Aviation safety investigations & reports

Raytheon Aircraft B200C, VH-AMR, 6 km NE Coffs Harbour Airport, 15 May 2003

Investigation number:
200302172
Status: Completed

On 15 May 2003, at about 0833 Eastern Standard Time (EST), a Raytheon[1] Beech Super King Air B200C, VH-AMR, impacted the sea or a reef about 6 km north-east of Coffs Harbour airport. The impact occurred immediately after the pilot initiated a go-around during an instrument approach to runway 21 in Instrument Meteorological Conditions (IMC) that included heavy rain and restricted visibility. Although the aircraft sustained structural damage and the left main gear detached, the aircraft remained airborne.

During the initial go-around climb, the aircraft narrowly missed a breakwater and adjacent restaurant at the Coffs Harbour boat harbour. Shortly after, the pilot noticed that the primary attitude indicator had failed, requiring him to refer to the standby instrument to recover from an inadvertent turn. The pilot positioned the aircraft over the sea and held for about 30 minutes before returning to Coffs Harbour and landing the damaged aircraft on runway 21. There were no injuries or any other damage to property and/or the environment because of the accident.

The aircraft was on a routine aeromedical flight from Sydney to Coffs Harbour with the pilot, two flight nurses, and a stretcher patient on board. The flight was conducted under instrument flight rules (IFR) in predominantly instrument meteorological conditions (IMC).

During the descent, the enroute air traffic controller advised the pilot to expect the runway 21 Global Positioning System (GPS) non-precision approach (NPA). The pilot reported that he reviewed the approach diagram and planned a 3-degree descent profile. He noted the appropriate altitudes, including the correct minimum descent altitude (MDA) of 580 ft, on a reference card. A copy of the approach diagram used by the pilot is at Appendix A.

The aerodrome controller advised the pilot of the possibility of a holding pattern due to a preceding IFR aircraft being sequenced for an instrument approach to runway 21. The controller subsequently advised that holding would not be required if the initial approach fix (SCHNC)[2] was reached not before 0825.

At about 0818, the aerodrome controller advised the pilot of the preceding aircraft that the weather conditions in the area of the final approach were a visibility of 5000 m and an approximate cloud base of 1,000 ft.

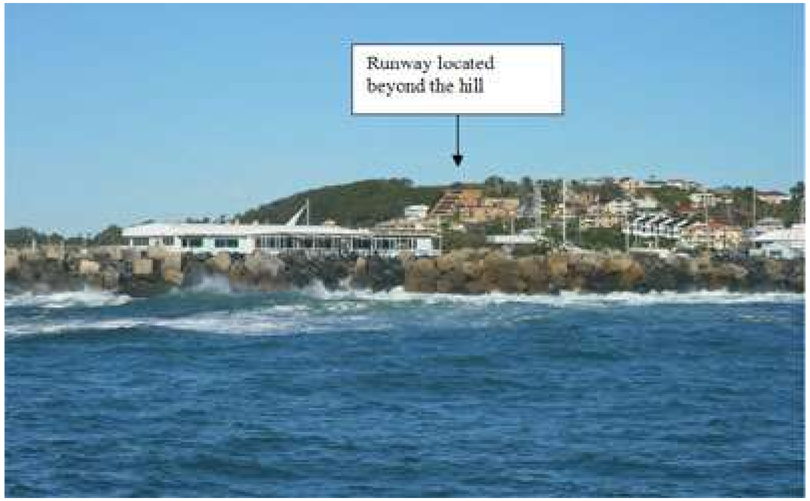
At 0825 the aerodrome controller cleared the pilot of the King Air to track the aircraft from the initial approach fix to the intermediate fix (SCHNI) and to descend to not below 3,500 ft. The published minimum crossing altitude was 3,600 ft. About one minute later the pilot reported that he was leaving 5,500 ft and was established inbound on the approach.

At 0828 the pilot reported approaching the intermediate fix and 3,500 ft. The controller advised that further descent was not available until the preceding aircraft was visible from the tower.

At 0829 the controller, having sighted the preceding aircraft, cleared the pilot of the King Air to continue descent to 2,500 ft. The pilot advised the controller that he was 2.2 NM from the final approach fix (SCHNF). At that point an aircraft on a 3-degree approach slope to the threshold would be at about 2,500 ft. The controller then cleared the pilot for the runway 21 GPS approach, effectively a clearance to descend as required.

The pilot subsequently explained that he was high on his planned 3-degree descent profile because separation with the preceding aircraft resulted in a late descent clearance. He had hand flown the approach, and although he recalled setting the altitude alerter to the 3,500 ft and 2,500 ft clearance limits, he could not recall setting the 580 ft MDA. He stated that he had not intended to descend below the MDA until he was visual, and that he had started to scan outside the cockpit at about 800 ft altitude in expectation of becoming visual. The pilot recalled levelling the aircraft, but a short time later experienced a 'sinking feeling'. That prompted him to go-around by advancing the propeller and engine power levers, and establishing the aircraft in a nose-up attitude. The passenger in the right front seat reported experiencing a similar 'falling sensation' and observed the pilot's altimeter moving rapidly 'down through 200 ft' before it stopped at about 50 ft. She saw what looked like a beach and exclaimed 'land' about the same time as the pilot applied power. The pilot felt a 'thump' just after he had initiated the go-around. The passenger recalled feeling a 'jolt' as the aircraft began to climb.

Figure 1. View of Coffs Harbour boat harbour northern breakwater from north-east.



Witnesses on the northern breakwater of the Coffs Harbour boat harbour observed an aircraft appear out of the heavy rain and mist from the north-east. They reported that it seemed to strike the breakwater wall and then passed over an adjacent restaurant at a very low altitude before it was lost from sight. Wheels from the left landing gear were seen to ricochet into the air and one of the two wheels was seen to fall into the water. The other wheel was found lodged among the rocks of the breakwater.

Figure 2. Northern breakwater of Coffs Harbour boat harbour. King Air flight path was from left to right of picture.

During the go-around the pilot unsuccessfully attempted to raise the landing gear, so he reselected the landing gear selector to the 'down' position. He was unable to retract the wing flaps. It was then that he experienced a strong g-force and realised that he was in a turn. He saw that the primary attitude indicator had 'toppled' and referred to the standby attitude indicator, which showed that the aircraft was in a 70-degree right bank. He rapidly regained control of the aircraft and turned it onto an easterly heading, away from land. The inverter fail light illuminated but the pilot did not recall any associated master warning annunciator. He then selected the number-2 inverter to restore power to the primary attitude indicator, and it commenced to operate normally. The pilot observed that the left main landing gear had separated from the aircraft. He continued to manoeuvre over water while awaiting an improvement in weather conditions that would permit a visual approach.

About 4 minutes after the King Air commenced the go-around, the aerodrome controller received a telephone call advising that a person at the Coffs Harbour boat harbour had witnessed an aircraft flying low over the harbour, and that the aircraft had '…hit something and the wheel came off'. The controller contacted the pilot, who confirmed that the aircraft was damaged. The controller declared a distress phase and activated the emergency response services to position for the aircraft's landing. Witnesses reported that the landing was smooth. As the aircraft came to rest on the runway, foam was applied around the aircraft to minimise the likelihood of fire. The occupants exited the aircraft through the main cabin door.

Aircraft damage

The left main landing gear oleo strut was severed, consistent with rapid rearwards bending. It was located in the water about 25 m to the north of the breakwater, with only one of the two wheels attached. The other wheel was found among rocks at the base of the breakwater. There were no impact marks on the tyres. The separation of the left main landing gear from the aircraft damaged the left inboard flap and resulted in an average flap asymmetry of 9 degrees. The impact force bent the right main landing gear rearwards about 5 degrees, but it remained attached to the aircraft. The nose landing gear and propellers displayed no evidence of impact damage.

Figure 3. King Air on runway 21 at Coffs Harbour.

The structural damage resulting from the impact with the sea or reef was consistent with damage sustained in a heavy landing. The impact forces damaged both engine nacelles and main landing gear wheel wells. The wing centre-section outboard ribs rear of the main spar and the lower fairing skins were buckled, and both ailerons were buckled outboard of the inboard hinge points. All of the upper and lower inboard wing assemblies were distorted. The inboard lower fuel tank linings were wrinkled and some fuel tank lining skins were cracked. The inboard wing leading edge upper skins were cracked, and the left wing leading edge upper skin and stringer were wrinkled.

The damage to the tips of the left propeller was consistent with their contact with the runway during the subsequent landing. About 40 mm of the upper left landing gear was ground away during the landing.

Pilot information

The pilot held an Air Transport Pilot (Aeroplane) Licence endorsed with the aeroplane type, and held a Class 1 medical certificate. He also held a command Instrument Rating (multi-engine aeroplane) with approval to conduct GPS NPA procedures. He was current on the aircraft type, and met GPS NPA recency requirements. He had 18,638 hours total flying experience, which included 1,460 hours on type. He was familiar with operating into Coffs Harbour, and had last flown there on the day prior to the occurrence flight.

The pilot reported no physiological or psychological conditions that may have affected his performance. He was within the limits of the operator's prescribed flight and duty time limitations. He said that he slept normally the previous night before rising at 0425 and signing on for duty at 0600 for the scheduled 0700 departure.

Aircraft information

The aircraft was equipped and certified for single-pilot IFR operations. Although the aircraft was fitted with an NPA-capable[3] Trimble 2101 GPS receiver, there was no record of the Civil Aviation Safety Authority (CASA) approval required to authorise conduct of GPS NPAs in that particular aircraft. Installation of the GPS was consistent with the CASA requirements that provided for non-precision approach approval.[4] However, that approval required a specific supplement that was not incorporated into the aircraft flight manual. Examination of the GPS receiver revealed that it was capable of normal operation, and that its data card was current at the time of the occurrence.

The counter drum-pointer altimeter[5] on the pilot's instrument panel and the three-pointer altimeter on the right panel were tested and found to operate normally. Examination of the two independent static systems found no water or obstructions. Functional tests did not reveal any defects or anomalies. Both altimeter sub-scales were found set to the appropriate aerodrome QNH.[6] Radar data, recorded down to 3,600 ft, indicated appropriate altitude keeping consistent with a correct QNH setting. Testing of the vertical speed indicator did not reveal any defects or anomalies.

The aircraft was equipped with an altitude alerting system to provide the pilot with visual and aural warnings 1,000 ft before reaching a preselected altitude and for deviations exceeding 300 ft when at a preselected altitude. The altitude alerting system was subsequently tested and found to operate normally.

The aircraft was fitted with a radio (radar) altimeter system that measured actual height above terrain and was able to provide a pilot with an alert when the aircraft reached a preselected height. However, the radio altimeter system was inoperative. This was recorded in the aircraft's maintenance release. The operator's B200 Minimum Equipment List (OMEL), which was approved by CASA, permitted the dispatch of the aircraft without an operative radar altimeter.

The aircraft had two inverters capable of independently supplying power to the main attitude indicator. A master warning and inverter inoperative annunciator indicated failure of an inverter. Flags and full nose-up indication warned a pilot of primary attitude indicator failure. Examination of the inverter number-1 system revealed that its circuit breaker in the left wing was open and, when reset during test, the system functioned normally. The circuit breaker was in a poor condition and operated erratically when tested. The investigation concluded that the circuit breaker had tripped as a result of the impact, but could not determine why there was no associated master warning.

The aircraft was fitted with an automatic flight control system that was capable of controlling the aircraft during the final approach of a GPS NPA.

The aircraft's automatic flight control system included a flight director. When the autopilot was not engaged, the flight director could be used to provide the pilot with attitude and pitch command cues. With an altitude selected, and armed on the altitude alerting system, the pilot would receive a main attitude indicator pitch command to capture and maintain the preselected altitude.

The wing flap system incorporated a safety mechanism that disconnected the power supply to the electric flap motor if any one of the four flap surfaces was 3 to 6 degrees out of phase with the other flaps. Failure of the flap to retract after the impact was consistent with operation of that safety mechanism.

The retractable landing gear was electrically controlled and hydraulically actuated. A safety switch on each main landing gear prevented inadvertent gear retraction by opening the retraction control circuit when weight was on the wheels. Failure of the landing gear to retract after impact was consistent with interruption of the retraction circuit resulting from the disruption of the left main landing gear.

The aircraft was not fitted with a ground proximity warning system, nor was it required to be.

Meteorological information

The Bureau of Meteorology (BoM) forecasts indicated that IMC were to be expected in the Coffs Harbour area. The applicable area forecast (ARFOR) predicted frequent showers over the sea and coastal areas, with localised heavy falls. Moderate turbulence was forecast below 5,000 ft. The Coffs Harbour aerodrome forecast (TAF) predicted that there would be periods of up to an hour duration when the visibility would reduce to 2,000 m in rain showers with broken cloud at 1,000 ft.

The BoM weather radar imagery recorded at Grafton showed that there were a number of large convective cells in the vicinity of Coffs Harbour at the time of the occurrence. There was no associated lightning activity, or any other indication of thunderstorms. Steady rain had fallen in the area throughout the morning prior to the occurrence and heavy rain was reported at the aerodrome shortly after the pilot of the King Air executed the go-around. During the morning, the recorded surface wind at the aerodrome remained a constant light south-south-westerly of about 8 kts, gusting to 12 kts.

A BoM analysis of the weather data indicated that one or more convective cells may have produced downdrafts that affected the aircraft, but the magnitude of any downdrafts could not be determined.

Witnesses sheltering at a caf on the northern breakwater near where the aircraft impacted the surface related that, although there was heavy rain, there were no significant wind gusts at the time of, or immediately following, sighting the aircraft. However, another witness who was working on a boat in the harbour reported that an umbrella was overturned by an easterly wind just after he observed the aircraft overfly the boat harbour.

The pilot commented that the descent and approach had been flown almost entirely in cloud and rain showers with continuous moderate turbulence. Although he had briefly sighted the water at the commencement of the approach, he had not seen land or water throughout the approach or go-around. The pilot indicated that prior to joining the approach he had noticed some weather radar returns, but the intended aircraft track was clear of those areas.

The pilot of the preceding aircraft commenced a runway 21 VOR instrument approach at about 2219. He advised that the heavy showers on the outbound leg were the worst he had 'ever experienced' and that his aircraft was still in cloud and rain on arrival at the MDA.

The pilot in command of a Dash 8 aircraft which landed on runway 03 about 5 minutes after the pilot of the King Air executed the go-around, reported that he could not see the far end of the runway during the landing, and that there appeared to be '…a sheet or wall of water' to the north of the aerodrome. That pilot also reported that after shutdown, the rain '…was torrential'.

The Australian Transport Safety Bureau (ATSB) investigation into a B737 microburst encounter during heavy rain conditions associated with an intense thunderstorm at Brisbane on January 2001 (VH-TJX, BO/200100213) highlighted that significant aerodynamic penalties may be imposed on an aircraft during flight through heavy rain. Those penalties can be sufficient to substantially degrade the flight performance of an aircraft.

GPS Non-Precision Approaches

The GPS NPA provided the pilot with track guidance to the runway via a series of pre-programmed waypoints. Track information was displayed on the pilot's Horizontal Situation Indicator (HSI) as a left or right deflection of a Course Deviation Indicator (CDI) needle. In the absence of electronic vertical course guidance, a series of descending steps, shown on the profile diagram of the approach chart, provided the pilot with terrain clearance guidance.

Civil Aviation Advisory Publications (CAAPs) provided information on relevant regulatory requirements relating to a variety of matters. The CAAPs were intended to aid in the understanding of, and compliance with, regulatory requirements. CAAP 178-1(0), published after the occurrence in October 2003, provided information on non-precision approaches. In the information relating to descent gradients, the following advice was provided:

> For an approach to be safe the descent gradient should be neither too steep, nor too shallow. A steep approach requires high rates of descent which are undesirable and increase the risk of inadvertent descent below critical altitudes.

More specifically, Aeronautical Information Publication related that:

> Aircraft may commence a segment in excess of the specified commencement altitude provided that any upper altitude limitation is observed. However, rate of descent after the FAF [final approach fix] should not normally exceed 1,000 ft/min.

CAAP 178-1(0) also included advice that the International Civil Aviation Organization has:

> … identified that many CFIT [controlled flight into terrain] accidents have occurred because pilots did not possess good situational awareness in regard to terrain beneath the approach flight path …

Controlled flight into terrain and approach-and-landing accident risk

Controlled Flight into Terrain occurs when an airworthy aircraft under the control of the flight crew is flown unintentionally into terrain, obstacles or water, usually with no prior awareness by the crew. According to the Flight Safety Foundation (FSF), CFIT is currently the greatest threat to air safety and is the primary causal event in the approach and landing accidents studied by the FSF Approach and Landing Accident Reduction (ALAR) Task Force.[7] FSF analysis of 287 fatal approach-and-landing accidents between 1980 and 1996 showed that, of the accidents where data was available, 75 percent happened where a precision approach aid was not available or was not used.[8]

The consequences of CFIT are normally severe to catastrophic in terms of loss of life or severe injury and damage to property and/or the environment. All flights can be considered to be at moderate risk of CFIT, based on historical data relating to the frequency and consequences of CFIT accidents. As risk is dependent on consequences and likelihood of an event, the only way that CFIT risk can be reduced is for operators to ensure that the necessary defences are present to reduce its likelihood.

The ATSB has recently completed two investigations into CFIT accidents that involved destruction of the aircraft and loss of life to aircraft occupants (VH-FMN at Mt Gambier, BO/200105769 and IL-76 at Timor, BO/200300263). Both investigations referred to the FSF initiatives in approach-and-landing accident reduction, and the FSF checklist to evaluate CFIT risk as part of its international program to reduce CFIT events that present risk to aircraft, crews, and passengers.

The FSF ALAR Task Force has concluded, amongst other things, that:

- establishing and adhering to adequate standard operating procedures (SOPs) and crew decision-making processes improve approach-and-landing safety
- failure to recognise the need for a missed approach and failure to execute a missed approach is a major cause of approach-and-landing accidents
- unstabilised and rushed approaches contribute to approach-and-landing accidents (FSF definition of stabilised approach is at Appendix B)
- the risk of approach-and-landing accidents increases in operations conducted in low light and poor visibility
- effective use of radio altimeters will help to prevent approach-and-landing accidents.

An ALAR Tool Kit, which comprised a unique set of pilot briefing notes, videos, presentations, risk-awareness checklists and other tools on compact disc is available from the FSF. In a news release, dated March 2003, the FSF expressed concern that, not everyone in the industry had taken note of the ALAR work.

Air traffic control approach procedures

The Manual of Air Traffic Services (MATS) Part 6.2.6, Approach Clearances, stated that:

> Unless authorised to make a visual approach, an IFR flight must conform to the published instrument approach procedure nominated by ATC.
>
> A controller shall not issue an air traffic clearance which authorises or requires a pilot to descend in IMC below the lowest safe altitude for the route segment in a manner different from that specified in:
>
> > a. … GPS Arrival procedures
> > b. the procedures, plan and profile diagram of IAL [instrument approach and landing charts] charts published in AIP/FLIP Terminal …

MATS Part 3.4.2 further stated that:

> When an aircraft will make an instrument approach, clearance for the approach should be issued at least 3 minutes before the procedure is expected to commence, or as a soon as conditions allow.

MATS Part 6.12.14 also noted that a temporary level restriction during an instrument approach can only be applied to civilian aircraft during practice [instrument] approaches in Visual Meteorological Conditions.

A clearance to conduct a GPS instrument approach authorises a pilot to descend from the IAF altitude to the minimum descent altitude and to continue to the airport for landing if visual, or to make a missed approach if unable to land or the pilot cannot see the airport.

Operator information

The operator was an aeromedical service provider that was contracted to provide crews and aircraft maintenance services for a 24-hour, all weather, aerial ambulance service based at Sydney airport. Instrument approaches promulgated for aerodromes in NSW were non-precision approaches except for Instrument Landing System (ILS) approaches at Sydney and Tamworth.

With regard to formal CFIT risk management at the time of the occurrence the operator reported that:

> Pilots are required to watch the CFIT video which is viewed on appointment and annually as part of the recurrent training program. The pilots are issued with the CFIT brochures and checklist. The ALAR Tool Kit has not been used in the past.

The operator advised that, following the Mt Gambier CFIT accident involving VH-FMN (BO/200105769), the following action was initiated:

> Synopsis of accident and conditions … included in February 2002 safety report
>
> Flight Safety Foundation CFIT checklist conducted February 2002. Report and recommendations circulated by Aviation Safety Officer and adopted by Aviation Manager/Check & Training pilots.
>
> All aircraft fitted with Flight Profile Annunciators

The operator's documented standard operating procedures did not specifically address, or were considered to be unclear in relation to, the following:

- Stabilised approach parameters
- Go-around and missed approach policy
- Use of radio altimeter in conduct of non-precision approaches
- Use of flight director in conduct of non-precision approaches
- Use of autopilot in conduct of non-precision approaches.

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1 Raytheon Aircraft Company superseded the Beech Aircraft Corporation as the manufacturer of King Airs.
2 Approach fixes are given a five letter designator to identify the fix in the GPS database and on the approach diagram. A copy of the approach diagram is at Appendix A.
3 TSO-C129 Class A1.
4 Airworthiness directive AD/RAD/61 GPS Installation for Non-Precision Approaches required compliance with Civil Aviation Advisory Publication (CAAP) 35-1(0).
5 Type of altimeter recommended in Annex 6 of Convention on International Civil Aviation (Chicago 1944) for aeroplanes operated in accordance with instrument flight rules.
6 The barometric pressure in hectopascals that enables an altimeter to show height above mean sea level.
7 Appendix A of the Flight Safety Foundation, Approach-and-Landing Accident Reduction Task Force, Operations and Training Working Group, Final Report (Version 2.0).

8 Flight Safety Foundation, Approach-and-Landing Accident Reduction Task Force, Analysis of Critical Factors During Approach and Landing in Accidents and Normal Flight, Data Acquisition and Analysis Working Group, Final Report (Version 2.0).

This occurrence is a CFIT accident resulting from inadvertent descent below the MDA on the final segment of a non-precision approach, fortunately without the catastrophic consequences normally associated with such events. The investigation was unable to conclusively determine why the aircraft descended below the MDA while in IMC, or why the descent continued until CFIT could no longer be avoided. However, the investigation identified a number of factors that influenced, or had the potential to influence, the development of the occurrence.

The pilot's workload during the approach was high, primarily due to hand flying of the instrument approach in IMC. A steeper than normal descent angle and higher than normal rate of descent, resulting from the delayed descent clearance from the ADC, added to that workload. While in IMC, with the absence of any alert at the MDA, the pilot relied on specific reference to the altimeter during his instrument scan to alert him to the proximity to the MDA and any descent below it. Although use of the altitude alerter on the final segment of the approach was not established, an alert from a unit configured with the MDA would not be expected until at least 300 ft below the MDA. As such, the altitude alerter was not effective as an immediate alert to descent below MDA.

Given the potential for downdraft activity from convective cells, the 'sinking feeling' experienced by the pilot and the 'falling sensation' experienced by the front seat passenger, indicate that the aircraft probably encountered a convective downdraft shortly before it impacted the surface. It was possible that the heavy rain also had an adverse effect on the sink rate of the aircraft. An absence of specific data prevented the investigation from quantifying the effect of the downdrafts and heavy rain on aircraft performance. Furthermore, the almost simultaneous application of power and the impact indicate that the go-around was initiated well below the MDA. It was therefore not possible to determine if the environmental forces were sufficient to overcome optimum aircraft performance.

In the context of high pilot workload and a high rate of descent probably compounded by downdraft activity, it is possible that, with an expectation of becoming visual before the MDA, the pilot may have become preoccupied with acquiring visual reference to the ground as he descended through 800 ft. As any increased scanning outside the cockpit reduces instrument scan time and therefore time to assimilate the significance of altitude information, the pilot may not have recognised that the descent was continuing unchecked. Had the pilot confirmed that the aircraft was maintaining level flight at the MDA prior to attempting visual acquisition, the risk of inadvertent descent may have been reduced.

The likely trajectory of the King Air over the restaurant indicates that the aircraft overflew the breakwater at sufficient height for any attached landing gear to clear it. Therefore, the left main landing gear was dislodged, and the right main landing gear was impacted, prior to the aircraft passing over the breakwater. Although the lack of impact marks on the tyres suggests impact with water, contact with an outlying reef could not be ruled out. Whatever the surface, the impact force probably had a similar effect to a 'bounced' landing, and helped impart sufficient upward momentum to the aircraft to allow it to clear the buildings on the breakwater as it overflew them in the go-around. Had the aircraft not bounced, it may not have had sufficient height to clear the breakwater, and as a result it could have impacted the buildings with catastrophic consequences. Additionally, had the aircraft not been in the go-around attitude and the nosewheel impacted the water, it may have resulted in the aircraft cartwheeling into the breakwater.

Failure of the landing gear and flaps to retract during the go-around distracted the pilot from the primary task of controlling the aircraft. When the pilot sensed the g-force produced by the inadvertent turn, the depicted attitude on the failed primary attitude indicator was not an accurate representation of the aircraft's attitude. This had the potential to induce loss of control at a low altitude. The pilot's prompt and effective response prevented uncontrolled flight.

CFIT in the approach and landing phases of flight is a well-known and well-researched risk for which there are formal assessment and prevention tools. The operator demonstrated an awareness of that risk, and a desire to treat that risk, by providing FSF CFIT training material to pilots and by conducting the CFIT checklist in February 2002. The operator reported that recommendations arising from the CFIT checklist were adopted by the aviation manager and check and training pilots. Notwithstanding, the investigation found that the ALAR task force recommendations had not been incorporated into the operator's standard operating procedures.

The absence of documented procedures regarding the use of the radio altimeter, flight director and autopilot in the conduct of GPS NPAs allowed for variability in pilot technique and did not provide assurance that the potential safety benefits of using that equipment would be optimised. Also absent was a definition of stabilised approaches and specification of associated go-around criteria in the operator's standard operating procedures; criteria considered by the ALAR task force to have the potential to reduce CFIT risk.

Notwithstanding, the pilot indicated that, had the radio altimeter been serviceable, he would have used it to alert him of proximity to the MDA. Given the demonstrated increased risk of approach-and-landing CFIT without an alert to proximity to MDA, the application of one or more defences to the conduct of the GPS NPA in IMC would have reduced the risk of CFIT. Possible defences included: limiting the rate of descent on final approach; nominating a higher MDA; utilising flight director or autopilot; and operating with two pilots.

Use of the flight director in conjunction with the altitude alerter after the final approach fix would have provided the pilot with an attitude indicator 'fly-up' command when the aircraft descended below MDA. As the primary reference in manual instrument flying is the attitude indicator, it is likely that the pilot would have noticed a 'fly-up' command earlier than recognition of the 'sinking feeling'. This may have prompted an earlier go-around or missed approach and avoided the surface contact.

Autopilots are commonly used to control an aircraft's track and descent profile during an instrument approach. Such use can reduce pilot workload and allows a pilot or crew to monitor the critical parameters of an approach. Had the pilot utilised the autopilot with the altitude capture function armed, after the final approach fix, it would have reduced the risk of inadvertent descent below the MDA.

Although the pilot was aware of stabilised approach criteria, such parameters were not defined in the operator's documentation, nor was a go-around policy specified for any exceedance of such parameters. With a lack of specific data, it is not known if there were any such exceedances during the approach. However, a specific missed approach policy increases the likelihood of a timely missed approach. Conduct of a holding pattern prior to commencement of the approach would have provided increased separation from traffic and probably allowed a more stabilised approach profile. Although the intent of the ATC approach clearance procedures was to prevent the imposition of altitude restrictions during an instrument approach in IMC, those instructions were not clearly defined in the MATS.

The aircraft was not fitted with a ground proximity warning system, nor was it required by regulation. The function of such systems is to prevent CFIT accidents. A ground proximity warning system may have provided the pilot with a more salient warning to enable him to take corrective action in time to avoid ground contact.

This report highlights the potential safety benefits of the Flight Safety Foundation ALAR Tool Kit, especially in regard to the conduct of non-precision approaches.

Local safety action

The operator has advised that a review of processes has been carried out and new procedures are in place to ensure that a similar incident does not occur again. Some of the changes were reported to have been in the process of being introduced at the time of the accident.

Reported changes included the following:

- Appointment of new personnel to key operational roles
- Creation of a position of Flight Training Manager
- Creation of a position of Quality Assurance Manager - Engineering
- Review of Flight Manual Supplements
- Rewriting of the Flight Operations Manual
- Issue of a standing order to all pilots that a go-around is to be conducted anytime on approach below 1,000 ft above ground level, if the approach is not stabilised and the sink rate is in excess of 1,000 fpm
- Reviewing the use of radio altimeter in non-precision approaches
- Rewriting of the Check and Training Manual
- Development of a Quick Action Handbook to cover emergency procedures

At the time of the occurrence, replacement aircraft for the Sydney-based aeromedical service were on order. Specifications for the new aircraft included an Enhanced Ground Proximity Warning System. Those aircraft are now in service.

Airservices Australia is reviewing the Manual of Air Traffic Services to clarify and remove the ambiguity relating to descent restrictions for pilots conducting instrument approaches in IMC.

Appendix A: Coffs Harbour Runway 21 GPS NPA Approach diagram
Published with permission of Jeppesen Sanderson, Inc. - NOT TO BE USED FOR NAVIGATION.

Appendix B: Elements of a Stabilised Approach

Note: A suggested definition or policy that might be considered by operators could be as follows: "All flights shall be stabilised by 1,000 feet height above touchdown (HAT) in instrument meteorological conditions (IMC) and by 500 feet HAT in visual meteorological conditions (VMC)." An approach is considered stabilised when all of the following criteria are met:

1. The aircraft is on the correct flight path
2. Only small changes in heading and pitch are required to maintain that path
3. The aircraft speed is not more than Vref + 20 knots indicated airspeed (KIAS) and not less than Vref
4. The aircraft is in the proper landing configuration (approach configuration for small twins)

5. Sink rate is maximum 1,000 feet per minute; if an approach requires a sink rate greater than 1,000 feet per minute, a special briefing is to be performed
6. Power setting appropriate for configuration and not below the minimum power for approach as defined by the aircraft operations manual
7. All briefings and checklists have been performed
8. Specific types of approaches are considered stabilised if they also fulfil the following:
    - Instrument landing system (ILS) approaches - must be flown within one dot of the glideslope or localiser; a category II or III approach must be flown within the expanded localiser band.
    - Visual approaches - wings must be level on final when the aircraft reaches 500 feet HAT.
    - Circling approaches - wings must be level on final when aircraft reaches 300 feet HAT
9. Unique approaches such as the 'old' Hong Kong airport, and the DCA (Washington, D.C.) river visual approach to Runway 18 require a special briefing

Source: Flight Safety Foundation Approach-and-Landing Accident Reduction Task Force.

General details

Date:	15 May 2003	**Investigation status:**	Completed
Time:	0833 hours EST		
Location (show map):	6 km NE Coffs Harbour Airport		
State:	New South Wales	**Occurrence type:**	CFIT
Release date:	26 August 2004	**Occurrence category:**	Accident
Report status:	Final	**Highest injury level:**	None

Aircraft details

Aircraft manufacturer	Raytheon Aircraft Company
Aircraft model	200
Aircraft registration	VH-AMR
Serial number	BL-126

Type of operation	Aerial Work
Damage to aircraft	Substantial
Departure point	Sydney, NSW
Departure time	0700 hours EST
Destination	Coffs Harbour, NSW

Crew details

Role	Class of licence	Hours on type	Hours total
Pilot-in-Command	ATPL	1460.0	18638

Last update 13 May 2014