

Undesirable Features of Luminary 209 LM Program

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Interest has been expressed in a list of some of the undesirable features of the Luminary 209 program, understood to be the currently planned LM Apollo 15 flight program. The material has been divided into two categories in order to present some resemblance of classifications for the troubles:

Category 2 are those items which will probably be cause for program notes

~~They do not necessarily impact mission safety or performance, but have apparent (or real) "nuisance" value.~~ They do not necessarily impact mission safety or performance, but have apparent (or real) "nuisance" value.

Category 1 are those items which are unlikely to cause any interest, although for various reasons they represent unsavory program behavior.

No Category 3 items ("if an opportunity exists, should change ropes") were detected, due to lack of familiarity with the LM coding (FSB has published the Programmed Guidance Equations document for all Luminary flights). In addition, the major review mechanism employed was a scan of the new FSB RTCC-paper symbolic comparison program: this technique, of course, cannot be relied upon to identify incompletely incorporated changes. No attempt has been made to separate out "new features" from "old ones", nor to list items other than those encountered during the review process mentioned, or previously under this MTCP task.

Category 2 (Building 30/4 Attention)

1. PCR 334R1 has not been completely implemented. As a result, N94 is displayed during abort(P70/71)nominal sequence, but N63 would still be displayed in the event that ENTR to F V97 (thrust fail). Section 4 GSOP requires N94 (N63 now has LR "error", which of course is not of interest in P70/P71).

✓ ANOM
PN.

2. Section 4 and 5 GSOPs require that a V34E response to the N49 display in R22 do a pass through R65 before taking another reading. This pass is omitted (so, depending on delay in response to the N49, the last R65 update may be of considerable age when again attempt the R22).

GSOP fix
PCN 7

3. PCR 319 required the "pre-terrain model" LR altitude error to be placed on the downlink. In P66, there seems a possibility, depending on execution time, that the information telemetered would be a velocity cell (DELVROD) loaded by the one-second P66 loop. In this case, of course, the P66 entrance disables the terrain model and the "post-model" cell could be used to construct the desired data. A constraint, however, exists on ground use of the cell. The cell sharing with DELVROD is TEMDELH.

P.N.

4. Interrupt inhibits are missing in at least 2 areas when flagword bits are changed. This in general can be a dangerous procedure (since an interrupt could arise which would also cause bit change, and return to non-interrupt mode would then cause the change to be lost). One effective solution might be to have the bit-by-bit simulation check for loading flagword cells without interrupts being inhibited. The two areas are:

a) In V56 if TRACKFLG = 0, FLAGWRDO is changed without interrupts being inhibited. True

b) In radar designation (tag "RRDESDUN", page 567 of listing) the radar mode cell RADMODES is similarly changed (here an inhibit is done before the storage, but after the sampling, so reasonable for interpreter not to catch it). write
LUM
MEMO

5. Some old anomalies have had apparently related coding modifications done, but incompletely (hence they still can be presumed to be appropriate material for program notes):

a) Anomaly L-1D-17, N54 display in P22 when exit 400 nmi, should have been fixed, as pointed out to MSC on 21 May 1970, by setting the display enable bit when first enter the 400 nmi logic. Instead, however, a separate bit for use in R26 has been defined (for which no authorizing PCR for Section 2 GSOP impact has been seen). As a consequence, would expect to see the 400 nmi display in P22 either at beginning or at end (but not both).

ANOM
PCN

b) Anomaly L-1D-25, V37 near ullage turn-on, has been incompletely fixed, although the possible "window" of difficulty is considerably less. The problem is that the coding sequence employed is: inhibit interrupts; terminate ullage (DAPBOOLS); release interrupts; terminate waitlist task. What should have been done, of course, is not to release interrupts, or to terminate the ullage waitlist task before, not after, resetting the DAPBOOLS bit.

CHANGE
ANOM

Anomaly LNY-51 (26 March 1969, blank program number after non-fresh-start actions) seems to have been fixed, although the "paperwork" authority for it (or even explanation, since the MSC AAP G&N contractor claimed "The program is designed to operate as described...This is not an anomaly") is not known.

Follow
from
PCN

6. DVTOTAL (R3 of N40) was formerly incremented when Average-G was on, as required by page 2-106 of Section 2 Rev. 10 GSOP. It no longer is incremented when SURFFLAG is set. The "authorization" for this is apparently ACB L-30, to avoid incrementing while on lunar surface in P12. The SURFFLAG bit, however, is not = 0 at P12 ignition(nominal), but instead the cycle after (as far as Servicer is concerned) the P12 acceleration criterion is met. Since this change impacts DSKY display information, and telemetered(GSOP-defined) material, it should not have been done without suitable MSC authorization(DSKY an on-call for possible use in determining engine status, perhaps). It is probably debatable whether the new mechanization (delay in N40 incrementing) is "better" or "worse" than the "premature" N40 incrementing of previous programs (for the new program, is at least now consistent with the late mass decrementing done in same area).

✓
PV
clarify
magn
error

7. As pointed out to MSC on 5 October 1969, exiting P63 after nominal ignition via V37 means does not reset the LETABORT bit (as a consequence, P47 selection e.g. 10 hours later, followed by V37E71E, would attempt P71 execution). Since other residual bits have recently claimed anomaly attention, and since the MSC AAP G&N contractor "discovered" another erroneous flagbit "residue" (anomaly report COM 40, dated over 8 months later) pointed out in the same 1969 document, perhaps MSC should require anomaly reports to be publicized on every such residual bit.

DN

8. As pointed out to MSC on 17 December 1969, an incomplete update of the program constants due to PCN 765 was accomplished. As a result, the constant "K(1/DV)", using Section 5 GSOP numbers, is in error by considerably more than the percentage error reflected in the erroneous constant [REDACTED] in anomaly report L-1D-16 [REDACTED]

WHAT DOES
THIS MEAN

[REDACTED] The constant is used in the P70 thrust filter initialization.

Category 1 (FSB GSOP comment Attention)

1. At start of T4RUPT processing, a CCS on DSPTAB+11 is done, followed, if negative, by XCH DSPTAB+11, MASK LOW11, TS DSPTAB+11. A restart between the XCH and the TS would find garbled information in the word, and hence might put IMU into coarse align. PIN

2. For PCR 334R1, noun 94 has been added. The "no load" bit in the noun tables is set for this noun, even though noun table information for loading is available for each component. Although loading is not "reasonable", other such nouns (e.g. N63) are not locked out in this fashion (a reflection of the design philosophy change made after the excessive crew lockouts in the AS-204 program were found objectionable). N95 in Artemis 71, on the other hand, is missing the setting of the bit, even though it should be in this category. OK

3. In violation of Section 2, Section 4, and Section 5 GSOPs (e.g. RENDWFLG definitions), the criterion used in P22 for W matrix initialization is the mark counter, not this bit. Hence the elaborate POO integration checks for the Surface flag are not meaningful in connection with W matrix extrapolation, and the W matrix is initialized whenever P22 is selected (presumably "update mode" of P22 is not planned, however). ANOM

4. If an R60 maneuver is interrupted by taking PGNCs mode out of Auto, the "ZATTEROR" routine is entered without interrupts being inhibited. A similar problem exists for the "STOPRATE" entrance (as reported to MSC 25 November 1970). A similar CSM program problem was the subject of anomaly report COM 33. ANOM

5. As reported to MSC on 23 May 1970, LRWH1 is not used for P66 LR weighting if P66 entered from P63 directly. This was the subject of L-1D-13, but the published Section 5 Rev. 9 GSOP shows the performance directed by MSC in PCR 1028. Ed Δ to 650P

6. A V30E in CSM uses bits 14-10 of R1 of N26 (unshared) for the job priority; in the LM, at no saving in program steps, bits 15-2 are used. DN

7. During the erasable memory self-test (per G&N dictionary, a normal procedure), the cell ERESTORE is not exempt from the cells tested. As a consequence, a restart encountered while that cell is being tested would find "improper" information in the cell, leading to a fresh start. A similar problem exists in CSM. DN

8. Per Luminary memo #181, a convergence constant in the new "P57 mode" optics processing is supposed to be 0.0001745 (i.e. 0.01° expressed in radians). The constant (tag "COS.01") is actually twice this value, due to use with quantities scaled B1 rather than B0. The same document specifies an iteration loop counter initialization of "16", which is 28 in program (perhaps a deliberate change). CKGSOP

9. PCN 1132 authorized turning POODOO alarms into BAILOUT ones "if extended verb active". The check made, however, includes bit 2 of EXTVBACT, which is set for optics processing, not "extended verbs active", thus inviting a restart loop (since a phase change is made just before entrance to "AOTMARK" from P51, for example). DN

10. As pointed out to MSC on 3 June 1970, the P66 IMU "bobbing" correction of PCN 1052 uses OMEGAQ from the DAP which may not be a valid measure of vehicle performance (if e.g. in AGS control, perhaps). - 3

11. The upper limit on R1 of N99 (V67) is 99997, not 99999 as would be the case if the intended value was converted to meters properly. as specified in GSOP DN

TRW A-201 3 MARCH 1971
CATEGORY 1

- PN 1. This is true in COLOSSUS - covered by P.D. 109
2. This is true - no action

ANOMALY 3. This is true and should probably be anomaly since program is in error and conflicts with GSOP. (don't select P22 in update mode)

ANOMALY 4. True in COLOSSUS also - ANOMALY COM 33

EDITORIAL CHANGE TO GSOP 5. I don't think we need to do anything (he's upset because he feels MSC suggest the anomaly by PER 10)

6. This is true

NO ACTION
FOR
TOM P.

maybe P.D. Under P26 in R2 don't load bit 15 or bits 9 thru 2

DO NOT 7. CSM people did nothing

CHECK GSOP 8. what he says is true

PN 9. This could be done if some interrupt logic continuously cannot on P00000 during AOTMARK - AOTMARK doesn't do a P00000 explicitly

P.H. 10. yes

DN 11. this is advertised in GSOP Page 6-106

TRW A-201 5 MARCH 1971
Category 2

1. TRUE D. MOORE LUMINARY MEMO $\pm 20\%$ describing this
maybe P.D.

2. TRUE should make PCN for GSOP change
consistent with program.

3. True P.W.

4. a. True - maybe Ground Note

b. not true? inhibit after MASK somehow
protects MASK

5. a. Pile says anomaly, PCN to reflect new flagword
b. check with Rye - initial anomaly 4-10-75 was assigned
to ~~Gen~~ ADOM

6. how much DV are we looking with current DUTIAL
initial incrementing criteria. (Bennett)

Section 2 GSOP description to include P12
P.N. include how DV is manually lock

7. Perhaps this should be a Ground Note? SJN

8. a. COMPUTE REAC VALUE & DETERMINE % ERROR
b. IF $\% \text{ ERROR} \geq 1\%$, WRITE ANOMALY,
OTHERWISE END.

how
what does this really affect the minimum