A business jet was in clouds when the pilots initiated a steep descent, following a spurious navigation signal toward high terrain.

False Localizer Signal

BY MARK LACAGNINA

The flight crew initiated an emergency return to an Irish airport after the Gulfstream IV-SP's windshield cracked on takeoff in instrument meteorological conditions. The aircraft was outside the localizer coverage area when the crew armed the autopilot approach mode. As a result, the autopilot captured a false localizer signal. The crew then deviated from the instructions they had received from air traffic control (ATC) and initiated a rapid descent while tracking the false signal. The aircraft was 702 ft above the ground and headed toward the highest mountains in the country when the crew responded to warnings from ATC and from the on-board enhanced ground-proximity warning system (EGPWS).

After climbing — and experiencing further navigational difficulties — the crew landed the GIV. Neither the pilots nor their lone passenger was injured, but damage to the aircraft was substantial, not only from the cracked windshield but from foreign object damage to the no. 1 engine that likely occurred after the aircraft was landed.

In its final report, the Irish Air Accident Investigation Unit (AAIU) said that the probable cause of the serious incident — which occurred at (County) Kerry Airport (EIKY) in Killarney the morning of July 13, 2009 — was that "the crew suffered a serious loss of navigational and situational awareness while attempting to return to EIKY following a windshield fracture encountered shortly after takeoff." The report said that the following were contributing factors:

- "The crew made a number of rushed and inappropriate decisions during the flight, thus displaying poor crew resource management;
- "The first officer's lack of recent flying hours is likely to have contributed to his loss of navigational and situational awareness;
- "A false localizer signal was received due to the approach mode

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being armed while the aircraft was outside the specific localizer coverage sector;

- "The captain commenced a descent without having a valid ILS [instrument landing system] signal and without cross-checking other available navigational aids; [and,]
- "The situational awareness of the controller in Kerry Tower was compromised by erroneous position reports from the crew and noncompliance with his instructions, as well as a lack of direct radar information."

Trouble on Rotation

The GIV, built in 1999, was operated in the United States until it was registered by a private company in India in 2008. The crew for the incident flight, with an intended destination of London Luton Airport, comprised a contract pilot serving as captain and a company pilot serving as first officer.

The captain, 45, held a U.S. airline transport pilot certificate and an authorization by the Directorate General of Civil Aviation in India to fly GIVs. He had 12,500 flight hours, including 2,600 hours in Gulfstreams, with 1,027 hours in GIV-SPs.

The first officer, 38, held commercial certificates issued by India and by the United States. He had 3,200 flight hours, including 200 hours in GIVs.

The reported weather conditions at Kerry Airport included calm winds, 8,000 m (5 mi) visibility in rain, scattered clouds at 1,000 ft and a broken ceiling at 1,400 ft, and there was convective activity in the vicinity of the airport.

The windshield cracked shortly after the aircraft was rotated for takeoff from Runway 08 at 0806 local time. The captain, the pilot flying, told investigators that he then noticed abnormally high readings on the left-engine vibration monitor. He said that he momentarily retarded the left thrust lever to idle, in accordance with quick reference handbook guidance, and the indicated engine vibration level returned to normal. All other engine parameters also were normal.

The captain was initiating a right turn to a southeasterly heading, in compliance with the standard instrument departure procedure (SID), when the first officer radioed, "Sir, we have a cracked windshield. We're leveling off at three thousand. We'd like to come back to Kerry." The control tower at Kerry Airport was not equipped with radar, and the airport traffic controller asked for a position report. The first officer erroneously replied that the aircraft was 35 nm [65 km] southeast of the airport. The report said that he likely mistook the indicated distance to Cork, the next navigational fix on the SID, for the distance from Kerry. The GIV actually was about 10 nm [19 km] southeast of the airport (Figure 1, p. 18).

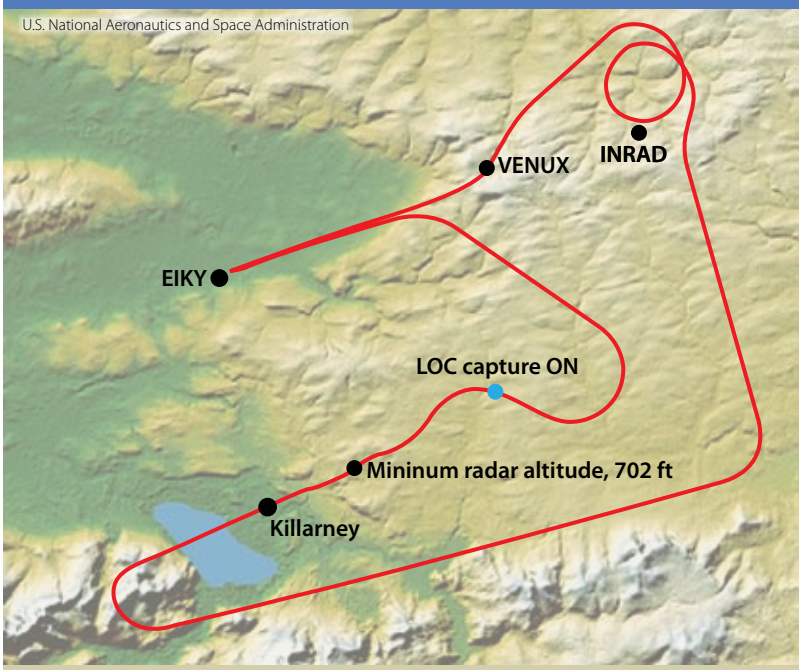
The controller asked the crew if they would prefer to navigate to INRAD, an intermediate fix for the ILS approach to Runway 26 — the only precision approach procedure available at the airport — or to navigate directly back to the airport and establish the aircraft outbound on the ILS. The first officer replied, "OK, confirm. Call you overhead at three thousand."

The first officer entered the airport waypoint in the flight management system (FMS), and the aircraft, which was being flown with the autopilot engaged, made a 180-degree turn and began to fly a northwesterly heading back to the airport.

Electrical arcing caused the GIV's windshield to crack on takeoff.

Irish Air Accident Investigation Unit

Flight Path

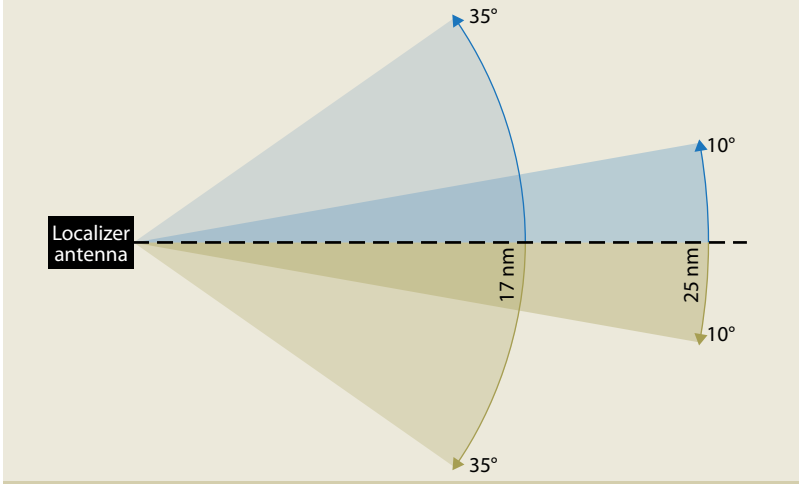


EIKY = Kerry Airport; LOC = localizer

Source: Irish Air Accident Investigation Unit

Figure 1

Localizer Coverage Area



Source: Irish Air Accident Investigation Unit, Susan Reed

Figure 2

At 0810, the controller again asked for a position report, and the first officer responded, "Ah, we're turning inbound now; one zero miles inbound." The controller asked him to confirm that the aircraft was inbound on the localizer, and the first officer said, "Turning back on the localizer now; one … correction, niner miles inbound now." The controller then cleared the crew to conduct the ILS approach.

Confusion Reigns

The autopilot, which was maintaining the selected altitude of 3,000 ft, commanded a left turn to a southwesterly heading after capturing the false localizer signal. The first officer announced that the course deviation indicators were "alive" and told the captain to begin a descent. The captain disengaged the autopilot and "commenced descent, in cloud on a track approximately parallel to the ILS but 6 nm [11 km] south of it," the report said.

The localizer coverage area, as specified by the International Civil Aviation Organization, extends to a maximum of 35 degrees of the localizer centerline (Figure 2). The aircraft was at an angle of 43 degrees from the centerline when it intercepted the false localizer signal. Such signals — also called "false courses" — are normal byproducts of ILS signal generation and are created at various angles outside the coverage area.[1] False localizer and glideslope signals also can be generated inside the coverage area during ILS maintenance and testing.

At 0812, the tower controller requested another position report. The first officer replied, "Coming up on the localizer, ah, seven DME" — that is, 7 nm [13 km] from distance measuring equipment located near the approach threshold of Runway 26.

The report said that the tower controller should have realized that the crew's position reports were inconsistent and inaccurate, and that they had deviated from his instructions. The controller later told investigators that he recognized the crew was under intense pressure and that he did not believe it was prudent to challenge them about their noncompliance with his instructions.

Both navigation displays were in the weather radar map mode. The report said that if at least one of the displays had been in the EGPWS map mode, the pilots might have realized that they were heading toward terrain rising above 3,000

ft. "It is fortunate that the descent was made over ground that was relatively low-lying in comparison to much of the terrain in the vicinity of EIKY," the report said.

'Climb Immediately'

Likely believing that he needed to capture the glideslope from above, the captain established a descent rate of 1,300 fpm and then called for the landing gear to be extended and the flaps to be extended 20 degrees.

At 0812, a Shannon Center radar controller, who was monitoring the flight but was not in radio communication with the crew, phoned the tower controller and told him that the GIV was about six miles south of the localizer at 1,600 ft. The radar controller said, "Climb him now, please."

The tower controller advised the crew of their position and said, "Climb immediately to 3,500 ft." About the same time, the EGPWS generated an alert that the GIV was at a radio altitude of 800 ft.

The aircraft was in a climb when the tower controller handed off the flight to a Shannon Center controller, who instructed the crew to climb to 5,000 ft and issued a heading of 090 degrees at 0815. About six minutes later, the controller issued a heading of 350 degrees, a vector toward the localizer course.

The first officer, who had flown only 1.4 hours in the preceding 28 days, had difficulty in programming the FMS for the ILS approach. He initially entered an approach to Runway 26 at London Luton.

At 0823, the Shannon controller told the crew to turn left, navigate directly to VENUX (the ILS final approach point), establish the aircraft inbound on the localizer and descend to 3,300 ft when ready. (The glideslope intercept altitude was 3,000 ft.)

"However, the aircraft did not turn left toward VENUX or descend but maintained the heading of 350 [degrees]," the report said. "As it passed through the localizer, it commenced a right turn onto a heading of 010 [degrees]. This was followed by a left-hand orbit to the north of the localizer."

At 0826, the crew reported that they were having problems with the FMS and requested clearance to maintain their current position. The controller cleared the crew to circle, provided the ILS approach frequency and offered radar vectors to the final approach course. The crew accepted the offer, flew the ILS approach and landed the aircraft at 0834.

Ground Runs

Later that morning, the crew taxied the aircraft to an unused taxiway and performed a ground run of the left engine that included a series of accelerations and decelerations. AAIU inspectors arrived at Kerry Airport the next day. Their initial examination of the aircraft revealed that the left engine, a Rolls-Royce Tay 611-8, had received severe foreign object damage and required replacement. "Many of the fan blades had V-shaped nicks in their leading edges while a boroscopic examination of the forward stages of the compressor showed significant blade damage," the report said.

The captain told investigators that the company's "senior management" had instructed him to perform the engine ground run to determine whether a ferry flight to a maintenance base was possible. The company "stated categorically" that no such instruction was issued, the report said.

The report said that the engine damage, which was exacerbated by the ground run, was not related to the windshield damage — the windshield had remained intact, and no fragments had been released. Laboratory analyses indicated that the left engine had ingested a round low-carbon-steel object with a diameter of about 25 mm (1 in) after the aircraft was landed.

The report said that, despite the captain's recollection of substantial engine vibration after lift-off, recorded flight data showed no significant vibration and that "the engine operated in a normal manner throughout the flight." The data, however, showed indications of compressor stalls shortly before the engine was shut down and later during the ground runs.

Investigators determined that the outer ply of the windshield had cracked because of electrical arcing between a heating system bus bar and the anti-icing film covering the inner surface of the outer ply. "The electrical arcing resulted when moisture ingress was absorbed by the interlayer and caused degradation of the bus bar at the bottom forward corner of the windshield," the report said.

Based on the findings of the investigation, the AAIU recommended that the Irish Aviation Authority (IAA) consider installing ATC radar equipment at Kerry Airport. The report noted that the IAA in November 2009 issued an aeronautical information circular warning pilots about the hazards of receiving false localizer signals outside the localizer coverage area.

This article is based on AAIU Synoptic Report No. 2010-012. The full report is available at <aaiu.ie/AAIUviewitem.asp?id=12639&lang=ENG&loc=1652>.

Note

1. FSF Editorial Staff. "Erroneous ILS Indications Pose Risk of Controlled Flight Into Terrain." *Flight Safety Digest* Volume 21 (July 2002).