



NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS 77058

IN REPLY REFER TO: 69-FC56-11

DEC 8 1969

MEMORANDUM TO: Apollo 12 Flight Director
FROM : Guidance Officers
SUBJECT : Apollo 12 Postflight Report

I. Problems/Resolution.

A. Prelaunch - At approximately T-1:30, the crew reported observing "all 8's" appear on the DSKY for one update then return to normal P02 configuration. The data was not observed in Houston. The mission timer also experienced a shift to its internal configuration at that time. At some time later another similar sequence occurred. No one could find any further problems nor an exact explanation. MIT was asked to investigate. Since no further effects could be found, a GO from all concerned was given. MIT provided the likely explanation which is included as enclosure 1. The GNC Controllers state that a similar problem had been observed during system testing at North American.

B. Launch through Evasive.

1. Launch.

a. Data recorded during this phase is as follows:

The GMT guidance reference release times observed were:

IU 16:21:43.02

CMC 16:22:00.68

This resulted in a computed launch azimuth of 72.029° .

IU timebase times passed to HOSC after BSE confirmation were:

TB1 :17

TB4 9:29

TB5 11:51

b. Loss of the CSM inertial platform - At approximately GET = 36 secs, all data from the CMC was lost as indicated on display and stripcharts. A power "glitch" was reported by EECOM. The data returned at ~ 48 secs at which time two reasonable CMC state vectors were obtained which reflected on the stripcharts. The CMC data was again lost until approximately 61 secs at which time an event indicating a G and N platform failure was recorded on the stripcharts. Several failure events were observed, five restarts and the 1105 (downlink too fast) and 3777 (CDU failure caused the ISS warning) alarms were noted. The CDU's indicated the platform was still spinning out of control. No further valid acceptable state vectors were obtained, verifying the CMC had lost all knowledge of its navigation state. An effort was made to secure the platform to minimize damage to the inertial components. We considered using the "IMU cage" switch but decided that might be too hard on the components. It should have "coarse aligned" when the CMC determined that the platform had apparently rotated into gimbal lock. Due to the large attitude errors in the error counter, the platform never stabilized until the IMU power was turned off via the circuit breakers at approximately 10:30. A detailed MIT investigation was conducted and is included as enclosure 2.

Crew reports were sufficient confirmation that the platform was lost and that the G and N was "NO-GO. Discussions with FDO resulted in the following reports to Flight:

- There would be no "SIVB to COI" call.
- The only Mode IV capability was "one-impulse-line-on-the-horizon", i.e., the delayed Mode IV call.

c. IU state vector errors at EOI - At EOI, noticeable differences existed between the IU state vector and the high speed C-band radar vector. Only very slight differences were detectable during source shifts late in launch phase. There was no positive indication of problems in the IU navigation. No stripchart failure discretes from the IU were recorded during the anomaly at 36 secs nor throughout the launch phase. BSE3 reported a possible platform anomaly which was later determined inconclusive and was dropped by all as possible bad data.

FDO, having no confirmation of IU problems, elected to go to orbit with that source since all sources confirmed a GO orbit. The problem was not again considered discussion worthy until post-CRO tracking was in, confirming differences observed at EOI. All other IU guidance reports during launch phase were nominal.

2. Earth Orbit - All normal activities for earth orbit were completed with the following additions:

a. G and N evaluation - The G and N needed to be returned to a normal configuration to verify that it was satisfactory for continuing the mission. The following sequence was recommended and executed to verify the G and N:

- Had "AGC" verify all possible CMC data available on high speed telemetry displays. Verified no problems.
- Generated and loaded the RTCC launch REFSMMAT at CYI shortly after insertion. The P52 preferred option 1 was required since a P51 alignment was necessary to determine the platform orientation. P51 destroys the onboard REFSMMAT which was valid. RTC reconfigured CYI from IU to CSM for commanding. The crew completed the alignment shortly after CRO AOS, torquing at 52:29.
- The following sequence established CRO/HSK first pass:
 - V96E - To stop CMC integration prior to a NAV update. He got a 20430 alarm indicating a sub-surface vector prior to executing the V96E, which was valid.
 - EMOD dumps - Over CRO since their command computer was down. TIC was briefed and a good recording was obtained at GET = 55 mins. It was played back at CRO LOS and verified as "all GO" by AGC at GET 1:46.
 - Navigation updates - First update was to get CMC back on line at HSK using EOI insertion vector. Did V66 and V45 to get configuration back to nominal prior to HSK LOS.
 - CMC self-check - Done as backup to EMOD. Completed satisfactory at GET 1:37 prior to receipt of EMOD.
 - IMU vs IU gimbal angle comparisons - Began at CRO and continued through TLI. Showed no drifting trends.
 - Second P52 - Recommend second P52 option 3 as drift check during second darkness prior TLI. This was completed at GET 2:20:20 with the following GO torque angles:
 - X -00.014°
 - Y -00.028°
 - Z $+00.018^{\circ}$
 - Gross PIPA checks - They were conducted by GNC. These were given a GO over the states.
- States pass: Updated CMC state vector with TEXS17 for TLI.

- CRO second pass: Gave final "GO" on G and N based on P52 torque angles (GET = 2:28).
- Post-TLI - ARIA telemetry data recorded during TLI was played back through the HAW ground station. The data was run through a vector comparison scheme similar to launch phase. The differences between IU and CMC after correcting for initial state vectors errors showed excellent performance of the G and N under powered flight conditions.

b. IU state vector errors - We used the normal procedure of checking IU orbital elements in the case when stripchart data is lost at EOI. The orbital elements were checked at CRO/HSK and over the states. Both radar vectors reflected similar differences from the IU vector as follows:

Station	GET	ΔR	Δa (1:45)	$\dot{\Delta W}_{max}$ (1:45)
HSK512	1:01	48719	-1.01 n.m.	negligible
TEXS17	1:45	N.A.	-1.30	negligible
Mission rule limits		105100	3.28	32 fps

The errors were considered large but not near the limit value.

Discussion with FDO post-HSK update showed that using an IU vector for TLI prediction and integrating the radar vector over the TLI profile reflected a slightly smaller than nominal MCC1. Decided there was no justification for updating IU due to greater concern for CSM at this point in the mission, and the fact that no criteria exists for updating with no observed discrete IU guidance failures. Flight was advised of noteworthy IU errors, but that they were not near limits. The trajectory support area at HOSC, Huntsville, Alabama, was sent the IU telemetry vectors, the HSKS12 and TEXS17 track vectors and apprised of the vector differences including comments that the error, assuming no further degradation, would not cost us any MCC penalty.

MSFC data predicted on the IU vector reflected 22 fps total inertial velocity difference a TLI cutoff when compared to the RTCC double integrated output. The difference was such that TLI cutoff would be effectively underspeed. The MCC1 prediction indicated that it would be in such a direction as to cost less ΔV but rotate the trajectory conic back to the desired conditions. The TLI pad was based on the expected cutoff conditions. At actual cutoff, the vector comparisons reflected approximately 24 fps difference in the underspeed direction. FDO and GDO were satisfied with the resultant comparisons which showed good agreement between high speed radar sources and the CMC cutoff vector. The IU showed the expected error.

The IU telemetry vector was sent to HOSC (ICHU 15) per premission plan. An attempt to contact HOSC to determine if they desired a high speed radar cutoff vector was futile. The problem was unknown loss of the HOSC Network loop. Since HOSC was not nominally expecting any further vectors, there was no further attempt to communicate until at the agreed on later time. Houston voice later was contacted and the line reestablished. There was no particular concern at MCC about not sending the high speed radar vector since the pre-TLI radar vector and IU telemetry vectors were there and MFCC had previously stated their plan to use the IU vector for the 507 slingshot maneuver predictions.

3. Evasive - The timeline from TLI cutoff through the evasive was nominal.

C. Translunar Coast.

1. Due to the problems encountered during the launch with the S/C G and N, the decision was made to checkout the LM. Upon entering the LM, the crew powered up the LGC and preformed a computer self-test, which was successful, and an erasable memory dump. The erasable memory was checked by AGC and given a "GO". The Guidance Officer was in agreement and gave Flight a "GO" on the LM PGNS.

2. A procedural problem was encountered the first time the CSM dumped the erasable memory, which required a second dump. While the data was coming into the remote site on LBR, the INCO commanded HBR causing the RSDP to lose telemetry lock. During the second dump, the site had no problems, and all the data was recorded.

3. Two problems were encountered performing star searches in the GOST (MSK 229). The first was an intermittent problem which displayed a star LOS time which was prior to the start of search time. The second anomaly was the displayed star number for certain boresight stars had a leading plus sign rather than a leading zero. Both problems remain open at this time and are being investigated.

4. The first two sets of P23's, which are used to determine the horizon altitude bias, revealed a discrepancy. The data from the first set of P23's yielded an altitude bias of 49.2 km and the second set an altitude bias of 24.8 km. In an attempt to resolve the discrepancy, the crew was asked several questions. Based on their answers, it was determined that a different part of the horizon had been used on the two sets. On set No. 1, the top of the haze line was used, and on set No. 2, the blue horizon was used. Then by some sort of black magic, Math Physics and MIT recommended an horizon bias update of 19 km. The horizon bias update of 19 km was passed to the crew.

D. LOI₁/LOI₂.

1. The maneuver pads and command loads were voiced and uplinked to the spacecraft as per the timeline. Also, an addition to the LOI abort

procedure was passed to the crew which would reset the C Moon (flagword 8 bit 12) and L Moon (flagword 8 bit 11) flags to lunar reference. The update was to correct an error in the prelaunch initialization of the flagword, which was set to earth reference. If left unchanged, the LGC would assume it was in earth orbit rather than lunar orbit.

An additional error that was made during the prelaunch loading of the erasable memory was pointed out by AGC. The transpose of the lunar landing REFSMMAT, which would be used in the LM LOI abort procedures, was loaded rather than the matrix itself. Due to the transpose being an orthogonal matrix, no problem would be encountered had it been used. These two errors in erasable memory initialization point out that a more careful check of the initialization and the crew procedures should be undertaken by MIT.

E. Predescent Lunar Orbit - No problems were encountered prior to the start of LM activation.

F. LM Activation through T₃.

1. LGC Program Alarms - Two alarms of significance were experienced in this period with no impact on the activity. These are discussed in detail below:

a. Alarm 212 - PIPA fail but PIPA not being used. This alarm occurred during the DSKY light test and was expected as a normal event. However, there was some concern generated in that the alarm never occurred during simulations. The alarm is a side effect of conditions generated to cause the warning lights of illuminate, in particular, the LGC warning light. With the computer fail indication, the LGC inhibits or turns off the gyro torque power supply for the IMU. This power supply also provides the current to bias or compensate the accelerometer. When the float ceased the null activity, the PIPA fail indication was triggered. The alarm never occurred in simulations because the LMS does not exactly duplicate the flight software/hardware interfaces.

b. Alarm 1106 - Uplink too fast. This alarm occurred shortly after the command uplink of PIPA compensation values. The occurrence was noticed after the crew was told of the uplink completion. It is believed by this position that the alarm triggered by the crew changing the DUA switch setting. The LGC carefully checks every signal received from the command hardware. A group of bits in each signal must be of a particular configuration or the LGC disregards the signal as bad data. When the LGC receives a random stray signal, the 1106 alarm is set. To be completely satisfied that the last command uplink was successful, the Guidance position requested the crew to readout the address locations that had been updated. The resultant values readout were as uplinked and everyone was happy. This type of alarm has been experienced on a previous mission, Apollo 7, where a FDAI switch was determined to create noise spikes which gave CMC 1106 alarms throughout the mission.

2. Command Uplink Difficulty - During LM activation, a remote site command computer problem was discovered which explained a command uplink difficulty. On the first two command loads uplinked to the LGC, not all of the data was received. The uplink had to be retransmitted by the line-by-line mode. On investigation to insure all the data was being transmitted by the remote site, it was discovered that the site (GDS) had experienced ground loop failures during the uplink of the above mentioned command loads. The ground loop failures were further explained as a timing sync problem between the 642B command computer and the updata link buffer hardware. The timing problem caused the updata buffer to request keycode data from the computer at a rate faster than it could transmit. As a result, a keycode was transferred but never transmitted. The timing problem was a random type thing and proved to be only an inconvenience whenever it occurred.

G. Lunar Stay - The same remote site command problem that occurred during the activation occurred again.

H. Ascent/Rendezvous - During ascent, the LGC/AGS velocity differences grew to approximately 5 fps in all axis at cutoff. During powered flight, these differences were too small to definitely identify either system as the correct one. In fact, the cutoff vectors indicate that although the PGNS was in error in downrange velocity, at least part of the radial velocity difference was due to slight AGS errors. In any case, all errors were well below any switchover limits.

After insertion, Control advised Guidance that the PIPA bias values had changed by $X = -.0049 \text{ fps}^2$, $Y = -.005 \text{ fps}^2$, and $Z = +.01 \text{ fps}^2$. These numbers account for all the downrange error and part of the radial error seen during ascent. The Guidance Officer was later informed that the change in the PGNS PIPA bias on the surface may have been caused by the V35 (DSKY test), which also caused the 212 alarm as described in the descent section.

I. Postdocking Lunar Orbit - The LM impact burn was executed as planned, but there was an apparent overburn of approximately 5.4 ft/sec, which resulted in the LM impacting short of the target point. Exact cause of this miss, though within preflight predictions, is still under investigation.

J. TEI - No problems were encountered during this phase.

K. Transearth Coast/Entry - The only problem that occurred during the transearth phase was an OCDU fail during P23. The fail indication occurred because the crew did a "Verb 37 Enter" too soon after selecting zero optics. The computer did not have sufficient time to complete optics zeroing process, consequently, it remained in this mode and was unable to drive the optics in CMC when asked. For a more detailed explanation, see enclosure 3.

II. Recommendations.

A. The errors in the IU vector did not cause any concern at MCC when considering MCC1. However, they apparently cost MSFC a good slingshot maneuver. MCC, for Apollo 12, did not have an acceptable way to simulate the slingshot in the RTCC and was, therefore, not aware of the effect the vectors had on the slingshot. Had a navigation update been the acceptable route in earth orbit, the problems would have been nonexistent. It is recommended that for all future missions, navigation updates be procedurally planned for the IU whenever the vectors reflect confirmed differences outside the accepted MSFN accuracies. Current limits on the IU vectors are unacceptably larger than the MSFN capability.

B. We strongly recommend that Guidance and Control Division investigate the PIPA bias that occurred on the surface, especially any connection with the V35 test. If there is the remotest chance that V35 execution can influence PIPA biases under the right circumstance, then a careful review of both LM and CSM checklist use of V35 should be made.

C. We strongly recommend that MIT verify all crew procedures and that the prelaunch erasable memory initialization be compatible with the procedures.

D. The procedures for formatting ARIA playback of TLI information should be reviewed with the RTCC/GPB personnel, quite a bit of confusion resulted when a playback was attempted during translunar coast. Any influence on these procedures by the new RTCC offline vector analysis program should also be clarified.

Stephen G. Bales
Descent Team

William E. Fenner
Gold Team

Granville B. Poulos
Lunar Team

Enclosures (3)

Willard S. Presley
Green Team

J. Gary Renick
Black Team

Kenneth W. Russell
Orange Team

Kenneth W. Russell

FC561:SGB:WEF:GEP:WSP:JGR:KWR:ldw

USE BLACK BALLPOINT PEN	SPAN / MISSION EVALUATION ACTION REQUEST		USE BLACK BALLPOINT PEN
TIME (T- MINUS/GET) 23:20 22:00	REQUEST ORGANIZATION FOD	RESPONSE ORGANIZATION 45	CONTROL NUMBER C-14
ACTION REQD BY (TIME): - 30:00		REQUESTER FOD	
SUBJECT: DSKY PRELAUNCH ANOMALY		APPROVAL	
During the prelaunch period a DSKY ANOMALY OCCURRED. THIS WAS DISCUSSED OVER THE APOLLO CHIEF ENGINEER LOOP TO KSC. PLEASE PROVIDE A WRITTEN DETAILS WHEN THE ANOMALY OCCURRED AND AN EXPLANATION OF THE ANOMALY.		FOD REP REACH	
		TIME :	
		SPAN MGR [Signature]	
		TIME 22:49	
- DOCUMENT -			
RESPONSE: See attached		CONCUR	
See SPAN ATTACHED INFO.		TEAM LDR [Signature]	
		TIME 28:00	
		CON SR REP [Signature]	
		TIME 28:00	
		ME MGR [Signature]	
		TIME 28:17	
		SPAN MGR [Signature]	
		TIME 28:25	
RESPONDER [Signature]		LOG MANAGER: [Signature]	
FOD REP [Signature]		SPAN MANAGER	
TIME 28:00		TIME 29:04	

ENCLOSURE 1

DSKY DISPLAY ANOMALY

Approximately 1.5 hours before liftoff, the crew reported the intermittent appearance of all 8's on the main DSKY numeric display. The reported condition was not observed on telemetry.

The cause of the anomaly is not known at this time, however, one mechanism which could cause the reported symptoms has been encountered previously in the block II DSKY. The electroluminescent segments which make up the displayed characters are controlled by a relay matrix as illustrated in the attached figure. The relays have a small (approximately 0.003 inch) clearance between the contacts, and despite extensive screening, have a history of contamination causing shorts in this area. Because the segments are capacitive, they must be discharged positively to avoid residual glow when turned off. As indicated on the figure the discharge path for all segments is through a common resistor. If, with the relays in the off position as shown, a short occurs across the contacts of any one of the relays, the operating voltage will be applied to all segments through the common discharge path and 8's will appear in all locations.

A failure of this type will affect only the display function of the DSKY involved. All data entry and control functions and the display function of the redundant DSKY (in the CM) will remain operational.

FLIGHT DIRECTOR'S MISSION LOG		DAY	REV	PG
FILE/ACQ/LOG	FLIGHT EVENTS/HISTORY/BRIEFING			
GET				
27:30	EXPLANATION OF DSKY DISPLAY OF ALL 8'S PRELAUNCH.			
	MIT HAS INVESTIGATED THE OCCURENCE OF THE DSKY DISPLAYING ALL 8'S (APPROXIMATELY 4 TIMES) DURING FINAL COUNTDOWN. MIT BELIEVES THAT THERE WAS CONTAMINATION IN THE COMPUTER ACTIVITY LIGHT (RELAY) WHICH PROVIDED A MAKE BEFORE BREAK ACTION WHICH PROVIDED A RETURN FOR ALL THE E-L SEGMENTS WHICH MAKES ALL 8'S APPEAR. SINCE ANY RELAY SHORTING THE REWARD NORMALLY OPEN AND NORMALLY CLOSED CONTACTS WOULD CAUSE ALL 8'S, THE PARTICULAR RELAY (COMP ACTY) WAS SUSPECT SINCE 1) THE CREW REPORTED THE PHENOMENON WAS SYNCHRONIZED WITH THE COMPUTER CYCLE TIME AND 2) THE DISPLAY WAS STATIC EXCEPT FOR THE COMP ACTY LIGHT (DISPLAY CONTAINED POZ AND VERB, NOUN, R1, R2, R3 CORRESPONDING TO LAST K-START LOAD.			
	P. Felleman MIT			

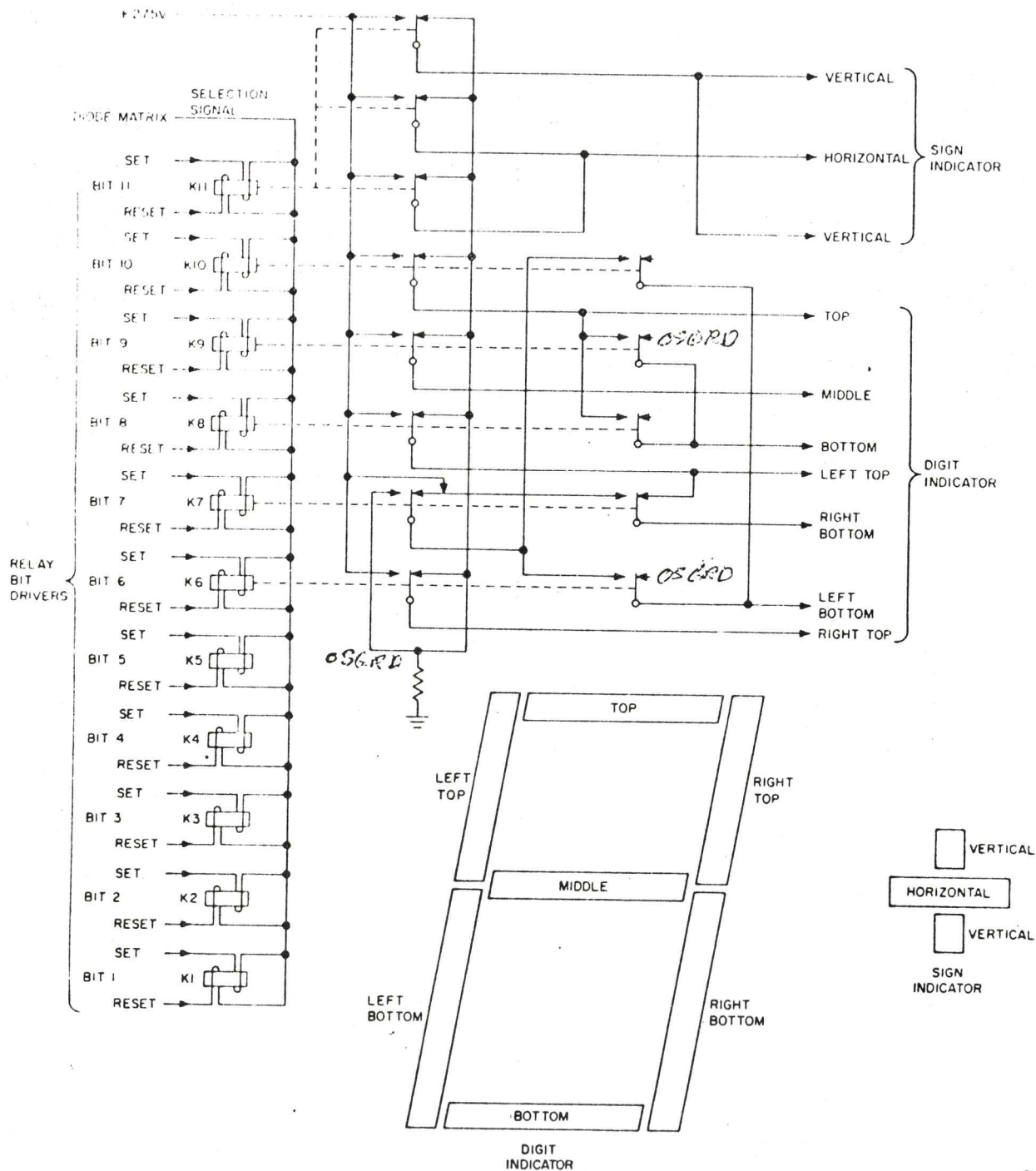


Figure 4-136. Relay Matrix, Simplified Schematic Diagram

FLIGHT DIRECTOR'S MISSION LOG		REV	PG
SITE/ACQ/LDS	FLIGHT EVENTS/HISTORY/BRIEFING		
28:00	SEQUENCE OF EVENTS FOR IMU		
	LOSS OF REFERENCE DURING BOOST.		
	INVESTIGATION OF THE SEQUENCE OF		
	EVENTS DURING BOOST INDICATES:		
	1. AT GET 00:00:36 A POWER		
	TRANSIENT CAUSED THE OUTER GIMBAL		
	CDU TO INCREMENT BY 180° AND THE		
	INNER GIMBAL CDU TO INCREMENT BY		
	82°. THE MIDDLE GIMBAL CDU WAS		
	APPARENTLY UNAFFECTED. THE INERTIAL		
	PLATFORM (AS INDICATED BY THE 1x		
	RESOLVER ANALOG TELEMETRY) WAS REMAINED		
	INERTIAL. THE ATTITUDE ERRORS		
	WERE PEGGED IN PITCH AND ROLL.		
	2. AT GET 00:00:45, THE CMC		
	INDICATED ANOTHER POWER TRANSIENT		
	HAD OCCURRED BY HAVING 5 RESTARTS.		
	3. AT GET 00:00:55, THE IMU		
	LOST ITS INERTIAL REFERENCE AND		
	WAS OBSERVED TO BE TUMBLING.		
	IT APPEARS THAT ANOTHER POWER		
	TRANSIENT CAUSED THE MIDDLE GIMBAL		
	CDU TO INCREMENT TO THE POINT		
	THAT THE CMC THOUGHT THAT		

FLIGHT DIR MISSION LOG		REV	PG
SITE/ACQ/LOS	FLIGHT EVENTS/HISTORY/BRIEFING		
	THE MIDDLE GIMBAL ANGLE WAS		
	GREATER THAN 85° . THIS CAUSES THE		
	COARSE ALIGN ENABLE BIT, NO ATTITUDE		
	LIGHT AND GIMBAL LOCK WARNING		
	LIGHT TO BE SET. SINCE THE		
	D/A ERROR COUNTERS WERE SET AT		
	A LARGE NUMBER, THE OUTPUT OF		
	THE ERROR COUNTER DRIVES THE		
	GIMBAL TORQUE MOTORS AT A HIGH		
	RATE ($\sim 40^{\circ}/\text{sec}$). ANALOG TELEMETRY		
	SEEMS TO SUPPORT THIS LEVEL. THE		
	CMC TELEMETRY DURING THIS PERIOD		
	WAS UNRELIABLE AS INDICATED BY		
	THE 1105 ALARMS (TELEMETRY TOO		
	FAST) WHICH WAS IN FAIL REG		
	AFTER THE DIGITAL TELEMETRY		
	WAS RESTORED.		
	SUMMARY: THERE WERE THREE		
	DISTINCT POWER TRANSIENTS		
	APPROXIMATELY 10 SECS APART.		
	THE FIRST AFFECTED CDUX AND		
	CDUY. THE SECOND CAUSED 5		
	RESTARTS. THE THIRD CAUSED		
	A CDUZ TRANSIENT (POSSIBLY CDUX		
	AND CDUY) WHICH INDICATED A		
	GIMBAL LOCK CONDITION.		

USE BLACK BALLPOINT PEN		SPAN / MISSION EVALUATION ACTION REQUEST		USE BLACK BALLPOINT PEN	
TIME (T-MINUS/GET)	REQUEST ORGANIZATION	RESPONSE ORGANIZATION	CONTROL NUMBER		
191/107	FOD	FOD	D 112		
ACTION REQD BY (TIME):			REQUESTER		
SUBJECT:		OCDU FAIL AT 190:00		APPROVAL	
DURING P23 AT 190:00 GET WE RECEIVED AN INDICATION OF OPTICS CDU FAIL. INDICATION WAS THAT THE OPTICS ZERO WAS CONTINUOUS AND IN CMC OR MANUM THE OPTICS WOULD NOT DRIVE. PROBLEM CAUSED BY V37 DURING LAST 0.2 SEC OF OPTICS ZEROING ROUTING (15 SEC DURATION) WHICH LEAVES COMPUTER MODE INDICATION IN WRONG STATE. AVOIDANCE PROCEDURE - WAIT MORE THAN 15 SECS AFTER OPTICS ZERO BEFORE DSKY ACTIVITY. INFO ONLY NO RESPONSE REQ				FOD REP	
				BACH	
				TIME 91:07	
				SPAN MGR	
				TIME :	
RESPONSE:		CONCUR			
INFO ONLY NO RESPONSE REQ				TEAM LDR	
				TIME :	
				CON SR REP	
				TIME :	
				ME MGR	
				TIME 91:23	
				SPAN MGR	
				TIME :	
RESPONDER		TIME :		LOG MANAGER:	
FOD REP				SPAN MANAGER	
BACH		P. Sellenman		R. D.	
TIME 191:07		MIT		TIME 191:08	

ENCLOSURE 3

APOLLO 12

NOV. 22, 1969

GET 193 hrs

1 of 6

SITE/ACQ/LOS

FLIGHT EVENTS/HISTORY/BRIEFING

HOW TO "BREAK" THE OPTICS

WHEN THE CMC SENSES THE TURNING ON OF THE OPTICS ZERO SWITCH, IT INITIATES A 15.8 SEC LOCKOUT OF TURNING THE SWITCH OFF. IF THE SWITCH IS TURNED OFF DURING THE 15.8 SEC DELAY AN ALARM 116 IS GENERATED. DURING THE 15.8 SECONDS TWO BITS ARE SET. ONE (OPT B02) TO INHIBIT THE TRACKER LIGHT IF OCDU FAIL IS DETECTED, AND ANOTHER (OPT B03) TO DENOTE THAT THE DELAY IS IN PROGRESS AND TO CAUSE GENERATION OF THE ALARM. AT THE END OF 15.8 SEC A FURTHER .4 SEC DELAY OCCURS DURING WHICH THE CMC ITSELF COMMANDS OPTICS ZERO AND ZEROES THE CDUS AND CDUT CELLS, THEN RELEASES OPTICS ZERO AND ALLOWS THE CELLS TO COUNT UP TO THE SHAFT/TRUNNION POSITIONS. DURING THIS PERIOD A THIRD BIT IS SET (OPT B01) TO DENOTE THAT THIS LAST .4 SEC DELAY IS IN PROGRESS.

SITE/ACQ/LOS

FLIGHT EVENTS/HISTORY/BRIEFING

THIS BIT INHIBITS THE 116 ALARM
BUT ALSO INHIBITS THE CMC FROM
RECOGNIZING THE TURNING OFF
OF THE OPTICS ZERO SWITCH.

AT THE END OF THE TOTAL DELAYS
($16.2 = 15.8 + .4$) ALL THREE BITS
ARE RESET.

DURING ONE OF THE P23's
TODAY WE NOTED THE FOLLOWING
ON OUR EVENT LIGHTS:

- 1) OCDU FAIL
- 2) THE 15.8 SECOND DELAY IN
PROGRESS (OPT B03)
- 3) AND (SINCE #2 WAS ON) THE
(OPT B02)
LIGHT ^{SHOWING} INHIBIT OF
TRACKER LIGHT (WHICH IS
WHY THE CREW DIDN'T SEE
THE OCDU FAIL).

SINCE THE 15.8 SEC DELAY HAD
BEEN ON FOR FAR LONGER THAN
15.8 SEC, I KNEW THAT THERE
WAS A SOFTWARE PROBLEM THAT
WOULD PROBABLY EXPLAIN THE
THE OCDU FAIL. FURTHER
LOOKING SHOWED THAT THE CMC
OPTICS ZERO DISCRETE AND THE
CMC ENABLE OF OPTICS DRIVE

FLIGHT DIR MISSION LOG		DAY	REV	PG
				3 of 6
SITE/ACQ/LOS	FLIGHT EVENTS/HISTORY/BRIEFING			
	<p>WERE BOTH SET WHICH EXPLAINED THE OCDU FAIL WHILE IN CMC MODE (I.E. OPTICS COMMANDED TO ZERO AND OUT OF ZERO POSITION AT THE SAME TIME). FURTHER, THE BIT SHOWING THAT THE LAST .4 SEC DELAY WAS RUNNING WAS ALSO SET (THUS EXPLAINING THE CMC OPTICS ZERO DISCRETE). IT WAS AT THIS POINT THAT RECOMMENDATION TO ZERO THE THREE BITS WAS GIVEN TO GUIDO (THE SAFEST WAY - I.E. SET THE CELL, OPTMODES, TO ITS FRESH START CONFIGURATION) (THE INITIAL REQUEST TO SELECT POO WAS GIVEN TO REMOVE AUTO OPTICS ROUTINE AS A SUSPECT). THIS ALL COMPLETELY CORRECTED THE SITUATION AND BY SOME DIGGING I FOUND HOW HE GOT INTO THE EXACT SITUATION. IT WAS THE FOLLOWING:</p> <ol style="list-style-type: none"> 1) AFTER MARKING HE TURNED THE OPTICS ZERO SWITCH ON. 2) HE HIT THE FINAL ENTR OF V37E X X E BETWEEN 			

FLIGHT DIR MISSION LOG		DAY	REV	PG 4 of 6
SITE/ACQ/LOS	FLIGHT EVENTS/HISTORY/BRIEFING			
	15.8 AND 16.0 SECONDS AFTER			
	THE CMC DETECTED OPTICS ZERO			
	SWITCH ON.			
	3) HE WENT BACK INTO P23			
	AND PUT THE OPTICS ZERO			
	SWITCH TO OFF PRIOR TO			
	ENTERING AUTO OPTICS (R52)			
	(nominal procedure).			
	4) HE ENTERED AUTO OPTICS			
	(AND THE OCDU FAIL APPEARED).			
	THE OPTICS DRIVE ROUTINE (WHICH			
	SETS THE CMC OPTICS DRIVE ENABLE			
	BIT) IS NORMALLY INHIBITED DURING			
	OPTICS ZERO. HOWEVER, IF			
	THE CMC WERE STUCK IN THE FIRST			
	.2 SEC OF THE FINAL .4 SEC			
	DELAY, THEN IT WOULD RECOGNIZE			
	THE OPTICS IN CMC BECAUSE			
	A CELL CALLED "OPTIND" WOULD			
	NOT BE UPDATED. THAT CELL			
	IS SET TO SHOW NONE-OPTICS ZERO			
	BY R52, AND HENCE THE OPTICS			
	DRIVE ROUTINE ENABLES DRIVE			
	AND WITH THE CMC OPTICS ZERO			
	DISCRETE STILL PRESENT (DUE TO			
	BEING STUCK IN THE .4 SEC DELAY)			
	OCDU FAIL OCCURS.			

SITE/ACQ/LOS

FLIGHT EVENTS/HISTORY/BRIEFING

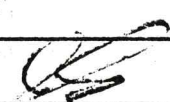
THE INITIAL 15.8 SEC DELAY IS NOT ALTERED BY A SOFTWARE RESTART. THE LAST .4 SEC DELAY IS ON TWO .2 SEC WAITLIST CALLS WHICH ARE KILLED BY A SOFTWARE RESTART LIKE V37.

THIS PROGRAM ANOMALY IS ANOTHER EXAMPLE OF THOSE WHICH ARE ALMOST IMPOSSIBLE TO FIND THROUGH SOFTWARE VERIFICATION. IT AND OTHERS WE DO AND DON'T KNOW ABOUT HAVE PROBABLY BEEN WITH US FOR AGES AND WILL BE FOUND AS TIME GOES ON. THIS PARTICULAR PROBLEM, THOUGH, IS IN AN AREA WHERE MANY PROBLEMS HAVE BEEN FOUND — THE FACT THAT V37 DOES A SOFTWARE RESTART BUT DOES NOT RESET ALL POSSIBLE FLAGBITS. A PCR TO DO THIS WAS RECENTLY DISAPPROVED BECAUSE MIT FELT THAT CHANGING THE PROGRAM TO SUCH AN EXTENT AT SUCH A DETAILED LEVEL WOULD CREATE

SITE/ACQ/LOS

FLIGHT EVENTS/HISTORY/BRIEFING

MORE ANOMALIES THAN IT
WOULD FIX. THIS MAY BE
TRUE SINCE EACH TIME SUCH
A BIT PROBLEM IS FOUND, THAT
PARTICULAR RIT IS ADDED TO THE
LIST OF THOSE WHICH ARE INITIALIZED
BY V37 (OR SOMETHING EQUIVALENT
IS DONE) AND BY THIS TIME
ONE WOULD HOPE THAT THERE
ARE NOT MANY SUCH PROBLEMS
STILL AROUND.


AGC - JOHN R. GARMAN