SERIOUS INCIDENT

Aircraft Type and Registration:	Boeing 737-33A, G-CELC
No & Type of Engines:	2 CFM56-3B2 turbofan engines
Year of Manufacture:	1987
Date & Time (UTC):	7 February 2010 at 1154 hrs
Location:	On approach, Chambery Airport, France
Type of Flight:	Commercial Air Transport (Passenger)
Persons on Board:	Crew - 6 Passengers - 103
Injuries:	Crew - None Passengers - None
Nature of Damage:	None
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	43 years
Commander's Flying Experience:	3,446 hours (of which 2,696 were on type) Last 90 days - 94 hours Last 28 days - 33 hours
Information Source:	AAIB Field Investigation

Synopsis

The flight crew were carrying out an ILS approach to Chambery Airport, in IMC, with the autopilot engaged and the LOC (localiser) and VS (vertical speed) modes selected. The crew reported that they had observed some anomalies with the ILS and DME information before and during the approach. Final descent, at a high rate of descent, was initiated from an altitude of 5,000 ft, with the aircraft established on the localiser but two dots below the glideslope. At a range of 8.6 nm from the runway and at 1,125 ft agl, an EGPWS Mode 2 Terrain and Pull Up warning activated. The co-pilot had just initiated a go-around and the pitch attitude was increased to a maximum value of 32.7° nose up. The aircraft climbed clear of terrain, returned to the holding fix and a second approach was carried out successfully.

History of the flight

The flight departed from Leeds Bradford Airport on a service to Chambery Airport, France. The TAF for Chambery, available before departure, was:

> '070500Z 0706/0806 36008kt 9999 BKN024 OVC 033 BECMG 0710/0712 BKN033 TEMPO 0706/0715 360/15kt'

The co-pilot was designated as the Pilot Flying (PF) for the sector because, with a northerly wind forecast, a circling approach to Runway 36 might have been required and the right hand seat pilot would have been better placed to maintain a clear view of the runway.

En-route, the crew received Chambery's ATIS

information 'C', which reported a surface wind from 340° at 9 kt. The aircraft was directed by ATC to the VIRIE holding pattern and at 1148 hrs was cleared for the ILS to Runway 18 with a circling approach to Runway 36, which the commander acknowledged. (The approach chart is included at Figure 1.) At 1150 hrs, as the aircraft crossed over the VIRIE initial approach fix to start the approach, ATC advised the commander that the wind was from 360° at 7 kt and asked if he could accept a landing on Runway 18. The commander replied that he could if the wind remained the same. The aircraft was cleared to continue the approach.

The aircraft left the hold at VIRIE, in IMC, at an altitude of 6,500 ft, with the autopilot engaged, and proceeded in accordance with the published approach procedure. The commander selected the CY ILS (he previously had the CBY VOR beacon tuned for the earlier part of the procedure) and observed that it was indicating correctly. The FDR recorded a valid 13 DME CY (nm) signal. At a distance of 12 nm from the airfield, and level at an altitude of 5,000 ft, the aircraft captured the localiser in VOR/LOC mode and turned to track about one dot to the right of the localiser, before gradually adjusting towards the centreline. As the aircraft approached 11 DME CY (nm), the autopilot VS mode engaged and the aircraft started to descend at about 2,200 fpm (see Figure 2).

The commander noticed a loss of ILS information on his electronic attitude indicator (EADI) and looked across the flight deck to see if the co-pilot's ILS indications were still available. They appeared to be, so, trying to resolve the problem, he looked down at the AUTO/MAN selection switch for the navigation frequency, on his side of the aft electronic panel on the centre pedestal, to check that the ILS frequency was set correctly. He cycled the switch to ensure that it had properly engaged and his ILS indications then returned to view. ATC then contacted the aircraft with a frequency change instruction, which the commander acknowledged. However, before he checked in on the new frequency he noticed that the aircraft was below the glideslope and descending at a rate of more than 2,000 fpm.

The commander queried this with the co-pilot by saying "are you happy". The co-pilot responded that he was not and commenced a go-around. As he did so, an EGPWS Mode 2 TERRAIN TERRAIN, PULL UP warning activated and he increased the pitch angle to achieve a maximum rate of climb. The commander called "positive climb" and then selected the gear up in response to a call from the co-pilot.

The aircraft broke out of the cloud layer at an altitude of 6,000 ft with a pitch attitude in excess of 20° nose up and an airspeed of 110 kt. The co-pilot levelled the aircraft to accelerate and then continued the climb to FL90. During the climb, the aircraft's track was adjusted towards the CY NDB, a point of reference which the crew considered reliable, being uncertain of the aircraft's true position and the reliability of their other navigation systems.

The commander contacted ATC again and asked about the serviceability of the ILS. On being assured that it was serviceable the crew discussed their options and the commander decided on a second approach. That approach was completed successfully.

Airport information

Chambery Airport has an ILS installed on Runway 18, the glideslope for which is set at 4.45°. There are two published ILS approach procedures. One is a straight-in procedure, with descent from an altitude of 6,500 ft commencing at a range of 12.1 DME (nm). The second is via the VIRIE initial approach fix and CBY

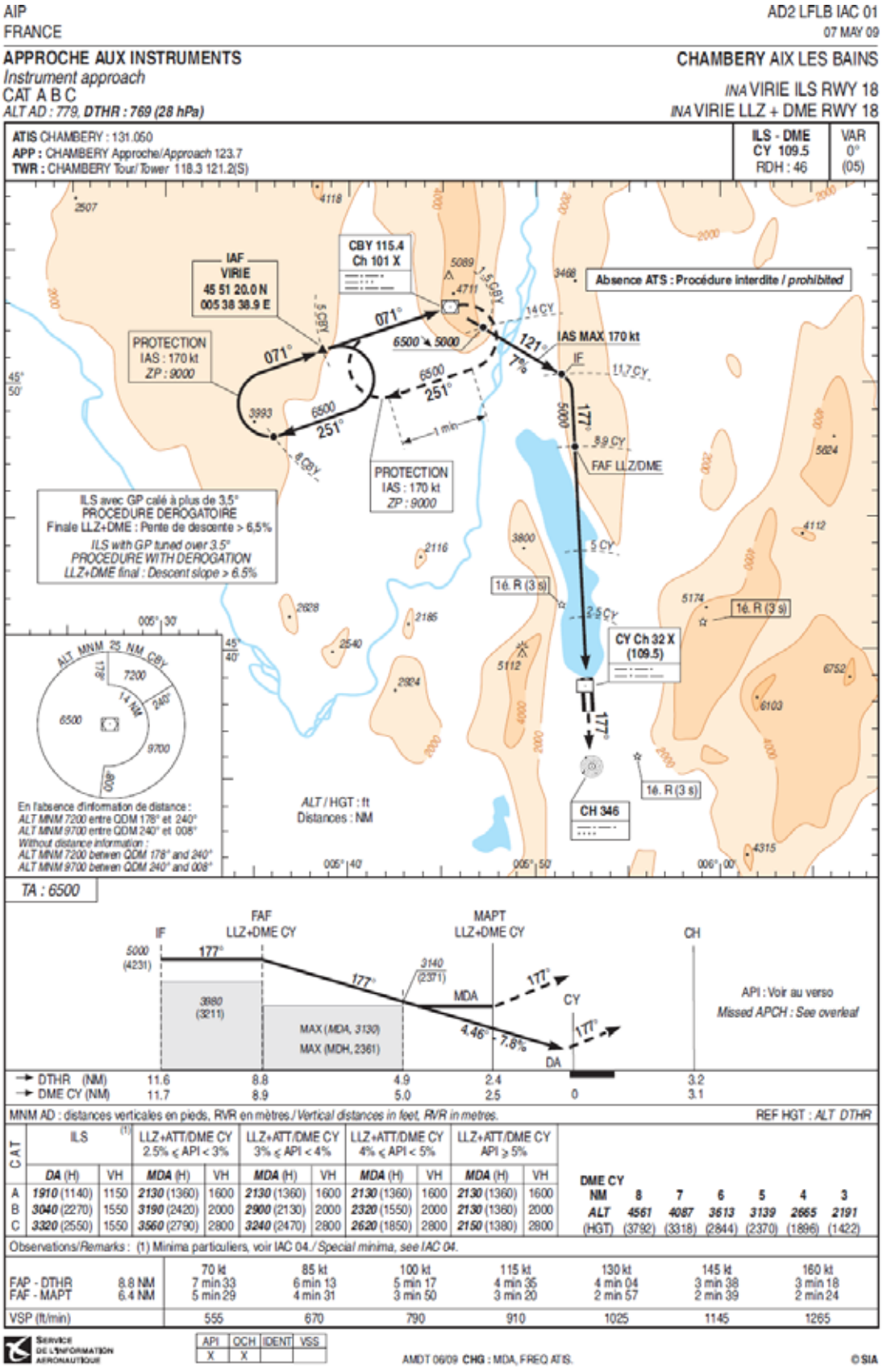

Figure 1

ILS RWY 18 approach via VIRIE

VOR beacon, with descent from an altitude of 5,000 ft commencing at 8.9 DME (nm). There is no instrument approach for Runway 36 but there is a circling procedure with prescribed flight tracks. The operator's circling minimum was 2,200 ft amsl or greater, according to the missed approach climb gradient. The airport is in a valley, with high terrain all around, and the final 8 nm of the ILS approach is over a lake. (See Figure 1.)

The most recent flight inspection of the ILS at Chambery Airport was conducted on 26 November 2009. The ILS was found to conform with the requirements for a Category 1 ILS. No reports were found concerning the serviceability of the ILS or the DME at Chambery.

The airport is designated Category C and there is a state requirement for commanders of commercial flights to receive special training from the operator before they are allowed to fly there. The commander had received this training four years earlier and since then had complied with the annual recency requirements. At the time of his initial training he had been a co-pilot; no further training was given when he was promoted to Captain. His most recent visit to the airport was on the day preceding the incident and the co-pilot's most recent visit was one week prior to the incident. The operator also provided its crews with a special brief for Chambery. The brief was comprehensive and included the following note:

> *'Beware of possible false glide-path indications. The glide path should not be used until within 12.1 DME "CY".'*

Aircraft information

The aircraft had a single Flight Management Computer (FMC) installation, without GPS, and an EGPWS with its own dedicated GPS. The EGPWS caution 'GLIDESLOPE', to alert the crew that the aircraft is more than 1.3 dots below the glideslope, is active below 1,000 ft agl and with the landing gear extended.

An ILS approach with the autopilot(s) engaged would usually be flown using the APP (approach) mode. However, when a circling approach is carried out following an ILS approach, the manufacturer recommends using the VOR/LOC and VS modes. The operator had adopted this as a Standard Operating Procedure. This method is used for two reasons. Firstly, in APP mode the Autopilot Flight Director System (AFDS):

> *'does not level aircraft at Mode Control Panel (MCP) altitude' and, secondly, 'exiting the APP mode requires either initiating a go-around or disconnecting the autopilot and turning off the flight directors.'*

The AUTO/MAN switch for the navigation frequency is located on the aft electronic panel on the centre pedestal. With the switch in AUTO the associated VHF navigation aid is selected by the FMC, and in MAN it is selected by rotating the manual frequency selector. The frequency is manually tuned to receive an ILS.

The autothrust go-around mode is armed when the aircraft descends below 2,000 ft agl.

The aircraft was inspected following the incident. No fault was found with the navigation system and none has been reported, to date, since the aircraft returned to service.

Recorded information

Recorded radar information and ATC communications at Chambery were available for the investigation. The

radar recording allowed the position of the aircraft to be determined accurately, whereas the Flight Data Recorder (FDR) information recorded the FMS position, which is susceptible to errors.

Flight recorders

The aircraft was equipped with a 25-hour duration FDR and a 120-minute Cockpit Voice Recorder (CVR). The FDR contained a complete record of the incident flight. However, the CVR record of the incident had been overwritten due to the aircraft being flown from Chambery to the UK before the CVR was removed. In addition to the flight recorders, the EGPWS computer was also downloaded. This provided thirty seconds of flight data, recorded during the aircraft's first approach to Chambery when an EGPWS Mode 2[1] warning was activated. Salient parameters from the FDR included the commander's ILS glideslope, localiser and DME indications. The DME parameter recorded by the FDR was recorded once every 64 seconds and the ILS parameters were recorded once every two seconds. The co-pilot's ILS and DME indications were not recorded by the FDR or the EGPWS.

The flight was uneventful until the latter stages of the first approach, as the aircraft was being positioned for a landing on Runway 18. The approach was being conducted with the autopilot engaged and 14 nm from the runway the flight crew commenced the first of two published step descents, from an altitude of 6,500 ft to 5,000 ft. Levelling at 5,000 ft, the aircraft closed the localiser from the right before making a gentle turn to intercept it – the autopilot ALT and VOR/LOC modes were selected.

Approaching a range of 11 nm, the autopilot VS mode was engaged. At this stage, the aircraft was about 850 ft below the glideslope. The aircraft started to descend at about 2,200 fpm (see Figure 2). About ten seconds later, the commander's localiser and glideslope signals were both briefly recorded as non computed data (NCD) – indicative that the raw data was no longer reliable or not available. Recorded at almost the same time, the DME indicated 10.5 nm, which was accurate. Due to the low recording frequency of the DME parameter, the reliability of the data in the seconds prior to the descent could not be established. As the aircraft descended, two further recordings were made of the commander's localiser and glideslope signals temporarily being NCD.

Approaching the airport from the north, the aircraft is required to overfly a ridge of high ground to the east of Lake Bourget. As the aircraft descended, the terrain closure rate progressively increased to about 6,000 fpm. When the terrain clearance reached 1,125 ft, the EGPWS Mode 2 warning was activated. Almost simultaneously, the autopilot was disconnected and a go-around was carried out (due to the recording rates, it could not be determined if the go-around had been initiated before the EGPWS warning). The minimum terrain clearance was 1,112 ft.

During the go-around, the rate of climb was stabilised at about 3,800 fpm. The maximum nose up pitch attitude was 32.7° (which occurred shortly after the EGPWS warning) and the minimum airspeed was 109 kt (when the aircraft was levelled, following the go-around).

During the subsequent approach and landing, no anomalies in the recorded ILS or DME data were observed.

Footnote

[1] An EGPWS Mode 2 warning is generated when an excessive closure rate with terrain is detected.

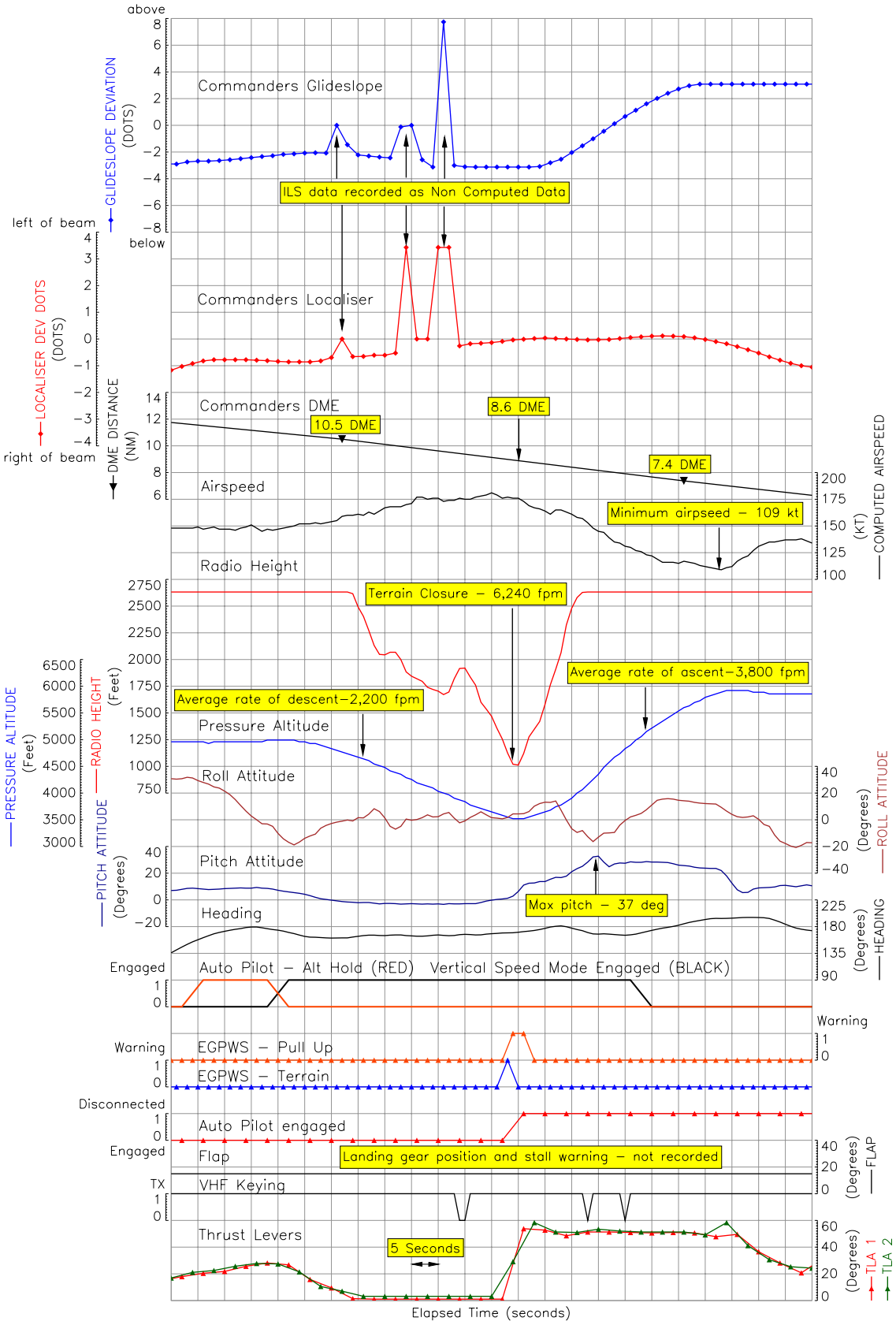

Figure 2

Recorded FDR data for the (first) ILS approach to Chambery Airport

Flight crew information

The co-pilot reported that the aircraft satisfactorily established on the localiser but that the DME was intermittent. The aircraft was configured with flap 15° and the landing gear extended, in anticipation of the final descent. He saw the glideslope pointer move rapidly down the scale and, in response, he engaged the VS mode and selected a rate of descent that he intended to be 1,200 fpm. He recollected hearing the commander say "its operating in the reverse sense" and took this to mean the localiser indication. To check the tracking he selected his expanded VOR/ILS display (the switch is located on the aft pedestal) and observed that the beam bar was displaced slightly to one side. The co-pilot commented that this action briefly distracted his attention from monitoring the descent profile.

The co-pilot caught a glimpse of a mountain ahead through a break in the cloud and noticed that the aircraft was well below the glideslope, with a rate of descent that was too high. He heard the commander say "are you happy" and, recognising that the flightpath differed from previous approaches, he disconnected the autopilot and commenced a manual go-around. He did not use the TOGA (takeoff go-around) switch because he thought the aircraft was above 2,000 ft agl and that it would not be available. When the co-pilot heard the EGPWS warning he increased the pitch attitude as much as possible. The aircraft climbed clear of cloud, at which point he flew level and accelerated before continuing the climb to FL90. He commented afterwards that the control column needed a strong push to recover the aircraft to a level attitude.

The commander reported that the final decision as to the landing runway was to be decided once visual contact had been established. He selected the ILS frequency when the aircraft was 1.5 DME (nm) outbound from the CBY VOR beacon and saw and announced that the localiser had been captured, although he noted that the aircraft was slow to establish on the centreline. He called out "12 DME with descent at 8.9", which was intended as a crosscheck and a reminder to the co-pilot about the descent point. After passing 11.7 DME from the airfield he noticed that the ILS indications on his EADI had disappeared. There was no DME indication and there were ILS fail flags on the standby Attitude Indicator. He checked across to the co-pilot's instruments where they still appeared to be available. He then checked and cycled the AUTO/MAN switch, after which his indications reappeared.

The commander recalled that his attention then returned to the flight instruments, where he saw that the aircraft was descending at a high rate and was below the glideslope. He questioned the situation with the co-pilot who, in response, initiated a go-around.

The commander reported that he had called "positive climb", in error, as a matter of habit. The manufacturer recommends that the configuration should not be changed during a terrain avoidance manoeuvre.

Analysis

There was no evidence of any signal interruption or failure of the CY ILS or DME at Chambery. A routine flight inspection two and a half months prior to the incident showed the ILS to be serviceable at that time and there had been no reports of any failures since then. The aircraft's navigational equipment was found to be serviceable when tested after the event. Thus, while an onboard or ground-based malfunction or interruption is possible, it would probably only have been of short duration.

The reason for the loss of the commander's localiser and glideslope signals could not be determined. However, the second and third recorded events of NCD during the descent were probably as a result of him cycling the AUTO/MAN switch.

Standard operating procedures are designed to assist with identifying and managing navigation interruptions and failures. On this occasion, the commander's attention was diverted for a short time while he resolved his ILS display problem and responded to a call from ATC. During this time, the co-pilot initiated a descent, at an excessive rate, before the aircraft had reached the final approach fix, possibly in response to a movement of the glideslope pointer. The commander remained unaware of the descent profile until his attention returned to monitoring the flightpath. At that point he questioned the situation with the co-pilot. The discrepancy was acknowledged between the pilots and the co-pilot initiated a go-around. As the EGPWS warning sounded, the co-pilot increased the pitch attitude to achieve a maximum rate of climb.

At its minimum height the aircraft was crossing a ridge of high ground. This gave rise to a very high terrain closure rate and generated the EGPWS warning. The terrain clearance was never less than 1,100 ft.

Safety action

After the incident the operator issued an Operating Staff Instruction to its flight crews which stated:

> *'In the case of Chambery, the final approach is not to be commenced unless both pilots are able to crosscheck both glide slope indication and DME distance appropriate to the approach plate in use.'*