



**FINAL REPORT
AIC 16-2001**

AIRCRAFT SERIOUS INCIDENT REPORT

**Air Niugini & SIL Aviation
P2-AND & P2-SIR
Fokker 100 & Quest Kodiak-100
TCAS RA 3.5 nm (6.4 km) northwest of Nadzab Airport
Morobe Province
PAPUA NEW GUINEA
16 December 2016**

On 20 December 2016, the Papua New Guinea Accident Investigation Commission (AIC) was informed of a Traffic Alert and Collision Avoidance System (TCAS) Resolution Advisory (RA) serious incident involving a Fokker FK28- Mk010 (F100) aircraft and a Quest Kodiak 100 aircraft that occurred on 16 December 2016. The serious incident occurred 3.5 nm northwest of Nadzab Airport, Morobe Province, at 10:57 local time. An investigation was immediately commenced by the AIC.

This Final Report, was produced by the AIC, PO Box 1709, Boroko 111, NCD, Papua New Guinea. It has been approved for public release.

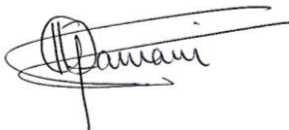
The Final Report¹ is based upon the investigation carried out by the AIC, in accordance with Annex 13 to the Convention on International Civil Aviation, Papua New Guinea (PNG) Civil Aviation Act 2000 (as amended), and Civil Aviation Rules 2015 (as amended). It contains factual information, analysis of that information, findings and contributing (causal) factors, other factors, safety actions, and recommendations.

Readers are advised that in accordance with Annex 13 to the Convention on International Civil Aviation, it is not the purpose of an AIC aircraft accident investigation to apportion blame or liability. The sole objective of the investigation and the Final Report is the prevention of accidents and incidents. (Reference: ICAO Annex 13, Chapter 3, paragraph 3.1.) Consequently, AIC reports are confined to matters of safety significance and may be misleading if used for any other purpose.

When the AIC makes recommendations as a result of its investigations or research, safety is its primary consideration. However, the AIC fully recognises that the implementation of recommendations arising from its investigations will in some cases incur a cost to the industry.

Readers should note that the information in AIC reports and recommendations is provided to promote aviation safety. In no case is it intended to imply blame or liability.

Approved



Mr. Hubert Namani

Chief Commissioner

21 August 2017

¹ Cover graphic photo adjusted for illustrative purposes.

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INTRODUCTION

SYNOPSIS

On 16 December 2016, at 00:57 (UTC) a Fokker FK28-Mk 0100 (F100) aircraft, registered P2-AND (AND), operated by Air Niugini (ANG) Ltd, and a Quest Kodiak 100 aircraft, registered P2-SIR (SIR), operated by Summer Institute of Linguistics (SIL) Aviation, were involved in a TCAS RA breakdown of separation serious incident about 3.5 nm (6.4 km) northwest of Nadzab Airport, Morobe Province.

SIR had tracked from the Yalumet area towards Nadzab via the Saidor Gap, located 20 nm (36.8 km) north of Nadzab Airport, to remain in visual meteorological conditions (VMC). The pilot obtained an airways clearance from Moresby Flight Service for the new destination, Nadzab, and was cleared to track 166° to Nadzab. The pilot transferred to Nadzab Approach as instructed at time 00:52:49 UTC, and the Approach Controller subsequently cleared SIR to *“track 157° to the field”*, and cleared the aircraft to descend to 3,000 ft visual. After establishing contact with the Aerodrome Controller (ADC) at 10 nm (18.5 km) from Nadzab, SIR was cleared to join the circuit mid-downwind for runway 27, and was advised that a departing aircraft was tracking on the 300° radial.

At 00:49:11, AND was issued Standard Departure Clearance (SDC) 36 by the Aerodrome Controller. At 00:51:34, AND reported ready for takeoff from runway 27 and the Aerodrome Controller provided the following clearance. *“Alpha November Delta make a left or right turn, QNH now 1008, cleared for take-off.”* The crew of AND chose a right turn after take-off and tracked to intercept the 003° radial in accordance with the SDC 36.

At 00:56:06, the pilot of SIR transmitted *“Nadzab Tower, due TCAS alert, Sierra India Romeo, this is only caution on climb again to 7000. Ah got 2 miles traffic”*. At 00:57:17 the crew of AND transmitted on the Approach Control frequency *“Alpha November Delta we on a TCAS climb”*.

AND first received a Traffic Advisory (TA), which appeared on the navigation display as a yellow triangle, and aural advisory stating *“Traffic, Traffic”*. The crew reported that this was followed by a Resolution Advisory (RA), displayed as a red square, and aural instruction, which stated *“Maintain vertical speed”*. The crew complied with the TCAS RA instruction.

The investigation found that the duty Aerodrome Controller (ADC) had taken a rest break, leaving the Approach Controller (APP)/Supervisor to cover both frequencies. Subsequently, an off-duty Aerodrome Controller took over the ADC responsibilities. However, he did so without authority, and had not received a briefing or coordination, although the supervisor condoned his actions.

The ADC lacked situational awareness by telling the pilot of SIR that the outbound F100 was tracking 300°, when in fact AND was making a right turn in accordance with the take-off clearance and the SDC 36 to intercept 003° track from Nadzab. In clearing AND to make a right turn, the ADC placed the outbound AND into direct conflict with the inbound SIR.

The investigation found that there was a lack of coordination between the ATS controllers, which also contributed to the breakdown of separation between the aircraft. There was a lack of compliance with PNG ASL Standard Operating Procedures for the ATS responsibilities and management of the functions of the Aerodrome Controller and the Approach Controller.

PNG Air Services Limited and Air Niugini did not report the incident, and SIL Aviation provided an initial notification 4 days after the incident. The initial notification actions were not in accordance with PNG legislated requirements. The lack of timely notification deprived the investigation of significant data from AND’s Flight Recorders, that would have assisted in the analysis of factors that contributed to this serious incident.

PNG ASL procedures exceeded the legislated notification requirements, but the duty supervisor did not comply with the procedures.

The AIC issued safety recommendations to SIL Aviation and Air Niugini recommending amendments to their safety manuals to ensure their procedures complied with the mandatory notification obligations of the primary legislation, Civil Aviation Act, Section 60.

SIL Aviation provided evidence of manual amendments to address the safety deficiency.

At the time of publication of this Final Report on 21 August 2017, Air Niugini Limited had not provided evidence to assure the AIC that their notification procedures were in accordance with of the primary legislation, Civil Aviation Act 2000 (as amended), Section 60.

1 FACTUAL INFORMATION

1.1 History of the flight

On 16 December 2016, at 00:57 (UTC)² a Fokker FK28-Mk 0100 aircraft³, registered P2-AND (AND), operated by Air Niugini (ANG) Ltd, and a Quest Kodiak 100 aircraft, registered P2-SIR (SIR), operated by Summer Institute of Linguistics (SIL) Aviation, were involved in a breakdown of separation occurrence about 3.5 nm (6.4 km) northwest of Nadzab Airport, Morobe Province.

SIR was being operated as a private flight and under the visual flight rules⁴ (VFR). On board were 3 persons: 1 pilot; and 2 adult passengers. The aircraft departed Aiyura, Eastern Highlands Province for Yalumet, Morobe Province as the planned destination, but diverted to Nadzab due to adverse weather in the Yalumet area.

AND was being operated as scheduled passenger service, flight number was PX292, under the instrument flight rules⁵ (IFR) from Nadzab to Momote. On board were 85 persons: 2 pilots; 3 flight attendants; and 80 passengers.

SIR tracked from the Yalumet area towards Nadzab via the Saidor Gap, located 20 nm (36.8 km) north of Nadzab Airport, to remain in visual meteorological conditions⁶ (VMC). The pilot obtained an airways clearance from Moresby Flight Service for the new destination, Nadzab, and was cleared to track 166° to Nadzab, with an instruction to enter controlled airspace on climb to 12,000 ft, and to contact the Nadzab Approach Controller (APP).

The pilot transferred to Nadzab Approach as instructed at time 00:52:49 UTC, and advised the controller that he was “*tracking inbound on the 166° radial⁷, 16 miles to run, maintaining 12000 ft, with infor Charlie. Request top of descent. ETA Nadzab on the hour*”. Shortly after, the pilot of SIR informed the Approach Controller that he was heading 157° with a track of 157°. The Approach controller then cleared SIR to “*track 157° to the field*”, and cleared the aircraft to descent to 3,000 ft visual, and transfer to the Aerodrome Controller (ADC) at 10 nm (18.5 km) from Nadzab.

At 00:49:11, AND was issued with a Standard Departure Clearance⁸ (SDC) 36 by the Aerodrome Controller. At 00:51:34, AND reported ready for take-off from runway 27 and the Aerodrome Controller provided the following clearance. “*Alpha November Delta make a left or right turn, QNH now 1008, cleared for take-off.*” The crew of AND chose a right turn after take-off and, in accordance with the SDC 36, subsequently tracked to intercept the 003° radial.

In accordance with the clearance from the Approach Controller, SIR was descending to 3000 ft visual. It was descending at 2,000 ft per minute. At 00:56:06, the pilot of SIR transmitted “*Nadzab Tower, due TCAS alert, Sierra India Romeo, this is only caution on climb again to 7000. Ah got 2 miles traffic*”.

² 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.

³ The Fokker FK28 Mk 0100 aircraft is commonly referred to as the Fokker 100.

⁴ Visual Flight Rules: Prescribed in Civil Aviation Rules Part 91, Sub-Part D. The rules allow a pilot to only operate an aircraft in weather conditions where the flight can be conducted clear of cloud and in sight of the surface with a flight visibility of not less than 5 km.

⁵ Instrument Flight Rules: 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.

⁶ Visual Meteorological Conditions: expressed in terms of visibility, distance from cloud, and ceiling equal to or better than specified minima

⁷ The pilot incorrectly stated the 166° radial. He was actually tracking 166° magnetic, which was on the 346° radial of the Nadzab Very High Frequency Omni-Directional Radio Range (VOR).

⁸ SDC 36: A Standard Departure Clearance requiring the departing aircraft to track 003° from NZ to OKTUX and MOE.

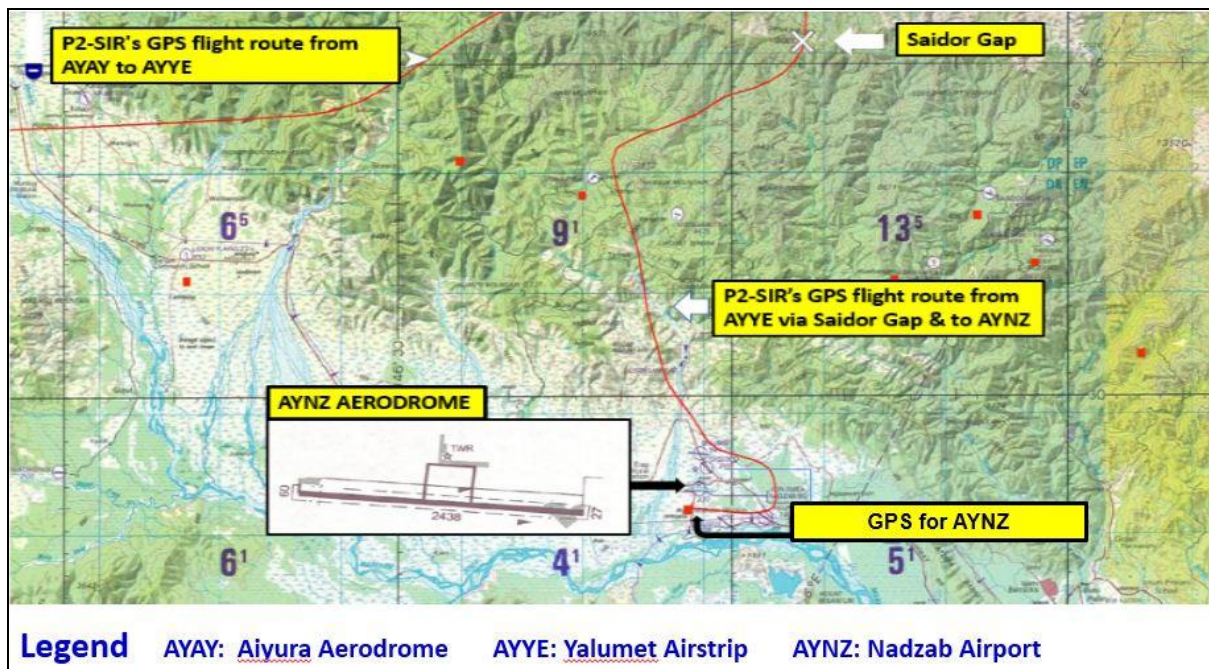


Figure 1: GPS flight Route for P2-SIR
(Source: SIR GPS track. Image enhanced by the AIC)

To avoid the traffic displayed as a symbol on the Multi-Function Display⁹ (MFD), the pilot of SIR immediately stopped the descent and commenced climbing to 7,000 ft at a rate of 1000 ft per minute.

At 00:57:17 the crew of AND transmitted on the Approach Control frequency “Alpha November Delta we on a TCAS climb”.

At the same time that SIR was climbing to 7000 ft to avoid AND, (the conflicting traffic) AND was on an unrestricted climb to FL290 (29,000 ft). Aural and visual alerts were triggered by the airborne collision avoidance systems (ACAS) of each aircraft; AND was fitted with a Traffic Collision Avoidance System (TCAS), and SIR was fitted with a Traffic Avoidance System (TAS).

The crew of AND reported that they first received a Traffic Advisory¹⁰ (TA), which appeared on the navigation display as a yellow triangle, and aural advisory stating “Traffic, Traffic”.

They stated that the TA was followed by a Resolution Advisory¹¹ (RA), displayed as a red square, and an aural instruction, which stated “Maintain vertical speed”. Because they were on a maximum rate climb at the time they continued at that rate of climb.

The crew of AND stated that they continued climbing until they received the aural message “Clear of traffic”, and then continued on the assigned track to Momote.

⁹ A **multi-function display** is a small screen (CRT or LCD) surrounded by multiple **soft keys** (configurable buttons) that can be used to display information to the user in numerous configurable ways. MFDs allow the pilot to display navigation routes, moving map, weather radar, NEXRAD, GPWS, TAS or TCAS and airport information all on the same screen.

¹⁰ An indication given to the flight crew that a certain intruder is a potential threat.

¹¹ RA: An indication given to the flight crew recommending a maneuver intended to provide separation from all threats; or a maneuver's restriction intended to maintain existing separation. When an RA is issued, pilots are expected to respond immediately to the RA unless doing so would jeopardize the safe operation of the flight. This means that aircraft will at times have to maneuver contrary to ATC instructions or disregard ATC instructions. In these cases, the controller is no longer responsible for separation of the aircraft involved in the RA until the conflict is terminated.

1.2 Injuries to persons

Table 3: Injuries to persons P2-AND

Injuries	Flight crew	Passengers	Total POB	Others
Fatal	-	-	-	-
Serious	-	-	-	-
Minor	-	-	-	Not applicable
Nil Injuries	5	80	85	Not applicable
TOTAL	5	80	85	-

Table 2: Injuries to persons P2-SIR

Injuries	Flight crew	Passengers	Total POB	Others
Fatal	-	-	-	-
Serious	-	-	-	-
Minor	-	-	-	Not applicable
Nil Injuries	1	2	3	Not applicable
TOTAL	1	2	3	-

1.3 Damage to aircraft

No damage to both aircraft.

1.4 Other damage

No other damage.

1.5 Personnel information

1.5.1 Pilot in Command P2-AND

Age	: 45
Gender	: male
Type of licence	: ATPL
Valid to	: perpetual (valid with medical)
Aircraft Type Ratings	: DHC6; DHC8; E110; F70/F100
Total flying time	: 9,909.00 hours
Total on this type	: 512.94 hours
Total last 90 days	: 167.90 hours

Total on type last 90 days	: 167.90 hours
Total last 7 days	: 19.8 hours
Total on type last 7 days	: 19.8 hours
Total last 24 hours	: 5.03 hours
Total on the type last 24 hours	: 5.03 hours
Total on duty last 48 hours	: 15.92 hours
Total rest period(s) last 48 hours	: 29.0 hours
Last recurrent training	: 11 October 2016
Last proficiency check	: 12 October 2016
Last line check	: 29 June 2016
Route recency	: 29 June 2016
Medical class	: One
Valid to	: 4 March 2017
Medical limitations	: nil

1.5.2 Copilot P2-AND

Age	: 27
Gender	: female
Type of licence	: CPL
Valid to	: perpetual (valid with medical)
Aircraft Type Ratings	: BE-76; DHC8; F70/F100
Total flying time	: 3,373 hours
Total on this type	: 1,580.00 hours
Total last 90 days	: 130.00 hours
Total on type last 90 days	: 130.00 hours
Total last 7 days	: 14.68 hours
Total on type last 7 days	: 14.68 hours
Total last 24 hours	: 3.57 hours
Total on the type last 24 hours	: 3.57 hours
Total on duty last 48 hours	: 3.57 hours
Total rest period(s) last 48 hours	: 38.0 hours
Last recurrent training	: 17 September 2016
Last proficiency check	: 16 September 2016
Last line check	: 17 Jan 2013
Route recency	: 17 Jan 2013
Medical class	: one
Valid to	: 21 April 2017
Medical limitations	: nil

1.5.3 Pilot in Command P2-SIR

Age	: 43 years
Gender	: male
Type of licence	: CPL
Valid to	: perpetual (Valid with medical)
Rating	: Kodiak 100, Baron/Travel-air
Total flying time	: 2,672.1 hours
Total on this type	: 1,306.2 hours
Total last 90 days	: 93.0 hours
Total on type last 30 days	: 93.0 hours
Total last 7 days	: 8.8 hours
Total on type last 7 days	: 8.8 hours
Total last 24 hours	: 3.7 hours
Total on the type last 24 hours	: 3.7 hours
Total on duty last 48 hours	: 18.0 hours
Total rest period(s) last 48 hours	: 30.0 hours
Last proficiency check	: 31 August 2016
Last line check	: 28 January 2016
Route recency	: 30 September 2016
Nadzab airspace recency	: 23 November 2016
Medical class	: one
Valid to	: 15 June 2017
Medical limitation	: near vision correction required

1.5.4 Aerodrome Controller

The duty Aerodrome Controller (ADC) was operating the ADC frequency until 00:06:02 when he left the console to take a rest break, leaving the Approach Controller (APP) /Supervisor to cover both frequencies. The Approach Controller's first transmission after taking over from the duty ADC transmitted was at 00:23:55, when he cleared P2-ANU for a visual approach. He continued operating both the ADC and the APP frequencies until 00:38:49.

At 00:41:18, an off-duty controller, without authority, and without a hand-over, take-over briefing or coordination, took over Aerodrome Control communication and issued a visual approach clearance to P2-ATC. At 00:46:18 the off-duty controller issued a start clearance to AND. Between 00:41:18 and 01:02:16 the Approach Controller and the off-duty ADC were talking on the ADC frequency at various times.

The off-duty Aerodrome Controller had 3 years of experience as an Aerodrome Controller. His ratings and endorsements were current at the time of the occurrence, and his last performance check was on 7 November 2016, a month before the serious incident (incident)¹².

¹² This TCAS RA occurrence was a serious incident. However, for ease of reading, the report will normally use the term incident when discussing the serious incident.

He held a class 3 medical certificate, valid until 23 December 2020. For the 3 days prior to the day of the incident, the controller had not been on duty while he undertook ATS medical renewal duties. He had not reported any fatigue- or health-related issues, and he was not taking any medication. On the day of the incident, he was rostered to commence duty at 02:00.

1.5.5 Approach Controller

The approach controller was a senior controller with approximately 26 years air traffic control experience. He resigned in 2010, and was recalled as a trainer in 2012. During the 2 days prior to the incident, the Approach Controller had worked two shifts in the area/approach role as follows:

14 December 2016 1200 to 1900 (as area/approach controller); and

15 December 2016 1200 to 1900 (as area/approach controller).

The shift during which the incident occurred, was the third shift of the operational shift cycle:

16 December 2016 0500 to 1200 (as area/approach controller/supervisor)

His license, ratings and endorsements were current at the time of the occurrence, and his last performance check was on 22 January 2016. He held a Class 3 medical certificate, valid until 24 August 2017.

The Approach Controller had not reported any fatigue- or health-related issues.

1.6 Aircraft information

1.6.1 Aircraft data P2-AND

Aircraft manufacturer	: FOKKER
Model	: FK28-Mk 0100
Serial number	: 11473
Date of manufacture	: April, 1995
Nationality and registration mark	: PNG, P2-AND
Name of the owner	: Bank South Pacific
Name of the operator	: Air Niugini
Certificate of Airworthiness issued	: 04 January 2007
Valid to	: non-terminating
Certificate of Registration issued	: 04 January 2007
Valid to	: non-terminating



Figure 2: P2-AND

1.6.2 Aircraft data P2-SIR

Aircraft manufacturer	: Quest
Model	: Kodiak 100
Serial number	: 100-0038
Country and year of manufacture	: USA; 2010
Nationality and registration mark	: PNG, P2-SIR
Name of the owner	: SIL Aviation
Name of the operator	: SIL Aviation
Certificate of Airworthiness issued	: 19 November 2010
Valid to	: non-terminating
Certificate of Registration issued	: 19 November 2010
Valid to	: non-terminating



Figure 3: P2-SIR

1.6.3 Engine data

The engines were not relevant to this serious incident.

1.6.4 Propeller data

The propellers were not relevant to this serious incident.

1.6.5 Collision avoidance systems

1.6.5.1 Traffic Alert and Collision Avoidance System (TCAS) fitted to AND

AND was equipped with a Traffic Alert and Collision Avoidance System (TCAS) as required under *Civil Aviation Rule (CAR) 121.381, Airborne Collision Avoidance System*, with a serviceable Mode S transponder.

TCAS fitted to AND

Manufacturer	Rockwell Collins
Model	TPU 67A TCAS-II
Part Number	822-1293-033
Serial Number	133057
FAA TSO	C-119b
Version	7.1

TCAS II is a system used for detecting and tracking other aircraft in the vicinity. By interrogating their transponders, it analyses the replies to determine range, bearing, and if reporting altitude¹³, the relative altitude of the intruder. Should the TCAS II processor determine that a possible collision hazard exists, it issues visual and audio advisories to the crew for appropriate vertical avoidance manoeuvres. TCAS II is unable to detect any intruding aircraft without a serviceable transponder operating in Mode A, or C, or S.

Should TCAS II predict that certain safe boundaries may be violated, it will issue a Traffic Advisory¹⁴ (TA) to alert the crew that closing traffic is in the vicinity.

If the intruder continues to close, TCAS II will issue a Resolution Advisory (RA)¹⁵ to maintain safe vertical separation between the aircraft. TCAS II bases the advisory instructions on a 5-second crew reaction time to achieve adequate separation. Increase or reversal of an RA requires a reaction in 2.5 seconds.

The traffic conflict information is provided in the form of visual and aural vertical-manoeuving instructions on the EFIS Display Unit.

The manufacturer of the TCAS equipment advised the AIC that:

TCAS does not receive an RA, but generates it depending on the Transponder assuming a Mode C or Mode S Transponder is installed. In this situation the TCAS unit could generate an RA, but TCAS II does not coordinate with TCAS I on the other aircraft. It is our understanding that TCAS I aircraft do not generate RA's only TA's.

¹³ Means if the aircraft has an operable Mode C or Mode S transponder. If Mode A, altitude is not reporting.

¹⁴ An indication given to the flight crew that a certain intruder is a potential threat

¹⁵ An indication given to the flight crew recommending a manoeuvre intended to provide separation from all threats; or a manoeuvre restriction intended to maintain existing separation.

A TCAS II equipped aircraft (AND) could not coordinate with the TAS equipped aircraft (SIR), but the AND system could generate a RA. The TAS equipment will only provide TA information to the TAS equipped aircraft (SIR), but the TCAS II equipped aircraft (AND) generates a RA.

1.6.5.2 Air Niugini Standard Operating Procedures for TCAS advisories.

The *Fokker Flight Crew Operating manual, Volume 1, Section 2.42.2.3 Response to Traffic Advisories* states;

A traffic advisory, with its associated TCAS voice annunciation “Traffic, Traffic”, is a prediction that another aircraft will enter the collision airspace within 25 to 45 seconds. It does not provide authority to deviate from an Air Traffic Control clearance.

Immediately upon a TA annunciation, Pilots must attempt to establish visual contact with the intruder. The PF must not manoeuvre solely on the basis of a TA, although subsequent visual acquisition of the intruder may make it necessary to perform some avoidance action.

Section 2.42.2.4 Response to Resolution Advisories states:

WARNING: NEVER MANOEUVRE OPPOSITE TO A TCAS RA.

A resolution advisory with its associated TCAS voice acquisition, is a prediction that another aircraft (that is providing altitude data) will enter the collision airspace within 25 seconds. When TCAS predicts an RA, TCAS vertical guidance is displayed.

The PF must immediately disengage the autopilot and respond to the RA commands unless the Captain considers that doing so would jeopardise the safe operation of the flight. ...

... The PM should attempt to establish visual contact, ensure proper compliance with the RA by the PF and advise Air Traffic Control of the deviation as soon as practicable, stating the aircraft call sign and the nature of the TCAS manoeuvre (for example “TCAS RA”)....

1.6.5.3 Traffic Advisory System (TAS) fitted to SIR

SIL Aviation installed a Garmin GTS 800 Traffic Advisory System (TAS), with a Mode S transponder in SIR. The system is an ACAS I.

TAS fitted to SIR

Manufacturer	Garmin
Model	GTS 800
Part Number	010-00519-00
Serial Number	15L009054
FAA TSO	C-147

This system essentially works like a TCAS, with the difference that no resolution advisories (RA) can be generated. The TAS uses an on-board interrogator-processor, and altitude reporting transponder for the air-to-traffic data link. Traffic is displayed according to TCAS symbology using four different symbols. There are four levels of traffic information; Non-Threat Traffic; Proximity Advisory; Traffic Advisory; and Traffic Advisory off scale.

A Traffic Advisory (TA) alerts the crew to a potentially hazardous confliction with an intruder aircraft. Closing rate, distance, and vertical separation meet TA criteria.

1.6.5.4 SIL Aviation Standard Operating Procedures on TAS advisories.

SIL Aviation

Page 7-36 of the SIL Aviation *Quest Kodiak 100 Pilot Operating Handbook* states;

Warning: The GTS 800 Traffic Advisory System (TAS) is intended for advisory use only, to aid the pilot in visually acquiring traffic. No avoidance maneuvers should be based solely upon TAS traffic information. It is the responsibility of the pilot in command to see and maneuver to avoid traffic.

The *SIL Aviation Fixed Wing Line Operations Manual* reinforces the *Quest Kodiak 100 Pilot Operating Handbook* warning, and states:

An effective lookout for other traffic is a critical part of flight operations.

1.6.5.5 TCAS and TAS recorded data

The TCAS and TAS installed in AND and SIR respectively, did not contain internal memory. Therefore, incident data was not recorded. *ICAO Document 9863, Airborne Collision Avoidance System (ACAS) Manual, Appendix 5*, recommends the data to be stored by a dedicated ACAS recorder.

1.7 Meteorological information

The weather at Nadzab Airport was clear of cloud. Most of the area around the airport was clear of cloud and visual meteorological conditions existed, however there were a few clouds towards the north and northwest of the airport.

The crew of AND described the weather at the time of the traffic conflict as a ‘*clear day and we saw the Kodiak at the 11 o’clock position*’ relative to their aircraft.

1.8 Aids to navigation

Ground-based navigation aids and on-board navigation aids and their serviceability were not a factor in this occurrence.

1.9 Communications

AND was equipped with very high frequency (VHF) radio communication systems. The Air Niugini Standard Operations Procedures (SOP) require the VHF radio 1 and VHF radio 2 to be tuned to ATS frequencies and the company’s allocated frequency respectively.

The crew of AND stated that the VHF radios were tuned according to SOP’s requirement. VHF radio 1 on the Captain’s side was tuned to 118.6 the Approach Control frequency, and VHF radio 2, on the First officer’s side was tuned to the company’s frequency. The ATS transcript is at *Appendix 3*.

SIR was equipped with two VHF radio communication systems. The SIL Aviation SOPs require one of the VHF radios to be tuned to the relevant ATS frequency, and the other to be on standby, for other ATS frequencies.

The pilot of SIR was communicating with Nadzab Aerodrome Control using VHF radio 2 on frequency 121.7. VHF radio 1 was still tuned to 118.6, the Approach Control frequency, having just transferred to the ADC frequency. Shortly after the TAS display showed the symbol denoting potentially conflicting traffic, the pilot selected the audio on VHF radio 1 (the Approach Control frequency) “ON”, to enable him to monitor traffic information.

All communications between the Nadzab Air Traffic Controllers and the crew of SIR and AND were recorded by ground based automatic voice recording equipment for the duration of the flights within the Nadzab Control Airspace. The quality of the recording was good.

1.10 Aerodrome information

Nadzab Aerodrome is located 30 km northwest of Lae, with coordinates; Latitude 06°34'11.38''S, Longitude 146°43'33.59''E. The Aerodrome has one runway, which is oriented 09/27.



Figure 4: Aerial View of Nadzab Airport

1.11 Flight recorders

SIR was not fitted with a cockpit voice recorder or a flight data recorder, nor were they required by PNG Civil Aviation Rules.

AND was equipped with a Cockpit Voice Recorder (CVR) and Flight Data Recorder (FDR) in accordance with PNG Civil Aviation Rules Part 121.369 and 121.371 respectively.

The CVR installed in AND was a Solid State CVR (SSCVR). The duration for data storage was 120 minutes. The serious incident was not reported by either of the operators or PNG Air Services Limited, at the time of the occurrence.¹⁶ SIL Aviation notified the Accident Investigation Commission about the incident 4 days after the occurrence.

The recorded data from the SSCVR in AND was overwritten by the more recent data, and therefore was not available for the AIC's investigation.

The FDR installed in AND was a Solid State Flight Data Recorder¹⁷ (SSFDR). See *Appendix 4*, for the Details of the SSFDR and the FDR System.

The data was retrieved from the recorder by the AIC's Flight Recorder Investigator while on-wing¹⁸, on 22 December 2016, and was taken to the AIC Flight Recorder Laboratory in Port Moresby for analysis.

Teledyne Data Frame Layout Documents were provided by the Air Niugini, and were used in the analysis.

¹⁶ Notification requirements: PNG Civil Aviation Act 2000 (as amended) Section 60, PNG Civil Aviation Act 2015 (as amended) (CAR) Part 12, Section 12.55 and 12.57. The RA is a serious incident CAR 12.55 (b) and ICAO Annex 13 Attachment C.

¹⁷ Is a crash survivable data recorder capable of retaining up to 25 hours of flight. The SSFDR is connected to the FDAU and receives a serial Harvard Bi-phase data stream at a rate of 64, 128, 256 or 512.

¹⁸ The technical terminology used when the data is downloaded from the flight recorders while installed in the aircraft.

Further documentation was requested from Fokker Services, Netherlands, due to the documentation obtained from Air Niugini not having the conversion equations, as required under *ICAO Annex 6, Operations of Aircraft, Part I, Appendix 8, Flight Recorders, Paragraph 2.3.3*, which states:

Documentation concerning parameter allocation, conversion equations, periodic calibration and other serviceability/maintenance information shall be maintained by the operator.

The documentation needs to be sufficient to ensure that accident investigation authorities have the necessary information to read out the data in engineering units.

The following parameters were used to check if the serious incident data was recorded and still available for analysis.

Date (Day/Month)

GMT (h/m/s) in UTC

Flight Number

Latitude

Longitude

The recorded data covering the time of the serious incident had been overwritten due to the delay in the AIC being notified of the incident and therefore able to access the aircraft and the flight recorders. The serious incident occurred at 00:57 and the available data commenced at 04:25:36. See *Appendix 4, Section 5.5* for data retrieved from the SSFDR from 04:25:36.

ICAO Annex 6, Operations of Aircraft, Part I, Chapter 11, *Manual, Logs and Records* Paragraph 11.6, states that the Operator shall:

Ensure, to the extent possible, in the event the aeroplane becomes involved in an accident or incident, the preservation of all related flight recorder records and, if necessary, the associated flight recorders, and their retention in safe custody pending their disposition as determined in accordance with Annex 13.

NOTE: The lack of timely notification deprived the investigation of significant data that would have assisted in the analysis of factors that contributed to this incident.

1.12 Wreckage and impact information

Not relevant to this investigation. Neither aircraft were damaged.

1.13 Medical and pathological information

No medical or pathological investigations were conducted as a result of this occurrence, nor were they required.

1.14 Fire

This section is not relevant to this investigation.

1.15 Survival aspects

This section is not relevant to this investigation.

1.16 Tests and research

No tests or research were required to be conducted as a result of this occurrence.

1.17 Organisational and management information

1.17.1 Summer Institute of Linguistics (SIL) Aviation

SIL Aviation

PO BOX 413

Ukarumpa, EHP 444

Papua New Guinea

SIL Aviation operates a fleet of Quest Kodiak 100 aircraft and Bell 206 L3 Long Ranger helicopters throughout PNG, from its base at the Aiyura Aerodrome in the Eastern Highlands of PNG.

1.17.1.1 Procedures for Notification and Reporting of accidents/incidents

The SIL Aviation's *Safety and Quality Manual, Chapter 13*, dated 1 January 2012, specifies the accident and incident notification and reporting requirements:

13.1.1 At the time of an occurrence, it must be determined whether it is an accident or incident before proceeding to the notification steps.

The manual refers the user to *CAR 12.3* for definitions of accident, incident and serious incident. However, *CAR Part 12* does not define accident, incident or serious incident. Accident and incident are defined in *The Civil Aviation Act 2000 (as amended)*, and in *ICAO Annex 13*.

Section 13.2 of the manual provides a flow chart depicting the steps to be followed in the notification process. See *Appendix 5*.

The manual states that the CEO shall ensure that CASA PNG is initially notified as soon as practicable regarding the occurrence of the following:

- a. Aerodrome incident
- b. Aircraft incident
- c. Airspace incident
- d. ...

Section 13.7 of the manual states that:

Occurrence reporting shall be made on form CASA PNG 005 within 10 days of an accident and within 14 days of an incident.

The incident involving AND and SIR was a TCAS/TAS breakdown of separation incident, which involved SIR taking avoidance manoeuvring action resulting in a deviation from a cleared flight path. It was therefore a serious incident.

Note: The SIL Aviation notification requirements did not comply with the requirements of the Civil Aviation Act 2000 (as amended), Section 60, and the Civil Aviation Rules 2015 (as amended), Part 12, Section 12.55.

1.17.2 Air Niugini Limited

Air Niugini Limited
Air Niugini House
Jacksons Airport
Port Moresby

Air Niugini Limited is the national airline of Papua New Guinea operating scheduled passenger air transport services throughout PNG and internationally, using a fleet of wide- and narrow-body jet aircraft and twin engine turbo-propeller aircraft.

1.17.2.1 Air Niugini procedures for notification and reporting of accidents/incidents

The Air Niugini occurrence notification reporting procedures in the case of any operational safety events or incidents, require that the Pilot in Command (PIC) or First Officer must raise an Operational Occurrence Report (OOR) at the end of their shift, and drop it in the company's Corporate Quality & Safety OOR box at the Air Niugini Operation Control Centre and at other operational areas.

On the next working day, staff from Corporate Quality & Safety collect the OORs and register the details in the Aviation Quality Database (AQD) system. Once registered, all reportable incidents are reported to CASA PNG.

Note: This procedure is not in compliance with the *Civil Aviation Rules 2015, Part 12, Section 12.55*.

On 5 May 2017, the AIC conducted a review of the Air Niugini *Corporate Safety Management System Manual, Part 11*, version 12.2, dated 1 May 2017, and found that it did not meet the notification requirements of the primary legislation, the *Civil Aviation Act 2000 (as amended), Section 60*, and the *Civil Aviation Rules 2015, Part 12*. References in the manual to *CAR Part 12* were from the version of *CAR Part 12* effective 1 January 2011.

CASA PNG had promulgated a new version of *CAR Part 12*, effective 1 April 2015.

On 6 June 2016, CASA signed and stamped the Authorisation page of the Air Niugini *Corporate Safety Management System Manual, Part 11*, accepting the version 12.1, dated 6 May 2016.

With the issue of version 12.2 of the Air Niugini *Corporate Safety Management System Manual, Part 11*, the Authorisation page of the manual had not been changed, there was no evidence that version 12.2 of the manual had been accepted by CASA.

At the time of finalising this report on 21 August 2017, Air Niugini Limited had not provided the AIC with evidence that their procedures manuals addressed the requirements of the primary legislation, the *Civil Aviation Act 2000 (as amended), Section 60*.

1.17.3 PNG Air Services Limited

PNG Air Services Limited
Jacksons ATC Tower
8 Mile,
Port Moresby.

PNG Air Services Limited, is a State Owned Enterprise (SOE), which was registered as a company in July of 2007, but started its operation in 1 January 2008. Its primary business is to provide Air Navigation Services to the domestic and international airline operators who use PNG air space.

1.17.3.1 PNG ASL's Procedures for Notification and Reporting of accidents/incidents as per the Manual of Air Traffic Service (MATS)

In accordance with MATS, Admin-8-1, Section 0, GENERAL, effective 25 July 2013, controllers are required to notify a TCAS RA event immediately. The section states:

0.1 The Civil Aviation Rules Part 12 requires that all accidents occurring to a Papua New Guinea based aircraft or to any other aircraft in Papua New Guinea Territory, be notified immediately to the Authority. Additionally, certain incidents are regarded as immediately notifiable (INI). In both instances the correct receipt point for notification to the Authority is CASA PNG.

0.2 The reason for making certain incidents immediately notifiable is that they normally require immediate follow up action by other Sections to prevent recurrence of the incident.

If this action is not taken promptly there could be important operational consequences and embarrassment to the CASA PNG and /or PNGASL.

0.3 Examples of incidents which should be reported immediately are:

(a)

(b) All occurrences in which an aircraft is operated without a clearance, or without compliance with a clearance, or without completely understanding the terms of a clearance

PNG ASL is required to notify CASA PNG and AIC of all incidents in accordance with *Civil Aviation Rules (CAR) 12.55 (d)(1)*, and *MATS/ADMIN-8-2, Section 2, Notification*, effective 25 July 2013, which states:

2.1 The responsibility for notification of accidents and immediately notifiable incidents [INI] lies with the unit first becoming aware of the occurrence, and should whenever possible be made by telephone. Station Managers shall ensure a list of current names and telephone numbers for this purpose is maintained at the unit.

2.1.1 Telephone notification shall be supplemented by the transmission of a message sent via email.

2.1.2 In addition CASAPNG and AIC shall be informed of all INI.

In relation to a TCAS RA incident, *MATS/RAD-11-9, Section 4, AIRBORNE COLLISION AVOIDANCE SYSTEM (ACAS/TCAS) DEVIATION, Sub-section 4.4* states:

4.4 If you become aware that an aircraft has deviated from an ATC clearance or instruction as a result of an ACAS/TCAS resolution advisory, advise your immediate supervisor and complete a CA005.

ICAO Annex 13, Attachment C, Page ATT C-1 dated 10/11/16 is a list defining serious incidents. It states:

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

The breakdown of separation incident between AND and SIR involved a deviation from a clearance in order to take avoidance manoeuvring action. It was therefore a serious incident. The pilots reported the deviation to the Aerodrome Controller.

Note: The controllers did not notify the Authority (CASA PNG) of the serious incident as required in the *Civil Aviation Rules 2015, Part 12, Section 12.55*, and the *Manual of Air traffic Services, Admin-8-1 and Admin-8-2*.

PNG Air Services Limited, Air Traffic Services Management informed the AIC that controllers are reminded of the notification requirements in *MATS* and *CAR Part 12*, including during refresher training and following all incidents involving ATS.

1.18 Additional information

1.18.1 Nadzab Airspace Structure

The Nadzab Airspace classification is Class C. In accordance with PNG AIP ENR 1.4 paragraph 1.3, IFR and VFR flights are permitted within that airspace to an upper limit of FL245. All aircraft within that airspace are provided with air traffic control services, and IFR aircraft are separated from other IFR and VFR aircraft. VFR aircraft are separated from VFR aircraft, and they are provided with traffic information if requested. There are different control area steps in different sectors, depending on the terrain. Nadzab is a non-radar environment and therefore the controllers use non-radar control procedures (procedural control).

The Nadzab Aerodrome Controller's main function is to authorise an aircraft to: taxi; takeoff; operate in the aerodrome circuit area; and land.

The Nadzab Approach Controller combines approach and area control duties, therefore is responsible for the control of aircraft that overfly Nadzab. A further responsibility is to establish an orderly approach sequence for all arriving aircraft, while separating them from departing traffic.

1.18.2 Nadzab and nearby sectors

Clearances for aircraft arriving at Nadzab Airport from outside controlled airspace, are normally authorised by the Approach Controller at Nadzab through coordination channels with Flight Service, either by telephone on intercom lines. Clearances are subsequently passed to the aircraft from Moresby or Madang Flight Services.

Aircraft departing from Nadzab are issued with an Airways Clearance depending on a number of circumstances including other aircraft in the airspace and their flight plans. Since Nadzab's upper limit is FL245, the controllers get concurrence from nearby controllers for their concurrence before clearing the aircraft. Coordination is a vital role apart from controlling of aircraft in order for the controllers to perform their duties effectively.

Nadzab Approach Control assumes responsibility at a point when a departing aircraft is established on its outbound route, and has established communications on the Approach Control frequency. Likewise, for an arriving aircraft when the aircraft establishes contact at a frequency transfer point. At a transfer point, the controller may give a descent clearance specific altitude of Flight Level depending on the lower safe altitudes on the route and other aircraft operating in the sector.

Visual approach instructions given to VFR aircraft are in accordance to PNG MATS, RAC-3-20, Paragraph 10.14.14, which states:

Where there is no traffic conflict requiring assignment of an altitude, a VFR category aircraft shall be cleared to make a visual approach.

1.18.3 Nadzab Special Procedures

The *PNG Aeronautical Information, Flight Supplement, SAP 2-1, Part 2 Special Procedures, Sub-section 2.1 Standard Departure Clearances* states:

2.1.1 Standard Departure clearances (SDC) are produced to facilitate ATC clearance issued at airports affording IFR traffic separation. The SDC contains details of the route to be flown in the Control Zone (CTR) and Control Areas (CTA, TMA and UTA) and are valid until the point that the aircraft leaves controlled airspace.

There are 21 Standard Departure Clearance (SDC) numbers allocated for Nadzab.

SDCs contain details of the routes to be flown in the Control Zone and Control Areas, and are valid until the point that the aircraft leaves controlled airspace, or is amended with a revised clearance. Normal provisions apply in relation to intercepting the cleared departure track by 5 nm, in accordance with the requirements of *MATS RAC*.

Two SDC numbers for Nadzab Standard Departures Clearance were significant in the breakdown of separation serious incident,

SDC 33 Track 300° from NZ to UGTOK thence 334 to MD. DME DEPARTURE

SDC 36 Track 003° from NZ to OKTUX and MOE.

ICAO Annex 11, Appendix 2, Principles Governing the Establishment and Identification of Significant Point, requires unique five-letter pronounceable names for waypoints. In compliance, the waypoint names OKTUX and UGTOK, had been promulgated by PNG Air Services Limited in *AIP Supplements* dated 28 April and 21 July 2016 respectively and requiring hand amendment to the *Radio Navigation Chart (RNC)*. The AIP Supplement amendment date was the date of effect of the change, and remained current until the information was incorporated in the relevant RNC. Therefore, the waypoint names were in use at the time of the incident.

Even though the waypoint names were in use at the time of the incident, the replacement *RNC* with the names UGTOK and OKTUX published was not effective until 2 February 2017.

The *ICAO Codes and Route Designators (ICARD) 5 Letter Name Code (LNC) Guidelines, Section 4, Posting a Request and Checking Proximity of 5LNC*, states:

When an Authorised User has ticked the box for “Proximity check done”, he/she is confirming that he/she has either checked that the 5LNC requested is not located close to another similar sounding 5LNC, or that no sound-like issues are expected due to the specific use of the 5LNC requested, and has therefore met this requirement.

Checking the sound-like proximity of a 5LNC is mandatory and is the responsibility of the Authorised User. It is also the Authorised User’s responsibility to coordinate any sound-like issues/mitigations with relevant States, if required.

The 5LNCs UGTOK and OKTUX are sound-like proximity.

1.18.4 Flight progress strips for the aircraft involved in the incident

A flight progress strip is a small strip of paper containing essential flight data necessary for the control or in-flight information with respect to a Fix (a position reporting point, or a point of departure or arrival). It is a quick way to annotate a flight's details, to keep a legal record of the instructions that were issued, to allow other controllers to see instantly what is happening, and to pass this information to other controllers who go on to control the flight.

The Flight Progress Strips (FPS) of the Nadzab Aerodrome Control, Approach Control, and Port Moresby Flight Services were examined during the investigation and were determined to be significant to the investigation.

1.18.4.1.1 Flight Services Flight Progress Strip

The Port Moresby (Moresby) Flight Services Flight Progress Strip (Fig 5) showed that SIR, after departing the Yalumet area, had been issued with a clearance to track 166°, and to climb to 12,000 ft enroute to Nadzab.

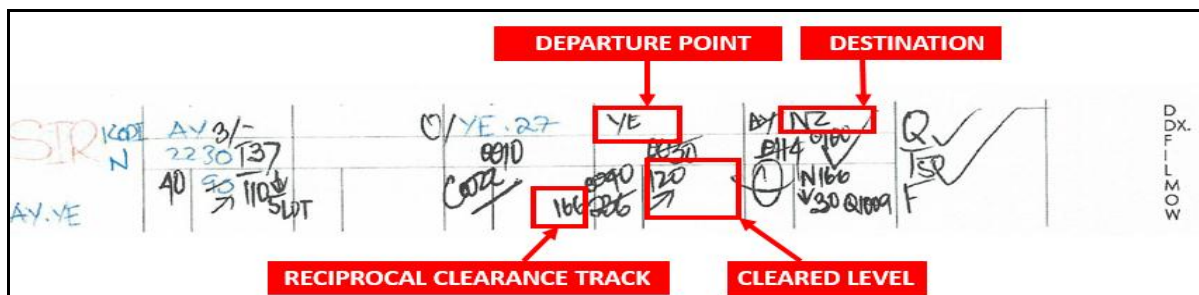


Figure 5: Flight Service Flight Progress Strip

(Source: Jacksons FLIGHT SERVICE FLIGHT PROGRESS STRIP at Appendix 2. Image highlighted by the AIC)

The Aerodrome Controller's (ADC) Flight Progress Strip (Fig 6) for AND, showed that AND had been issued with a SDC 36, on an unrestricted climb to FL 290 (29,000 ft). It also showed that AND was cleared to take off from runway 27 with an airborne time of 54 (00:54:00), and made a right turn, with a departure track 003°R [The 003° radial of the Nadzab VOR].

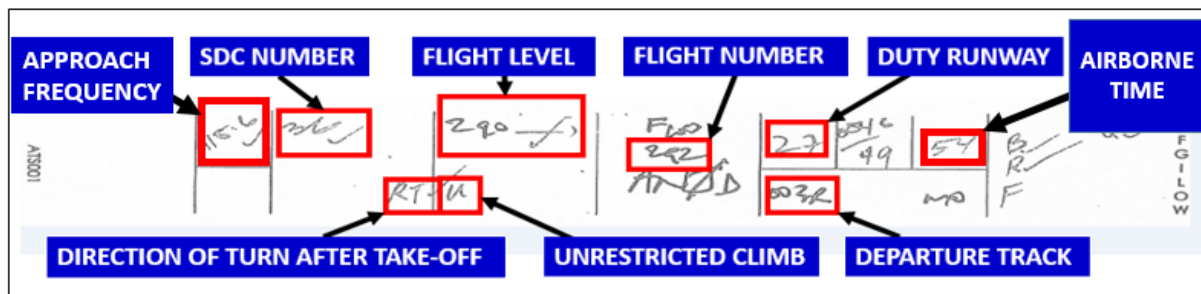


Figure 6: Extract of Nadzab ATC Flight Progress Strip (ADC/AND)

(Source: NADZAB ATC FLIGHT PROGRESS STRIP at Appendix 2. Image highlighted by the AIC)

The Approach Controller's (APP) Flight Progress Strip (Fig 7) for SIR, showed that SIR was cleared to track 166° to Nadzab, and shortly after that clearance was changed to 157°. (166° was not deleted on the flight strip). It also noted a track inbound on the 346° radial, which is the reciprocal of the inbound track. SIR was operating a VFR flight. The altitude annotation showed descent from 12,000 ft initially to 3000 ft, then on a visual approach and cleared to join circuit on a mid-right downwind for runway 27.

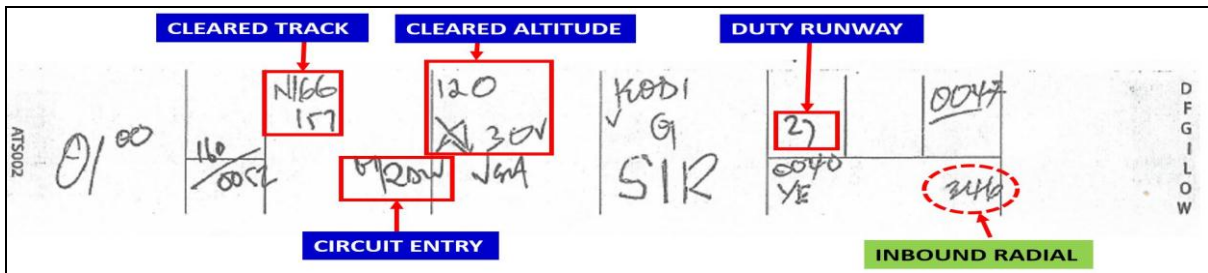


Figure 7: Extract of Nadzab ATC Flight Progress Strip (APP/SIR)

(Source: NADZAB ATC FLIGHT PROGRESS STRIP at Appendix 2. Image highlighted by the AIC)

The Approach Controller's (APP) Flight Progress Strip (Fig 8) for AND contained the same basic information as on the ADC's Flight Progress Strip, with the addition of a waypoint OGTVK. [This 5LNC is unknown]

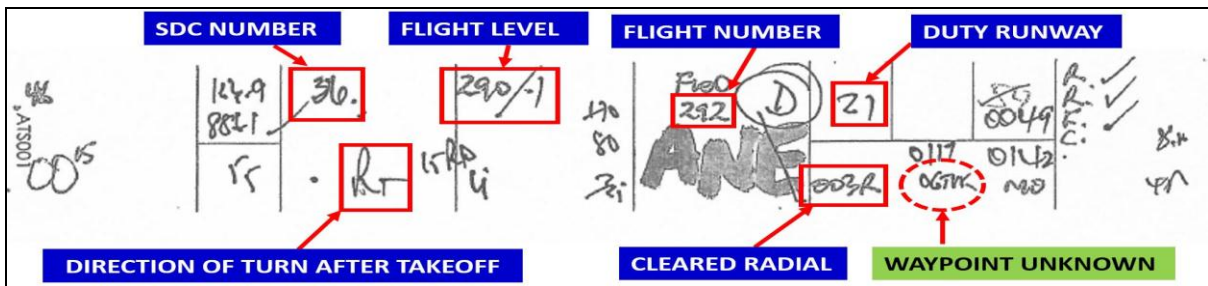


Figure 8: Extract of Nadzab ATC Flight Progress Strip (APP/AND)

(Source: NADZAB ATC FLIGHT PROGRESS STRIP on Appendix 2. Image highlighted by the AIC)

The Aerodrome Controller's (ADC) Flight Progress Strip (Fig 9) for SIR, showed that SIR was cleared to descend to 3000 ft and further cleared to join the Nadzab circuit on a mid-right downwind for runway 27. It also noted a track inbound of 345°, which was actually the reciprocal of the inbound track, and a radial of the Nadzab VOR

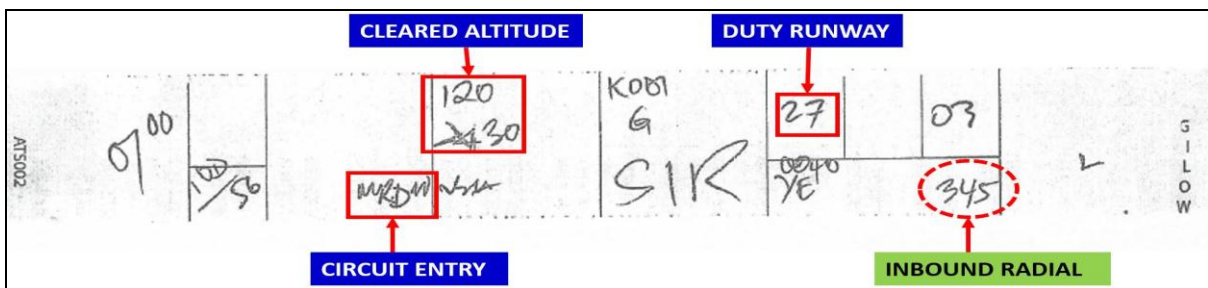


Figure 9: Extract of Nadzab ATC Flight Progress Strip (ADC/SIR)

(Source: NADZAB ATC FLIGHT PROGRESS STRIP on Appendix 2. Image highlighted by the AIC)

1.18.4.2 P2-AND and P2-SIR tracks

Figure 10 depicts the estimates points where SIR reversed the descent and commenced climb from 3,500 ft to 7,000 ft, and the estimated point SIR passed AND.

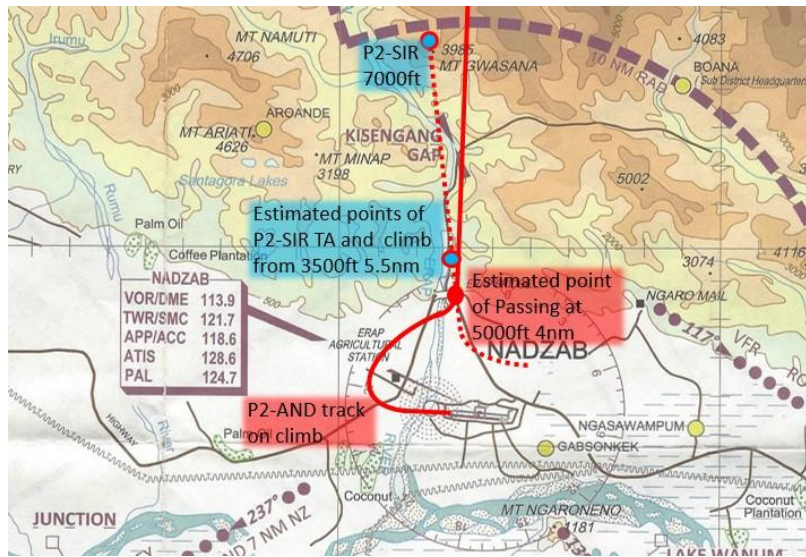


Figure 10: Estimated tracks of P2-AND and P2-SIR at time of incident
(Source: PNG Visual Terminal Chart. Image modified by AIC)

1.18.4.3 Nadzab Visual Terminal Chart

The Standard Departure Clearance 36 track to waypoint OGTUX for AND, and the inbound track for SIR on the 346° radial are highlighted on the following extract from the Radio Navigation Chart (RNC) (Figure 11). Also highlighted is the track to waypoint UGTOK on the 300° radial.

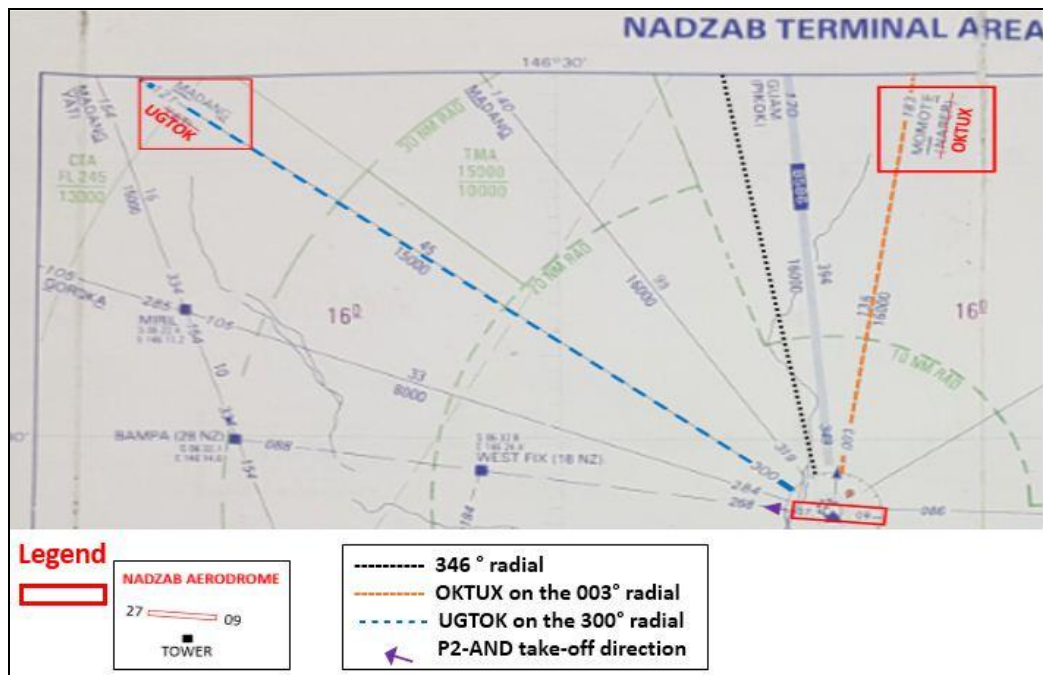


Figure 11: Tracks to OKTUX and UGTOK
(Source: PNG Radio Navigation Chart shown on Appendix 1. Image modified by AIC)

1.18.5 Civil Aviation Rules (CAR), Part 12 notification requirements

CAR Part 12.55 Sub-section (b) requires that a person who is involved in an incident that is a serious incident or an immediate hazard to the safety of aircraft operations must notify the Authority (CASA PNG) as soon as practicable.

CAR part 12.57 requires details to be sent to the Authority (CASA PNG), on a CA005 form or other means acceptable to the Authority, within 3-working days of the incident.

1.19 Useful or effective investigation techniques

The investigation was conducted in accordance with Papua New Guinea Legislation, and the PNG Accident Investigation Commission policies and procedures, and in accordance with the Standards and Recommended practices of Annex 13 to the Chicago Convention.

2 ANALYSIS

2.1 Introduction

The Nadzab Aerodrome Controller (ADC) issued the crew of P2-AND with a Standard Departure Clearance (SDC) 36. The clearance required them to track from Nadzab on the 003° radial of the Nadzab VOR, to the waypoint OKTUX, thence to Momote, on an unrestricted climb to FL290 (29,000 ft). The crew elected to make a right turn after takeoff from runway 27, and contacted the Approach Controller shortly after becoming airborne.

The pilot of SIR was operating in accordance with the VFR and was tracking 166° inbound to Nadzab. The Approach Controller cleared SIR to descend to 3,000 ft, and instructed the pilot to contact the ADC 10 nm from Nadzab. The ADC informed SIR that there was traffic, a Fokker 100 that had just departed for Momote, and was on a right turn tracking on the 300° radial.

The clearance from the ADC to AND contained SDC 36, which is the 003° radial to track for Momote via waypoint OKTUX. Because the ADC said that the Fokker 100 (AND) was *on a right turn, tracking 300° radial*, the pilot of SIR considered that AND would be clear of his inbound track, on the 346° radial.

2.1.1 Traffic Alert and Collision Avoidance System Resolution Advisory serious incident

The investigation determined that while AND was in the right turn intercept the 003° radial and climbing to FL290, SIR was descending at a rate of 2000 ft per minute to 3,000 ft visual. Because the pilot of SIR had noticed a potential traffic confliction 2 nm from his aircraft, displayed as a symbol on his Traffic Avoidance System Multi-Function Display, he stopped his descent and climbed at 1000 ft per minute. As SIR was climbing, AND was also climbing at a faster rate than SIR, which then triggered traffic advisory information in the form of a symbol on the EFIS and an aural advisory stating “Traffic Traffic”.

The crew of AND reported that this was followed by a Resolution Advisory (RA), in the form of a symbol and an aural instruction to maintain vertical speed. Even though both aircraft were climbing, the rate of climb of AND quickly separated the two aircraft.

Because the TCAS data was not recorded and the flight recorded information had been overwritten, the investigation was unable to confirm the veracity of the reported RA.

2.1.2 Air Traffic Control

At no stage had AND been instructed to track outbound on the 300° radial, and the investigation was unable to determine why the controller informed SIR that AND was outbound on the 300° radial. The ADC used the waypoint name similar in sound to a point on the 300° radial. The flight strip annotation for that waypoint name did not resemble what was said, nor did it resemble the waypoint on the *Terminal Area Radio Navigation Chart* on the 300° radial.

The off-duty controller took over the ADC duties without authorisation, and without any hand-over, take-over briefing or coordination. The Approach Controller, who was also the supervisor, condoned the off-duty controller taking over the ADC duties.

The ADC lacked situational awareness by telling the pilot of SIR that the outbound Fokker 100 was tracking 300°, when in fact it was making a right turn in accordance with the take-off clearance and the SDC 36 to intercept 003° track from Nadzab. In clearing AND to make a right turn, the ADC placed the outbound AND into direct conflict with the inbound SIR.

The investigation found that there was a lack of coordination between the ATS controllers, which also contributed to the breakdown of separation between the aircraft. There was a lack of compliance with PNG ASL Standard Operating Procedures for the ATS responsibilities and management of the functions of the Aerodrome Controller and the Approach Controller.

2.1.3 Notification and reporting

PNG Air Services Limited and Air Niugini did not report the incident, and SIL Aviation provided an initial notification 4 days after the incident. The initial notification actions were not in accordance with PNG legislated requirements.

- The notification procedures contained in the SIL Aviation Safety and Quality Manual, Chapter 13, did not meet legislated requirements.
- The Air Niugini notification procedures did not meet PNG legislated requirements.
- The PNG ASL notification procedures met or exceeded the legislated requirements. However, there was a lack of compliance with the procedures by the unit supervisor. He did not notify CASA PNG of the serious incident by telephone as required by PNG ASL.

The lack of timely notification deprived the investigation of significant data from AND's Flight Recorders, that would have assisted in the analysis of factors that contributed to this serious incident.

3 CONCLUSIONS

3.1 Findings

1. Aircraft

- a) Both aircraft were certified, equipped and maintained in accordance with existing regulations and approved procedures.
- b) Both aircraft were certified as being airworthy when dispatched for the flight
- c) There was no evidence of any defect or malfunction in the aircraft that could have contributed to the serious incident

2. Crew / pilots

- a) The pilots of both aircraft were licensed and qualified for the flight in accordance with existing regulations.

3. Flight operations

- a) Both flights were conducted in accordance with the procedures in the company Operations Manual.
- b) The flight crew carried out normal radio communications with the relevant ATC units.
- c) The pilots of AND maintained the maximum rate climb configuration in response to the TCAS Resolution Advisory.
- d) The pilot of SIR took evasive manoeuvring action in a precautionary response to the TAS Traffic Advisory. His TAS could not generate a RA.

4. Operators

- a) Both the Air Niugini and SIL Aviation's Quality Assurance system did not fully comply with the requirements of the Civil Aviation Act 2000 (as amended), and CAR Part 12 with respect to notification of accidents and incidents.
- b) The PNG Air Services Limited notification procedures were not followed.

5. Air traffic services and airport facilities

- a) An off-duty controller assumed Aerodrome Control duties without authorisation.
- b) The controller who assumed the ADC duties lacked situational awareness
- c) The ADC gave confusing and incorrect information to the pilot of SIR.
- d) The APP was confusing the waypoints of SDC 36 and SDC 33.
- e) The ADC cleared AND to make a right turn placing the outbound AND into direct conflict with the inbound SIR.

6. Flight recorders

- a) SIR was not equipped with a flight data recorder (FDR) or a cockpit voice recorder (CVR); neither was required by PNG Civil Aviation Rules.
- b) AND was equipped with a flight data recorder (FDR) and a cockpit voice recorder (CVR).
- c) Due to the elapsed time between the serious incident and the AIC being notified by SIL Aviation, the data for the time of the incident had been over written.
- d) The lack of recorded information covering the period of the incident prevented detailed analysis of flight information with respect to AND.
- e) Air Niugini did not have data conversion equations, as required under *ICAO Annex 6, Operations of Aircraft, Part I, Appendix 8, Flight Recorders*, Paragraph 2.3.3.
- f) The TCAS and TAS installed in AND and SIR respectively, did not contain internal memory.
- g) The TCAS and TAS incident data was not recorded in accordance with *ICAO Document 9863, Airborne Collision Avoidance System (ACAS) Manual, Appendix 5*, which recommends that data should be stored by a dedicated ACAS recorder.

7. Medical

- a) There was no evidence that incapacitation or physiological factors affected the flight crew performance.
- b) The off-duty Aerodrome Controller had passed medical examinations for the renewal of his ATC licence in the days prior to the incident.

8. Safety oversight

- a) The PNG Civil Aviation Safety Authority's safety oversight of the SIL Aviation and Air Niugini accident and incident notification procedures did not detect the documented procedural, and operational shortcomings.

3.2 Causes [contributing factors]

1. An off-duty controller took over the Aerodrome Control duties without any hand-over briefing and without authorisation. The controller lacked situational awareness resulting in him directing a departing aircraft into the path of an inbound aircraft.
2. There was a lack of coordination between the ATS controllers, which contributed to the breakdown of separation between the aircraft. There was a lack of compliance with PNG ASL Standard Operating Procedures for the ATS responsibilities and management of the functions of the Aerodrome Controller and the Approach Controller.

3.3 Other factors

Other factors is used for safety deficiencies or concerns that are identified during the course of the investigation, that while not causal to the accident or serious incident, nevertheless should be addressed with the aim of accident and serious incident prevention, and the safety of the travelling public.

1. The unique 5-letter waypoints known as UGTOK for SDC 33, and OKTUX for SDC 36, appeared to be similar, “sound-like” words. In promulgating these words for routes out of Nadzab, PNG Air Services Limited had not ensured that such “sound-like” words were not in proximity, in accordance with ICAO Annex 6 requirements and the ICAO Codes and Route Designator (ICARD) guidelines.
2. The lack of timely notification deprived the investigation of significant data from AND’s Flight Recorders, that would have assisted in the analysis of factors that contributed to this serious incident.

4 SAFETY ACTIONS AND RECOMMENDATIONS

4.1 Safety action

4.1.1 Safety Action taken by Summer Institute of Linguistics Aviation

On 21 December 2016, SIL Aviation informed the AIC that it had been working on employing a person to work in the Safety and Quality. This person was to be an assistant to the Quality and Safety Manager, and was scheduled to commence work immediately after the Christmas Break. This appointment *will provide backup extra manpower*.

On 23 March 2017, SIL informed the AIC that they had employed an assistant to the Quality and Safety Manager, at the end 2016 and was undergoing training with SIL Aviation.

4.1.1.1 PNG Accident Investigation Commission (AIC) assessment of the SIL Aviation response

The AIC notes that since this deficiency was brought to the attention of SIL Aviation during the course of the investigation, subsequent notifications to the AIC have met the CAR requirements. The AIC assessed the SIL Aviation response as satisfactorily addressing the identified safety deficiency. With respect to AIC 17-R05/16-2001 addressed to SIL Aviation, the **Status of the AIC Recommendation: Closed Response Accepted.**

4.2 Recommendations

As a result of the investigation into the serious incident involving Fokker FK28-Mk 100 aircraft, registered P2-AND, and Quest Kodiak 100 aircraft registered P2-SIR, about 3.5 nm (6.4 km) northwest of Nadzab Airport, Morobe Province, the Papua New Guinea Accident Investigation Commission issued the following recommendations to address concerns identified in this report.

4.2.1 Recommendation AIC 17-R01/16-2001 to PNG Air Services Limited

The PNG Accident Investigation Commission recommends that PNG Air Services Limited should review the list of unique 5-letter waypoints to ensure that “sound-like” words are not used for routes in proximity. Refer *ICAO Annex 11, and ICAO Codes and Route Designator (ICARD), 5 Letter Name Code (LNC) Guidelines, Section 4, Posting a Request and Checking Proximity of 5LNC*.

4.2.1.1 PNG Air Services Limited response

On 18 May 2017, PNG Air Services Limited informed the Accident Investigation Commission of its safety action to address the AIC’s safety concern, as follows:

When positioning and registering waypoint names (5-Letter Name Codes) through the ICAO Codes and Route Designators (ICARD) system, part of the process is to check phonetic similarities to limit the chances of any waypoint confusion. This checking is conducted during the registration waypoints in PNG's airspace. PNG Air Services checks for phonetic similarities within a radius of 3000 nautical miles. When the subject waypoints were registered, no such phonetic similarities were observed at the time and therefore, the waypoint registration process continued.

Notwithstanding that a controller could confuse any waypoint name/position, my staff will re-assess all waypoints, especially in the vicinity of Nadzab, to check for any circumstances where waypoint names could be considered phonetically similar. Where any waypoint names are found to be potentially similar, one of them will be immediately deregistered and replaced.

On 30 July 2017, PNG Air Services Limited informed the Accident Investigation Commission that it had checked the waypoint names, and they were not phonetically similar enough to be of concern.

4.2.1.2 PNG Accident Investigation Commission (AIC) assessment of PNG Air Services Limited response and safety action

On 31 July 2017, the AIC assessed the PNG Air Services Limited safety action as *fully satisfactory* to address the identified safety deficiency. With respect to AIC 17-R01/16-2001 addressed to PNG Air Services Limited; **Status of the AIC Recommendation: Closed Response Accepted**

4.3 Recommendations; other factors

While not causal to the accident, the investigation highlighted a number of avoidable procedural matters with respect to compliance with PNG Legislation, that effectively deprived the PNG Accident Investigation Commission of evidence and data that would have enabled more timely and complete analysis of the factors contributing to this serious incident. Accordingly, the AIC issued the following recommendations.

4.3.1 Recommendation AIC 17-R02/16-2001 to Civil Aviation Safety Authority of PNG

The PNG Accident Investigation Commission recommends that the Civil Aviation Safety Authority of PNG should ensure that all Operators of aircraft with Flight Data Recorders required under *CAR Part 121.371, Flight Data Recorder*, and *CAR Part 125.369 Flight data recorder*, comply with *ICAO Annex 6, Operations of Aircraft, Part I, Appendix 8, Flight Recorders, Paragraph 2.3.3* which states:

Documentation concerning parameter allocation, conversion equations, periodic calibration and other serviceability/maintenance information shall be maintained by the operator. The documentation needs to be sufficient to ensure that accident investigation authorities have the necessary information to read out the data in engineering units.

This is also relevant in the context of the State of PNG addressing its ICAO compliance requirements.

4.3.1.1 Civil Aviation Safety Authority of PNG response

At the time of publishing the Final Aircraft Serious Incident Report AIC 16-2001 on 21 August 2017, the Civil Aviation Safety Authority of PNG had not provided the AIC a response to this recommendation.

4.3.1.2 PNG Accident Investigation Commission (AIC) assessment of Civil Aviation Safety Authority of PNG response and safety action

Due to no response to the recommendation from the Civil Aviation Safety Authority of PNG, with respect to Recommendation AIC 17-R02/16-2001 addressed to CASA PNG; **Status of the AIC Recommendation: Active**

4.3.2 Recommendation number AIC 17-R03/16-2001 to Air Niugini Limited

The PNG Accident Investigation Commission recommends that Air Niugini Limited should ensure that it meets the requirements of *ICAO Annex 6, Operations of Aircraft, Part I, Appendix 8, Flight Recorders, Paragraph 2.3.3* Standard which states:

Documentation concerning parameter allocation, conversion equations, periodic calibration and other serviceability/maintenance information shall be maintained by the operator. The documentation needs to be sufficient to ensure that accident investigation authorities have the necessary information to read out the data in engineering units.

4.3.2.1 Air Niugini Limited response

On 12 July 2017 Air Niugini provided a copy of their Data Frame Layout Document that detailed the relevant parameter allocations, conversion equations, periodic calibration and other serviceability/maintenance information.

4.3.2.2 PNG Accident Investigation Commission (AIC) assessment of Air Niugini Limited response and safety action

The AIC reviewed the Air Niugini Limited Data Frame Layout Document, and determined that it satisfactorily addressed the requirements of *ICAO Annex 6, Operations of Aircraft, Part I, Appendix 8, Flight Recorders, Paragraph 2.3.3* Standard. With respect to AIC 17-R03/16-2001 addressed to Air Niugini Limited; **Status of the AIC Recommendation: Closed Response Accepted**

4.3.3 Recommendation number AIC 17-R04/16-2001 to Air Niugini Limited

The PNG Accident Investigation Commission recommends that Air Niugini Limited should ensure that it meets the notification requirements in accordance with the *Civil Aviation Act 2000 (as amended) Section 60*, and the *Civil Aviation Rules Part 12*.

4.3.3.1 PNG Accident Investigation Commission (AIC) assessment of Air Niugini Limited response and safety action

At the time of publishing the Final Aircraft Serious Incident Report AIC 16-2001 on 21 August 2017, Air Niugini Limited had not provided a response to this recommendation with evidence addressing the requirements of the *Civil Aviation Act 2000 (as amended), Section 60*. With respect to AIC 17-R04/16-2001 addressed to Air Niugini Limited; **Status of the AIC Recommendation: Active**

4.3.4 Recommendation number AIC 17-R05/16-2001 to SIL Aviation

The PNG Accident Investigation Commission recommends that SIL Aviation should ensure that it meets the notification requirements in accordance with the *Civil Aviation Act 2000 (as amended) Section 60*, and the *Civil Aviation Rules Part 12*.

4.3.4.1 SIL Aviation response

On 13 June 2017, SIL Aviation informed the Accident Investigation Commission of its safety action to address the AIC's safety concerns, as follows:

SAFETY AND QUALITY MANUAL, Section 13, ACCIDENT & INCIDENT REPORTING, amended as follows:

13.2 *ACCIDENT/INCIDENT FLOWCHART* includes the Accident Investigation Commission in initial notifications and the follow-up CAR Part 12.55 CA005 report within 3 working days.

13.3 includes notifying the Accident Investigation Commission of all initial notifications.

13.7.2 includes the requirement to submit an occurrence report on form CASA PNG 005 within 3 working days of an accident and incident.

SECURITY AND EMERGENCY RESPONSE MANUAL, Section 4.1 paragraph 4.1.2 ACCIDENT & INCIDENT PILOT RESPONSIBILITY, amended to restrict release of information pertaining to the accident/incident except to the CASA PNG and AIC or SIL Aviation.

4.3.4.2 PNG Accident Investigation Commission (AIC) assessment of the SIL Aviation response

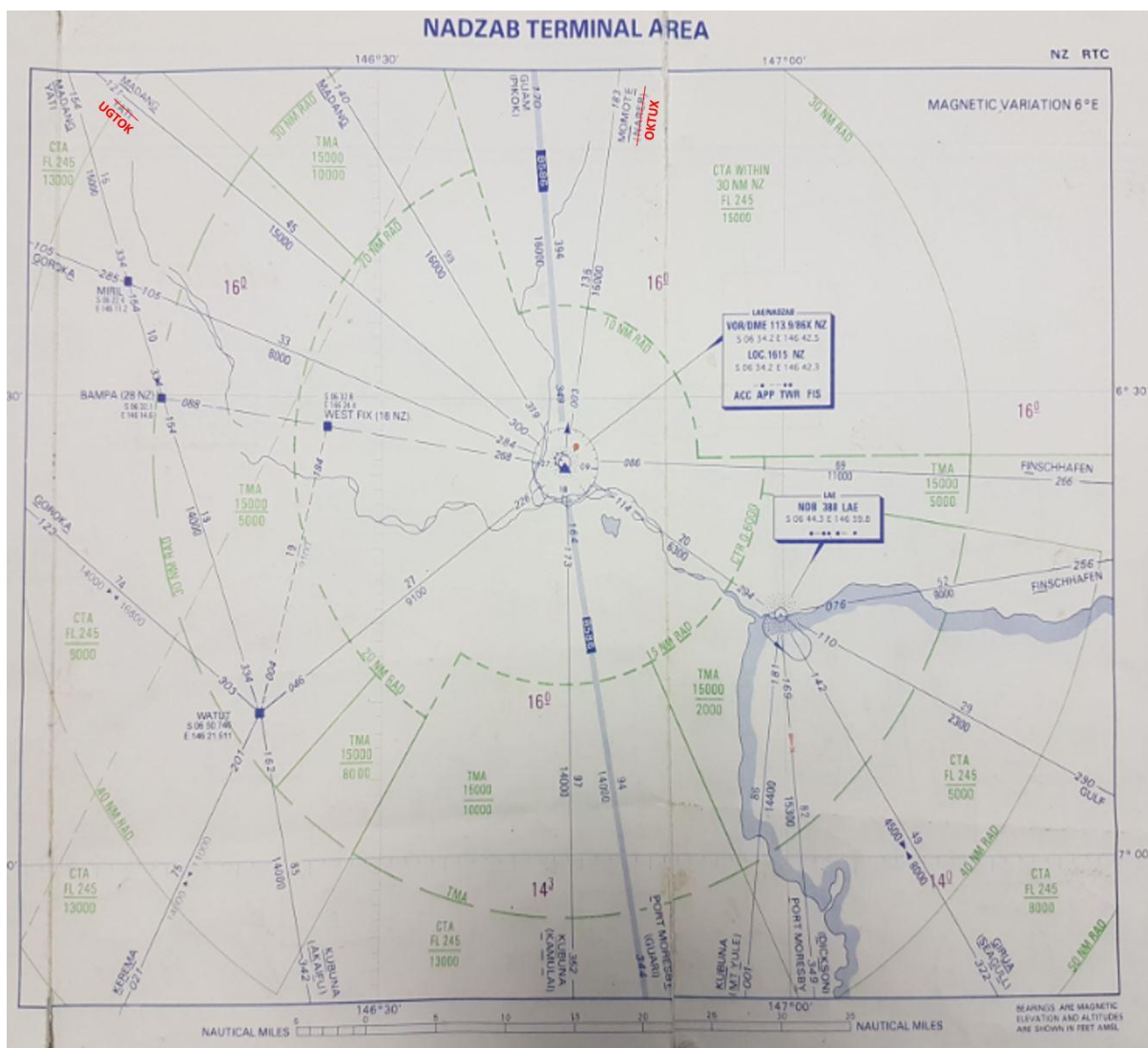
The AIC notes that since this deficiency was brought to the attention of SIL Aviation during the course of the investigation, subsequent notifications to the AIC have met the CAR requirements. The AIC has assessed the SIL Aviation response as satisfactorily addressing the identified safety deficiency. With respect to AIC 17-R05/16-2001 addressed to SIL Aviation, the **Status of the AIC Recommendation: Closed response accepted.**

5 APPENDICES

5.1 Appendix 1: Nadzab Terminal Area RNC

The waypoint names OKTUX and UGTOK had been promulgated by PNG Air Services Limited in *AIP Supplements* dated 28 April and 21 July 2016 respectively requiring hand amendment to the *Radio Navigation Chart (RNC)*. The AIP Supplement amendment date was the date of effect of the change, and therefore was in use at the time of the incident. The replacement *RNC* with the names UGTOK and OKTUX was not effective until 2 February 2017.

The RNC depicted below is the chart at the time of the incident with the waypoints hand amended.



5.2 Appendix 2: Flight Progress Strips

5.2.1 Flight Services Flight Progress Strip

7 JULY 2002	SIR	KODI N	AV 3/- 2230	137	01/27	YE	BY NZ B44	Q ✓	D DX F I L M O W
	AV.YE	40	30	110	0010	0030	N160	F	
			5/10	5/10	166	120	0100		

5.2.2 Aerodrome Flight Progress Strip

ATIS002	0700	120	KODI G	27	03	L	G I L L O W
	10/50	230	SIR	0040 YE	345		
ATIS001	1156	290	F10 292 ANE	27	54	B/- R/- F	Q ✓
		RTU		0032	MD		

5.2.3 Approach Flight Progress Strip

ATIS002	0100	N166 157	120	KODI G	27	0047	D F G I L L O W
	110	0052	300	SIR	0040 YE	240	
ATIS001	1249	300	290/-1	F10 292 ANE	27	0049	R/- R/- C/- ✓ ✓ ✓
	15	R	15	170 80 20	0032	0117 06TK MD	8+ ✓

5.3 Appendix 3: 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-AND, P2-SIR and the Nadzab Tower and Approach Controllers between 00:46:14 and 00:59:26. The table has three columns, containing the time, to and from, and also the conversion. The investigation also created a fourth column of the table, highlighting the important of the transcript.

The table is broken into four parts, according to the colours as shown below.

1. ADC to AND on frequency 121.7, which is highlighted with Yellow
2. APP to SIR on frequency 118.6, which is highlighted with Light Green
3. ADC to SIR on frequency 121.7, which is highlighted with Light Blue
4. APP to AND on frequency 118.6, which is highlighted with Light Grey

TIME	FROM	TO	TRANSCRIPT REMARK	AIC Main Highlights
00:46:14	AND	ADC	Nadzab tower Alpha November Delta for Momote, request start	
00:46:18	ADC	AND	Alpha November Delta start approved	
00:46:24	AND	ADC	Start approved Alpha November Delta	
00:48:22	AND	ADC	Nadzab tower Alpha November Delta received Charlie request taxi	
00:48:34	ADC	AND	Alpha November Delta.....taxi for runway 27	
00:48:41	AND	ADC	Clear to taxi runway 27 Alpha November Delta	Clearance was transmitted to AND from ADC on rw27, SDC 36 and unrestricted climb to FL290. R/Turn or L/Turn depend on AND crew.
00:49:11	ADC	AND	Alpha November Delta Clearance 36 cruise FL290	
00:49:16	AND	ADC	Clearance 36 FL290, Alpha November Delta	
00:50:08	ADC	AND	Alpha November Delta, cfm you in receipt of clearance?	
00:50:11	AND	ADC	Affirm, Alpha November Delta	
00:50:20	ADC	AND	Alpha November Delta thank you	
00:51:34	AND	ADC	Tower Alpha November Delta ready	
00:51:48	ADC	AND	Alpha November Delta line up runway 27	
00:51:51	AND	ADC	Line up runway 27 Alpha November Delta	
00:52:23	ADC	AND	Alpha November Delta make a left or a right turn, QNH now 1008 cleared for take-off	
00:52:30	AND	ADC	1008 will take a right turn clear for take-off Alpha November Delta	Decision for right turn made by AND
00:52:49	SIR	APP	Nadzab approach good morning Sierra India Romeo is tracking inbound on the 166Radial 16 Miles to run maintaining 12000 with information Charlie. Request top of descent ETA Nadzab on the hour	

00:52:50	ADC	AND	Alpha November Delta and contact approach on 118.6 airborne	
00:52:51	AND	ADC	Approach 118.6 airborne Alpha November Delta	
00:53:03	APP	SIR	Sierra India Romeo roger copied report your distance now?	
00:53:06	SIR	APP	Ah through 16GPS miles, Sierra India Romeo	
00:53:14	APP	SIR	Sierra India Romeo roger...pause track via the 166Radial correction (long pause here) advise your track for a direct track to the field	
00:53:30	SIR	APP	Say again for Sierra India Romeo	
00:53:34	APP	SIR	Sierra India Romeo say again your track to Nadzab	
00:53:36	SIR	APP	Ah am on the 16. Correction 3..4..5...Radial heading 157 with ah.. track of 157, Sierra India Romeo	
00:53:52	APP	SIR	Sierra India Romeo roger track 157 to the field, descent now to 3000 visual, QNH 1008 and contact tower 121.7 at 10miles.	SIR was cleared to and started descending to 3000 ft visual by APP and transferred to ADC
00:54:07	SIR	APP	Cleared track inbound on 157 on descent 3000 visual 1008 and contact tower at 10 miles, Sierra India Romeo, thanks a lot.	
00:54:58	SIR	ADC	Nadzab tower good morning Sierra India Romeo is 10miles to run, heading 157 inbound on descent 3000 visual	
00:55:18	AND	APP	Nadzab app, Alpha November Delta 4 DME runway heading on a right hand turn and passing 3500, departed Nadzab 53 climbing to FL290, estimate OKTUX at time 17	
00:55:21	SIR	ADC	Nadzab tower Sierra India Romeo	SIR was informed of the traffic (AND) on right turn from rw27, on an unrestricted climb to intercept 300° radials as transmitted by ADC, and not 003° radials for SDC 36 given above during the Clearance for AND from ADC. SIR did not consider AND as traffic because SIR's track was about 46° ((180+166=346)-300=46) away from the 300° radial that the ADC said AND was tracking on. Also he was tracking to mid right downwind for runway 27.
00:55:22	ADC	SIR	Sierra India Romeo Nadzab tower good day, traffic is Fokker 100, just departed for Momote on a right turn, tracking 300Radial, cleared visual approach, track for mid right down wind(MRDW) runway 27	
00:55:42	SIR	ADC	Ah looking for traffic, we should be clear this sector and track for MRDW runway 27 Sierra India Romeo thanks	
00:55:50	APP	AND	Alpha November Delta approach you tracking towards OKTOK thence Momote confirm?	APP transmitted to AND to track towards OKTOK. OKTOK is not the unique 5-letter name for either waypoints for SDC 33(300) or SDC 36 (003).
00:55:55	AND	APP	Confirm Alpha November Delta	

00:56:01	APP	AND	Alpha November Delta that was estimate 17 at OKTUX	
00:56:03	AND	APP	Yes Sir and next Momote at 42	
00:56:06	SIR	ADC	Nadzab tower due TCAS alert, Sierra India Romeo this is only caution on climb again to 7000 ah got 2 miles traffic.	Period of the Serious Incident. SIR tried to avoid the traffic (AND), about or more than 12 seconds before AND aural alerts (TA and RA) were triggered.
00:56:18	APP	AND	Alpha November Delta roger copied stand-by for transfer	
00:57:17	AND	APP	Alpha November Delta we on a TCAS climb	
00:57:27	ADC	SIR	Sierra India Romeo say again your last	Traffic Cleared from both system of the aircraft. SIR descended back to 3000 ft visual. AND continued on 003 radial to Momote
00:57:28	SIR	ADC	Ah due to TCAS traffic alert ah passed traffic now descent back to 3000, tracking for visual RDW 27	
00:57:29	ADC	SIR	Sierra India Romeo copied that and report approaching RDW	
00:57:30	SIR	ADC	Report approaching RDW, Sierra India Romeo	
00:57:41	AND	APP	Alpha November Delta we clear of conflict, we just got visual sighting of a light single engine aircraft, we currently 5DME passing 8000ft, he passed 600ft below us.	
00:57:55	APP	AND	Alpha November Delta...(pause in between)..confirm you on the 0, correction....(long pause) on the 300 track outbound confirm?	APP requesting AND to confirm if 300 tack was the outbound.
00:58:05	SIR	ADC	And Sierra India Romeo is RDW	
00:58:11	ADC	SIR	Sierra India Romeo	
00:58:22	AND	APP	Our clearance was via the 36 and that's on the 004Radial	AND replied as SDC CNCE 36.
00:58:46	APP	AND	Alpha November Delta report distance	
00:58:48	AND	APP	Alpha November Delta 8DME 10 000	
00:59:06	APP	AND	Alpha November Delta	
00:59:14	AND	APP	And cfm were you aware of that aircraft?	
00:59:17	APP	AND	Yeah we aware of the aircraft now, it's Kodiak from the north.	
00:59:20	SIR	ADC	And Nadzab tower Sierra India Romeo, just confirm cleared for visual approach?	
00:59:25	ADC	SIR	Sierra India Romeo affirm cleared visual approach for runway 27	
00:59:26	SIR	ADC	We cleared for visual approach runway 27 Sierra India Romeo, thank you	

5.4 Appendix 4: Flight Data Recorder (FDR) installed in P2-AND

5.4.1 Details of the FDR.

The table below shows the reported details of SSFDR.

Table 1: FDR Details

Manufacturer	Honeywell
Model	Solid State Flight Data Recorder
Part Number	980-4700-003
Serial Number	07865
Recording Duration	2X > 25 hours @ 64 words per second
TSO	C-124

5.4.2 FDR System

The FDR system consisted of:

- Solid State Flight Data Recorder (SSFDR)
- Flight Data Acquisition Unit (FDAU)
- Axes Accelerometer
- Rudder Voltage Differential Transducer (RVDT)
- FDR/CVR Control Switch

5.5 Data downloaded from the SSFDR from AND

The serious incident occurred at 00:57:17 on 16 December 2016, and the available data commenced at 04:25:36 on 16 December 2016. The AIC received an email notification at 02:00 on 20 December 2016. The recorded data covering the time of the serious incident had been overwritten due to the delay in the AIC being notified and subsequently being able to access the aircraft and the flight recorders. The chart below shows the available data.

Relative Time	Frame	Day	Month	GMT (h)	GMT (m)	GMT (s)	Ft#	Ft#	Ft#	Lat (Big Increment)	Lat (Small Increment)	Lon (Big Increment)	Lon (Small Increment)
0:00:02	0.2	16	12							-9	-0.01	-147	-0.063
0:00:03	0.3							3		-9	-0.01	-147	-0.064
0:00:04	0.4						2	9		-9	-0.01	-147	-0.065
0:00:05	1.1			4	26	36				-9	-0.02	-147	-0.066
0:00:06	1.2	16	12							-9	-0.02	-147	-0.067
0:00:07	1.3							3		-9	-0.02	-147	-0.068
0:00:08	1.4						2	9		-9	-0.02	-147	-0.069
0:00:09	2.1			4	26	40				-9	-0.02	-147	-0.07
0:00:10	2.2	16	12							-9	-0.02	-147	-0.071
0:00:11	2.3							3		-9	-0.02	-147	-0.072
0:00:12	2.4						2	9		-9	-0.03	-147	-0.073
0:00:13	3.1			4	26	44				-9	-0.03	-147	-0.074
0:00:14	3.2	16	12							-9	-0.03	-147	-0.075
0:00:15	3.3							3		-9	-0.03	-147	-0.076
0:00:16	3.4						2	9		-9	-0.03	-147	-0.077
0:00:17	4.1			4	26	48				-9	-0.03	-147	-0.078
0:00:18	4.2	16	12							-9	-0.03	-147	-0.079
0:00:19	4.3							3		-9	-0.04	-147	0.08
0:00:20	4.4						2	9		-9	-0.04	-147	0.82
0:00:21	5.1			4	26	52				-9	-0.04	-147	0.082

5.6 APPENDIX 5. SIL Aviation Accident and Incident Notification Flow Chart

