DOCKET NO. **SA - 510**

EXHIBIT NO. **13 B**

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.

Group Chairman's Simulator Study I

NATIONAL TRANSPORTATION SAFETY BOARD
Office of Research and Engineering
Washington, D.C.

December 15, 1994

Group Chairman's Simulator Study I

A. ACCIDENT DCA-94-MA-076

Location: Aliquippa, Pennsylvania
Date : September 8, 1994
Time : 1904 Eastern Daylight Time
Aircraft: Boeing 737-300, N513AU

B. GROUP IDENTIFICATION

The Aircraft Performance Group met at the airplane manufacturer's facility in Seattle, Washington on September 21 and 22, 1994. The following group members participated in the investigation:

Chairman: Thomas R. Jacky, NTSB
Member : Bob McCullough, USAir
Member : Steven E. O'Neal, FAA
Member : H. Keith Hagy, ALPA
Member : James Kerrigan, Boeing

Additionally, the following persons participated in the investigative effort:

John Clark, NTSB
Keith McGuire, NTSB
Marty Ingham, Boeing
Mike Carriker, Boeing
Paul Sturpe, USAir
Les Berven, FAA

C. SUMMARY

On September 8, 1994 at 1904 Eastern Daylight Time, USAir Flight 427, a Boeing 737-3B7, N513AU, crashed while maneuvering to land at Pittsburgh International Airport, Pittsburgh, Pennsylvania. The airplane was being operated on an instrument flight rules (IFR) flight plan under the provisions of Title 14, code of Federal Regulation (CFR), Part 121, on a regularly scheduled flight from Chicago O'Hare International Airport, Chicago, Illinois, to Pittsburgh. The airplane was destroyed by impact forces and fire near Aliquippa, Pennsylvania. All 132 persons on board the airplane were fatally injured.

D. DETAILS OF INVESTIGATION

The group met at Seattle, Washington to review simulator data provided by Boeing and to develop a preliminary list of possible failure scenarios to investigate using Boeing's simulator capability. Forty five simulator runs were attempted on September 22, 1994, with seven runs either aborted or not recorded. The group used the Boeing Multipurpose Engineering Cab (MCAB) Simulator with the Aerodynamic Data and Control System Description for the 737-300 Flight Simulator (Document D6-37908, rev C).

The primary objective of the study was to attempt to replicate USAir 427's flight data recorder data through the accident sequence. Most specifically, the group intended to match the initial heading change rate found at the beginning of the accident sequence or initial upset. In addition, the group intended to simulate initial failure or malfunction scenarios, record the simulator aircraft's response to the input, and then compare the resultant data to FDR data.

Attachment 1 lists the failure or malfunction scenarios examined. Attachment 2 lists the simulator runs and a summary of the simulator scenario. The resultant data from the simulator runs was not included in this report, however, each party to the investigation received a set of data plots from the simulator runs.

[redacted]
Tom Jacky
Aerospace Engineer

Attachments

1. Failure Scenarios or Malfunctions
2. Simulator Run Log

ATTACHMENT 1

Failure Scenarios or Malfunctions

List of Simulator Failures or Malfunction Scenarios Attempted

1) 1 engine cut at climb power by using fuel lever - to use as baseline for the type of upset

2) Rudder hardover rates:

   a) 0.5°/second
   b) 2.5°/second
   c) 5°/second
   d) 10°/second
   e) Maximum rate (52°/second)
   f) Maximum Yaw Damper Input

3) Input rudder hardover, let aircraft roll to 80°, then pull column back into stickshaker

4) Leading Edge Assymetry, with or without auto-slats (number 2 slat)

5) Auto-slat misfire at stickshaker

6) Initial rudder input, hands off wheel (i.e. no aileron input) then pull column back

7) Backdrive the simulator with FDR data control inputs to replicate the FDR data

8) Put in maximum rudder position and maximum wheel position and then hold in - adverse wheel and rudder

9) Limited lateral control - eliminate roll control spoilers

10) Check of aircraft roll rates

   a) δ_{WH} - wheel input rate
   b) δ_R - rudder input rate
   c) $\delta_{WH} + \delta_R$ - additive rate
   d) $\delta_{WH} + \delta_R$ - adverse rate

ATTACHMENT 2

Simulator Run Log

SUMMARY OF BOEING ENGINEERING FLIGHT SIMULATOR RUNS FOR USAIR FLIGHT 427 INVESTIGATION - AIRCRAFT PERFORMANCE GROUP
September 22, 1994

RUN #	SCENARIO SUMMARY
1	Maximum wheel roll rate, no rudder input
2	Maximum wheel roll rate, rudder input - wheel added after rudder
3	Maximum wheel roll rate to left using wheel only, roll LWD & return to 0° bank using max right rate
4	Maximum wheel roll rate using wheel and rudder input
5	Maximum adverse right wheel & left rudder - stick shaker and auto-slat fired
6	Failure using left engine cut @ 5700', free controls - IAS too high ~200 KIAS
7	Repeat scenario no. 6, IAS closer to 190 KIAS - speedbrake handle up
8	Repeat scenario no. 6, without speedbrake input
9	Repeat scenario no. 6, with pilot recovery input @ roll = 45°, used full wheel and pedal input
10	Repeat scenario no. 6, with pilot recovery input @ roll = 45°, used wheel input only
11	0.5° /sec. rudder input, no auto-pilot (A/P), pilot recover @ roll = 90°
12	Repeat scenario no. 11, A/P on, missed onset of the full wheel and rudder
13	2.5°/sec rudder input, A/P off, recovery initiated at roll = 90°
14	Repeat scenario no. 13, but A/P on
15	Repeat scenario no. 13 - No Data
16	2.5°/sec rudder input, A/P on, no recovery attempted
17	Repeat scenario 16 - CANCEL
18	Repeat scenario 16 - rudder input at 8° bank; pull at -70° pitch
19	5°/sec rudder input, no A/P; no recovery attempted
20	Repeat scenario 19, A/P on
21	10°/sec rudder input - Abort
22	Repeat scenario 21, A/P off
23	Repeat scenario 21, A/P on
24	Maximum rudder input, A/P off
25	Repeat scenario 24, A/P off, Y/D off
26	Repeat scenario 24, A/P on, Y/D on
27	2.5°/sec rudder input, A/P on, at roll = 70°, pull to stickshaker; A/P on throughout maneuver
28	2.5°/sec rudder input, A/P off, roll = 70° pull back
29	2.5°/sec rudder input, A/P on, disconnect A/P at roll = 55° and pull column back to stickshaker

RUN	SCENARIO SUMMARY
30	Roll checks - A/P on and off
31	2.5 °/sec rudder input, A/P off - Practice - data not plotted
32	Cancel
33	Cancel
34	Cancel - data plotted
35	2.5°/sec rudder input, at roll = 20° pull column to stickshaker, auto-pilot disconnect at 8° roll
36	Auto-slat fail to fire, flaps = 5°
37	Repeat scenario 36
38	Repeat scenario 36, pull column back into stall
39	Slat Assymetry
40	2.5°/sec rudder input, disconnect A/P at 60° - 70° roll
41	Yaw damper hardover
42	Repeat scenario 41
43	Abort
44	Dual Flight Spoilers Hardover
45	Repeat scenario 44