

National Aeronautics and
Space Administration
Lyndon B. Johnson Space Center
Houston, Texas
77058

Reply to Attn Of: DA8-88-78 (FT)

September 22, 1988

TO: Distribution

FROM: DA8/Chairman, Ascent/Entry Flight Techniques Panel

SUBJECT: Ascent Entry Flight Techniques Panel Meeting #49 Minutes

The 49th Ascent/Entry Flight Techniques Panel (FTP) meeting was held at JSC on September 15, 1988. Rockwell-Downey participated via teleconference. Any questions or comments should be directed to DA8/R. D. Dittmore at 713-483-5417 or FTS 525-5417. The following items were discussed with the decisions made and actions assigned as noted.

Overall Summary:

a. The FTP determined that 31 degree alpha was an acceptable angle of attack to be used to increase ranging capability when insufficient energy exists to reach the desired landing site contingent upon successful resolution of structural concerns (aero/flight control is also being reviewed). Thermal analyses completed by Rockwell-Downey and JSC indicate thermal damage will occur as a result of the lower alpha profile. However, analysis performed at JSC and verified by the Vought Corporation indicate critical wing leading edge burn through will not occur (Rockwell-Downey is concerned that burn through will occur and consequently recommended against 31 degree alpha).

b. Applying the increased ranging capability brought about as a result of flying the 31 degree alpha profile to the performance boundary resulted in the ability to reach an instrumented landing site at "droop" plus 35 seconds for a Ben Guerir TAL and "droop" plus 65 seconds for a TAL abort to Moron. The first opportunity to reach Banjul on the in-plane leg with stretch capability included is "droop" plus 20 seconds. Recall that "droop" is the first time that auto TAL procedures can be implemented in addition to protecting ET heating constraints.

Detailed Minutes:

1. Low Alpha Tal Contingency Abort Thermal Assessment - Rockwell-Downey/
T. Hughes

Mr. Hughes presented results of the Rockwell-Downey thermal assessment that indicate thermal damage will occur for both the 31 degree and 34 degree low alpha profiles. Heating rates are higher due to the initial deeper penetration into the atmosphere as a result of the lower alpha trajectory (enclosure 1). RCC and control surfaces damage are expected (enclosure 2).

Mr. Hughes stated that 31 degree alpha is acceptable for all Orbiter areas of concern except the wing leading edge ("acceptability" based on no burn through although tile loss/slumping will occur). The concern with the wing leading edge is the high temperature environment (>3400 degrees F). Rockwell analysis indicates loss of the RCC coating will occur along with ablation of the silicon substrate material (note that the Rockwell analysis used "crew flown" SES trajectory profiles provided by JSC for both the 31 degree and 34 degree assessment). As a result, Rockwell recommended not using the 31 degree alpha profile.

Mr. Hughes acknowledged that additional analysis of the leading edge temperature profile has been completed at JSC by ES32/D. M. Curry. Consequently, the FTP used the analysis completed by Mr. Curry in the evaluation of wing leading edge acceptability (see item 2 below).

2. Reduced Angle-of-Attack Entry for Contingency Aborts--RCC Overtemperature Assessment - ES32/D. M. Curry

The JSC thermal assessment was performed utilizing the same entry trajectories for both the 31 and 34 degree profiles that were provided to Rockwell. As with the Rockwell analysis, the results indicate total RCC coating loss will occur along with the partial loss of the silicon substrate for a 31 degree alpha. Mr. Curry's results show approximately 67 percent mass loss for the wing leading edge panels of concern (enclosure 3) while the Rockwell analysis predicted 66 percent mass loss assuming laminar flow characteristics. An independent analysis completed by the Vought Corporation indicated a 45 percent mass loss. For 34 degree alpha, both JSC and Vought Corporation indicate complete loss of the RCC coating does not occur.

The bottom line to the JSC/Vought analyses is that burn through is not predicted to occur. However, because of loss of load carrying substrate material, the possibility of structural failure of the panels may exist. A structural assessment is in work at JSC to determine if panels will fail and if subsequent damage to the wing/leading edge panels can occur as a result of the aerodynamic loads. Completion of this assessment is required prior to utilizing the 31 degree alpha profile.

ED3/D. B. Kanipe addressed the aerodynamic concerns associated with loss of wing leading edge panels. Based on previous studies, Mr. Kanipe felt that loss of the panels in the subsonic region should not affect flight control (i.e., Orbiter control remains to effect a bailout is required) although a drag/performance affect would certainly be realized. Mr. Kanipe also believes sufficient control authority exists in the hypersonic region for the loss of leading edge panels and agreed to research the aero data base for confirmation of control.

The FTP determined to press forward utilizing 31 degree alpha as the baseline to increase ranging capability assuming the structural and aerodynamic assessments would be satisfactory.

3. Engine Limits Call Recommendation Based on Reduced Angle-of-Attack Contingency Abort - DM3/K. B. Joosten

Mr. Joosten presented several charts indicating the increased capability to reach an instrumented landing site as a result of flying the 31 degree alpha profile (enclosure 4). The FTP agreed to reference the "single engine limits" call from the "droop" boundary assuming 109% throttle, undispersed entry, and an allowance for 2 sigma ascent performance (5 seconds). The "single engine limits" boundary will exist as follows:

TAL to Moron	"droop" plus 65 seconds
TAL to Ben Guerir	"droop" plus 35 seconds
Abort in-plane to Banjul	"droop" plus 20 seconds

STS-26 performance boundary calls were reviewed to determine changes required, if any. Subsequent to the meeting, CB/F. H. Hauck and DA8/G. E. Coen agreed to the following calls concerning application of max stretch (other calls remain unchanged):

Abort TAL Ben Guerir:

Droop Amilcar-109 (no change)

"Limits Enable" (internal MCC call is "Single Engine Limits"--includes stretch)

Single Engine Banjul 104 (was 109)

Single Engine Ben Guerir 109 (no change)

Abort TAL Moron:

Droop Las Palmas-109 (no change)

"Limits Enable" (includes stretch)

Single Engine Ben Guerir 104 (was 109)

Single Engine Moron 109 (no change)

In-Plane:

In-Plane calls remain the same with the exception that the "limits enable" call will now be based on inclusion of stretch capability.

Ronald D. Dittimore

4 Enclosures□