AAIB Bulletin No: 7/2005 **Ref: EW/C2004/12/03** **Category: 1.1**

INCIDENT

Aircraft Type and Registration:	Boeing 747-2D7B, N523MC
No & Type of Engines:	4 General Electric CF6-50 turbofan engines
Year of Manufacture:	1979
Date & Time (UTC):	12 December 2004 at 1611 hrs
Location:	On approach to Runway 05 at London Stansted Airport, Essex
Type of Flight:	Public Transport (Cargo)
Persons on Board:	Crew - 3 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	None
Commander's Licence:	FAA Airline Transport Pilot Certificate
Commander's Age:	56 years
Commander's Flying Experience:	Approximately 14,000 hours (of which 6,000 were on type) Last 90 days - 196 hours Last 28 days - 66 hours
Information Source:	AAIB Field Investigation and operating company report

Synopsis

The incident occurred when the crew became involved with an apparent unserviceability, which resulted in no-one in the cockpit monitoring the flight path of the aircraft during an ILS approach. The aircraft broke cloud at 900 feet amsl just over 6 nm from the threshold. The commander then disconnected the autopilots and manually flew the aircraft to acquire the proper glideslope. Subsequent to the incident, the crew did not report the incident to the airport authority nor to their company. The incident and subsequent lack of proper reporting procedures by the crew indicated a serious breakdown in crew effectiveness.

History of the flight

The aircraft, with three crew members on board, departed Chicago International Airport at 0909 hrs for a flight to London Stansted International Airport. Departure had been delayed more than three

hours due to loading problems. There were some minor unserviceabilities noted in the Technical Log but the crew considered that the aircraft was fully serviceable during the transit.

As the handling pilot in the left cockpit seat, the commander briefed for a practice Category II approach and automatic landing on Runway 05 at Stansted. By 1600 hrs, the aircraft was at Flight Level 75 and overhead Barkway (BKY) VOR/DME. Then, following instructions from Essex Radar on frequency 126.95 MHz, the commander established the aircraft on a heading of 050ºM from BKY and commenced a descent to 6,000 feet on the QNH of 1027 mb; he was controlling the aircraft with autopilot 'A' selected. Over the next few minutes, the aircraft was given further instructions by ATC and, by 1605 hrs it was at 3,000 feet amsl and heading 180ºM. Then, at 1607 hrs, the ATC controller apologised for a late turn and instructed the aircraft to turn left onto 020ºM and to report established on the ILS. While the aircraft was still in the turn, the controller cleared the aircraft to "DESCEND TO 2,000 FEET AND FURTHER WITH THE ILS"; this instruction was correctly acknowledged by the crew of N523MC. At 1609 hrs, the crew reported that they were "ESTABLISHED ON LOCALISER FOR 5". The controller again apologised for the late turn, cleared the aircraft to descend on the ILS and instructed the crew to call 'Stansted Tower' on frequency 123.8 MHz. After acknowledging this instruction, the crew then checked in with 'Stansted Tower' and reported "ON ILS 5". The controller acknowledged with "CONTINUE AS NUMBER ONE WITH ONE AIRCRAFT DEPARTING AHEAD". At 1610 hrs, the controller cleared the aircraft to land. After landing, N523MC cleared the runway using the normal rapid exit taxiway.

Within the aircraft, the commander had configured with Flap 20 and with the gear still retracted for the descent from 3,000 to 2,000 feet amsl. By this time, both autopilots had been selected. During the descent, the co-pilot noted 'flags' on his instruments indicating that the localiser and glideslope were not being received. The commander had indications from his instruments that they were established on the localiser and all three crew members then discussed the problem and attempted to identify the cause. Shortly afterwards the aircraft broke cloud at approximately 900 feet amsl. With the ground and PAPIs in visual contact, the commander immediately disconnected the autopilots and levelled the aircraft. He maintained the aircraft on the localiser and entered a gentle climb to intercept the normal glideslope from below. The crew completed the normal pre-landing checks and made an uneventful landing.

After shutdown, entries were made in the aircraft's Technical Log. These included a statement that the autoland was unsuccessful and that the co-pilot's 'G/S and LOC' flags were in view until 800 feet on the approach. Ground engineers carried out a BITE check in accordance with the maintenance manual but were unable to replicate the fault. The aircraft was cleared for flight with a request for airborne reports on the next sector.

The commander did not submit any reports about the incident. The co-pilot reported the incident using both the confidential 'National Aeronautics and Space Administration (NASA) Aviation Safety Reporting System' and the confidential 'Aviation Safety Action Program (ASAP)'. The flight engineer submitted a 'NASA' report. The airport authority had no indication of the occurrence until a number of noise complaints resulted in an examination of the radar recording. Subsequently, the AAIB were advised of the incident by the airport authority on 15 December and initiated an investigation the same day. The aircraft operating company also initiated an internal inquiry, in collaboration with the Federal Aviation Administration (FAA) and the National Transportation Safety Board (NTSB), and provided full support to the AAIB investigation.

Weather information

The Terminal Aerodrome Forecast (TAF) at Stansted on 12 December from 1300 to 2200 hrs indicated the following conditions: Surface wind 100º/08 kt, visibility 8,000 metres and cloud broken at 600 feet agl; temporarily throughout the period visibility could reduce to 4,000 metres and the broken cloud base could reduce to 400 feet agl; there was also a 40% chance of a temporary reduction between 1800 and 2200 hrs of 400 metres visibility in fog and a cloud base of less than 100 feet agl.

The actual weather at Stansted at 1550 hrs was as follows: Surface wind 100º/9 kt, visibility of 8,000 metres, cloud scattered at 700 feet agl and broken at 900 feet agl. At 1620 hrs, the surface wind was reported as 100º/8 kt, the visibility was 8,000 metres, cloud was scattered at 800 feet agl and broken at 900 feet agl. The QNH was steady at 1027 Mb.

ATC information

Examination of the ATC radio recordings show that all appropriate clearances were correctly acknowledged and there was no indication of any confusion between the controllers and crew.

The 'Tower' controller at Stansted had both landing and departing aircraft on frequency. On initial check-in by the crew of N523MC, she recalled that she looked at the aircraft label on her radar display and noted the displayed altitude as not being unusual; thereafter, she could not recall looking at the altitude information. As a 'Tower' controller, her priorities were visually to monitor the movement of departing and landing aircraft. She obtained visual contact with N523MC at about 3 nm from touchdown.

Stansted Tower, in common with other UK major airports is equipped with an Approach Monitoring Aid (AMA). This system monitors the lateral position of aircraft on approach relative to the runway

centre-line and activates audible and visual alarms if the aircraft goes outside certain parameters within a range of 4 nm from touchdown. The system does not monitor vertical deviation.

Controllers at Essex Radar have an instruction within the Manual of Air Traffic Services (MATS) Part 2 to monitor the altitude of aircraft on approach to Stansted Airport after they have been transferred to 'Tower'. The controller omitted to do so in the incident involving N523MC; at the time, he assessed his work load as low to medium.

The crew of N523MC were using current Jeppesen approach charts. The relevant approach chart for Runway 05 shows the Final Approach Fix at 6.6 DME, based on the ILS, at an altitude of 2,500 feet amsl; the runway elevation is 324 feet. Enquiries with Stansted controllers indicate that it is not unusual for aircraft to be vectored towards the ILS at 2,000 feet amsl.

Recorded information

Due to the late notification of the incident, both the Cockpit Voice Recorder (CVR) and the Flight Data Recorder (FDR) had overrun and so no relevant information was available.

The radar recording, based on Stansted Radar was evaluated by the AAIB. This indicated that the descent from 3,000 feet amsl was at an average descent angle of 5.4º. The rate of descent was fairly constant at 1,570 feet per minute until the level off at approximately 900 feet amsl; Stansted Airfield elevation is 348 feet amsl. Figure 1 shows the recorded descent path of the aircraft relative to the normal glideslope together with the range from touchdown and the ground elevation.

Ground Proximity Warning System (GPWS) evaluation

The aircraft was equipped with a Honeywell Mk VII GPWS. The crew reported that the GPWS had not activated during the incident. The crew actions effectively pre-empted any GPWS warning. An evaluation by the AAIB indicated that, if the crew had not taken remedial action, the first warning (Mode 4 alert: "Too Low Gear") by the GPWS would have activated within a further 6 to 10 seconds.

Crew information

When the operating company initially became aware of the incident, the commander was immediately recalled to the USA. The other two crew members continued one further sector under the command of a company check pilot but, once the serious nature of the incident was realised, they were also recalled to the USA. All three crew members were individually interviewed on 20 December 2004. The interviews revealed the following information:

1. Both the commander and flight engineer had been off-duty for six and five days respectively before positioning to Chicago on 11 December, arriving at 1611 hrs. The co-pilot had been on simulator duties on 10 December and positioned to Chicago on 11 December, arriving there at 1859 hrs. On 12 December 2004, the crew were woken at 0330 hrs (2130 hrs local) for an on-duty time of 0430 hrs based on a planned departure of 0600 hrs.

2. Pre-flight checks were normal including a successful check of the GPWS and its associated radar altimeter.

3. An aircraft requirement for a Category II autoland evaluation was due shortly and the commander decided to carry one out at Stansted. The crew agreed that some briefing was completed but that individual crew duties were not reviewed. The radar altimeters were 'bugged' at 107 feet. ATC were not informed of the intention to complete an autoland.

4. The flight engineer was facing forward during the approach and the ILS was correctly identified.

5. The crew could not all positively recall that the aircraft was cleared to 2,000 feet during the final turn. The commander stated that he had selected 500 feet per minute vertical speed for this descent and had selected the cleared altitude on the Mode Control Panel (MCP).

6. The commander thought that the standard company calls had been made regarding the localiser interception and altitude checks. The co-pilot had no recollection of any altitude calls being made and the flight engineer could not be certain either way. The crew considered that the localiser capture was smooth.

7. The commander and co-pilot confirmed that both autopilots were engaged and that 'LAND' was selected. No-one recalled hearing any altitude alert sound after the descent from 3,000 feet.

8. All three crew members recalled seeing warning flags on the co-pilot's instruments when the aircraft was established on the localiser and between 3,000 and 2,500 feet. During the crew interviews, there were some differences in recollection as to which flags were in view.

9. All three crew members confirmed that they were all involved in troubleshooting the problem.

10. The commander stated that he disconnected both auto-pilots, added power and levelled off immediately he became visual with the ground at about 900 feet altitude.

11. The aircraft was configured with Flap 20, but with gear still retracted, at localiser capture and the configuration was unchanged at the time the commander levelled the aircraft below cloud.

12. When level, the commander was visual with the runway PAPIs and felt comfortable continuing with the approach. He was also reluctant to re-enter cloud because of the flag indications. All crew members considered that they subsequently remained visual with the runway although the aircraft may have climbed slightly.

13. At about 3 nm range, the ILS glideslope was captured and the 'G/S' and 'LOC' flags on the co-pilot's instruments retracted at about 800 feet altitude.

14. The gear was selected down and landing checks completed at between 3 and 5 nm range from touchdown.

15. The subsequent landing was uneventful.

16. During the last 10 minutes of flight, all crew members considered that the atmosphere on the flight deck was normal although the commander considered that he was tired.

17. The commander completed the Technical Log after landing and wrote that the autoland was unsuccessful and that the co-pilot's 'G/S' and 'LOC' flags were visible until 800 feet altitude.

Company information

The company operates 10 'classic' Boeing 747s (models earlier than the 747-400). Within this total, there are differences in equipment and therefore operating procedures; these differences are detailed in the company Flight Hand Book (FHB) 20.06.1. Because of this variety, it is a company requirement for the commander to brief the crew on the differences prior to the first of any series of flights. The crew could not recall completing this briefing before the flight from Chicago. However, one of the company simulators is based on the same standard as N523MC and all the crew members had completed their most recent simulator flights on that model. The crew was also required to operate in accordance with the company Flight Operations Manual (FOM). The following is a selection of relevant instructions and information from the FHB and FOM:

1. '*The priority is to fly the aircraft when an emergency or abnormal condition arises.*' Reference FHB 3.01.2.

2. *'A stabilised approach must be established before descending below 1,000 feet above the airport touchdown zone elevation (TDZE) during an instrument approach or*

a go-around is required. A stabilised approach is defined as being in an approved landing configuration, on the proper flight path, at approach speed with engines spooled-up.' Reference FOM 6.8.4 and FHB 2.19.3.

3. The standard call outs and commands are detailed in FHB 2.01.1 through to FHB 2.01.4.

4. *'For a Category II autoland, both ILS Glideslope and Localiser must be operating.'* Reference FHB 4.01.7.

5. *'Below 800 feet above TDZE, any failure requires an immediate go-around.'* Reference FHB 2.19.19.

6. On N523MC, the Altitude Mode switch will trip to 'OFF' as the glideslope is captured when in 'ILS' or 'Land' mode. Reference FHB 22.01.06.

7. Flight Crew Reports are required to be submitted if there has been a '*significant deviation from normal operating practice, whether caused by mechanical systems, weather or personnel'.* Reference FOM 2.2.3.

Company records indicate that no fault was identified with the aircraft systems and, following the incident a Category II autoland was successfully completed on 17 December 2004. Between the incident and the autoland, no rectification was carried out on N523MC.

The crew and aircraft were operating on behalf of a UK airline and the crew were therefore subject to the appropriate UK Flight Time Limitations which were stipulated in the company's FOM. With an on-duty time of 2230 hrs local, the crew were restricted to a maximum Flight Duty Period (FDP) of 10¼ hours. The commander had the authority to extend this FDP by up to 3 hours for a single sector duty. The total duty in the incident involving N523MC was just under 12 hours. The UK Flight Time Limitations are more stringent than those established by the FAA.

The three crew members had previously flown together. All three had complied with the company qualifications and recurrent training required by the FOM and the company 'Training Program Manual'.

Discussion

The crew were approaching the end of an uneventful flight in a serviceable aircraft. The flight had been subject to a three hour delay before departure, which resulted in the crew operating for longer

than the normal maximum FDP. However, the extension was within the authority of the commander. Although the commander was tired, all the crew considered that they were operating normally.

As the handling pilot, the commander had decided that he would complete a practice Category II autoland. For an experienced crew, this would not be an unusual event and the approach was briefed, although not specifically covering individual duties. Additionally, the crew omitted to notify ATC that they would be carrying out an autoland. This omission had no effect on the incident as there were no aircraft or vehicles within the ILS protected area during the approach.

The initial approach was uneventful except that the final turn to intercept the localiser was late. This did not appear to be of concern to the crew and the controller's apology was readily accepted. During this final turn, the aircraft was cleared to descend from 3,000 to 2,000 feet and further with the ILS. During subsequent crew interviews, there appeared to be some confusion about the cleared altitude but, at the time the crew correctly acknowledged the clearance. At this point, the aircraft was configured with gear up and Flap 20 and the normal procedure would be for the handling pilot to select the cleared altitude and then 'ALT SEL' on the MCP. The commander recalled that he controlled the descent using vertical speed at 500 feet per minute. However, as indicated on Figure 1, the rate of descent was fairly constant at 1,570 feet per minute. Furthermore, there was no indication of any change in rate of descent as the aircraft approached its cleared altitude of 2,000 feet. This meant that the cleared altitude had either not been selected or had deselected early in the descent, possibly due to a technical unserviceability or at an apparent glideslope capture. After the incident, no faults were identified with the ground or aircraft systems. The lack of FDR and CVR information meant that this apparent anomaly could not be resolved. Nevertheless, the primary role of the crew was to monitor the aircraft manoeuvres to ensure that it remained on the required flight path. At about this time, the crew became aware of flags on the co-pilot's instruments indicating a failure to display the ILS. This appeared to be a trigger for all three crew members to start troubleshooting the problem. The result was that no-one was actively controlling or monitoring the aircraft. This was a clear breakdown in crew effectiveness. While the commander has overall responsibility for the safety of any flight, the other crew members also have a responsibility to ensure that safety is not compromised. Once the crew became distracted, the situation was reliant on safety back-up systems to recognise the potential danger.

It was the commander who first recognised the danger as the aircraft broke cloud at 900 feet altitude and he immediately resumed positive control of the aircraft. In addition to active crew monitoring, back-up systems, which may also have identified the potential danger, were aircraft systems (GPWS) and monitoring by ATC. ATC was evaluated to see what safeguards were in place. There was a requirement for the radar controller to monitor the altitude of the aircraft even after it had been transferred to 'Tower' and the controller omitted to carry out this task. Following the incident,

London Control issued a Supplementary Instruction, SI 21/05 TC, which clarified the responsibilities of controllers with regard to radar monitoring of aircraft on ILS approaches. The 'Tower' controller had no specific requirement to monitor the altitude of aircraft on approach and her primary responsibilities were runway occupancy of both departing and landing aircraft

Following the recovery of the aircraft from the descent, the commander decided to continue his approach with the PAPIs in sight. In accordance with company regulations, the approach should have been discontinued since the aircraft was neither stabilised on approach nor configured for landing. The commander's decision was based on his visual acquisition of the PAPIs, and the unresolved instrument problem, which made him reluctant to climb back into cloud. The glideslope was captured at about three miles range and with normal landing configuration achieved, the commander made an uneventful landing.

Following such an incident, the crew had a clear duty to report it to their company. The commander decided not to do so but the other two crew members did report the incident but as individuals and in different ways. The result was that the reporting was late and the airport authority was not aware of the incident until it was brought to their attention by other means. The lack of reporting was another indication of a breakdown in crew effectiveness. The normal procedure should have been to discuss the incident as a crew and report the incident to the airport and to their company.

Subsequent company action

Following notification of the incident, the aircraft operator instituted a full investigation in collaboration with the FAA and NTSB. Full assistance was provided to the AAIB.

The company procedures were clear and comprehensive, both in cockpit duties and for incident reporting. The investigation concluded that there was a serious breakdown in crew procedures during N523MC's approach to Stansted. Accordingly, the crew members undertook subsequent training with a human factor specialist, before further ground and simulator training. At the completion of this training, each crew member was to be evaluated before any return to normal duties.

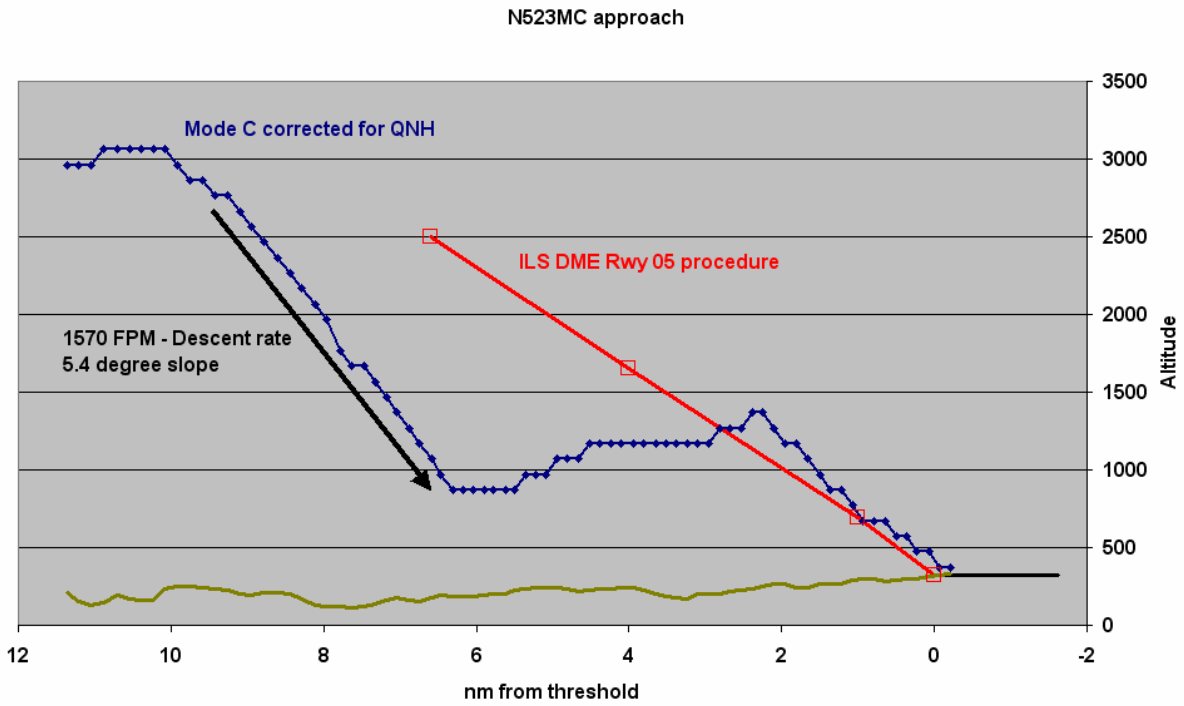

Figure 1 N523MC Approach and normal glideslope