Kill Stoval

OPTIONAL FORM NO. 10 MAY 1962 EDITION GSA FPMR (41 CFR) 101-11.6 UNITED STATES GOVERNMENT

## Memorandum

TO : Flight Director, Apollo 10

DATE: JUN 1 3 1969

FROM : Guidance Officer

SUBJECT: Postflight report

1. The following comments and data were pertinent to the launch phase through TLI and the SPS evasive:

a. The GMT guidance reference release times observed were:

IU 18:16:48:43.02

CMC 18:16:49:00.70

resulting in a computed launch azimuth of 72.03°.

b. At EOI, the Guidance stripcharts were all Mode A or GO for TLI, with the following values (fps):

${}^{{\rm DV}_{\rm T}}$	=	3.09	$\Delta V_{\rm X} = 2.47$
$\Delta V_{\mathbf{v}}$	=	-16.12	$\Delta_{7} = 2.32$

The  $\triangle A_Z$  value computed at approximately GET = 2 mins was -.11 degrees, which was confirmed by the P52 torque angles over CRO. The stripchart values were so small that no attempt was made to correct the EOI values for initial errors at lift-off.

c. The  $\Delta R_V$  orbital element check at CRO resulted in a 15245-ft difference between IU and MSFN. Values for  $\Delta a$  and  $\Delta W_{MAX}$  were negligible. Orbital element checks on the CMC EOI vector indicated it would have been satisfactory for doing a manual TLI had it been necessary. Continued drift checks in EPO indicated no problems.

d. TLI and the SPS evasive were executed nominally.

2. The following non-nominal situation occurred during the translunar phase of the mission:

a. At a GET of approximately 24:00:00, CMC program alarm 122 ("marking not called for") occurred. There was some concern since there was no scheduled or apparent use of the optics at that time.



Buy U.S. Savings Bonds Regularly on the Payroll Savings Plan

(1) In issuing the alarm, the CMC used the following logic. While operating in POO the CMC received an interrupt. Once the interrupt was received, the CMC looked to see what hardware input had occurred by looking at inbits via the input channels. This input came from depression of the mark or mark reject button. Once confirmation of the interrupt and hardware input had been made, the CMC looked to see if it was in a program requiring such inputs; if not, the referenced program alarm would have been issued.

(2) It's important to note that if no hardware input had been received along with the interrupt program alarm 113, "no inbits" would have been issued. This is the CMC's method of indicating that the interrupt occurred with no inbit present. The only conclusion with the available evidence is that a valid hardware input was received either by accidental button depression or some form of momentary button failure. Since the situation never occurred again, the latter seems highly unlikely.

b. At a GET of 52:00:00, a P23 trunnion bias calibration was performed. Once the bias had been determined by several successive computations, the most consistent number was chosen for entry via the N87 display. The proper number was loaded in R2, but instead of "proceeding" on the N87 display to cause copying of the bias into the proper erasable cells, a V32E was executed. This caused the program to recycle for computation of a new bias number rather than transferring the desired bias number to its erasable location.

The procedural problem was called to the attention of the crew. There was still concern about the impression that calling up the N87 display would always display the desired trunnion bias loaded in erasable. It should be noted that N87 calls intermediate working cells which are shared between several programs and doesn't call the permanent trunnion bias cell.

c. At approximately 54:00:00 while reviewing the digital autopilot routine, a V44 was executed. This set the surface flag bit in the CMC to indicate that the LM was on the lunar surface, and that the LM state vector should no longer be integrated starting with the next permanent LM state vector integration cycle. The crew immediately reset the flag by executing a V45. No problem occurred since permanent LM state vector integration did not occur between the time the bit was set and reset.

3. Non-nominal situations occurring during the lunar orbit phase are detailed as follows:

a. In the process of preparing the LM for undocking, some anomalies developed in computing the post-coarse align torquing angles and the subsequent angle set to be used for an initial drift check. Since the preparation timeline was ahead of schedule, the LM inertial platform was coarse aligned to the CSM approximately one revolution in advance. This procedure was performed prior to the CSM coarse/fine align to the final landing site 2 REFSMMAT. Therefore, the ground computed LM torquing angles, based on the first gimbal angle set computed after the CSM coarse/

fine align contained the LM coarse align error, plus the CSM platform drift accumulated since the last CSM alignment (8 hrs or more in the past). The computed torquing angles were as follows: Outer gimbal, -0.730°; inner gimbal, -.700°; and middle gimbal, +.570°. These angles were then torqued out by the crew at approximately 95:20:00. The next gimbal angle set, used by the ground for recomputing torquing angles to indicate platform drift, gave the following at 96:45:00: Outer gimbal, -3.54°; inner gimbal, -.230°; and middle gimbal, +.800°. The numbers gave cause to believe that either the platform was drifting or that the gimbal angle set for computing the numbers was in error. A second set of gimbal angles was requested and gave the following results at 97:10:00: Outer gimbal, -3.53; inner gimbal, -.390; and middle gimbal, +.760. Note that this set is 25 mins later giving almost the same results as the initial set. It was indicative that the large outer gimbal difference was attributable neither to platform drift nor gimbal angle set errors used in the computations. The large outer gimbal angle apparent misalignment was created by physical slippage of the docking interface during the tunnel venting problem. Some physical misalignment was also confirmed visually by the pilots. The first IM P52 fine alignment after undocking produced torquing angles of -.668°, outer gimbal; -.195°; inner gimbal; and -.055°, middle gimbal. The larger outer gimbal is expected due to the initial docking angle uncertainty (without slippage).

b. Prior to undocking, an onboard computation of local vertical angle was made in both the LGC and AGS. A 20<sup>°</sup> difference between the two computations was reported by the crew. No further difficulty was reported after undocking. At this time there is no satisfactory explanation of the problem. A possible cause might result from the method used by each system depending on the LM's attitude with respect to the orbital plane. The LGC makes no distinction if the vehicle is not actually inplane while the AGS computes the inplane angle.

c. During the rendezvous, two momentary rendezvous radar CDU fail discretes were sensed by the LGC. There is no explanation of their cause. There was no visible effect of their occurrence on the LGC rendezvous processes.

d. After the LM insertion maneuver, P76 was executed using LM targeting. The post-P76 apogee/perigee computation gave a non-nominal orbit. It appears that in executing targets in P76, the final "enter" on the velocity component loaded in R3 was not performed. This invalidated copying of all three registers into the proper erasable locations, i.e., none of the velocity components were applied to the CMC LM state vector. The situation was remedied by the planned ground uplink of the post-insertion LGC LM vector to the CSM.

4. Transearth coast - The following anomalies occurred: At a GET of 150:30:00 during the P23 sequence using the star/lunar landmark option, a large position/velocity correction was experienced on the first set. The large correction may possibly have resulted from the following: Once the star/landmark code has been loaded in P23, the next display (N89) requires loading of the latitude, longitude, and delta altitude for the chosen

landmark. If this display isn't properly loaded, the desired landmark coordinates aren't transferred to the proper erasable cells. Each register loaded in N89 must be followed by an "enter" before proceeding, or none of the three lines of data will be transferred to the appropriate erasable cells. It's likely that the "enter" on the third register was skipped followed by a "proceed". This invalidated transfer of the desired latitude, longitude, and delta altitude and caused the CMC to use whatever "old" information was stored in the proper erasable cells. This idea is substantiated by two other facts. Firstly, the pilot reported that the CMC did not orient the spacecraft properly which indicates it was seeking out some unknown landmark coordinates, i.e., whatever "old" data was in the proper erasable cells. Secondly, the N89 display output by the program for use in verifying the original input numbers displayed unfamiliar numbers to the pilot, i.e., again the "old" data from the erasable cells was being called by the program. It is believed that use of an erroneous landmark by the CMC caused the large velocity/position correction calculated.

> Kenneth W. Russell GDO, Black Team

William & Ferner

William E. Fenner GDO, Orange Team

Harry 1

J. Gary Renick GDO, Maroon Team

anville E. Paules GDO, Launch/TLI

Kenneth W. Russell for Stephen G. Bales GDO, Rendezvous