

R. Larson

Mission Techniques Memo #34

TO: Distribution
FROM: Malcolm W. Johnston
DATE: July 11, 1969
SUBJECT: "G" Manual Ascent

MSC has reviewed possible manual ascent techniques utilizing partially failed PGNCS and/or AGS. Time constraints for mission "G" have limited this study to consideration of major subsystem failures and crude ascent guidance schemes only.

H. W. Tindall's "gram" of June 19, 1969, (69-PA-T-94A) provides an excellent review of the work to-date. For those who have read this "gram" MIT suggests that the Dap be loaded with LOASCENT (4850 lbs) for the LM mass; all other procedures called out are fine!* Those who have not read the "gram" should continue reading.

For a "bare-bones" approach the following assumptions were made: depend on out-the window cues (horizon, S/C shadow, etc.) for an attitude reference, a canned, multi-step pitch profile for guidance, and APS depletion for engine cut-off. This leaves only the requirement of vehicle controllability ("Direct" is considered nearly impossible).

Further, it appears that a substantial PGNCS capability is retained if an accelerometer fails, while gyro failures are crippling.

For "G" then, the major request of MIT was to provide "controllability" (RCAH) with a failed accelerometer(s). (Either saturated or zero output failures).

A nominal LGC program sequence can be used! P57 to landing site orientation (AT 0 or 2), and P12 through countdown and ascent, with the exception that the DAP should be loaded with a LM mass corresponding to LOASCENT (4850 lbs).* This is only necessary for the cases where the X or Z pipa has failed off, and subsequent verification may prove that even this step is unnecessary.

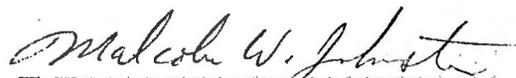
P12 was selected rather than P00 or P47 because it allows normal DAP initialization to a 1° dead band (otherwise it would have to be set to 0.3° or 5° via R03), and it provides a redundant engine-on discrete without requiring a manual erasable load sequence.

Both MIT's hybrid and digital simulations have been "jury rigged" and have successfully exercised the above procedures. (I. Johnson and L. Berman). This should only cautiously be considered "formal verification", however, due to limited time and simulation capability.

The crew may expect an ISS warning lite and program alarms (777 or 212) due to a pipa fail, and FINDCDUW type program alarms (401 and/or 402) due to guidance computation irregularities. These do not degrade the RCAH DAP capability.

Another PGNCS failure case postulated was . . . "If the LGC has failed, do we still have an attitude reference"? (For verification purposes, here at MIT, we assumed the LGC power was turned off as a result of the failure). Two situations could occur . . . IMU on and aligned or IMU off. In the latter case the IMU would have to be caged to the body axes. Otherwise, all that is lost is software compensation and LGC clock timing to power supplies. Alignment accuracy will degrade to about 1° average (better if caging was not required), and an LGC warning lite will be displayed.

Post "G" analysis may provide schemes to cover a wider variety of failures, and a more sophisticated variety of responses. (For instance, a y pipa failed off seems to allow a near-nominally guided ascent).


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* In addition, if the pipa has failed saturated, the ADIA and ADSRA terms should be zeroed.