

NATIONAL TRANSPORTATION SAFETY BOARD
Office of Research and Engineering
Washington, D.C. 20594

April 22, 1995

Group Chairman's Report of Investigation
Cockpit Voice Recording and Aircraft Simulation

DCA-94-MA-076

A. ACCIDENT

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

B. GROUP

Chairman:	James R. Cash Electronics Engineer National Transportation Safety Board	
Member:	Tom Hauter Investigator In-Charge National Transportation Safety Board	(group 4)
Member:	Chuck Leonard Operations Group Chairman National Transportation Safety Board	(group 2)
Member:	Eric VanOpstal (CVR Group) Aircraft Accident Investigator Federal Aviation administration (FAA)	(group 3)
Member:	Chris MacWhorter (Operations Group) Aircraft Accident Investigator Federal Aviation administration (FAA)	(group 1)
Member:	Paul Sturpe (CVR Group) Flight Operation Representative USAir Inc.	(group 2)
Member:	Joseph Lofaso (Operations Group) Flight Operation Representative USAir Inc.	(group 1)

Member:	Lance C. Youree Flight Operation Representative USAir Inc.	(group 3)
Member:	Coby Johnson (CVR Group) Accident Investigator Air Line Pilots Association (ALPA)	(group 1)
Member:	John Brookman (Operations Group) Accident Investigator Air Line Pilots Association (ALPA)	(group 2)
Member:	John Cox Accident Investigator Air Line Pilots Association (ALPA)	(group 3)
Member:	John Long Accident Investigator Air Line Pilots Association (ALPA)	(group 4)
Member:	Mike Carriker (CVR Group) Flight Test Engineer Boeing Aircraft Company	(group 1)
Member:	Jim Dunham (CVR Group) Flight Test Engineer Boeing Aircraft Company	(group 2)
Member:	Jim McRoberts Flight Test Engineer Boeing Aircraft Company	(group 3)
Member:	Jerry Swain Flight Test Engineer Boeing Aircraft Company	(group 4)

Simulator Team:

Marty Ingham (Performance Group)
Engineer
Boeing Aircraft Company

Meg Morgan
Engineer
Boeing Aircraft Company

Jeff Derr
Engineer
Boeing Aircraft Company

C. SUMMARY

A portion of the cockpit voice recording was synchronized with the full motion engineering simulator at the Boeing Company. The simulator was programmed to recreate as accurately as possible the flight scenario derived from the data that was recovered from the digital flight data recorder. Several groups of test subjects were exposed to the simulation and their general observations are included.

D. DETAILS OF INVESTIGATION

The engineering simulator that was provided by the Boeing Company contained full motion and full front view visual displays. The digital flight instruments in the simulator were programmed to resemble the accident aircraft's analog instruments. The flight profile and motion used was derived from recorded radar information and from the aircraft's flight data recorder. A short segment of four channel audio information from the aircraft CVR was synchronized to the simulator's motion. The audio segment began at 1902:24 (CVR time) until 1903:08 (CVR time).

The group was randomly split into 4 sub-groups for the simulation. There were four seats located inside of the simulator: pilot, co-pilot, and two observer seats. Each position in the simulator was equipped with headphones. There were also four stations equipped with headphones located outside of the simulator "box" for other group members to hear the recording while they waited their turn. Also provided outside of the simulator cab next to the headphones were two TV screens. One screen displayed the same view that was displayed on the captain's forward window in the simulator. The second screen displayed a computer generated graphical presentation of the aircraft and flight instruments shown from a wing man view.

Each group member had at least six runs in one of the two forward crew (captain or co-pilots) positions in the simulator. The simulator runs were scheduled with a break in between so each group would have time to reflect on the previous runs before they received their next set. At a minimum each group member was exposed to 12 runs with audio, with and without motion inside of the simulator. In addition each group had the opportunity to observe several more runs outside of the simulator in the control room.

Each of the four group's written observations of their experiences in the simulator are as follows:

Group 1

1. We got a much better appreciation of time scale, sequence and acceleration of the cockpit activities.
2. There was some airborne noise that occurred prior to the captains and first officers exclamations. The exclamations were preceded by three thumps and followed by two thumps.
3. The thumps are not common to cockpit noises normally associated with the 737 cockpit. We cannot attribute those thumps to any specific items.
4. We could not hear any noises that we could attribute to specific cockpit actions by the flight crew. This excludes the autopilot disconnect wailer, altitude warning horn, stick shaker warning and engine noise.
5. Captain's and first officer's exclamations are due to physical effects.
6. We heard first officer's noises similar to physical exertion. We didn't hear similar captain's noises.
7. We also heard various spikes or sparking sounds prior to the initial upset. The origin of these spikes is unknown.

Summary: We as a team felt this was a valuable exercise. Although we may have not added additional information to this event, the combining of FDR, CVR in a cockpit simulator added a great deal to the team's appreciation of the time scale, complexity of noises, events and visual images. This investigation technique was and is useful tool for accident investigation.

Group 2

1. The group was able to ascertain the following identifiable sounds.
 1. Trim wheel operating
 2. Auto pilot disconnect wailer
 3. Altitude alert
 4. Stick shaker


Summary: The group heard other sounds which could not be identified as to origin, but believe would not be inconsistent with a turbulence encounter. The unidentifiable sounds are heard beginning as the first officer is announcing traffic in sight.

Group 3

Summary: The team believed this exercise to be beneficial. The simulator session added to the overall understanding of the events, however, in regards to sound analysis the exercise was of limited value. While the team agreed there were several sounds mixed with human conversation and exclamations, these sounds remained unidentified.

Group 4

Summary: We were not able to find any noise that we could contribute to an accident cause. The loud thump sound could be galley sounds or a foot hitting the floor, or other unexplained noises. We could not attribute the first or last tapping sound to any explainable sound. We could not explain the co-pilot's "ugh" or the captain's inhalation to anything through this simulation. We could not hear any identifiable control inputs or movements.


James R. Cash
Electronics Engineer 