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FIGURE 5-5  CSM O₂ PROFILE (ONE TANK)
FIGURE 5-6  CSM H₂ PROFILE (ONE TANK)
LM EPS ANALYSIS

GROUND RULES AND ASSUMPTIONS

1. The descent state batteries go on the line 30 minutes prior to earth liftoff.

2. A 3.6-hour checkout was assumed for lunar orbit.

3. Ascent and descent batteries were paralleled for the powered descent burn and prior to liftoff from the lunar surface.

4. The S-band equipment was assumed on 100 percent from initial activation in lunar orbit until completion of the mission.

5. The rendezvous radar electronics was assumed to be operational for the period of time dictated by the current G Mission flight plan.

6. The primary navigation and guidance subsystem (PGNCS) was left in the operate mode for the entire lunar stay.

7. The forward window heaters were left off for the lunar stay.

---

**TABLE 12 SUMMARY FOR DESCENT STAGE EPS ANALYSIS**

Total load = 1600 A-h
Total unusable for premission planning = 131 A-h (8.2%)
Total used = 1243.0 A-h (77.7%)
Usable remaining at liftoff = 226 A-h (14.1%)
Figure 5-8 presents the descent power profile

---

**TABLE 13 SUMMARY FOR THE ASCENT STAGE EPS ANALYSIS**

Total loaded = 592.0 A-h
Total unusable for premission planning = 31.0 A-h (5.2%)
Total used = 326.0 A-h (55.1%)
Usable remaining at completion of crew transfer = 235.0 A-h (39.7%)
Figure 5-9 presents the ascent power profile
Figure 5-10 presents the descent & ascent current profile
FIGURE 5-9  LM ASCENT POWER PROFILE

Amp hours remaining, A-h

Ground elapsed time, hr

Asc bat c/o
Paralleling
L.O.
CSI
CDH
TPI
Docking
Crew tx comp
FIGURE 5-10 LM TOTAL CURRENT PROFILE

Ground elapsed time, hr

Start of 2nd c/o
DOI
End sim
TD
Start EVA prep
Start EVA
End EVA
Start pwr up
L.O.
CDH
CSI
TPI
Docking
LM ECS BUDGET

GROUND RULES AND ASSUMPTIONS
1. Cabin $\text{O}_2$ leakage rate was 0.1 lb/hr while pressurized

2. Metabolic rates were varied according to Volume 2 of the Spacecraft Operational Data Book.

3. Metabolic $\text{O}_2$ consumed was $(1.643 \times 10^{-4}) \times \text{(metabolic rate)}$.


5. Cabin pressure regulator check requires 2.65 lb of $\text{O}_2$.

6. $\text{H}_2\text{O}$ consumed because of sublimator cooling was total heat removed divided by 1040 (Btu per lb) of $\text{H}_2\text{O}$.

7. $\text{H}_2\text{O}$ lost due to urination was 0.11 lb/hr per man.

8. Cabin temperature control was set to 72°F.

9. Average glycol flow rate was 250 lb/hr.

TABLE 5-14 LM ECS SUMMARY

(a) Descent stage

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<tr>
<th>Description</th>
<th>$\text{O}_2$, lb</th>
<th>$\text{H}_2\text{O}$, lb</th>
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(b) Ascent stage

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FIGURE 5-11 LM DESCENT O₂ PROFILE
Figure 5-14 LM ASCENT H2O PROFILE
MISSION G PLSS CONSUMABLE ANALYSIS

THE RESULTS OF THE PLSS BATTERY, OXYGEN, WATER AND LiOH CONSUMABLE ANALYSIS ARE SUMMARIZED IN THE FOLLOWING FIGURES:

FIGURE 5-15 LMP AND CDR PLSS BATTERY PROFILE
FIGURE 5-16 CDR OXYGEN PROFILE
FIGURE 5-17 LMP OXYGEN PROFILE
FIGURE 5-18 CDR H₂O PROFILE
FIGURE 5-19 LMP H₂O PROFILE
FIGURE 5-20 LMP AND CDR LiOH CO₂ PROFILE
FIGURE 5-15 LMP AND CDR - PLSS BATTERY

VOLTAGE AND CURRENT READOUT IS AVAILABLE ON REAL TIME BASIS.

- INCLUDES END-TO-END TM ERROR.

POWER CONSUMED 42 W/HR.

PLSS CHECKOUT

270 - 290 WATT-HRS.

EVA 2+40 HOURS

RED LINE INTERSECTS AT 5+40 HOURS.

HOURS PLUS MINUTES
NOMINAL LUNAR SURFACE EVA

FIGURE 5-16 CDR - OXYGEN

NOTE A: BASED ON MINIMUM BOTTLE,
378 CU. IN.
1060 PSIA = 1.304

NOTE B: 85 PSIA ULLAGE
67 PSIA GAUGE INACCURACY
52 PSIA UNSABLE

BASED ON PREDICTED METABOLIC RATE
1550 BTU/HR. PLUS PGA SPEC LEAKAGE
.034 LBS/HR. O2

OXYGEN READOUT IS AVAILABLE ON REAL TIME
Basis.
NOTE A: BASED ON MINIMUM BOTTLE, 378 CU. IN. 1060 PSIA = 1.304 LBS.

NOTE B: 85 PSIA ULLAGE 67 PSIA GAUGE INACCURACY 732 PSIA UNUSABLE

BASED ON PREDICTED METABOLIC RATE 1250 BTU/HR PLUS PGA SPEC. LEAKAGE .034 LBS/HR. O₂ OXYGEN READOUT IS AVAILABLE ON REAL TIME BASIS.
NOMINAL LUNAR SURFACE EVA

FIGURE 5-18 CDR - WATER

PREDICTED RATES IN BTU/HR.

A. METABOLIC
   HEAT LEAK (33° SUN ANGLE)
   10/1 CRATER ASPECT RATIO)
   LIOH
   POWER
   TOTAL
   1550
   294
   405
   145
   2394 BTU/HR.

B. METABOLIC
   HEAT LEAK (LUNAR NIGHT)
   LIOH
   POWER
   TOTAL
   1550
   -268
   405
   145
   1832 BTU/HR.

HOURS PLUS MINUTES

FEEDWATER WARNING TONE

RED LINE

EVA 2+40 HOURS

RETURN TO LM

RETURN TO LM

FEEDWATER LBS.
NOMINAL LUNAR SURFACE EVA

FIGURE 5-19 LMP - WATER

PREDICTED RATES IN BTU/HR.

A. METABOLIC
   HEAT LEAK (33° SUN ANGLE)
   LIOH
   POWER
   TOTAL
   1250
   294
   327
   145
   2016 BTU/HR.

B. METABOLIC
   HEAT LEAK (LUNAR NIGHT)
   LIOH
   POWER
   TOTAL
   1250
   -268
   327
   145
   1454 BTU/HR.

HOURS PLUS MINUTES

FEEDWATER WARNING TONE

RED LINE

EVA 2+40 HRS.

30 RETURN TO LM
NOTE A: 1550 BTU/Hr reaches specification limit at 4.2 to 4.6 hours.

NOTE B: 1250 BTU/Hr reaches specification limit at 6.5 to 8.8 hours.
FLIGHT PLAN

120:00
P22 (LM)
EAT PERIOD
(LMT)

132:00
LIFT OFF 122:28:11

136:00
CS1 123:26:27
PLANE CHANCE 123:55:25

138:00
CDH 124:24:25
TP1 125:02:46
TPF

140:00
TRANSFER EQUIPMENT TO CSM THEN IVT TO CSM

142:00
P52 IMU REALIGN
P30 EXT AV
P40 SPS THRUST

144:00

MISSION | EDITION | DATE | TIME | DAY/REV | PAGE
------- | ------- | ---- | ---- | ------- | ----
APOLLO 11 | PRELIMINARY | APRIL 15, 1969 | 120:00-144:00 | 6/LPO | 6-6

MSC Form 8450 (Jan 69) FLIGHT PLANNING BRANCH
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Memorandum

TO: Distribution

FROM: CF/Chief, Flight Crew Support Division

DATE: MAY 12 1969

SUBJECT: Revision A and Option 1 to Apollo 11 Preliminary Flight Plan

In reply refer to:
CF34-9M-78

Enclosed is Revision A and Option 1 to the Apollo 11 Preliminary Flight Plan. Revision A includes:

a. Revisions to the DOI, PDI, Lunar Surface, CSI, CDH, TPI, LM update forms and a new LM form, PDI + 10 minutes abort (Enclosure 1).

b. Revision of the post-EVA period of the detailed timeline to include back contamination procedures (Enclosure 2).

c. A comparison of the LM activation and checkout procedures for the July launch windows (Enclosure 3).

The Option 1 plan includes:

a. A new detailed timeline from docking to splashdown (Enclosure 4). This incorporates a sleep period prior to TEE (TEE delayed 12 hours from the nominal plan) and incorporates the postdocking back contamination procedures.

b. A new summary flight plan (Enclosure 5) which agrees with the Option 1 detailed timeline of (a.) above.

Warren J. North

CF34:TAGuillory:avg 5-8-69

Buy U.S. Savings Bonds Regularly on the Payroll Savings Plan
P30 LM MANEUVER (REV A, MAY 9, 1969)

PURPOSE

PURPOSE OF MANEUVER
(SUCH AS DOI TARGETING)

TIG N33

HR XXX
MIN XX
SEC XX.XX

IGNITION TIME FOR THE MANEUVER

LOCAL VERT N81

ΔVX +XXX.X (fps)
ΔVY +XXX.X (fps)
ΔVZ +XXX.X (fps)
ΔVR +XXX.X (fps)
BT X:XX (MIN:SEC)

LOCAL VERTICAL ΔV
COMPONENTS OF THE
MANEUVER

TOTAL ΔV REQUIRED FOR THE MANEUVER
DURATION OF THE MANEUVER

INERTIAL FDAI ANGLES AT
THE BURN ATTITUDE

FDAI INER

R XXX (DEG)
P XXX (DEG)

N86

ΔVX AGS +XXX.X (fps)
ΔVY AGS +XXX.X (fps)
ΔVZ AGS +XXX.X (fps)

LOCAL VERTICAL ΔV
COMPONENTS OF THE
MANEUVER USED TO
TARGET THE AGS: ROTATED
THROUGH THE HALF-ANGLE
OF THE BURN

COAS STAR CHECK

STAR XX (OCTAL)

IDENTIFIER FOR COAS STAR
USED TO VERIFY SPACECRAFT
ATTITUDE AT THE BURN
ATTITUDE

AZ +XX.X (DEG)
EL +XX.X (DEG)

THE AZIMUTH AND ELEVATION
ANGLE OF THE COAS STAR

2-23
Ignition time for the maneuver: XXX.XX

Local vertical components of the maneuver:
- ΔVX = +/-XXXX.X fps
- ΔVY = +XXXX.X fps
- ΔVZ = +XXXX.X fps
- ΔVR = +XXXX.X fps

Total ΔV required for the maneuver: X:XX (min:sec)

Local vertical components of the maneuver used to target the AGS:
- VX AGS = +XXXX.X fps
- VY AGS = +XXXX.X fps
- VZ AGS = +XXXX.X fps

Inertial FDAI angles at the burn attitude:
- R = XXX (deg)
- P = XXX (deg)

Identifier for Coas Star used to verify spacecraft attitude at the burn attitude:
- STAR = XX (octal)

Azimuth and elevation angles of the Coas Star:
- AZ = +XX.X (deg)
- EL = +XX.X (deg)
**PURP**

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**MISSION APOLLO 11 SOURCE FC/BALES**

2-24
PURPOSE XXXXXXX

N33 GETI XX:XX:XX

N84 DELTA VX(O VEH) XXXXX.X (FPS)
DELTA VY(O VEH) XXXXX.X (FPS)
DELTA VZ(O VEH) XXXXX.X (FPS)

PURPOSE OF MANEUVER

TIME OF IGNITION (HR:MIN:SEC)

COMPONENTS OF ΔV APPLIED ALONG LOCAL VERTICAL AXIS AT TIG (LM VEH)
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<td><strong>N81 LOCAL VERT</strong></td>
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**IGNITION TIME FOR THE CSI MANEUVER**

**IGNITION TIME FOR THE TPI MANEUVER**

**LOCAL VERTICAL ΔV COMPONENTS OF CSI MANEUVER**

**LOCAL VERTICAL ΔV COMPONENTS OF CSI MANEUVER USED TO TARGET AGS**

**EXT ΔV: ROTATED THROUGH THE HALF-ANGLE OF THE BURN**

**LM FDAI INERTIAL PITCH ANGLE AT CSI BURN ATTITUDE**
IGNITION TIME FOR THE CDH MANEUVER

HR XXX
MIN XX
SEC XX.XX

LOCAL VERTICAL ΔV COMPONENTS OF THE CDH MANEUVER

ΔVX \(±XX.X \text{ (fps)}\)
ΔVY \(±XX.X \text{ (fps)}\)
ΔVZ \(±XX.X \text{ (fps)}\)

LOCAL VERTICAL ΔV COMPONENTS USED TO TARGET AGS EXT ΔV: ROTATED THROUGH THE HALF-ANGLE OF THE BURN

ΔVX AGS \(-XX.X \text{ (fps)}\)
ΔVY AGS \(±XX.X \text{ (fps)}\)
ΔVZ AGS \(±XX.X \text{ (fps)}\)

LM FDAI INERTIAL PITCH ANGLE AT CDH BURN ATTITUDE

PLM FDAI XXX (DEG)
P34 UPDATE (REV A, MAY 9, 1969)

**N37 TIG TPI**

- **HR** XXX
- **MIN** XX
- **SEC** XX.XX

**AV TPI** $\pm XX.X$ (fps)

**AV TPI** TOTAL $\Delta V$ REQUIRED FOR THE MANEUVER

**N59 AV LOS**

- **F/A** $\pm XX.X$ (fps)
- **R/L** $\pm XX.X$ (fps)
- **D/U** $\pm XX.X$ (fps)

**N81 LOCAL VERT**

- **AVX** $\pm XX.X$ (fps)
- **AVY** $\pm XX.X$ (fps)
- **AVZ** $\pm XX.X$ (fps)

**N42 FDAI INER**

- **R LM** XXX (DEG)
- **P LM** XXX (DEG)

**N54 TIG-5**

- **R TPI** XX.XX (FT)
- **R TPI** $\pm XX.X$ (fps)

**BT** XX:XX (MIN:SEC)

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REMARKS:
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<th>Purp</th>
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<th>LM State Vector-Velocity Components</th>
<th>LM Time for Which the State Vector is Accurate</th>
<th>CSM State Vector-Position Components</th>
<th>CSM State Vector-Velocity Components</th>
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</table>
PDI PAD (REV A, MAY 9, 1969)

TIG PDI

HRS XXX
MIN XX
SEC XX.XX

N61 TGO XX:XX(HRS:MIN) TIME FROM THROTTLE UP TO 1ST TARGET POINT

CR(CROSS RANGE) +XXXX.X (N.M.) OUT OF PLANE DISTANCE BETWEEN LM ORBITAL PLANE AND LANDING SITE (POSITIVE INDICATES LANDING SITE IS NORTH OF ORBITAL PLANE)

FDAO AT TIG

R XXX (DEG) INERTIAL FDAO ANGLES AT IGNITION
P XXX (DEG)
Y XXX (DEG)

DEDA 231 XXXXX (100's FT) LUNAR RADIUS AT THE LANDING SITE

PDI +10 ABORT PAD

SAME AS LM P30 PAD WITHOUT THE COAS CHECK STAR

2-37
LUNAR SURFACE PAD
(REV A, MAY 9, 1969)

T2

T3

P

P+ T

N32
TIG TPI

2-38
**LUNAR SURFACE PAD (REV A, MAY 9, 1969)**

**T2**

<table>
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<tr>
<th>HRS</th>
<th>XXX</th>
<th>LIFT OFF TIME -SECOND</th>
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<tbody>
<tr>
<td>MIN</td>
<td>XX</td>
<td>PREFERRED TIME AFTER</td>
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<tr>
<td>SEC</td>
<td>XX.XX</td>
<td>TOUCHDOWN (T.D. + 11 MIN)</td>
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</table>

**T3**

| HRS  | XXX  | LIFT OFF TIME -AFTER |
|------|------|FIRST CSM REVOLUTION |
| MIN  | XX   |                       |
| SEC  | XX.XX|                       |

**P**

| XXX:XX:XX (HRS:MIN:SEC) | CSM PERIOD |

**P + Δt**

| XXX:XX:XX (HRS:MIN:SEC) | CSM PERIOD PLUS THE TIME INTERVAL BETWEEN CLOSEST APPROACH AND LIFT OFF TIME |

**TPI**

| HRS  | XXX  | TIME OF IGNITION FOR TPI |
|------|------|AFTER ABORT FROM POWER DESCENT |
| MIN  | XX   |                         |
| SEC  | XX.XX|                         |
**LM ASCENT PAD**

<table>
<thead>
<tr>
<th></th>
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<th>SEC</th>
<th>CROSSRANGE N76</th>
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</table>

**NOTE:** LOAD 8 MI IF CROSSRANGE IS GREATER THAN 8

**COMMENTS:**

- DEDA 47
- DEDA 53

**APRIL 1, 1969**
FLIGHT PLAN

CSM

1:30 AM EDT

112:00

CMD

CDR

EASEP DEPLOYMENT

112:10

MSFN

112:30

112:41

112:47

113:00

LMP

LMP

LMP

LMP

LMP

1+30

1+40

1+50

2+00

2+10

2+20

2+30

DOCUMETED SAMPLE COLLECTION

DOCUMETED SAMPLE COLLECTION

WIPE SUIT & EMU

WIPE FEET ON LM LANDING PAD AND LADDER

SRC PACK AND TRANSFER

MISSION EDITION DATE TIME DAY/REV PAGE

APOLLO 11 PRELIM REV A MAY 9, 1969 112:00 - 113:00 5/20 3/80