

Massachusetts Institute of Technology
C. S. Draper Laboratory
Cambridge, Massachusetts

LUMINARY Memo #157

To: Distribution
From: D. Densmore
Date: 10 June 1970
Subject: LUMINARY Revisions 164-167

The following changes were incorporated into Revisions 164-167:

- 1) (Anomaly L-1C-01) In P40 S40.8 does a phase change (the original fix to the anomaly) and then calls FINDCDUW which returns to the S40.8 caller via QPRET. A restart, however, could change VAC areas thus losing the proper QPRET return. Because there is only one caller of S40.8 (UPDATEVG, X product steering), the subroutine was changed so that FINDCDUW returned to S40.8 (called with a CALL instead of GOTO with QPRET set up) and S40.8 branched directly back to the instruction in UPDATEVG after the one that called S40.8. This instruction was tagged S40RET. Other exits from S40.8 besides the one after the return from FINDCDUW were also changed to branch directly to S40RET rather than QPRET.
- 2) Routine ALARMIT in S40.8 was moved from FBANK 27 into FBANK 24 because to implement the fix described in (1) above two words had to be added to ALARMIT and Bank 27 had zero words left. ALARMIT formerly (in Bank 27) was 6 words long and only called by S40.8 in interpretive (BPL). It sent out a 1407 alarm and branched (via GOTO) to FINDCDUW -2, returning therefrom via QPRET. As implemented in Bank 27 it was 8 instructions long: FINDCDUW -2 was "CALL"ed and two lines were added after the CALL to "GOTO S40RET."
- 3) (PCR 1012)
Padload TOOFEW was in E7 1464 sharing with QSAVED and /AFC/ +1. QSAVED was used by P30; therefore a DOI could not be done before PDI as advertised in the GSOP as P30 with P63 as a "DOI and Coast Phase."

It was assigned to share here anyway because it was known that it was not intended to do DOI with the LEM.

/AFC/ is the double precision acceleration magnitude desired by the Descent thrust guidance equations. It is loaded every second in the P66 throttle-computation equations. This completely destroys TOOFEW, with which it shares. TOOFEW is padloaded and used in P66 as a criterion for the issuance of alarm 1466. If a high TLOSS causes a P66 guidance omission TOOFEW will be consulted and could result in an erroneous 1466 alarm or failure to produce the alarm when appropriate depending on the value of /AFC/ +1.

TOOFEW was moved to an unshared location in unswitched (1354).

- 4) A block of erasables starting with AT and defined with respect to AT were moved back to the absolute locations they were assigned to in Luminary 1C and in 1D up to Revision 154. The original (and current) locations are E4, 1662-1765. The locations in Revisions 154-163 were E4, 1630-1733. The affected erasables included two blocks of ascent guidance erasables divided by a block of ascent-descent servicer erasable. These erasables were returned to their traditional locations just to be sure no new bugs would turn up due to their being moved. One problem which resulted, YDOT and ELEV sharing, was fixed independently by initializing ELEV before the display. YDOT, the cross axis velocity to which the ascent guidance is steering was part of the block moved up when AT was moved. It came to share with ELEV and happened to leave very small numbers in the erasable as initial values for ELEV. This garbage was displayed in N55 and showed as +00000 because it was too small to be significant. By coincidence, zero ELEV is an option and the astronaut would have proceeded on the nonzero zero rather than loading his own zeros.
- 5) (PCN 1048) Garbage was left in ELEV and displayed in the N55 display in P34. The coding was changed to zero ELEV and ELEV +1 before putting up the display. It would be possible for ELEV (in R2) to be displayed as +00000 when it is actually a small positive number. If the

astronaut then proceeds thinking ELEV is already zero rather than loading zeros himself, a 611 alarm (no elevation angle for this TIG) could result. (Zero is an option to compute elevation angle based on TPI TIG.)

- 6) (PCR 988) The tag STRTP66A was moved down a few instructions to avoid part of P66 initialization not desired on a restart (STRTP66A is a restart point). Now bypassed on a restart are the setting of P66PRO flag which is reset to turn off the RCS jets and the initialization of CNTTHROT to minus TOOFEW to require the minimum number of throttlings before an omission. This would have required the minimum number of throttlings not just between omissions but between a restart and an omission, making possible an erroneous 1466 alarm.
- 7) (ACB L-20) The original implementation of the ACB was done incorrectly. Rather than correcting the input scaling for N60 the output scaling was changed. Although the noun was not intended to be used for output it was corrected back to what it was originally. The input scaling was corrected as originally intended.
- 8) (PCN 1052)

Due to the IMU being located approximately $1 \frac{1}{2}$ meters from the center of gravity, X translational acceleration is induced by any attitude vehicular rates by a factor of WR where W is the rate and R is the moment arm. This acceleration sensed by the X PIPA affects the P66 vertical throttle control if the PIPAs are read while the vehicle rates are in progress.

To correct this OLDPIPAX is initialized for bobbing effects on velocity if there are any attitude rates when entering P66 or after a restart in P66. During normal P66 operation OLDPIPAX is updated for attitude rate affecting the vertical velocity estimate.

9) (PCR 896)

The landing radar velocity reasonableness test could fail erroneously due to Servicer being too fast. As previously implemented Servicer could start to process LR velocity data before the complete set of radar readings are taken for a particular velocity beam.

To correct this a flag R12RDFLG is set in R12READ before taking the velocity data readings. When all 5 readings are completed the flag is reset. In Servicer at VMEASCHK the flag is tested. If it is clear, velocity data is processed. If it is set the program loops checking NEWJOB (and permitting waiting jobs to come on if higher priority) and checking R12RDFLG. The flag is also cleared on a Fresh Start or restart. The flag bit is flagword 11 bit 3.

10) (ACB L-27) Three words were saved in FBANK 5 in order to implement the clearing of R12RDFLG in Fresh Start. An unused constant, OCT7777, was deleted. A BANKCALL to restarts routine was done directly rather than indirectly by picking up a CADR. And a new constant was designed for masking in the SWINIT initialization of FLAGWRD8 rather than adding in each bit individually.

11) Routine RADSAMP (16 words) was moved out of Bank 25 into Bank 15. This made room in Bank 25 for the setting and resetting of R12RDFLG in R12READ.