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DA8/Chief, Ascent/Entry Flight Techniques

Ascent/Entry Flight Techniques Panel Meeting #6 Minutes

The sixth Ascent/Entry Flight Techniques Panel meeting was held on August 12, 1983. The meeting originated at JSC with Rockwell-Downey, NASA Headquarters, Draper Laboratory, and DFRC tied in via teleconference.

Summary

a. The STS-8 runway priorities for nominal EOM and AOA are EDW 22, EDW 17 and NOR 17. Both EDW runways will be lit simultaneously.

b. For STS-9 TAL to Zaragoza, double-toggling will be done at Mach 17 after crossing the runway centerline to ensure an overhead LH approach on ZAR 31, or to prevent "wrapping-up" on ZAR 13. No double-toggling will be done for NEOM EDW 17, while for all other runway selections, the FDO's will determine the need for double-toggling and uplink any changes predeorbit.

c. The vent doors will continue to be left open postlanding if the purge cart is not available, regardless of blowing dust or sand, because of the threat of hazardous gas build-up if there is a leak.

d. The mission rule requiring less than 50 percent cloud cover for landing was changed to a 20K ft ceiling for STS-8, and 15K ft for subsequent flights. However, precipitation will continue to be a no-go.

e. The mission rule basing runway selection upon the STA evaluation of turbulence if the Orbiter has lost one APU was retained for STS-8, because we switched from the lakebed to the concrete runway.

1. Results - KC 135 Dust, vs. Testing - CB/G. Gardner

As reported in the last Flight Techniques meeting, night landing tests done with a KC 135 at Edwards 17 revealed a problem with the main gear dust plume blocking out the landing lights and thus reducing visibility prior to derotation during roll-out. Subsequently, similar tests have been conducted at Northrup 17 and showed no dust problem there. Other night landing observations were made in the STA on EDW 22 to see if it was acceptable to have EDW 17 lights on at the same time The STA crew recommended we baseline nominally having the runway lights illuminated on both EDW 17 and 22 during STS-8, and that is planned. This also alleviates the need for attending to lighting configuration for a late runway redesignation. The AOA site priorities for STS-8 are the same as EOM, i.e., EDW 22, EDW 17, and NOR 17.

2. STS-9 Overhead/Straight-in Options - FMS/J. Hanson
ŠThe HAC selection depends on the vehicle position relative to the runway centerline (enclosure 1). An overhead HAC remains latched throughout entry, while a straight-in HAC will switch when the Orbiter crosses the runway centerline, thus always choosing the "nearest" HAC. Overhead approaches can fly over the runway and usually have large turn angles (>180 deg), while straight-in approaches do not fly over the runway and have smaller turn angles (<180 deg). Overhead targeting provides better

energy margins and is usually preferred. Upon entering MM304, guidance selects overhead. This can be manually toggled (via item 6 on HSD) to straight-in, or will automatically downmode during TAEM due to low energy conditions. This auto downmoding can be inhibited by double toggling. The crew prefers to do the downmoding manually when alerted to the low energy condition, rather than having it done automatically.

On STS-9 there is a problem with the HAC selection because of the high inclination orbit. The initial overhead HAC approach would degrade to a straight-in (turn angle < 180 deg) because the Orbiter crosses the runway centerline while still a long way out. This occurs for STS-9 for nominal EOM to EDW 17 on rev 145, and for a TAL to Zaragoza RW 31 (ZAR 31) as shown in enclosure I. The overhead HAC can be reselected by doing a double toggle after crossing the runway centerline. This causes guidance to select a new HAC based on the side of the centerline the Orbiter is on. However, the crew prefers doing a left hand (LH) HAC turn to allow the <DR earlier, better visual site acquisition. This could be switched to RH by double toggling. Since all the STS-9 approaches are nominally LH without double toggling except for ZAR 31, it was decided not to nominally double toggle for EDW 17. This means that EDW 17 will be a 160o straight-in LH approach. Also, double toggling should not be done if it could interfere with PTI's.

The tendency for these problems is increased with higher crossranges. Another characteristic at ZAR 13 without toggling is a `wrap up' of the turn angle to over 360 deg (in this case it would be 390 deg), which is unacceptable from an energy standpoint. Also double toggling should be done as soon after crossing the runway centerline as possible to avoid roll command, range and delay transients. We decided to include double-toggling as a nominal procedure in the checklist for a TAL to ZAR. The optimum time is M 17. DH3/C. Lewis has submitted the procedures change.

For all other entries, except to NEOM EDW-17, the FDO's will determine the need for double toggling and advise the crew via the `Entry Summary Message normally sent on entry morning.

3. Vent Door Mission Rule- Postlanding - DF4/M. Suarey

The vent doors are automatically opened by the GPC's at Mach 2.4. Current postlanding mission rules state that they will remain open if a purge cart is not available to preclude the build-up of hazardous gas in case of a leak. If a purge cart is available, the crew puts the doors into purge position. However, on STS-7 this mission rule was knowingly violated because the doors were put into purge position shortly after landing. Rationale was that the cart would be available soon." After a Štowing problem on the runway it actually got hooked up 6 or 7 hours later.

KSC prefers having the doors in purge position postlanding with or without the purge cart to expedite turnaround time. If the doors have been left open and the Orbiter powered down, external power would have to be applied to reposition them to the purge position. (It is required anyway to go to ferry position.)

There was also a concern about dust contamination if the doors are left open. Standard KSC procedure calls for positioning the doors and towing the vehicle in the proper direction to reduce contamination in high winds. It was proposed to modify the mission rule to close the doors from

open to purge position if the wind exceeded 22 kts. However, due to concerns about the far more dangerous threat of hazardous gas build-up than possible contamination from winds, it was decided to leave the current mission rules unchanged. The vent doors will be left open if the purge cart is not available. The rules were amended to say that blowing dirt and dust do not matter.

4. Proposed 15K ft Ceiling Rule - ES3/J. Smith

A proposal to change the current mission rule requiring no more than 50 percent cloud cover for EOM to a requirement of at least a 15K ft ceiling was reviewed. AEFTP was unable to resolve this issue, and referred the question to management for resolution. The outcome was that we will use a ceiling of no less than 20K ft for STS-8, and 15K ft for subsequent flights. Mission rules to reflect this were written.

There was also discussion about what type of precipitation conditions would be acceptable to fly through, if any. Mr. Smith presented some charts (enclosure 2) showing the damage ranges that would have been experienced by flying through small droplets of rain on STS-1 through S. Tests on TPS materials have shown no damage for rain/Orbiter relative velocities of less than 310 mph and light rain, but above 350 mph damage is almost certain. You can see from the curves that the Shuttle velocities correspond to ~2000 ft altitude. The amount of damage depends on the water particle size, incident angle, rain rate and relative velocity. A T38 flying through heavy rain at 300 kts (345 mph) caused serious damage to some TPS tiles it was carrying. There was also a question on the effect of rain damage and water soaked tiles on the weight and aerodynamic performance of the Orbiter. Because of the 10-15 deg alpha during approach, the only tiles that would be exposed to driving rain at high incident angles are on the wing and tail leading edges, nose and possibly the front of the OMS pods. Also, the upper surfaces are

not burnt and thus will not absorb water. Studies at Rockwell showed that a 10 percent increase in drag due to tiles with degraded surfaces resulted only in a minor change in the TD point when in autoland.

It should be pointed out that this is not a safety of flight issue, but only a question of tile lifetime and turnaround time for tile repair and replacement. Although it appears that the Orbiter can fly through clouds Šwith small droplets of precipitation if at low altitude and speeds (<310 mph) without damaging the tiles, it is very hard for weather men to accurately predict the size of rain droplets in clouds. Based on these facts, it was decided to accept the cloud ceiling rule and permit the Orbiter to fly through clouds. However, we retained the rule against flying through precipitation.

S. STS-8 APU Mission Rule (walk-on) - CB/B. O'Conner

A STS-8 mission rule that was under review because of the change to the concrete runway, would base the runway selection with one Orbiter APU down upon the STA evaluation of thin turbulence level. Mr. O'Conner confirmed continued agreement for the rule from his office.

Gary E. Coen