

Massachusetts Institute of Technology
Instrumentation Laboratory
Cambridge, Massachusetts

LUMINARY Memo #39

TO: Distribution
FROM: George W. Cherry
DATE: August 27, 1968
SUBJECT: Scheduling Proposed Modifications to the LUMINARY
Digital Autopilot

1. Source of Proposed Modification

Proposed modifications have come from both MIT (Bill Widnall et al) and MSC (Ken Cox et al). Some of the MSC proposals (PCR's) were approved by the Flight Software Branch for MIT evaluation and others were on the PCR form but did not as of this writing have Flight Software Branch approval for MIT official evaluation. I have ranked all the proposals in my personal judgement according to their relative merit and priority. My ranking is arguable and negotiable, but it is the first step to choosing what we ought to attempt for each LUMINARY.

2. Proposed Action Items

- 1) MIT/IL should put all its proposals on the PCR form and obtain an FSB number. (Bill Widnall/Alex Kosmala)
- 2) MSC (G&C) should do likewise. (Thomas Price)

3. Enumeration and Ranking of LUMINARY DAP Change Proposals

(See Table on next page.)

Item Number	PCR # (If avail.)	Source MIT or MSC	Description	Visibility Impact for LUMINARY
1		MIT	Improve stability margin of CSM-docked autopilot, probably through reduced gain of state estimator at the bending frequency.	5 days
2		MIT	Provide DAP initialization without a software restart when the DAP interrupts itself. (Alarm code 2000)	1 day
3		Both	Limit diverging attitude error which occurs in the light ascent configuration during +X translation with an undetected jet failure. This was an unfixable SUNDANCE problem.	1 day
4	PCR242*	Both	Provide option in DPS burns for favoring +X or -X jets for Pitch-Roll Control.	3 days,* 8 days
5		Both	Reduce cross-coupling effects between U-V axes especially during ascent. See AG letter #105-68.	7 days
6		MSC	CSM-docked LM Trim Gimbal Control Modification. See SAD #9-68 and AG# letter.	3 days to study
7		MIT	Provide faster moment offset estimation (especially for ascent) in the DAP state estimator by (a) starting with a non-zero <u>a priori</u> estimate and (b) programming a simple time-varying acceleration filter gain.	2 days
8		Both	Provide a special jet select logic for the CSM-docked DAP which uses the Y-Z translation jets for pitch and roll control.	5 days
9		Both	Downlink jet-firing information	5 days

Item Number	PCR # (If avail.)	Source MIT or MSC	Description	Visibility Impact for LUMINARY
10		MSC	Increase possible duty cycle of jet firings by removing the skip or quiescent cycle following the termination of a jet firing. (May result in P & I Spec. violation.)	10 days
11		MIT	Use the trim gimbal control system for S/C steering even during the rate-command attitude hold mode of landing. (This is a very low priority item.)	?
12		MSC	Smooth DPS throttle commands in the R-O-D mode. (This is really not a "DAP" item; but was sent to us by Ken Cox with other DAP items.) The throttle changes during R-O-D should be rather small and have small compliance effects. Also, smoothing the throttle commands may slow down the R-O-D mode response to an intolerable degree. We would appreciate the transmission of any analysis of this proposal to us.	?

* 3 days for implementing PCR 242; 8 days for implementing PCR 242 and providing a second rate error deadband in the rate command mode to provide both +X jet and -X jet torque when the rate error is high and the astronaut wants full control authority.

4. Incorporating the Items into LUMINARY1 and LUMINARY2

We believe that we should attempt to put the first four items into LUMINARY;. (The DAP designers feel so strongly about the first three items that they want to try to put them into LUMINARY1 even if MSC will not redefine the End of Level IV to accomplish this.)

We propose to have the first nine items in the LUMINARY2 program. (End of Level IV for this program is predicted for 8 April 1968.)

5. Incorporating the Items into LUMINARY, a single program release that is practically equivalent to LUMINARY2.

We propose to put the first seven items into this development plan. The end-of-level IV for this program is predicted for 10 December 1968.

6. Proposed additional action items.

I propose that a joint MIT/MSC meeting be held (Co-chaired by Dr. Kenneth Cox and Dr. William Widnall) to examine the strawman proposed in this memo and make a definitive recommendation concerning LM DAP PCR's to the Flight Software Branch and the Software Control Board.