NATIONAL TRANSPORTATION SAFETY BOARD
OFFICE OF AVIATION SAFETY (AS-50)
Washington, D.C. 20594

June 16, 1998

SPEECH EXAMINATION FACTUAL REPORT
ADDENDUM

A. ACCIDENT: DCA-94-MA-076

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

B. SPEECH EXAMINATION GROUP

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C. SUMMARY

On September 8, 1994, at 1904 Eastern Daylight time USAir flight 427, a Boeing 737-300, 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 cockpit voice recorder (CVR) transcript notes "sounds similar to pilot grunting" on the cockpit hot microphone of the first officer at 1903:01.6.[1] Two speech experts examined these sounds and concluded that they represented physical straining by the first officer, as described in the Speech Examination Factual Report of May 5, 1997. Both experts noted additional sounds related to physical straining. These observations of pilot straining are of critical interest to the human performance investigation, since they occurred during a brief time period during which the airplane went from controlled flight into a loss of control situation. Therefore, the Safety Board staff attempted to measure all sounds by the first officer related to physical straining on the possibility that this information would be meaningful to understanding the actions of the first officer during this period.

One of the speech experts, Dr. Alfred S. Belan, of the Interstate Aviation Committee, Moscow, Russia, provided the following observations:

> "The first officer, from the moment 1902:59.5, most likely was actively involved in the control of the airplane. Beginning at this time, and continuing for several seconds, speech disruptions could be observed that included grunting and forced exhalations (1902:59.5; 1903:01.1; 1903:02.0)[2]....These are signs of high physical loads. Normal use of the cockpit controls should not produce the types of sounds shown in this period. These sounds indicate that the first officer was struggling unusually hard, for example if he was pushing a control against its stops or if he was experiencing an unusual resistance in the use of a control."

The second speech expert, Dr. Scott Meyer, of the Naval Aerospace Medical Research Laboratory, provided the following observations:

> "after the onset of the emergency, two rapid grunting exhalations were heard. The first grunting sound was soft indicating some submaximal muscular exertion. The second grunting sound was louder and more forceful representative of the use of increased, but probably submaximal, muscular force. The grunts suggest that the first officer was straining possibly in an attempt to manipulate the controls of the aircraft to override the autopilot."

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[1] NTSB, Specialist's Factual Report of Investigation, Cockpit Voice Recorder, by Albert G. Reitan, October 5, 1995.

[2] The timings cited by Dr. Belan were derived from notes he left in Washington after his visit and may be distorted. One purpose of the present effort was to obtain precise timings for the observations made by Dr. Belan.

To measure these sounds, Safety Board staff digitized the CVR tape at a sampling rate of 20 KHz. and studied this sample in its laboratory using the Entropic Signal Processing System (Entropic Research Laboratory, Inc., Washington, D.C.). Speech samples were examined using the Waves video display of the waveform with aural presentation to listen to the selection being displayed. Using visual and auditory cues, the exact start and stop times of certain statements were captured.

The Speech Examination Group employed this measurement analysis to examine the hot microphone channel of the first officer between the times 1902:57.6-1903:05.1 [134.6-142.1].[3] The following human sounds were recorded:

- the statement "zuh" from 1902:57.6-1902:57.8 [134.6-134.8]
- a sound like a rapid inhale from 1902:59.7-1902:59.9 [136.7-136.9]
- a sound like soft grunting from 1903:00.3-1903:00.5 [137.3-137.5]
- a sound like loud grunting from 1903:01.5-1903:01:6 [138.5-138.6]
- a sound like a loud exhale from 1903:01.8-1903:02:1 [138.8-139.1][4]
- the statement "oh #"[5] from 1903:04.6 to 1903:05:1 [141.6-142.1]

No other human sounds, breathing or statements, were observed during this period.

[redacted]
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[redacted]

[3] The first numbers are eastern daylight time, while the second numbers, in brackets, are the equivalent values expressed as elapsed FDR time.
[4] One of the investigators (MB) thought that the sounds resembling loud grunting and a loud exhale were part of the same straining effort, the first part being voiced and the second unvoiced, but the investigators agreed to provide separate timings for both.
[5] "oh shit"