MIT/IL SOFTWARE ANOMALY REPORT

1.1 ORIGINATOR:	1.2 ORGANIZATION:	1.3 DATE:	1.4 ORIGINATOR CONTROL NO.	SWR REPORT NO.: L-1B-09
R. COVELLI	MIT/IL	10/28/69		PROGRAM: LUMINARY
				PROGRAM REVISION: 99, 116

1.5 DESCRIPTION OF ANOMALY:

If a restart occurs during a radar read, the following radar read may be incorrect. If this happens in R12, the state vector may be incorrectly updated.

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1.6 DESCRIPTION OF RUN:

Apollo 11 flight. There were two incorrect altitude readings in powered descent after software restarts.

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- MIT ANALYSIS -

2.1 CAUSE:

See Digital Development Memo #483, "LGC Radar Timing," by Allen Harano, 26 August 1969.

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2.2 RECOGNITION:

Monitor radar data on downlink.

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2.3 MISSION EFFECT:

With the current landing radar weighting functions, an altitude error of up to 4100 ft. could be introduced into the state vector. In the worst possible case,

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2.4 AVOIDANCE PROCEDURE:

None

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2.5 RECOVERY PROCEDURE:

Subsequent radar updates will correct the state vector.

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2.6 PROGRAM CORRECTION:

Inhibit incorporation of landing radar data on the first radar read after a restart.

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2.7 RECOMMENDED DISPOSITION (Fix, Work-around, etc):

Fix in LUMINARY 1C.

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2.8 RECOMMENDED RE-TESTING:

Digital simulation with restarts to verify that the radar data is not incorporated after a restart.

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2.9 MIT/IL SIGNATURE: [signature]

2.10 DATE: 11-3-69

3.1 NASA DIRECTION:

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4.1 CLOSING ACTION TAKEN:

Incl in 1C

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3.2 NASA/MSC SIGNATURE:	3.3 ORGANIZATION:	3.4 DATE:	4.2 SIGNATURE:	4.3 ORGANIZATION:	4.4 DATE:

MSC Form 1403 (Rev May 68)

2.3 Mission Effect, cont'd.

the radar might indicate zero altitude. The altitude update, ΔR, is then given by:

$$\Delta R_{max} = W_h \Delta H = W_h (O - H) = -W_h H$$

The present weighting function is

$$W_h = .35 (1 - H/50000)$$

so that

$$\Delta R_{max} = -.35 H (1 - H/50000)$$

The following table gives the value of the update as a function of altitude in the case where the radar gives a zero reading:

H	ΔR_{max}
50000 ft.	0 ft.
40000	-2800
30000	-4200
25000	-4375
15000	-3675
10000	-2800
5000	-1675 (would fail reab. test)
1000	- 333

In Apollo 11, the two bad readings gave altitude errors of -1000 ft. and -272 ft., which was much less than the maximum possible error.