

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

DA8-8B-96 (FT)

December 19, 1988

TO: Distribution

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

SUBJECT: Ascent/Entry Techniques Panel Meeting #52 Minutes

The 52nd Ascent/Entry Flight Techniques Panel (FTP) was held at JSC on December 9, 1988. Rockwell-Downey participate via teleconference. Any questions or comments should be directed to DA8/N. W. Hale at 713-483-0693 or FTS 525-0693. The following items were discussed with the decisions made and actions assigned as noted.

Overall Summary:

a. FRCS issues were resolved: No action will be taken to prevent helium ingestion during ET separation following loss of propellant during ascent; the minimum loading to protect single engine roll control is 68 percent.

b. It is acceptable to restart an APU that inadvertently started following a 20 minute cool down period. APU prestart will remain as is; an APU will continue to be used for FCS checkout.

Detailed Minutes:

1. Action Item Closeout

a. 88/09/09-001: Jet Flow rate Capability from the Forward Reaction Control System (FRCS) Lower Compartment (with/without gas ingestion) - Rockwell-Downey/AD56/M. Ramos

The analysis showed that as long as approximately 9.6 percent PVT quantity remained in the lower compartment (of 15.3 percent total when the lower compartment is full), a three jet flow rate can be supported with no helium ingested to the jets. The 9.6 percent is made up by using 4 percent as the failure limit for the lower compartment, 2 percent helium gas transfer from the upper to lower compartment during screen reheating, plus a 3.6 percent usage which is the worst case flight usage to date. At the same quantity level, a five jet flow rate (which is the digital autopilot limit) will cause some helium gas ingestion but within limits that will not cause redundancy management jet deselection. Therefore the FTP decided that no special action needs to be taken to limit the number of jet firings for external tank separation. The action is closed.

b. 88/09/26-004: Determine the capability to reach Ben Guerir, Moron, and Banjul with 1 engine hydraulically locked up and a second engine failure during the abort leg. - DM3/J. V. West

Discussion was limited to clarifying the assumptions to be used in answering the action item. Data for STS-29 will be ready for the January 20, 1989, Ascent/Entry FTP, with other flights to follow later. This action is open.

c. 88/10/20-001: How much time is required for auxiliary power unit (APU) cool down after an inadvertent APU start with the tank isolation valves closed. - Rockwell-Downey/AE85/T. Farkas

Test data from JSC's Thermo Chemical Test Area (TTA) indicates that a 20 minute cool down is sufficient. Since APU pre-start occurs at time-of-ignition (TIG) - 45 minutes this allows sufficient time and will not present a deorbit delay. This action is closed.

d. 88/10/20-002: Determine if a concern exists with restarting an APU that has already been subjected to an inadvertent start as a result of one of the identified single point controller failures. - Rockwell-Downey/AE85/R. S. Stedman

Rockwell-Downey's position is that there is no concern with this situation. This action is closed.

e. 88/10/20-003: Determine if the APU pre-start activity is still required. - DF4/J. W. Medford

The Mechanical and Crew Systems Branch believes APU pre-start is useful to determine system status prior to APO start. Risks incurred by having the APU controller powered on for slightly longer than the minimum were judged to be acceptable. The new APU controller which will be available this year will eliminate the concern. JSC Systems Division recommends pre-start to remain as is, Rockwell-Downey concurs; the Ascent/Entry FTP concurs. This action is closed.

2. Quantify Benefits Realized from Throttling SSME Back to 65 Percent for 2 or 3 Engine Trans-Oceanic Abort Landing (TAL) - DM3/J. V. West

RS0C/R16B/E. R. Johnson lead discussion that indicated that on systems aborts the intact center-of-gravity (CG) box and weight limits could not be met without throttling back. The FTP indicated that the issue was only on performance TAL's, not contingency ("late") TAL's. The FTP requested specific data relating to OMS loading. The issue is open and due at the January 20, 1989, Ascent/Entry FTP meeting.

3. Recommendation to Either Use Circ Pump or Start an APO to Perform FCS Checkout Part I (ASA null driver test) - Rockwell-Downey/FB81/R. G. Zach, DF/J. Knight, CB/J. O. Creighton, VF3/D. W. Camp.

Mr. Camp presented an integrated engineering recommendation that the APU nominally be used. The APU subsystem manager indicated that the saving of one APU start was inconsequential and noted that running a questionable APU is always recommended; the hydraulics subsystem had no preference; the Flight

Control System area preferred the APU since pressures generated by the circ pumps could be misleading. The Rockwell-Downey, Systems Division, and Astronaut Office representatives concurred. FTP concurred, the issue is closed.

4. 1988 Ames "KSC" Tire Wear Results - EH2/H. G. Law

Deferred to the January 20, 1989, Ascent/Entry FTP meeting.

5. Ascent 2 or 3 Engine-out Contingency Abort Site Capability - DM3/G. L. Norbraten

- a. List of potential sites as a function of inclination (63, 57, 34, 38.5).
- b. Plan/schedule for development of sequential engine out boundaries.
- c. Communication/tracking capabilities.
- d. Simulation requirements.

DM3/D. L. Bentley proposed a number of sites to be investigated. Bermuda will be analysed for STS-29 and subsequent missions to determine the benefits of adding it to the landing site table. No decision as to actual implementation was made. A review of boundaries, assumptions, g loading is required to determine the feasibility of any additional sites. The FTP directed that the next priority work be done on sequential second main engine failures for the higher inclination flights. A review of the assumptions and groundrules as well as a status will be due for the January 20, 1989, Ascent/Entry FTP meeting.

6. FRCS Single Engine Roll Control (SERC) Requirements and Minimum FRCS Quantity Constraints for Multiple Space Shuttle Main Engine (SSME) Failures - DM3/G. L. Norbraten

- a. Include discussion of variables and assumptions used in analysis.
- b. Determine vector angle for first engine failure at earliest TAL boundary with second failure at single engine TAL boundary. Repeat for first failure at last TAL boundary.
- c. Determine vector angle for first failure at press-to-MECO boundary with second failure at single engine press-to-MECO.
- d. Provide recommendation on vector angles to be protected and associated FRCS quantity.

RSOC/R16B/G. Abellard presented study results that showed the maximum acceleration angle and the maximum propellant usage did not occur under the same circumstances; the maximum angle occurred when the single remaining SSME was the center engine; the maximum propellant usage occurred with the remaining engine was either left or right. However, the turning angle was greater than previously expected, up to 18.5 degrees versus 14 degrees previously expected. Since acceleration angle determines the amount of propellant "unusable" during this period, the cases that drive the constraint are all

center engine remaining cases. The result of the analysis indicates that 68 percent is the minimum FRCS loading to protect the worst case single engine roll control requirement. This case is based on the first SSME out at 150 seconds after liftoff and the second engine out at 660 seconds (RTLS single engine press), with the remaining engine the center SSME. This results in an return-to-launch-site (RTLS) abort. The TAL and press to main engine cutoff cases were better, as were all cases that resulted in either a left or right SSME remaining. Flight Dynamics Division has the action to present the change to the minimum loading to Level II. A further action was generated when it was noted that very late failures of the second SSME during RTLS aborts resulted in 477 lbs of usage from the Aft RCS tanks prior to MECO.

Action: 88/12/12-001 - Rockwell-Downey/FC94/J. S. Yasuhara - Determine that aft RCS tank constraints are not violated for late second SSME failures that cause large propellant usage not interconnected.

7 Walk-On Single Main Engine Roll Control (SERC) Constraint Revisions - DM3/K. D. Buie

Mr. Buie presented an issue that had to do with the orbital maneuvering systems dispersion due to gaging error and its possible affect on abort dump timers. Since appropriate personnel were not available to clarify the issue; Mr. Buie was referred to DF7/D. A. Nelson to determine if an issue really exists or not. If there is an issue the Flight Analysis Branch will return to the FTP with a consolidated presentation.

8. Walk-On SSME Out of First Pass of PRTLS Guidance - RSCO/R16B/R. A. Schmidgall

Mr. Schmidgall presented flight software Discrepancy Report #101764 which showed that an SSME failure during the same 1.9 second guidance cycle as an RTLS select could result in incorrect constant selection which would result in excessive vehicle lofting. A flight software change request (#89903) has been submitted for Operational Increment (OI) 8C. The FTP decided that the extremely low probability of occurrence of this failure did not warrant extreme measures to expedite the software change or to develop a crew procedure. Crew training to take pitch control manually or to wait 2 seconds between selecting an abort mode and pushing an SSME shutdown button for an engine in data path failure should be sufficient until the software change is incorporated.

The next Ascent/Entry FTP meeting is planned to take place on January 20, 1989, at JSC Building 29, Room 109.

N. Wayne Hale, Jr.

Enclosure