B. Larson

Massaehusetts Institute of Teehnology
C. S. Draper Laboratory
DG Memo No. 1702

TO: Distribution

FROM: S. Drake

DATE: February 17, 1971

SUBJECT: LM Hybrid Simulator Support of The Apollo 14 Mission

The LM hybrid faeility was used on three oeeasions for real time support during the Apollo 14 Mission, one of whieh was of major signifieance in determining the eourse of action of the astronauts during landing. The first request for simulation support eame after a negative number came up in the third word of TEPHEM during an update of the ephemeris time on Wednesday, February 3. This phenomenon was explained by MIT, Cambridge as a possible oeeuranee of no partieular operational signifieanee. However, several landing simulations were run ineluding an all automatie landing to eonfirm this.

The diseovery of a erroneous abort signal by NASA, Houston shortly after 12:00 midnight Thursday (Friday?) approximately 4 hours prior to PDI led to an intensive 3 1/2 hour session of landing simulations on the LM hybrid. Approximately two hours prior to this time the normal setup and preflight had been performed in the event that there would be any aetion items prior to the landing. Thus the simulator was up and available in the eorreet eonfiguration when the problem arose.

All together five different fixes were postulated by either MIT, Cambridge, MIT, Houston or NASA, Houston. Three of these were tested on the hybrid simulator. The first fix tested involved resetting the LETABORT flag (flagword 9 bit 9) after PDI ignition and eonfirming that the abort button no longer had any effeet on the landing. This ran as predieted but left open a window between ignition and the resetting of the flag where the abort signal

would cause the abort guidance to take effect. MIT, Cambridge, suggested a more complicated fix that would eliminate the window and absolutely prevent the abort button from having any effect. This was done by setting the mode (program), register to 71 (V21, N01E, 1010E, 107E) after P63 integration and before ignition. This in effect bypassed the abort monitor as the computer would read that it was already in an abort program. After manually throttling up at TIG PDI +26 sec, the LETABORT flag was reset (V25 N07E, 105E, 400E, 0E) and the mode register was set back to 63 (V21 N01E, 1010E, 77E). On the first simulation of this fix, it was found that the abort button had no effect at any time during the landing but this procedure bypassed the setting of the ZOOMFLG bit which indicates to computer that throttle up has occurred. Therefore, the descent guidance calculations were not started and the landing failed as the LM remained in the initial burn attitude until it crashed. This was fixed by setting the ZOOMFLG bit immediately after the manual throttle up (V25 N07E, 101 E, 200 E, 0 E) on the next simulation. Then the LETABORT flag was reset and the mode register reset to 63. This simulation was successful in all aspects and was the procedure recommended and used.

After this, the original fix tested was modified by placing the mode control switch to attitude hold before PDI ignition and leaving it there until the LETABORT flag bit had been reset. This would prevent the vehicle from pitching over if the abort switch was triggered between ignition and the resetting of the LETABORT bit. There were no problems with this simulation. Then the recommended procedure was tested with throttle up two seconds early. This did not cause any noticeable effects. Finally this procedure was restart tested with one software restart before the mode register was reset to 63 and another after it was reset. No difficulties were encountered but the first restart caused the program number to change from 63 to 71. After the mode register was reset to 63 the restart caused the program to change back to 63. This test was concluded approximately 20 minutes prior to the actual PDI.

The third usage of the LM hybrid involved testing the ascent with the abort button activated on Friday afternoon. No problems were expected (the abort stage button is normally activated just prior to ignition as normal procedure) and none occurred.

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