U.S. Government
MEMORANDUM
Lyndon B. Johnson Space Center NASA

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SUBJ: Candidate OFT Mission Zero (OFT-Ø) Flight Profile

While reflecting on the plan for the conduct of OFT, the thought occurred to me that this is perhaps the first flight test program in which we have started out at the high speed end of the spectrum with a firm commitment to making it all the way through the flight regime on one flight, i.e., the first orbital flight. Granted, ALT may be expected to prove out the handling characteristics of the vehicle at the low subsonic end of the spectrum in the approach and landing configuration. However, we are still faced with the fact that, as currently planned, OFT #1 features an entry with velocities starting at approximately Mach 25 and progressing on down to a full stop and with heating rates and heat loads selected to be benign from the standpoint of the maxima expected on later missions, but nonetheless formidable in themselves.

Approached from the standpoint of sound engineering practice and historic flight test procedures, it would seem more prudent and appropriate to try to work our way up incrementally into these high speed flight regimes and hot environments. The thought that immediately comes to mind is a return to landing site (RTLS) type mission profile where, never having achieved orbital velocity, the portion of the entry-TAEM envelope flown through is considerably less. One could experience enough heating on the vehicle to perhaps partially verify the thermal math models. Also verified would be the tenacity with which the TPS tiles adhere to the vehicle through a launch profile and portions of reentry. We would, however, be in a posture where loss of a number of these tiles would not be catastrophic due to the extremely benign nature of the profile. Maximum flight velocity could be selected in order to provide penetration into the supersonic flight regime sufficient to allow us to correlate with wind tunnel data and models, and yet not go so deeply as to penetrate the areas of greatest concern with respect to vehicle stability. Additionally, owing to the much milder heating environment, it might be feasible to "scab on" an auxilliary stabilizing device such as a deployable/jettisonable drag chute for increased stability in the Mach 5 regime, without having to make the installation capable of withstanding the full range of entry heating.

Pursuing the RTLS question somewhat further, it would seem reasonable that by means of employing only a partial load of fuel and oxidizer in the external tank, and perhaps either a reduced number of segments on the SRB, reduced propellant grain size in the SRB or a combination of all of the foregoing we should

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be able to tailor q_{max}, g_{max}, ALT_{max}, $Mach_{max}$ and max heating to our specifications. Hopefully, this would provide a profile that both kept us near the ejection envelope throughout the flight profile and kept us within regions where we have fairly high confidence in the vehicle aerodynamics and that enabled us both to evaluate the heating and to employ auxilliary stability enhancing devices that might not be appropriate for a full orbital mission.

As is apparent from the fact that this is titled "CB Discussion Item," this proposal has not yet been fully coordinated; however, I solicit your thoughts on the subject. There are some drawbacks immediately apparent. First, since we are considering a vertical launch, from a practical standpoint this means a launch from Cape Kennedy. RTLS, whether with a full load of fuel and full SRBs or partial loads, implies then we are going to come back somewhere within the vicinity of the launch site, in all probability KSC itself. This means we are going to be landing on a runway and are going to have to get rid of the external tank in the Atlantic Ocean not too far off the coast. Also, one would expect that an OFT "zero" flight like this would cost, in the end at least as much as an orbital mission, maybe more due to the additional analysis of flight maneuvers required. It would also obviously slip the schedule of the first actual orbital flight, probably by two to four months. However, it also allows us the use of all of the tracking equipment (S-band, C-band tracking radar) installed at the Cape to help calibrate our air data system; it provides us with a flight profile which is not subject to large dispersions on entry due to IMU disalignment or things of this sort; it gives us a flight profile without "blackout"--that is, constant communications and constant ability for update--and it maintains constant communication capability with the NASA facilities at the Cape. The microwave landing system would be expected to be functional and, although we don't have a desert landing area, we do have a fairly large buffer zone surrounding the runway at the Cape.

Additionally, through firing the OMS engines during powered flight or perhaps immediately after ET-SEP we can get a verification of OMS engines/OMS propellant tankage performance prior to their being required for a burn in support AOA, ATO, or a nominal mission profile into orbit. ~~However,~~ It offers the advantages of a slower approach to the flight regimes of concern and of a more conservative commitment of the vehicle to flight. We must bear in mind that in addition to the hides of the flight crew, OV102 represents 20 percent of our nation's planned space program for the next ten years and, in fact, if the vehicle were lost, it might be catastrophic to the success of the overall program. A final factor is that the responsible thing to do is prove out the techniques and the feasibility of an RTLS somewhere within the OFT efforts prior to committing to carrying passengers through a regime from which the advertised way out in the event of an anomaly is an RTLS profile. Such an "abbreviated RTLS" could demonstrate the feasibility of a full scale RTLS with lesser stress and risk.