

INCIDENT

Aircraft Type and Registration:	Boeing 767-200, N653US	
No & Type of Engines:	2 GE CF6-80 turbofan engines	
Year of Manufacture:	1990	
Date & Time (UTC):	6 November 2005 at 0745 hrs	
Location:	Final approach to Runway 26L, London (Gatwick) Airport	
Type of Flight:	Public Transport (Passenger)	
Persons on Board:	Crew -10	Passengers - 197
Injuries:	Crew - None	Passengers - None
Nature of Damage:	None	
Commander's Licence:	Airline Transport Pilot's Licence	
Commander's Flying Experience:	22,334 hours (of which 4,048 were on type) Last 90 days - 198 hours Last 28 days - 38 hours	
Information Source:	ATC report, operator's report, pilot's statements and flight data recorder	

Synopsis

The aircraft landing gear selection was delayed until the aircraft was at 500 ft agl, and the final landing flap was not fully deployed until a few seconds before touchdown. At 500 ft agl ATC asked the crew to confirm that the landing gear was down and requested that the aircraft should carry out a go-around if it was not.

History of flight

The aircraft was at the end of a scheduled flight from Philadelphia, USA, to London (Gatwick) Airport. The descent was conducted with the autopilot and autothrust engaged with the commander, acting as the handling pilot, in the left seat. The crew were given radar vectors by ATC to intercept the final approach course for the Runway 26L ILS approach. As the aircraft descended

through 750 ft agl the autopilot and then the autothrust were disconnected. The first officer (FO) selected the landing gear down at around 500 ft agl and once it was locked down, landing flap (flap 30°) was selected.

The tower controller saw the aircraft on short final approach and noticed that the landing gear was not down. He contacted the aircraft to advise the crew and gave an instruction that if the gear was not down they should go around. The crew replied that the gear was down and the controller then issued a landing clearance. The flap reached 30° shortly before touchdown and an uneventful landing was carried out.

Recorded flight data

A recording of the transmissions between the ATC tower controller and the aircraft was available for the investigation. The cockpit voice recorder information was not recovered, since it would have been overwritten during subsequent flights.

The flight data recorder was downloaded by the operator and data for the flight was recovered. A plot of selected parameters is included at Figure 1 and an expanded plot incorporating ATC recordings is provided at Figure 2. The significant parameters in the sequence of events are listed below:

- Flap 20 selected at 2,900 ft amsl
- Localiser established at 2,000 ft amsl
- Glideslope established and followed from 2,000 ft amsl
- At 740 ft agl autopilot disconnected
- At 711 ft agl autothrust disconnected
- At approximately 500 ft agl, gear lever moved down (this occurred between 2 and 4 seconds before ATC queried the gear position)
- At 420 ft agl, whilst gear doors were open and gear position disagreed with gear lever position, N653US crew responded to ATC confirming three greens
- At 229 ft agl, GPWS alert began
- Between 225 ft agl and 175 ft agl crew confirmed three gear down and locked. During this transmission the gear doors closed and gear position agreed with lever position (gear down)
- At 170 ft agl, flaps began to extend past 20°

- 5 seconds later at 90 ft agl flaps moved through 25° and GPWS alert stopped
- 7 seconds later, at 16 ft agl, flaps reached 29.7 deg (stopped)
- 9 seconds later, aircraft touched down

The recorded flight data indicated that there was a GPWS mode 4b alert active for a period of eleven seconds.

Meteorological conditions

The METAR at Gatwick, issued 25 minutes before the aircraft landed, contained the following information:

Surface wind from 190° at 11 kt, varying between 150 and 240°, visibility 10 km or greater, light rain, scattered cloud at 900 ft, and at 1,400 ft, broken cloud at 2,000 ft, temperature 13°C, dewpoint 11°C and pressure 1016 mb.

Crew reports

There were three crew members on the flight deck for the descent and approach. The commander was the pilot flying (PF), the FO was the pilot not flying (PNF) seated in the right seat, and the in-flight relief officer (IRO) occupied the jump seat. The pilots were each interviewed by the operator two weeks after the event.

The commander recollected having briefed the crew for a visual approach to Runway 26. He recalled that he had disconnected the autopilot and flown manually from around 10,000 ft. He remembered that at some stage ATC had asked for speed control on approach. Then, descending through 1,000 ft with the flap set at 20° he had called “GEAR DOWN AND LANDING CHECKLIST”, but the FO had apparently missed the call. He then called for flap 30° but the FO pointed out to him that the gear was not down. The commander

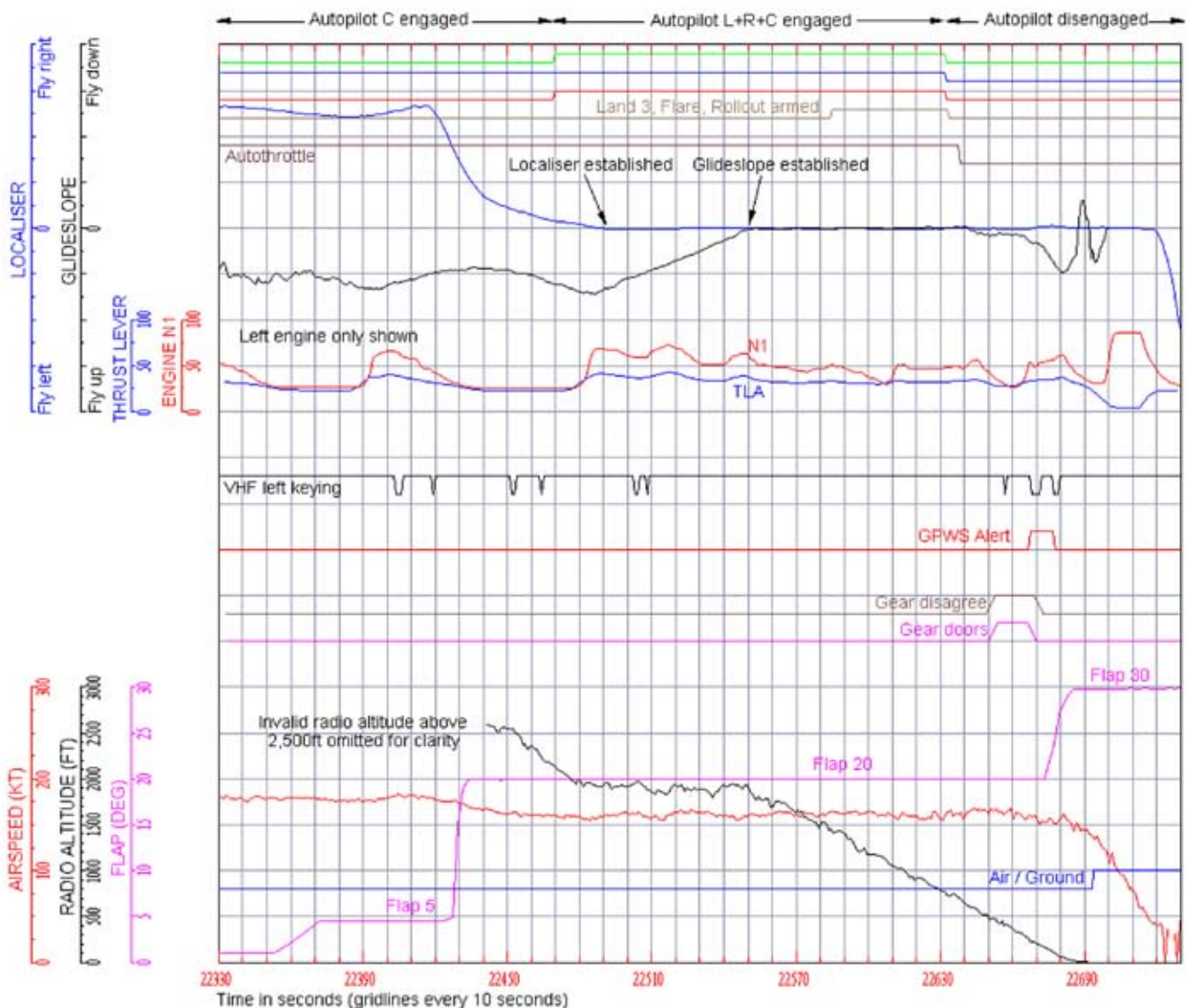


Figure 1

Selected parameters

asked again for the gear down and landing checklist. He remembered that ATC had contacted the aircraft during the approach and advised that there was no landing gear. He did not recollect hearing any warnings from the GPWS.

The FO remembered that as soon as he had put the gear handle down the tower had called to question the gear position. At that point two of the three green lights were on. When all three were green he confirmed to

the tower that the gear was down. He believed that this had all been completed by 500 ft agl. He remembered that the tower had advised that if the gear was not down the aircraft should go-around. The FO thought that there may have been a momentary gear warning from the GPWS.

The IRO had been making an operational radio call to the ground handling agent during the first part of the approach. When he turned his attention back to the

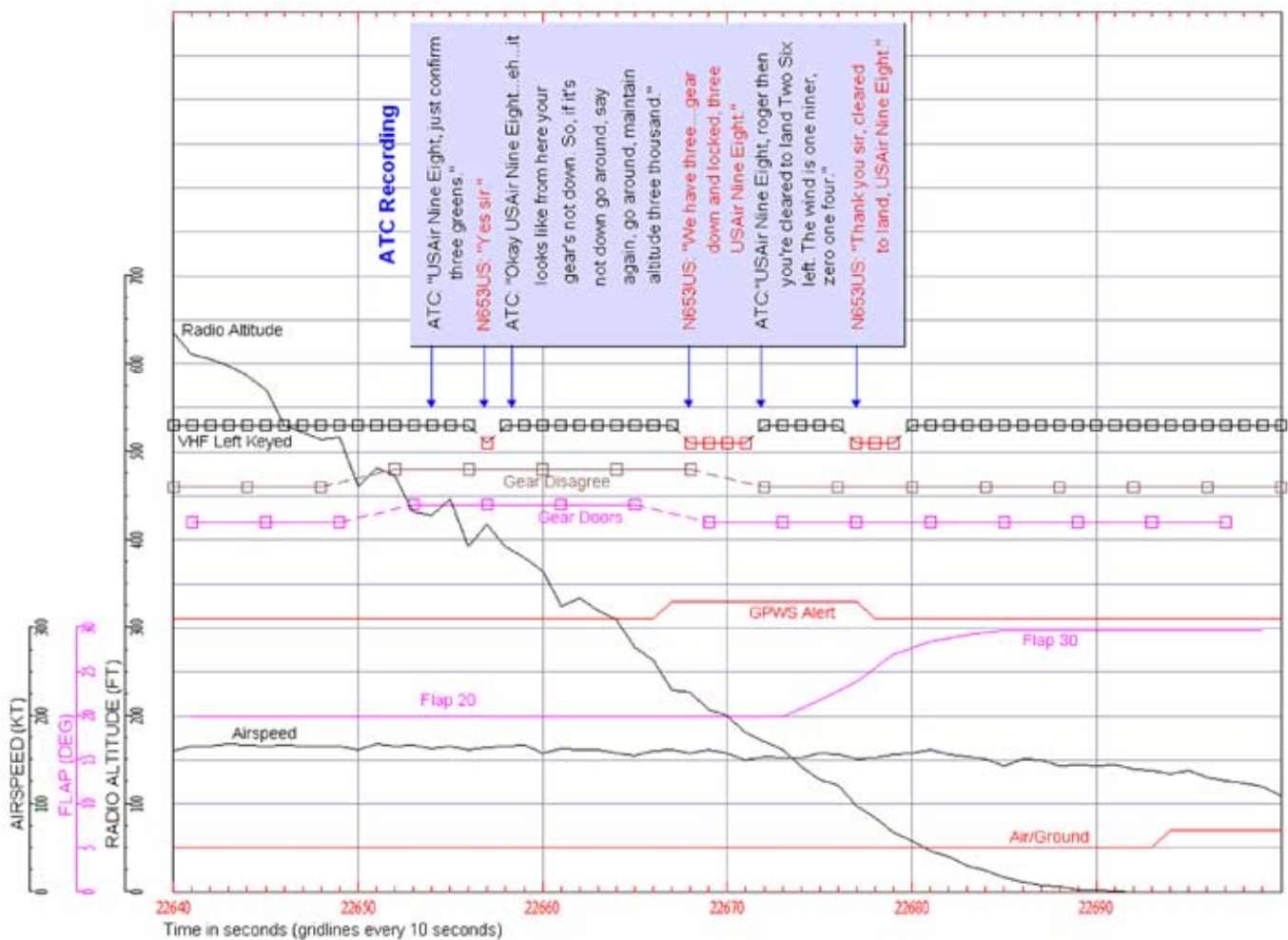


Figure 2

Expanded plot incorporating ATC recordings

approach he believed that the aircraft was intercepting the glideslope at around 1,000 ft. He thought he heard a 'TOO LOW FLAPS' and a 'TOO LOW GEAR' alert from the GPWS.

Operator information

The Flight Operations Manual (FOM) contains criteria to be observed for a stabilised approach and pilots are required to carry out a missed approach if these are not met. The FOM criteria were as follows:

'Flight parameters. Below 1,000 feet AFE¹, the aircraft is

- *on a proper flightpath (visual or electronic) with only small changes in pitch and heading required to maintain that path,*
- *at a speed no less than V_{ref} and not greater than $V_{ref} + 20$ allowing for transitory conditions, with engines spooled up,*
- *in trim, and*
- *in an approved landing configuration.*

Footnote

¹ Above field elevation

<i>at or below 1,000 ft. AFE</i>	<i>IMC</i>	<i>the first pilot recognizing unstable condition calls “unstabilized” and the PF performs the go around.</i>
	<i>VMC</i>	<i>compliance with the flight parameters shown above (not rate of descent) may be delayed until 500 ft. AFE as long as the deviation is verbalized (e.g., “slightly high correcting”, etc.).</i>

Analysis

A significant period of time elapsed before the crew were interviewed about the event, so it is understandable that their recollections were not accurate. The commander's recollection of events differed from what was recorded on the ATC tapes and the flight data recorder, in particular his recollections of his non-use of the autopilot and the stage by which the aircraft was fully configured for landing.

The approach until the point of glideslope intercept had apparently been normal and was flown with the autopilot and autothrust engaged. The company procedures required the aircraft to be configured for landing by 1,000 ft aal (or 500 ft agl in VMC and with a verbal recognition of the aircraft status), normal practice would be to select the gear down at or soon after the glideslope intercept at 2,000 ft amsl. There was no evidence of any external distraction or operational reason why this action was not completed at that time, and why the commander delayed his request for the gear until 1,000 ft was not explained. By asking for a selection at 1,000 ft, relatively late on the approach, there was little opportunity for any error/inaction to be corrected. The commander disconnected the autopilot at 740 ft agl to fly the aircraft manually which may then have distracted him from noticing that the gear was not down. The aircraft was not stabilised by 500 ft and at this point one of the crew should have called for a go-around. Once the gear was down, 30° landing flap was selected but, because of

the time it takes to travel, it was not fully deployed until the aircraft was just above the ground. One purpose of a stabilised approach is that all the pre-landing actions are completed in good time thereby allowing crew members to focus on the landing task. This was not achieved on this occasion.

On the Boeing 767 aircraft the GPWS Mode 4a and 4b 'gear not down' discrete is based on the position of the landing gear lever. The landing gear lever was selected down as the aircraft descended through 500 ft Radio Altitude¹ (RA), thus the 'TOO LOW GEAR' part of the mode became inactive, regardless of the actual gear position. The flight data recorder showed that a GPWS Mode 4b alert was active for a period of eleven seconds, between 229 ft and 90 ft agl. During this time the aircraft was within the Mode 4b envelope but, because it was close to the internal boundaries related to airspeed, the exact audio callouts made in the flight deck were not definitely determined. The Mode 4b alerts would have been either one or both of "TOO LOW FLAP" and "TOO LOW TERRAIN".

It is of interest to compare the different recollections of each crew member with respect to the GPWS alerts. Typically a crew member who is busy and occupied with flying or other tasks may not necessarily hear an alert, but one who is not so absorbed will do so. In this instance there was a gradient from the commander, who

Footnote

¹ 500 ft RA is the height below which the Mode 4a 'TOO LOW GEAR' alert would activate

was particularly busy as he had just disconnected the autopilot, and who did not hear any alert, through to the IRO, the observing pilot, who heard two distinct calls. This demonstrates how important it is that that all crew members should respond to an alert and not to assume that it has been heard by another pilot.

The aircraft was configured for landing at a late stage of the approach, outside the operator's stabilised approach criteria, and this resulted in the final landing configuration being achieved only seconds before touchdown. The tower controller became concerned about the safety of the aircraft when the crew confirmed that the gear was down but he could see that it was not. He suggested that they should carry out a go-around if it was not down. He

had made contact with the aircraft in time for corrective action to be taken, although in fact his intervention was unnecessary as the crew had already initiated the gear extension.

The reason for the late configuration of the aircraft was not determined but the safety net of stabilised approach criteria requiring a mandatory go-around was not effective. A GPWS alert was similarly ineffective in that it was either not heard or not responded to by crew members. Furthermore the crew could have been alerted by the concern demonstrated by the controller and his suggestion that the aircraft should go-around. Although a safe landing was made, established safety margins were compromised.