NATIONAL TRANSPORTATION SAFETY BOARD
Vehicle Recorder Division
Washington, D.C. 20594

October 21, 2013

Flight Data Recorder - 10

Specialist's Factual Report
By George Haralampopoulos

1. EVENT SUMMARY

Location: Newark, New Jersey
Date: May 18, 2013
Aircraft: DHC-8-100
Registration: N934HA
Operator: Piedmont Airlines
NTSB Number: DCA13FA094

On May 18, 2013, about 0104 eastern daylight time, N934HA, a Piedmont Airlines, Boeing (DeHavilland) DHC-8-100, operated as US Airways Express flight 4560, a Title 14 CFR Part 121 scheduled domestic commuter passenger fight from Philadelphia, Pennsylvania, to Newark, New Jersey, had the left main landing gear fail to lower completely and lock prior to landing. After attempting to lower the left main landing gear, the crew elected to conduct a gear up landing on runway 04L at Newark Liberty International Airport (KEWR), Newark, New Jersey. The airplane incurred substantial damage. There were no injuries to the 3 crewmembers or 31 passengers that were onboard.

2. FLIGHT DATA RECORDER GROUP

A flight data recorder (FDR) group was not convened.

3. FDR Carriage Requirements

The event aircraft, N934HA, was manufactured in March 1989 and was operating such that it was required to be equipped with an FDR that recorded, at a minimum, 22 parameters, as cited in Title 14 *Code of Federal Regulations* (CFR) Part 121.344(b).

4. DETAILS OF FLIGHT DATA RECORDER INVESTIGATION

The Safety Board's Vehicle Recorder Division received the following FDR:

Recorder Manufacturer/Model: **Allied Signal SSUFDR 64 wps**
Recorder Serial Number: **3717**

4.1. Allied Signal SSUFDR Description

The Allied Signal SSUFDR is configured to record 64 12-bit words of digital information every second. Each grouping of 64 words (each second) is called a subframe. Each subframe has a unique 12-bit synchronization (sync) word identifying it as subframe 1, 2,

3, or 4. The sync word is the first word in each subframe. The data stream is "in sync" when successive sync words appear at proper 64-word intervals. Each data parameter (for example, altitude, heading, airspeed) has a specifically assigned word number within the subframe. The Allied Signal SSUFDR is designed to meet the crash-survivability requirements of TSO C124.

4.1.1. Recorder Condition

The recorder was in good condition and the data was extracted normally using the FDR manufacturer's recommended procedures.

4.1.2. Recording Description

The FDR recording contained approximately 27 hours of data. Timing of the FDR data is measured in subframe reference number (SRN), where each SRN equals one elapsed second. The accident flight was captured near the end of the recording and flight was about 133 minutes in duration. The parameters evaluated for the purpose of this report appeared to be in accordance with the federal FDR carriage requirements.

Power was lost to the FDR and returned later at an undetermined time. Subsequent data after the power interruption is not shown due to lack of activity in the recorded parameters.

4.1.3. Engineering Units Conversions

The engineering units conversions used for the data contained in this report are based on documentation from the aircraft operator. Where applicable, the conversions have been changed to ensure that the parameters conform to the NTSB's standard sign convention that climbing right turns are positive (CRT=+).[1]

Appendix A lists the FDR parameters verified and provided in this report.

4.2. Time Correlation

Correlation of the FDR data from SRN to the event local time, Eastern daylight time (EDT), is referenced in the 'Cockpit Voice Recorder – Factual Report'.

Accordingly, the time offset for the event flight data from SRN to local EDT is the following: EDT = SRN – 7803 seconds. For the rest of this report, all times are referenced as EDT, not SRN.

4.3. FDR Plots and Corresponding Tabular Data

Figures 1 and 2 contain FDR data recorded during the event on May 18, 2013. All the parameters plotted are listed in table A-1.

[1] CRT=+ means that for any parameter recorded that indicates a climb or a right turn, the sign for that value is positive. Also, for any parameter recorded that indicates an action or deflection, if it induces a climb or right turn, the value is positive. Examples: Right Roll = +, Pitch Up = +, Elevator Trailing Edge Up = +, Right Rudder = +.

Figure 1 shows an overview of entire flight, which includes aircraft attitude, acceleration, and air data. A dashed line shows when power was removed from the FDR at 01:02:03 EDT.

Figure 2 is an eight minute segment prior to the FDR power being removed, which includes aircraft attitude, acceleration, and air data.

The entire accident flight consists of 3 segments of which the aircraft climbs and descends. During the first segment, the aircraft took off around 23:05:22 EDT on May 17, 2013 and at 23:12:38 EDT, the aircraft leveled out at an average pressure altitude of 6,800 feet. The aircraft began descending to land at about 23:27:42 and when on final approach the aircraft performed a go around at roughly 23:30:52, pitching to nine degrees and climbing to a pressure altitude of 2800 feet.

The second segment includes the change of day to May 18, 2013, while the aircraft maintained an average pressure altitude of about 2800 feet and began to descend at 00:04:42 to perform another approach, which resulted in another go-around. At 00:12:21 EDT, the aircraft pitched up to eleven degrees and climbed back to an average pressure altitude of 2800 feet.

The final segment contains two vertical G maneuvers; the first that reached a recorded value of 1.6 g’s performed at 00:32:20 EDT and the second which reached a recorded value of 1.4 g’s performed at 00:32:52 EDT. At 00:57:58, the aircraft begins to land and descends from 2600 feet. During the landing, high excitations in the aircrafts accelerations begin to build at 01:01:51 EDT, in which the aircrafts airspeed drops from about 81 knots (kts) to a final value of 58 kts after power was lost to the FDR.

These figures are configured such that right turns are indicated by the trace moving toward the bottom of the page, left turns towards the top of the page, and nose up attitudes towards the top of the page.

The corresponding tabular data used to create figures 1 and 2 are provided in electronic comma separated value (*.csv) format as attachment 1 to this report.

Figure 1. Plot of basic parameters for entire event flight.

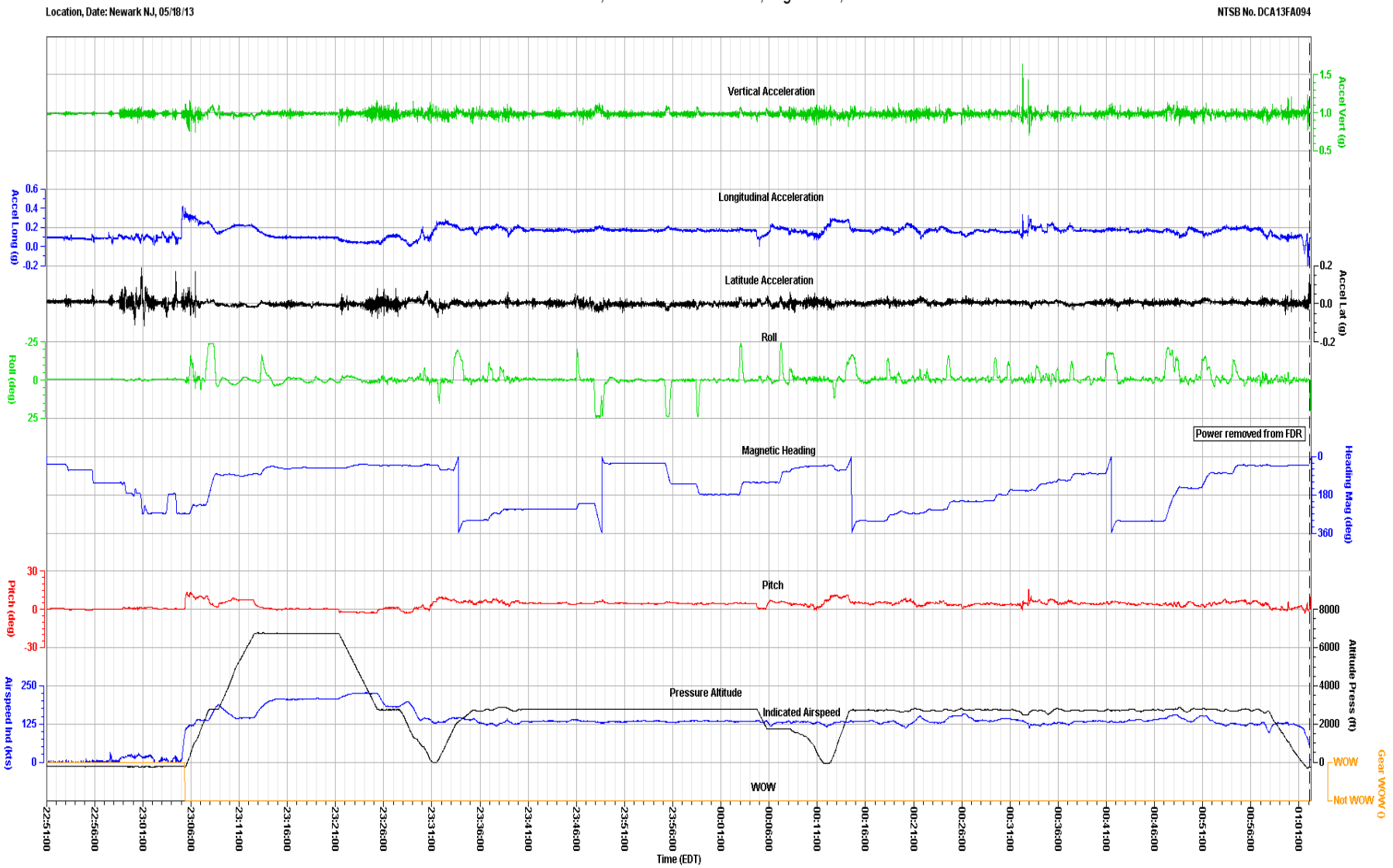
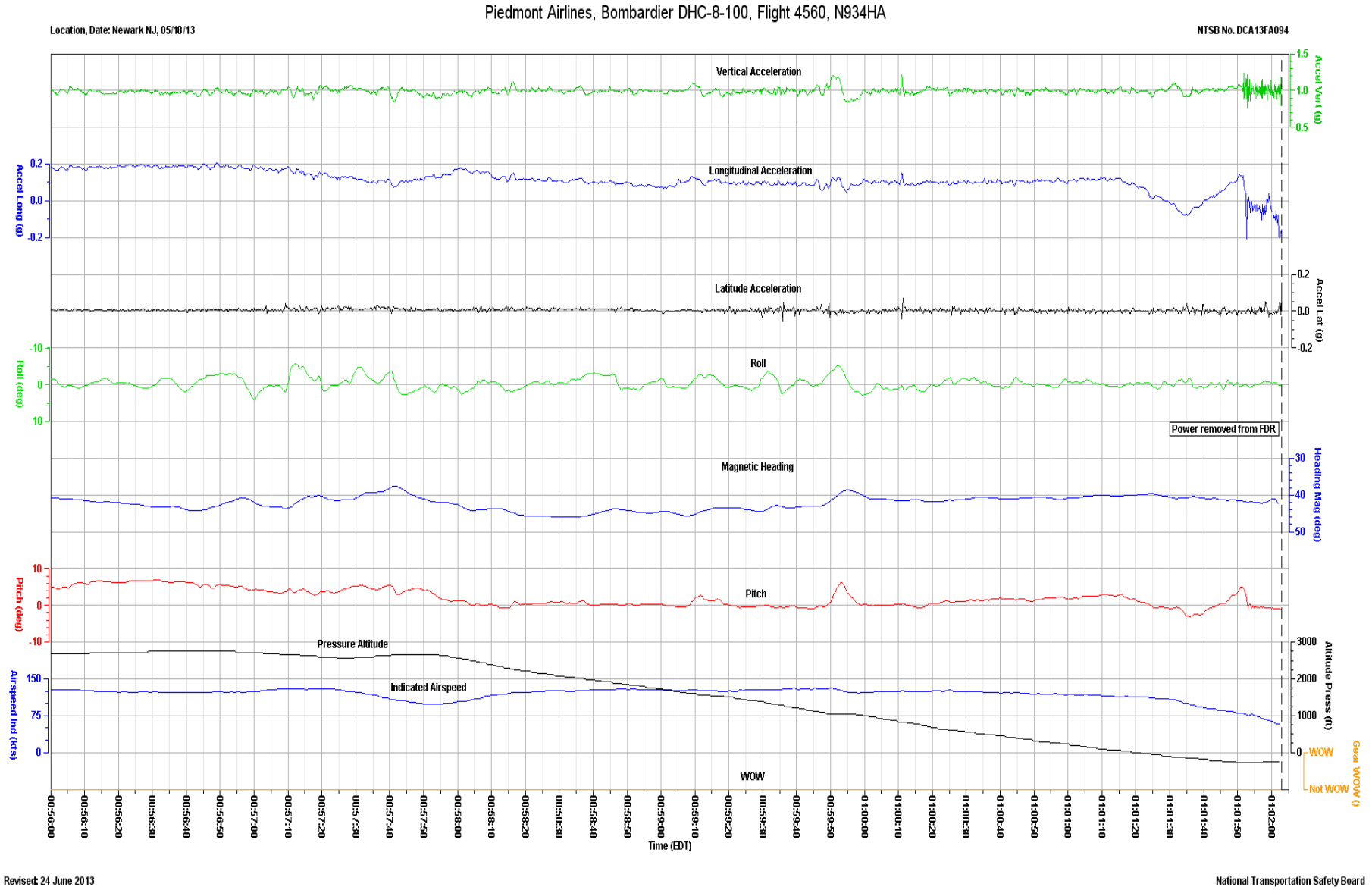


Figure 2. Eight minute segment prior to power removed from FDR.



APPENDIX A

This appendix describes the parameters provided and verified in this report. Table A-1 lists the parameters and table A-2 describes the unit abbreviations used in this report.

Table A-1. Verified and provided FDR parameters.

Parameter Name	Parameter Description
1. Accel Lat (g)	Lateral Acceleration
2. Accel Long (g)	Longitudinal Acceleration
3. Accel Vert (g)	Vertical Acceleration
4. Altitude Press (ft)	Pressure Altitude
5. Gear WOW (discrete)	Gear Weight on Wheels
6. Heading Mag (deg)	Magnetic Heading
7. Indicated Airspeed (kts)	Indicated Airspeed
8. Key VHF-1 (discrete)	Key Microphone VHF Channel 1
9. Key VHF-2 (discrete)	Key Microphone VHF Channel 2
10. Pitch (deg)	Pitch Angle
11. Roll (deg)	Roll Angle

Table A-2. Unit abbreviations.

Units Abbreviation	Description
deg	degrees
kts	knots
ft	feet
g	g
discrete	discrete
psi	pounds per square inch
deg/s	degree per second
%	percentage

NOTE: For parameters with a unit description of discrete, a discrete is typically a 1-bit parameter that is either a 0 state or a 1 state where each state is uniquely defined for each parameter.