NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Washington, D.C. 20594
October 1, 2009

Addendum 1 to Group Chairmen's Factual Report

OPERATIONAL FACTORS / HUMAN PERFORMANCE

DCA09MA026

A. Accident

Operator: US Airways Group, Inc.
Location: Hudson River, New York, New York
Date: January 15, 2009
Time: 1527 eastern standard time[1]
Airplane: Airbus A320-214, Registration Number: N106US, Serial #: 1044

Additional Information that was provided after the completion of the Factual Report:

9.8 Ground Proximity Warning System (GPWS)

The Airbus A320 incorporated a ground proximity warning system. The ground proximity warning system generated aural and visual warnings in various modes of operation to increase pilots' situational awareness between 30 feet and 2,450 feet RA (radio altitude). In addition to the basic GPWS functions, the GPWS had an enhanced function (EGPWS) which improved low terrain warnings and predicted terrain conflicts based on a worldwide terrain database.

The GPWS modes and conditions that triggered visual and aural alerts were as follows:[2]

Mode 1: Excessive rate of descent.
Mode 2: Excessive terrain closure rate.
Mode 3: Altitude loss after takeoff, or go-around.
Mode 4: Unsafe terrain clearance when not in landing configuration.
Mode 5: Too far below glideslope.

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[1] All times are eastern standard time (EST) based on a 24-hour clock, unless otherwise noted. Actual time of accident is approximate.
[2] GPWS modes obtained from Airbus FCOM volume 1, 1.34.70.

A review of the cockpit voice recorder transcript indicated that GPWS and EGPWS alerts were triggered during the accident airplanes descent to the Hudson River.[3]

Aural alerts during decent from approximately 500 feet[4]

Time	Source	Aural Alert
15:29:37	FWC[5]	Continuous repetitive chime for 37.4 seconds
15:29:37	GPWS – mode 4	"too low, terrain"
15:29:41	GPWS – mode 4	"too low, terrain"
15:29:43	GPWS – mode 4	"too low, terrain"
15:29:45	EGPWS	"caution, terrain"
15:29:48	EGPWS	"caution, terrain"
15:29:49	GPWS – mode 2	"terrain, terrain. pull up, pull up"
15:29:55	GPWS – mode 2	"pull up, pull up, pull up, pull up, pull up, pull up"
15:30:04	GPWS – mode 4	"too low, terrain"
15:30:06	GPWS – mode 4	"too low, gear"
15:30:13	EGPWS	"caution, terrain"
15:30:15	FWC	Continuous repetitive chime to end of recording
15:30:15	EGPWS	"caution, terrain"
15:30:23	EGPWS	"caution, terrain"
15:30:24	EGPWS	"terrain, terrain. pull up, pull up" – "pull up" repeats to end of recording

In addition to the aural alerts, a red GPWS light on each pilot's glareshield illuminated when any alert mode from 1 to 4 was activated. The EGPWS function included a terrain awareness display (TAD) which displayed terrain on each pilot's navigation display in either red or amber in various pattern densities. If the TERR ON ND[6] was not selected on, the terrain was

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[3] Refer to Cockpit Voice Recorder Group Chairman's Factual Report.
[4] Time and aural alerts obtained from Cockpit Voice Recorder Group Chairman's Factual Report. Altitude approximated from charts contained in Flight Data Recorder Group Chairman's Factual Report.
[5] "FWC" - Flight Warning Computer
[6] "TERR ON ND" – a pushbutton located on each pilot's instrument panel. When set to ON the respective navigation display displayed the terrain from a database dependent upon airplane position. The terrain was displayed in various densities of green, yellow, red, or magenta, depending on the threat level.

automatically displayed, and the TERR ON ND push button illuminated on each pilot's instrument panel, when an EGPWS caution or warning was activated.

9.8.1 GPWS Checklist Guidance

The ditching procedures contained in the US Airways QRH and in the Airbus QRH both included guidance to select the GPWS system off in order to avoid nuisance warnings. The US Airways QRH Ditching procedure, page 89, stated in part:

> *c. GPWS SYS[7] .... OFF*
> *d. GPWS TERR[8] .... OFF*
>   *[Pressing OFF the SYS and TERR pb's avoids nuisance warnings.]*

The Airbus QRH Ditching procedure contained similar guidance.

The ditching portion of the ENG DUAL FAILURE procedures contained in the US Airways QRH and in the Airbus QRH did not include guidance to select the GPWS system off.

9.8.2 Alert Order of Priority

The A320 was designed with an alert prioritization hierarchy that considered inputs from various airplane systems including GPWS, FWC (flight warning computer), TCAS (traffic collision avoidance system), and radar.

The EGPWS aural alerts, when triggered, had priority over the "speed, speed, speed" aural alert generated by the FWC.

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[7] "GPWS SYS" – A pushbutton on the pilot's overhead panel. When selected OFF, all basic GPWS alerts (Mode 1 to 5) are inhibited.
[8] "GPWS TERR" – A pushbutton on the pilot's overhead panel. When selected to OFF, the Terrain Awareness Display (TAD) and Terrain Clearance Floor (TCF) modes are inhibited.