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

May 31, 2012

Enhanced Ground Proximity Warning System

Specialist's Factual Report
By
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1 EVENT SUMMARY

Location: Nashville, Pennsylvania
Date: December 22, 2011
Aircraft: Cessna 441
Registration: N48BS
NTSB Number: ERA12FA120

On December 22, 2011, about 1735 eastern standard time, a Cessna 441, N48BS, was substantially damaged when it impacted terrain near Nashville, Pennsylvania, while approaching York Airport (THV), Thomasville, Pennsylvania. The certificated commercial pilot was fatally injured. Night visual meteorological conditions prevailed. The airplane had been operating on an instrument flight rules (IFR) flight plan from Long Beach Airport - Daugherty Field (LGB), Long Beach, California, to THV; however, the pilot had cancelled the flight plan and was proceeding visually via the airport traffic pattern at the time of the accident. The personal flight was operating under the provisions of 14 Code of Federal Regulations Part 91.

2 ENHANCED GROUND PROXIMITY WARNING SYSTEM DATA GROUP

An enhanced ground proximity warning system (EGPWS) group was not convened.

3 DETAILS OF EGPWS INVESTIGATION

On February 09, 2012, the Safety Board's Vehicle Recorder Division received the following device:

Recorder Manufacturer/Model: **Bendix/King KGP 560 GA-EGPWS**
Recorder Serial Number: **3483**

The EGPWS was in good condition and the data were extracted normally from the device using the manufacturer's recommended procedure. The data extracted from the device was provided to the EGPWS manufacturer for decoding. The decoded files were then provided to the NTSB.

3.1 Recorder and Data Description

The EGPWS non-volatile memory (NVM) does not continuously record, but rather stores data only when certain criteria are met. The readout process at the manufacturer's facility

produces several files of flight history data which encompass operational, documentary, fault and warning information.

The flight history data warning file outputs performance data as related to the operation of the aircraft. These data do not continuously record but, rather, if an alert or warning related to the EGPWS function activates, the unit retains data points for 20 seconds prior to the activation of the warning and 10 seconds afterwards. The EGPWS parameters are only sampled 1 time per second but the actual time of occurrence can be anywhere within the second.

The download file structure of the warning data includes a standard EGPWS parameter listing, not all of which is applicable to the accident aircraft, N48BS. For instance, torque 3 would not be relevant to the Cessna installation. Other parameters listed (such as accelerations) did not record any information as they were not wired to send data to the EGPWS in this installation. Some of the data points contained in the file are denoted with an asterisk. According to a Honeywell representative, the asterisk indicates invalid data as evaluated by the EGPWS logic. In some cases, the data coming from the original aircraft source is correct, just not considered reasonable by the programming of the EGPWS. EGPWS parameters referenced in this report can be found in Table 1.

One of the parameters recorded in the warning file is “RecID”. When an alert is present, the normally recorded value, “DATA”, is supplemented by another line at the same time sample which indicates the alert mode detected and usually corresponds to an aural annunciation in the cockpit by the unit.

3.2 Time Correlation

The downloaded files contain data logged based on hours of operation (operational time) of the individual EGPWS unit and have no reference to any other time base. In the data files, each power cycle is tagged with a sequential flight leg number. The accident flight was identified as flight leg 403. Only the warning data pertaining to the event flight, 403, were extracted for use in this report.

The data in the warning file for flight leg 403 began recording at operational time 912:08:28. The event that most likely triggered this recording was an “Excessive Rate of Descent Warning” which occurred at 912:08:48. The data logged continuously each second until the last recorded point in the file which occurred at operational time 912:08:48.

3.3 Engineering Units Conversions

The operational data is converted during the readout process by Honeywell software and the files contain engineering units. Where applicable, changes to the conversions have been made to ensure the parameters conform to the Safety Board’s standard sign convention that climbing right turns are positive (CRT=+).[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

3.3.1 Parameters Provided and Verified

The following table lists the EGPWS parameters provided and verified in this report, including the associated plot label.

Table 1 - Verified and Provided EGPWS Parameters

Plot Label	EGPWS Parameter	EGPWS File Name
1. Altitude-GPS (ft)	GPS Altitude (feet)	GPS Alt
2. Altitude-Tactical (ft)	Tactical Altitude (feet)	TACAlt
3. Altitude-Uncorrected(ft)	Uncorrected Altitude (feet)	Uncorr Alt
4. Flight Leg[2]	Flight Leg	Flt Leg
5. Ground Spd (kts)	Ground Speed (knots)	Gspd
6. Latitude (deg)	Latitude (degrees)	Lat
7. Longitude (deg)	Longitude (degrees)	Long
8. Operating Time[2]	Operating Time	Oper Time
9. Position Source[2]	Position Source	Pos Src
10. Roll (deg)	Roll (degrees)	Roll
11. Track-Mag (deg)	Track, Mag (degrees)	Mag Trk
12. Track-True (deg)	Track, True (degrees)	Tru Trk

3.4 EGPWS Recorded Takeoff Information

The EGPWS also recorded takeoff event data. The most recent takeoff recorded by the EGPWS was flight leg 403. Table 2 contains the recorded takeoff data.

Table 2 - EGPWS recorded takeoff data

Operating Time (HH:MM:SS)	905:47:56
Airport	KLGB (Long Beach Airport)

3.5 EGPWS Plots and Corresponding Tabular Data

The following two plots contain data recorded during the December 22, 2011 event and Table 1 lists all of the EGPWS parameters plotted.

Plot one contains the 19 seconds of recorded data from the EGPWS. The time scale of the plot is referenced to 0 seconds at the start of the recording which corresponds to the recorded operational time of 912:08:28. The pull-up warning is annotated at 20 seconds. As stated in section 3.1, at times data is noted as invalid by the EGPWS and not used by the EGPWS. At a plot time of 15 and 16 seconds, the parameters for Roll and Track-Mag recorded invalid values. Track-True recorded an invalid value a plot time of 15 seconds only. The invalid data is not plotted. Additionally the position source for the EGPWS changed from GPS1 to DR (Dead Reckoning) and then returns to GPS1. These times are noted on the plot.

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turn, the value is positive. Examples: Right Roll = +, Left Aileron Trailing Edge Down = -, Right Aileron Trailing Edge Up = +, Pitch Up = +, Elevator Trailing Edge Up = +.

[2] This parameter is provided in the tabular data only and was not plotted in the plots included in the report.

Plot two contains the 19 seconds of recorded data from the EGPWS overlaid on a Google Earth terrain image. The altitude source used in the plot is GPS altitude.

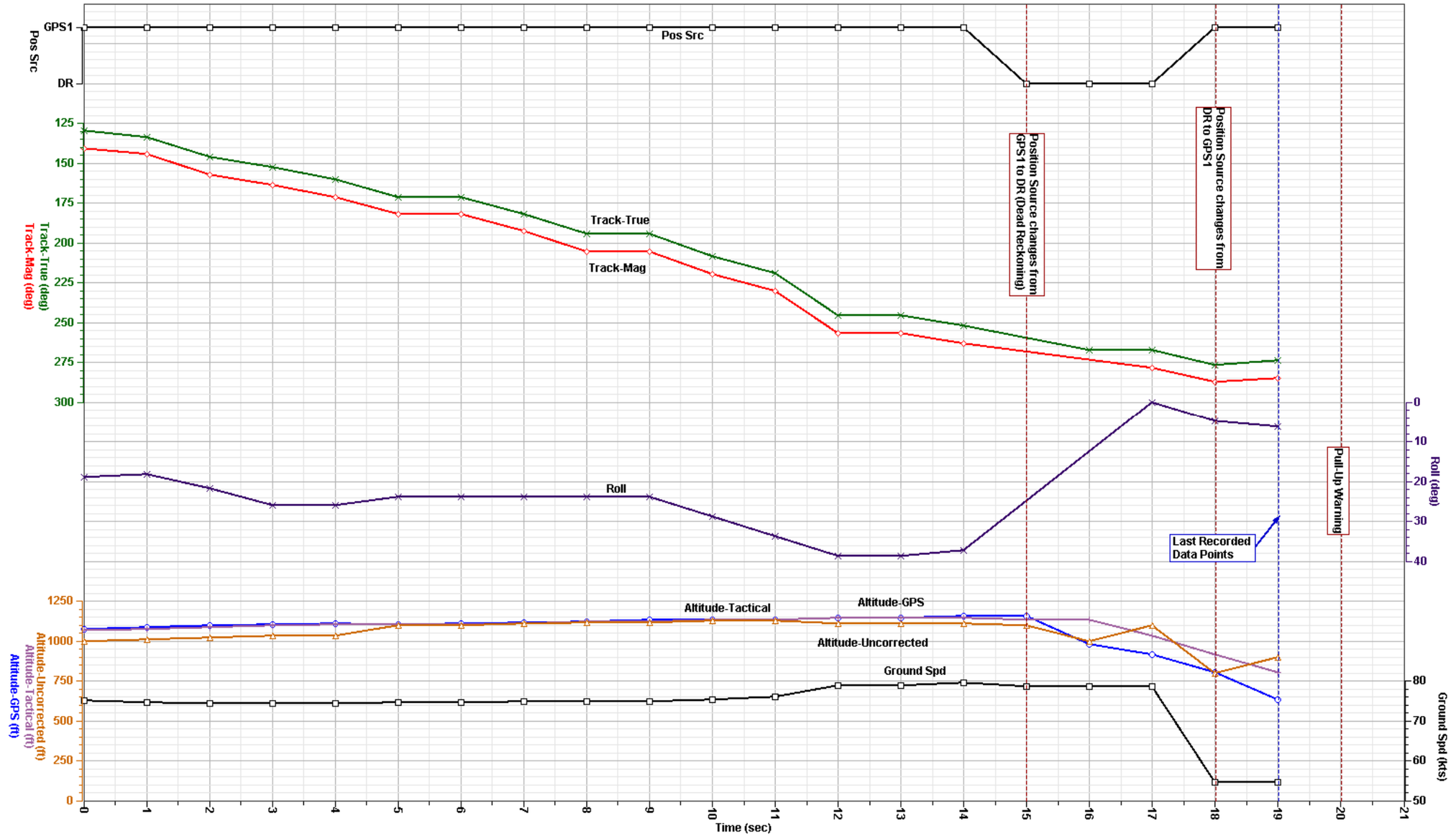
Additionally, these plots are configured such that right turns are indicated by the trace moving toward the bottom of the page, left turns towards the top of the page, and nose up attitudes towards the top of the page.

The corresponding tabular data used to create these two plots are provided in electronic (.CSV) format as Attachment 1 to this report.

Cessna 441, N48BS

Location, Date: Nashville, Pennsylvania, 12/22/11

NTSB No. ERA12FA120



Revised: 24 May 2012

Accident Flight - EGPWS Data

National Transportation Safety Board

Plot 1 – EGPWS Data from the accident flight

Plot 2 – EGPWS Data overlaid on a Google Earth terrain image using GPS altitude.