

P. Rye

MIT/IL SOFTWARE ANOMALY REPORT

REPORT NO.	ILNY 77
PROGRAM	LUMINARY
PROGRAM REVISION	99

1.1 ORIGINATOR: C. Schulenberg	1.2 ORGANIZATION: MIT/IL	1.3 DATE: 6/18/69	1.4 ORIGINATOR CONTROL NO.
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1.5 DESCRIPTION OF ANOMALY:
 It is possible for all computer activity governed by the TIME3 interrupt structure (i. e. , Waitlist) to be suspended for a period of about 163 seconds following the selection of P70 by means of the abort button or P71 by means of the abortstage button. The problem develops in the following manner: R11 (abort-discretes monitor) together with R10 (landing-analog displays routine) form a task under TIME3 interrupt control which is executed every...
 CONTINUED ON PAGE 2

1.6 DESCRIPTION OF RUN:
 Discovered and analyzed by TRW Systems.
 CONTINUED ON PAGE

- MIT ANALYSIS -

2.1 CAUSE:
 Software restarts do not initialize the TIME3 register.
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2.2 RECOGNITION:
 When the abort button is pushed the DSKY will always blank within about a half-second. Then major mode, 70 or 71, will quickly appear in the mode lights.
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2.3 MISSION EFFECT:
 If avoidance procedure #1 is used there would be no mission effect beyond requiring more time of the astronaut in selecting an abort program.
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2.4 AVOIDANCE PROCEDURE:
 There are in this instance two possible types of avoidance procedures. The recommended avoidance procedure is to select the aborts via V37 and then
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2.5 RECOVERY PROCEDURE:
 A recovery procedure is not recommended since by the time recognition of the problem is made, the LGC would have, in general, been stalled for so long a...
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2.6 PROGRAM CORRECTION:
 Recode software restart logic so that TIME3 (and for consistency, TIME4 and TIME5) is initialized in the same manner as in the logic activated by a hardware restart.
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2.7 RECOMMENDED DISPOSITION (Fix, Work-around, etc):
 Fix in 1 module re-release of LUMINARY 1A (LMY 99, Rev. 1)
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2.8 RECOMMENDED RE-TESTING:
 A Digital run should be made with P70 selected and TIME3 forcibly set to a small number.
 CONTINUED ON PAGE

2.9 MIT/IL SIGNATURE:
George W. Cherry
 2.10 DATE:
 6/23/69

3.1 NASA DIRECTION:
 CONTINUED ON PAGE

4.1 CLOSING ACTION TAKEN:
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3.2 NASA/MSC SIGNATURE:	3.3 ORGANIZATION	3.4 DATE:	4.2 SIGNATURE:	4.3 ORGANIZATION:	4.4 DATE:
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1.5 Description of Anomaly

.25 seconds. If this R10, R11 task is scheduled to be executed and then within .249 seconds another task is requested by some other routine to be executed at the same time, WAITLIST will dispatch the R10, R11 task when TIME3 has overflowed from 37777₈ to 00000₈. WAITLIST will not reset TIME3 because it has the intention of letting the second task commence operation as part of the same interrupt - as soon as R10, R11 returns control. This is perfectly normal operation - unless R10, R11 fails to return control, and this is what it does when the R11 part sees the inbit requesting either P70 or P71. The R10, R11 task sets major mode to 70 or 71 and performs a software restart with TIME3 counting up from 00000₈. The software restart routine makes requests for the appropriate jobs and tasks needed to perform the abort, but although the jobs begin execution the tasks are held up for 163 seconds until TIME3 overflows again! This is because WAITLIST observes the small value of TIME3 and interprets it to mean that some task is pending in the interrupt chain. It then will not use TIME3 to schedule the new tasks until the non-existent "current" task has begun and completed operation. This behavior can actually occur at any time the following conditions are met:

- 1) Two or more tasks were scheduled for the same time; and
- 2) A software restart is generated within a task while another task is waiting to be processed in the same interrupt.

Since the possibility of occurrence in circumstances other than abort selection is extremely remote, this report is confined to a discussion of this case only.

2.2 Recognition

Subsequent DSKY activity will show whether the problem has occurred or not.

If the DSKY blanks and stays blank, the problem has occurred and the DAP will maintain attitude-hold.

If the DSKY blanks and then puts up a static, unchanging V06N63, the problem has occurred and the DAP may initiate and hold a constant rate of as high as 10 degrees/sec. This is because there has been one and only guidance pass and the resulting DAP commands are never overridden.

If the DAP was not in AUTO at the time of abort, or if P70 was selected and the throttle was not in AUTO, a flashing V50N25 will always appear. If an ENTER is keyed in to bypass LGC checks and get rid of the display and the DSKY remains blank, then the problem has occurred and the DAP will maintain attitude hold. If, however, the DSKY puts up a V06N63 the problem did not occur and everything is normal.

There is another way of recognizing the problem also. If the tape meters (altitude and altitude-rate) are in the PGNS mode at the time the abort buttons are depressed, the meters should stop driving momentarily and then resume operation within .5 seconds. If they do not resume operation in that time, then the problem has occurred. If the meters were not in PGNS at the moment of abort, the astronaut could switch to PGNS mode subsequently and see if they commence operation.

2.3 Mission Effect

If avoidance procedure #2 is taken in a timely manner there should be little or no state vector error introduced and the abort should be successful. If no avoidance procedure is exercised and the problem occurs then the LGC will remain in a state with all T3RUPT activity suspended and thus incapable of effecting the abort. The

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DAP will either maintain an attitude hold state or a constant rate. (See 2.2)

2.4 Avoidance Procedure

depress the appropriate button. An alternative avoidance procedure (which is actually a recovery procedure executed whether the problem occurs or not) is to depress the abort or abortstage button, wait until the DSKY blanks, and then key in V69E to cause a hardware restart.

AVOIDANCE PROCEDURES

- #1 V37E70E then push abort button.
V37E71E then push abortstage button.
- #2 Push abort or abortstage button.
Wait until DSKY blanks.
Key in V69E.

The advantage of method #1 is that it absolutely precludes the occurrence of the problem. The disadvantage, of course, is the seven keystrokes.

The advantage of method #2 is that it requires only 4 keystrokes. The disadvantages are, however, that it induces a hardware restart (which may cause problems outside the LGC) and may introduce state vector errors in the LGC even if the V69E is done almost immediately. A delay of a second or two would not, in itself, cause enough state vector error to preclude a safe insertion but it would greatly increase the dispersion of injection conditions. (See 2.5)

2.5 Recovery Procedure

time that a V69E, although it would cause normal operation of the abort guidance to resume, would leave the LGC with estimates of position and velocity that would be substantially in error. In this case, insertion of the LM into a safe orbit by the LGC could not be guaranteed.