

Massachusetts Institute of Technology  
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Cambridge, Massachusetts

LUMINARY MEMO #57

TO: Distribution  
FROM: George W. Cherry  
DATE: December 9, 1968  
SUBJECT: Report on the LUMINARY FACI

On Thursday morning, December 5, 1968, Craig Schulenberg, Jim Kernan, Jim Nevins, Norm Sears and I attended a brief (3 hours) non-dramatic LUMINARY FACI. The MSC FACI reviewers had very few negative issues to discuss (of negative issues, more later) and, on the whole, were positive about the program. I want to thank everyone who, with some personal sacrifice and much professional skill, contributed to turning out a LUMINARY on schedule which has been tested through levels 1, 2, 3, and 4.

Mr. Kraft, after he heard all the reports, said "Let's fly it to the moon" and also said "outstanding!". Whereas I think we can count on a few program changes before landing on the moon, I am sure that MSC intends now to fly Rev. 69 on mission "F", which is slated, you may know, for early spring. Remember, that COLOSSUS Rev. 237, is also only a "FACI" program; but it is slated to fly around the moon this month. The message I have for you is obvious "Let's test the hell out of LUMINARY."

Because Kraft said "Let's fly it to the moon," level 5 and level 6 testing constitute the 2nd highest priority item in the LM program area (SUNDANCE level 6 being higher right now). Jim Kernan has asked Peter Volante to take charge of LUMINARY level 5 and level 6 testing.

I have asked Jim and Pete to try to finish level 5 testing before the Christmas holidays. As I explained at the FACI, Level 5 consists of running the tests requested by MSC at the FACI review and re-running and re-scrutinizing many of the level 3 and level 4 tests. (Clark Hackler announced at the FACI that he was going to request about "forty more tests.")

The unresolved criticisms levied by MSC are the following:

1. Some programs were not checked for correctness of the downlink data. Jim and Pete, please be sure that level V picks up these areas.
2. DAP edit programs were not run with enough of the level IV runs particularly in the powered flight area. Bill Widnall, please provide LUMINARY DAP edit programs to Pete who will attach them to some of the level IV runs.
3. P64, P65 landing programs showed excessive RCS propellant consumption and excessive thrust vector commands from about 200 feet altitude on down. I suggest that a design review team composed of the following people meet to understand this problem.

Bill Widnall  
Don Eyles  
Bernie Kriegsman  
Allan Klumpp  
Craig Schulenberg

We found out that the time constant for nulling velocity errors in P65 is not in erasable although the GSOP specifies this.

We should consider whether changing this time constant is necessary, whether increasing the frequency of the sampled data system is necessary (Variable Guidance Period, PCR 650), etc.

I suspect that P64 is suffering  $T_{go}$  approaching zero problems just as P63 used to before modified 2 phase or 1 phase came along.

4. There were a few comments on the DAP which did not appear to move Kraft to believe anything is wrong. Bill Peters pointed out that with a jet failed on, an injudicious use of the ACA, etc., a large-signal CSM-docked DAP instability could be excited. Peters said that this was perhaps unsafe. Kraft said that any airplane

that doesn't have a "g limiter" is unsafe and that you can pull the wings off most planes by injudicious use of the controls. I think that Kraft will agree to change the DAP only if there is no schedule impact to his need dates. Bill Widnall, I am sending you copies of the Bill Peters presentation.

5. Bill Goeckler was disturbed somewhat about the LUMINARY ephemeris and some information given to him by Joe Saponaro. Joe, would you please straighten this out.
6. Most of the MSC reviewers recommended running at least a few additional tests. These are already being run.
7. There was a moderate amount of criticism of the ancientness, obsolescence, and general erroneousness of LUMINARY GSOP Section 4. We are trying to get the grand new Section 4 to the publisher by 24 December 1968. I want to be able to distribute this GSOP before or at the Mission "F" crew training. Walker Kupfer and Jack Shillingford are striving to accomplish this.

There was a short discussion about performance testing of the LGC programs for lunar landing. I explained that we required additional all-digital simulator capability (Lunar terrain model and Landing Radar error and drop-out boundaries) before we could start and that these changes had just been requested. Alex Kosmala, we need this capability by 10 January 1968.

After the FACI I asked MSC about LUMINARY 1A. They are very interested right now in how we would handle the LUMINARY 1A program. Tom Gibson likes the way we made SUNDANCE 306 from SUNDANCE 302. In the preparation of SUNDANCE 306 we

1. Had several people check (eye-ball) each piece of new coding that went in. (Including the original programmer, whenever possible.)

2. Usually checked the coding in a version before putting it in the official assembly.
3. Designed special tests for each change which we kept record of in a test plan.
4. Had a committee peruse each test result and certify that the new coding worked properly. (Including the original programmer, whenever possible.)
5. Discussed each change with Jim Harrison, Peter Heinneman, and Ed Grace to see whether we were going to impact Cape testing, Sim flight, K-Start tapes, or systems tests.
6. Checked the documentation implications of each change and assigned action items to take care of them.

We had a checklist for each item which reminded us to do each of the above.

I told Tom that I would like to start a modest LUMINARY 1A effort now on the long lead-time items. He agreed that such an effort should be started as soon as we explained how it would be handled. He wants to be sure that we think of 1A as carefully crafted changes to 1, not a new program. The idea is so to conduct the assembly control and testing that we maintain and enhance the confidence we will continually be building in LUMINARY. I'm sure that the COLOSSUS folks can give us a paradigm or model for doing this. MSC wants to make sure that LUMINARY 1A profits from the experiences of SUNDANCE 306 and COLOSSUS 1A.