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UNITED STATES GOVERNMENT

Memorandum

NASA Manned Spacecraft Center

TO : See list attached

DATE: September 16, 1969
69-PA-T-119A

FROM : PA/Chief, Apollo Data Priority Coordination

SUBJECT: We don't have to change LUMINARY much for point landing but there's gold in them hills!

On September 12 we had a spacecraft computer program requirements meeting for Apollo 13. We called it because there were a lot of proposals floating around which had been advertised as "needed for point landing." On the other hand, these programs must be released for rope manufacture on about November 15 and so there obviously wouldn't be time to take much action after Chris Kraft's software CCB late this month. But it turns out that that doesn't matter because we came out with only one or two changes we felt were worthwhile for LUMINARY and maybe one small, unimportant change for COLOSSUS.

We also uncovered what appears to be a DPS ΔV gold mine! Some GCD guys (Tom Moore and Ed Smith) and Allen Klump (MIT) have been working on a scheme which involves temporary throttling down early in Braking (P63) to almost eliminate the need for sustained low throttle operation at the end of P63. If this isn't Fool's Gold the potential saving appears to be in excess of 100 fps. This technique certainly deserves a lot of attention pronto! MPAD will immediately crank up their analysis factory to learn more about the effect on attitudes, monitoring procedures, MCC-H trajectory processing, etc., and to develop confidence in it. An off-line program tape will be made by MIT for the crew to try in the LMS. We must also get a Data Book change to permit operating the DPS this way. (Ed Smith is gonna do this.) And, we'll look for other hardware problems too.

We've requested that, if possible, this descent program modification be designed so that it can be deactivated by changing constants or something if some late discovery scares us.

The other significant change is to compensate for a spacecraft deficiency. Pressurization causes the LM to become bloated and that in turns moves the LPD window markings. Since this can't be corrected on the Apollo 13 LM, we propose to add some biases in the LPD program. (Conrad will have to do this in his head, I guess.)

One other change is still under consideration but will probably be dropped. That is the "co-ordinated turn" feature proposed for P66. The PGNCS would align the z-axis along the velocity vector as a pilot aid. It appears they don't need or want it but they're taking one last look.

Two programs were deleted outright, forevermore. They are:

a. The docked alignment technique - since it doesn't fit in the new timeline and we don't need it anyway. That is, we wouldn't use it if we had it.

b. The pre-PDI landmark observation program in the LM. As noted in an earlier memo, this idea didn't pan out.

The rest of the ideas were rejected for Apollo 13. Maybe some will turn out to be worthwhile on some later flight, particularly the first one. They are:

a. "Delta Guidance" which tends to standardize the terminal trajectory and reduce LPD ΔV costs.

b. Landing radar (LR) pre-filter

c. Addition of a terrain model for use in LR processing

d. Provision for enabling only LR velocity data (without altitude data) into the PGNCS navigation.

e. Changes in the LR weighting structure.

f. Increase in the LR sample rate into the PGNCS navigation.

g. Increasing the LR data rate on the downlist in R77 from 1 to 10 per second.

Neither of the two COLOSSUS proposals are really associated with point landing, nor are they really needed. One is the rate assistance for the optics and the other is a change to permit the computer to accept optics marks when the spacecraft attitude rate exceeds $2/3^{\circ}$ /sec - the current limit in the program. This change increases the danger of CDU transients and we must learn from MIT how much before we buy this one.

I was surprised and pleased to find we could get by so cheaply. I expected we would want more but the message appears to be that we have a good - and reliable - program already. Let's leave it alone! I swear I don't see how I could have been unaware of that ΔV nugget - considering how hard everyone's been looking for them. Had my head up and locked, I guess.

Howard W. Tindall, Jr.

Enclosure
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Enclosure 1

SEP 2 5 1969

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