

8-5-70

## VARIABLE SERVICER DESIGN REVIEW

August 5, 1970

### BACKGROUND

Although previous consideration had been given to the of a Variable Guidance Period Servicer, it was not until Apollo 11 encountered serious time-loss difficulties in landing that the urgency of the TLOSS problem was realized and occasioned the revival of the arguments in favor of incorporating a Variable Servicer.

By lifting the 2-second restriction on the guidance period and allowing it to stretch when the computational load requires it, ZERLINA's variable servicer allows safe and reliable program performance at TLOSS levels up to, and in some cases exceeding, 20%. At low TLOSS values, Variable Servicer runs at its 2-second minimum period as in the current LUMINARY.

Operating Servicer as a continuously running loop, the danger of one cycle overlapping another, with the ensuing alarms due to stacked up Servicer jobs, is eliminated. Also eradicated is the tedium of worrying about the TLOSS margin each time a program change affecting the fixed-period servicer is implemented.

ZERLINA has been updated with the corresponding changes in LUMINARY, and is, in fact, equivalent to the current version of that program with the exception of the Variable Servicer.

## TESTING

The first group of tests presented here is a recap of the list distributed at the May 27th meeting in Cambridge, when a brief presentation on the Variable Servicer was given. Since then, the primary change in Zerlina has been the addition of the new Landing Analog Display routine.

The second list of tests includes rigorous TLOSS testing in the landing area, as well as a double abort case run with 20% TLOSS. Also, nominal runs in the ascent, abort, and orbital manuevers programs were done, more to uncover logical errors in the coding than for TLOSS stress testing.

## TEST CONCLUSIONS

Whereas ZERLINA's performance at zero TLOSS is equivalent to that of LUMINARY, at TLOSS levels up to 20% (and higher in some cases) satisfactory test objectives have been achieved. Time loss induced by V16 monitor operation is handled equally well.

## ADDITIONAL TESTING

The following test outline is offered as a suggestion of what would be necessary to be assured of the flight-worthiness of ZERLINA:

1. Restart testing of all powered flight programs at a significant level of TLOSS (say 10%).
2. A Level IV test series equivalent to the one developed for LUMINARY. Additionally, powered flight phases should be tested at a TLOSS sufficient to produce alarms without resulting in a breakdown of program logic.
3. Extended verbs necessary during powered flight should be introduced into simulations running at a high TLOSS.
4. Testing on the hybrid simulator of runs with different levels of TLOSS.
5. The usual Level VI test series run at zero TLOSS, with time loss susceptible areas of programs tested at higher TLOSS. (This could be accomplished via rollbacks to reduce computer time requirements.)

ROUND ONE:

A. Landing (documented in Luminary memo 144):

1. Landing without terrain or TLOSS.
2. Landing without terrain or TLOSS, with PGMIN = 1 second to show landing's "natural" guidance period.
3. Landing without terrain, with 20% TLOSS.
4. Landing without terrain, with 30% TLOSS.
5. Landing without TLOSS, with terrain and terrain model.
6. Landing without terrain or TLOSS, with redesignations in P64 and a N69 site update in P63.
7. Landing with terrain and terrain model, with 10% TLOSS and V16 monitors in P63 and P66.
8. Stability tests run as rollbacks of 1 and 3 (see Luminary memo 149):
  - a. Lateral velocity noise spike at TGO -70.
  - b. Spike at TGO -70, 20% TLOSS.
  - c. Spike at TGO -70, 20% TLOSS, LEADTIME 3 seconds.
  - d. Lateral velocity noise spike at TGO -50.
  - e. Spike at TGO -50, 20% TLOSS.
  - f. Spike at TGO -50, 20% TLOSS, LEADTIME 3 seconds.
  - g. Lateral redesignations at TGO -50.
  - h. Redesignations at TGO -50, 20% TLOSS.
  - i. Redesignations at TGO -50, 20% TLOSS, LEADTIME 3 seconds.
  - j. Exercise of P66 Auto.
  - k. Exercise of P66 Auto, 20% TLOSS.

B. Ascent (see Luminary memo 153):

1. P12 without TLOSS.
2. P12 with 20% TLOSS.

C. Aborts (see Luminary memo 153):

1. P70 without TLOSS.
2. P70 with 20% TLOSS.
3. P71 without TLOSS.
4. P71 with 20% TLOSS.

D. Orbital manoeuvres (see Luminary memo 153):

1. P40 in moon orbit without TLOSS.
2. P40 in moon orbit with 20% TLOSS.
3. P41 in moon orbit without TLOSS.
4. P41 in moon orbit with 20% TLOSS.
5. P42 in moon orbit without TLOSS.
6. P42 in moon orbit with 20% TLOSS.

ROUND TWO:

The following tests have been run on recent revisions of ZERLINA. The revision number is in parentheses after each test.

LANDINGS All landing tests have terrain and terrain model, and all but the first test include redesignations, V16 N92, and ROD clicks.

1. Landing with 20% TLOSS (One 555 alarm) (28)
2. Landing without TLOSS (31)
3. Landing with 10% TLOSS (31)
4. Landing with 15% TLOSS (31)
5. Landing with 22.5% TLOSS (31) Experienced 32000 and 555 alarms.
6. Landing with 17.5% TLOSS (34)
7. Landing with 30% TLOSS (35) Experienced 32000 and 555 alarms.
8. Landing with 17.5% TLOSS and N69 in P64

ASCENT

1. P12 without TLOSS (31)
2. P57/P22/P12 without TLOSS (35)

ABORTS

1. P70 without TLOSS (35)
2. P71 without TLOSS (35)
3. P70/71 double abort case without TLOSS (35)
4. P70/71 with 20% TLOSS (35)

ORBITAL MANEUVERS

1. P40 in lunar orbit without TLOSS (31)
2. P41 in lunar orbit without TLOSS (31)
3. P42 in lunar orbit without TLOSS (31)
4. P40 with 10% TLOSS and restarts (randomly chosen) (35)