Learning From Experience: Incident No. 2

Misapplied Fix

Second in a series focusing on approach and landing incidents that might have resulted in controlled flight into terrain but for timely warnings by TAWS.

BY DAN GURNEY

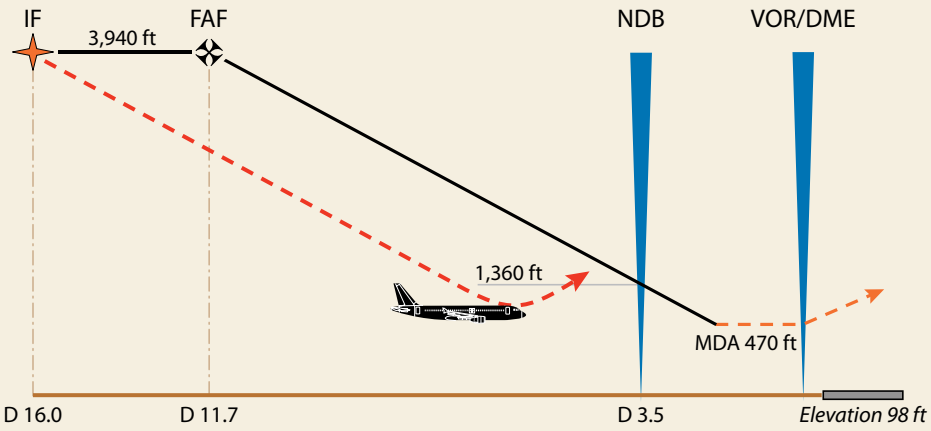
A premature descent for the final segment of a nonprecision approach in this incident might have resulted from a mistake in identifying the final approach fix (FAF). Moreover, the flight crew's continuation of the descent until a terrain awareness and warning system (TAWS) warning occurred indicates a possible breakdown in cross-checking and monitoring.[1]

The crew of the modern, glass-cockpit aircraft was conducting a VOR/DME (VHF omnidirectional radio/distance measuring equipment) approach in daytime instrument meteorological conditions. The approach chart shows that a minimum altitude of 3,940 ft should be maintained until reaching the FAF, 11.7 nm DME from the VOR/DME station. However, TAWS data indicate that the descent was begun 16.0 nm from the station — 4.3 nm before reaching the FAF (Figure 1, page 26).

The aircraft was 540 ft above ground level and 4.5 nm (8.3 km) from the runway threshold when the TAWS generated a "TERRAIN, PULL UP" warning. The crew stopped the descent and conducted a missed approach, climbing away safely.

The author's analysis of the incident, which was reviewed by a select group of aviation safety professionals and airline pilots, considered the following as potential threats to safely conducting the instrument approach:

Aircraft Flight Path



D = distance from VOR/DME (nm) IF = intermediate fix

Source: Dan Gurney

Figure 1

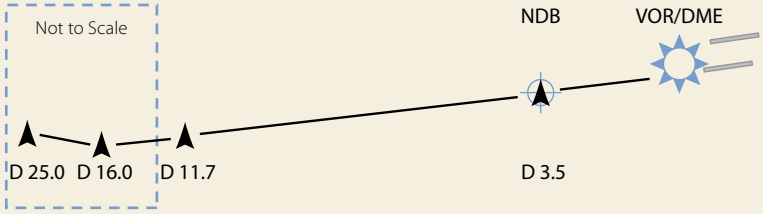
- The aircraft operator uses metric altimeter procedures. The approach chart includes a table for converting specific, pertinent altitudes from feet to meters, but the altitude/range table included on the chart shows altitudes only in feet. If the crew had not prepared their own altitude/range table, they would have had to mentally convert the range values to meters.
- The VOR/DME station is not colocated with the runway threshold; it is 0.2 nm (0.4 km) from the threshold. This would have added to the mental workload.
- The location of the FAF at 11.7 nm DME results in a long final descent.
- The approach procedure includes an initial approach fix at 25 nm DME and an intermediate fix at 16 nm DME. Both fixes are shown in a dotted box in the plan view of the approach procedure with a note that the ranges are not to scale (Figure 2); the initial approach fix and the intermediate fix are not shown in the profile view of the published approach procedure.

A likely explanation for the premature descent is that the crew mistook the intermediate fix for the FAF. The intermediate fix is 4.3 nm from the FAF.

The error might have resulted from a simple misinterpretation of the chart, incorrect programming of the flight management system (FMS) or misinterpretation of the waypoints programmed in the FMS or displayed by the electronic flight instrument system (EFIS).

After the premature descent was begun, the aircraft was flown below the usual flight path. Before reaching the nondirectional beacon (NDB) 3.5 nm from the VOR/DME station, the

Approach Plan View



D = distance from VOR/DME (nm)

Source: Dan Gurney

Figure 2

aircraft descended below 1,360 ft, the minimum altitude for crossing the NDB. (The aircraft did not descend below the minimum descent altitude, 470 ft.)

The following factors might have been involved in the continued flight below the expected flight path and in the premature descent below the NDB minimum crossing altitude:

- Altitude/range was not monitored during the descent.
- The airport or the runway threshold was not programmed as a "TO" waypoint in the FMS and/or was not displayed on the EFIS map.
- The NDB symbol displayed on the EFIS map was mistaken for the airport or the runway.

Lessons to Be Learned

Simple mistakes or misinterpretations of published approach procedures often occur. They must be identified by careful cross-checking and monitoring. Flight Safety Foundation research on approach and landing accidents and serious incidents has shown that crew resource management failures involving cross-checking and coordination are involved in nearly two-thirds of the events.[2]

It appears likely in this incident that both pilots made the same error in identifying the FAF. Standard operating procedures (SOPs) must guard against such occurrences by requiring two complete sets of charts in the cockpit and that the pilot flying and the pilot not flying (pilot monitoring) use the charts during the approach briefing. SOPs also must require the crew to cross-check that their understandings of the approach procedure agree.

During an approach briefing, most crews check that their chart dates agree, but how many cross-check that their understandings of the procedure agree?

The incident also suggests that special approach briefings, as well as stricter cross-checking and monitoring, may be required when nonstandard procedures such as metric altimeter procedures are used.

Flight crews should ensure that the airport or runway is displayed on the EFIS map before beginning a descent for the final segment of an approach. During descent, altitude/range checks should be conducted using a published table, a table prepared before flight or mental calculations, using 300 ft per nm for a three-degree glide path.

Moreover, one of the most important lessons to be learned from this incident is that *altitudes* should be the basis for altitude/range checks during descent. If the crew waits until crossing a specific fix or reaching a specific range, the aircraft might already have descended below the required check altitude, resulting in reduced terrain clearance. ●

[This series, which began in the July issue of *Aviation Safety World*, is adapted from the author's presentation, "Celebrating TAWS Saves, But Lessons Still to Be Learned," at the 2006 European Aviation Safety Seminar and the 2006 Corporate Aviation Safety Seminar.]

Dan Gurney served in the British Royal Air Force as a fighter pilot, instructor and experimental test pilot. He is a co-author of several research papers on all-weather landings. Gurney joined BAE Systems in 1980 and was involved in the development and production of the HS125 and BAe 146, and was the project test pilot for the Avro RJ. In 1998, he was appointed head of flight safety for BAE Systems. Gurney is a member of the FSF CFIT/ALAR Action Group, the FSF European Advisory Committee and the FSF steering team developing the "Operators Guide to Human Factors in Aviation."

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Notes

1. *Terrain awareness and warning system* (*TAWS*) is the term used by the International Civil Aviation Organization to describe ground-proximity warning system (GPWS) equipment that provides predictive terrain-hazard warnings; *enhanced GPWS* (*EGPWS*) and *ground collision avoidance system* (*GCAS*) are other terms used to describe TAWS equipment.
2. FSF Approach-and-landing Accident Reduction (ALAR) Task Force. "Killers in Aviation: FSF Task Force Presents Facts About Approach-and-landing and Controlled-flight-into-terrain Accidents." *Flight Safety Digest* Volume 17 (November–December 1998) and Volume 18 (January–February 1999).