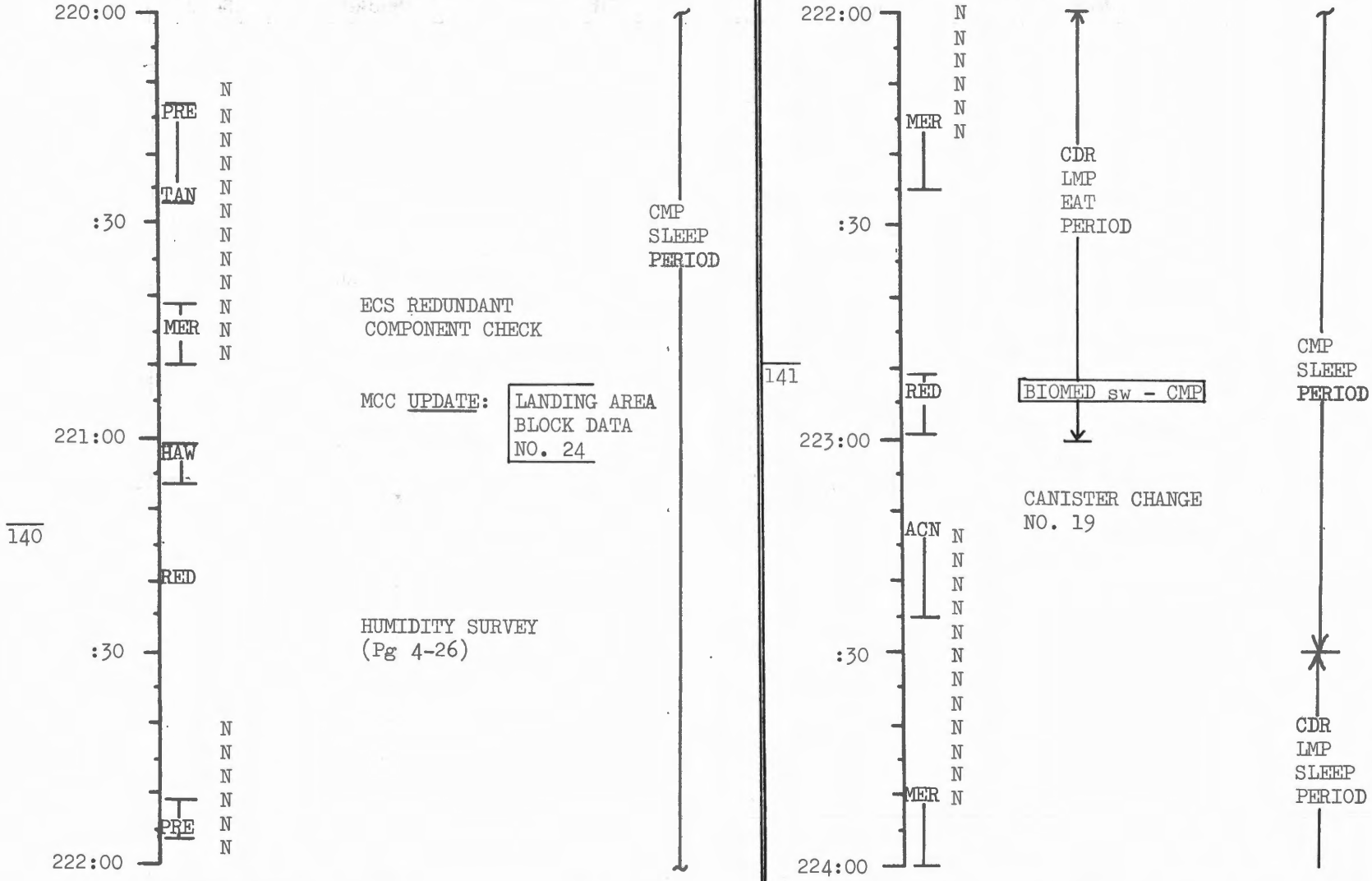
139

S005 PHOTOGRAPHY (S.E. COAST
S. AMERICA, S0121 FILM)

220:00

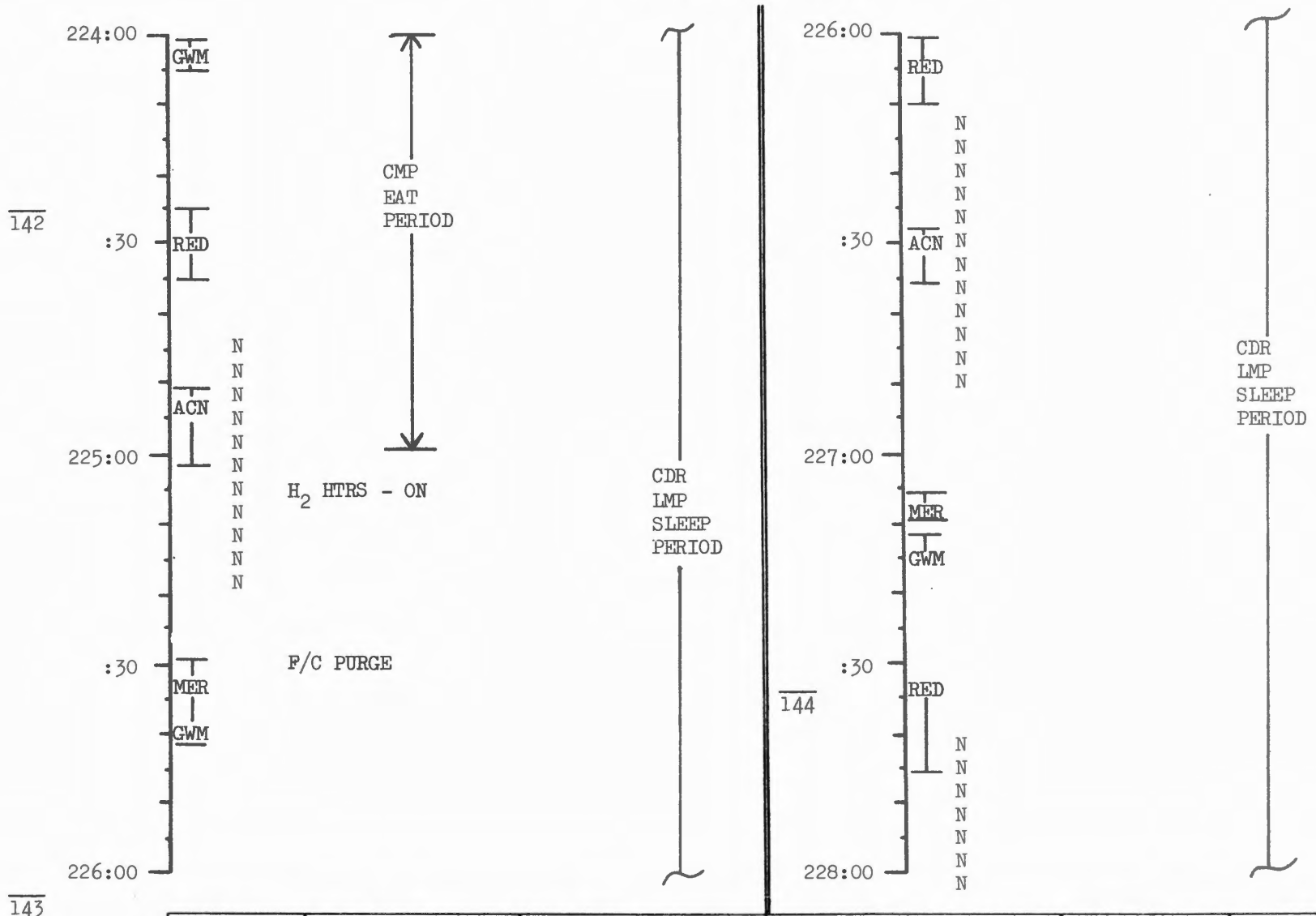
MISSION	EDITION	DATE	TIME	DAY/REV	PAGE
AS-205/101	FINAL	SEPTEMBER 16, 1968	216:00 - 220:00	9/136-139	2-68

FLIGHT PLAN



MISSION	EDITION	DATE	TIME	DAY/REV	PAGE
AS-205/101	FINAL	SEPTEMBER 16, 1968	220:00 - 224:00	9/139-141	2-69

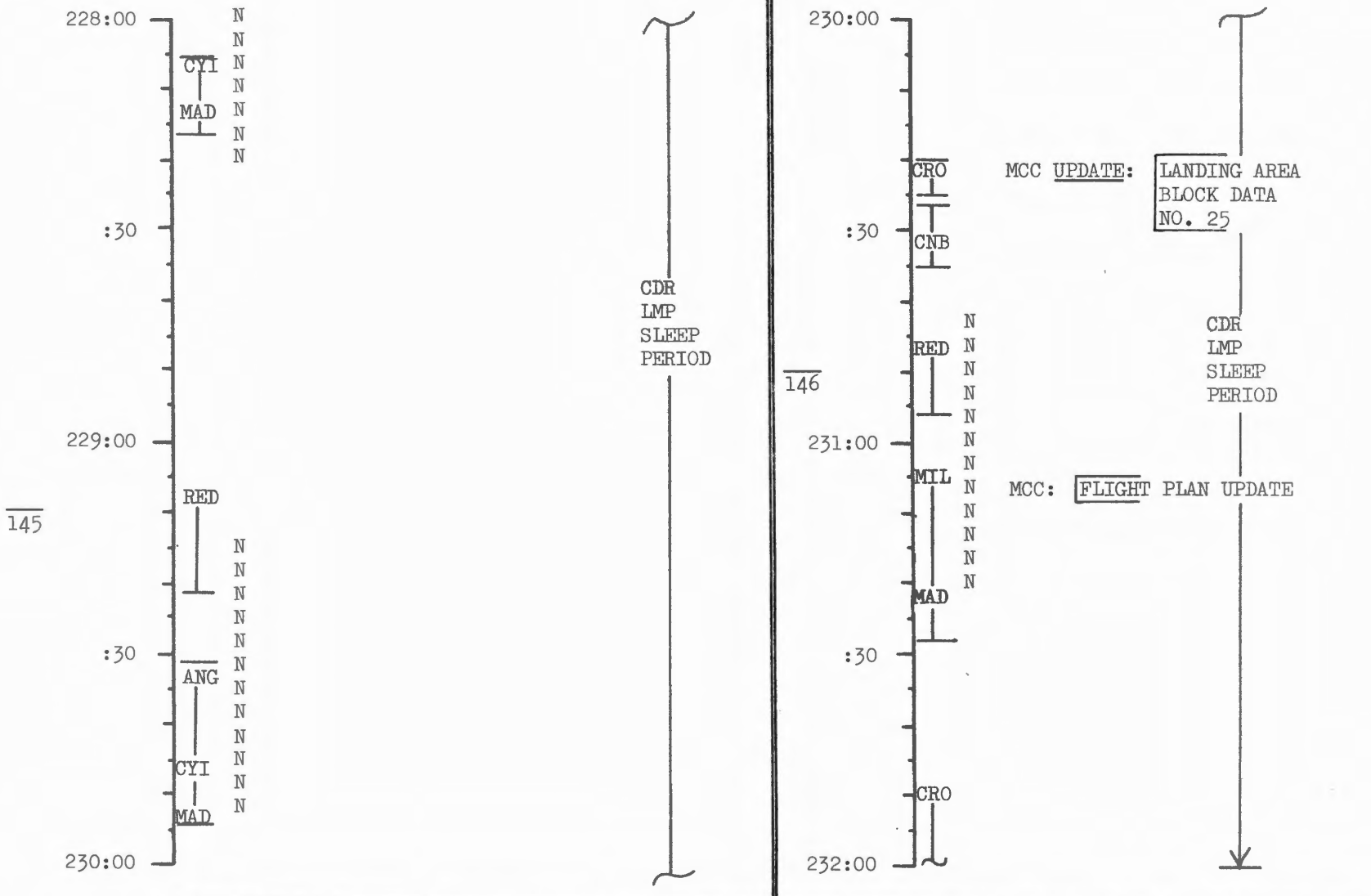
FLIGHT PLAN



MISSION	EDITION	DATE	TIME	DAY/REV	PAGE
AS-205/101	FINAL	SEPTEMBER 16, 1968	224:00 - 228:00	9/141-144	2-70

MSC FORM 1186 (SEP 67) FLIGHT PLANNING BRANCH

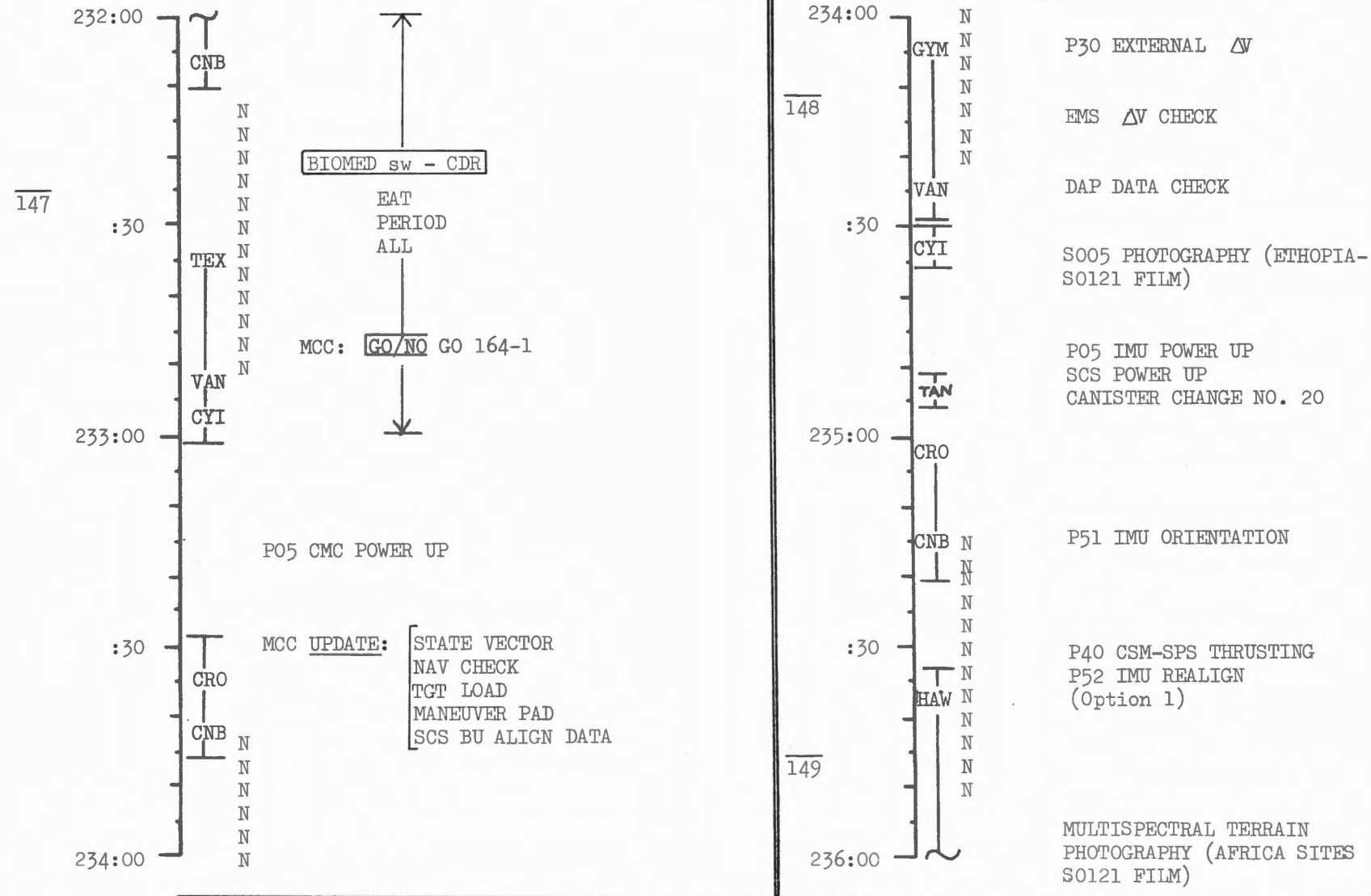
FLIGHT PLAN



MISSION	EDITION	DATE	TIME	DAY/REV	PAGE
AS-205/101	FINAL	SEPTEMBER 16, 1968	228:00 - 232:00	9/144-146	2-71

MSC FORM 1186 (SEP 67) FLIGHT PLANNING BRANCH

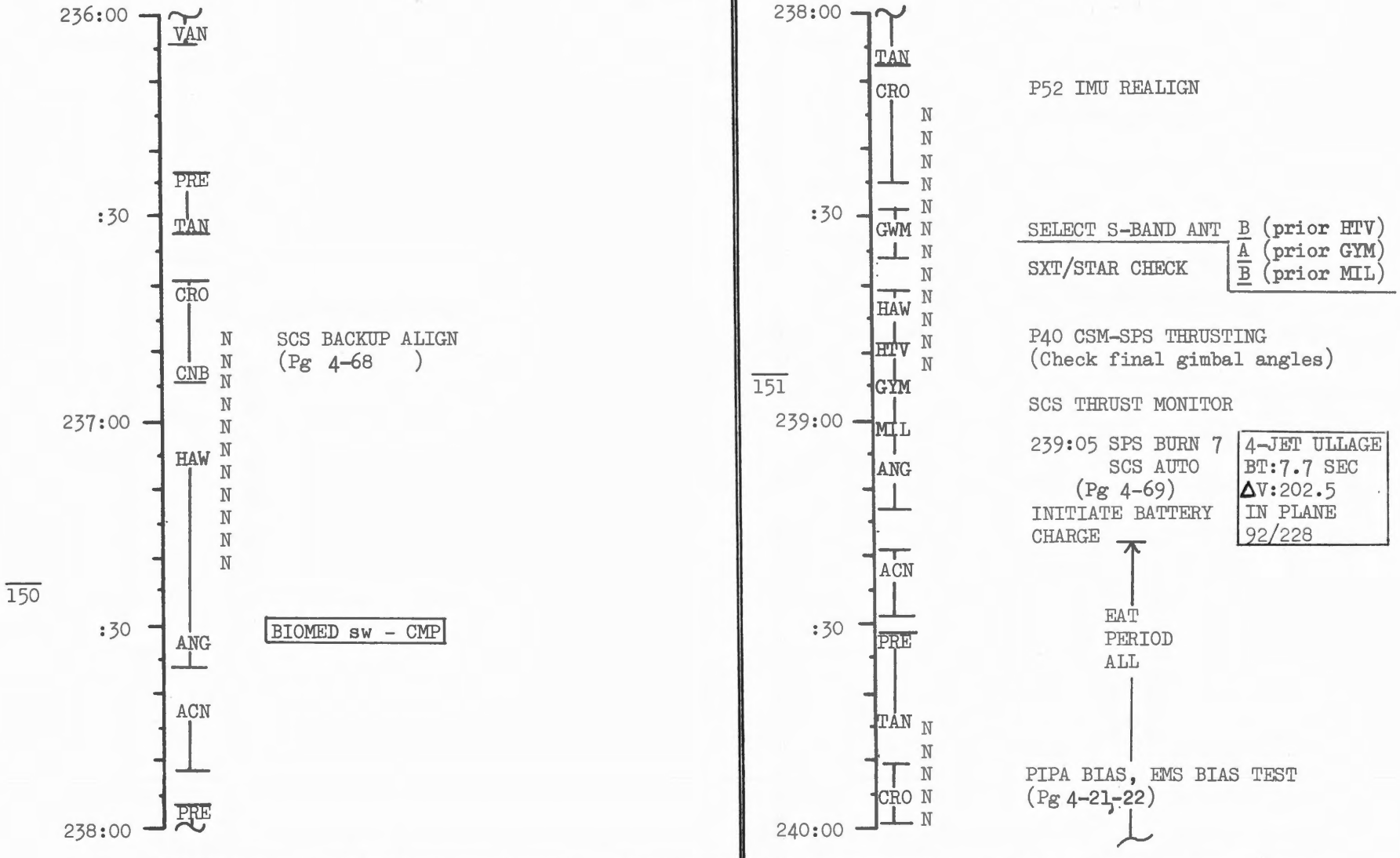
FLIGHT PLAN



MISSION	EDITION	DATE	TIME	DAY/REV	PAGE
AS-205/101	FINAL	SEPTEMBER 16, 1968	232:00 - 236:00	9/146-149	2-72

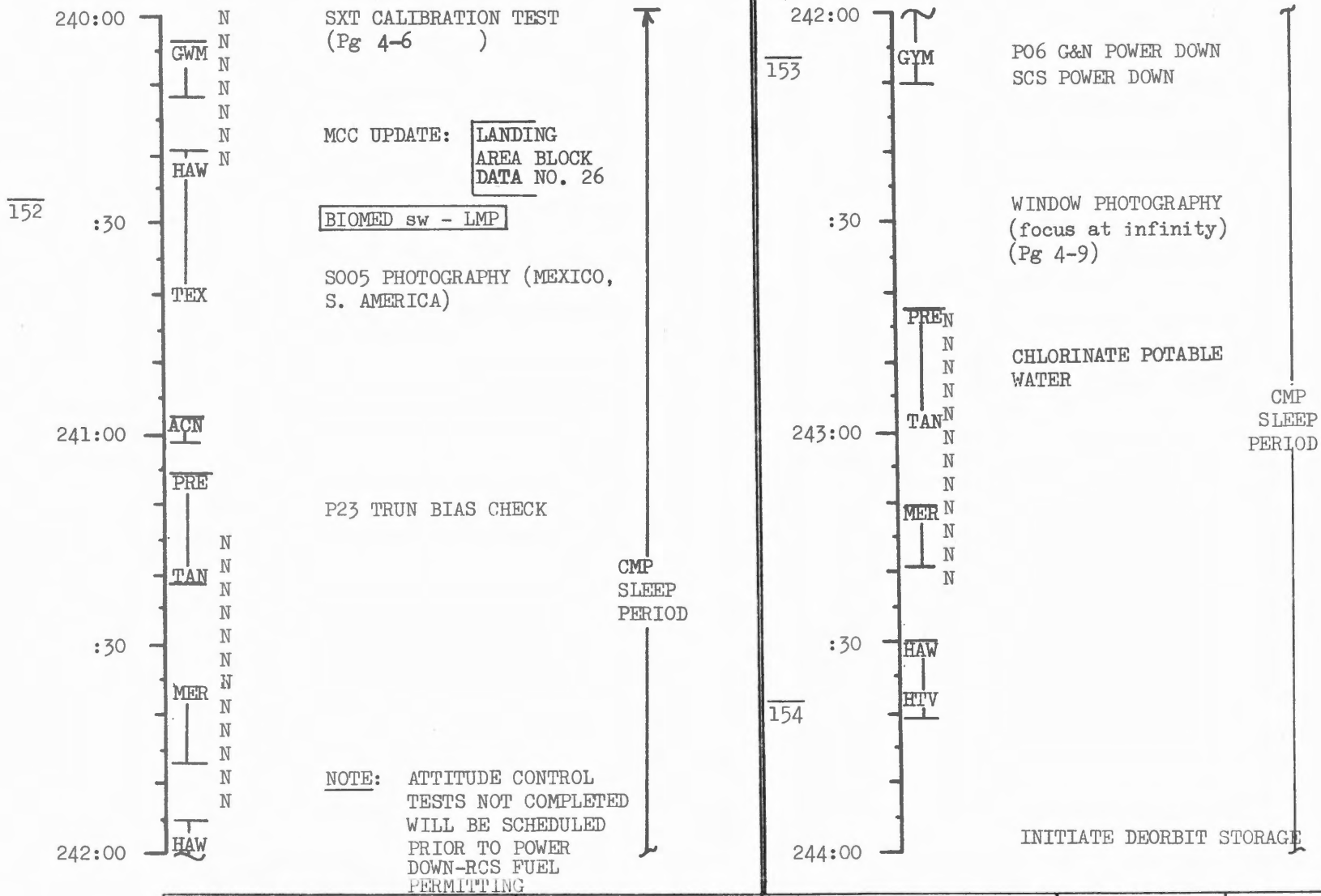
MSC FORM 1186 (SEP 67) FLIGHT PLANNING BRANCH

FLIGHT PLAN



MISSION	EDITION	DATE	TIME	DAY/REV	PAGE
AS-205/101	FINAL	SEPTEMBER 16, 1968	236:00 - 240:00	9/149-151	2-73

FLIGHT PLAN



MISSION	EDITION	DATE	TIME	DAY/REV	PAGE
AS-205/101	FINAL	SEPTEMBER 16, 1968	240:00 - 244:00	10/151-154	2-74

MSC FORM 1186 (SEP 67) FLIGHT PLANNING BRANCH

FLIGHT PLAN

244:00

CRYOGENIC STRATIFICATION TEST 3 (Pg 4-29)

PRE — TAN (N N N N N N N N N N N)

:30

MER

ECS REDUNDANT COMPONENT CHECK

CMP SLEEP PERIOD

245:00

HAW

RED

155

HUMIDITY SURVEY (Pg 4-26)

:30

S005 PHOTOGRAPHY (S.E. COAST S. AMERICA, S0121 FILM)

ACN (N N N N N)

246:00

246:00 (N N N N N N N N)

MER

:30

RED

156

247:00

CANISTER CHANGE NO. 21

CDR LMP EAT PERIOD

CMP SLEEP PERIOD

ACN (N N N N N N N N N N N N)

:30

MER

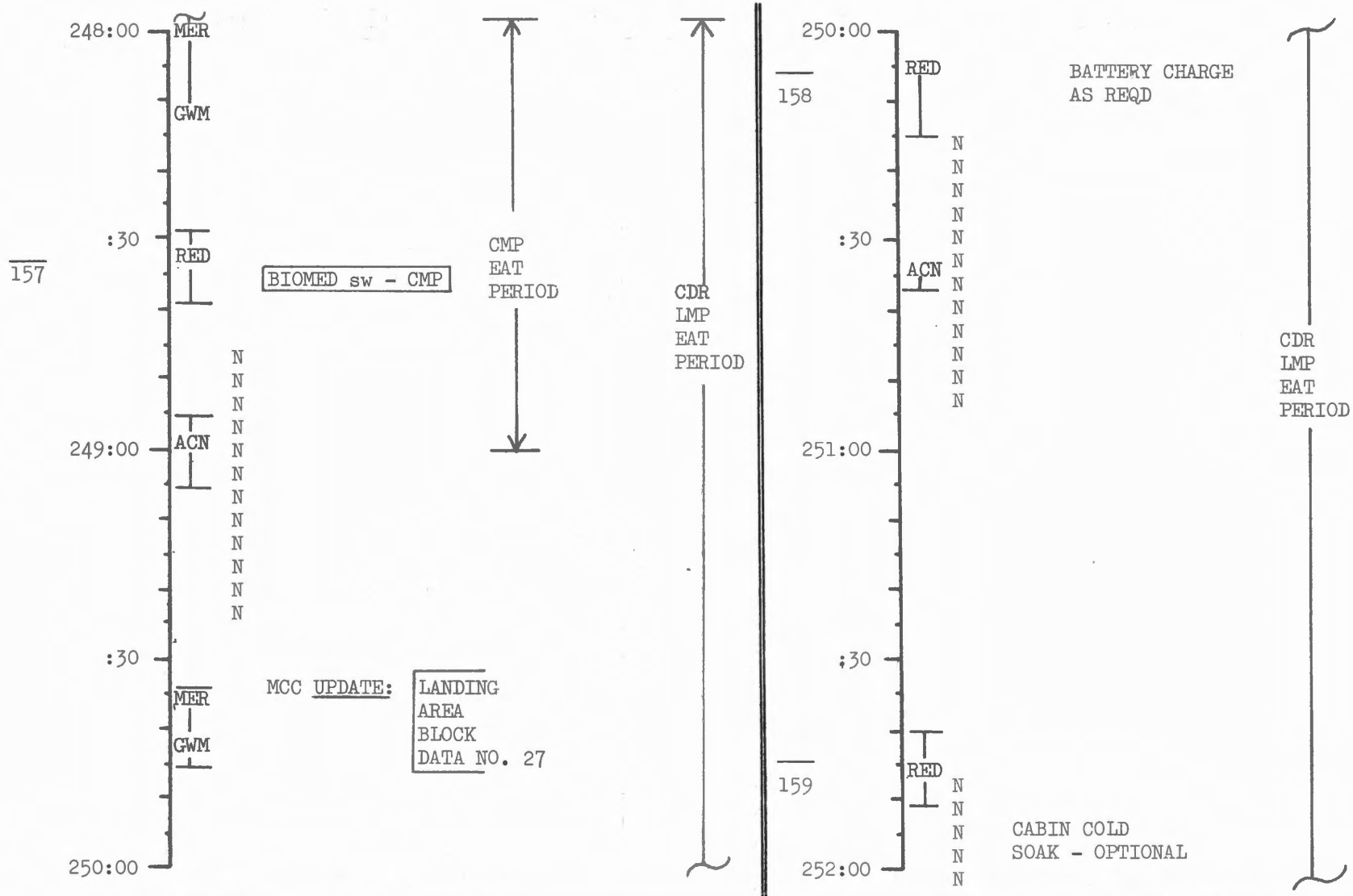
248:00

MISSION	EDITION	DATE	TIME	DAY/REV	PAGE
AS-205/101	FINAL	SEPTEMBER 16, 1968	244:00 - 248:00	10/154-156	2-75

MSC FORM 1186 (SEP 67)

FLIGHT PLANNING BRANCH

FLIGHT PLAN



MISSION	EDITION	DATE	TIME	DAY/REV	PAGE
AS-205/101	FINAL	SEPTEMBER 16, 1968	248:00 - 252:00	10/156-159	2-76

MSC FORM 1186 (SEP 67) FLIGHT PLANNING BRANCH

FLIGHT PLAN

252:00 — ANG, CYI, MAD (N N N N N N N)

:30

253:00 — CNB

RED (N) — 160

:30 — ANG, MAD (N N N N N N N N N N N N)

MCC: FLIGHT PLAN UPDATE

CDR LMP SLEEP PERIOD

254:00

254:00 — H2 HTRS - ON

CRO — F/C PURGE

:30

CNB

N N N N N N N N N N N N

161

255:00 — RED — P05 CMC POWER UP

MIL — MCC UPDATE:

- REFSMMAT
- STATE VECTOR
- NAV CHECK
- TGT LOAD
- MANEUVER PAD
- ENTRY UPDATE

:30 — MAD

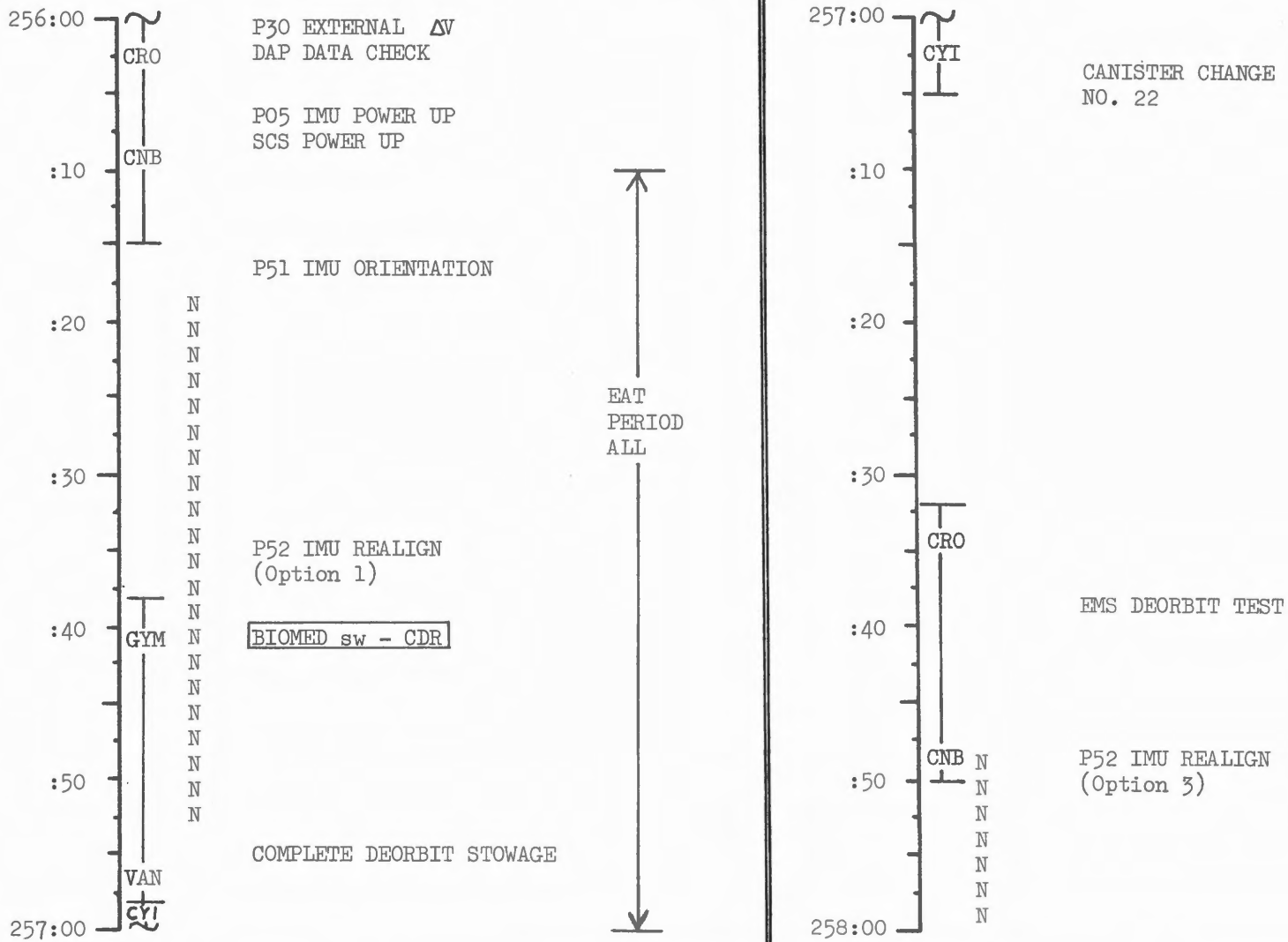
DON SUITS - ALL

CDR LMP SLEEP PERIOD

256:00 — CRO

MISSION	EDITION	DATE	TIME	DAY/REV	PAGE
AS-205/101	FINAL	SEPTEMBER 16, 1968	252:00 - 256:00	10/159-161	2-77

FLIGHT PLAN

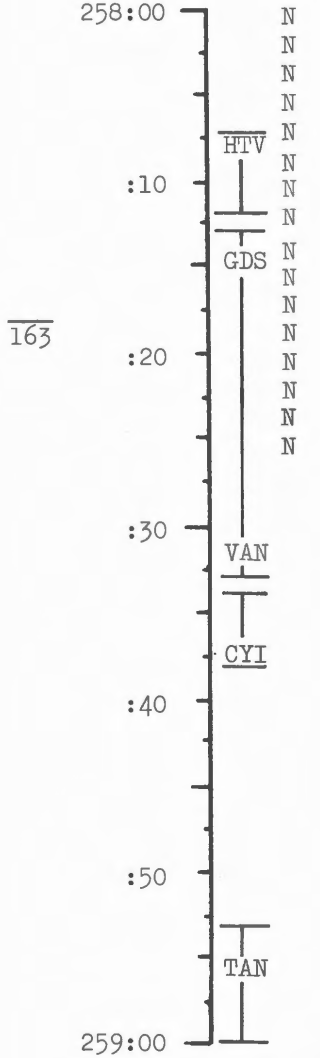


162

MISSION	EDITION	DATE	TIME	DAY/REV	PAGE
AS-205/101	FINAL	SEPTEMBER 16, 1968	256:00 - 258:00	10/161-162	2-78

MSC FORM 1186 (SEP 67) FLIGHT PLANNING BRANCH

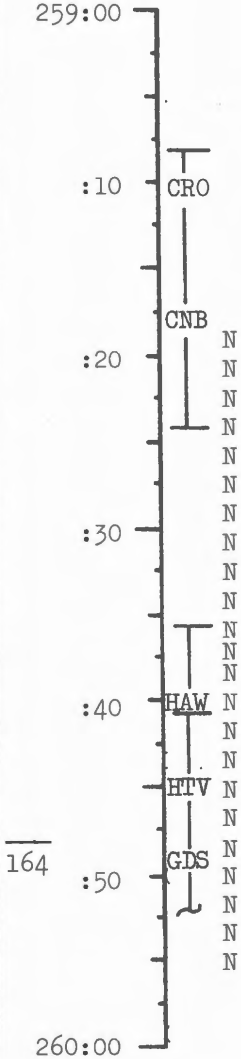
FLIGHT PLAN



SUIT INTEGRITY CHECK

CM RCS PREHEAT (20 MIN)

STOW ORDEAL



MCC: REPORT GO/NO GO
FOR PYRO ARM
CM/RCS THRUSTER CHECK
FQ RECORDER REQD
FOR DEORBIT

-12 MIN FDAI 2 @ 180 PITCH
P40 CSM-SPS THRUSTING

SELECT S-BAND ANT A (prior HAW)
C (prior HTV)

-5:30 GIMBAL DRIVE CHECK

259:40 DEORBIT
G&N ΔV
(Pg 4-70)

4-JET ULLAGE
BT:10 SEC
ΔV:278.3 fps

+6:25 CM/SM SEP
12:25 400 K
15:25 05 G
16:07 .2 G
21:03 MAX G
24:13 DROGUES (23 K)
24:59 MAINS (10 K)
29:42 SPLASHDOWN

ARIA
COVERAGE
400K
to
SPLASH

MISSION	EDITION	DATE	TIME	DAY/REV	PAGE
AS-205/101	FINAL	SEPTEMBER 16, 1968	258:00 - 260:00	10/162-164	2-79

SECTION III - CONSUMABLE ANALYSIS

NOTE

Acknowledgement is made to the Consumable Analysis Section (CAS) of the Mission Planning and Analysis Division (MPAD) for their work in the preparation of the RCS and cryogenic consumable analysis presented herein.

AS205/CSM 101 SM-RCS BUDGET

The results of the SM-RCS budget analysis are summarized in the following tables and figures:

	Page
Table 3-I RCS USAGE SUMMARY	3-3
Table 3-II AS205/CSM 101 PARAMETRIC DATA	3-4
Table 3-III, SM-RCS DEORBIT REDLINE SCS MODE/HYBRID ALLOWANCE	3-5
Figure 3-1 NOMINAL MISSION SM-RCS PROFILE	3-5A
Table 3-IV NOMINAL MISSION SM-RCS BUDGET	3-6

Ground Rules and Assumptions

The following ground rules and assumptions are listed below to give the user some insight into the construction of SM-RCS profiles.

1. Data Source: Data for SM/RCS engine performance and propellant requirements were obtained from Part 4 of the CSM/LM Spacecraft Operational Data Book, May 1968.
2. Maneuvers: Since it is nearly impossible to predict in all cases what maneuver rates or angles will be required, it was assumed that all maneuvers were 3 axis orientations at rates of 0.2°/sec, unless otherwise specified. It was also assumed that all IMU alignments required 3 axis orientations, which may seem conservative, but would allow for propellant usage at higher rates and angles. A 3 axis orientation at 0.2°/sec was predicted to cost 0.7 lb with 0.3 allotted for corrections and minimum impulse control.

3. Flow Rate: A propellant flow rate of 0.361 lb/sec/engine was assumed for calculating propellant costs for applicable translation and SM spin-up maneuvers (SODB, Table 4-I).

4. Steady State Isp: A value of 276 seconds was assumed (SODB, Table 4-I).

5. Propellant Quantity:

	LB
Maximum loaded	1362
Unusable	58
Minimum Del.	1304
Gaging accuracy	82
Total available for mission	1222

6. Deorbit Philosophy:

Since the SCS mode for translation costs approximately 10% more propellant than the GNCS, the SM-RCS redline includes this additional SCS cost. An additional allowance of 15 lb is included for damping rates caused by a possible SPS engine hard-over or for SCS attitude reference alignment.

For the case of a hybrid deorbit (SM and CM RCS), it was assumed that 80 fps of the required deorbit ΔV could be obtained from the CM-RCS and the SM-RCS propellant required for this deorbit mode was reduced by an amount proportional to this ΔV.

TABLE 3-I

RCS USAGE SUMMARY

	RCS PROPELLANT - lbs		
DAY (GET)	PER DAY	CUMULATIVE	REMAINING
0 (0-24)	101	101	1261
1 (24-48)	412.7	513.7	848.3
2 (48-72)	28.6	542.3	819.7
3 (72-96)	63.5	605.8	756.2
4 (96-120)	27.8	633.6	728.4
5 (120-144)	20.1	653.7	708.3
6 (144-168)	45.8	699.5	662.5
7 (168-192)	2.4	701.9	660.1
8 (192-216	61.3	763.2	598.8
9 (216-240)	43.6	806.8	555.2
10 (240-CM/SM sep)	65.2	872.0	490.0

TABLE 3-II

PARAMETRIC DATA FOR MISSION AS205/CSM 101

PARAMETRIC DATA	PRIOR TO BURN							
	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8
CSM Weight, lb	32,658	31,950	30,900	30,600	30,500	26,560	26,410	25,855
CM Weight, lb	12,379	12,379	12,379	12,379	12,379	12,379	12,379	12,379
SM RCS Propellant Requirement for X-axis Translation lb/ft/sec								
PGNCS Mode	3.7	3.7	3.6	3.5	3.5	3.1	3.1	2.9
SCS Mode	4.4	4.3	4.2	4.1	4.1	3.8	3.8	3.7
Orbital Parameters, Perigee/ Apogee n.m.(orbital decay and other dispersions are neglected)	127/170	121/198	124/164	96/155	94/160	97/242	91/232	92/228
Total RCS ΔV Required for Deorbit, fps(40 n.mi. perigee	158	148	153	103	99	105	94	96
Total SM RCS Propellant Requirement for SM RCS Deorbit, lb								
SCS Mode	752	691	698	470	453	445	403	399

TABLE 3-III

SM-RCS DEORBIT REDLINE SCS MODE/HYBRID ALLOWANCE

	PROPELLANT REQUIRED PRIOR TO SPS BURN							
	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8
S/C Wt Lbs	(32 658)	(31 950)	(30 900)	(30 600)	(30 500)	(26 560)	(26 410)	(25 855)
IMU Align	3	3	3	3	3	3	3	3
Orient To Deorbit Att. (4°/sec) & Att Hold 0.2° db 15 min.	13	13	13	13	13	13	13	13
SM-RCS Longitudinal Deorbit Translation (3% Accel. Error) (40 n.mi. Perigee)	716	655	662	435	418	411	369	366
Orient For Jettison (4°/sec)	5	5	5	5	5	5	5	5
Jettison (Spin 5.5 sec VEL 3 fps)	15	15	15	14	14	13	13	12
Total SM-RCS Prop. Req'd For Deorbit (SCS Mode)	752	691	698	470	453	445	403	399
Hybrid Allowance (80 fps)	352	344	336	328	328	304	304	296
Total SM-RCS Prop Req'd For Deorbit (SCS Hybrid Mode)	400	347	362	142	125	141	99	103

Figure 3-1

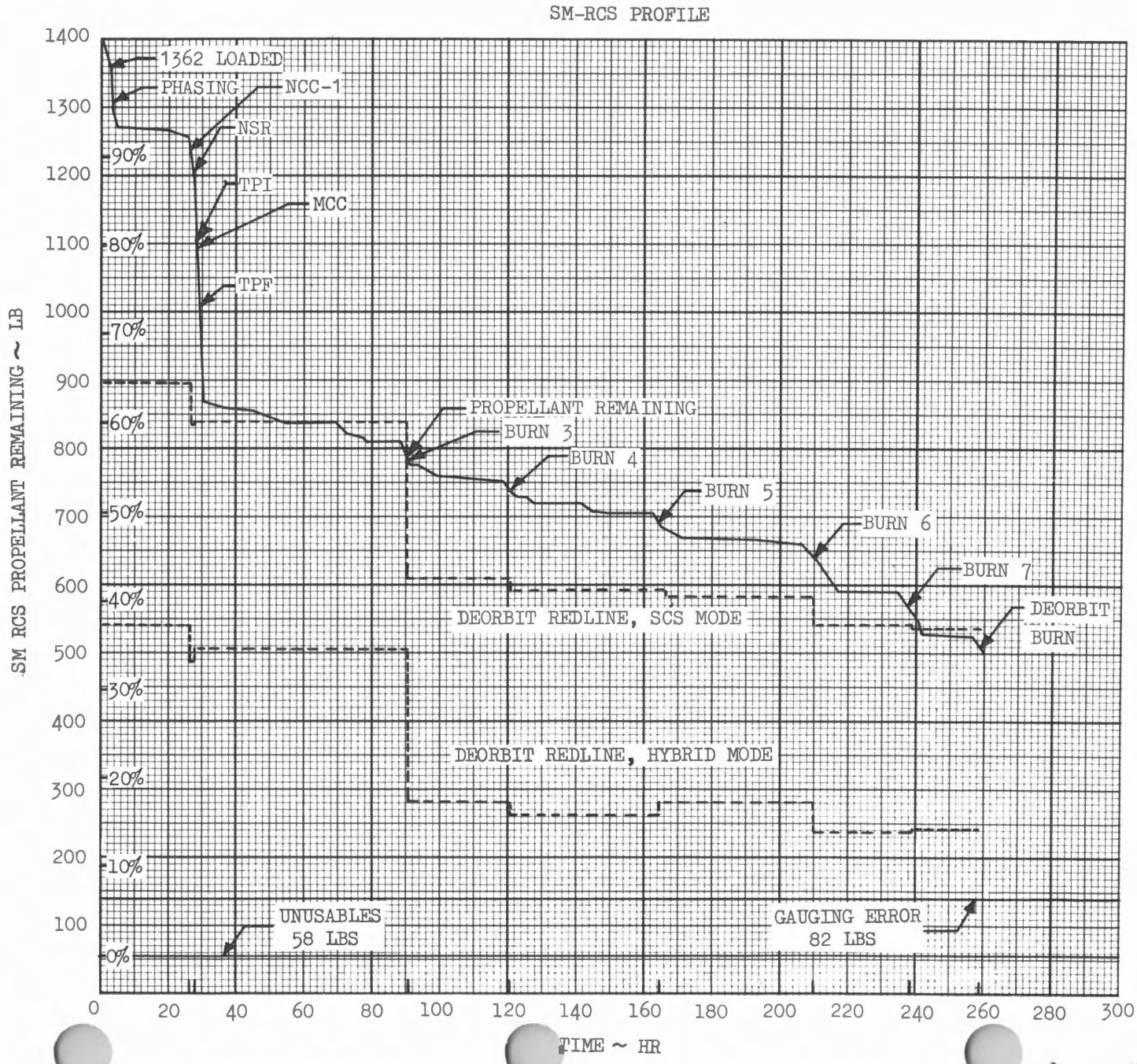

SM-RCS PROFILE
SM RCS PROPELLANT REMAINING ~ LB
TIME ~ HR
1362 LOADED
PHASING
NCC-1
NSR
TPI
MCC
TPF
PROPELLANT REMAINING
BURN 3
BURN 4
BURN 5
BURN 6
BURN 7
DEORBIT BURN
DEORBIT REDLINE, SCS MODE
DEORBIT REDLINE, HYBRID MODE
UNUSABLES 58 LBS
GAUGING ERROR 82 LBS
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
1400
1300
1200
1100
1000
900
800
700
600
500
400
300
200
100
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300

TABLE 3-IV

NOMINAL MISSION SM/RCS BUDGET

ITEM	TIME	EVENT	MANEUVER	PROPELLANT LBS PER MANEUVER	TOTAL PROP. USED, LBS.
1	Prelaunch	SCS Prelaunch SM-RCS checkout	Fire each jet for 1 sec	5.8	
			SUBTOTAL	5.8	5.8
2	2:55	CSM/S-IVB SEP and transposition	SCS S/C WT ≈32300		
			+X, 3 sec, Sep ΔV≈1 fps	4.2	
			-X, 1,5 sec, Null Vel. & -X jets check	2.1	
			Pitch Up 180° @ 5°/sec	12.8	
			Roll 60° @ 2°/sec	3.0	
			SUBTOTAL	22.1	27.9
3	3:03	Simulated Docking Formation flying, & SLA photography	+X, 1.5 sec, null sep. vel.	2.1	
			Indexing allowance	10.0	
			Fly around		
			±Y, ΔVel≈0.5 fps	4.5	
			±X, ΔVel≈0.5 fps	4.1	
			Yaw 90° @ 2°/sec & Att Hold, 0.2°db	3.0	
			±Z, ΔVel ≈ 0.5 fps	4.5	
			±X, ΔVel ≈ 0.5 fps	4.1	
			Pitch 90° 0.2°/sec & att hold (front, side & top view)	3.0	
			SUBTOTAL	35.3	63.2

ITEM	TIME	EVENT	MANEUVER	PROPELLANT LBS. PER MANEUVER	TOTAL PROP. USED, LBS.
4	3:20	RCS Phasing	GNCS/P-47 - 3 axis orient		
			Orient att hold, 0.5 db	1.2	
			+X, 7.5 fps	27.1	
			RCS slosh damping test (3 axis orient to burn att +10 min G&N max db att hold)	1.3	
			SUBTOTAL	29.6	92.8
5	4:30	PIPA & EMS Bias Test	Null Rates	1.0	
	5:09	IMU Realign	GNCS/P-52 - 3 axis orient/MI	1.0	
	6:00	SPS Thrusting Check & Manual Retro Checks	GNCS/P40 - 2-3 axis orient/ att hold, 0.5° db, 15 min.	2.2	
			SUBTOTAL	4.2	97.0
6	12:40	IMU Realign	GNCS/P-52 - 3 axis orient/MI	1.0	
	20:00	IMU Realign	GNCS/P-52 - Orient/MI	1.0	
			SUBTOTAL	2.0	99.0
7	21:37	COAS Calibration	GNCS/Auto - 3 Axis Orient/MI	1.0	
	23:05	IMU Realign	GNCS/P-52 - 3 Axis Orient/MI	1.0	
	24:30	IMU Realign	GNCS/P-52 - 3 Axis Orient/MI	1.0	
	24:55	Rendezvous Navigation	GNCS/P-20 - 2-3 Axis Orient/MI	2.0	
			SUBTOTAL	5.0	104.0

ITEM	TIME	EVENT	MANEUVER	PROPELLANT LBS. PER MANEUVER	TOTAL PROP. USED, LBS.
8	26:00	IMU Realign	Orient/MI	1.0	
		NCC-1 (SPS)	GNCS/P-40 - Orient for SPS/att hold & MI	2.7	
			GNCS/P-40 - Ullage, 4 jets, 15 sec.,	21.1	
				24.8	128.8
	26:30	NCC-2 (SPS)	GNCS/P-40 - 3 axis orient for SPS/ Att Hold	2.7	
			Ullage, 4 jets, 15 sec	21.1	
			Null VG's	25.5	
				49.3	178.1
	27:35	IMU Realign	GNCS/P52 - Orient/MI	1.0	
	27:57	NSR	GNCS/P-40 - 3 axis orient/ MI & Att Hold	2.7	
			Ullage, 4 jets, 15 sec	21.1	
			Null VG's	24.8	
				49.6	227.7
	28:00	Rendezvous Navigation	GNCS/P-20 - 2-3 axis orient/MI	2.0	
			Orient to Tracking Att	1.6	
			Backup Data Collection	7.4	
	29:11	SM-RCS Burn	GNCS/P-41 - TPI/TRIM	83.4	
			Maneuver to Track Att.	1.2	
			Navigation Tracking	0.2	
			Backup Data Collection	3.6	
	29:38		Midcourse Burns	36.1	
			Braking & LOS Control	131.9	
			Station Keeping	2.0	
			SUBTOTAL	269.4	497.1
9	30:20	Final S-IVB Sep (RCS)	Orient/MI	1.2	
			GNCS/P-47 +X, Vel = 2 fps	7.4	
	36:30	SXT Calibration Test	GNCS/P-52 - orient/MI	2.0	
			SUBTOTAL	10.6	507.7

ITEM	TIME	EVENT	MANEUVER	PROPELLANT LBS. PER MANEUVER	TOTAL PROP. USED, LBS.
10	39:30	IMU Realign	3-axis orient/MI	1.0	
	40:10	Post Rendezvous S-IVB Tracking @ 80 n.mi.	GNCS/P-20 - 2-3 axis orient/MI	2.0	
			SUBTOTAL	3.0	510.7
11	45:30	IMU Realign	3-axis orient/MI	1.0	
	46:10	Post Rendezvous S-IVB Tracking @ 160 n. mi.	GNCS/P-20 - 2-3 axis orient/MI	2.0	
			SUBTOTAL	3.0	513.7
12	49:10	G&N Att Control Test	Min, Max db 30 minutes	8.0	
	51:30	IMU Realign	GNCS/P-52 - 3 axis orient/MI	1.0	
	52:05	Post Rendezvous S-IVB Tracking @ 320 n.mi.	GNCS/P-20 - 2-3 axis orient/MI	2.0	
			SUBTOTAL	11.0	524.7
13	53:30	SCT Star Count Test 1	GNCS/Auto - 3 axis orient for GET_{SR} Attitude	0.7	
			GNCS/Auto - 35 min. att hold 5.0° db	0.7	
			GNCS/Auto - 3 axis orient for GET_{SS} Attitude	0.7	
			GNCS/Auto - 35 min. att hold 5.0° db	0.7	
	55:10	P52; IMU Realign Daylight Align Test		2.0	
			SUBTOTAL	4.8	529.5

ITEM	TIME	EVENT	MANEUVER	PROPELLANT LBS. PER MANEUVER	TOTAL PROP. USED, LBS.
14	56:00	Power Down	SCS - Allot 2-3 axis/orient 10 min att Hold to damp drift rates when req'd. & photography orientations (S-005&6)		
			SUBTOTAL	2.4	531.9
15	69:20	IMU Align	GNCS/P-51, 52 - 2-3 axis orient/MI	2.0	
	71:00	IMU Realign	GNCS/P-52 - 3 axis orient/MI	1.0	
	71:41	WSMR LM RR Test	G&N Manual - Orient to Tracking Att	1.4	
			Att Hold 0.5° db, 20 min, null rates	6.0	
			SUBTOTAL	10.4	542.3
16	73:00	Orbital Navigation	GNCS/P-52 - Realign IMU	1.0	
			GNCS/P-22 - 3 axis orient/MI	1.0	
			Est. Orbital Rate, MI P, Y&R Att Hold 0.5° db	1.0	
			SUBTOTAL	3.0	545.3
17	74:30	Orbital Navigation	GNCS/P-52 - Realign IMU	1.0	
			GNCS/P-22 - 3 axis orient/MI	1.0	
			Est. Orbital Rate, MI P, Y&R Att Hold 0.5 db	1.0	
			SUBTOTAL	3.0	548.3

ITEM	TIME	EVENT	MANEUVER	PROPELLANT LBS. PER MANEUVER	TOTAL PROP. USED, LBS.
18	76:00	Orbital Navigation	GNCS/P-52 - Realign IMU	1.0	
			GNCS/P-22 - 3 axis orient/MI	1.0	
			Est. Orbital Rate, MI P, Y&R		
			Att Hold 0.5° db	1.0	
			SUBTOTAL	3.0	551.3
19	77:15	SCT Star Count Test 2	GNCS/Auto - 3 axis orient for GET_{SR} Attitude	0.7	
			GNCS/Auto - 35 min. att hold 5.0° db	0.7	
			GNCS/Auto - 3 axis orient for GET_{SS} Attitude	0.7	
			GNCS/Auto - 35 min. att hold 5.0° db	0.7	
			SUBTOTAL	2.8	554.1
20	78:30	Power Down	SCS - Allot 2-3 axis/orient 10 min att Hold to damp drift rates when req'd & photography orientations (S-005&6)		
			SUBTOTAL	2.4	556.5
21	88:30	IMU Align	GNCS/P51,52 - 2-3 axis Orient/MI	2.0	
		SCS Att. Ref.Ck.	Null rates, 0.5° db 10 min.	0.5	
	90:10	IMU Realign	GNCS/P-52 - 3 axis orient/MI	1.0	
		SCS Att.Ref. Ck.	Null rates, 0.5° db 10 min	0.5	
	91:43	SPS Burn 3	SCS - 3 axis orient/MI & Att Hold 15 min	6.0	
			SCS - Ullage, 4 jets, 15 sec	22.8	
			SUBTOTAL	32.8	589.3

ITEM	TIME	EVENT	MANEUVER	PROPELLANT LBS. PER MANEUVER	TOTAL PROP. USED, LBS.
22	91:50	Slosh Damping Test	SCS - Att Hold 4.2° db, 10 min.	1.0	
			SUBTOTAL	1.0	590.3
23	93:20	P52 IMU Realign	GNCS P-52 3-axis orient/MI	1.0	
	94:00	ECS Radiator Test	3 axis orient	1.0	
			SCS/Est. Roll Orb Rate/ 2 axis att. hold 4.2° db, 4½ hr.	13.5	
			SUBTOTAL	15.5	605.8
24	99:15	Power Down	SCS - Allot 2-3 axis/orient 10 min att Hold to damp drift rates when req'd. & photography orientations (S-005&6)		
			SUBTOTAL	2.4	608.2
25	115:30	P23 - Trunnion Bias Check	3-axis Orient/MI		
			SUBTOTAL	1.8	610.0
26	118:30	IMU Align	GNCS/P51-52 - 2-3 axis Orient/MI	2.0	
	120:52	SPS Burn 4	GNCS P-40 - 3 axis orient/MI & Att hold	2.7	
			GNCS/P40 - Ullage 2 jet, 20 sec	16.1	
			SUBTOTAL	20.8	630.8

ITEM	TIME	EVENT	MANEUVER	PROPELLANT LBS. PER MANEUVER	TOTAL PROP. USED, LBS.
27		Slosh Damping Test	GNCS, Free - Inhibit Att Hold, 3 min	N. A.	
28	121:42	SCT Star Count Test 3	GNCS/Auto - 3 axis orient for GET_{SR} Attitude	0.7	
			GNCS/Auto - 35 min att hold 5.0° db	0.7	
			GNCS/Auto - 3 axis orient for GET_{SS} Attitude	0.7	
			GNCS/Auto - 35 min. att hold 5.0° db	0.7	
			SUBTOTAL	2.8	633.6
29	123:00	COAS Calibration	GNCS - 3 axis orient/MI	1.0	
	123:40	SCS Att Control Test	SCS Att. Hold 4.2° db 20 min. low rate	2.1	
	124:25	P54	Backup IMU alignments	2.0	
			SUBTOTAL	5.1	638.7
30	125:30	P23 Star Horizon Sightings	2-3 axis orient/MI	3.6	
			SUBTOTAL	3.6	642.3
31	127:10	Power Down	SCS - Allot 2-3 axis/orient 10 min att Hold to damp drift rates when req'd. & photography orientations (S-005&6)		
			SUBTOTAL	2.4	644.7

ITEM	TIME	EVENT	MANEUVER	PROPELLANT LBS. PER MANEUVER	TOTAL PROP. USED, LBS.
32	140:40	IMU Align	GNCS/P51, 52 - 2-3 axis orient		
			SUBTOTAL	2.0	646.7
33	142:10	IMU Realign	GNCS/P-52 - 3 axis orient	1.0	
	142:45	Orbital Navigation	GNCS/P52 - Realign IMU	1.0	
			GNCS/P-22 - 3 axis orient/MI	1.0	
			Est. Orbital Rate, MI P, Y&R Att Hold 0.2° db	1.0	
			SUBTOTAL	4.0	650.7
34	143:30	IMU Realign	GNCS/3 axis orient/MI	1.0	
	144:15	Orbital Navigation	P-22 - 3 axis orient/MI	1.0	
			Est. Orbital Rate, MI P, Y&R Att Hold 0.2° db	1.0	
			SUBTOTAL	3.0	653.7
35	145:05	IMU Realign	GNCS 3-axis orient/MI	1.0	
		Orbital Navigation	P-22 3 axis orient/MI	1.0	
			Est. Orbital Rate, MI P, Y&R Att. Hold 0.2° db		
			SUBTOTAL	2.0	655.7

ITEM	TIME	EVENT	MANEUVER	PROPELLANT LBS. PER MANEUVER	TOTAL PROP. USED, LBS.
36	147:00	SCT Star Count	GNCS/Auto - 3 axis orient for GET_{SR} Attitude	0.7	
			GNCS/Auto - 35 min att hold 5.0° db	0.7	
			GNCS/Auto - 3 axis orient for GET_{SS} Attitude	0.7	
			GNCS/Auto - 35 min. att hold 5.0° db	0.7	
			SUBTOTAL	2.8	658.5
37	149:30	Power Down	SCS - Allot 2-3 axis orient/ 10 min att Hold to damp drift rates when req'd. & photography orientations (S-005&6)		
			SUBTOTAL	2.4	660.9
38	162:50	IMU Align	GNCS/P51-52 - 2-3 axis orient/MI	2.0	
	164:20	IMU Realign	GNCS/P52 - 3 axis orient/MI	1.0	
	165:08	SPS Burn 5	GNCS/P40 - 3 axis orient/MI & Att. Hold 15 min.	2.7	
			Ullage, 2 Jet, 20 sec	14.2	
			SUBTOTAL	19.9	680.8

ITEM	TIME	EVENT	MANEUVER	PROPELLANT LBS. PER MANEUVER	TOTAL PROP. USED, LBS.
39	165:50	IMU Realign	GNCS/P52 - 3 axis orient/MI	1.0	
	167:00	Passive Thermal Control	SCS - 3 axis orient & att hold 0.2° db 30 min	11.0	
			Est. roll rate 0.3°/sec & att hold 0.2° db P&Y, 26 min	1.5	
	168:00	SPS Thermal Control Test	GNCS-3 axis orient/MI		
			SCS att cntl-min db high rate 1 hr; max db 30 min, SCS max db 1+30	5.2	
			SUBTOTAL	18.7	699.5
40	171:10	Power Down	SCS - Allot 2-3 axis orient/ 10 min att Hold to damp drift rates when req'd & photography orientations (S-005&6)		
			SUBTOTAL	2.4	701.9
41	193:00	IMU Backup Align			
			SUBTOTAL	2.8	704.7
42	206:40	IMU Align	GNCS/P-51,52 - 2-3 Orient	2.0	
	208:15	IMU Realign	IMU Realign	1.0	
	210:13	SPS Burn 6	GNCS/P-40 - 3 axis orient/ 15 min att hold	2.7	
			Ullage 2 Jet, 20 sec	15.9	
			SUBTOTAL	21.6	726.3

ITEM	TIME	EVENT	MANEUVER	PROPELLANT LBS. PER MANEUVER	TOTAL PROP. USED, LBS.
43	211:10	IMU Realign	GNCS/P-52 - 3 axis orient	1.0	
	212:00	Passive Thermal Control Test	SCS - 3 axis orient & att hold 0.2° db 30 min	11.0	
			Est. roll rate 0.3°/sec & att hold 0.2° db P&Y, 26 min	1.5	
	213:30	Passive Thermal Control Test	SCS - 3 axis orient & att hold 0.2° db 30 min	11.0	
			Est. roll rate 0.3°/sec & att hold 0.2° db P&Y, 26 min	1.5	
			SUBTOTAL	26.0	752.3
44	215:00	Window Visibility Test	S20.16-2 - 3 axis orient	0.7	
			P&Y @ 0.5°/sec	1.8	
	215:30	IMU Realign	GNCS 3-axis orient/MI	1.0	
	216:29	WSMR LM RR Test 2	(Same as Item 15)	7.4	
			SUBTOTAL	10.9	763.2
45	216:50	SCS Att Cntl Test	Max db - high rate 1 + 30	2.3	
	218:40	Power Down	(Same as item 40)	2.4	
			SUBTOTAL	4.7	767.9
46	235:20	IMU Align	GNCS/P51,52 - 2-3 axis orient	2.0	
	236:40	SCS Backup Align		2.8	
	238:10	IMU Realign	GNCS/P52 - 3 axis orient	1.0	
	239:05	SPS Burn 7	SCS - 3 axis orient/15 min att hold	6.0	
			Ullage 4 Jet, 15 sec	23.1	
	239:50	PIPA & EMS Bias Test	SCS - Null rates, 0.2°/db, att hold 6 min	2.0	
			SUBTOTAL	36.9	804.8

ITEM	TIME	EVENT	MANEUVER	PROPELLANT LBS. PER MANEUVER	TOTAL PROP. USED, LBS.
47	240:00	SXT Cal Test	GNCS/P-23 - 2-3 axis orient/MI		
			SUBTOTAL	2.0	806.8
48	241:00	RCS Control Test (if not previously completed)	GNCS/ACC - 1-3 axis orient	0.9	
			GNCS/Auto - 1-3 axis @ 0.5°/sec	1.4	
			GNCS/Auto - 1-3 axis @ 4°/sec	8.0	
			GNCS/FREE - 1-3 axis @ 0.5°/sec	1.2	
			GNCS, FREE - 1-3 axis @ 4°/sec	7.4	
			SUBTOTAL	18.9	825.7
49	242:00	Power Down	SCS - Allot 2-3 axis orient/ 10 min att Hold to damp drift rates when req'd & photography orientations (S-005&6)		
			SUBTOTAL	2.4	828.1
50	256:15	IMU Align	2-3 axis orient.	2.0	
	257:50	IMU Realign	3 axis orient	1.0	
	259:40	SPS Deorbit	Orient for SPS, 15 min		
			0.5° att hold	2.7	
			Ullage 4 Jets, 15 sec	20.2	
			SUBTOTAL	25.9	854.0
51		S/C Separation	CM/SM Sep 4 Jet -X Translation of 3 FPS & SM Spin UP		
			SUBTOTAL	18.0	872.0

CRYOGENIC CONSUMPTION ANALYSIS

SUMMARY

	O_2 (lbs)	H_2 (lbs)
Loaded (2 tanks)	58.4	653.0
Less Unusable	2.4	13.0
Less 2.65% Inst. Error	1.5	17.0
	54.5	623.0
Mission Requirement		
(a) EPS	49.0	398.1
(b) ECS	--	149.9
(c) Venting	*	30.0**
(d) 2-orbit contingency	.7	7.1
Total	49.7	585.1

* No Data Available on H_2 venting
** Based on one data point

The results of the cryogenic consumption analysis are summarized in the following figures:

	Page
Figure 3-2 - Nominal Mission O_2 Profile	3-20a
Figure 3-3 - Nominal Mission H_2 Profile	3-20b
Figure 3-4 - Nominal Mission Power Profile	3-20c

The following ground rules and assumptions were used for the construction of the mission H_2 and O_2 profiles. Note: Prelaunch cryogenic usage is not shown in Figures 3-2 and 3-3.

1. Fuel cell purge after the expenditure of approximately 30 kwh.
2. Cabin O_2 leak rate of 0.2 lb/hr.
3. Metabolic O_2 rate of 0.23 lb/hr.
4. Waste management O_2 rate of 0.05 lb/hr.
5. Water tank O_2 purge rate of 0.056 lb/hr.
6. 2 inverter operation
7. Batteries were on for lift-off and for the first 12 minutes of flight

8. Batteries shared the loads for all 8 burns
   Batteries were put on the line 5 minutes before each burn and taken off immediately after the burn.
9. Batteries were charged after the second, third, fourth, fifth, sixth, and seventh burns.
10. The hydrogen consumption rate is
    .00257 lb/amp/hr.
11. The oxygen consumption rate is
    7.936 times the hydrogen consumption rate
12. The average load summary for each checklist procedure was used as shown in Table 3-V.

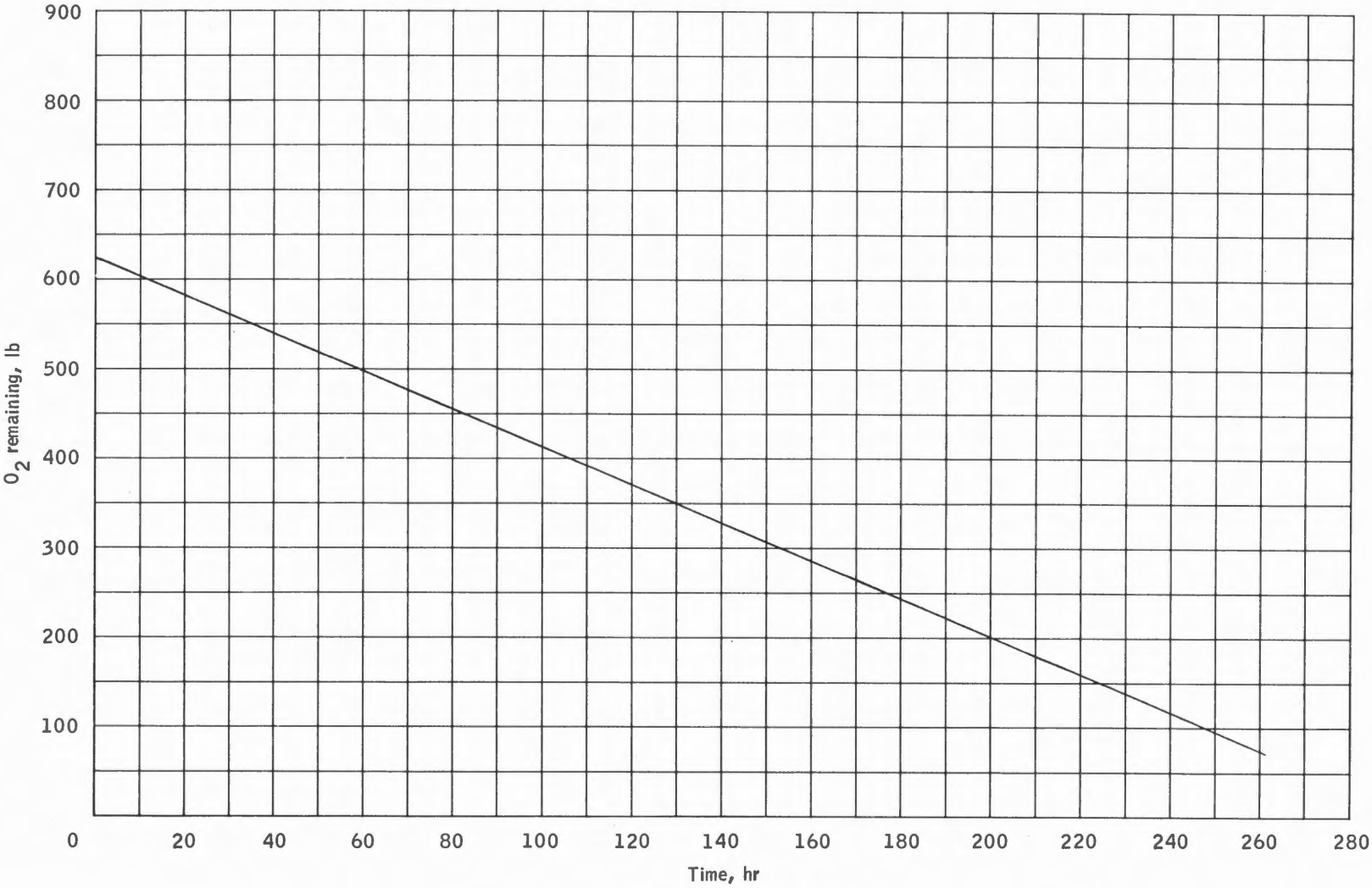


Figure 3-2 Nominal mission O_2 profile.

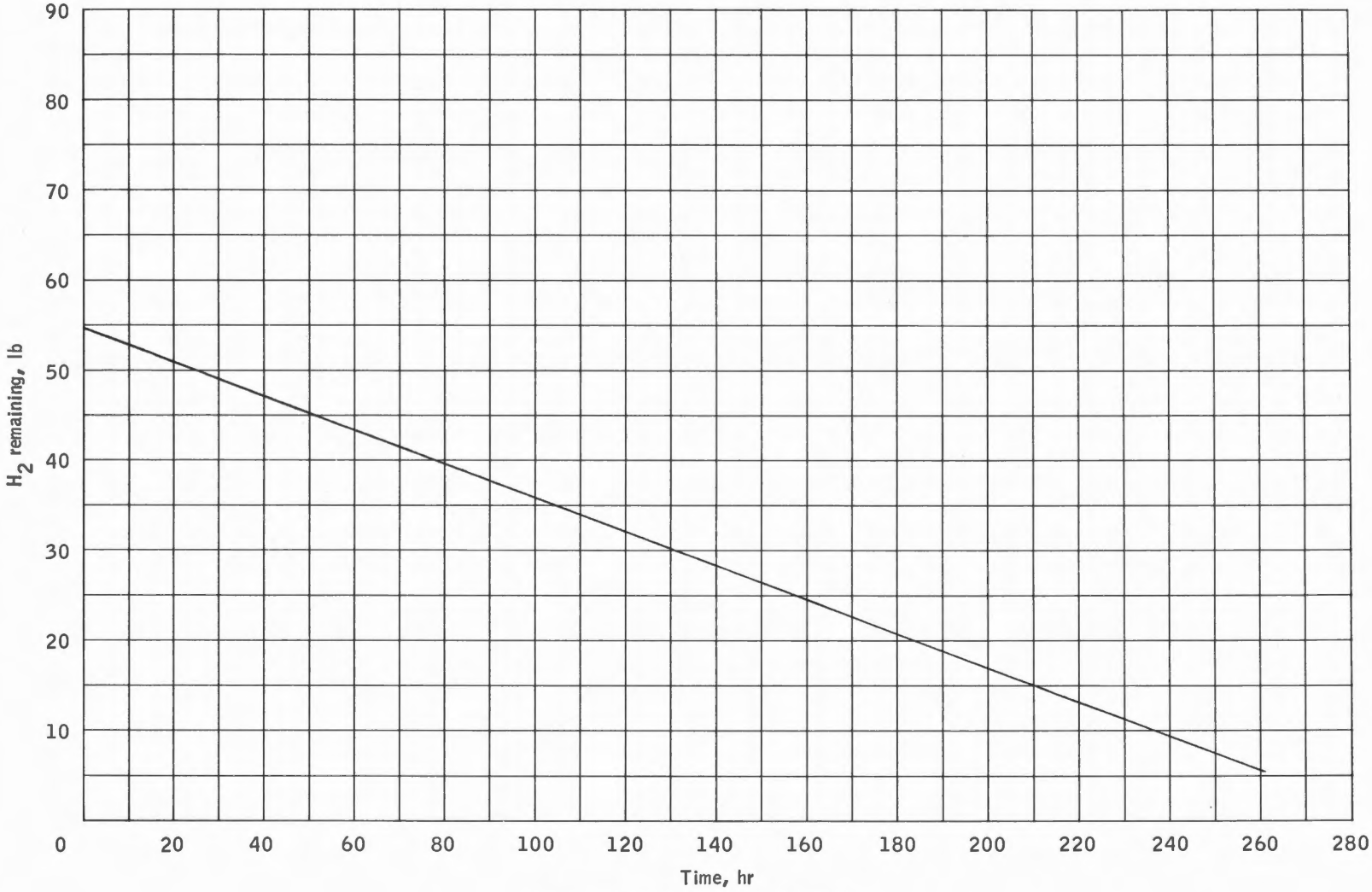


Figure 3-3 Nominal mission H_2 profile.

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MISSION PLANNING AND ANALYSIS DIVISION
BRANCH GDB DATE 9-13-68
BY SCOTT PLOT NO. 308

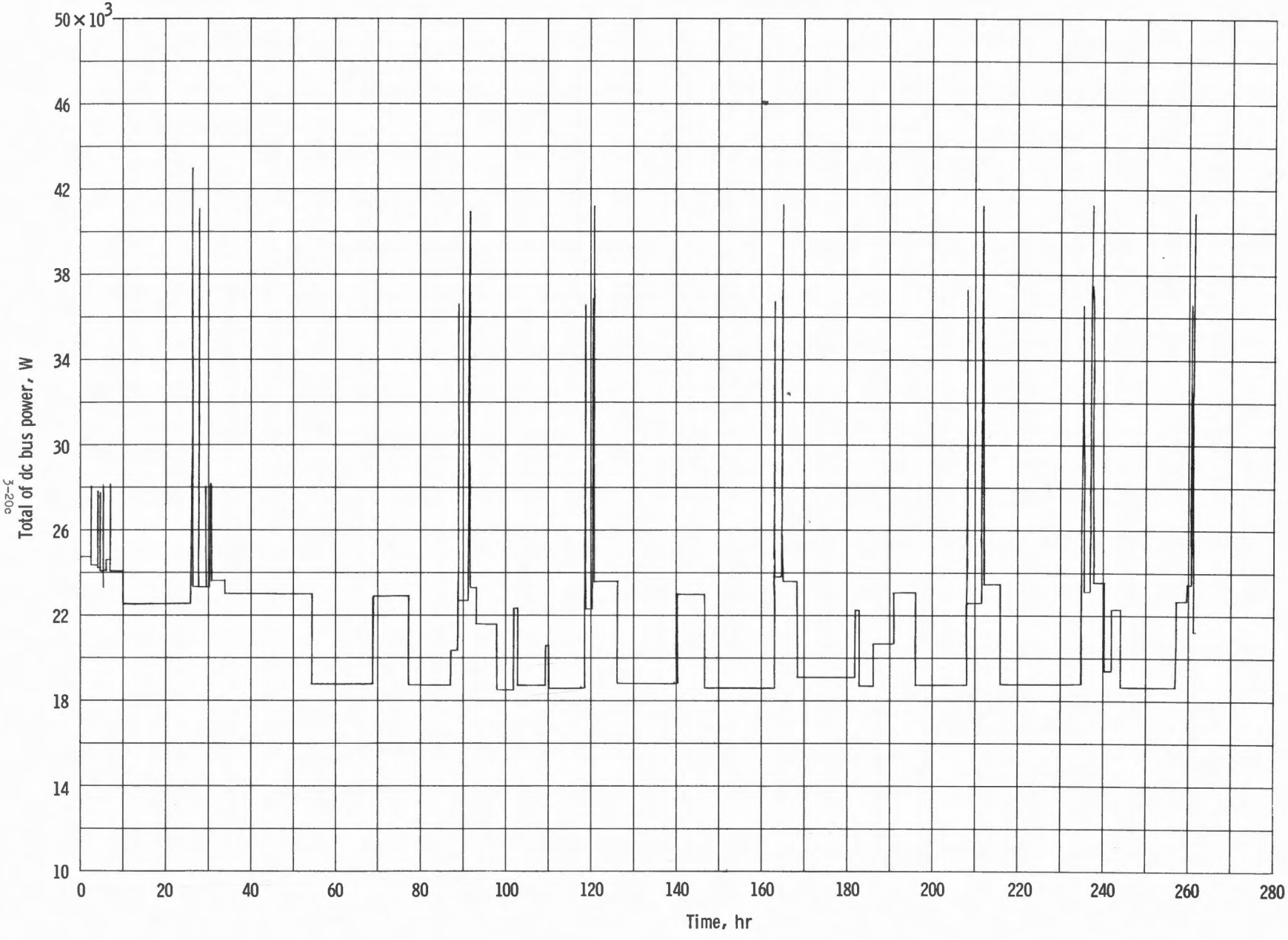

Figure 3-4 NOMINAL POWER PROFILE

TABLE 3-V
CREW CHECKLIST PROCEDURE/CONSUMABLES DATA SUMMARY
(AVERAGE ELECTRICAL POWER LOADS)

CHECKLIST PROCEDURE	AVERAGE LOAD		BUS VOLTAGE	BATTERY CURRENT	BATTERY POWER	FUEL CELL CURRENT	BUS POWER	CRYO CONSUMPTION		H_2O PRODUCTION
	AC	DC						H_2	O_2	
	WATTS	WATTS	VOLTS	AMPS	WATTS	AMPS	WATTS	LB/HR	LB/HR	LB/HR
Drift Flight	568.8	921.1	29.1	----	----	64.0	1862	0.164	1.30	1.46
Lift-Off	772.5	1306.3	29.1	24.0	698	63.0	2532	0.162	1.29	1.45
Boost Insertion Thru Post Separation										
a) T = 2:35	760.1	2002.9	28.55	34.0	972	75.5	2155	0.194	1.54	1.74
b) Postorbital Insertion	751.7	1587.8	27.7	----	----	94.5	2620	0.243	1.93	2.16
c) Separation: 1. Initial	765.1	1639.6	27.6	----	----	97.0	2680	0.249	1.97	2.23
2. Separation ΔV = 1 FPS	751.7	1587.8	27.7	----	----	94.5	2620	0.243	1.93	2.16
3. T = 1:00	765.1	2019.8	27.1	----	----	110.1	3000	0.284	2.25	2.53
d) Post Separation	765.1	1639.6	27.6	----	----	97.0	2680	0.249	1.97	2.23
Rendezvous Nav. (P20) / Orbital Nav. (P22):										
a) Optics On	669.9	1300.4	28.3	----	----	82.0	2320	0.215	1.67	1.88
b) Optics Off	669.9	1213.4	28.4	----	----	78.0	2220	0.205	1.59	1.78
Cislunar Midcourse Navigation (P23):										
a) Optics On	568.8	1089.4	28.8	----	----	70.0	2015	0.180	1.44	1.61
b) Optics Off	568.8	1002.4	28.9	----	----	65.6	1900	0.170	1.35	1.52

TABLE 3-V (cont'd)

CHECKLIST PROCEDURE	AVERAGE LOAD		BUS VOLTAGE	BATTERY CURRENT	BATTERY POWER	FUEL CELL CURRENT	BUS POWER	CRYO CONSUMPTION		H_2O PRODUCTION
	AC	DC						H_2	O_2	
	WATTS	WATTS	VOLTS	AMPS	WATTS	AMPS	WATTS	LB/HR	LB/HR	LB/HR
IMU Orientation Determination (P51)/ IMU Realign (P52):										
a) Optics On	678.9	1280.3	28.3	----	----	81.0	2295	0.206	1.64	1.84
b) Optics Off	678.9	1193.3	28.44	----	----	78.0	2220	0.200	1.59	1.78
Orbit Change G&N/SPS Thrust (P40):										
a) Initial	661.4	1241.0	28.4	----	----	79.0	2240	0.204	1.62	1.82
a1) Deorbit	661.4	1296.0	28.3	----	----	82.0	2320	0.208	1.66	1.86
b) TTI = 5:30	674.8	1927.3	28.67	32.0	917	73.0	2095	0.188	1.49	1.68
c) TTI = 2:00	674.8	1973.3	28.65	33.0	945	73.5	2106	0.189	1.50	1.69
d) TTI = 0:30 (Burn #5 & Deorbit)	689.2	2067.2	28.6	34.0	972	74.0	2110	0.193	1.52	1.73
e) TTI = 0:15	689.2	2499.2	28.2	42.0	1184	83.5	2355	0.215	1.70	1.93
f) Ignition	738.7	3055.6	27.78	51.0	1417	93.5	2597	0.240	1.91	2.15
g) Ignition + 0:01	738.7	2623.6	28.1	45.0	1263	87.0	2441	0.224	1.77	2.00
G&N Startup (P05)										
a) CMC and IMU	592.1	1168.0	28.6	----	----	74.0	2119	0.190	1.50	1.70
b) CMC Only	590.7	1003.8	28.4	----	----	66.0	1907	0.174	1.38	1.56
G&N RCS Thrust (P41):										
a) Initial	650.4	986.6	28.8	----	----	69.0	1989	0.177	1.42	1.57
b) TTI = 5:00	658.3	1015.4	28.77	----	----	71.0	2045	0.182	1.44	1.63
c) TTI = 0:30	672.7	1109.3	28.6	----	----	74.5	2130	0.192	1.53	1.72
d) Ignition	672.7	1541.3	27.9	----	----	85.9	2400	0.299	1.83	2.04
SCS Power Up	658.4	1003.1	28.8	----	----	71.0	2045	0.182	1.44	1.63

TABLE 3-V (cont'd)

CHECKLIST PROCEDURE	AVERAGE LOAD		BUS VOLTAGE	BATTERY CURRENT	BATTERY POWER	FUEL CELL CURRENT	BUS POWER	CRYO CONSUMPTION		H_2O PRODUCTION
	AC	DC						H_2	O_2	
	WATTS	WATTS	VOLTS	AMPS	WATTS	AMPS	WATTS	LB/HR	LB/HR	LB/HR
SCS Orbit Change:										
a) Initial	639.9	963.5	28.88	----	----	68.0	1965	0.190	1.51	1.69
b) TTI = 12:00	647.8	992.3	28.8	----	----	69.0	1990	0.177	1.41	1.57
c) TTI = 5:30	660.2	1678.5	28.9	27.5	795	67.5	1950	0.174	1.38	1.56
d) TTI = 2:00	660.2	1724.5	28.9	28.0	808	68.5	1976	0.177	1.40	1.58
e) TTI = 0:30	674.6	1818.4	28.75	31.0	892	71.0	2250	0.184	1.45	1.64
f) TTI = 0:15	674.6	2250.4	28.4	37.0	1051	78.5	2230	0.202	1.60	1.00
g) Ignition	724.1	2806.8	27.9	45.5	1270	90.0	2510	0.231	1.84	2.06
h) Ignition + 0:01	724.1	2374.8	28.26	35.9	1015	82.0	2320	0.210	1.67	1.88
G&N Entry Thru Touchdown:										
a) Initial Thru P61	674.3	1309.8	29.2	24.0	700	60.0	1752	0.155	1.22	1.38
b) P62 Thru Separation	674.3	1360.2	29.16	22.5	656	62.0	1800	0.159	1.25	1.42
c) Separation Thru Main Chute Deployment	461.0	841.0	27.6	55.0	1520	----	----	----	----	----
d) G> 0.05	461.0	862.0	27.55	56.0	1543	----	----	----	----	----
e) Main Chute Deployment Thru Touchdown	461.0	884.2	27.5	57.0	1565	----	----	----	----	----
Postlanding	----	67.9	30.0	2.26	67.9	----	----	----	----	----
Battery Charge	616.8	970.1	28.93	----	----	68.0	1965	0.172	1.36	1.53
Secondary Coolant Loop (Low Power)	536.8	918.3	29.13	----	----	63.0	1835	0.160	1.27	1.43
(High Power)	626.4	1000.3	28.84	----	----	69.0	1990	0.173	1.40	1.57
Fuel Cell Purge	568.8	930.3	29.1	----	----	64.1	1866	0.165	1.31	1.48

SECTION IV - MISSION ACTIVITIES - DETAILED TEST OBJECTIVES

SECTION IV - MISSION ACTIVITIES - DETAILED TEST OBJECTIVES

This section contains data intended to aid in correlating Mission Activities and Detailed Test Objectives (DTO's)/Functional Test Objectives (FTO's), and in identifying specific DTO's and FTO's which will be accomplished during a major mission activity. Data in this section include the following:

a. A Mission Activities - Page Location Index which identifies each major Mission Activity Data Sheet and its page number location.

b. A DTO/FTO - Page Location Index which identifies in numerical order all DTO's, the associated FTO's, and the page number location of each.

c. Mission Activity Data Sheets which list all DTO's/FTO's involved during a major mission activity, specific activities and associated DTO/FTO's, special procedures for performing activities, data collection requirements, and crew log or voice record requirements. (Other procedures required to accomplish activities and/or DTO's/FTO's are contained in crew procedure documents.)

MISSION ACTIVITY DATA SHEETS - PAGE LOCATION INDEX

	MISSION ACTIVITY DATA SHEET	PAGE NO.
1.	Launch	4-1
2.	SCS Reference Drift Checks	4-2
3.	CSM Communications	4-3
4.	S-IVB Propellant Pressure Displays	4-5
5.	CSM IMU Alignments/SXT Calibration Check	4-6
6.	S-IVB Attitude Control Demonstrations	4-8
7.	Window Photography	4-9
8.	CSM/S-IVB Separation/Transposition/Simulated Docking and Formation Flying	4-11
9.	SCS Attitude Control	4-16
10.	GNCS Attitude/Translation Control	4-18
11.	SM RCS	4-20
12.	PIPA Bias Test	4-21
13.	EMS ΔV Accelerometer Bias Test	4-22
14.	Manual Retro Attitude Tests	4-23
15.	Crew Activities	4-24
16.	CSM ECS	4-26
17.	Cryogenic Stratification Tests	4-29
18.	COAS Evaluation	4-33
19.	Sextant Tracking	4-34
20.	Rendezvous	4-36
21.	SPS G&N Burn No. 1 (Rendezvous NCC1 Burn)	4-37
22.	SPS G&N Burn No. 2 (Rendezvous NSR Burn)	4-38
23.	SCT Daylight Star Observations	4-39
24.	Synoptic Terrain Photography	4-44
25.	Synoptic Weather Photography	4-47
26.	WSMR LM RR Test	4-50
27.	Orbital Navigation/Landmark Tracking	4-52
28.	SPS SCS AUTO Burn No. 3/Slosh Damping	4-54

MISSION ACTIVITY DATA SHEET	PAGE NO.
29. Radiator Degradation Test	4-56
30. Midcourse Navigation	4-58
31. SPS G&N Burn No. 4 (Minimum Impulse)/Slosh Damping	4-59
32. SPS G&N MTVC Burn No. 5	4-61
33. Passive Thermal Control Tests	4-62
34. SPS Cold Soak	4-64
35. ECS Secondary Coolant Loop Test	4-65
36. SPS Burn No. 6 (Minimum Impulse)	4-67
37. SCS Backup Alignment	4-68
38. SPS SCS AUTO Burn No. 7	4-69
39. Deorbit SPS G&N Burn No. 8 and Entry	4-70

DTO/FTO - PAGE LOCATION INDEX

DTO/FTO DESCRIPTION NO.	TITLE	PAGE LOCATION
P1.6	IMU INFLIGHT ALIGNMENT	
P1.6-1	CMP perform 3 alignments, 1 of each option with alignment check. a. Preferred (Option 1) b. Refsmmat (Option 3) c. Local Horizontal (Option 2)	4-6
P1.6-2	CMP perform one daylight alignment with back-to-back alignment check	4-6
P1.6-3	Perform one S-IVB realignment (Any Crew Member)	4-6
P1.6-4	Each other crewman perform any alignment with alignment check	4-6
P1.6-5	CMP perform SXT Calib. Check (One early in mission, One late)	4-6
P1.7	IMU ORIENTATION DETERMINATION	
P1.7-1	3 star count exercises early in the mission	4-39
P1.7-2	1 star count late in mission	4-39
P1.7-3	1 IMU orientation determination (P51) (CMP preferred)	4-39
P1.8	ORBITAL NAVIGATION/LANDMARK TRACKING	
P1.8-1	3-orbit set of LMK sightings using 3X3 navigation (P22)	4-52
P1.8-2	3-orbit set of LMK sightings using 9X9 navigation (P22)	4-52
P1.8-3	Targets of opportunity (Known and Unknown)	
P1.10	SEXTANT TRACKING	
P1.10-1	CSM Behind and Below S-IVB	4-34
P1.10-2	CSM ahead and above S-IVB	4-34
P1.10-3	S-IVB greater than 400NM	4-34
P1.10-4	Automatic maneuver to tracking attitude and auto optics positioning	4-34
S1.11	BOOST PHASE MONITORING	
S1.11-1	State Vector Comparison	4-1
S1.11-2	Program 11 Evaluation	4-1
S1.11-3	Adequacy of Displays	4-1
P1.12	GNCS ATTITUDE CONTROL	
P1.12-1	Max Deadband (±5°) Attitude Hold for 20 to 30 Min.	4-18
P1.12-2	Min Deadband (±0.5°) Attitude Hold for 10 to 20 Min.	4-18

DTO/FTO - PAGE LOCATION INDEX

DTO/FTO DESCRIPTION NO.	TITLE	PAGE LOCATION
P1.12-3	Automatic Maneuver at 0.2°/Sec.	4-18
P1.12-4	Manual rate CMD at 0.2°/Sec.	4-18
P1.12-5	Minimum Impulse Limit Cycle (Rates) (-15 pulses - P52)	4-18
P1.12-6	RCS Translation Control	4-18
P1.12-7	CMC free mode - 3 axis	4-18
P1.12-8	Auto Maneuvers at 0.05, 0.5 and 4°/Sec.	4-18
P1.12-9	Man Maneuvers at 0.05, 0.5 and 4°/Sec.	4-18
P1.13	GNCS ΔV CONTROL	
P1.13-1	1 SPS maneuver, 10 to 30 seconds duration	4-37
P1.13-2	1 SPS maneuver, 0.5 to 8 seconds duration in G&N	4-38
P1.13-3	1 SM/RCS maneuver, 2 to 12 seconds duration in G&N	4-20
P1.14	GNCS ENTRY MONITORING	
P1.14-1	Perform DAP Entry DSE Data MSFN Track Crew Eval	4-70
P1.14-1a	Or Perform SCS Entry With G&N Displays	4-70
P1.15	MIDCOURSE NAVIGATION	
P1.15-1	Perform earth horizon sightings on three different horizon locators	4-58
P1.15-2	Perform at least six sets of star/earth horizon sightings under optimum lighting conditions using optimum locator	4-58
P1.15-3	Perform star/horizon sightings with various lighting conditions	4-58
P1.16	IMU PERFORMANCE	
P1.16-1	1 Gyro Drift Test with B/B Align Check (1 hr between checks)	4-6
P1.16-2	IMU Performance Evaluation	4-1, -37, -38, -54, -59, -61, -67, -69
P1.16-3	2 PIPA Bias Checks (One early in mission, one late)	4-21
P2.3	EMS PERFORMANCE	
P2.3-1	Crew Time Correlate G-V Plot	4-70
P2.3-2	Crew Comments on Entry Displays	4-70
P2.3-3	Evaluation of ΔV Counter for Maneuvers	4-37, -38, -54, -59, -61, -67, -69, -70
P2.3-4	Determine Accelerometer Bias	4-22
P2.4	SCS ATTITUDE CONTROL	
P2.4-1	Max Deadband (±4.2°) Low Rate (0.2°/Sec.) (20 - 30 Min.)	4-16

DTO/FTO - PAGE LOCATION INDEX

DTO/FTO DESCRIPTION NO.	TITLE	PAGE LOCATION
P2.4-2	Min Deadband (±0.2°) Low Rate (0.2°/Sec.)	4-16
P2.4-3	Rate Command Low Rate (0.2°/Sec.)	4-16
P2.4-4	Minimum Impulse	4-16
P2.4-5	Acceleration Command	4-16
P2.4-6	Translation Control (with P47 Monitor)	4-16
P2.4-7	Manual Direct	4-16
P2.4-8	Rate Command High Rate (2.0°/Sec.)	4-16
P2.4-9	Max Deadband (±8°) High Rate (2.0°/Sec.)	4-16
P2.4-10	Min Deadband (±0.4°) High Rate (2.0°/Sec.)	4-16
P2.5	SCS ΔV CONTROL	
P2.5-1	1 SPS Maneuver in SCS Auto ≥5 Sec.	4-54, -69
P2.6	G&C MTVC ΔV TAKEOVER	
P2.6-1	1 MTVC Takeover ≥10 Sec.	4-61
P2.7	SCS ATTITUDE DRIFT CHECKS	
P2.7-1	Boost Performance Evaluation (on S-IVB)	4-2
P2.7-2	Zero-G Performance (GDC Align - Ck Drift at 1/2 Hr. Intervals)	4-2
P2.7-3	ORDEAL Rate and Display Check	4-2

DTO/FTO DESCRIPTION NO.	TITLE	PAGE LOCATION
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P2.10-1	SCS att alignment to thrusting attitude using South set stars	4-68
P3.14	SPS MINIMUM IMPULSE BURN	
P3.14-1	1 SPS Minimum Impulse Burn (<.5 Sec >1.0 Sec.) G&N	4-59
P3.14-2	Repeat Above Burn	4-67
P3.15	SPS PERFORMANCE	
P3.15-1a	1 long-duration burn with 2 PT sensors uncovered (≈57 Sec.)	4-61
P3.15-1b	1 burn >20 sec.	4-61
P3.16	PRIM/AUX PROPELLANT GAUGING SYSTEM	
P3.16-1	1 long-duration burn with 2 PT sensors uncovered	4-61
S3.17	SM/RCS PERFORMANCE	
S3.17-1	Pitch, yaw, and roll attitude maneuver	4-20
S3.17-2	Forward, aft - lateral translations	4-20
P3.20	SPS PROPELLANT THERMAL CONTROL	
P3.20-1	Normal operation - Turn heater on when feedline reaches 45°F	4-64
P3.20-2	Cold Soak - 3 hrs. (Plus X to Sun) Maintain feedline temps between 45 and 65°F	4-64

DTO/FTO - PAGE LOCATION INDEX

NO.	DTO/FTO DESCRIPTION TITLE	PAGE LOCATION
P4.4	CM ECS LIFE SUPPORT FUNCTIONS	
P4.4-1	Pressure Control a. Cabin b. Suit c. Water d. Water-Glycol	4-27
P4.4-2	Thermal Control a. Primary coolant loop b. Evaporator (launch and as required) c. Radiator heat rejection	4-27
P4.4-3	Habitability a. Comfort b. CO_2 Removal c. Humidity/Temp d. Toxic Gas/Odor Removal	4-26, -27,
P4.6	CM WASTE MANAGEMENT	4-26
P4.6-1	Demonstrate urine dump operations	4-27
P4.6-2	Demonstrate adequacy of fecal containment provisions	4-27
P4.6-3	Demonstrate adequacy of waste storage ventilation	4-27
P4.6-4	Evaluate cleanliness of S/C with respect to free floating objects.	4-27
P4.8	CSM SECONDARY COOLANT LOOP	
P4.8-1	Deactivate primary loop, operate on secondary coolant loop (5 Revs.)	4-65
P4.8-2	Radiator	4-65
P4.8-3	Evaporator	4-65
P4.9	CSM WATER MANAGEMENT	4-26
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P4.9-2	Procedures and equipment used to chlorinate potable water	4-28
P4.10	CM POSTLANDING VENTILATION	4-26
P4.10-1	Postlanding ventilation	4-28
P4.10-2	Measure of water in CSM (if any)	4-28
P5.8	ZERO-G EFFECTS ON CRYOGENICS	
P5.8-1	90% Quantity Conduct heater and fan test	4-29
P5.8-2	60% Quantity Conduct heater and fan test	4-29
P5.8-3	15% Quantity Conduct heater and fan test	4-29
P5.9	CRYOGENIC PRESSURE CONTROL	
P5.9-1	No specific crew functions are required for success. Evaluation indicates adequate cryogenic pressure control.	4-29

DTO/FTO - PAGE LOCATION INDEX

NO.	DTO/FTO DESCRIPTION TITLE	PAGE LOCATION
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P5.10-2	Fuel cell water potability (Requires crew evaluation)	4-28
P6.7	S-BAND UPDATA LINK	
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P6.8	OVERPASS SIMULATION WITH LM RR	
P6.8-1	1 pass over WSMR with radar lock-on	4-50
P6.8-2	Additional successful pass	4-50
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P7.20-1b	Or recover flat APEX	4-71
S7.21	SLA DEPLOYMENT SYSTEM	4-11
S7.21-1	Verification of deployment symmetry a. Crew evaluation b. Head-on photo c. Side photo	4-12
S7.21-2	Deployment and separation debris (identify if any)	4-12
S7.21-3	Determine and estimate soot effects on a LM on 103	4-12
S7.24	PASSIVE THERMAL CONTROL PROCEDURE	
S7.24-1	a. Determine initial coning angles b. Repeat c. Repeat	4-62 4-62 4-62
S7.28	CSM STRUCTURAL PERFORMANCE	
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S7.28-2	Obtain structural vibration data during SPS maneuvers	4-61, -70
P20.8	SEPARATION/TRANSPOSITION/SIMULATED DOCKING	
P20.8-1	Evaluate simulated docking maneuvers	4-11
P20.8-2	Evaluate transposition maneuver	4-11
P20.8-3	Evaluate SM RCS propellant usage	4-11
P20.8-4	S-IVB stability (adequacy for docking)	4-11

DTO/FTO - PAGE LOCATION INDEX

DTO/FTO DESCRIPTION NO.	TITLE	PAGE LOCATION
S20.9	MANUAL RETRO ATTITUDE ORIENTATION	
S20.9-1	Perform day retrofire alignment maneuver	4-23
S20.9-2	Perform night retrofire alignment maneuver	4-23
P20.10	CSM/MSFN S-BAND COMMUNICATION PERFORMANCE	
P20.10-1	2-way A/G S-band comm a. Uplink (Voice, updata, ranging) b. Downlink PM (voice, TM, ranging)	4-3
P20.10-2	Downlink FM a. Playback TM b. Voice	4-3
P20.11	CONSUMABLES USAGE Obtain data on the following:	
P20.11-1	SM/RCS for various control modes	4-20, -37, -38, -54 -59, -61, -67, -69
P20.11-2	SPS required for various ΔV's	4-37, -38, -54, -59, -61, -67, -69
P20.11-3	Power for various loads	Through Mission
P20.11-4	Water usage	4-28
P20.11-5	ECS O_2 usage	4-27
P20.11-6	LIOH usage	4-28
P20.11-7	Crew food and water requirements	4-28
P20.11-8	CM/RCS entry usage	4-71

DTO/FTO DESCRIPTION NO.	TITLE	PAGE LOCATION
S20.12	MANUAL S-IVB ATTITUDE CONTROL	
S20.12-1	Enable S/C control and perform any 3-axis maneuver	4-8
P20.13	CSM ACTIVE RENDEZVOUS	
P20.13-1	Terminal Phase Initiate	4-36
P20.13-2	Terminal Phase Final	4-36
S20.14	L/V PROPELLANT PRESSURE DISPLAYS	
S20.14-1	Perform switching, and read fuel and oxidizer displays before and after a vent period	4-5
P20.15	CREW ACTIVITIES EVALUATION	
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LAUNCH

A. DTO/FTO Requirements

1. S1.11 - Boost Phase Monitoring
   a. S1.11-1 - State Vector Comparison
   b. S1.11-2 - Program 11 Evaluation
   c. S1.11-3 - Adequacy of Displays

2. P1.16-IMU Performance
   a. P1.16-2 - Launch Performance Evaluation

3. S7.28 - CSM Structural Performance
   a. S7.28-1 - Obtain Structural Vibration Data During Launch

4. P20.15 - Crew Activities Evaluation
   a. P20.15-1b - Crew Evaluation of Launch Displays
   b. P20.15-6 - Acoustics (Crew Evaluations of Sounds and Vibrations and Air/Ground Noises)

B. Activity - Launch and Boost Monitoring

C. Procedures

1. Flight Recorder Operation
   a. FLT RCDR - RECORD (at 45 seconds before liftoff)
   b. Monitor launch.
   c. FLT RCDR - OFF (at liftoff plus 4 minutes)

D. Data Requirements
   a. CSM HBR Data (M)
   b. FQR (M) from 45 seconds before liftoff to 4 minutes after liftoff
   c. MSFN Tracking Data (M)
   d. L/V TM Data (M)

E. Crew Logs or Voice Record Requirements

1. Subjective Comments:
   a. Displayed Data: Scaling, resolution, lighting, display location, and readability. (M)
   b. DSKY Displays: Attitude and attitude rates (M)
   c. FDAI Displays: Attitude rate. (M)
   d. Noises and vibrations

SCS REFERENCE DRIFT CHECKS

A. DTO/FTO Requirements

1. P2.7 - SCS Attitude Drift Checks

   a. P2.7-1 - Boost Performance Evaluation
   b. P2.7-2 - Zero-G Performance
   c. P2.7-3 - ORDEAL Rate and Display Check

B. Activity

1. Record the difference between GNCS and SCS attitude angles on FDAI 1 and 2 prior to S-IVB separation.

2. SCS drift checks - Perform in coasting flight as follows:

   a. Perform an IMU realign (P52).
   b. Align GDC to IMU gimbal angles.
   c. Perform an attitude reference system comparison each half-hour prior to the SPS burn.
   d. Perform another IMU realign (P52) to the same REFSMMAT at the end of the coasting phase. (HD)

3. ORDEAL check - Perform as follows

   a. Orient S/C to local horizontal, small end forward.
   b. Monitor orbital rate 5-15 minutes
   c. Compare pitch travel to time monitored.
   d. One FDAI will be driven by the IMU, and the other by the ORDEAL.
   e. Perform the check twice for earth and lunar rates.

C. Data Requirements

. CSM LBR Data (M)

D. Crew Logs or Voice Record Requirements

1. IMU gimbal angles and attitude set dial angles each time SCS drift check is performed.(M)

2. ORDEAL rate selected (earth or lunar) and the difference between pitch attitude on the FDAI's at beginning and end of test.

CSM COMMUNICATIONS

A. DTO Requirements

1. P6.7 - S-Band Updata Link
2. P20.10 - CSM/MSFN S-Band Communications Performance
3. S20.18 - CSM ARIA Communications
4. S20.19 - CSM/MSFN VHF Voice Communications

B. Activities

1. S-Band Updata Link

   a. At least one automatic CMC update
   b. Normal MSFN RTC of following CSM communication functions:

      - S-band PRN to OFF to ON
      - S-band PCM to OFF to ON
      - S-band PCM data rate to LBR to HBR
      - S-band P/A to HIGH PWR to LOW
      - DSE playback to PCM/ANLG to LM/PCM
      - DSE record to RECORD to OFF to PLAYBACK
      - DSE transport to FWD to POWER OFF to REWIND
      - S-band AUX to TAPE to OFF to DN VOICE BU

   c. A CTE update if the CTE time is more than 5 seconds different from the MSFN GET.

2. CSM/MSFN S-band Communications Performance

   a. Voice, RT-HBR, Ranging
   b. Voice, RT-LBR, Ranging
   c. Voice, RT-LBR (and HBR)
   d. Voice and Ranging
   e. Voice
   f. Backup Voice
   g. Backup - Down Voice
   h. Backup - Down Voice and RT-LBR
   i. Key
   j. Down Data Backup
   k. Dump PCM/Analog, LBR and HBR
   l. Dump LM (simulated) PCM
   m. Voice Relay
   n. TV

3. CSM ARIA Communications

   a. ARIA to CSM S-band voice
   b. CSM to ARIA S-band voice and HBR
   c. CSM to ARIA Simplex A voice
   d. ARIA to CSM Simplex A voice
   e. CSM to ARIA dump FM data
   f. CSM to ARIA to MSFN RT TM and dump FM data

4. CSM/MSFN VHF Voice Communications

a. VHF - Duplex A
b. VHF - Simplex A
c. VHF - Simplex B
d. VHF - Duplex B

S-IVB PROPELLANT PRESSURE DISPLAYS

A. DTO/FTO Requirements

1. S20.14-L/V Propellant Pressure Displays

a. S20.14-1 - Record S-IVB Propellant Pressure Displays

B. Activities

1. Record LVPD prior to S-IVB Passivation
2. Record LVPD after S-IVB Passivation

C. Procedures

1. Verify the following switch position:

a. SII/S-IVB-GPI - SII/S-IVB

2. Record GET and LVPD (Fuel and Oxid)

D. Data Requirements

1. CSM HBR Data (HD)
2. L/V TM Data (M)

E. Crew Logs or Voice Record Requirements

1. Fuel and Oxidizer pressures (M)
2. GET of readings (M)

CSM IMU ALIGNMENTS/SXT CALIBRATION CHECK

A. DTO/FTO Requirements

1. P1.6-IMU Inflight Alignment

   a. P1.6-1 - CMP perform 3 alignments, 1 of each option with alignment check
   b. P1.6-2 - CMP perform one daylight alignment with back-to-back alignment check.
   c. P1.6-3 - Perform S-IVB realignment on S-IVB (any crew member) (one alignment)
   d. P1.6-4 - Other two crewmen perform any alignment check (two alignments)
   e. P1.6-5 - CMP perform SXT Cal. Check (one early in mission, one late)

2. P1.16-IMU Performance

   a. P1.16-1 - 1 Gyro Drift test (back-to-back IMU alignments)

B. Activities

1. Perform IMU alignment using the following options:

   a. Preferred (Option 1)
   b. Refsmmat (Option 3)
   c. Nominal (Option 2)

2. Perform daylight IMU alignment and alignment check according to procedure

3. Perform one IMU alignment prior to separation from the S-IVB

4. All crewmen perform at least one IMU alignment and alignment check

5. Perform a SXT calibration check early in mission

6. Perform a SXT calibration check late in mission

7. Perform one gyro drift test (back-to-back IMU alignment)

C. Procedures

1. Alignment Check

   a. The alignment check consists of re-running the alignment procedure with the following deviations:

- Key into the DSKY two other navigation stars and perform sightings on these stars

- After the gyro torquing angles are displayed, exit the program

2. SXT Calibration Check

a. Call P23 (Optics calibration not required)

b. Modify step 4 as follows:

- Acquire known star in SXT LLOS
- Acquire known star in SXT SLOS
- Superimpose the two stars and mark
- Record:

  Star 1 ID (LLOS)
  Star 2 ID (SLOS)
  SA
  TA
  T MARK

- Without changing the LLOS star, acquire a third known star in the SLOS approximately perpendicular to original stars
- Superimpose the two stars and mark
- Record:

  Star 3 ID (SLOS)
  SA
  TA
  T MARK

- For all optical sightings allow at least 10 seconds between marks when recording LBR

D. Data Requirements

- CSM LBR Data (M)

E. Crew Logs **or** Voice Record Requirements

1. Attitude control mode used for each alignment (M)

2. Time required to complete each alignment (M)

3. Star ID for each sighting (M)

4. Star angle difference (subtended angles) (M)

5. Gyro torquing angles (M)

6. Subjective comments on controls, displays, or difficulties encountered (M)

S-IVB MANUAL ATTITUDE CONTROL DEMONSTRATIONS

A. DTO/FTO Requirements

1. S20.12 - Manual S-IVB Attitude Control

   a. S20.12-1 - Enable S/C Control and Perform Maneuvers in Three Axes

B. Activity - S-IVB Manual Attitude Control Demonstration

C. Procedures

1. Perform the following maneuvers:

   a. Pulse in each axis (30 seconds or less)
   b. - pitch for 3° (10 seconds)
   c. Stop rate, hold attitude (10 seconds)
   d. + pitch for 12° (40 seconds)
   e. Stop rate, hold attitude (10 seconds)
   f. - roll for 5° (10 seconds)
   g. Stop rate, hold attitude (10 seconds)
   h. + roll for 5° (10 seconds)
   i. Stop rate, hold attitude (10 seconds)
   j. - yaw for 3° (10 seconds)
   k. Stop rate, hold attitude (10 seconds)
   l. + yaw for 3° (10 seconds)
   m. Stop rate, hold attitude (10 seconds)

2. Return control to IU per checklist

3. When control of the S-IVB is returned to the IU, the normal attitude timeline will be resumed.

D. Data Requirements

1. CSM LBR Data (M)

2. CSM HBR Data (HD)

3. L/V Data (HD)

E. Crew Logs or Voice Record Requirements

. Subjective comments on S-IVB handling ability. (HD)

WINDOW PHOTOGRAPHY

GENERAL DTO'S

1. S20.16 - Environmental induced window deposits

ACTIVITIES

A. Still Window Photography

- Prior to S-IVB separation (focus on window)
- Post simulated docking (focus on window)
- Prior to deorbit stowage (focus on window)
- Any time in mission (focus at infinity)

1. SPECIFIC DTO/FTO'S

   a. S20.16-1a - Hand-held still photograph prior to S-IVB separation (focus on window)
   b. S20.16-1b - Hand-held still photograph post-simulated docking (focus on window)
   c. S20.16-1c - Hand-held still photograph late in mission (focus on window)
   d. S20.16-1d - Hand-held still photograph any time in mission (focus at infinity)

2. Procedures

   a. Configure Hasselblad camera
   b. Photograph LH rendezvous window to obtain best possible photos of window deposits.

3. Data Requirements - None

4. Crew Logs or Voice Record Requirements

   a. Photo Log (M)
   b. Comments on deposits effects on visibility (M)
   c. Comments on pattern of deposits, if any (M)
   d. Film magazine number (M)
   e. Frame number (M)
   f. GET of picture (M)
   g. Window designation (M)

B. Sequence Window Photography

1. Specific DTO/FTO

   a. S20.16-2-Sequence Camera photography of LH rendezvous window

2. Procedures

   a. The following are required:

- CMC - ON
- IMU - At known orientation
- SCS - Powered up
- Sequence Camera Prepared

b. Receive the following update:

- T_0 (Time for test initiate)
- R, P, Y (To place - Z axis toward sun)

c. Maneuver to update attitudes
d. Hand-hold sequence camera 2 feet from and normal to LH rendezvous window
e. SEQ CAM - ON
f. Pitch up 180° thru sun at 0.5°/sec with roll and yaw in attitude hold, max deadband
g. SEQ CAM - OFF
h. Roll right 90°
i. SEQ CAM - ON
j. Yaw right 180° through sun at 0.5°/sec with roll and pitch in attitude hold, max deadband
k. SEQ CAM - OFF (end of test)

3. Data Requirements

a. CSM LBR Data (M)

4. Crew Logs or Voice Record Requirements

a. Maneuver being performed (M)
b. GET at start of maneuver (M)
c. Rate of maneuver (M)
d. GET when camera is turned on each time the sun traverses across the window (M)
e. Location of the sun (crew estimate) with respect to window at start of maneuver (M)
f. Film magazine number (M)
g. Subjective comments on:

- Visibility at time photographs are taken (M)
- Structural pattern of window deposits, if any (M)

CSM/S-IVB SEPARATION/TRANSPOSITION/SIMULATED DOCKING AND FORMATION FLYING

GENERAL DTO's

A. P7.21 - SLA Deployment

B. P20.8 - Separation/Transposition/Simulated Docking

C. S20.20 - COAS Evaluation

Activities

A. CSM/S-IVB Separation/Transposition

1. Specific DTO/FTO's

a. P20.8-2 - Evaluate Transposition Maneuver
b. P20.8-3 - Evaluate SM RCS Propellant Usage

2. Procedures

a. Perform S-IVB/CSM Separation and Transposition
b. Sequence Camera - ON when S-IVB comes in view

3. Data Requirements

a. CSM HBR Data (HD)
b. CSM LBR Data (M)

4. Crew Logs or Voice Record Requirements

a. Subjective comments on separation and transposition (M)

B. Simulated Docking

1. Specific DTO/FTO's

a. P20.8-1 - Evaluate Simulated Docking Maneuver
b. P20.8-3 - Evaluate SM RCS Propellant Usage
c. P20.8-4 - Evaluate S-IVB Stability for Docking
d. S20.20-1 - Evaluate COAS in conjunction with docking.
e. S7.21-1b - Head-on Photograph (looking alone the S-IVB +X axis)

2. Procedures

a. Perform simulated docking
b. Operate Sequence Camera
c. Obtain Hasselblad photographs along S-IVB X axis (See Figure 4-1)

3. Data Requirements

   a. CSM HBR Data (HD)
   b. CSM LBR Data (M)

4. Crew Logs or Voice Record Requirements

   a. Subjective comments on the CSM's capability to perform docking (M)
   b. Comments on use of the COAS
   c. Photographs of transposition and docking maneuvers and S-IVB (M)

C. Formation Flying and SLA Photography

1. Specific DTO/FTO's

   a. P7.21-1a,-1b - Verification of SLA deployment symmetry
   b. P7.21-2 - SLA Deployment and Separation Debris
   c. P7.21-3 - Determine and estimate soot effects on the LM

2. Procedures

   a. Fly formation with the S-IVB
   b. Operate Sequence Camera
   c. Take Hasselblad photographs with emphasis on the following: (See Figures 4-2 and 4-3)

      . Evidence of materials which have penetrated the debris catchers.
      . Any "stringers" of material attached to the SLA
      . The smoothness of all four edges of all the SLA panels.
      . Pattern and distribution of soot deposits on the SLA

3. Data Requirements - None

4. Crew Logs or Voice Record Requirements

   a. Estimate of angle of each panel with respect to S-IVB X-axis.
   b. Record any anomalies such as bent or missing panels and stringers
   c. Comments on evidence of the debris catchers being out of place or materials having penetrated them.
   d. Comments on visibility of all SLA panel seam lines as affected by soot.
   e. Comments on pattern of soot deposited and conclusions as to the probability of effect on LM had there been one present.

Figure 4-1.- Desired view for head-on photography, still camera 80mm lens range 75 feet. (END VIEW - Nominal SLA Deployment)

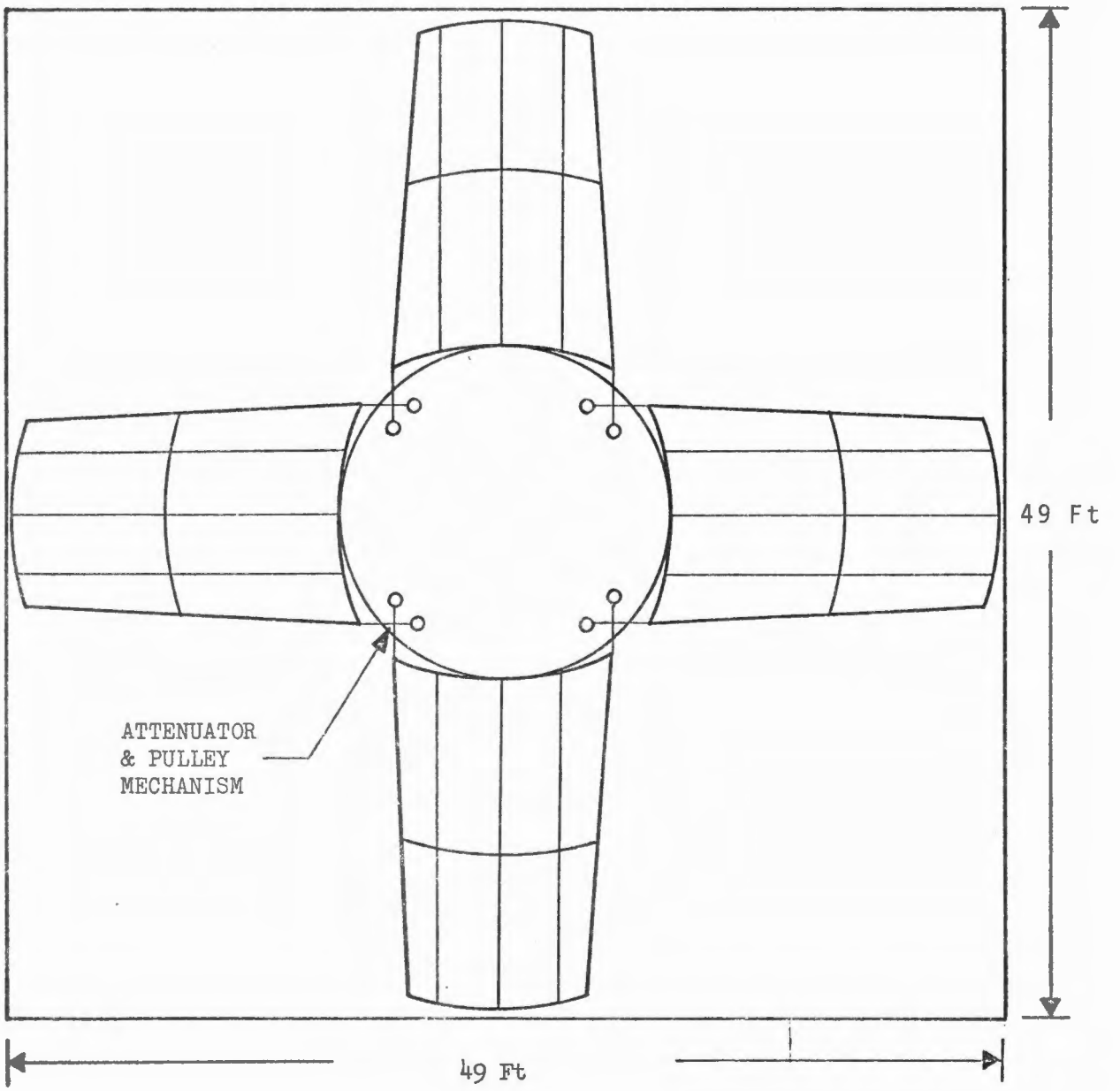
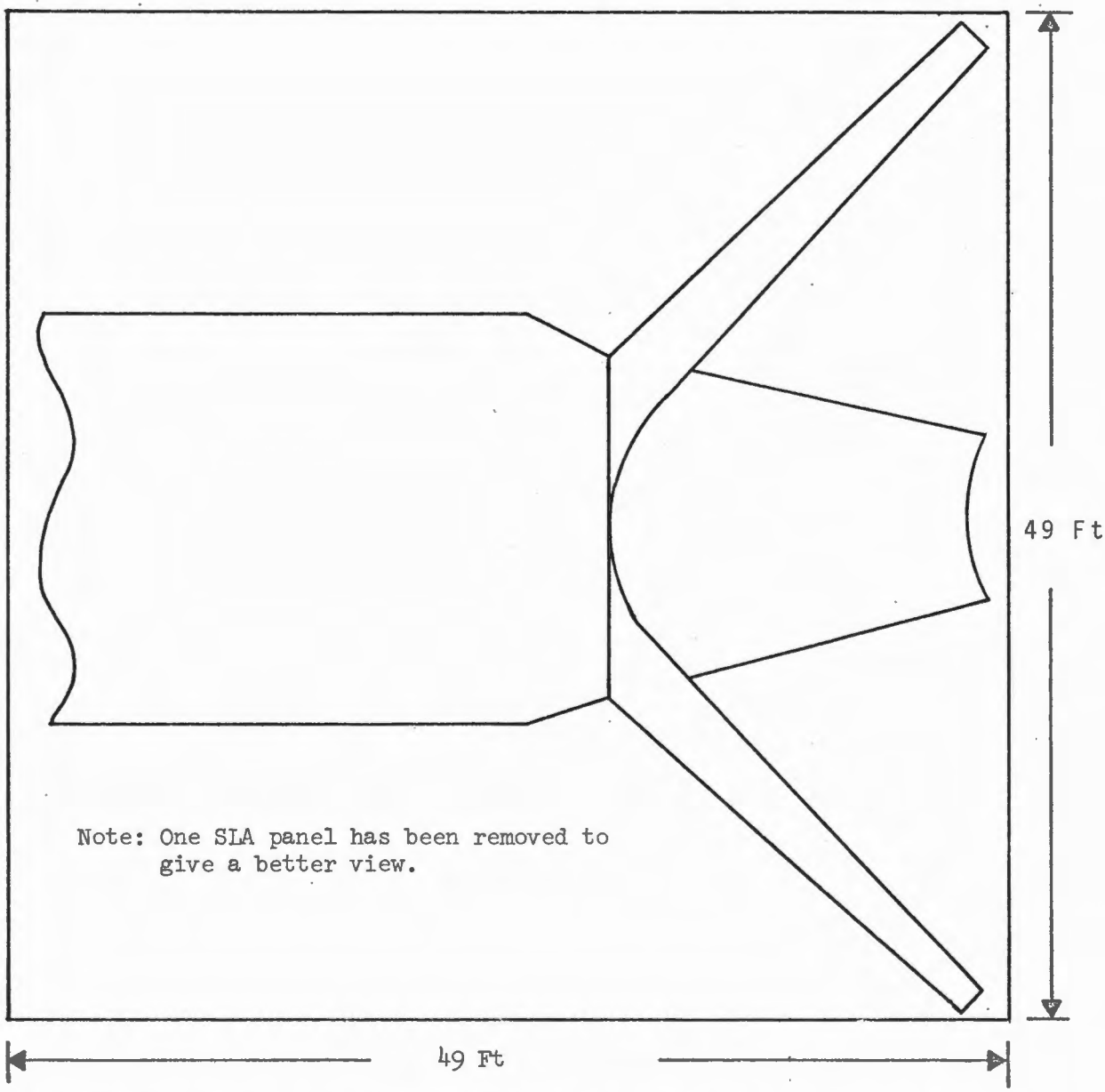
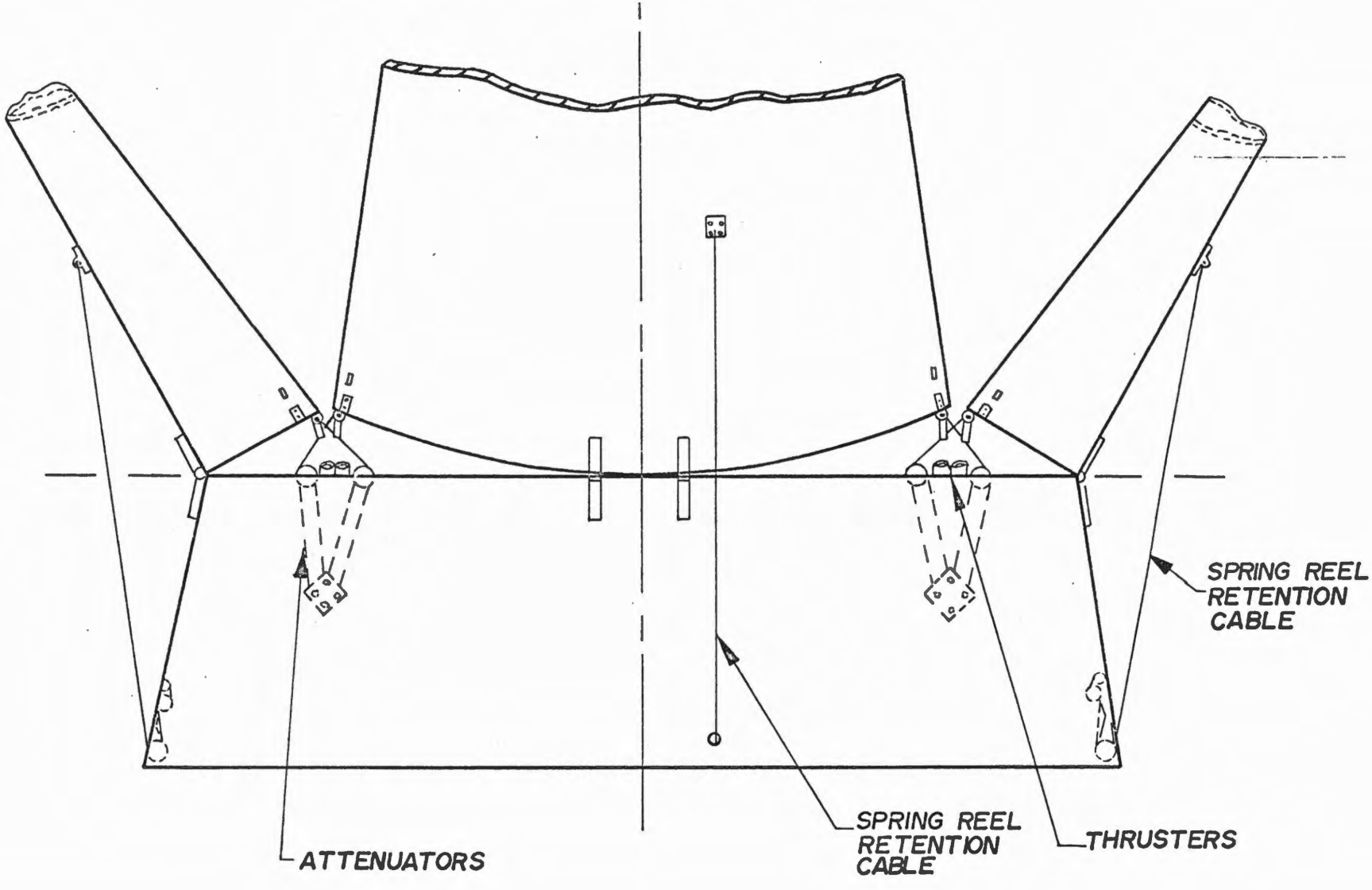


Figure 4-2.- Desired view for side photography
still camera 80mm lens, range 75 feet.
(SIDE VIEW - Nominal SLA Deployment)



(A similar view from top or bottom is desired to get both angles of SLA deployment)

Figure 4-3.- Items of special interest



SCS ATTITUDE CONTROL

A. DTO Requirements

1. P2.4 - SCS Attitude Control

B. Activities

Test No.	FTO No.	Function
1.	P2.4-1	Max db attitude hold ($\pm$4.2°) low rate, 20 to 30 minutes
2.	P2.4-2	Min db attitude hold ($\pm$0.2°) low rate, 10 to 20 minutes
3.	P2.4-3	Rate Cmd attitude maneuver @ 0.3°/sec
4.	P2.4-4	Minimum impulse attitude control
5.	P2.4-5	Acceleration Cmd attitude maneuver @ 0.5°/sec
6.	P2.4-6	Translations ($\pm$X, $\pm$Y, $\pm$Z)
7.	P2.4-7	Manual direct attitude maneuver @ 0.5°/sec $\pm$ all axes
8.	P2.4-8	Rate Cmd attitude maneuver @ 1.5°/sec
9.	P2.4-9	Max db attitude hold ($\pm$8°) high rate, 1.5 to 2.5 hrs.
10.	P2.4-10	Min db attitude hold ($\pm$4°) high rate, 1 to 1.5 hrs.

C. Procedures

1. Attitude Maneuvers

   a. Jet Select 2-2-2
   b. Attitude maneuvers are accomplished as part of the normal attitude maneuvers throughout the mission.

2. Attitude Hold

   a. Desired vehicle rate $\geq$1°/sec before attitude hold initiated (Tests 1,2,9,10).
   b. Attempt to initiate attitude hold tests at AOS + 30 seconds (or TM lock-on)
   c. 20 to 30 minutes of continuous TM coverage required for maximum deadband tests.
   d. 10 to 20 minutes of continuous TM coverage required for minimum deadband tests.
   e. Attitude hold demonstrations are accomplished as part of the normal attitude hold activities throughout the mission.

3. Translations

   . Translations are accomplished during the normal RCS translations scheduled in the Mission.

D. Data Requirements

- CSM HBR Data (M)

E. Crew Logs or Voice Record Requirements

1. GET of start of each test. (M)

2. Subjective comments relevant to the success of controlling the spacecraft. (M)

GNCS ATTITUDE/TRANSLATION CONTROL

A. DTO Requirements

1. P1.12 - GNCS Attitude Control

B. Activities

Test No.	FTO No.	Function
1.	P1.12-1	Max db (5°) att hold, 20 to 30 min.
2.	P1.12-2	Min db (0.5°) att hold, 10 to 20 min.
3.	P1.12-3	Automatic attitude maneuver @ 0.2°/sec
4.	P1.12-4	Manual attitude maneuver @ 0.2°/sec ± all axes.
5.	P1.12-5	Minimum impulse attitude control
6.	P1.12-6	Translations (±X, ±Y, ±Z)
7.	P1.12-7	Acceleration Cmd attitude maneuver @ 0.3°/sec ± all axes
	P1.12-8	Automatic attitude maneuvers:
8.	P1.12-8a	0.05°/sec
9.	P1.12-8b	0.5°/sec
10.	P1.12-8c	4.0°/sec
	P1.12-9	Manual attitude maneuvers ± all axes:
11.	P1.12-9a	0.05°/sec
12.	P1.12-9b	0.5°/sec
13.	P1.12-9c	4.0°/sec

C. Procedures

1. Attitude Maneuvers

   a. Jet select 2-2-2
   b. Attitude hold or free drift desired before manual maneuvers initiated
   c. Schedule 4° and 0.05°/sec maneuvers real time late in the mission if propellant is available. Other maneuver rates are accomplished as part of the normal attitude control activities throughout the mission.

2. Attitude Hold

   a. Desired vehicle rate $\geq 1°$/sec before attitude hold initiated.
   b. Attempt to initiate attitude hold tests at AOS + 30 seconds (or TM lock-on).
   c. 20 to 30 minutes of continuous TM coverage for maximum deadband attitude hold test
   d. 10 to 20 minutes of continuous TM coverage for minimum deadband attitude hold test.
   e. Attitude holds are accomplished as part of the attitude hold activities throughout the mission.

3. Translations

   a. Translations are accomplished during normal ullage burn, formation flying, rendezvous, etc.

D. Data Requirements

   . CSM HBR Data (M)

E. Crew Logs or Voice Record Requirements

   1. GET of tests

   2. Comments on handling characteristics

SM RCS

A. DTO/FTO Requirements

1. S3.17 - SM RCS Performance

   a. S3.17-1 - Pitch, yaw and roll attitude maneuvers
   b. S3.17-2 - Forward/aft translations

2. P20.11 - Consumables Usage

   a. P20.11-1 - SM RCS propellant requirements for various control modes and translation requirements

3. S20.17 - Propellant Slosh Damping

   a. S20.17-3 - RCS Translations

4. P1.13 - GNCS ΔV Control

   a. P1.13-3 - 1 SM/RCS maneuver (G&N - 2 to 12 seconds)

B. Activities

1. Normal mission attitude control and RCS translation requirements.

2. Slosh Damping Test - wide d/b attitude hold - after +X RCS translation.

3. Slosh damping test - narrow d/b attitude hold - after +X RCS translation (desirable to repeat)

4. Slosh damping test - wide d/b attitude hold - after ±Z RCS translation.

C. Procedures - Slosh Damping Tests

1. Approximately 10 seconds after the RCS translation select the appropriate d/b.

2. Maintain initial thrusting attitude for 10 minutes.

D. Data Requirements

. CSM HBR Data (M)

E. Crew Logs or Voice Record Requirements

. Comments on consumable usage. (HD)

PIPA BIAS TEST

A. DTO/FTO Requirements

1. P1.16 - IMU Performance

a. P1.16-3 - Two PIPA Bias Checks

B. Activities

1. Conduct a PIPA bias test prior to first power down
2. Conduct a PIPA bias test prior to deorbit maneuver

C. Procedures

1. CMC must be powered up
2. Perform PIPA bias test per checklist

D. Data Requirements

. CSM LBR Data (M)

E. Crew Logs or Voice Record Requirements

1. GET at start of each PIPA bias test
2. GET at end of each PIPA bias test

EMS ΔV ACCELEROMETER BIAS TEST

A. DTO/FTO Requirements

1. P2.3 - EMS Performance

   a. P2.3-4 - Determine Accelerometer Bias

B. Activities

1. Accelerometer Bias Test 1 (Perform before SPS Burn No. 1/ NCC 1 Burn during drifting flight).

2. Accelerometer Bias Test 2 (Perform before SPS Burn No. 5 during drifting flight).

3. Accelerometer Bias Test 3 (Perform before SPS Burn No. 8/ deorbit burn during drifting flight).

C. Procedures

1. Establish drifting flight with no RCS Firings.

2. EMS Function switch - ΔV (Record GET)

3. EMS Mode switch - AUTO (after 100 seconds, record value of bias displayed on ΔV counter)

4. Inform MSFN of results so that bias correction can be established as required

D. Data Requirements

. CSM LBR Data (M)

E. Crew Logs or Voice Record Requirements

. Numerical value in ΔV counter before and after each bias test period, and the duration of the test (M)

MANUAL RETRO ATTITUDE TESTS

A. DTO/FTO Requirements

1. S20.9 - Manual Retro Attitude Orientation

   a. S20.9-1 - Perform Day Retro Alignment Maneuver
   b. S20.9-2 - Perform Night Retro Alignment Maneuver

B. Activities

1. Day Retro Test
2. Night Retro Test

C. Procedures

1. The following required for both tests:

   a. CMC - ON
   b. IMU - at known orientation
   c. SCS - powered up
   d. FDAI Select - 1/2

2. Ground update:

   a. GET of retro

3. With couches in boost position, maneuver in ACCEL CMD or DIRECT to retro attitude

4. At retro time, record:

   a. GET
   b. R,P,Y (record for airglow and earth limb)

5. Post-pass - ground will compare calculated and recorded roll, pitch, and yaw angles to assess results of the procedure

D. Data Requirements

. CSM LBR Data (M)

E. Crew Logs or Voice Record Requirements

. Subjective comments pertinent to the maneuver (M)

CREW ACTIVITIES

A. DTO/FTO Requirements

1. P20.15 - Crew Activities Evaluation

   a. P20.15-1 - Displays and Controls
   b. P20.15-2 - Mobility
   c. P20.15-3 - Sleep
   d. P20.15-4 - Stowage
   e. P20.15-5 - Eating
   f. P20.15-6 - Acoustics

B. Activities

1. Normal mission crew activities

2. Optional sequence camera photography of normal mission events

C. Procedures - Take 16mm photographs, at crew option, of the following activities (camera is handheld).

1. Doffing and donning of PGA

2. The preparation for stowing and unstowing of the PGA's.

3. A crewman entering the couch assembly and attaching the crew restraints when he is in the PGA and again when not in the PGA.

4. A crewman leaving the couch assembly and going to the lower equipment bay.

5. Unstowing, erecting, and stowing sleep stations.

6. Entering and exiting from sleep stations.

7. Leaving couch assembly and going to stowage area on aft bulkhead.

8. Unstowing and stowing of the LiOH elements.

9. Installing and removing the LiOH elements

10. Unstowing and use of optical scanning equipment.

11. Using the DSKY.

12. Moving about in the forward equipment bay.

13. Using flight plan and other documents.

14. Routing used by crewmen for ECS umbilicals in couch assembly

15. Unstowing, preparing, and eating food

16. Unstowing and stowing of photographic equipment

17. G&N station operations

18. Simulated foldable couch docking position

D. Crew Logs or Voice Record Requirements

1. Photo log (HD)

2. Crew comments on normal activities (M)

E. Crew Status Reporting

Record the following data:

1. Food - A daily record of the meal identification code, together with a description or serial number, of only those items each crew member did not consume from a scheduled meal.

2. Water - A daily record of the number of standard drinks (5 oz. of water, i.e. ten squeezes of the water gun trigger) each crewman consumed. Water used for food rehydration will not be recorded.

3. Sleep - A daily estimate of sleep quantity and quality for each crew member.

4. Exercise - A daily record of any deviations from the exercise protocol for each crewman.

NOTE:

Real time air-to-ground communications will not be made regarding food, water, and sleep data unless red line limits are exceeded.

GENERAL DTO'S

A. P4.4 - CSM Life Support
B. P4.6 - CSM Waste Management
C. P4.9 - Water Management
D. P4.10 - CM Postlanding Ventilation
E. P5.10 - Water Separation and Potability
F. P20.11 - Consumables Usage

Activities

A. Emergency oxygen mask evaluation

1. Specific DTO/FTO's

a. P4.4-3 (Habitability - partial)

2. Procedures

a. Crewman in center couch will don emergency oxygen mask and demonstrate that he has access to all controls in lower equipment bay.

b. Crewman in either outboard couch will unstow his emergency oxygen mask without assistance with the center couch occupied.

3. Data Requirements - None

4. Crew Logs or Voice Record Requirements

a. Comments on adequacy of emergency oxygen mask evaluation (M)

B. Humidity Survey

1. Specific DTO/FTO's

a. P4.4-3 (Habitability - partial)

2. Procedures

a. Humidity Survey Schedules

- Partially suited - once each six hours
- Shirtsleeve - once a day
- When condensation appears

b. Perform Humidity Survey in the following locations:

- Any suit circuit inlet
- Cabin heat exchanger outlet
- LHEB near suit circuit return air check valve
- Near right-hand window

c. Observe for condensation on the heater glycol lines, inside the cabin heat exchanger and particularly for areas of stagnation or gas flow channeling.

3. Data Requirements - None

4. Crew Logs or Voice Record Requirements

a. Dew point measurements (HD)
b. GET and place where condensation is observed, if any (HD)

C. Normal ECS operation

1. Specific DTO's/FTO's

a. P4.4-1 - Evaluate pressure control (cabin, suit, water tank, water-glycol reservoir)
b. P4.4-2 - Evaluate thermal control characteristics (primary loop, evaporator and radiation heat rejection)
c. P4.4-3 - (Habitability - partial)
d. P4.6-4 - S/C cleanliness with respect to free floating objects
e. P20.11-5 - ECS O_2 Usage

2. Procedures - Normal mission duration

3. Data Requirements

. CSM HBR Data (M) (15 seconds each hr)

4. Crew Logs or Voice Record Requirements

a. GET when O_2 flow HI caution light comes on (M).
b. GET and CABIN TEMP thumbwheel position when changed (HD)
c. GET and suit configuration when changed (HD)
d. Comments on floating objects and overall S/C cleanliness.

D. Perform the following normal mission events:

. Urine dump
. Fecal containment
. Waste storage compartment ventilation
. Potable water chlorination
. Postlanding operations
. Monitoring fuel cell parameters
. Eating and drinking
. LiOH canister changes

1. Specific DTO/FTO's

a. P4.6-1 - Urine dump operation
b. P4.6-2 - Fecal Containment Provision Adequacy

c. P4.6-3 - Waste Storage Compartment Ventilation Adequacy
d. P4.9-1 - Potable/Waste Water Storage/Expulsion Adequacy
e. P4.9-2 - Potable Water Chlorination Procedures/Equipment Adequacy
f. P5.10-1 - Fuel cell water generation and transfer
g. P5.10-2 - Crew evaluation of fuel cell water potability
h. P20.11-4 - ECS water usage
i. P20.11-6 - LiOH Usage
j. P20.11-7 - Crew Food and Water Requirements
k. P4.10-1 - Postlanding ventilation adequacy
l. P4.10-2 - Automatic operation of postlanding ventilation values.

2. Procedures - Normal mission activities

3. Data Requirements

- CSM HBR Data (M) (15 sec per rev)

4. Crew logs or Voice Record Requirements

a. Water usage per crew per day (M)
b. Comments on any discomfort or difficulty encountered during use of urine subsystem and fecal containment system. (M)
c. Comments on changes in O_2 flow during times that overboard drain switch is in DUMP position. (HD if T/M not available).
d. Comments on noxious odors (M)
e. Comments on adequacy of procedures and equipment used for potable water chlorination (M)
f. Debriefing comments on postlanding ventilation to include the following:
   - Adequacy of ventilation during fan operation. (M)
   - Adequacy of intake and exhaust ventilation valves to prevent the entry of sea water if the CM tilted 60°. (M)
   - Approximate time in hours that fans operated at HIGH flow and LOW flow. (HD)
   - Time that fans were operated and reason for final cessation of fan operation (M)

CRYOGENIC STRATIFICATION TESTS

A. DTO/FTO Requirements

1. P5.8 - Zero-G Effects on Cryogenics

   a. P5.8-1 - Conduct Heater and Fan Test (90% Quantity)
   b. P5.8-2 - Conduct Heater and Fan Test (60% Quantity)
   c. P5.8-3 - Conduct Heater and Fan Test (15% Quantity)

2. P5.9 Cryogenic Pressure Control

   a. P5.9-1 - Evaluate Adequacy of Cryogenic Pressure Control

B. Activities

1. Cryogenic Stratification Test 1

   a. H_2 Quantity: 90 ± 5%
   b. O_2 Quantity: 90 ± 5%

2. Cryogenic Stratification Test 2

   a. H_2 Quantity: 60 ± 5%
   b. O_2 Quantity: 60 ± 5%

3. Cryogenic Stratification Test 3

   a. H_2 Quantity: 15 ± 5%
   b. O_2 Quantity: 15 ± 5%

4. Cryogenic Pressure Control

   a. Throughout the mission

C. Procedures

1. H_2 Test Procedures

   a. The following are required:
      - Steady state power
      - Quantity balance
      - Tank pressures
      - Total H_2 flow to the F/C's exceeds minimum flow required to prevent overpressurization (see curve - Fig. 4-4)

b. H_2 heaters (both) - OFF

H_2 fans (both) - OFF (Record GET)

c. When either H_2 TANK PRESS reaches 230 psia:

H_2 heaters (both) - ON (Record GET)

d. Monitor H_2 TANK PRESS (both) for 260-265 psia limit; note rate of pressure rise

e. At approximately 260-265 psia (either tank):
H_2 heaters (both) - OFF

H_2 fans (both) - ON (Record GET)

f. H_2 heaters (both) - AUTO

H_2 fans (both) - AUTO (Record GET)

2. O_2 Test Procedures

a. The following are required:
- Steady state power
- Quantity balance
- Tank pressures
- Total O_2 flow to the F/C's exceeds minimum flow required to prevent overpressurization (see curve - Fig. 4-5)

b. O_2 heaters (both) - OFF

O_2 fans (both) - OFF (Record GET)

c. When either O_2 TANK PRESS reaches 820 psia:

O_2 heaters (both) - ON (Record GET)

d. Monitor O_2 TANK PRESS (both) for 910 psia. Note rate of pressure rise.

e. At approximately 910 psia (either tank):
O_2 heaters - OFF

O_2 fans - ON (Record GET)

O_2 heaters (both) - AUTO

f. O_2 fans (both) - AUTO (Record GET)

D. Data Requirements

- CSM LBR Data (M)

E. Crew Logs or Voice Record Requirements

- If manual balancing of tanks is required, record GET times that H_2 heaters switches (1 and 2), H_2 fan switches (1 and 2), O_2 heater switches (1 and 2), and O_2 fan switches (1 and 2) are changed; also record the new switch position (ON, OFF or AUTO),

Figure 4-4. Cryogenic H_2 Heater and Fan Duty Cycles

(curves to be supplied)

Figure 4-5. Cryogenic O_2 Heater and Fan Duty Cycles

(curves to be supplied)

COAS EVALUATION

A. DTO/FTO Requirements

1. S20.20 - COAS Evaluation

   a. S20.20-5 - Perform COAS calibration
   b. S20.20-6 - Perform P53 backup IMU orientation determination.
   c. S20.20-7 - Perform P54 backup IMU realign
   d. S20.20-8 - Perform IMU/GDC alignment w/o CMC
   e. S20.20-9 - Align camera with COAS (16mm sequence camera)
   f. S20.20-10 - Evaluate optical properties

B. Procedures - Accomplish above listed requirements using standard procedures.

C. Data Requirements

. CSM LBR Data (M)

D. Crew Log or Voice Record Requirements

. Subjective crew comments on all phases of the use of the COAS.

SEXTANT TRACKING

A. DTO/FTO Requirements

1. P1.10 - Sextant Tracking

   a. P1.10-1 - CSM Behind and Below S-IVB
   b. P1.10-2 - CSM Ahead and Above S-IVB
   c. P1.10-3 - CSM Separated from S-IVB (ranges up to 400 nm)
   d. P1.10-4 - Auto Maneuver to Tracking Attitude and Auto Optics Positioning

B. Activities

1. Perform pre-rendezvous sextant tracking

2. S-IVB tracking at 80 nm (post-rendezvous)

3. S-IVB tracking at 160 nm (post-rendezvous)

4. S-IVB tracking at 320 nm (post-rendezvous)

C. Procedures (Post Rendezvous)

1. The following updates are required for post-rendezvous tracking:

   a. CSM state vector (Time tag at S/C sunrise)
   b. S-IVB state vector (Time tag at S/C sunrise)
   c. T_0: Time to initiate sighting - Target sunrise
   d. GET Align if required (Sunrise time of the night pass in which P52 is performed)
   e. R, P, Y. (CDU fly-to-angles to assist in target acquisition at target sunrise of SXT SA 0° and SXT TA 0°.)

2. Align IMU to nominal alignment (Option 2) during the night pass preceding tracking.

3. Use P20 checklist procedure to track S-IVB.

4. Allow 10 seconds minimum between marks if recording LBR, and 2 seconds minimum if recording HBR.

5. Monitor both the S/C auto maneuver to tracking attitude and the auto optics positioning.

D. Data Requirements

. CSM LBR Data (M)

E. Crew Logs or Voice Record Requirements

1. Record GET that S-IVB tracking became feasible (M)

2. Subjective comments regarding:

a. Adequacy of auto optics positioning.
b Ability to track S-IVB.

RENDEZVOUS

A. DTO/FTO Requirements

1. P20.13 - CSM Active Rendezvous

   a. P20.13-1 Terminal Phase Initiate (TPI)
   b. P20.13-2 Terminal Phase Final (TPF)

2. S20.20 - COAS Evaluation

   a. S20.20-2 Evaluate COAS in conjunction with rendezvous

B. Activity - Rendezvous (TPI then TPF)

C. Procedures

1. Perform rendezvous per rendezvous procedures plan.

2. Record HBR data (DSE) from 10 seconds prior to 10 seconds after each burn if MSFN coverage not available.

D. Data Requirements

1. CSM LBR Data (M)

2. CSM HBR Data (HD)

E. Crew Logs or Voice Record Requirements

1. Comments on rendezvous procedures and maneuvers (M)

2. Comments on adequacy of backup charts (M)

3. Comments on COAS

SPS G&N BURN NO. 1 (RENDEZVOUS NCC1 BURN)

A. DTO/FTO Requirements

1. P1.13 - GNCS ΔV Control

   a. P1.13-1 - One SPS Maneuver (10-30 seconds)

2. P1.16 - IMU Performance

   a. P1.16-2 - Evaluate IMU performance (data gathering)

3. P2.3 - EMS Performance

   a. P2.3-3 - Evaluation of EMS ΔV counter for maneuvers

4. P20.11 - Consumables Usage

   a. P20.11-1 - SM/RCS for translational requirements
   b. P20.11-2 - SPS required for various ΔV's

B. Activity - SPS Burn No. 1

1. Burn Profile

Time (Min:Sec)	ΔV (Ft/Sec)	Engine
00:15	5.8	4 JET RCS
00:09.6	208.6	SPS

2. Perform normal G&N SPS burn (scheduled during Rendezvous as NCC1 burn).

C. Data Requirements

. CSM HBR Data (M) (from 60 seconds prior to burn to end of burn)

D. Crew Logs or Voice Record Requirements

1. EMS ΔV set in prior to the burn and ΔV at end of burn.

2. Subjective crew comments on success of maneuver.

SPS G&N BURN NO. 2 (RENDEZVOUS NSR BURN)

A. DTO/FTO Requirements

1. P1.13 - GNCS ΔV Control

   a. P1.13-2 - One SPS maneuver (0.5-8 seconds)

2. P1.16 - IMU Performance

   a. P1.16-2 - Evaluate IMU performance (data gathering)

3. P2.3 - EMS Performance

   a. P2.3-3 - Evaluation of EMS ΔV counter for maneuvers

4. P20.11 - Consumables Usage

   a. P20.11-1 SM/RCS for translational requirements
   b. P20.11-2 - SPS required for various ΔV's

B. Activity

1. Burn Profile

Time (Min:Sec)	ΔV (Ft/Sec)	Engine
00:15	6.0	4 JET RCS
00:08.4	185.6	SPS

2. Perform normal G&N SPS burn (scheduled during Rendezvous as NSR burn).

C. Data Requirements

- CSM HBR Data (M) (from 60 seconds prior to burn to end of burn)

D. Crew Logs or Voice Record Requirements

1. EMS ΔV set in prior to the burn and ΔV at end of burn (M)

2. Subjective crew comments on success of maneuver (M)

SCT DAYLIGHT STAR OBSERVATIONS

A. DTO/FTO Requirements

1. P1.7 - IMU Orientation Determination

   a. P1.7-1 - 3 star count exercises early in mission
   b. P1.7-2 - 1 star count late in mission
   c. P1.7-3 - 1 P51 IMU Orientation Determination

B. Activities

1. Perform three star counts early in mission:

   a. SCT star observations - count the number of stars visible during daylight early in the mission through the SCT for the following conditions:

      . SCT SUN LOS 120° (with window shades)
      . SCT SUN LOS 70° (with window shades) (HD)
      . SCT SUN LOS 120° (w/o window shades) (HD)

2. SCT Star Observations - Perform one star count late in the mission - SCT SUN LOS 120° (with window shades)(HD)

3. IMU Orientation Determination - Perform in the 15-minute period following sunset.

4. Alternates: (If prime activities are not successful)

   a. SXT star observation with SXT pointed away from earth and sun
   b. SXT star observation with SXT to sun LOS between 40° and 70°
   c. Luminance check with CSM +X axis to sun LOS 120°
   d. Luminance check with CSM +X axis to sun LOS 70°

C. Procedures

1. SCT Star Observation

   a. The following are required:

      . CMC - ON
      . IMU - ON
      . SCT - SA 0°, TA 0°
      . SCS - powered up
      . Window shades installed (except for 120° without window shades)
      . Cabin lights subdued

b. Receive the following updates:

- State vector (if test is conducted with IMU initially powered down) - Time tag to spacecraft sunrise
- GET align. The time of align will be the spacecraft sunset time of the night pass that the test is initiated
- GET_{SR}. Spacecraft sunrise
- R, P, Y. CDU fly-to-angles at sunrise for a SCT-SUN LOS of 120° (or 70°) with SCT shaft and trunnion angles of 0°.
- GET_{SS} spacecraft sunset time minus 12 minutes
- R, P, Y CDU fly-to-angles to achieve a SCT-SUN LOS of 120° (or 70°) with SCT shaft and trunnion angles of 0°.

c. Maneuver to updated attitude for GET_{SR}. Maintain attitude hold, maximum deadband.
d. Initiate SCT observation at SR-15 for darkness adaptation
e. At SR, count stars visible in SCT; count stars at 4-minute intervals until SR + 12 minutes
f. Maneuver to updated attitude for GET_{SS}. Maintain attitude hold, maximum deadband
g. At SS-12 minutes, count stars visible in SCT; count stars at 4-minute intervals until SS
h. Keep ground appraised of star visibility conditions during test. The use of the SCT will be discontinued in any sighting where no stars are visible in the SCT-FOV. Star counting is not required in any interval in which the stars noted number greater than 50.

2. SXT Star Observation (See Figure 4-6 when implemented)

a. The following are required:

- CMC - ON
- IMU - at known orientation
- SCS - powered up
- Window shades installed
- Cabin lighting subdued

b. Ground Update:

- GET Start of test
- R, P, Y CDU fly-to-angles to acquire Star A with SXT shaft and trunnion angles of 0°
- Navigation Star A (a star away from the sun and earth)
- Navigation Star B (a star that provides a SXT/SUN LOS of 40 to 70 deg. when boresighted in SXT)

c. Maneuver to updated attitude prior to sunrise

d. During daylight, use auto-optics to acquire Star A. With Star A centered on the reticle, count stars visible in the SXT-FOV.

e. Repeat procedure for Star B

3. Luminance Check (See Figure 4-6 when implemented)

a. The following are required:

- CMC - ON
- IMU - at known orientation
- SCS - powered up
- Spotmeter - unstowed

b. Ground update:

- GET_{SR} spacecraft sunrise
- R, P, Y CDU fly-to-angles at sunrise for a S/C +X axis SUN LOS of 120° (or 70°), heads down
- GET_{SS} spacecraft sunset minus 12 minutes
- R, P, Y CDU fly-to-angles at sunset for a S/C +X axis SUN LOS of 120° (or 70°), heads down

c. Obtain and record spotmeter readings through LH rendezvous window at updated attitude and at times noted in primary procedure.

D. Data Requirements

- CSM LBR Data (M)

E. Crew Logs or Voice Record Requirements

1. The number of stars seen at each sighting (M).

2. The time of each sighting (GET). (M)

3. The SCT or SXT shaft and trunnion angles at each sighting. (If CG 0001 V is not available). (M)

4. The names of up to two identifiable stars and their reticle coordinates to the nearest degree as determined by the SCT or SXT reticle at each sighting. (HD)

5. The time of installation of the window shades and dimming of the cabin lights.

6. The time of removal of the window shades. (HD)

7. Earth cloud cover estimate at each sighting by any astronaut. (HD)

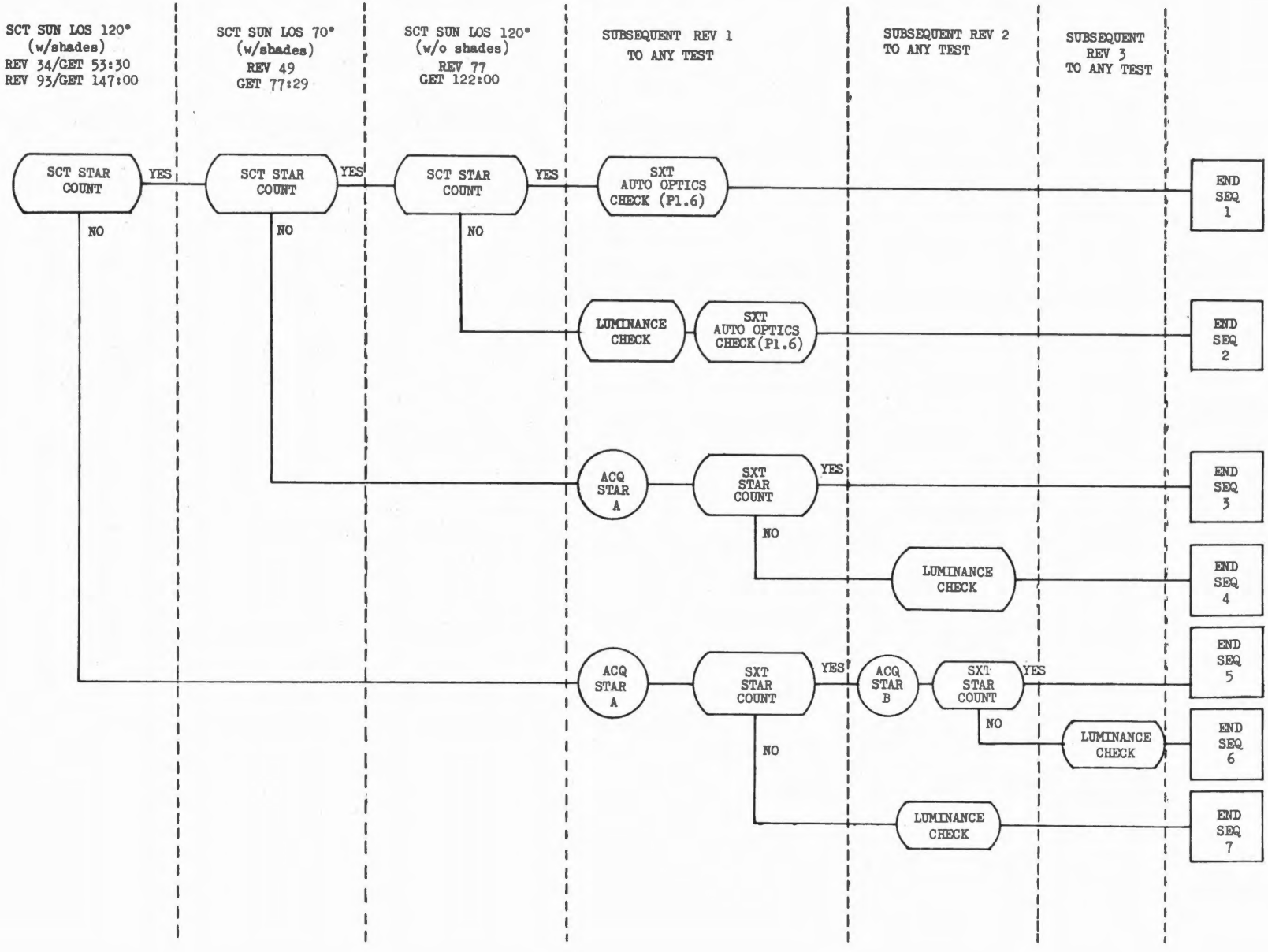
8. The window used, the condition of the window as to cleanliness, and the sky color are to be logged along with the luminance reading of the spotmeter. (To be done only if star counting with SCT is impossible.) (M)

9. SXT star counts to include CSM inertial attitude, name of navigational star, number of stars, GET and astronauts comments. (To be done only if star counting with SCT is replaced by star counting using the SXT.) (M)

10. Comment on whether the auto optics positioning routine placed a known star in the FOV, and comment on the position of the star in the FOV. (M)

11. Comment on whether SCT - LOS is aligned on same star as SXT - LOS (M)

Figure 4-6. Star Count Operational Sequence



SYNOPTIC TERRAIN PHOTOGRAPHY

A. DTO/FTO Requirements

1. S005 - Synoptic Terrain Photography

B. Activities

1. Strip Photography with S0121 color film
2. Strip Photography PAN-X black & white film
3. Stereo Photos with S0121 color film
4. Multispectral Photography with PAN-X black & white film
5. Multispectral Photography with S0121 color film

C. Procedures

1. Prepare camera accessories for photography as time permits or as per ground update
2. Interior lights - OFF
3. Record photo log
4. Control spacecraft attitude as required to photograph area of interest if propellant is available:
   a. Window should be parallel to earth's surface as possible
   b. NADIR photos are desired for best data
   c. Control roll as required to keep spacecraft window in shade if propellant is available
   d. Photography should be done between 9 a.m. and 3 p.m. local time, unless otherwise updated
5. Strip photos - a long sequence of overlapping photographs taken every 5 seconds to cover large land areas
6. Stereo photos - two or more photographs taken 5 seconds apart, to cover small land areas
7. Multispectral photos - Photographs of identical land areas using different film/filter combinations
8. Strip photography with S0121 color film of the following areas:
   a. Southwest United States with emphasis on San Diego Imperial Valley - Yuma area, Tucson, El Paso, and New Orleans

b. Southern Mexico
c. Northern Chile and adjacent areas
d. Southeast Coast of South America
e. Lake Chad and adjacent areas
f. Southwest Coast of Africa
g. Eastern and Southern Africa
h. Southwest Asia - Iran, Oman, and West Pakistan
i. Southern India
j. Indonesia
k. Northwest Australia
l. Solomon Islands

. Ruguria Is.
. Killinalau Is.
. Ontong Java, Is.

9. Strip photography with PAN-X black & white film of the following areas:

a. Southwest United States with emphasis on San Diego Imperial Valley - Yuma area, Tucson, El Paso; and New Orleans

10. Stereo photography with SO121 color film of the following areas:

a. Colorado River mouth
b. Mississippi River mouth
c. Any other river mouths in Southeast United States
d. Florida Straits
e. Tongue of the Ocean
f. Echo Bank (shoal; no island visible)
g. Argus Island (Texas tower)
h. Dry lake in Mexico (Bolson de Mapina)
i. Dry lake in Mexico (Laguma de Mayran)
j. Dry lake in Mexico (Guadalupe)
k. Dry lake in Mexico (San Luis Potosi)
l. Yucatan coastal waters
m. Oyster Bay, Jamaica
n. St. Andrews and Old Providence Islands
o. Northeast Coast of South America
p. Amazon River mouth
q. Northwest Coast of South America
r. Liberia
s. Congo River mouth
t. Diego Garcia Islands (Chagos Islands)
u. Dangerous ground, South China Sea
v. Wake Island
w. Johnson Island
x. Islands in large area North and Northeast of Phoenix Island
y. Christmas Island
z. Danger and Nassau Islands
aa. Hawaii

11. Multispectral Photography with PAN-X black & white film using different filter combinations and S0121 color film of the following areas:

a. Primary Areas

- Baja California, West Coast
- Baja California, East Coast
- Gulf California
- Arizona, Tucson, Wilcox Lake
- New Mexico, Lordsburg, Deming
- New Mexico, Texas, El Paso
- Texas, Fort Worth, Dallas
- Georgia Coast
- Bermuda

b. Secondary Areas

- Africa, Mauritania
- Africa, Mali
- Africa, Ghana
- Gulf of Guinea, Principle Island
- Africa, Gabon, Bay of Mondah
- Africa, Congo Republic
- Zambia
- Africa, Malawi
- Africa, Mozambique Coast
- Malagasy Republic W. Coast

D. Crew Logs or Voice Record Requirements

1. GET within $\pm$ 5 seconds of the beginning and end of each group of strip photographs. (M)

2. GET within $\pm$ 5 seconds of each single frame photograph. (M)

3. Magazine number for each single frame photograph or strip of photographs. (M)

4. Frame number of first and last frame for each group of strip photographs. (M)

5. Frame number for each single frame photograph. (M)

6. General location of each single frame photograph unless it is obvious that some prominent terrain feature will provide positive identification of the scene. (M)

7. Unusual camera setting for any specific single frame photograph. (HD)

8. Any window obscuration that would possibly degrade the usefulness of any strip or single frame photograph. (HD)

SYNOPTIC WEATHER PHOTOGRAPHY

A. DTO/FTO Requirements

1. S006 - Synoptic Weather Photography

B. Procedures

1. Prepare camera and accessories for photography as time permits or as per ground update.

2. Interior light - OFF

3. Record in photo log

4. Control spacecraft attitude as required to photograph area of interest if propellant is available.

   . Control roll as required to keep spacecraft window in shade if propellant is available

   . Photography should be done between 9 a.m. and 3 p.m. local time, unless otherwise updated.

5. Desired photographic coverage areas:

   . W01 - Tropical storms
   . W01A - Precursor easterly waves over North Equatorial Africa
   . W01B - Incipient disturbed areas north of the Atlantic inter-tropical convergence zone
   . W02 - Extra-tropical storms
   . W03 - Frontal cloud patterns
   . W04 - Thunderstorms
   . W04A - Indonesia
   . W04B - Southern U.S.A.
   . W04C - Guinea Coast countries
   . W05 - Coastal cloudiness - sea breeze effects
   . W05A - India
   . W05B - East Coast of Florida, South Carolina, Georgia
   . W05C - Texas Coast
   . W05D - South Peru and Chile
   . W05E - Venezuela
   . W05F - Eastern Brazil
   . W05G - Capetown, South Africa area
   . W06A - Galapagos Islands
   . W06B - Northwest of Sumatra
   . W06C - Southwest of Sumatra
   . W06D - Hawaiian Islands
   . W06E - Mozambique Channel
   . W07 - Eddies induced by islands or coastal prominences
   . W07A - Guadalupe Islands

- W07B - Cape Verde Islands
- W07C - Canary Islands
- W07D - Madeira Islands
- W08 - Mountain - Induced clouds
- W08A - Wave clouds in lee of Andes
- W08B - Wave clouds in lee of Sierra Nevada
- W09 - Cloud streets
- W10 - Cellular cloud patterns
- W11 - Complex convective cloud patterns
- W12 - Cirrus clouds
- W12A - Jet stream cirrus
- W12B - Cirrus movement
- W12C - Cirrus from thunderstorm tops
- W12D - Cirrus from 1 CZ
- W13 - Fog and stratus patterns on land
- W14 - Ship contrails
- W15 - Wet and dry ground
- W16 - Indicators of climatic zones and changes
- W17 - Flooding
- W18 - Snow cover
- W18A - Mountains of the Southwest U.S. and Mexico
- W18B - Andes Mountains
- W18C - Atlas Mountains
- W18D - Kenya and Tanganyika
- W18E - Himalayas
- W19 - Air pollution
- W19A - Smoke from industrial sources
- W19B - Smoke from forest fires
- W19C - Los Angeles Basin
- W20 - Dust storms
- W20A - Sahara
- W20B - Arabian Peninsula
- W20C - Asia
- W21 - Atmospheric layers observed at twilight
- W22 - Sand dunes
- W22A - Southwest Africa
- W22B - Western Sahara
- W22C - Arabian Peninsula
- W23 - Sun glitter on ocean
- W24 - Water color
- W24A - Gulf stream
- W24B - Lombok Straits
- W24C - West of Gilbralter
- W25 - Shorelines showing surf
- W26 - Ocean bottom configuration
- W26A - Bahama area
- W26B - Eastern Puerto Rico - Virgin Islands area
- W27 - Special studies
- W27A - Barbados experiment
- W27B - Florida convective activity
- W27C - Bahama area convective activity

- W27D - Project Stormfury
- W27E - Panama Canal Area
- W27F - Special Weather
- W27G - Satellite Studies

C. Crew Logs or Voice Record Requirements

- GET, object number, magazine number, and magazine frame number of the photographs (M)

WSMR LM RR TEST

A. DTO/FTO Requirements

1. P6.8 - Overpass Simulation with the LM RR

   a. P6.8-1 - First Successful Pass Over WSMR
   b. P6.8-2 - Second Successful Pass Over WSMR

B. Activity - WSMR LM RR Test

1. Perform first test

2. Perform second test

C. Procedures

1. Prerequisites

   a. WSMR system verification tests completed
   b. Proper orbits verified by RR Support Specialist
   c. Trajectory meets following constraints during tests:

      . Max range: 400 nm
      . LOS velocity: $\pm$5500 ft/sec
      . LOS acceleration: 300 ft/sec^2
      . Slew rate: Max 2.6°/sec
      . ACQ time: Min 15.0 sec
      . Elevation: Min 8°

2. The following is required:

   a. CMC - ON
   b. IMU - aligned to known orientation
   c. SCS - powered up
   d. RR transponder self-test completed

3. Receive following update:

   a. CSM state vector (if required) - Time Tag to WSMR closest approach
   b. GET align for a nominal alignment (if required). The align time will be the spacecraft closest approach time to WSMR -45 min.
   c. GET_{WSMR}. WSMR AOS
   d. GET_{RR}. Lock-on by RR
   e. R, P, Y CDU fly-to-angles to enable WSMR acquisition (32° 26', 106° 22') at AOS time

4. Maneuver to updated attitude at least 10 min prior to WSMR AOS; null S/C rates.

5. At WSMR AOS, go free drift (disable roll, pitch, and yaw channels) to eliminate RCS plume effects.

6. Repeat transponder self-test check just prior to WSMR AOS. Leave SYSTEM TEST (2) at XPNDR and D; RNDZ XPNDR - PWR

7. Report fluctuations and steady indications of Systems Test Meter needle; record AGC signal level.

8. After WSMR LOS, RNDZ PWR - OFF

D. Data Requirements

- CSM HBR Data (during test) (M)

E. Crew Logs or Voice Record Requirements

- Rendezvous Radar AGC signal level as shown on panel 101 SYSTEMS TEST meter (switch 1 in position D and switch 2 in XPNDR position)(HD)

ORBITAL NAVIGATION/LANDMARK TRACKING

A. DTO/FTO Requirements

1. P1.8 - Orbital Navigation/Landmark Tracking

   a. P1.8-1 - One-Orbit Set with 3 x 3 W Matrix
   b. P1.8-2 - Three-Orbit Set of LMK Sightings Using 9 x 9 W Matrix

B. Activities

1. Landmark Tracking (with 3 x 3 W. Matrix)

2. Landmark Tracking (with 9 x 9 W. Matrix)

C. Procedures

1. Receive the following updates:

   a. CSM state vector (voice and cmd) - Time tag to S/C sunrise.
   b. GET align for a nominal alignment (if IMU align required). The time of align will be the spacecraft sunrise time of the night pass in which the P52 is performed.
   c. Landmarks ID. Landmarks selected are greater than 35° elevation to spacecraft, weather 0.3 cloud cover or less, and local time between 0900 and 1500. Update will include whether landmark is North or South of ground track.
   d. GET_{LMK}. Time when spacecraft is within the landmark 35° elevation angle (if landmark is North or South of track).
   e. Available on request:
      . SFT and TRN angles to assist in landmark acquisition for a S/C attitude of R-0°, P-350°, Y-0° with respect to the local horizontal.
      . Orbital Map Node

2. Perform IMU realign each night pass prior to landmark tracking if possible.

3. Perform P22-CSM ORBITAL NAV

4. Update state vector for each landmark sighting (checklist step 12)

5. Obtain a minimum of three marks per known landmark; four per unknown landmarks.

6. If recording LBR, allow ΔV, ΔR (checklist step 12) to remain displayed at least 10 seconds - 2 seconds for HBR recording.

7. For the day 3 sightings, the state vector will be updated by MSFN during each night pass between sightings.

8. Prior to the day 6 sightings, MSFN will update the covariance matrix.

D. Data Requirements

- CSM LBR Data (M)

E. Crew Logs or Voice Record Requirements

1. Time required for recognition of landmark (M)

2. Mode of manual attitude control (M)

3. Ease of use of the optics in the landmark tracking mode (manual dexterity required). (M)

4. Ease of locating and identifying landmarks (include landmark visibility conditions, i.e., clear, partially obscured, etc). (M)

5. CMC computed ΔR, ΔV as read from the DSKY. (M)

SPS SCS AUTO BURN NO. 3/SLOSH DAMPING

A. DTO/FTO Requirements

1. P1.16 - IMU Performance

   a. P1.16-2 - Evaluate IMU performance (data gathering)

2. P2.3 - EMS Performance

   a. P2.3-3 - Evaluation of EMS ΔV counter for maneuvers

3. P2.5 - SCS ΔV control

   a. P2.5-1 - One SPS maneuver in SCS auto (5 seconds)

4. P20.11 - Consumables Usage

   a. P20.11-1 SM/RCS for translational requirements
   b. P20.11-2-SPS required for various ΔV's

5. S20.17 - Propellant Slosh Damping

   a. S20.17-1 - Perform evaluation following an SCS controlled SPS ΔV maneuver.

B. Activities

1. Burn Profile

Time	ΔV	Engine
00:15	6.1	SCS 4 JET RCS
00:05:1	115.7	SPS

2. Perform normal SCS auto SPS burn

3. Perform propellant slosh damping test

C. Procedures

1. SPS Burn

   a. SCS in minimum deadband

   b. Perform activities per checklist except use P40 to display cross-axis error at cutoff.

2. Propellant Slosh Damping Test

   a. Select G&N or SCS maximum attitude hold approximately 10 seconds after SPS shutdown.

b. Select low rate
c. Maintain attitude at time of tail-off for 10 minutes

D. Data Requirements

- CSM HBR Data (M) (during burn and for 10 minutes during propellant slosh damping test after the burn)

E. Crew Logs or Voice Record Requirements

1. EMS ΔV set in prior to burn and ΔV at end of burn (M)

2. Subjective crew comments on handling characteristics and any unusual attitude/rate transients (M)

RADIATOR DEGRADATION TEST

A. DTO/FTO Requirements

1. P7.19 - CSM Primary Radiator Coating Degradation

   a. P7.19-1 - Isolate radiator and perform evaluation of degradation

B. Activity - Radiator Degradation Test

C. Procedures

1. The following are required:

   a. CMC - ON
   b. IMU - at known orientation
   c. S/C electrical load 2100 watts
   d. ECS monitoring and redundant component check completed

2. Receive the following update:

   a. CSM state vector (if GNCS initially powered down)
   b. GET time to initiate test

3. Align IMU as follows:

   a. Maneuver south out-of-plane 30° to 60°
   b. Perform P30 using GET of test initiate as TIG, ΔVX = 00000, ΔVY = +1000, ΔVZ = 00000
   c. Load Dap - N48 (gimbal trim angles); load pitch gimbal angle of+2°, yaw gimbal angle of -1°.
   d. Perform P40 thru Step 5 (Establishes preferred orientation out-of-plane at GET of test initiate)
   e. Perform P52 using Option 1 (Preferred option)

4. Set DET to 47:00

5. Fly to 052°, 0°, 0° by GET test initiate

6. At GET test initiate DET counting up

7. Establish roll left @ 0.07°/sec

8. Disable radiator 1 as follows:

   a. ECS RADIATORS MAN SEL - RAD 2
   b. ECS RADIATORS FLOW CONT - MAN SEL MODE
   c. GLYCOL EVAP TEMP IN - MAN
   d. PRIMARY GLYCOL EVAP INLGT TEMP vlv - MIN HEAT
   e. Maintain ECS RADIATOR TEMP PRIM OUT at 38°F

9. Monitor roll angle vs time as follows:

TIME	ROLL	TIME	ROLL	TIME	ROLL
47:00	052	01:30	000	03:15	300
00:00	000	01:45	300	03:30	240
00:15	300	02:00	240	03:45	180
00:30	240	02:15	180	04:00	120
00:45	180	02:30	120	04:15	060
01:00	120	02:45	060	04:30	000
01:15	60	03:00	000		

10. Terminate test when ECS RADIATOR TEMP PRIM OUT goes below 38° or at 04:30 time elapse from start of test as follows:

    a. GLY EVAP TEMP IN - AUTO
    b. ECS RADIATORS FLOW CONT - PWR
    c. ECS RADIATORS MAN SEL - CENTER

D. Data Requirements

. CSM HBR Data (M) (as available from MSFN)

E. Crew Logs or Voice Record Requirements

. None Required

MIDCOURSE NAVIGATION

A. DTO/FTO Requirements

1. P1.15 - Midcourse Navigation

   a. P1.15-1 - Perform earth horizon sightings on the three different horizon locators.
   b. P1.15-2 - Perform at least six sets of star/earth horizon sightings under optimum lighting conditions using the optimum locator.
   c. P1.15-3 - Perform star/earth horizon sightings with various lighting conditions.

B. Activities

1. Perform earth horizon observations on the three different horizon locators to determine which one is the best for sightings.

2. Perform six sets of star/earth horizon sightings under optimum lighting conditions using the optimum locator.

3. Perform star/earth horizon sightings with degraded lighting conditions.

C. Procedures

1. The following is required:

   a. IMU powered up
   b. OSS powered up
   c. CMC powered up

2. Observe the horizon and determine which of the three horizon locators is the best.

3. Take 6 sightings (3 marks per sighting) using STAR/HORIZON technique with optimum lighting conditions.

4. Take 3 sightings (3 marks per sighting) using STAR/HORIZON technique with degraded lighting conditions.

5. The P23 checklist shows an optics calibration check each time the procedure is accomplished.

   For this mission, an optics calibration check is only required at beginning and end of the mission.

D. Data Requirements

. CSM HBR Data (M)

E. Crew Logs or Voice Record Requirements

1. Subjective comments on which locator is easiest to see and reasons (M)

2. Time at which each star/horizon exercise is started (M)

3. DSKY displays shaft angle and trunnion angle and mark time. (Required if data are not recorded on tape recorder or telemetered down.)

4. Star identification

5. Horizon identification (near or far)

SPS G&N BURN NO. 4 (MINIMUM IMPULSE/SLOSH DAMPING)

A. DTO/FTO Requirements

1. P1.16-IMU Performance

   a. P1.16-2-Evaluate IMU performance (data gathering)

2. P2.3 - EMS Performance

   a. P2.3-3 - Evaluation of EMS ΔV counter for maneuvers

3. P3.14 - SPS Minimum Impulse Burn

   a. P3.14-1 - One SPS minimum impulse burn (0.5 - 1.0 second) G&N.

4. P20.11 Consumables Usage

   a. P20.11-1 - SM/RCS for translational requirements
   b. P20.11-2 - SPS required for various ΔV's.

5. S20.17 - Propellant Slosh Damping

   a. S20.17-2 - Perform evaluation following a G&N controlled ΔV maneuver.

B. Activity

1. Burn Profile

ΔTime (MIN:SEC)	ΔV (FT/SEC)	Engine
00:20	4.4	2 JET RCS
00:00.5	14.9	SPS

2. Perform normal G&N SPS Burn

3. Perform propellant slosh damping test

C. Procedures

1. Perform normal G&N SPS burn

2. Inhibit attitude hold approximately 10 seconds following SPS shutdown.

3. Terminate at end of 3 minutes or if attitude error is greater than 50 degrees or if rate is greater than 2°/second.

D. Data Requirements

- CSM HBR Data (M) (during burn and for 10 minutes during propellant slosh damping test after the burn).

E. Crew Logs or Voice Record Requirements

1. EMS ΔV set in prior to burn and ΔV at end of burn (M).

2. Verify PU valve setting prior to burn (MDC-3) (M).

SPS G&N MTVC BURN NO. 5

A. DTO/FTO Requirements

1. P1.16 - IMU Performance

   a. P1.16-2 - Evaluate IMU Performance (data gathering)

2. P2.3 - EMS Performance

   a. P2.3-3 Evaluation of EMS ΔV counter for maneuvers

3. P2.6 - G&N/MTVC ΔV Takeover

   a. P2.6-1 - One MTVC Takeover (>10 seconds)

4. P3.15 - SPS Performance

   a. P3.15-1 - One long-duration burn with 2 PT sensors uncovered (57 seconds)

5. P3.16 - PRIM/AUX Propellant Gauging System

   a. P3.16-1 - One long-duration burn with 2 PT sensors uncovered

6. S7.28 - CSM Structural Performance

   a. S7.28-2 - Obtain structural vibration data during SPS maneuvers

7. P20.11 - Consumables Usage

   a. P20.11-1 - SM/RCS for translational requirements
   b. P20.11-2 - SPS required for various ΔV's

B. Activity - SPS Burn No. 5

1. Burn Profile

ΔTime (MIN:SEC)	ΔV (FT/SEC)	Engine
00:20	4.4	2 JET RCS
00:61.5	1465.4	SPS

2. Perform G&N burn with MTVC takeover for the last 30 seconds.

C. Data Requirements

1. CSM HBR Data (M)

2. FQR (beginning 30 seconds before ullage through 30 seconds after SPS shutdown)

D. Crew Logs or Voice Record Requirements

. Comments on handling characteristics and any unusual attitude/ rate transients (M)

PASSIVE THERMAL CONTROL TESTS

A. DTO/FTO Requirements

1. S7.24 - Passive Thermal Control Procedure

   a. S7.24-1 - Determine initial coning angles

B. Activities

1. Passive Thermal Control Test 1

2. Passive Thermal Control Test 2 (HD)

3. Passive Thermal Control Test 3 (HD)

C. Procedures

1. Prerequisites

   a. PTC must be accomplished above 200 nm
   b. SPS propellant quantity should be approximately 2000 pounds (HD)
   c. No SPS burns should be accomplished between the three tests (HD)

2. The following is required:

   a. CMC - ON
   b. IMU - At known orientation
   c. SCS - Powered up and aligned to IMU

3. Receive following update:

   a. CSM state vector (Time tag to GET align)
   b. T_0. GET to start pretest preparation
   c. GET align. T_0 + 26 minutes
   d. R, P, Y. CDU fly-to-angles for S/C orientation. (To position S/C along the local horizontal at T_0 + 26 minutes.)

4. Maneuver to and maintain updated attitude.

5. At T_0 select SCS attitude hold, minimum deadband. DET counting up.

6. At T_0 + 5 minutes, set up a roll rate of approximately 0.3°/sec; maintain pitch and yaw attitude hold.

7. At T_0 + 26 minutes, disable pitch and yaw channels. Minimize S/C disturbances and crew motion during the next 20 minutes.

8. At T_0 + 46 minutes - end of Test

D. Data Requirements

- CSM LBR Data (M) two minutes prior to and 20 minutes after release of ATT HOLD

E. Crew Logs or Voice Record Requirements

- Voice record of sequence of events as accomplished (M)

SPS COLD SOAK

A. DTO/FTO Requirements

1. P3.20 - SPS Propellant Thermal Control

   a. P3.20-1 - Normal Operation
   b. P3.20-2 - Cold Soak

B. Activities

1. Normal SPS Propellant Fuel Thermal Control

2. SPS Cold Soak

C. Procedures - SPS Cold Soak

1. The following is required:

   a. CMC - ON
   b. IMU - at known orientation for two revs preceding test to determine attitude timeline for determination of structural and skin temperatures.
   c. SCS - powered up
   d. Perform at least 2 hours following an SPS burn

2. Receive the following update:

   a. CSM state vector (if required) - Time tag to spacecraft sunrise
   b. GET of test initiate
   c. GET align. The time of align will be the spacecraft sunrise of the day pass that the test will commence.
   d. R, P, Y CDU fly-to-angles to place S/C +X axis toward sun.

3. Maneuver to updated attitude. Maintain attitude hold, maximum deadband for 3 hours.

4. Monitor SPS PRPLNT TANKS TEMP

5. SPS LINE HTRS - A/B @ 45° (OFF @ 65°)

6. MSFN will monitor temperature trend data from TEMP 1 or DISTR line (SP0054T) and TEMP 1 Fuel DIST (SP0057T) for minimums of 33° and 25° respectively.

D. Data Requirements

1. CSM HBR Data (M) (as available from MSFN)

E. Crew Log or Voice Record Requirements

None required

ECS SECONDARY COOLANT LOOP TEST

A. DTO/FTO Requirements

1. P4.8 - CSM Secondary Coolant Loop

   a. P4.8-1 - Operate on Secondary Coolant Loop (Primary Loop Deactivated)
   b. P4.8-2 - Evaluate Radiator Operation
   c. P4.8-3 - Evaluate Evaporator Performance

B. Activity - Secondary Coolant Loop Test

C. Procedures

1. Prerequisites

   a. Potable and waste water quantity must total at least 30 pounds.
   b. Terminate test if total water quantity decreases to 15 pounds.
   c. DSE off, SCE duty cycle TBD, and CMC and IMU in standby.

2. Establish S/C secondary coolant loop operation per checklist (about 1800 watts)

3. Activate secondary coolant loop; deactivate primary coolant loop (T=0)

4. Operate in this configuration for 2.0 revolutions

5. At T+3 hrs establish S/C power load of about 2200 watts (configuration TBD).

6. Operate for 3.0 revolutions

7. At T+4.5 hrs perform humidity survey. Record dew point measurements.

8. At T+7.5 hrs activate primary coolant loop; deactivate secondary coolant loop

NOTES

1. If desired, the primary loop pumps can be turned on for about 5 minutes each orbit, and a check made of radiator outlet temperature change.

2. The following MDC displays are inoperative with the SCE off:

   a. F/C 1, 2, 3 Cond Exit
   b. F/C 1, 2, 3 Skin Temp
   c. SPS Flange Temp Hi
   d. INV 1, 2, 3 Temp Hi

D. Data Requirements

   . CSM HBR Data (M) (As near continuous as possible: The minimum requirements are 15 sec per hour.)

E. Crew Logs or Voice Record Requirements

   1. If SCE is off, record data from DC-AMPS meter (M9/MDC-3) at least once each hour during both high and low thermal loads. (HD)

   2. Record the initial position of SECONDARY CABIN TEMP valve, new position if changed, and GET of changes. (HD)

SPS G&N BURN NO. 6 (MINIMUM IMPULSE)

A. DTO/FTO Requirements

1. P1.16 - IMU Performance

   a. P1.16-2 - Evaluate IMU performance (data gathering)

2. P2.3 - EMS Performance

   a. P2.3-3 - Evaluation of EMS ΔV Counter for maneuvers

3. P3.14 - SPS Minimum Impulse Burn

   a. P3.14-2 - One SPS minimum impulse burn (0.5-1.0 second) G&N

4. P20.11 - Consumables Usage

   a. P20.11-1 - SM/RCS for translational requirements
   b. P20.11-2 - SPS required for various ΔV's

B. Activity

1. Burn Profile

ΔTime (MIN:SEC)	ΔV (FT/SEC)	Engine
00:20	5.0	2 JET RCS
00:00.5	16.9	SPS

2. Perform G&N Minimum Impulse Burn

C. Data Requirements

. CSM HBR Data during burn (M)

D. Crew Logs or Voice Record Requirements

1. EMS ΔV set in prior to burn and ΔV at end of burn (M)

2. Verify PU valve setting prior to burn (MDC-3) (M)

SCS BACKUP ALIGNMENT

A. DTO/FTO Requirements

1. P2.10-SCS Backup Alignment Procedure

a. P2.10-1 - SCS Backup Alignment

B. Procedures - SCS Backup Alignment

. Perform backup alignment per checklist procedures

C. Data Requirements

1. CSM LBR Data (M)

2. CSM HBR Data (M) during attitude maneuvers or real time T/M in order to accurately determine amount of propellant required.

D. Crew Logs or Voice Record Requirements

1. Actual CDU reading from DSKY when at simulated thrusting attitude, and elapsed time for procedure

2. Subjective comments on evaluation of controls, displays, and procedures

SPS SCS AUTO BURN NO. 7

A. DTO/FTO Requirements

1. P1.16 - IMU Performance

   a. P1.16-2 - Evaluate IMU Performance (data gathering)

2. P2.3 - EMS Performance

   a. P2.3-3 - Evaluation of EMS ΔV counter for maneuvers

3. P2.5 - SCS ΔV control

   a. P2.5-1 - One SPS maneuver in SCS auto (5 seconds)

4. P20.11 - Consumables Usage

   a. P20.11-1 - SM/RCS for translational requirements
   b. P20.11-2 - SPS required for various ΔV's.

B. Activity - SPS Burn No. 7

1. Burn Profile

ΔTime (MIN:SEC)	ΔV (FT/SEC)	Engine
00:15	7.2	4-JET RCS
00:07.7	202.5	SPS

2. Perform normal SCS AUTO SPS burn

C. Data Requirements

. CSM HBR Data (M)

D. Crew Logs or Voice Record Requirements

1. Comments on handling characteristics and any unusual attitude/rate transients. (M)

2. EMS ΔV reading at end of burn (M)

GENERAL DTO'S

1. P1.14 - GNCS Entry Monitoring
2. P1.16 - IMU Performance
3. P2.3 - EMS Performance
4. P7.20 - Flat Apex Thermal Protection
5. S7.28 - CSM Structural Performance
6. P20.11 - Consumables Usage
7. S20.20 - COAS Evaluation

Activities

A. Deorbit SPS Burn

1. Specific DTO/FTO's

a. P1.16 - IMU Performance
b. P2.3-3 - Evaluation of ΔV counter
c. S7.28-2 - Obtain structural vibration data during deorbit SPS burn.
d. S20.20-4 - Evaluate COAS in conjunction with deorbit attitude

2. Procedures

a. Use COAS to verify deorbit burn attitude
b. FLT RCDR - RECORD (TIG - 30 sec)

c. Perform normal deorbit burn

3. Data Requirements

a. CSM HBR Data (M)
b. FQR (30 seconds prior to deorbit burn thru ECO+10 seconds; prior to CM-SM separation through end of tape)

4. Crew Logs or Voice Record Requirements

a. Pre- and post-deorbit burn radiation (M)
b. Subjective comments on displays (M)
c. Subjective comments on use of COAS.
d. Values slewed into ΔV counter before deorbit, and ΔV value remaining after deorbit (M).

B. Entry

1. Specific DTO/FTO's

a. P1.14 - Perform DAP entry, or,
b. P1.14-1a - Perform SCS entry with GNCS displays
c. P2.3-1 - Crew time correlate G-V plot

d. P2.3-2 - Crew comments on entry displays
e. P7.20-1 - Record flat Apex data or recover flat Apex
f. P20.11-8 - CM/RCS Entry usage

2. Procedures - Fly GNCS controlled entry

3. Data Requirements

. CSM HBR Data (M)

4. Crew Logs or Voice Record Requirements

a. Subjective comments on adequacy of DSKY and FDAI displays during DAP entry. (M)
b. RTG from ΔV counter, time-correlated with scroll inertial velocity for three readings minimum (M)
c. Subjective comments on adequacies of displays (M)