R. Larson
MIT/IL

RECEIVED
JAN 13 1970
R. A. LARSON

GRUMMAN AEROSPACE CORPORATION

LM MEMORANDUM

LMO-500-742
7 January 1970

From: S. Greene

To: R. Schindwolf

Subject: FMES/FCI Auto P66 Verification (LUMINARY 131 Rev. 2)

SUMMARY

The Software Control Board Meeting #34 (18 December 1969) approved a LUMINARY program change which deletes P65 and incorporates an "Auto P66" mode in addition to the already established attitude hold P66 mode. In response, FMES/FCI tests of LUMINARY 131 Revision 2 were performed from 29 to 31 December, supporting the expected 5 January 1970 program release date. The test matrix, presented by GAC at the SCB meeting, is included as Table 1. A summary of the results of each run is given below. Both modes of P66 were verified and result in successful landings, although other minor problems not associated with P66 landing were identified as software errors.

DISCUSSION

The test results follow. Test descriptions are in Table 1.

H2A-1#1 The vehicle maintained a fairly constant altitude rate of about 2.7 FPS after entering P66. Good landing; LGC horizontal velocity was zero.

H2A-2#1 P66 attitude hold, with ROD inputs, performed properly and was not affected by the program change.

H2A-3#1 and -4#1 In both runs large horizontal velocities for a given altitude were imposed on the Auto P66 mode. The excessive horizontal velocities were not nulled before landing because of the 20 degree pitch attitude limit in the Auto P66 mode. In -4#1, the LGC landed with this 20 degree pitch attitude, still trying to null the horizontal velocity up to the last second. Of course these tests are software verification oriented and not recommended as crew procedures.

TABLE 1

LUM - 1C PCR 988 - AUTO P66

VERIFICATION

FMES/FCI TEST MATRIX

Test No.	Test Title and Description
H2A-1 #1 12/29	PDI Auto Landing - auto mode only - no ROD.
H2A-2 #1 12/29	PDI - Auto - Attitude Hold Landing - auto mode; at 125 feet switch to attitude hold, (ROD) to touchdown.
H2A-3 #1 12/30	PDI - ROD Auto - At 700 feet altitude switch to attitude hold, * 1 ROD click, do not null horizontal velocities, switch back to auto immediately after P66; at 100 feet altitude ROD to 3 Fps.
H2A-4 #1 12/30	PDI - Attitude Hold - Auto - At 700 feet altitude switch to * attitude hold; erect to vertical attitude, one ROD click, after P66 observe for 20 seconds no nulling of horizontal velocities, switch to auto and ROD landing.
H2A-5 #1 12/30	PDI - Auto Landing With Restarts - Exercise X-Axis override.
H2A-6 #1 12/30	PDI - Attitude Hold with Restarts - Repeat H2A-2 with restarts
H2A-7 #1 12/30	PDI - Auto Landing with LPD - In P64 enter 7 downrange and 5 left crossrange LPD's, auto - mode only.
H2A-8 #1 12/30	PDI - P66 from Attitude Hold - Switch to attitude hold at 600 feet altitude, observe enter P66 automatically, switch to auto mode landing.
H2A-8 #2 12/31	
H2A-10 #1 12/30	PDI - Jet Fail - Repeat H2A-4 with one horizontal jet on failure (Jet 3).

All tests: at landing, PRO and disarm engine, engine off.

* This procedure is used to introduce a larger than nominal horizontal velocity during P66 operations.

H2A-5#1 and -6#1 — There were no observed effects on landing caused by restarts. Transient effects were momentary zeroing of the crosspointer display and error needles and momentary lighting of the tape-meter fail light.

H2A-7#1 — Good landing

H2A-8#1 and -8A#2 — Going from P64 attitude hold to P66 attitude hold without using the ROD switch can only be done if the pilot nulls his displayed attitude errors well enough to fly to the Lo Gate targets. Again, the test used unconventional crew procedures to verify proper program performance.

H2A-10#1 — Good landing.

Two problems appeared during testing which did not affect the P66 landings. One problem was that the automatic nulling of yaw attitude, normally occurring at 30,000 feet in P63, was consistently 3,000 feet lower. The other was that for most runs, in both modes of P66, jets continued to fire after landing (but could stopped by exiting P66). Both problems have been reported to NASA and MIT and are recognized as LGC software problems. (LUM 131 Rev. 8, the current LM-7 software candidate, still contains the first problem.)

SG/bf

cc: H. Tindall, FM
T. Price, FM5
H. Shelton, EG43
D. Scott, CB
T. Moore, EG27
D. Cheatham, EG2
A. Klumpp, MIT/IL
D. Eyles, MIT/IL
R. Larson, MIT/IL
G. Smith
J. Marino
L. Tucker
P. Hoffman
M. Rimer
J. Cagnazzi
D. Seidenspinner
A. LaRuffa
A. Theiss
J. Wachtel
C. Tillman
J. Hussey