Note of Interest - Apollo 14 LM Impact

The LM ascent stage will be targeted to impact the lunar surface at 19.27°W and 3.5°S, about 29 n.m. west of the Apollo 14 landing site. After docking, the ground will uplink to the LM P-99 (RCS maneuver program), LM SV, and XAV loads, and will voice a P-30 pad and S-Band steerable angles. Prior to egress, the crew will execute P-30 and leave the IGC in P-00, PNG SEL to AUTO, ENG ARM to OFF, and UPDATA UPLINK to ENABLE.

The CSM will maneuver the LM to burn attitude and jettison the LM at GET 146:23:30.5. The CSM jettisons the LM radially outward and does not station keep with the LM ascent stage. Jettison occurs approximately three-fourths of a revolution prior to the LM impact maneuver. CSM gimbal angles and LM jettison time will be voiced by the ground to the CSM.

A CSM SEP maneuver will be executed 5 minutes after jettison. It will be 1 fps retrograde using the +Z axis thrusters. The ground will voice the SEP attitude to the crew.

After the separation maneuver, the ground will call P-99 and wait for lunar impact TIG which occurs at GET 147:52:58.9 at approximately 67°E longitude. The total ΔV is 183.7 fps which requires a 77-second, 4-jet +X RCS burn. The horizontal ΔV component is 180 fps retrograde and the out-of-plane component is 36.5 fps to the north. Impact velocity is 5500 fps horizontal and 365 fps down, and the impact angle is 4.0°.

The three uplink loads required to load the IGC with P-99, the sequence of events leading up to LM impact, and figure 1 (which shows the terminator and relative sun position at both CSM jettison and separation, and relative motion after LM impact maneuver to lunar impact) are enclosed as an attachment.

William E. Fenner

NOTE: This all assumes verification/checkout of new LM P-99 discloses no anomalies. If confidence in P-99 can’t be gained, Apollo 13 procedures will be used.
Apollo 14 LM Impact

1. CSM/LM docking GET 144:10:00.00

2. Voice CSM gimbal angles and time of LM jettison
   GET jet 146:23:30.5
   HGA
   \[
   \begin{align*}
   P &= 355.2 \\
   Y &= 348.6 \\
   R &= 300 \\
   \lambda &= 21^\circ \text{W}
   \end{align*}
   \]

3. LM check DAP

4. Ground U/L CSM and LM S.V. to CMC

5. Ground U/L LM with S.V., XAV, and P-99 loads

6. Ground voice CSM separation attitude and time
   \[T_{IG \text{ SEP}} = 146:28:30.5\]
   \[
   \begin{align*}
   P &= 342.2 \\
   Y &= 0 \\
   R &= 180 \\
   P_LV &= 90 \\
   Y_LV &= 0 \\
   R_LV &= 180
   \end{align*}
   \]

7. Voice LM P-30 PAD

8. LM run P-30, leave in POO and U/D, and configure AGS

9. CSM maneuver to jettison attitude

10. LM jettison GET 146:23:30.5
    \[
    \begin{align*}
    P_{LV} &= 90^\circ \\
    Y_{LV} &= -14
    \end{align*}
    \]
    IM Steerable: \(P = 88.7, Y = -6\)

11. CSM separation maneuver
    
    Range \(\approx 150\) ft at \(T_{IG}\)
    \[GET 146:28:30.5\]
    \[
    \Delta V = 1 \text{ fps (Z-axis thrusters retrograde)} \quad \Delta T = 6.7 \text{ sec}
    \]
\( P_{LV} = 90 \)
\( Y = 0 \)
\( R_{LV} = 180 \)
\( \lambda = 36^\circ W \)

12. Ground U/L

Call P-99 (V3OE)

13. LM impact burn

GET 147:52:58.9 (\( H_A = 58.4, H_P = -63.9 \))

14. Impact GET

\( \phi = 3.5^\circ S \)
\( \lambda = 19.27^\circ W \)

\( V_{HORIZONTAL} = 5500 \text{ fps} \)
\( V_{DOWN} = 385 \text{ fps} \)
\( \gamma = 4^\circ \)
## P99 uplink

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LM IMPACT
147:52:58.9 26.07°E
Vx = -180.0
Vy = +36.5
Vz = 0
ΔVt = 183.9

LM GIMBAL

Y = 0
P = 175.2
R = 11.4

y = 168.5
P = 2
R = 0

CSM SEP
146:28:30.5
1 FPS RETROGRADE
LM Jett
146:23:30.5

CSM CENTERED

SUN

LOS 146:52
AOS 147:38

IMPACT
19.22°W
3.8°S

TERRMINATOR