Mission Planning and Analysis Division
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS 77058

REPLY TO
ATTN OF: 70-FM22-120

JUL 2 1970

MEMORANDUM TO: FS/Flight Support Division
Attention: Mr. J. E. Williams, Jr.

FROM : FM2/Landing Analysis Branch

SUBJECT : LM descent engine time constant

Reference: TRW memorandum 70.4354.2-66 by Mr. R. K. M. Seto, "LM Descent Engine Time Constant," dated June 18, 1970.

Recently, there has been some concern over the feed-back between the LM descent engine and the P-66 landing program. The engine response time constant used in the guidance is 0.2 seconds. TRW has determined that the engine response is more in the order of 0.05 to 0.08 seconds (see reference). Therefore, it is recommended that the simulations of the descent engine reflect this smaller time constant. In addition, the Apollo 15 flight program should be corrected to reflect this response time.

WMB WB
FVB

James H. Alphin
James H. Alphin

APPROVED BY:

John P. Mayer
Chief, Mission Planning
and Analysis Division

Enclosure

cc:
(See attached page)

TRW

70.4354.2-66
18 June 1970

JUN 2 0 19

National Aeronautics and Space Administration
Manned Spacecraft Center
Houston, Texas 77058

Attention: Mr. W. M. Bolt, Task Monitor, FM2
MSC/TRW Task A-208
Mission Planning and Analysis Division

Subject: LM Descent Engine Time Constant

Gentlemen:

It has been noted that an unusually large number of throttle position changes occurred during the latter portion of the Apollo 11 and Apollo 12 descent engine duty cycles. LGC program P-66 (rate of descent) was in use at those times. It is suspected that one of the causes of the numerous throttle changes may be due to an incorrect throttle change time constant in the LGC rather than because of vehicle attitude or terrain changes. The time constant is defined as the time required from the initiation of a step throttle command to 60% of the total commanded change in engine throttle actuator position. The current value is 0.2 seconds.

In an effort to verify the value of the time constant, data from the descent engine Qualification B Test Program were reviewed. A computer model of the throttle response was also utilized. The time from initiation of command to 60% of the change is dependent on the magnitude of the actual throttle change. However, the time is approximately constant for throttle changes of twenty percent or smaller. This is the expected range when program P-66 is being used. During the Qualification Tests a step throttle change from the 40% throttle level to the 25% throttle level was performed during each test. The average time constant value was approximately 0.08 seconds. The throttle response model was used to determine the time constant for increases in throttle setting. For a 20% throttle change, the time constant value was found to be approximately 0.05 seconds. The shorter throttle-up value is expected and is due to an engine loading which opposes the throttle-down but aids the throttle-up.

It is clear that the current value of the time constant is too large. A value in the range of 0.05 to 0.08 seconds appears to be more appropriate and should certainly decrease the number of throttle changes commanded during the use of program P-66.

Sincerely,

R. K. M. Seto

R. K. M. Seto, Task Manager
MSC/TRW Task A-208

D. P. Johnson, Assistant Project Manager
Mission Design and Analysis
Mission Trajectory Control Program

RKMS:DPJ:skc

MSC: F. V. Bennett/FM2
W. M. Bolt/FM2
H. W. Byington/PD
M. Collins/FM13
W. Hammock/EP2
S. A. Kamen/FM7
R. H. Kohrs/PD7
~~Mr~~ N. Montez/FM2
J. D. Norris/EP2
R. P. Parten/FM13
D. T. Riley/BG6
R. E. Sims/FM13