International Civil Aviation Organization

Sixth Meeting of CNS/MET Sub-Group of APANPIRG

Bangkok, Thailand, 15 – 19 July 2002

Agenda Item: 5 Radio Navigational Aids

ILS SYSTEM FAILURE

(Presented by New Zealand)

SUMMARY

On 29 July 2000, during a standard ILS approach to Faleolo at night, an Air New Zealand Boeing 767 with 165 passengers and 11 crew on board commenced a go-around after descending to an altitude of about 400 ft some 6 miles short of the runway. An exhaustive investigation revealed that the ILS was transmitting invalid guidance information, while cockpit glide path and localiser indications were normal. This paper reviews the incident and sets out the results of the ensuing investigations.

1. INTRODUCTION

1.1 On 29 July 2000 flight NZ 60, an Air New Zealand Boeing 767 aircraft with 165 passengers and 11 crew members on board was cleared to Faleolo via a FALE arrival 15 NM arc for the ILS runway 08. The approach was planned to be auto-coupled using a low drag approach profile.

1.2 From FALE, the aircraft established on the 15 mile arc then captured the localiser inbound course at 14 miles. About one second after APPROACH was armed, the auto-flight system captured the glide path. Approximately 5 seconds after glide path capture, the rate of descent increased. Flight deck instruments confirmed the aircraft to be both on glideslope and on localiser and the ILS was identifying correctly.

1.3 Shortly after landing flap was selected, the pilot flying noted an anomaly in DME vs altitude. Around the same time, the pilot not flying, while trying to establish visual contact with the runway, became aware that visual cues did not correspond with what was expected.

1.4 Approximately 6 miles from the runway threshold a missed approach was carried out from an altitude of about 400 feet. The aircraft instruments indicated “on glideslope” throughout the go-around until abeam the runway. During the second approach the glide path deviation indicator again indicated “on glideslope” throughout the approach, which was manually flown with reference to the DME/altitude profile.

1.5 At no stage during the first approach, go-around, and second approach were any “flags” or EICAS messages displayed. Nor was there any autopilot warning or flight mode fault indicated.

2. DISCUSSION

2.1 Although a “false glide path capture” was initially suspected, analysis of FDR data revealed that at all positions within 40 degrees of the localiser front course, the aircraft was receiving a zero glideslope deviation signal - the aircraft “thought” it was on glideslope, yet it had descended on a path of approximately 3.5 degrees to a point 5.5 miles short of the runway.

2.2 It was established that the ILS glideslope transmitter had inadvertently been left in control (monitor) bypass mode, with the unserviceable transmitter selected. This resulted in the glideslope transmitter executive monitor being unable to shut down the faulty transmitter or to transfer to the serviceable transmitter. The result was the transmission of invalid glideslope guidance information. The transmitter was transmitting the carrier plus side bands (CSB) only signal, with the side bands only (SBO) signal missing.

2.3 Very significantly, the tower remote ILS transmission indicator was inoperative.

2.4 The importance of the remote status indicator in the tower, within sight of the Air Traffic Controller must be emphasised as the primary notification point of any ILS abnormalities. A technical centre can only be the secondary point of notification. It is also very important to ensure the wiring of the remote status indicator warnings in the tower is implemented in such a way that a warning is given any time the control bypass (monitor bypass) switch is activated by maintenance personnel, either by movement of a switch, by computer switching in the equipment shelter, or by remote logging on. Annex 10 needs to be clearly understood and followed.

2.5 The crew had read the NOTAMS, which showed that the VOR, ILS/GP, ILS/DME were unmonitored, and the ILS/GP had no standby transmitter.

2.6 There is a common idea among pilots that the ILS consists of narrowly focused localiser and glide path beams. Pilots have generally come to believe that ILS equipment is extremely accurate and reliable. Normally this is so; so much so that some pilots have been tempted to use an ILS when cockpit indications suggest the ILS is working, despite being NOTAMED as on test or not monitored.

2.7 The perception that the ILS consists of narrowly focused beams is incorrect. In fact the aircraft steering information is created by a combination of signals such that if any one of them is not radiating in accordance with specifications then the aircraft will receive false guidance. Such false guidance can include “on-course” or “on glideslope” indications regardless of the actual position of the aircraft and with no flag or alarm indications in the cockpit. Flight director and autopilot functions will also appear normal. In approach mode, the flight director will automatically capture the incorrect glide path without any prior fly-up or fly-down indication.

2.8 The crew of Flight NZ 60 was well prepared and competent, and executed their duties in accordance with company standard operating procedures (SOPS). Nothing in their collective experience and training had prepared them for the latent failures behind this event. It was most fortunate that, without discussion, the crew went straight from “inquiry” to “assertion” in less than 10 seconds in executing the go-around.

2.9 The investigation revealed much information that needs to be promulgated. For example, there is a need to remove potential ambiguity from standard NOTAM phraseology notifying the status of navigation aids. There is a need to further educate flight crews, ground technicians and air traffic controllers about ILS systems and their monitoring. The necessity for maintenance personnel and their managers to ensure that critical items are independently checked and signed off prior to return to service needs to be reinforced. Design and ergonomic issues arise regarding the inability of aircraft systems to detect the existence of some erroneous navigation aid conditions.

3. RESPONSE

3.1 In response to the preliminary incident notification, the Secretary General of ICAO issued State Letter AN 7/5-01/52 on the general subject of incidents caused by operational use of ILS signals radiated during testing and maintenance procedures. This letter requested States to invite the appropriate authorities, organisations and operators under their jurisdiction to review current practices and procedures as necessary to ensure that ILS will not be used for normal flight operations when test signals are being radiated or the executive monitoring function of the facility is inhibited for testing/maintenance purposes. The letter also listed a number of protective measures.

3.2 As soon as the implications of the event became apparent, the New Zealand CAA issued a letter to all New Zealand pilots holding Instrument Ratings, and aircraft operators, reminding pilots of the risks involved in using navigation equipment when it is NOTAMED as on test or unserviceable or not monitored. The letter described the cause of the serious incident in some detail and listed procedures for pilots to follow to prevent a recurrence.

3.3 The CAA also undertook a review of the requirements and practices for the operational use of radio navigation aids without status monitoring by the associated ATS unit. This led to the CAA writing to all organisations operating under New Zealand's CAR Part 171 (Aeronautical Telecommunication Service Organisations – Certification) to draw their attention to the relevant specific requirements within the rule that had apparently been widely overlooked in the past.

3.4 In order to promote further awareness of the hazards of erroneous ILS signals, Air New Zealand, with the assistance of the CAA, made a number of presentations on the event to other operators in New Zealand.

3.5 During October/November 2001, the investigator in charge of the CAA investigation conducted an international tour to publicise the incident and lessons learned. Presentations were made to the Air Navigation Commission and other representatives of ICAO, Transport Canada and IATA in Montreal; NTSB and FAA in Washington DC; NASA at Langley Field Virginia; UK Flight Safety Committee, UK CAA and AAIB in London; plus others.

3.6 The CAA worked closely with ICAO, Boeing and the FAA throughout the investigation. and it is understood that the FAA is in the process of changing their maintenance handbooks. In due course the CAA will publish the associated serious incident report on its website (www.caa.govt.nz) and intends to continue to advise and promote the safety message regarding this incident after closure of the investigation.

4. CONCLUSION

4.1 A controlled flight into terrain (CFIT) accident was narrowly averted on this occasion.

4.2 This serious incident has provided a valuable insight into a hitherto little recognised weakness in ILS systems that will create an extreme hazard unless great care is taken to adhere to ICAO standards and guidance material during ILS operation, design, and maintenance.

4.3 Maintenance personnel and their managers need to ensure the integrity of remote ILS transmission indicators, and that the wiring is such that the air traffic controller will be notified immediately the control (remote) bypass is activated.

4.4 The necessity for maintenance personnel and their managers to ensure that critical items are independently checked and signed off prior to return to service needs to be reinforced.

4.5 There is a need to further educate flight crews, ground technicians and air traffic controllers about ILS systems and their monitoring.

4.6 There is scope for improvement in NOTAM phraseology notifying the status of navigation aids, and further protective measures that can be taken during testing and maintenance. (Reference ICAO State Letter AN 7/5-01/52.)

4.7 Design and ergonomic issues arise regarding the inability of aircraft systems to detect the existence of some erroneous navigation aid conditions which may be transmitted accidentally, or deliberately when the navigation aid is undergoing maintenance.

4.8 This serious incident warranted extensive publicity in order to further guard against CFIT accidents.

4. ACTION BY THE MEETING

4.1 The meeting is invited to

(a) Note the content, and
(b) Exchange views on the various matters discussed in this paper.