ACCIDENT INVESTIGATION COMMISSION

Final Report

AIC 20-1006

Air Sanga Limited

P2-ASM

Viking DHC-6-300 Aircraft

Runway Excursion (RE) during takeoff roll

Wobagen Airstrip, Sandaun Province

Papua New Guinea

1 December 2020

About the AIC

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)*, and the *Commissions of Inquiry Act 1951*, and in accordance with *Annex 13* to the *Convention on International Civil Aviation*.

The objective 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 relevant 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

On 1 December 2020 at 14:37 local time (04:37 UTC), the AIC was notified by the Civil Aviation Safety Authority of Papua New Guinea (CASA PNG) via email, of an accident involving a Viking DHC-6-300 aircraft, registered P2-ASM and operated by Air Sanga Limited at Wobagen Airstrip, Sandaun Province. The AIC immediately commenced an investigation.

This Accident Final Report has been produced by the PNG AIC pursuant to ICAO Annex 13 and has been approved for public release.

The report is based on the investigation carried out by the AIC in accordance with Papua New Guinea *Civil Aviation Act 2000 (As Amended), Annex 13* to the *Convention on International Civil Aviation,* and the *PNG AIC Investigation Policy and Procedures Manual*. It contains factual information, analysis of that information, findings and contributing (causal) factors, other factors, safety actions, and a safety recommendation.

Capt.Aria Bouraga, MBE
Acting Chief Commissioner
13 May 2022

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1 FACTUAL INFORMATION

1.1 Occurrence Details

On 1 December 2020, at 09:13 local (23:13 UTC[1]), a Viking DHC-6-300 aircraft, registered P2-ASM, operated by Air Sanga Limited, was conducting a VFR[2] charter flight from Wobagen Airstrip, Sandaun Province to Bak Airstrip, Sandaun Province, when during the take-off, the aircraft ran off the side of the airstrip into a drainage ditch adjacent to the airstrip.

Figure 1: Accident site

The pilot in command (PIC) was pilot flying and was occupying the left seat. The co-pilot was occupying the right seat and was pilot monitoring. There were 8 persons on board the aircraft; 2 pilots and 6 passengers.

The crew had flown earlier that morning from Kiunga to Wobagen on a passenger and cargo charter flight, landing at 08:47. After unloading at Wobagen, the crew loaded passengers and cargo for its next leg to Bak.

The crew, during interview with the AIC, stated that they had noticed that the strip surface was wet during the landing roll and taxi to the parking area. As a result, they elected to conduct their *'before take-off'* checks at the parking area. They stated that this would enable them to conduct their planned taxi to take-off

1 The 24-hour clock, in Coordinated Universal Time (UTC), is used in this report to descried the local time as specific events occurred. Local time in the area of the serious incident, Papua New Guinea Time (Pacific/Port Moresby) is UTC + 10 hours.2Visual Flight Rules: Those rules as prescribed by national authority for visual flight, with corresponding relaxed requirements for flight instruments (Source: The Cambridge Aerospace Dictionary)

2 Visual Flight Rules: Those rules as prescribed by national authority for visual flight, with corresponding relaxed requirements for flight instruments (Source: The Cambridge Aerospace Dictionary)

transition without have to stop and line-up at the take-off area. The crew stated that they had developed this procedure only for their experienced pilots to use for take-off's on unpaved slippery and boggy airstrips.

At 09:11, the crew called Moresby Flight Services (FIS) on the radio, informing them that they were amending their destination to Bak from their initially planned destination, Kiunga. They subsequently completed their *'before take-off'* checks and began taxiing northwest towards the strip 11 (110°) take-off end of the airstrip.

According to recorded data from the aircraft, when they arrived at their intended take-off area, the PIC commenced a left turn to line up with the runway centreline using the tiller assisted by asymmetric thrust. As the aircraft turned, the PIC began progressively increasing power. According to the crew, they wanted to maintain enough momentum to avoid slipping down the strip's camber or bogging into the wet surface. The PIC then made a slight right turn to as they intercepted the centreline. The PIC subsequently increased to full power as the aircraft began accelerating down the strip.

With full power applied, as the aircraft accelerated to about 33 kts, the aircraft started deviating from the centreline, towards the right side. The PIC stated that as soon as he realised that the aircraft was diverging from the centreline, he tried to steer it back towards the centreline using the asymmetric thrust, but the aircraft continued away from centre.

About 200 m down the strip, with a speed of 42 kts, the aircraft started swerving towards the right. The PIC quickly pulled both throttles into idle and applied full brakes. The aircraft continued sliding sideways in the direction of its momentum forward past and ran into soft patchy undulated surface (see Figure 3). The aircraft subsequently impacted a drainage ditch along southwestern edge of the airstrip.

Figure 2: Significant events from take-off to accident

Figure 3: P2-ASM track when it began swerving to the right

The aircraft sustained significant damage to the cockpit forward bulkhead, nose landing gear (NLG) assembly and the left propeller and wing.

Figure 4 Damage sustained by P2-ASM

The crew stated during interview that after the aircraft came to rest, the flight crew carried out the procedure for shutting the engines down. The passengers opened the cabin door themselves and exited the aircraft. Both pilots exited through the cockpit doors and made their way away from the aircraft with the passengers.

One passenger was reported to have suffered minor injuries.

1.2 The Aircraft

1.2.1 Maintenance/Airworthiness

The aircraft had a valid Certificate of Airworthiness (CoA) and Annual Airworthiness Review (AAR) were current during the accident time.

The AIC reviewed relevant maintenance records. The records showed that there were no outstanding maintenance activities. The last scheduled maintenance was carried out at the Operates remote facility in Kiunga on 29 November 2020. There were no outstanding defects identified during the investigation review.

Therefore, the aircraft was deemed to be airworthy and serviceable at the time of the accident.

1.2.2 Engine

The aircraft was fitted with two Pratt & Whitney PT6A engines. (*See 4.1 Appendix A*).

During the investigation, the AIC conducted a Cockpit Voice Recorder (CVR) audio engine sound spectrum analysis as well as an Appereo cockpit video engine parameter gauge review. The investigation determined that the left engine was performance specifications while the right engine was performing at a considerably lower reading.

The table shows the engine performance parameters observed on the engine gauges.

Engine Parameter	**After Take-off power application**		**Manufacturers Take-off power specifications**
	Engine 1	**Engine 2**	**Max**
Torque Pressure (PSI)	**40**	**24**	**50**
Propeller RPM (%)	**96**	**85**	**96**
T5 Turbine (°C)	**700**	**900**	**725**
Oil Temp (°C)	**65**	**75**	**80-100**
Oil Pressure (PSI)	**85**	**90**	**10-99**
Fuel Flow (PPM)	**3.5**	**3**	
GG RPM (%)	**95**	**90**	

Table 1: Engine Parameters when take-off (full) power was applied to the engines

1.2.2.1 Engine Condition Trend Monitoring (ECTM)

During the investigation, three months records prior to the accident of the Engine 2 Engine Condition Trend Monitoring (ECTM) was requested. However, the Operator informed the investigation that they did not have the records as per the request.

1.2.3 Weight & Balance

The accident flight *Quick Trim Sheet and Load Message* (*Refer to 4.2 Appendix B*) showed that the aircraft departed from Wobagen with a take-off weight of 4,926 kg.

According to the *Quick Trim Sheet and Load Message*, the Maximum take-off weight of the aircraft at the time of the accident was 5,671 kg.

Note: The actual cargo was removed prior to the arrival of investigators at the wreckage site. Therefore, the only source available to the investigation is the trim sheet information.

The investigation determined, from information in the crew's trim sheet, that the aircraft was within its weight.

1.3 Flight Recorders

The aircraft was equipped with the following flight recording equipment:

- L3-Solid State Cockpit Voice Recorder (SSCVR)
- Appareo V1000 unit

A flight data recorder (FDR) was not installed in the aircraft, nor was an FDR required under PNG Civil Aviation Rules current at the time of the accident.

The data from the two recorders contained pertinent evidence data which were downloaded for the investigation.

According to the Appereo V1000 data, when the PIC set thrust levers to the full take-off position at take-off, the left propeller RPM was between 5-10% higher than the right propeller. There was no indication on the recorded data which indicate that crew noticed the thrust asymmetry. There was no adjustment of the thrust levers before until the PIC pulled both levers to idle about 4 seconds from impact.

1.4 Weather Condition

The pilots stated during interview that they did not get the weather information for Wobagen prior to the accident flight, due to the mobile network not being reliable. They only called their agent at Bak, the nearest village to Wobagen and one of their destinations for their days flight.

The crew informed the AIC that the weather was fine at Wobagen, with clear skies when they arrived at Wobagen. After landing, they noticed that the strip surface was generally wet. They then learned that it had rained earlier that morning or the day before.

Local villagers confirmed that it had rained at Wobagen the day before and the morning of the day the accident occurred.

See *4.3 Appendix C* for the PNG Weather Service Meteorological Information from National Weather Services (NWS).

1.5 Pilots

1.5.1 Co-pilot

The co-pilot of the accident flight had the following qualifications:

- PNG *CPL*[3]*(A)*[4] was issued on 28 February 2017
- Current medical class 1 with medical limitation as "Reading Spectacles"
- Endorsed on the single engine aeroplane less than 5,700 kg MTOW; P750XL and multiple engine aeroplane; BN2, C404, DHC6, E110, B1900

The co-pilot was issued with an IOA by the Civil Aviation Safety Authority (CASA) of PNG on 6 February 2020 to carry out functions of a Flight Examiner in accordance with PNG Civil Aviation Rule (CAR) Part 61.905(a)(2) for the purpose of conducting the following flight tests of pilots on DHC6 aircraft: -

	Flight Test	Trainee/type of Assessment
1)	Line checks	Check Captains, Captains, First Officers, Captains
2)	Base checks	Check Captains, Training Captains, Captains, First Officers
3)	Competency checks	Instrument Flying

The co-pilot was also issued with an IOA by the Civil Aviation Safety Authority (CASA) of PNG on 2 February 2020 to carry out functions of a Flight Instructor in accordance with PNG Civil Aviation Rule (CAR) Part 61.305(d) for the purpose of conducting the following flight tests of pilots on DHC6 aircraft: -

	Flight Test	Trainee/type of Training
4)	Line training	Training Captains, Captains, First Officers
5)	Base checks	Training Captains
6)	Captains Training	Captains to conduct First Officer/Captains Training
7)	Competency checks	Instrument Flying

See *4.1 Appendix A* for more information about the co-pilot.

1.5.2 PIC

The PIC of the accident flight had the following qualifications:

- PNG ATPL[5] *(A)* was issued on 20 March 2014
- Current medical class 1 with medical limitation as "Spectacle Distant Vision"
- Endorsed on the single engine aeroplane less than 5,700 kg MTOW and multi engine aeroplane; BE19, BE76, E110, DHC6, DHC8

Refer to *4.1 Appendix A* for more information about the PIC.

1.5.2.1 PIC Competency Training

The PIC's trainings records indicated that the PIC had undergone the following:

Date	Type of Check	Point of Departure	Destination
09 August 2020	Base & Line	Jacksons International Airport	Jacksons International Airport
17 August 2020	Route and Aerodrome	Kiunga Airport	Wobagen Airstrip

Table 2: PIC Check flights

3 Commercial Pilot License
4 (A) stands for Aeroplane
5 Air Transport Pilot License

1.5.2.2 PIC's recent history on DHC6 operation into Wobagen Airstrip

During the interview, the PIC informed AIC that he had conducted a flight into Wobagen Airstrip a month prior to the accident flight. The PIC's logbook showed that the PIC last flew into Wobagen Airstrip prior to the accident flight on 1 October 2020.

1.6 Airstrip Information

1.6.1 Wobagen Airstrip

Wobagen is located on the Southern slopes of the Emmanuel Ranges just to the West of Bak, surrounded by high mountains.

The investigation requested that the Operator provide the manual in its entirety for the purpose of identifying the standard characteristics and requirements of the airstrip category. However, the Operator did not provide the manual to the investigation.

During the interview, the crew stated that the Operator does not have documented special procedures for operating into Wabogen Airstrip. They further stated that they operated into Wobagen based on their experience and knowledge of the airstrip.

According to the Operator, the only information for Wobagen on their Route Guide and Training Manual was the extracted they provided as shown in *4.4 Appendix D*.

The Operator was not able to provide the investigation with any evidence that the Hazard Identification and Risk Assessment was carried out on Wobagen Airstrip prior to Operation into the airstrip. Also, during the interview, the PIC informed AIC that there was no risk assessment conducted on Wobagen Airstrip.

1.6.1.1 Onsite Observation

It was observed by the AIC on-site investigation team that the airstrip had the following characteristics,

Terms of Description	**Condition**		
	Centre	**Outside of Centreline (Approx. 5m)**	**Threshold**
Surface Cover	Patchy grass & Bare	Short grass	Short grass
Soil Type	Course-grain soil (Limestone gravel)	Clay	Clay
Surface Hardness	Medium	Soft	Soft
Surface Roughness	Rough	Rough	Smooth
Surface Evenness	Undulation	Undulation	Undulation

Table 3: On-site team assessment of Wobagen Airstrip

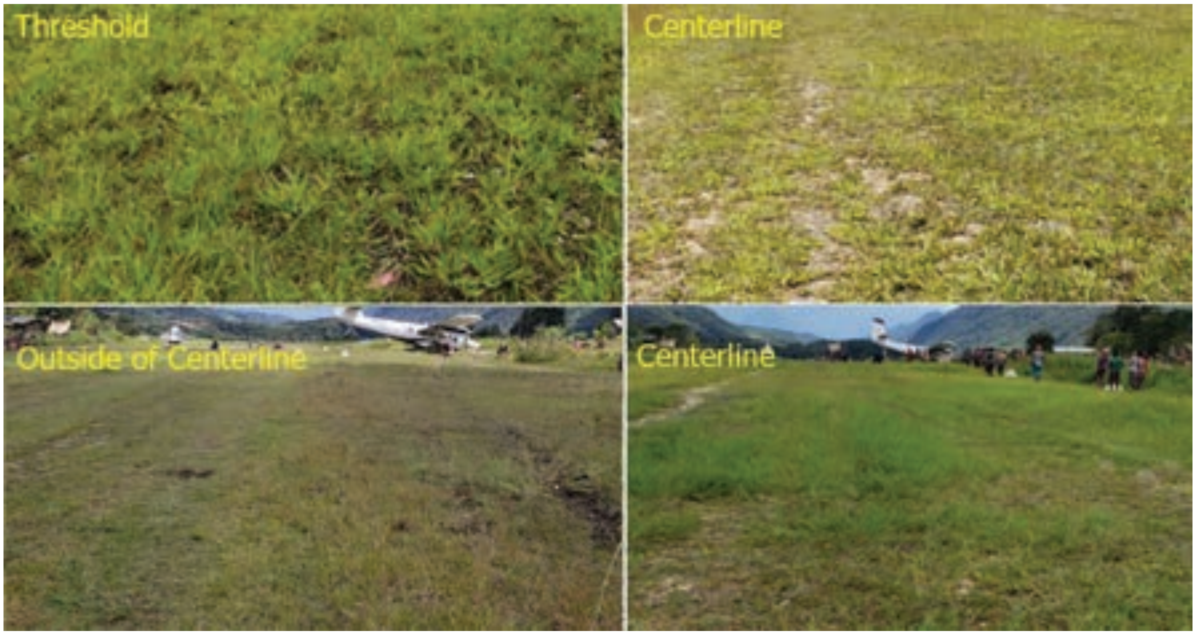


Figure 5: Images of Wobagen Airstrip taken by on-site team

1.7 Organisation

1.7.1 Operator – Air Sanga

Air Sanga Limited is an aircraft operator which conducts charter and regular Fares & Freight (F&F) operations within PNG. Most of its operations are into remote areas servicing rural communities. Air Sanga Limited holds an Air Operator's Certificate issued under CAR 119 for fixed wing air operations in accordance with CAR Part 125 and Part 135. The scope of Air Sanga Limited operations includes:

- Hire and reward air operations throughout PNG
- Regular and Irregular carriage of passengers
- Regular and Irregular carriage of cargo
- VFR operations

The Operator was not able to provide the investigation with information on Airstrip Classification. Therefore, the investigation was unable to verify the requirements for operating into the categories of airstrip.

1.7.1.1 Standard Operating Procedures

The Operator confirmed that they have adopted the Aircraft Manufacturers *Aircraft Flight Manual (AFM),* Revision No.53, Effective Date 10/02/2017. The investigation reviewed the procedures contained in the AFM for take-off against the actions taken by the crew. The AIC confirmed that the procedure contained in the AFM for take-off (*See 4.6 Appendix E*) was not actioned.

The take-off procedure, as described by the crew was:

> *Maintain speed and momentum from the taxi and as centreline gets intercepted, apply take-off power. The crew stated that the procedure is only used on wet, slippery, unsealed airstrips. The crew also confirmed that they did not have the procedure documented. However, they trained and permitted PNG airstrip experienced pilots to conduct this procedure.*

1.7.1.2 Applicable Civil Aviation Rule (CAR) Parts

The Civil Aviation Rules, more commonly shortened to CAR's are ordinary rules made by the Minister Civil Aviation for civil aviation operations in PNG.

NOTE: The CAR parts referenced in this section or report are those significant to the investigation.

CAR Part 91.109 Aircraft flight manual

> *(a) A person must not operate an aircraft unless it is operated in accordance with the aircraft flight manual approved by the Director.*
>
> *(b) The aircraft flight manual in paragraph (a), must:*
>
> > *(1) contain at least, the aircraft limitations, information and procedures; and*
> >
> > *(2) clearly identify, the specific aircraft or series of aircraft to which it is related; and*
> >
> > *(3) be updated by implementing changes made mandatory by the Director or the State of Registry.*
>
> *(c) The Director may approve the aircraft flight manual if the Director is satisfied that it meets the contents of paragraph (b).*

The crew carried out a procedure that was not contained in the Manufacturers Flight Manual. The investigation found that the procedure was also not in the Operators other operational manuals.

Civil Aviation Rule Part 125

The Operator was authorised under CAR Part 119 Air Operator Certificate to conduct civil aviation operations as a *CAR Part 125* Operator.

According to *CAR Part 125.67 Flight check systems:*

> *(a) The certificate holder shall establish a flight check system for use by flight crew members of each aeroplane that is operated under the authority of the certificate.*
>
> *(b) When establishing the flight check system required by paragraph (a), the certificate holder must have regard to the principles of human factors and crew resource management to ensure that the flight crew members can make safe decisions for the management of the aeroplane.*
>
> *(c) The flight check system required by paragraph (a) must-*
>
> > *(1) provide instructions and guidelines for the safe and efficient management of the flight deck; and*
> >
> > *(2) specify methods to be used for ensuring the safe conduct of the flight; and*
> >
> > *(3) include the procedures and checklists for ensuring compliance with-*
> >
> > > *(i) the aeroplane flight manual; and*
> > >
> > > *(ii) the manufacturer's technical and safety instructions; and*

The Take-Off procedure that was actioned by the crew was not consistent with the procedure contained in the AFM. The investigation confirmed that the procedure was also not contained in any other approved or accepted operational manuals. The crew stated, during interview, that the procedure was only known to their experienced pilots for take-off on wet, slippery airstrips and was not a documented procedure.

The investigation reviewed *CAR Part 91.127 Use of aerodromes (b)* which states:

> *b) The certificate holder shall, where its aeroplane uses an aerodrome not promulgated in the PNGAIP, maintaining a registry containing –*
> *1) the aerodrome data*
> *2) procedures to ensure that the condition of the aerodrome is safe for that operation.*

The Operator had a *'Route Guide Manual' Revision 0, Effective Date 02 June 2017* from which an extract containing information about Wobagen airstrip was retrieved for review (see 4.4 Appendix D). According to the extract from the Operator's Route Guide, the airstrip classifies Wobagen Airstrip as a "Category C" airstrip.

The Operator's criteria for considering the airstrip a class Category C airstrip was based on its observation of the airstrips conditions. The categorization mechanism or methodology was not provided to the AIC.

The investigation also reviewed *CAR Part 100.59 Hazard Identification* and 100.61 which state:
CAR Part 100.59

> *(a) An applicant for the grant of an organisational certificate must establish and maintain documented procedures for the identification and reporting of hazards to safety.*
>
> *(b) The procedures required by (a) must include provisions for—*
>
> *(1) regular systematic appraisals to assess the level of safety in the operation and to*
>
> *identify safety improvements; and*
>
> *(2) employee reporting of potential safety risks which the person becomes aware of.*
>
> *(c) The procedure required by paragraph (b)(2) must include an obligation for the senior person responsible for the safety management system to reply in writing to every employee*

CAR Part 100.61 Risk Management

> *(a) An applicant for the grant of an organisational certificate must establish and maintain documented procedures for risk management in the organisation.*
>
> *(b) The procedures required by paragraph (a) must include:*
>
> *(1) identification of the key personnel to be involved in the risk management process; and*
>
> *(2) a process for assessing the level of risk in the operation; and*
>
> *(3) identification and application of risk mitigators; and*
>
> *(4) arrangements for follow up on the effectiveness of mitigators.*

The Operator provided operational documentation showing its hazard identification and risk management processes and procedures. However, the investigation was not provided any evidence to show logs of hazard identification and/or risk assessment conducted for Wobagen.

CAR Part 21.99 Application for deviation from specification

> *(a) An applicant for a deviation to the performance standard of an accepted specification must complete form CA 21/06, and submit it to the Director withes a payment of the appropriate application fee prescribed by regulations made under the Act and provide the Director with—*
>
> *(1) the name and address for service in Papua New Guinea of the applicant; and*
>
> *(2) the identification of the product, component, or appliance to which the deviation is to apply; and*
>
> *(3) any documentation necessary to support the deviation and its suitability for application to the product, component, or appliance; and*

(4) evidence that the standard from which a deviation is requested is compensated for by factors or design features providing—

(i) an equivalent minimum performance standard; and

(ii) a level of safety acceptable to the Director; and

(5) any further particulars relating to the applicant required by the Director.

For the take-off procedure used by the crew at Wobagen, there was no record of application with supporting documents/evidence submitted for acceptance by the Director.

2 AIC COMMENT

2.1 The accident

The AIC determined from the available evidence that there was asymmetric thrust sustained during the take-off roll immediately following take-off power selection. There was a significant variation between engine parameter readings of the left and right engine. It was apparent that neither crew member noticed the variations, including the right engine exceedance of the intake turbine temperature limits for after selecting take-off power until the time the accident occurred.

During the PIC's interview, he confirmed that the aircraft was deviating right of his intended take-off track, against his steering and control inputs. However, he was not able to identify what was causing this deviation. Furthermore, the copilot, during his interview, could not explain what had caused the uncommanded deviation. He confirmed that he was looking outside during the take-off roll.

The investigation determined that the procedure used by the crew for take-off was an unapproved and undocumented procedure. The crew did action the procedure according to the Appereo data, however, the procedure did not include certain key considerations and from the standard approved Aircraft Flight Manual. The requirement for the crew to observe engine parameters when applying power for take-off, was the appropriate steps should have been taken. The crew, especially the PIC, would not have been able to carry out this observation effectively as their procedure is meant to transition directly from taxi to the take-off roll.

The investigation determined that the PIC's advancement of the throttles was relatively rapid and the engine parameters abruptly increased.

Although the Manufacturer's AFM Take-Off procedure contains a warning requiring that all take-off's be conducted with full take-off power, the Crew custom procedure did not incorporate a check for power correspondence. The AFM further adds that a 5 s delay is mandatory at 85% Ng for engine parameters to settle before take-off power can be applied. The crew did not conduct this step to ensure power must be present for take-off and also the crew customized procedure did not include this requirement. The crew must check that full take-off power has been achieved by delaying to allow engine parameters to settle was not catered for as the crew had planned to begin the take-off, transitioning directly from taxi. The right engine's exceedance of the T5 temperature limits could not be determined as the engine was not recovered and inaccessible. However, the AIC considered that actions contrary to those specified in the AFM Take-Off procedure can be considered a probable factor to the abnormal parameters sustained by the right engine.

2.2 Asymmetric thrust

The AIC, through the Appareo 1000 video data, observed a disparity between the Propeller RPM gauges for both left and right engine. The left propeller RPM, during the take-off roll was about 5 to as high as 10% higher than the right propeller RPM. This indicates that there was asymmetric thrust sustained during the take-off roll causing a righthand veering tendency. The AIC believes that the asymmetric thrust sustained would not be manageable over normal paved or dry surface conditions. However, because the aircraft was accelerating down a wet slippery clay/silt surface, the maneuverability was reduced significantly. Furthermore, as the aircraft diverged further from the center path, it signified that there was thrust asymmetry, which is likely to have contributed to the aircrafts tendency to veer right. The video also shows that the thrust asymmetry was not corrected in time to maintain the aircrafts intended center path.

Because the aircraft had veered off the hardened surface around the narrow center take-off path onto the wet and slippery clay/silt surface right of the centre path of the airstrip, the maneuverability was significantly reduced. The momentum of the aircraft and the lack of traction of due to the slippery surface caused the aircraft to continue past the boundary markers and into the drainage ditch.

The pilot records showed that the crew had significant experience operating into airstrips. The crew confirmed that they had operated on airstrips with similar conditions many times using the taxi turn transition technique. The video data shows that they had briefed on the procedure prior to take-off. As this was a take-off the PIC kept his eyes outside as is the appropriate practice. However, the monitoring pilot was also looking outside and did not notice the RPM.

The investigation parameters were for the engines reflected the engine control settings by the PIC. It was therefore deduced that the thrust asymmetry was due to thrust lever positions set by the PIC.

From the time between the take-off and accident, the AIC believes, the PIC did not have sufficient time to identify the cause of the aircrafts tendency to veer towards the right.

2.3 Airstrip Conditions

The investigation identified certain obvious hazards during its visit to the accident site. During interview with the crew, the investigators also understood that the crew were aware of some of those significant hazards, and through experience, took certain steps to mitigate the associated risks.

Due to unpredictable weather conditions at Wobagen Airstrip, the important weather and airstrip condition information from source at Wabogen was vital. However, that information was not gathered on the day of the accident. The investigation also identified that having a reliable source at each strip providing reliable information would be beneficial to the crew, to fully aware them of risks at a particular strip and how to mitigate those risks.

2.4 Hazard Identification

Although not directly causal to the accident, the AIC found that a risk assessment was not carried out at Wabogen Airstrip before operating there. According to the investigation, the last flight into Wabogen was a month prior to the accident so conditions of the strip was unknown at the time of the occurrence. Although the Operator had established Hazard Identification and Risk Management procedures in its SMS Manual, the operator did not identify hazards at Wobagen Airstrip and associated risks to properly develop special or specific procedures for Wabogen Airstrip according to the data gathered from the risk assessment. This would have ensured the crew were trained in these special procedures to avoid accident

2.5 Take-off technique

The take-off procedure described by the crew could not be found in the aircraft manufacturer flight manual or other operational manuals. The crew also confirmed that they did not have the procedure documented. However, they trained and permitted PNG airstrip experienced pilots to conduct this procedure.

Understanding the challenges posed by airstrips in Papua New Guinea, and the number of unconventional techniques that pilots operating into those airstrips use to allow services, it is still important to develop procedure and/ or deviations from procedures and submit to the appropriate authorities any deviation from standard operating procedures from approved procedure developed or procedures must be by Operators for only used by highly experienced pilots. They confirmed that they also did not have a written procedure for the take-off procedure.’

3 FINDINGS & CONTRIBUTING FACTORS

3.1 Findings

- The crew use an unapproved procedure for take-off on unsealed wet airstrips and did not action the approved Manufacturers AFM normal take-off procedure
- The take-off procedure used by the Operator does not cater for certain actions and/or considerations from the approved Manufacturers AFM.
- The crew were qualified and experienced operating in PNG airstrips and were experienced operating into Wobagen.
- The Operator did not have records of hazards associated with Wobagen, although the crew were aware of a number of hazards.
- The crew did not identify or recognize the right engine parameter abnormalities during the take-off.
- Maintenance records showed that the aircraft was serviceable
- The engine parameters before take-off power were applied, indicated that both engines were operating normally.
- The engine parameters for the right engine indicate that the right engine was operating abnormally (below specifications).
- The Operator's Route Guide was an outdated and did not contain the current useful information/data or surface conditions for Wobagen Airstrip

3.2 Contributing Factors

The crew did not action the appropriate take-off checklist which caused them to miss crucial checks and actions. This caused the engine abnormalities to go unnoticed after take-off power was applied. The abnormal parameters engine parameters remained unnoticed until impact. The parameters of right engine indicate that it was performing at considerably lower power than the left engine, which was operating to the manufacturer's specifications. The power difference between the right and left engine created the tendency of the aircraft to veer right. The right engine T5 Turbine temperature exceeded the limit which shows that the overtemperature condition was sustained by the right engine.

The wet deteriorated clay/silt surface did not allow aircrafts tires to gain sufficient traction to follow the control inputs of the PIC as he attempted to steer the aircraft back towards the centreline. As the aircraft accelerated towards the right, it ran over undulated surface. The aircraft continued veering right because the power was not reduced, and the asymmetric effect continued. With the asymmetric thrust, the undulated slippery surface, the aircraft swerved right. This prompted the PIC to pull power into idle and apply full brakes. After pulling power to idle, and applying full brakes, the aircraft continued with momentum over the significantly slippery surface and impacted the drainage ditch at the edge.

4 APPENDICES

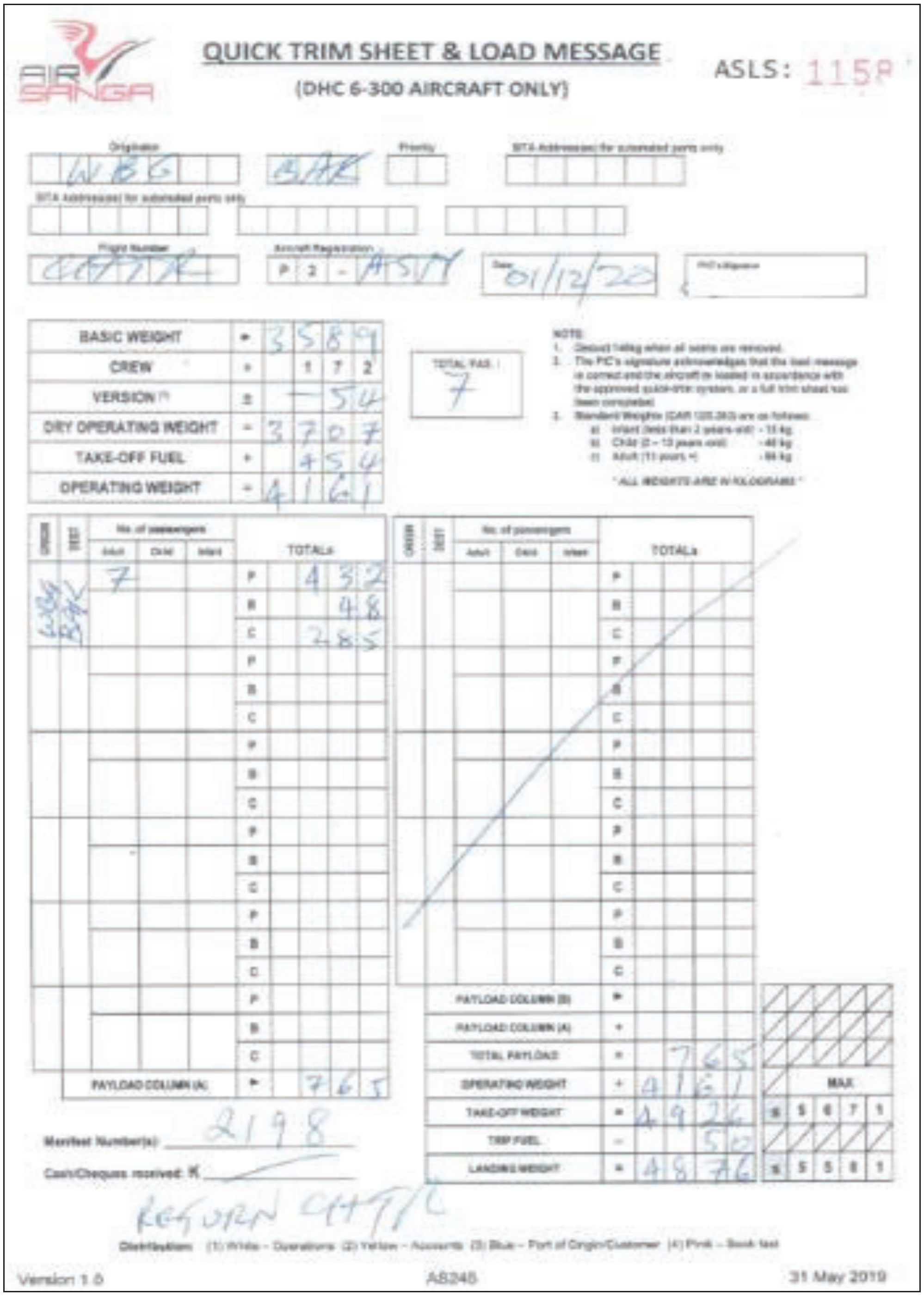
4.1 Appendix A

4.1.1 Crew, aircraft and operation data

General Details			
Date and time		1 December 2020, 23:13 UTC	
Occurrence category		Accident	
Primary occurrence type		Runway Excursion-(RE)	
Location		Wobagen Airstrip, Sandaun Province	
Type of Operation and damage details			
Type of Operation		VFR, Non-schedule passenger	
Damage		Cockpit forward bulkhead, nose landing gear (NLG), nose wheel assembly, left wing and propeller	
Crew details			
PIC		Co-pilot	
Gender	Male	Gender	Male
Age	48	Age	51
Nationality	Papua New Guinean	Nationality	Papua New Guinean
Licence type	PNG ATPL (A)	Licence type	PNG CPL (A)
Total hours	6,748.00	Total hours	14,865.60
Total hours in Command	2,696.40	Total hours in Command	5,130.20
Total hours on type	1,450.00	Total hours on type	9,550.10
Aircraft Details			
Aircraft Manufacturer		Viking Aircraft Limited	
Aircraft Model		DHC-6-300	
Serial Number		389	
Year of manufacturer		1973	
Total hours since new		48,082	
Total cycles since new		83,877	
Certificate of Registration (CoR) issued		31 October 2019	
Certificate of Airworthiness	Re-issued	6 December 2019	
	Expire	Non-Terminating	
Engine 1		**Engine 2**	
Manufacturer	Pratt & Whitney	Manufacturer	Pratt & Whitney
Model	PT6A	Model	PT6A
Type	PT6A-27	Type	PT6A-27
Serial number	PCE-50926	Serial number	PCE-52251
Total time since new	23,591.6	Total time since new	15,412
Total cycle since new	36,328	Total cycle since new	19,276
Propeller 1		**Propeller 2**	
Manufacturer	Hartzell Propeller Inc	Manufacturer	Hartzell Propeller Inc
Model	Hartzell	Model	Hartzell
Serial number	BUA25583	Serial number	BUA31127
Hours since Overhaul	1,081	Hours since Overhaul	361.2

4.2 Appendix B

4.2.1 Accident Flight Load Sheet



AIR SANGA

QUICK TRIM SHEET & LOAD MESSAGE

(DHC 6-300 AIRCRAFT ONLY)

ASLS: 115P

Originator: WBG | BAR | Priority

Flight Number: ZAT72 | Aircraft Registration: P2-ASYY | Date: 01/12/22 | PIC's Signature

BASIC WEIGHT	=	3589
CREW	+	172
VERSION	±	-54
DRY OPERATING WEIGHT	=	3707
TAKE-OFF FUEL	+	454
OPERATING WEIGHT	=	4161

TOTAL PAX: 7

NOTE

"ALL WEIGHTS ARE IN KILOGRAMS"

	Adult	Child	Infant		TOTALS
WBG BAR	7			P	432
				B	48
				C	285
PAYLOAD COLUMN (A)				►	765

			MAX
TOTAL PAYLOAD	=	765	
OPERATING WEIGHT	+	4161	
TAKE-OFF WEIGHT	=	4926	5671
TRIP FUEL	−	50	
LANDING WEIGHT	=	4876	5581

Manifest Number(s): 2198

Cash/Cheques received: K

RETURN CHT/C

Distribution: (1) White – Operations (2) Yellow – Accounts (3) Blue – Port of Origin/Customer (4) Pink – Book last

Version 1.5 | AS245 | 31 May 2019

4.3 Appendix C

4.3.1 Meteorological Information

WEATHER FORECAST	
Source	PNG National Weather Services
Forecast type	Area Forecast – Area 4 (Tabubil Area which includes Wobagen)
Issued	03:10, 1 December 2020
Validity	09:00-21:00, 1 December 2020
Upper Winds	At 2,000 ft & 5,000 ft – variable winds blowing at 10 kt. At 7,000 ft – winds blowing at 40º at 10 kt. At 10,000 ft – winds blowing at 40º at 10 kt. At 14,000 ft – winds blowing at 50º at 10 kt. At 18,500 ft – winds blowing at 60º at 10 kt.
Cloud	Scattered cumulonimbus clouds at 1,800 ft to 45,000 ft. Scattered stratus clouds at 500 ft to 3,000 ft with intermittent precipitation. Scattered cumulus clouds at 1,800 ft to 10,000 ft with broken showers. Scattered stratocumulus clouds at 3,000 ft to 8,000 ft with broken rain and drizzles. Broken altocumulus-altostratus clouds at 10,000 ft to 18,000 ft.
Visibility	At 500 m with fog. At 3,000 m with thunderstorms and rain. At 4,000m with showers and rain, or with rain and drizzles.
ACTUAL WEATHER	
Source	Pilot Report
PIC – departing Kiunga enroute Wobagen, the weather was fine. The weather was good at Wobagen airfield. FO – Patches of cloud.	

4.4 Appendix D

4.4.1 Operator's Route Guide

AIR SANGA	119/125 ROUTE GUIDE MANUAL	VOLUME 1 PART C
	SECTION 3: AIRPORT DATA	Page 3-226

3.123 Wobagen (Bimin)

3.123 Wobagen (Bimin)

WOBAGEN AYYB

Latitude/Longitude: .... S 05° 16' 12" E 142° 01' 04"
Elevation: 5758ft
Category: C

RADIO COMMUNICATIONS

Type	Call sign	VHF	HF	
ATS	Moresby	124.9 MHz	5565 KHz	8861 KHz

RUNWAY INFORMATION

RWY Characteristics	Runway 11	Runway 29
RWY Strip	525m x 30m	525m x 30m
Alignment:	117° M	297° M
Slope:	-10.0 %	+10.0 %
Restriction	Take off RWY 11	Land RWY 29
Surface/PCN/SECN	Grassed grey gravel SECN Group IV	

Aerodrome Operating Information

Terrain

Wobagen is located on the southern slopes of the Emmanuel Range just to the west of Bak. It is surrounded by high mountains. The best approach is via the Strickland River from the South.

From SE looking towards Kuskis Village (arrow pointing at RWY)

Version 0, 02 June 2017	Air Sanga Limited

4.5 Appendix E - DHC-6 Series 300 Before Take-off Checklist

SECTION 4
NORMAL PROCEDURES

TC Approved

VIKING
DHC-6 SERIES 300

4.9 Before Take-Off

1 Trims – Set. The elevator trim pointer should be aligned with the forward (lower) edge of the take-off range mark with aft center of gravity and to the aft (upper) edge of the take-off range mark with forward center of gravity. The rudder trim pointer should be aligned with the take-off index. Once the neutral aileron trim position has been determined and verified in flight, it is not normally adjusted.

2 PROP levers – Full INCREASE (MAX RPM)

3 PROP AUTO FEATHER switch – On. Check that the SEL light is illuminated.

4 Fuel Quantity – Sufficient for planned flight.

5 FUEL SELECTOR – NORM

6 Crossfeed valve indicator (S.O.O. 6035, if installed) – CL

7 FLAPS selector lever – 10°. Check flap indicator confirms flaps set to 10°

8 Compasses – Aligned

9 BLEED AIR Switches – ON if ice protection or cabin heat is required, otherwise OFF.

10 Ice protection, including intake deflectors – As required. Pitot Heat must be ON and intake deflectors must be extended when operating in visible moisture at temperatures below +5°C.

11 Cabin heat – As required

12 Altimeters – Set

13 Flight controls – Check that the control locks have been removed and properly stowed. Check elevator, ailerons and rudder are free and operate each control through the full range of travel.

14 Instruments – Check

15 Caution lights – Check that all are extinguished. The PNEUMATIC LOW PRESS light, if installed, will remain on if the BLEED AIR switches are at the OFF position, and will go out as power is increased if the BLEED AIR switches are at the ON position.

16 ANTI-COLL (strobe light) switch (if applicable) – On

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4.6 Appendix E - DHC-6 Series 300 Take-off Procedure

SECTION 4
NORMAL PROCEDURES

TC Approved

VIKING
DHC-6 SERIES 300

4.10 Take-Off

1 Line up on the runway and slowly roll forward a short distance until certain that the nose wheel is centered. Then, stop and apply brakes.

2 Advance the power levers until 85% N_G is reached, then pause for at least 5 seconds at this power setting until all engine indications – particularly the T_5 temperature indications – have stabilized.

NOTE

Pausing for at least five seconds at 85% N_G allows time for the engine compressor bleed valves to close and allows the pilot the opportunity to confirm (by observing the engine temperatures) that both compressor bleed valves have closed. This procedure also establishes airflow over the vertical stabilizer and rudder prior to brake release, which facilitates effective directional control of the aircraft by rudder pedal input during the early stages of the take-off roll.

WARNING

IT IS MANDATORY TO SET FULL CALCULATED TAKE-OFF POWER AS DERIVED FROM THE POWER SETTING CHART FOR EVERY TAKE-OFF, REGARDLESS OF AIRCRAFT WEIGHT OR RUNWAY LENGTH. REDUCED POWER TAKE-OFFS ARE PROHIBITED.

IT IS MANDATORY TO PAUSE FOR AT LEAST 5 SECONDS AT 85% N_G PRIOR TO SETTING FULL CALCULATED TAKE-OFF POWER.

IF EITHER ENGINE IS NOT CAPABLE OF ACHIEVING FULL CALCULATED TAKE-OFF POWER, OR IF EITHER ENGINE REACHES THE T_5 LIMIT OR THE N_G LIMIT PRIOR TO REACHING THE FULL CALCULATED TAKE-OFF POWER TORQUE VALUE, THEN THE CONDITION OF THE ENGINE HAS DETERIORATED AND THE PROBLEM MUST BE INVESTIGATED AND CORRECTED BEFORE FLIGHT.

IF EITHER ENGINE CANNOT ACHIEVE THE FULL CALCULATED TAKE-OFF POWER TORQUE VALUE AS PUBLISHED IN THE TAKE-OFF POWER SETTING CHART, OR IF THE T_5 OR N_G LIMIT IS REACHED BEFORE THE FULL CALCULATED TAKE-OFF POWER TORQUE VALUE IS REACHED, THE ENGINE IS NOT AIRWORTHY AND THE AIRCRAFT MUST NOT BE FLOWN.

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Page 4-36

Revision: 53
Date 10 Sep. 2010

3 Power levers – Advance smoothly to the full calculated take-off power setting (Figure 5-7). Check that the autofeather ARM light illuminates.

If a maximum performance take-off is desired, do not release the brakes until full take-off power has been set. It is not mandatory to set full calculated take-off power prior to brake release if sufficient runway and clearway is available to allow for a gradual increase in power from 85% N_G to full calculated take-off power following brake release. As airspeed increases, torque pressure will increase with a constant power lever setting. Adjust the power levers as required to avoid exceeding the calculated take-off power setting.

4 Maintain directional control with rudder.

5 Rotation IAS – As indicated in figure below.

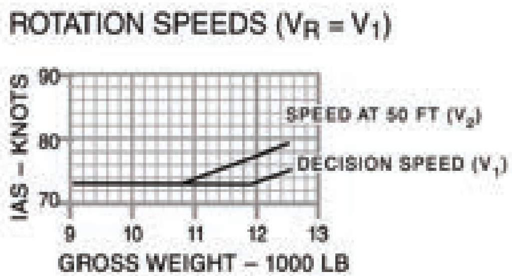

Figure 4-1 Rotation Speeds SFAR 23

6 Speed at 50 feet – 80 KIAS (all weights), or, according to Figure 4-1 if maximum performance is required.

7 Climb to a minimum of 400 feet AGL at 80 KIAS (all weights) prior to retracting flaps.

8 Do not reduce power from the take-off power setting until flap retraction is complete.

4.10.1 Crosswind Take-Offs

Take-off has been performed in crosswind components of up to 20 knots measured at 6 feet, which is equivalent to 27 knots at a tower height of 50 feet. This is the maximum experienced during crosswind trials and is not considered a limitation. Some application of "into wind" aileron will assist in maintaining wings level during the ground roll.

4.7 Appendix E - DHC-6 Series 300 Engine Overtemperature

NOTE

After this checklist has been completed, it is recommended that the power lever of the inoperative engine be moved forward to match the position of the power lever of the operative engine, and that the two power levers then be kept together and moved together for the remainder of the flight.

3.10.2 Oil Pressure in Caution Range

Oil pressure less than 80 PSI at or above 72% N_G:

1 Power lever (affected engine) – reduce N_G to 70% or less.

3.10.3 Engine Oil Pressure Light Illuminates

1 Confirm low oil pressure condition exists by referring to OIL PRESSURE gauge for the same engine.

IF OIL PRESSURE ON OIL PRESSURE GAUGE IS LESS THAN 40 PSI:

2 Shut down the affected engine

3 Complete the 'Engine Shutdown in Flight' checklist Para 3.10.1.

3.10.4 Engine Flameout

If the engine flames out during flight, as indicated by a sudden and substantial loss of thrust from the affected engine and engine instrument indications that are similar to a normal shutdown, complete the 'Engine Failure During Flight' checklist Para 3.3.4.

If the cause of the flameout can be corrected (for example, if the flameout was caused by improper fuel management or failure to extend the intake deflectors in conditions of visible moisture at temperatures of +5°C or less), an airstart may be attempted. Refer to the 'Normal Airstart' checklist Para 3.3.5.

3.10.5 Engine Overtemperature - T_5 Exceeds Limit

If the T_5 temperature exceeds the take-off or maximum continuous limit (725°) or climb and cruise limit (695°), as appropriate to the condition of flight, proceed as follows:

1 Power lever (affected engine) – reduce N_G until acceptable T_5 temperature is achieved.

IF AN ACCEPTABLE T_5 TEMPERATURE CANNOT BE ACHIEVED: