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LUMINARY Memo #34

To: Distribution
From: C. Schulenberg
Date: 15 July 1968
Subject: LUMINARY Revisions 27-34

Major Changes Incorporated into Revision 27

- 1) Unitizing operations were added to the Lambert sign-input calculations to afford more accuracy.
- 2) SUNDANCE anomaly Y43 was fixed.
- 3) A potential overflow situation in the Ascent guidance equations was circumvented.
- 4) SUNDANCE anomaly Y50 was fixed.
- 5) Noun 49 was changed to use the four erasables R22DISP - R22DISP +3 rather than DSPTEMI - DSPTEMI +3.

Major Changes Incorporated into Revision 28

- 1) SUNDANCE anomaly Y47 was fixed.
- 2) The Descent pad-loaded parameters 1/KIGNX and KIGNV were renamed KIGNX/8 and KIGNV/8 respectively.

Major Changes Incorporated into Revision 29

- 1) The Descent pad-loaded parameters KIGNX/8, KIGNY, and KIGNV/8 were renamed KIGNX/16, KIGNY/16, and KIGNV/16 respectively.
- 2) SUNDANCE anomaly Y39 was fixed.
- 3) SUNDANCE anomaly Y44 was fixed.
- 4) A large number of changes were made to the P20's in order to bring these programs up-to-date with SUNDANCE. In particular, SUNDANCE anomaly Y5 was fixed.
- 5) PCR 400 was implemented by elimination of the 15 second wait in R22 when the LM is on the lunar surface.

- 6) Changes were made to the lunar surface marking logic.
- 7) Verb 66 was modified to update R-OTHER and V-OTHER.
- 8) An INHINT was added to the TWIDDLE routine. This takes care of SUNDANCE anomaly Y29.
- 9) The call to 1/ACCS was eliminated from the ENEMA coding.
- 10) The values of IFAILINH and IM30INIR were changed so that it is now impossible for a restart to cause an IMU CDU ZERO. (This fixes SUNDANCE anomaly Y19.)
- 11) The DVTOTAL computation in SERVICER was corrected so that the ullage acceleration would be accurately incorporated.
- 12) The description of the alarm and abort codes was updated.
- 13) A programming error was corrected in the LASTBIAS routine. LASTBIAS was bypassing the call to CAGETSTQ.
- 14) PCN 466 was implemented. The docked RCS deadband (DKDB) is now a pad-load. It is, however, initialized to 1.4 degrees in Fresh Start.
- 15) APSFLAG moved from Bit 12 of FLAGWRD1 to Bit 13 of FLGWRD10.

Major Changes Incorporated into Revision 30

- 1) The following erasables and erasable tags were deleted: ENDSAFE, HALFY, ROOTRET, SQRARG, X789T, R02EXIT, DELAYCTR, GBIASX, FOUNDR, FOUNDRV, and LM504.
- 2) The Descent pad-loaded erasables KIGNX/16, KIGNY/16, and KIGNV/16 were renamed KIGNX/B4, KIGNY/B8, and KIGNV/B4, respectively.
- 3) PCR 137 was implemented in R12.
- 4) The noun 51 scaling was corrected.
- 5) Seven words of non-functional coding were removed from the DAP to make room for forthcoming changes.
- 6) The name "LRSTAT" was everywhere replaced by "FLGWRD11".

Major Changes Incorporated into Revision 31

- 1) The two Kalman input vectors SCAXIS and POINTVSM were moved to overlay SERVICER. This was made possible by PCR 472 which eliminated the requirement for R60 and AVERAGE-G to run simultaneously.
- 2) A storage conflict was resolved in SURFSTAR.
- 3) A call to STOPRATE was added to R13 prior to the setup of P66 and P67. This was necessary in order to clean up after FINDCDUW since at this point it ceases to be called.

- 4) PCR 470 was implemented (new program P68 for post-landing computations).
- 5) P68 was added to the V37 table.
- 6) Noun 17 was deleted since it is unused.
- 7) The landing radar altitude scale factor was fixed in PINBALL. This fixes part of SUNDANCE anomaly Y48.
- 8) An unnecessary call to TESTXACT and ENDEXT was deleted from V74.
- 9) Coding was added to the V91 termination logic to store SELFADRS in SKEEP1. This avoids unpredictable SELFCHK behavior.
- 10) SUNDANCE anomaly Y34 was fixed.
- 11) Routine 03 (V48) was completely rewritten in order to implement PCR 419.
- 12) The new DP erasable OPTIONX was defined for V82 (R30).
- 13) The LRS22.1 erasables were re-arranged so that RDOTM, TANGNB, MKTIME, and RM are near the end of EBANK 7. This solves an R29 erasable conflict problem with R10.
- 14) The value of UPDTPHAS was changed from octal 15 to octal 5, thus curing a P27 restart problem.
- 15) All usages of the stage-verify bit were replaced by usages of APSFLAG (PCR 419).
- 16) A bug was fixed in 1/ACCS.
- 17) SUNDANCE anomaly Y63 was fixed.
- 18) SUNDANCE anomaly Y35 was fixed.
- 19) PCR 420.2 was implemented. Verbs 61 and 62 were added to select Mode I and Mode II needle displays, respectively.
- 20) PCR 164.3 was implemented (Mode II attitude error displays).
- 21) Stagemon was deleted from T4RUPT (part of PCR 419 changes).

Major Changes Incorporated into Revision 32

- 1) Noun 75 was deleted (not needed as a result of PCR 472).
- 2) A new POODOO-style abort code (1406) was added for P63. The two alarm codes 1410 and 1412 were also made into POODOO aborts.
- 3) A change was made to the manner in which the Descent guidance equations set up the guidance coordinate frame.
- 4) Checklist codes 206 and 207 were deleted (not needed as a result of PCR 472).

- 5) The BURNBABY sequencing table for P70 and P71 was updated in accordance with PCR 472.
- 6) The tag "LRSTAT" was deleted.
- 7) A restart bug was corrected in BURNBABY. A pushlist quantity was being saved "across" a phase change.

Major Changes Incorporated into Revision 33

- 1) A new log section "PADLOADS" was created and documentation on about half of the LUMINARY pad-loaded parameters was added to it.
- 2) P76 (formerly R32) was added to the Verb 37 table (this is a result of COLOSSUS PCR 468 - a LUMINARY PCR is forthcoming).
- 3) P76 was modified to set the TRACK and not the UPDATE flag.
- 4) Verb 84 was made into a spare (formerly it called R32).
- 5) R32FLAG was deleted since it is no longer needed.
- 6) SUNDANCE anomaly Y65 was fixed.
- 7) POODOO-style abort 1410 was made into an alarm.
- 8) PCR 478 was implemented in the Ascent guidance equations.
- 9) PCR 472 was implemented for P71.
- 10) Noun 12 was defined using the new erasable OPTIONX. It will be the analog of noun 6 for extended verbs.
- 11) NOR29FLG and READRFLG were moved from FLAGWRD0 to FLAGWRD3 for R29.
- 12) PCR 134.2 was implemented in P52.
- 13) The P70 and P71 R40 sequences were recoded as a result of PCR 472.
- 14) The clearing of the Abort-enable flag in P70 was altered in order to conform to the GSOP (See LUMINARY memo #29 Item #10).
- 15) A programming error was corrected in R03.

Major Changes Incorporated into Revision 34

- 1) The Fresh Start coding which initializes the FLAGWORDS was modified so that Bit 13 of FLGWRD10 (APSFLAG) is not altered. This was necessitated by PCR 419 which placed the DAP in utter reliance on this bit. It is now necessary to padload this FLAGWORD to octal 0 for Descent or octal 10000 for Ascent.
- 2) The manner in which the Descent guidance constructs the guidance-coordinate frame was altered. The matrix CG is now updated after the computation of TTF/B.

- 3) New flagbits were defined for R12 (PCR 214).
- 4) Two new pad-loads, LOWCRIT and HIGHCRIT, were defined for the Throttle program (see PCR 210).
- 5) A new flagbit (POUTFLAG) was defined for the Throttle program to aid in controlling pulse-outs of the DPS engine.
- 6) The description of R04FLAG was corrected.
- 7) Two new pad-loads, WSURFPOS and WSURFVEL, were defined for Verb 67. (PCR 173.3) Also, the Noun 99 erasables WWPOS and WWVEL were equated to RANGE and RRATE. In addition, the flagword V45FLAG was renamed V67FLAG.
- 8) The following erasable tags were deleted: OPTY, OPTX, OPTYCMD, OPTXCMD, BMAGX, BMAGY, and BMAGZ. Coding was changed where needed. The replacement names were: CDUT, CDUS, CDUTCMD, CDUSCMD, Q-RHCCTR, P-RHCCTR, and R-RHCCTR.
- 9) The loading of OPTYHOLD was deleted from ANGLREAD since the values of CDUS and CDUT at this time are not needed.
- 10) Nouns 95 and 96 were deleted since they are unused. A note was made of the fact that noun 41 is used only during System Testing.
- 11) SUNDANCE anomalies Y18, Y30, Y32 and Y36 were fixed.
- 12) A new checklist code (00013) was added as a result of PCR 134.2.
- 13) PCR 214 was implemented for R12.
- 14) R29 was modified in order to have remodeling capability.
- 15) A zeroing of TRKMKCNT was added to P12 in order to indicate that R29 downlink data is not yet meaningful.
- 16) R29 was fixed so that it compared the RR boresight against the current, rather than the projected LOS.
- 17) PCR 210 was implemented.
- 18) PCR 173.3 was implemented (V67).
- 19) Verb 67 was added to the extended verb fan.
- 20) SUNDANCE anomaly Y17 was fixed.
- 21) The P42 minimum impulse ascent engine constants K1VAL, K2VAL and K3VAL were changed to agree with those in SUNDANCE revision 302.
- 22) Alarm codes 1411, 1413, 1414, 1415, 1706 (first meaning) and 1711 were deleted since they are now unused.
- 23) The setting of SURFFLAG was deleted from P22 and the clearing of SURFFLAG was deleted from P20.
- 24) P22 was connected to the Verb 37 table.
- 25) SUNDANCE anomaly Y23 was fixed.
- 26) SUNDANCE anomalies Y18 and Y49 were fixed.

- 27) Checklist codes 11 12, 16, 17, 31, 35, 36, 60, 61, 202, and 204 were deleted since they are unused.
- 28) SUNDANCE anomaly Y31 was fixed.
- 29) SUNDANCE anomaly Y23 was fixed.

Available Erasables in LUMINARY Revision 34

Unswitched	21
E3	8
E4	6
E5	2
E6	6
E7	20

Summary of Assemblies

Revision	Status	Word Count	Tapes
27	BAD, 1 cuss	34270	None
28	GOOD	34273	None
29	GOOD	34298	None
30	BAD, 1 cuss	34289	LMS, HYBRID
31	BAD, 21 cusses	34335	None
32	GOOD	34337	LMS, HYBRID
33	BAD, 7 cusses	34295	None
34	BAD, 31 cusses	34541	None

Statistical Summary for Revisions 27-34

1) Number of modification forms	180
2) Number of DAP mod forms	14
3) Changes for storage reduction	9
4) Changes for execution time reduction	0
5) Developmental changes	4
6) Non-program changes	71
7) Mandatory changes	96
8) Total fixed memory change	+246

PCR's Implemented in Revisions 27-34

PCR	Revision
1) 400	29
2) 466	29
3) 137	30
4) 470	31
5) 419	31
6) 420.2	31
7) 164.3	31
8) 472	32
9) 468	33
10) 478	33
11) 134.2	33
12) 214	34
13) 210	34
14) 173.3	34

SUNDANCE Anomalies Corrected in Revisions 27-34

Rev. 27	Y43, Y50
Rev. 28	Y47
Rev. 29	Y39, Y44, Y5, Y29, Y19
Rev. 31	Y48, Y34, Y63, Y35
Rev. 33	Y65
Rev. 34	Y18, Y30, Y32, Y36, Y17, Y23, Y18, Y49, Y31

SUNDANCE Anomalies Yet to be Fixed in LUMINARY

Y4, Y12, Y16, Y46, Y48, Y54, Y56, Y59, Y60, Y64, Y66