AIRCRAFT ACCIDENT REPORT NO 5/2007

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REPORT ON THE SERIOUS INCIDENT TO AIRBUS A321-231, G-MEDG DURING AN APPROACH TO KHARTOUM AIRPORT, SUDAN ON 11 MARCH 2005

Aircraft Operator:	British Mediterranean Airways Limited (known as BMED)
Aircraft Type and Model:	Airbus A321-231
Registration:	G-MEDG
Location:	On final approach to Runway 36, Khartoum Airport, Sudan
Date and Time:	11 March, 2005 at 0033hrs All times in this report are UTC

Synopsis

The incident was notified to the Air Accidents Investigation Branch (AAIB) on 14 March 2005. By that time the aircraft had returned to the UK where the aircraft's Flight Recorders were interrogated. The AAIB investigation team comprised:

Mr J J Barnett (Investigator-in-Charge)
Mr N C Dann (Operations)
Mr P Wivell (Flight Recorders)

The aircraft was attempting to land at Khartoum by night in conditions initially reported as blowing sand but which were in fact consistent with a forecast dust storm. Runway 36 was in use but the ILS on this runway was out of service. The commander assessed the weather conditions passed to him by ATC and believed that he was permitted, under his company's operations policy, to carry out a Managed Non-Precision Approach (MNPA) to Runway 36. This type of approach requires the autopilot to follow an approach path defined by parameters stored in the aircraft's commercially supplied Flight Management and Guidance System (FMGC) navigation database.

On the pilot's approach chart, which was also commercially supplied but from a different supplier, the final descent point was depicted at 5 nm from the threshold of Runway 36 whereas the FMGC's navigational database had been correctly updated with a recent change to this position published by the Sudanese CAA which placed it at 4.4 nm from the threshold. The discrepancy amounted to a difference in descent point of 0.6 nm from the Khartoum VOR/DME beacon, the primary navigation aid for the non-precision approach.

The pilots commenced the approach with the autopilot

engaged in managed modes (ie the approach profile being determined by the FMGC instead of pilot selections). The aircraft began its final descent 0.6 nm later than the pilots were expecting. Believing the aircraft was high on the approach, the handling pilot changed the autopilot mode in order to select an increased rate of descent. The approach became unstable and the aircraft descended through 1,000 ft agl at an abnormally high rate. The aircraft then passed through its Minimum Descent Altitude (equivalent to a height of 390 ft agl) with neither pilot having established the required visual references for landing. Instead each pilot believed, mistakenly, that the other pilot was in visual contact with the runway approach lights.

When the confusion between the two pilots became apparent, the aircraft had descended to approximately 180 ft agl and the handling pilot commenced a go-around. Between 3.4 and 5.1 seconds later, with the aircraft at a radio altitude of approximately 125 ft agl, in a position approximately 1.5 nm short of the runway, the Enhanced Ground Proximity Warning System (EGPWS) "TERRAIN AHEAD, PULL UP" audio warning was triggered. The correct emergency pull-up procedure was not followed in full, partly because the handling pilot had already initiated a go-around. The minimum recorded terrain clearance achieved during the recovery manoeuvre was 121 ft.

One further non-precision approach to Runway 36 was attempted using selected autopilot modes. The crew were attempting a third approach when they received visibility information from ATC that was below the minimum required for the approach. The aircraft then diverted to Port Sudan where it landed without further incident.

The following causal factors were identified:

1. The pilots were unaware of a significant discrepancy between the approach parameters on the approach chart and those within the navigation database because they had not compared the two data sets before commencing the approach.

2. Confusion regarding the correct approach profile and inappropriate autopilot selections led to an unstable approach.

3. The unstable approach was continued below Minimum Descent Altitude without the landing pilot having the required visual references in sight.

4. The UK CAA's guidance and the regulatory requirements for approval to conduct MNPA were fragmented and ill-defined.

5. The operator's planning and implementation of MNPA (Managed Non-Precision Approaches) procedures included incomplete operational and written procedures and inconsistent training standards.

6. The ability of the installed EGPWS to provide sufficient warning of inappropriate terrain closure during the late stages of the approach was constrained by the lack of a direct data feed from the GPS navigation equipment.

Following this serious incident, significant safety action was taken by the operator and the UK CAA. The AAIB made four safety recommendations.

Findings

1. The UK CAA had no official policy in place at the time of the incident which adequately described all the requirements for MNPA operations.

2. The pilots had not received all the appropriate training in MNPA operations from the operator.

3. The operator had received five feedback forms relating to issues associated with MNPA to Runway 36 at Khartoum.

4. The operator had not processed any MNPA feedback forms received prior to the incident.

5. The operator's Operations Manual recommended avoiding flight into sandstorms.

6. The aircraft was operated into conditions reported as blowing sand.

7. The pilots were passed incomplete or inaccurate information on the visibility at Khartoum.

8. The JAR-OPS1 minimum RVR for the approach was 1,600 m but this was inconsistent with the 1,600 m visibility specified by the Sudanese authorities on the State chart.

9. No check was made that the approach information on the chart agreed with that in the navigation database.

10. MNPA's were only authorised in VMC.

11. An MNPA was commenced to Runway 36 at Khartoum in IMC.

12. At the time of the incident, the operator used charts and databases supplied by different commercial organisations.

13. The FMGC navigation database correctly reflected the most recent revision of the Sudanese AIP which placed the FAF at 4.4 DME from the KTM VOR/DME beacon.

14. The approach charts showed the FAF at 5 DME from the KTM VOR/DME beacon; this position did not reflect the latest Sudanese AIP revision.

15. The autopilot flew the managed approach in accordance with the parameters stored in the FMGC navigation database.

16. The aircraft started its descent in a managed approach mode at KTM 4.4 DME.

17. The commander changed to selected descent mode at KTM 4 DME, believing the aircraft was high on the approach profile.

18. The maximum descent rate achieved during the final approach was 1,728 ft/min at a point where the aircraft was 1,100 ft aal, less than 4 miles from touchdown and whilst in IMC.

19. The approach was unstable as the aircraft passed through 1,000 ft agl.

20. The operator required that a go-around be

flown for any unstable approach in IMC when passing 1,000 ft agl.

21. As MDA was reached, each pilot mistakenly believed that the other pilot was visual with the runway approach lights.

22. No decision calls were made in accordance with the operator's procedures when approaching or at MDA.

23. TOGA power was selected approximately 160 ft below the published MDA, equating to 210 ft below the company MDA.

24. The minimum terrain clearance recorded was 121 ft agl at a position more than 1.5 nm from the runway threshold.

25. Between 3.4 and 5.1 seconds after the go-around manoeuvre had been initiated, an EGPWS pull up warning was triggered.

26. The EGPWS worked in accordance with its design and contemporary certification requirements.

27. It is likely that the EGPWS alert would not have provided sufficient warning time to prevent a CFIT accident.

28. During the EGPWS alert, the sidestick was not maintained in the fully aft position as required by the Emergency Procedure.

29. Since the initial TAWS certification requirements were drawn up, the EGPWS manufacturer has improved the system's design to reduce the CFIT risk areas.

30. A direct feed to the EGPWS of GPS position and accuracy data is necessary to improve EGPWS performance during the late stages of an approach.

31. Recent aircraft manufacturer's revisions to the integration procedures for EGPWS into Boeing and Airbus aircraft require pure GPS data, including GPS accuracy information, to be routed directly to the EGPWS.

32. In this incident, currently certified but not mandated EGPWS integration improvements could have yielded an earlier "TOO LOW TERRAIN" alert.

Safety Recommendations

The following Safety Recommendations have been made:

Safety Recommendation 2007-041

Airbus should revise the expanded information *'Pull up to full backstick and maintain'* of the A320 Emergency Procedure for the EGPWS Alert "TERRAIN TERRAIN PULL UP" to remove any ambiguity about the amount of rearwards sidestick that should be applied.

Safety Recommendation 2007-042

Airbus should expedite publication of guidance material relevant to flight and ground operations by Airbus aircraft types in conditions of blowing sand or low drifting sand.

Safety Recommendation 2007-044

The European Aviation Safety Agency, in conjunction with industry, should review the current TAWS

system design criteria (ETSO-C151a), and installation certification criteria, with particular emphasis on the timeliness of alerting when close to the runway. Revisions to these standards arising from this review should apply retrospectively to all aircraft currently covered by the TAWS mandate.

Safety Recommendation 2007-046

The UK CAA should publish guidance to pilots regarding the appropriate action when faced with a conflict in approach parameters between their approach charts and an FMS database authorised for managed non-precision approaches.