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

May 14, 2011

17 – Electronic Devices Factual Report

Specialist's Factual Report
by Bill Tuccio

1. EVENT

Location:	Delray Beach, Florida
Date:	March 23, 2012
Aircraft:	Bell 407
Registration:	N31PB
Operator:	Palm Beach County Sherriff's Office
NTSB Number:	ERA12TA251

On March 23, 2012, about 1455, eastern daylight time, a Bell 407 helicopter, N31PB, registered to and operated by the Palm Beach County Sheriff's Office as a public use flight, experienced a hard landing while maneuvering near Delray Beach, Florida. One of the two certificated commercial pilots received minor injuries and the other was seriously injured; the helicopter incurred substantial damage. Visual meteorological conditions prevailed at that time and no flight plan was filed for the local flight. The flight originated from the Palm Beach International Airport (PBI), West Palm Beach, Florida, about 1405.

2. DETAILS OF DEVICE INVESTIGATION

The Safety Board's Vehicle Recorder Division received the following devices on March 28, 2012:

Device 1:	Garmin GPSMAP 496
Device 1 Serial Number:	19725277
Device 2:	Rolls Royce Digital Electrical Control Unit (DECU)
Device 2 Serial Number:	JG0ALK0660

2.1. Garmin GPSMAP 496 Device Description

The Garmin GPSMAP 496 is a battery-powered portable 12-channel GPS receiver with a 256-color TFT LCD display screen. The unit includes a built-in Jeppesen database and is capable of receiving XM satellite radio for flight information including NEXRAD radar, lightning, METARs, TAFs, and TFRs. The unit stores date, route-of-flight, and

flight-time information for up to 50 flights. A flight record is triggered when groundspeed exceeds 30 knots and altitude exceeds 500 feet, and ends when groundspeed drops below 30 knots for 10 minutes or more. A detailed tracklog – including latitude, longitude, date, time, and GPS altitude information for an unspecified number of points – is stored within the unit whenever the receiver has a lock on the GPS navigation signal. Position is updated within the tracklog as a function of time or distance moved, depending on how the unit has been configured. Once the current tracklog memory becomes full, new information either overwrites the oldest information or recording stops, depending on how the unit is configured. The current tracklog can be saved to long-term memory and 15 saved tracklogs can be maintained in addition to the current tracklog. Tracklog storage may be activated or de-activated at user discretion. All recorded data is stored in non-volatile memory[1]. The unit contains hardware and software permitting the download of recorded waypoint, route, and tracklog information to a PC via a built-in serial port using the NMEA 0183 version 2.0 protocol. The unit can also communicate with external devices such as a computer using a built in USB port. An internal button-battery is used to back-up power to the internal memory and real-time clock during those periods when main power is removed.

2.1.1. Garmin GPSMAP 496 Data Recovery

Upon arrival at the Vehicle Recorder Laboratory, an exterior examination revealed that the unit had not sustained any damage. However, an examination of the unit settings, shown in figure 1, revealed the track log record mode was set to off and 0% internal memory was used. As such, no data pertinent to the investigation was retrieved from the unit.

Figure 1. GPSMap 496, track log settings.

[1] Non-volatile memory is semiconductor memory that does not require external power for data retention.

2.2. Rolls Royce DECU Description[2]

The Rolls-Royce DECU, model EC-35R, is part of the Rolls-Royce engine 250-C47B full authority digital engine control (FADEC) system. The FADEC provides automatic engine starting, speed governing, flameout detection/reignition, exceedance limiting, surge detection/recovery, fault detection, engine condition monitoring and incident recording (IR). The DECU provides the control logic and recording functions of the FADEC system. The DECU records both engine condition monitoring and IR information. IR data is constantly being recorded, held in memory for 12 seconds, and then written over. When any one of various parameters reaches a triggering value, an instantaneous snapshot of the data is recorded, plus the previous 12 seconds of data, and the ensuing 48 seconds of data are written to non-volatile memory. The data has a sample rate of 1.2 seconds. The IR is triggered by any of the following: excessive rate of engine torque increase (torque spike) or torque exceedance, engine overspeed, engine surge, main rotor droop, FADEC hard fault, engine temperature exceedance, gas generator or power turbine speed exceedance, uncommanded engine acceleration or deceleration, prolonged engine operation on the fuel limiter or a detected engine flameout.

2.2.1. Rolls Royce DECU Data Recovery

Upon arrival at the Vehicle Recorder Laboratory, an exterior examination revealed that the unit had not sustained any damage (figure 2). With the assistance of Rolls Royce personnel, recorded data was downloaded normally, without difficulty.

Figure 2. Rolls Royce DECU unit.

[2] Information provided by Rolls-Royce personnel.

2.2.2. Rolls Royce DECU Plots and Corresponding Tabular Data

The following two plots are expressed in elapsed time as recorded by the DECU unit. The data contains information from the March 23, 2012 event. The recording content began about 12 seconds prior to the first triggering event and continued for about 48 seconds. Two IR snapshot events were triggered at about 12 and 24 seconds.

Figure 3 shows a decrease in rotor speed from the beginning of the recording until about 9 seconds. At about 4 seconds, the power lever angle and torque increased, continuing until about 13 seconds. At about 13 seconds, the torque reached a maximum recorded value of 118%. Fuel flow and gas generator speed began to increase as about 7 seconds. After a decrease in torque, between 19 and 30 seconds, the torque achieved a maximum value of about 132%.

Figure 4 shows ambient air pressure and temperature recorded during the event. The recorded ambient air pressure was about 14.2 psi and the temperature about 81 degF.

The corresponding tabular data used to create these two plots are provided in electronic (*.csv[3]) format as Attachment 1 to this report.

[3] Comma Separated Value format.

Figure 3. DECU plot of basic parameters.

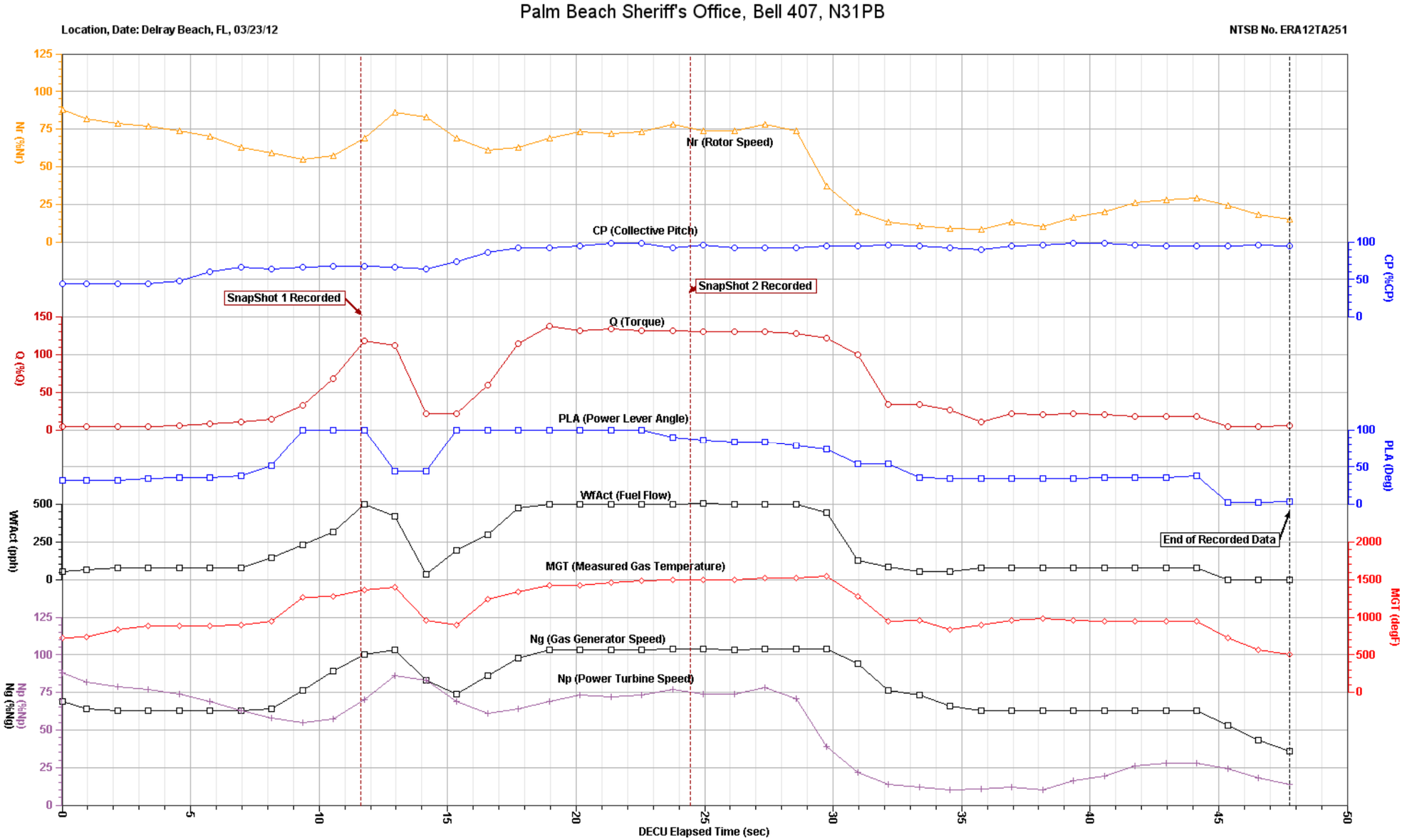
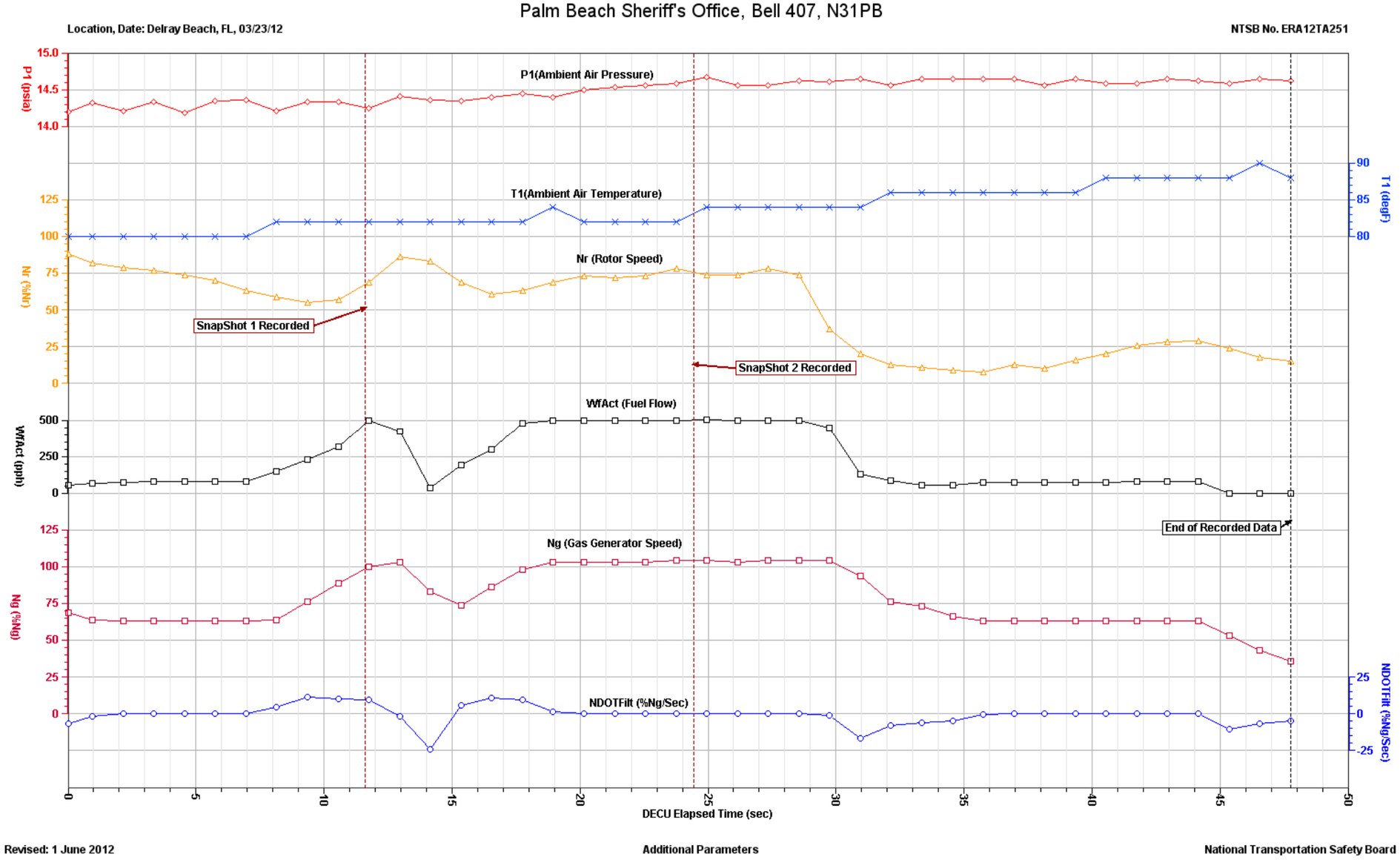


Figure 4. DECU plot of additinal parameters.



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. CP (%CP)	Collective Pitch
2. MGT (degF)	Measured Gas Temperature
3. NDOTFilt (%Ng/sec)	Rate of Change Gas Generator
4. Ng (%Ng)	Gas Generator Speed
5. Np (%Np)	Power Turbine Speed
6. Nr (%Nr)	Rotor Speed
7. P1 (psia)	Ambient Air Pressure
8. PLA (deg)	Power Lever Angle
9. Q (%Q)	Torque
10. T1 (degF)	Ambient Air Temperature
11. WfAct (pph)	Fuel Flow

NOTE: This FDR records pressure altitude, which is based on a standard altimeter setting of 29.92 inches of mercury (in Hg). The pressure altitude information presented in the FDR plots and in the electronic data has not been corrected for the local altimeter setting at the time of the event.

Table A-2. Unit abbreviations.

Units Abbreviation	Description
deg	degrees
degF	degrees Fahrenheit
Pph	pounds per hour
Psia	pounds per square inch absolute
sec	Seconds
%CP	percent collective pitch
%Ng	percent gas generator speed
%Np	percent power turbine speed
%Nr	percent rotor speed