



Final Report

AIC 15-2028

Travel Air and Airlines PNG

P2-TAE and P2-MCW

Fokker F27 Mk 050 and Bombardier DHC-8-102

Breakdown of Separation

9.5 NM (17.5 km) northwest of Lae

Morobe Province

PAPUA NEW GUINEA

About the Accident Investigation Commission

The Accident Investigation Commission (AIC) is an independent statutory agency within Papua New Guinea (PNG). The AIC is governed by a Commission and is entirely separate from the judiciary, transport regulators, policy makers and service providers. The AIC's function is to improve safety and public confidence in the aviation mode of transport through excellence in: independent investigation of aviation accidents and other safety occurrences within the aviation system; safety data recording and analysis; and fostering safety awareness, knowledge and action.

The AIC is responsible for investigating accidents and other transport safety matters involving civil aviation, in PNG, as well as participating in overseas investigations involving PNG registered aircraft. A primary concern is the safety of commercial transport, with particular regard to fare-paying passenger operations.

The AIC performs its functions in accordance with the provisions of the PNG Civil Aviation Act 2000 (as amended 2010), and the Commissions of Inquiry Act 1951 (as amended), and in accordance with Annex 13 to the Convention on International Civil Aviation.

The object of a safety investigation is to identify and reduce safety-related risk. AIC investigations determine and communicate the safety factors related to the transport safety matter being investigated.

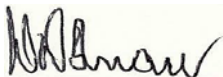
It is not a function of the AIC to apportion blame or determine liability. At the same time, an investigation report must include factual material of sufficient weight to support the analysis and findings. At all times the AIC endeavours to balance the use of material that could imply adverse comment with the need to properly explain what happened, and why it happened, in a fair and unbiased manner.

About this report

Decisions regarding whether to conduct an investigation, and the scope of an investigation, are based on many factors, including the level of safety benefit likely to be obtained from an investigation.

On Tuesday 25 August 2015, the AIC was informed of a TCAS Resolution Advisory (RA) event, involving a Fokker F27 Mk 050 and a Bombardier DHC-8-102 that occurred on 21 August 2015. The crew of the Dash 8 immediately acted on the RA instructions. This RA event constituted a serious incident as defined by ICAO Annex 13.

Because of the lack of verifiable documents, or incomplete maintenance documentation from Travel Air and the elapsed time between the serious incident and the notification to the AIC, the AIC was deprived of much data and information that could have enabled it to draft a more detailed ICAO Annex 13 style report into this serious incident. Therefore, the AIC has produced this *Short Summary Report* for industry awareness of identified safety issues and possible safety actions. The AIC draws the readers' attention to the safety recommendations made for safety enhancement.



David Inau, ML

Chief Executive Officer

25 November 2016

Breakdown of separation involving a Fokker F27 Mk050 and Bombardier DHC8-102

Occurrence Details

On 21 August 2015, at 02:47 (UTC)¹ a Fokker F27 Mk 050 (F50) registered P2-TAE (TAE) operated by Travel Air and a Bombardier DHC-8-102 (Dash 8), registered P2-MCW (MCW), operated by Airlines PNG, were involved in a breakdown of separation occurrence about 9.5 nm (17.5 km) northwest of Lae (Morobe Province).

The crew of MCW reported that shortly after they had levelled off at 8,000 ft and were visual, they received a traffic collision-avoidance system² (TCAS) Traffic Alert (TA), followed by a Resolution Advisory (RA), indicating that TAE had descended to 600 ft above MCW. They immediately made a visual evasive (avoidance) manoeuvre based on the RA instruction, to avoid TAE. The crew of MCW reported the TCAS RA event to their operator on 22 August when they returned to Port Moresby.

At the time of the occurrence, neither crew reported a it to the Nadzab Air Traffic Control (ATC) Approach Controller. The Accident Investigation Commission (AIC) investigators contacted the crew of TAE who stated that they did not receive any TCAS alerts during that flight.

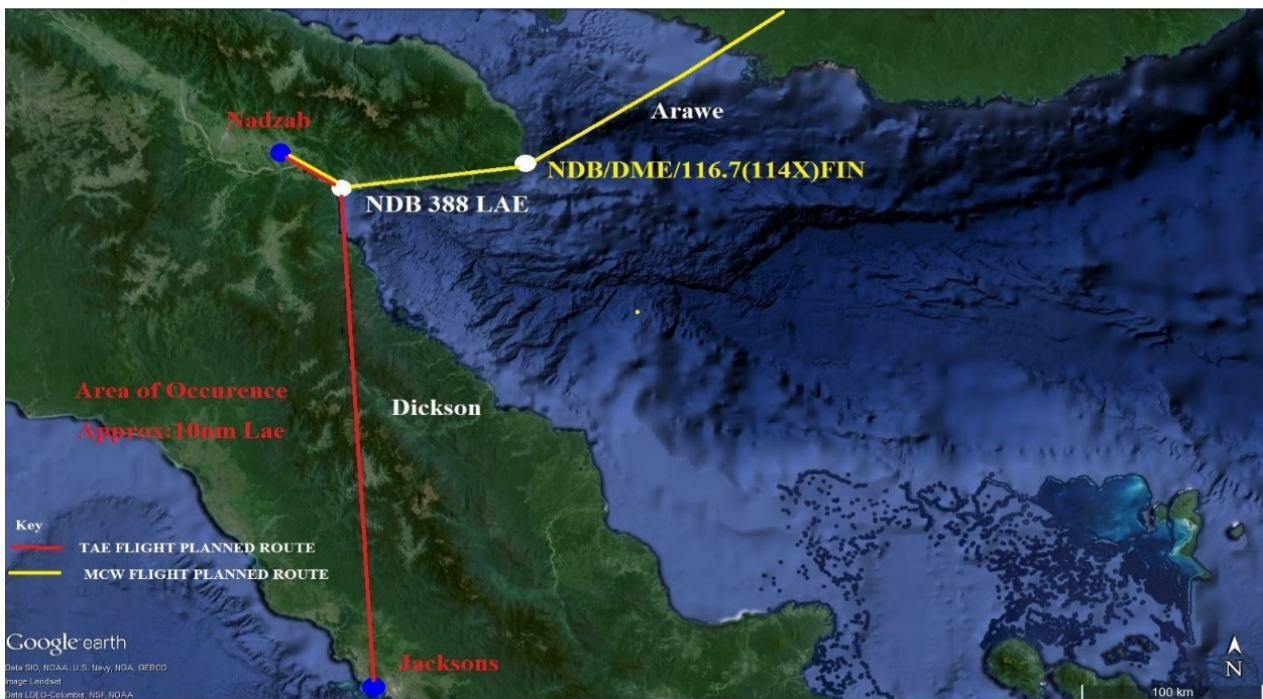


Figure 1: P2-MCW and P2-TAE flight plan route

¹ The 24-hour clock, in Coordinated Universal Time (UTC), is used in this report to describe the local time as specific events occurred. Local time in the area of the accident, Papua New Guinea Time (Pacific/Port Moresby Time) is UTC + 10 hours.

² Specific type of Airborne Collision Avoidance System.

Both aircraft were being operated as regular air transport service³ and under the Instrument Flight Rules⁴ (IFR). MCW was operating as flight number CG1716 from Nadzab to Tokua with 21 persons on board; two pilots, one flight attendant, and 17 adults and one infant passengers. TAE was operating as flight number 4P408 from Port Moresby, Jacksons International Airport to Nadzab with 42 persons on board; two pilots, two flight attendants, two company pilots as passengers, and 35 adults and one infant passengers.

At 02:36, MCW was issued with an ATC clearance to track from Nadzab via Lae on the 114° radial of the Nadzab VOR⁵, thence to Finschhafen, and Arawe, and to cruise at 19,000 ft, with an initial requirement to maintain 9,000 ft. During the interception of the outbound track, the approach controller provided MCW with information of opposite direction traffic TAE inbound to Nadzab, tracking via Dickson and Lae.

At 02:40:12 the crew of TAE made initial contact with the Nadzab Approach, informing Nadzab that they were 48 DME⁶ (89 km) south of Nadzab, with a descent point 42 DME (78 km). The controller then issued a descent clearance for TAE to descend to 12,000 ft. At 02:45:22 TAE reported 27 DME (50 km), and approaching 12,000 ft. The controller cleared TAE to descend to 10,000ft.

At 2:47:12 the crew of MCW reported passing 6,500 ft and the controller instructed them to maintain 8,000 ft. At 02:47:39 TAE was given further descent clearance to 9,000 ft, and was instructed to report sighting the outbound traffic MCW, a Dash 8 climbing to 8,000 ft, and estimated to pass at 15 DME (28 km). At 02:48:06 MCW was again instructed to climb to and maintain 8,000 ft, and to report sighting and passing TAE, that was inbound to Nadzab on the 114° radial of the Nadzab VOR and descending to 9,000 ft.

Both aircraft were on reciprocal tracks (114° radial of Nadzab VOR). MCW was outbound, cleared to 8000 ft, while TAE was inbound, cleared to 9000 ft when the TCAS TA followed by a RA⁷ was received by MCW. The crew of MCW subsequently reported that they were still on climb passing 7,600 ft when they received a TA and their TCAS showed TAE still descending towards them. A RA soon followed with instructions to descend. The crew of MCW stated that they believed that TAE had descended through 9,000 ft and was showing 600 ft vertical separation on MCW's TCAS, and the indication was that it was continuing to descend towards MCW. They also reported that the aircraft passed each other so close that they could read the F50's tail number P2-TAE. The crew of TAE reported sighting and passing MCW. They subsequently informed the AIC that their TCAS did not activate, thus giving them the impression that adequate separation was being maintained.

There was no reported damage and none of the aircrafts' occupants were injured during the manoeuvring by MCW.

³ Operation of aircraft for the purposes of the carriage of passengers, or both passengers and goods, on a regular air operation.

⁴ Instrument Flight Rules are applied when a flight is conducted in conditions when outside visual reference is either not possible or is not safe. IFR flight depends upon flying by reference to instruments in the flight deck and navigation is accomplished by reference to electronic signals.

⁵ VOR = very high frequency omni-directional radio range.

⁶ Distance Measuring Equipment (DME) is a transponder-based radio navigation technology that measures slant-range distance in nautical miles (nm) by timing the propagation delay of VHF or UHF radio signals.

⁷ See the section in this report titled **Traffic alert and collision-avoidance system (TCAS)**

ATC Flight Progress strips for P2-TAE and P2-MCW

The approach controller placed a ‘tick’ on the respective flight progress strips adjacent to the correct maintained altitude, ‘90’ representing 9,000 ft for P2-TAE and ‘80’ representing 8,000 ft for P2-MCW. Placing a tick to the right of the assigned level was the controller’s annotation that a correct read back of the level had been made by the pilot.

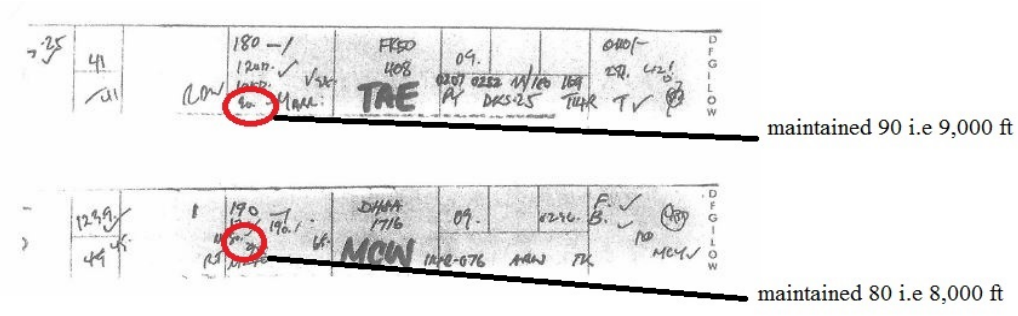


Figure 2: ATC flight progress strip

Meteorological Information

The prevailing meteorological conditions were not a factor in the occurrence.

Communications

All communications between the Nadzab Approach Controller and the crews of TAE and MCW were recorded by ground based automatic voice recording equipment for the duration of the flights in the Nadzab Approach Controller’s sector. The quality of all ATC recorded transmissions was good.

See Appendix A for Air Traffic Control Transcript for the period of the serious incident.

Traffic alert and collision-avoidance system (TCAS)

The Traffic alert and collision avoidance system (TCAS) is an aircraft collision avoidance system reduce the incidence of mid-air collisions between aircraft. The TCAS monitors the airspace around an aircraft for other aircraft equipped with a corresponding active transponder, independent of air traffic control, and warns pilots of the presence of other transponder-equipped aircraft which may present a threat of mid-air collision.

When a Traffic Advisory (TA)⁸ is issued, pilots are required to use all available information to assist in visual acquisition of the TA traffic. They must continue to comply with ATC instructions and ensure no manoeuvres are initiated based solely on the TCAS TA information. When a Resolution Advisory (RA)⁹ is issued, pilots are required to respond immediately to the RA instruction, unless doing so would jeopardize the safe operation of the aircraft. TCAS RA commands are to be given priority over conflicting ATC instructions. This means that the aircraft will at times have to manoeuvre contrary to ATC instructions or disregard ATC instructions.

⁸ An indication given to the flight crew that a certain intruder is a potential threat.

⁹ Aural voice and display information provided by the TCAS II to a flight crew advising that a particular manoeuvre should or should not be performed to attain minimum safe vertical separation from an intruder.

In such cases, the controller is no longer responsible for separation of the aircraft involved in the RA until the conflict is terminated. The PNG AIP ENR 1.6.2.1 (iv) states that pilots who, in response to an RA, deviate from ATC instructions or clearances shall, when the conflict is resolved, return promptly to the originally instructed or cleared level and/or track. The appropriate ATC unit shall, as soon as practicable, be advised of the deviation, including its direction and when the deviation has ended.

Circumstance	Phraseology * Denotes pilot transmission
After a flight crew starts to deviate from any ATC clearance or instruction to comply with a TCAS RA (Pilot and controller interchange)	* TCAS RA ROGER
After a response to a TCAS RA is completed and a return to the ATC clearance or instruction is initiated (Pilot and controller interchange)	* CLEAR OF CONFLICT RETURNING TO <i>(assigned clearance)</i> ROGER <i>(or alternate instructions)</i>
After a response to a TCAS RA is completed and the clearance or instruction is initiated (Pilot and controller interchange)	* CLEAR OF CONFLICT <i>(assigned clearance)</i> <i>RESUMED</i> ROGER <i>(or alternate instructions)</i>
After an ATC clearance or instruction contradictory to the TCAS RA is received, the flight crew will the RA and inform ATC directly (Pilot and controller interchange)	* UNABLE, TCAS RA ROGER

Figure 6: TCAS RA response phraseology

TCAS fitted to TAE

Manufacturer : Bendix/King
 Model : TPU 67A TCAS-II
 Part Number : 066-01146-1211
 Serial Number : 40192
 FAA TSO : C-119b

TCAS fitted to MCW

Manufacturer : Rockwell Collins
 Model : TTR 920 TCAS-II
 Part Number : 622-8971-122
 Serial Number : 1783
 FAA TSO : C-119a

The TCAS equipment fitted to TAE and MCW complied with PNG CAR Part 121.381, *Airborne Collision Avoidance System (ACAS II)*, and Federal Aviation Administration (FAA) Technical Standard Order¹⁰ (TSO).

The TCAS equipment from both aircraft was a significant component of the investigation. Data downloaded from the TCAS equipment fitted to TAE and was interpreted by the Bendix Technical Support Team. However, the Rockwell Collins TCAS equipment fitted in MCW did not contain an internal memory and as a result no data was recorded.

Due to the elapsed time between the alleged breakdown of separation and the AIC being notified of the occurrence, the TCAS data recorded by MCW’s flight data recorder was overwritten, resulting in the data for the flight on 21 August 2015 not being available to the AIC’s investigation. The AIC also sought to analyse the TCAS data to check the functionality and integrity of the TCAS system in TAE. Time and date data were not logged, which further hampered the accuracy of the AIC’s analysis of the TCAS data.

See appendices B and C for printouts obtained by the AIC, which demonstrate that the TCAS data was overwritten.

Transponders

A transponder is an electronic device that provides a response when it receives a radio-frequency interrogation. Transponders are installed in aircraft to assist in identifying the aircraft on air traffic control radar, and collision avoidance systems have been developed to use transponder transmissions as a means of detecting aircraft at risk of colliding with each other.

Both TAE and MCW were fitted with ATC Mode ‘S’ Transponders. Mode S transponders transmit information about the aircraft to the Secondary Surveillance Radar (SSR) system, to TCAS receivers on board aircraft, and to the Automatic Dependant Surveillance Broadcast (ADS-B) SSR system. This information includes the call sign (tail number) of the aircraft and/or the transponder's permanent ICAO 24-bit address in the form of a hex code.

Transponders fitted to TAE

Manufacturer	(Transponders 1 and 2)	: Honeywell
Model number	(Transponders 1 and 2)	: MST-67A
Part number	(Transponders 1 and 2)	: 066-01143-2101
Serial number	(Transponders 1)	: M191716
Serial number	(Transponders 2)	: M106216
FAA TSO		: C-112

Transponders fitted to MCW

Manufacturer		: Rockwell Collins
Model number	(Transponders 1 and 2)	: TDR-94D.
Part number	(Transponders 1 and 2)	: 622-9210-005
Serial number	(Transponders 1)	: 1C1XM
Serial number	(Transponder 2)	: 1MUG
FAA TSO		: C-112

¹⁰ Minimum performance standard issued by the United States Federal Aviation Administration for specified materials, parts, processes, and appliances used on civil aircraft.

The Mode ‘S’ Transponders fitted to both aircraft complied with *PNG CAR Part 91 A.22, Transponder Equipment*, and the *Federal Aviation Administration (FAA) Technical Standard Order*¹¹ (TSO).

In accordance with *ICAO Annex 10, Aeronautical Telecommunications Vol III*, TAE and MCW were assigned Mode ‘S’ codes from the Civil Aviation Safety Authority of PNG (CASA) for TAE and PNG Air Services Limited (ASL) issued MCW Mode S Code¹². The assigned Mode ‘S’ code on each aircraft was implemented by selectively strapping¹³ the 24 Mode ‘S’ address pins for accomplishment.

The investigation determined that each aircrafts’ strapping was in accordance with the Mode ‘S’ allocated by the CASA.

Avionic Tools

Icao Calc

Hex Addr	898051	TDR-94/94D
Hex:	898051	
Octal:	42300121	
Binary:	100010011000000001010001	
Strap TDR-94() J1:	33 37 40 41 50 52 56	
Open J1:	34 35 36 38 39 42 43 44 45 46 47 48 49 51 53 54 55	
Common pin	32, no parity	
<input type="button" value="Calc"/> <input type="button" value="Print"/>		

Figure 5: P2-MCW Mode ‘S’ strapping

Avionic Tools

Icao Calc

Hex Addr	898068	MST-67
Hex:	898068	
Octal:	42300150	
Binary:	100010011000000001101000	
Strap MST-67 J1A:	5 9 17 18 32 33 35	
Open J1A:	6 7 8 10 11 19 20 21 22 23 24 25 31 34 36 37 38	
Common pins	12, 39, no parity	
<input type="button" value="Calc"/> <input type="button" value="Print"/>		

Figure 6: P2-TAE Mode ‘S’ strapping

Maintenance records for TAE

The AIC requested maintenance records and documentation from the operator on several occasions, however the operator’s maintenance organisation only provided incomplete documentation to the AIC investigation. It was therefore not possible for the AIC to make conclusive findings on the maintenance history of the TCAS held in the operator’s inventory. From the documentation it was determined that:

TCAS serial number (SN) 40192 was installed on aircraft SN 20122 on 22 November 2005 and issued with an Authorised Release Certificate number 64894 by Honeywell Aerospace SAS, Toulouse, France.

Aircraft SN 20122 subsequently became P2-TAH on the PNG Civil register.

The *Travel Air Technical Log* number 00715 details the removal of TCAS SN 40192 from TAH and installed on TAE on 10 September 2014. However, the Operator’s maintenance *Serial Number history* for TCAS SN 40192 on 18 September 2014 was incomplete, but it appears to indicate a change of TCAS processor and satisfactory ground test¹⁴.

¹¹ Minimum performance standard issued by the United States Federal Aviation Administration for specified materials, parts, processes, and appliances used on civil aircraft.

¹² Formerly PNG ASL issued the Mode S Codes, then after 2010 CASA PNG issued the specifically assigned Mode S Codes.

¹³ Strapping: CASA issues Binary code ... to aircraft (P2-TAE, HEX Decimal 898068) which gives the “strapping pins” that are to be “grounded” (or, earthed); others [pins] are left “open” [at the bracket]. The grounded pins are then earthed upon fitment (at back end of the bracket). Verification is obtained [AIC/CASA action] using [ICAO Calculator](#) on website (under Aviation Tools) to determine “strapped pin”, and open pins.

¹⁴ From the available maintenance documentation and statements given by the Travel Air engineering staff and management, the AIC was unable to determine what “satisfactory ground test” meant. Refer to the section Functional testing of TCAS by Travel Air on page 7 of this report.

A further entry in the *Serial Number history* records details the removal of TCAS SN 40192 from TAH on 10 September 2014 and return to inventory.

The investigation determined that TCAS SN 40192 fitted to P2-TAE was reported on 10 September 2014 to have a defect stated as “*TCAS Resolution Presented with no connecting Traffic in the Vicinity*”. From this defect report it appears that the crew may have sighted close proximity aircraft, but had no TCAS TA or RA.

No further movements of TCAS SN 40192 were recorded on the operator’s *Serial Number history* document until 25 November 2015, and was followed by more TCAS changes listed, including two entries on 30 December 2015. However, a document supplied by the operator’s maintenance organisation titled “*Component Removals and Installation*” detailed the following:

TCAS SN 40200 removed from TAH on 24 October 2015, 65 days after the incident, because of stated defects “TCAS # 1 intermittent and #2 Failed”.

TCAS SN 40192 removed from TAE on 25 October 2015 because of stated defects “We are seeing other A/C, but they cannot see us Ops. No Go. Air PNG complain bitterly with possible report to follow”.

On 25 October 2015, 65 days after the incident, the TCAS was removed from TAE following a defect report by a pilot. A serviceable replacement TCAS was installed on TAE on the same day, 25 October 2015.

Functional testing of TCAS by Travel Air

The Travel Air *Maintenance Control Manual* specified that the following maintenance inspections of the avionics were to be carried out:

Radio Stations and Navigation Equipment - Every 24 months reference: Rule Part 43 Appendix B / CAR 91.605(e)1; and

Transponder - Every 24 months reference: Rule Part 43 Appendix E / CAR 91.605(e)3

According to the *Travel Air Job Card #578 P*, a Transponder check/test was performed on TAE on 20 January 2015, at airframe total time in service (TTIS) 31,895:30 hours, and airframe total cycles since new (TCSN) 39,205.

Other than a notation on the job card, the investigation was unable to find any evidence of maintenance tests being carried out by the operator in accordance with the aircraft manufacturer’s *TASK 34-46-00-720-815-A – Functional Test TCAS (Issue date Mar 01/14)*.

No supporting documentation/records were supplied by Travel Air. Notwithstanding the fact that there was no evidence to show how a functional test was carried out, the job card was notated as *Performed C/O*. A further entry on the job card in a different ink and writing style (entered by another engineer) noted *IAW Part 43 Appendix E CAR 91.605(e)3*. This additional entry was not signed or dated.

The details from Job Card #578 were not entered into the Remote Access Aviation System (RAAS)¹⁵ software by the Travel Air Maintenance Controller until 25 April 2015. That entry listed airframe TTIS 33,476.8 hours and airframe TCSN 35,84839. The next scheduled checks were listed as due on 25 April 2017. The differences between the Job Card #578 details (TTIS and TCSN) and the details entered in RAAS could not be explained.

Despite the numerous reported TCAS defects, the operator’s maintenance staff informed the AIC that they did not carry out further tests on the TCAS systems due to their understanding that the TCAS was an *On-condition Component*.

¹⁵ RAAS is a highly integrated internet browser-based maintenance and engineering workflow and data analysis solution for fleet operators supplied and administered by Aviation IntecTec Services, Ontario, Canada

On 27 January 2016, 5 months after the occurrence, as part of its investigation the AIC requested that Travel Air conduct the ATC system-functional test on TAE, using test equipment that could be borrowed for the purpose from another operator. The AIC sought to identify the Mode “S” code on TAE. Travel Air then informed the AIC investigators that they had the appropriate test equipment, IFR 6000, in their equipment/tooling inventory and that they had employed an avionics licenced maintenance engineer in December 2015.

Prior to December 2015 Travel Air did not have a qualified avionics maintenance engineer, nor was there staff available who were qualified or experienced to use the IFR 6000 test equipment. The TCAS system was tested during the 27 January 2016 AIC visit. The maintenance engineer conducting the TCAS defect remedial actions until December 2015 was not experienced or qualified to carry out the avionics defect rectification maintenance. His aircraft maintenance engineering licence coverage was for airframes and powerplants.

Flight Recorders

Both aircraft were fitted with a Flight Data Recorder¹⁶ (FDR) and Cockpit Voice Recorder¹⁷ (CVR). At the time of the incident, neither crew reported the incident to the AIC or air traffic control, but continued operating their company flight schedules. Due to the elapsed time between the incident and the AIC being informed, the data on the recorders had been overwritten. Therefore, none of the recorders were able to be used in support of this investigation.

Reporting the serious incident

Annex 13 states that the following safety occurrence is classified as a serious incident:

Near collisions requiring an avoidance manoeuvre to avoid a collision or an unsafe situation or when an avoidance action would have been appropriate.

In this reported occurrence a TCAS RA was received by one aircraft. The RA instructed the crew to take avoidance manoeuvring action. However, while a breakdown of separation was alleged by one crew, the AIC could not conclusively determine if in fact there was a breakdown of separation.

Subsequent incident reporting was not carried out in accordance with the *Civil Aviation Act Sections 60 and 62*, and *CAR Part 12*. Specifically:

- The pilot in command (PIC) of MCW submitted a report to the Airlines PNG Safety and Quality Management Group on the day after the serious incident, 22 August 2015 when he returned to Port Moresby. He did not report the serious incident to the CASA as soon as practicable as required by the *Civil Aviation Act Section 60* and *Civil Aviation Rule 12.55*.
- After processing the PIC’s report and raising an “Assessment request 15/AI/339” the Airlines PNG Safety and Quality Administrator notified CASA on 25 August 2015, by submitting a form CA005 to CASA by email, with a copy of the email to the CEO of the AIC. The notification was generated from the Airlines PNG Aviation Quality Database (AQD) Integrated Safety and Risk Management System. This was sent within the timeframe required CAR 12.53.

¹⁶ FDR: Electronic device fitted to an aircraft to automatically record flight and aircraft system data. It is housed in a crash and fire-proof container. The recorder has a time limit for which it can record data after which it overwrites.

¹⁷ CVR: Electronic device fitted to an aircraft that automatically records conversations in the cockpit, radio communications between the cockpit crew and others (including communication with air traffic control personnel), as well as ambient sounds. It is housed in a crash and fire-proof container. The recorder has a time limit for which it can record data after which it overwrites.

However, the CA005 was not sent by the PIC, and while the *Occurrence Title* refers to a “TCAS RA”, and under *Details, Effect on flight* the entry notes *Avoiding action*, other information on the CA005 differs from the subsequent information given to the AIC by the crew, specifically:

- The *Description* refers to the close proximity of the descending TAE, but it does not mention that MCW took avoidance manoeuvring action in response to the TCAS RA instruction; and
 - Under the heading *Airspace, Avoiding Action Taken*, it states “No”.
- On 28 August 2015, ASL was made aware of the serious incident by CASA.
 - On 28 August 2015 the Acting General Manager Flight Operations of Travel Air was notified by CASA. It appears that until that time, the crew of TAE had not mentioned the occurrence.
 - On 23 September 2015, ASL submitted a copy of its (internal) *Final Investigation Report number APNG 0527-15* to the AIC.
 - The AIC was not informed of the serious incident until 4 days after the occurrence, when it was copied in on an email from Airlines PNG. CASA did not notify the AIC in accordance with the *Civil Aviation Act Section 62*.

The *Civil Aviation Act (Act) Section 60*, and the *Civil Aviation Rules (CAR) Part 12* explicitly require a PIC who is involved in an incident, to report the incident CASA as soon as practicable.

CAR Part 12.55(c) specifies the notification obligations of the pilot in command of an aircraft involved in an airspace incident; again reports must be made *as soon as practicable*.

Because ASL was not immediately informed of the TCAS RA, and the crew of MCW did not advise the controller that they had made an avoidance manoeuvre, ASL could not be expected to report the event as contemplated by *CAR Part 12.55(a)(2)*.

In accordance with the *Act Section 62*, CASA is also obligated to report such occurrences to the AIC as soon as practicable after receiving a notification of an accident or serious incident. However, CASA was not notified of the serious incident by the pilots’ in command of TAE and MCW as required by *CAR Part 12.55(c)*.

Four days after the serious incident, the *CASA Aviation Quality Database (AQD)* Administrator received the form CA005 notification by email from Airlines PNG, which Airlines PNG also copied to the AIC. Because CASA was not informed of the TCAS RA until 4 days after the occurrence, CASA could not be expected to notify the AIC about the serious incident as contemplated by the *Act Section 62*. However, following receipt of the CA005 from Airlines PNG, CASA did not notify the AIC of the occurrence in accordance with *Section 62* of the Act, but appeared to have relied solely on the cc’d email from Airlines PNG, rather than telephoning the AIC with such important safety information.

Further TCAS RA notifications

During the month preceding the publication of this report, the AIC’s final report into the occurrence, Airlines PNG notified the AIC of two further TCAS RA notifications. One notification states that on 2 November 2016 at 15:48 local time, the crew of a Dash 8 aircraft received a TCAS RA. At the time of receiving the RA instruction to climb, the crew had visual contact with the opposing aircraft, a helicopter 1,000 ft below, that was maintaining 1,000 ft. That report was received by the AIC at 2:45 on 4 November. The pilot of the TCAS equipped helicopter, did not receive either a TCAS TA or RA. Because the pilots had visual contact/separation with the helicopter, the AIC did not investigate the reported occurrence.

The second notification states that on 5 November 2016, shortly after diverting right of track to allow an opposite direction Fokker F70 aircraft to have unrestricted climb, the crew of a ATR 72 aircraft, cruising at 12,000 ft received a TCAS RA. The report was received by the AIC at 03:46 local time on 15 November 2016.

At the time of receiving the RA instruction to climb, the crews of both aircraft were communicating with each other, and had each other sighted. They passed 5 nm visually to the left of each other. The crew of the TCAS equipped Fokker F70, did not report receiving either a TCAS TA or RA. Because the crews had visual contact/separation of at least 5nm, the AIC did not investigate the reported occurrence.

Accident and serious incident notifications within PNG

In 2015, PNG as a signatory State to the *Convention on International Civil Aviation* was required to demonstrate compliance with the *ICAO Universal Safety Oversight Audit (USOAP) Protocol Questions* related to all *ICAO Annexes to the Convention on International Civil Aviation*.

To ensure PNG meets its accident and serious incident reporting obligations under *ICAO Annex 13*, and the *PNG Civil Aviation Act* and *Civil Aviation Rules*, the AIC consulted with CASA about contact telephone numbers to ensure PNG meets its obligation for ensuring the PNG aviation industry has an accident and incident 24/7 telephone contact for CASA. On 22 July 2015, CASA and the AIC finalised updated telephone numbers, and a letter was sent to ICAO by the AIC as the PNG (State) investigation organisation, in order to update the ICAO State address list with respect to accidents and incidents. At that time CASA committed to informing the PNG aviation industry.

Figure 7 below (PNG 24/7 telephone contacts published by ICAO) has been copied from the ICAO contact list at <http://www.icao.int/safety/AIA/Pages/default.aspx>. It should be noted that the format is ICAO formatting. It provides a 24/7 availability to notify CASA of accidents and incidents, and a 24/7 availability for CASA to notify the AIC of accidents and serious incidents.

<p>Country : Papua New Guinea</p> <p>Chief Executive Officer Accident Investigation Commission P.O. Box 1709 Boroko 111, NCD Papua New Guinea</p> <p>Tel.: (675) 323-2911/2184 (24/7) (675) 302-7528 (Notification 2130-0600 UTC) (675) 7698-0239 (Notification 0600-2130 UTC) (675) 7031-4167 (Notification 0600-2130 UTC)</p> <p>E-mail: infor@aic.gov.pg</p> <p>Fax: (675) 323-2139</p>

Figure 7: PNG 24/7 telephone contacts for notifications to CASA published by ICAO

AIC comment

The flight crews of TAE and MCW were licensed, qualified, and medically fit in accordance with PNG *Civil Aviation Rules (CAR)*. The approach controller was properly licensed, medically fit and correctly rated to provide the service.

Both the outbound and inbound aircraft's crew acknowledged traffic information reported by the approach controller and were re-cleared to 8,000 ft and 9,000 ft respectively, on reciprocal tracks, before passing each other, which was adequate vertical separation for passing each other safely.

The crew of MCW stated that they received a TCAS Resolution Advisory (RA) and they initiated immediate action to comply with the TCAS RA instruction. However, they did not advise the ATC controller of the deviation, including its direction and when the deviation would end, as required in accordance with the AIP. As a result, PNG Air Services Ltd was not aware of the occurrence at the time. Therefore, there was no obligation at that time to fulfil their obligation under CAR 12.55.

Delays in notifications from Airlines PNG to CASA prevented the timely access to recorded information on each aircraft's flight and voice recorders. Both aircraft were certified as being airworthy when dispatched for their respective flights.

They were both fitted with TCAS equipment. Both aircraft were allocated with a unique Mode 'S' code by the PNG Civil Aviation Safety Authority (CASA). Both operators complied with the CASA Transponder code requirements and strapped the Mode 'S' transponders in accordance with codes assigned by CASA.

The TCAS equipment installed in TAE at the time of the incident was removed 65 days after the incident due to significant defects. It was replaced with a reportedly "serviceable" unit, however, further defects were reported through November and December 2015. The TCAS unit installed in MCW was determined to have been serviceable at the time of the incident.

The TCAS defect rectification testing and maintenance on the Travel Air fleet of Fokker F27 Mk 050 aircraft was not robust, and was not conducted in accordance with the approved Travel Air *Maintenance Control Manual*, and the aircraft manufacturer's *TCAS Functional Test Instructions*.

The TCAS defect rectification maintenance was not supported by appropriate testing equipment or qualified and experienced maintenance personnel. The maintenance documentation provided to the AIC by Travel Air was incomplete, and there were inconsistencies in documents, which included the *TCAS Serial Number History* and the *Component Removals and Installation*. Accordingly, the AIC was not able to verify the veracity of the maintenance carried out on the TCAS systems with any degree of confidence.

Due to the elapsed time between the serious incident and the AIC being notified, the data on the flight data recorders on TAE and MCW, and the TCAS recorded data on TAE, had been overwritten. Therefore, recorded data was not able to be used in support of this investigation.

The AIC was unable to determine why the TCAS on TAE did not provide the crew with a TA or RA, given that the TCAS in MCW provided both a TA followed by a RA. Furthermore, the crew of TAE reported sighting and passing MCW. Since the crew of TAE had descended significantly below their assigned level, coming into vertical proximity of MCW necessitating an avoidance manoeuvre by MCW, the AIC was not convinced that the crew of TAE could not have known that they had been involved in a serious incident, despite them asserting that they did not receive a TCAS TA or RA.

The AIC determined that the reporting requirements of the *Civil Aviation Act (Act)* and the *CARs* were not met by the pilots, and subsequently CASA. The delayed notification to the AIC prevented the timely download of the recorded flight data to assist the AIC's investigation into the breakdown of separation involving the Fokker F27 Mk 050, P2-TAE, and the Bombardier DHC-8-102, P2-MCW.

While *CAR Part 12.53* (accidents) and *CAR Part 12.57* (incidents) require the submission of a completed form CA005 to CASA within three working days, the *Act* and *Rules* make no provision for an organisation to delay on-forwarding an accident or serious incident notification to CASA, for the purpose of first conducting their own internal investigation or analysis of the notification. If an operator has internal procedural requirements for pilots to first notify the company of an accident or serious incident as soon as practicable, such procedures should require the PIC to also notify CASA as soon as practicable in accordance with *CAR Part 12.51* (accidents) or *CAR Part 12.55* (incidents). If a pilot is incapacitated, or is unable to notify CASA as soon as practicable about an accident or serious incident, the operator is required (in accordance with the same CARs) to notify CASA as soon as practicable.

It is evident that the PNG aviation industry in general, does not have a clear understanding of their statutory obligations under the *Act Sections 60 and 62* and *CAR Part 12*.

The AIC also found that the reporting and investigation requirements and obligations imposed on the Accident Investigation Commission through *ICAO Annex 13 to the Convention on International Civil Aviation*¹⁸, are not enunciated fully in the *PNG Civil Aviation Act* and the *PNG Civil Aviation Rules*, and may not be understood by the aviation industry, including pilots, operators, and personnel of CASA.

Safety Actions

Safety Action by Travel Air

On 27 January 2016, Travel Air informed the AIC that it had employed an Avionics Licenced Aircraft Maintenance Engineer (B2) in December 2015. Travel Air also informed the AIC that it had the appropriate TCAS Functional Test equipment, IFR 6000, and that the newly appointed avionics engineer was qualified and experienced to use the equipment.

Note: Travel Air ceased operations on 21 February 2016.

Safety Action by the Accident Investigation Commission

On 16 November 2016, the Accident Investigation Commission (AIC) notified the Civil Aviation Safety Authority of PNG (CASA), in accordance with the Civil Aviation Act, Section 244 that it was not investigating the TCAS RA events reported by Airlines PNG on 4 and 5 November 2016 respectively. In its notification to CASA, the AIC stated:

This is the fourth TCAS occurrence in the last 18 months involving Airlines PNG aircraft, where the crew of the opposing aircraft reported that they did not receive any TCAS TA or RA. Two reported occurrences involved P2-MCT (one was 14 days ago and the other 18 months ago resulting in a serious incident). One occurrence 14 months ago involved P2-MCW; that AIC investigation is nearing completion.

In bringing the notifications to the attention of CASA, the AIC recommended to CASA that *although these last two reported occurrences did not result in a serious incident, the AIC brings this ton the attention of CASA, for airworthiness considerations with respect to the TCAS and associated systems in the Airlines PNG fleet, since no opposing aircraft reported a TCAS TA or RA.*

¹⁸ PNG is a signatory State to the Convention on International Civil Aviation and must comply with the Standards of the ICAO Annexes unless a difference against a specific Standard has been filed with ICAO. Annex 13 contains the Standards and Recommended Practices for Accident and Serious Incident Investigation.

Recommendations

Recommendation number AIC 16-R01/15-2028 to Travel Air PNG Limited *(Issued 2 June 2016)*

Note: Travel Air ceased operations on 21 February 2016

The Accident Investigation Commission recommends that Travel Air PNG Limited should ensure that their Civil Aviation Safety Authority of PNG (CASA) approved maintenance organisation continues to have within its organisation or has CASA approved external access to:

- a) Appropriately experienced and qualified (licenced) aircraft maintenance engineers;
- b) Appropriate tools and equipment to conduct testing and maintenance of its aircraft fleet; and
- c) A maintenance documentation system that meets the CASA requirements of its Air Operators Certificate and Maintenance Control Manual.

Recommendation number AIC 16-R02/15-2028 to the Civil Aviation Safety Authority of PNG

(Issued 2 June 2016)

The Accident Investigation Commission recommends that the Civil Aviation Safety Authority of PNG, as a matter of urgent safety concern should:

1. Promulgate the 24/7 accident and incident notification telephone numbers for CASA in accordance with the PNG authorised ICAO published contact details on the ICAO State address list. (<http://www.icao.int/safety/AIA/Pages/default.aspx>).
2. Issue a written reminder to the PNG aviation industry, (which should include promulgation by *Notice to Airmen (NOTAM)*), including all aircraft operators and pilots, PNG Air Services Ltd, PNG National Airports Corporation, and CASA staff, articulating the PNG accident and serious incident reporting requirements of the *Civil Aviation Act Sections 60 to 62*, and *Civil Aviation Rules Part 12*, and drawing attention to *ICAO Annex 13 Attachment C, List of Examples of Serious Incidents*.

Recommendation number AIC 16-R03/15-2028 to the Civil Aviation Safety Authority of PNG

(Issued 2 June 2016)

The Accident Investigation Commission (AIC) recommends with respect to aircraft fitted with TCAS equipment (*Aircraft with a maximum all up weight of greater than 5,700 kg, under CAR 125 & 121 Ops; and aircraft fitted with Flight Data Recorder (FDR) and Cockpit Voice Recorder (CVR) equipment in accordance with CAR 125 & 121*) involved in a breakdown of separation incident where a TCAS Resolution Advisory (RA) is activated, that the Civil Aviation Safety Authority of PNG should require operators to:

1. Facilitate the aircraft's expeditious return to base or another suitable location where TCAS data download can be accomplished, and where the FDR and CVR can be quarantined for AIC collection for download and analysis at the AIC Flight Recorder Laboratory.
2. Notify the AIC of the operator's intention to download TCAS data before commencing the data download.
3. Download data from the TCAS as soon as possible after the incident and provide that data download to the AIC as soon as practicable.

Recommendation number AIC 16-R04/15-2028 to the Director of the Civil Aviation Safety Authority of PNG (Issued 2 June 2016)

In order to clarify the obligations imposed by the Civil Aviation Act for the notification and investigation of accidents and serious incidents in Papua New Guinea, and to meet the standards of Annex 13 to the Chicago Convention on International Civil Aviation imposed on PNG as a signatory State, the Accident Investigation Commission recommends that the Director of the Civil Aviation Safety Authority of PNG, under the powers vested in him by the Minister of Transport, should amend Civil Aviation Rules Part 12 as soon as possible, to include:

At Part 12.1 Purpose. After sub part (b) add the following note:

NOTE: All references to the Authority apply equally to the Civil Aviation Safety Authority and the Accident Investigation Commission with respect to sub-parts A; B; C; and Appendix A of CAR Part 12.

And insert a new Part 12.2

Part 12.2 Purpose of the Accident Investigation Commission

The Accident Investigation Commission is a statutory agency of the Papua New Guinea Government. The Commission is independent of transport regulators, policy makers and service providers. The Commission shall perform its functions in accordance with the provisions of the Civil Aviation Act, the Civil Aviation Rules, and the Commissions of Inquiry Act, and Annex 13 to the International Convention on Civil Aviation and, where applicable, other relevant international agreements. Annex 13 *Standards* shall be applied in all Commission investigations, unless a *Difference* against a *Standard* has been filed with the International Civil Aviation Organization.

The Commission shall have independence in the conduct of investigations, and shall have unrestricted authority over the conduct of its investigations, without delay, consistent with the provisions of Annex 13 and the Commissions of Inquiry Act.

Accident prevention is the sole objective of aircraft accident and serious incident investigations conducted by the Commission. Any investigation conducted by the Commission shall be separate from any judicial or administrative proceedings to apportion blame or liability. The non-disclosure provisions of Annex 13 shall be strictly applied.

Recommendation number AIC 16-R05/15-2028 to Airlines PNG (Issued 2 June 2016)

The Accident Investigation Commission recommends that Airlines PNG, as a matter of urgent safety concern should promulgate a company operational requirement:

1. for a pilot in command who is involved in an accident or incident to notify CASA as soon as practicable by telephone; and
2. for a pilot in command who is involved in an accident or incident to notify the company as soon as practicable in person, by telephone, or company radio; or
3. if a pilot is incapacitated or is unable to notify CASA, as soon as practicable after being notified of an accident or serious incident the company should notify CASA by telephone.

General Details

Date and time:	21 August 2015 0249 UTC	
Occurrence category:	Serious incident	
Primary occurrence type:	Break down of separation	
Location:	9.5 nm (17.5 km) northwest of Lae (Morobe Province)	
	Latitude: 6°39'2.50"S	Longitude: 146°51'52.72"E

Aircraft Details

Manufacturer and model:	Fokker F27 Mk 050	
Registration:	P2-TAE	
Serial Number	20202	
Type of operation:	Regular air operations	
Persons on board:	Crew: 4	Passengers: 37 adults and 1 infant
Injuries:	Crew: Nil	Passengers: Nil
Damage	Nil	



Figure 8: Fokker 27 Mk 050 (F50) P2-TAE

Manufacturer and model:	Bombardier DHC8-102	
Registration:	P2-MCW	
Serial number	067	
Type of operation:	Regular air operations	
Persons on board:	Crew: 3	Passengers: 17 adults and 1 infant
Injuries:	Crew: Nil	Passengers: Nil
Damage	Nil	



Figure 8: Bombardier DHC-8-102 (Dash 8) P2-MCW

Appendix A

Transcript of Air Traffic Control recorded communications

This table was prepared by the Accident Investigation Commission from the PNG Air Services Ltd recorded communications between P2-TAE, P2-MCW and the Nadzab Tower and Approach Controllers between 02:34:48 and 02:59:38.

Time	From	To	Transcript
02:34:48	MCW	TOWER	Nadzab tower "Mike Charlie Whiskey" for Tokua request taxi, received Charlie.
02:35:03	TOWER	MCW	"Mike Charlie Whiskey" tower, clear to taxi runway zero niner, QNH 1013.
02:35:11	MCW	TOWER	Clear to taxi runway zero niner and 1013 "Mike Charlie Whiskey"
02:35:58	TOWER	MCW	Mike Charlie Whiskey. Clearance one cruise one niner thousand.
02:36:14	TOWER	MCW	Mike Charlie Whiskey. Clearance one, cruise one niner thousand.
02:36:32	MCW	TOWER	Clearance one, one niner thousand, Mike Charlie Whiskey.
02:40:56	MCW	TOWER	Mike Charlie Whiskey is ready.
02:41:03	TOWER	MCW	Mike Charlie Whiskey. Maintain niner thousand, runway zero niner, make a right turn, cleared for take-off.
02:41:10	MCW	TOWER	Cleared for take-off runway zero niner maintain niner thousand right turn Mike Charlie Whiskey.
02:40:12	TAE	TWR	Nadzab approach good afternoon, Tango Alpha Echo passing 48DME south of Nadzab at one eight thousand with information echo estimate the field at 53 descent point 42 DME.
02:40:31	APP	TAE	Tango Alpha Echo Nadzab approach, when ready descent to one two thousand not below the DME Steps, report approaching with.....DME.
02:40:42	TAE	APP	Roger, when ready descend to one two thousand, not below DME steps, will report approaching with DME. Tango Alpha Echo.
02:45:22	TAE	APP	Tango Alpha Echo 27DME, approaching one two thousand.
02:45:29	APP	TAE	Tango Alpha Echo, descend to one zero thousand, not below the DME steps, and confirm still in IMC? The weather towards Lae. The visibility is okay, cloud there is a few across the valley at about ah 2000, overcast above 5000.
02:45:50	TAE	APP	Ah, Tango Alpha Echo, continue descent to one zero thousand, and we are visual on top. Yeah, I think, ah, overhead Lae we'll get into a bit of cloud there.
02:46:02	APP	TAE	Tango Alpha Echo, roger report when you are, if you are still visual.
02:46:06	TAE	APP	Wilco. Tango Alpha Echo.
02:46:26	MCW	TOWER	Nadzab tower, Mike Charlie Whiskey, departure.
02:46:31	TOWER	MCW	Mike Charlie Whiskey, go ahead.
02:46:34	MCW	TOWER	Mike Charlie Whiskey departed Nadzab at 45, tracking one one five, on climb niner thousand, passing five thousand five hundred, Finschaffan via Lae at zero seven.
02:46:55	TAE	APP	Tango Alpha Echo one zero thousand at 21 DME.
02:46:56	TOWER	MCW	Mike Charlie Whiskey. Roger contact approach on 118.6.
02:46:58	MCW	TOWER	118.6, Mike Charlie Whiskey.
02:47:01	APP	TAE	Tango Alpha Echo you visual?
02:47:03	TAE	APP	Visual on top. Tango Alpha Echo.
02:47:05	APP	TAE	Tango Alpha Echo roger, stand-by
02:47:08	APP	MCW	Mike Charlie Whiskey. Report DME and last vacated level.
02:47:12	MCW	APP	Mike Charlie Whiskey is 10 DME passing six thousand five hundred.
02:47:22	APP	MCW	Mike Charlie Whiskey. Roger maintain eight thousand.

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02:47:29	MCW	APP	Maintain eight thousand. Mike Charlie Whiskey.
02:47:32	APP	TAE	Tango Alpha Echo, report DME.
02:47:34	TAE	APP	Turning overhead Lae now, ah, Tango Alpha Echo.
02:47:39	APP	TAE	Tango Alpha Echo. Roger descend to niner thousand, report possible sighting of Mike Charlie Whiskey Dash 8 outbound on the one one four radial for Lae, thence zero seven six, climbing to eight thousand, estimate to pass at about 15 DME.
02:47:57	TAE	APP	Roger. We left one zero thousand for niner thousand. Will report sighting the outbound traffic. Tango Alpha Echo.
02:48:06	APP	MCW	Mike Charlie Whiskey. Climb to eight thousand, to maintain eight thousand. Report possible sighting and passing of Tango Alpha....HO..HO Echo a Fokker 50 inbound on the 114 radial, estimated to pass at about 15 DME, descending to niner thousand.
02:48:18	MCW	APP	Wilco Mike Charlie Whiskey.
02:49:06	TAE	APP	Tango Alpha Echo passed the outbound Dash 8. We are now 14 DME.
02:49:12	APP	MCW	Mike Charlie Whiskey any sighting?
02:49:14	MCW	APP	Mike Charlie Whiskey, sighted and passed Tango Alpha Echo.
02:49:16	APP	MCW	Mike Charlie Whiskey. Roger climb to one seven thousand.
02:49:25	APP	TAE	Tango Alpha Echo you visual yet?
02:49:28	TAE	APP	Ah, request arrival via Markham arrival. We are 13 DME at nine thousand.
02:49:33	APP	TAE	Roger. Descend via the Markham arrival. Report visual or at 5 DME.
02:49:39	TAE	APP	Via the Markham arrival, ah, will report visual or at 5 DME. Tango Alpha Echo.
02:49:45	APP	MCW	Mike Charlie Whiskey Confirm climb to one seven thousand and report approaching one seven thousand or 45 DME.
02:49:53	MCW	APP	Affirm. Mike Charlie Whiskey's on climb one seven thousand, report passing one thousand seven hundred, one seven thousand, or 45DME. Mike Charlie Whiskey.
02:51:03	TAE	APP	Tango Alpha Echo is 7 DME visual.
02:51:20	APP	TAE	Tango Alpha Echo. Cleared visual approach, enter circuit on right downwind and overfly is available. Advise?
02:51:27	TAE	APP	Ah, going tower joining right downwind zero nine. Tango Alpha Echo.
02:51:29	APP	TAE	Tango Alpha Echo.
02:59:28	MCW	APP	Nadzab approach, Mike Charlie Whiskey, 45 DME Lae, approaching one seven thousand, request higher.
02:59:38	APP	MCW	Climb to one niner thousand. Traffic OCTA is MCY, company Dash 8 departed Tokua for Nadzab at 0158, estimating Arawe at 0300, and Nadzab via Finschaffan and Lae 38. Contact Moresby on 123.9, or secondary 8861 at 50 DME.

Appendix B

***** TCAS II Input Data *****

Mag. Heading (Deg.): 201.35 Pitch (Deg.): up (0.13)
 Heading Status: VAL Pitch Status: VAL
 Heading Type: 429 Attitude Type: ARINC 429
 Enc. Altitude (ft.): 0.00 Roll (Deg.): right (0.92)
 Enc. Alt. Status: VAL Roll Status: VAL
 Enc. Alt. Resolution : Coarse Rad. Alt. (ft.): -1.00
 XNDR Source: Port #1 Rad. Alt. Status: VAL
 Landing Gear(A21): Extended Rad. Alt. Type: 429 Rad. Alt.
 Air/Ground(A22): On Ground Rad. Alt Source(A66): Port #1

Mode 'S' code address for
P2-TAE on HEX & Octal

Aircraft (Mode S) Address: NOT USA 898068 (HEX) 42300150 (Octal)
 Airborne Funct. Test: Inhibited Max Airspeed: NO MAX
 Performance Limit: Enabled Display Intruder Limit: 12
 Functional Test(A20): INACTIVE Adv Inhibits #1 - #2: OPEN OPEN
 Aural Output: No Tone or Muting Intruder File Format: ARINC 735
 Altitude Limit: 26000 Adv./Annunciator Cancel: NO (OPEN)
 SPARE: OPEN Display All Traffic: YES
 Own A/C Sensitivity: 1 Gnd Display Mode: STANDBY

Air Volume 20 mw, 0.0625 watts Gnd Volume 20 mw, 0.0625 watts
 Climb Inhib 1-2: OPEN OPEN Inc Climb Inhib 1-2: GND GND
 TA Flag #1, #2(A34,35): VAL INV RA Flag #1, #2(B85,86): VAL INV
 Top Antenna(J1-J4): 7f 80 80 80 Bottom Antenna(J1-J4): 7f 80 80 80
 DIAGNOSTIC LOG DUMP:

Unit Configuration:

Unit KPN: 066-01146-1211
 Unit Serial#: 40192
 EEPROM Unit Config Checksum: 146
 Unit Software ID: 206-00277-1105
 Software Version: TPU67A Ver 4.14
 Configuration Module Compatibility Code: 3

Part Number and
Serial Number of TCAS
installed on P2-TAE
during the incident

Current Hobbs Meter : 20117.7 hrs

TCAS SN 40192 Input Data (Fitted to P2-TAE at the time of the incident)

Appendix C

```
'CLEAR OF CONFLICT'
Own Aircraft:
  Altitude: 2500 ft.   Sensitivity: 4
  Altitude Rate: 0 ft./min.  Climb/Inc. Climb Inhib: N/N
  Rad. Alt.: 2369 ft.   Hobbs/clock: 1.0 hrs/3680.0 secs
Intruder (Mode C):
  Altitude: 2500 ft.   Range: 0.5 nmi
  Alt. Rate: 0 ft./min.  Rng Rate: 83 knots
  Bearing: -109 degrees

'INCREASE CLIMB; INCREASE CLIMB'
Own Aircraft:
  Altitude: 2473 ft.   Sensitivity: 4
  Altitude Rate: -9 ft./min.  Climb/Inc. Climb Inhib: N/N
  Rad. Alt.: 2373 ft.   Hobbs/clock: 1.0 hrs/3667.1 secs
Intruder (Mode C):
  Altitude: 2466 ft.   Range: 0.8 nmi
  Alt. Rate: -540 ft./min.  Rng Rate: -261 knots
  Bearing: -43 degrees
RA Information: TA Occurred
  ARA = 00000000100101, RAC = 0000, RAI = 0
  Crossing: N, Multi. Threat: N

'CLIMB, CLIMB'
Own Aircraft:
  Altitude: 2550 ft.   Sensitivity: 4
  Altitude Rate: -6 ft./min.  Climb/Inc. Climb Inhib: N/N
  Rad. Alt.: 2436 ft.   Hobbs/clock: 1.0 hrs/3656.1 secs
Intruder (Mode C):
  Altitude: 2467 ft.   Range: 1.6 nmi
  Alt. Rate: -360 ft./min.  Rng Rate: -281 knots
  Bearing: -38 degrees
RA Information: TA Occurred
  ARA = 00000000100001, RAC = 0000, RAI = 0
  Crossing: N, Multi. Threat: N
```

Event #1 (most recent)

Mode C transponder return from intruder aircraft. Unable to determine intruder registration number without Mode S code.

TCAS SN 40192 Input Data (Fitted to P2-TAE)¹⁹

¹⁹ Travel Air maintenance records were incomplete and this date may be inaccurate. However, it was the TCAS fitted to P2-TAE at the time of the 27 January 2016 TCAS investigation test conducted by the Accident Investigation Commission.