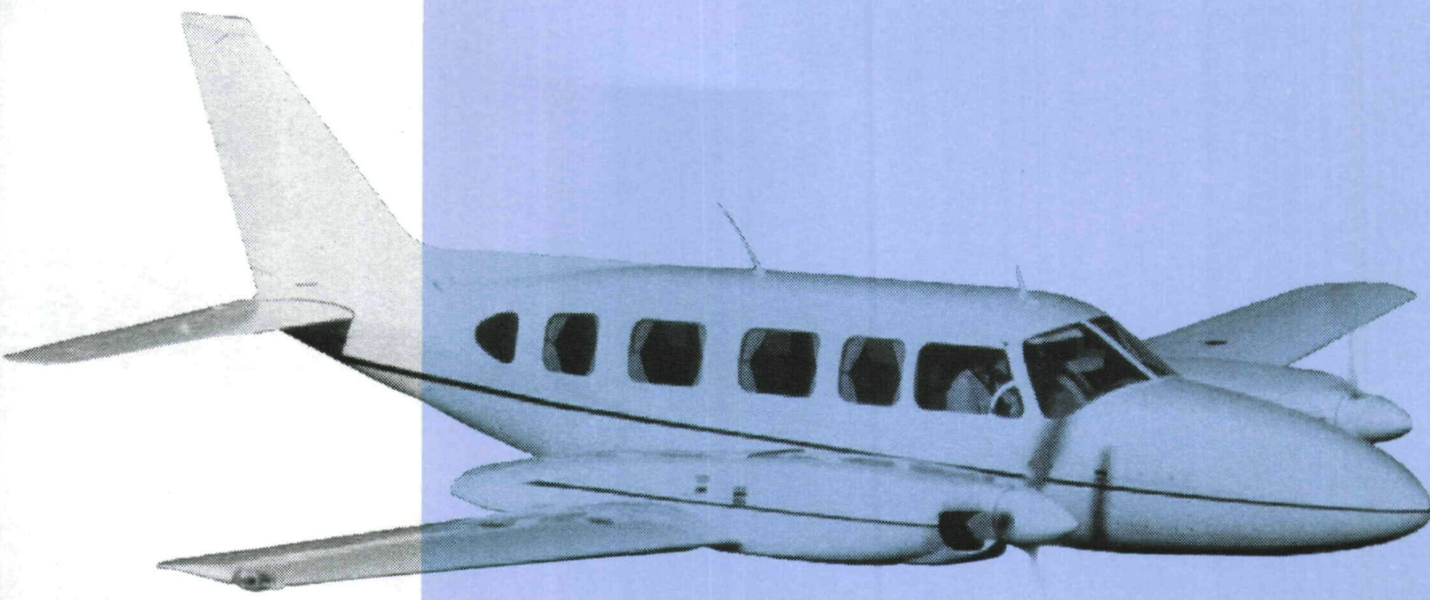
BUREAU OF AIR SAFETY INVESTIGATION REPORT

Investigation Report 9302851



Piper PA-31-350 Chieftain
Launceston Tasmania
17 September 1993

COMMONWEALTH DEPARTMENT OF
TRANSPORT AND REGIONAL DEVELOPMENT

BASI
Bureau of Air Safety Investigation

Department of Transport

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CONTENTS

GLOSSARY OF TERMS AND ABBREVIATIONS

AD	Airworthiness Directive
ADC	Aerodrome (Air Traffic) Controller
ADF	Automatic Direction Finder
AGL	Above Ground Level
AIP	Aeronautical Information Publication
AMSL	Above Mean Sea Level
AOC	Air Operators Certificate
ARFOR	Area Forecast(s)
ARP	Aerodrome Reference Point
ATC	Air Traffic Control
ATIS	Automatic Terminal Information Service
ATS	Air Traffic Services
AUW	All-up Weight
AVR	Automatic Voice Recorder
Ba	Blood Alcohol
BASI	Bureau of Air Safety Investigation
CAA	Civil Aviation Authority
CAO	Civil Aviation Order(s)
CAR	Civil Aviation Regulation(s)
CFI	Chief Flying Instructor
CG	Centre of Gravity
CP	Chief Pilot
CPL	Commercial Pilot's Licence
CVR	Cockpit Voice Recorder
DA	Decision Altitude
DAP	Departure and Approach Procedures
DAM	District Airworthiness Manager
DFOM	District Flight Operations Manager
DI	Directional Indicator
DME	Distance Measuring Equipment (gives a read out of distance equivalent to nautical miles).
ERSA	Enroute Supplement Australia (AIP)
EST	Eastern Standard Time
FAF	Final Approach Fix
FDR	Flight Data Recorder
FIS	Flight Information Service
FS	Flight Service (in general)
FOI	Flying Operations Inspector
GFPT	General Flying Progress Test
GPWS	Ground Proximity Warning System
g	Acceleration due to Earth gravity
hPa	Hectopascal(s)
HSI	Horizontal Situation Indicator
IAL	Instrument Approach and Landing
IAF	Initial Approach Fix
ICAO	International Civil Aviation Organisation

ICUS	In Command Under Supervision
IFR	Instrument Flight Rules
ILS	Instrument Landing System
IMC	Instrument Meteorological Conditions
kHz	Kilohertz
LLZ	Localiser
L	Locator
LPH	Litres per Hour
MAOC	Manual of Air Operator Certification
MAP	Manifold Pressure
MAPT	Missed Approach Point
MDA	Minimum Descent Altitude
Metar	Aviation routine weather report
MHz	Megahertz
NDB	Non-Directional Beacon
NM	Nautical Mile(s)
OCA	Obstacle Clearance Altitude
octa	Cloud amount expressed in eighths
Omni	See VOR
PA	Pressure Altitude
PPL	Private Pilot's Licence
RFFS	Rescue Fire Fighting Service
RH	Radio Height
RMI	Radio Magnetic Indicator
RPT	Regular Public Transport
SAR	Search and Rescue
SP	Single Pilot
SPS	Standby Power Supply
SR&S	CAA Safety Regulation and Standards
TAF	Aerodrome Forecast
TAS	True Airspeed
TBO	Time Between Overhaul
T-Vasis	'T' Visual Approach Slope Indicator System
Ua	Urine Alcohol
VAC	Volts, Alternating Current
VDC	Volts, Direct Current
VFR	Visual Flight Rules
VOR	VHF Omni-directional Radio Range (Omni)

Altitude	Height above mean sea level in feet.
Ceiling	Height of cloud base above the aerodrome elevation.
Circling area	The circling area is determined by drawing an arc centred on the threshold of each useable runway and joining these arcs by tangents. The radii for performance category B aircraft is 2.66 NM.
Height	Vertical distance in feet above a fixed point.
QNH	The altimeter sub-scale setting in hectopascals which when set on the altimeter, provides the pilot a reference in height as related to mean sea level.

All bearings are in degrees magnetic unless otherwise stated.

All temperatures are in degrees Celsius.

All times are Eastern Standard Time (Co-ordinated Universal Time plus 10 hours) unless otherwise stated.

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CLOSED – ACCEPTED.	The response is accepted by the Bureau without qualification.
CLOSED – NOT ACCEPTED.	The unacceptable response has been closed by the Bureau as not worthy, by itself, of further correspondence.
OPEN.	The response does not meet some, or all, of the criteria for acceptability to a recommendation which BASI considers safety significant and further correspondence will be entered into.

INTRODUCTION

The main purpose for investigating air safety occurrences is to prevent aircraft accidents by establishing what, how and why the occurrence took place, and determining what the occurrence reveals about the safety health of the aviation system. Such information is used to make recommendations aimed at reducing or eliminating the probability of a repetition of the same type of occurrence, and where appropriate, to increase the safety of the overall system.

To produce effective recommendations, the information collected and the conclusions reached must be analysed in a way that reveals the relationships between the individuals involved in the occurrence, and the design and characteristics of the systems within which those individuals operate.

This investigation was conducted with reference to the general principles of the analytical model developed by James Reason of the University of Manchester (see Reason, Human Error (1990)).

According to Reason, common elements in any occurrence are:

- organisational failures arising from managerial policies and actions within one or more organisations (these may lie dormant for a considerable time);
- local factors, including such things as environmental conditions, equipment deficiencies and inadequate procedures;
- active failures such as errors or violations having a direct adverse effect (generally associated with operational personnel); and
- inadequate or absent defences and consequent failures to identify and protect against technical and human failures arising from the three previous elements.

Experience has shown that occurrences are rarely the result of a simple error or violation but are more likely to be due to a combination of a number of factors, any one of which by itself was insufficient to cause a breakdown of the safety system. Such factors often lie hidden within the system for a considerable time before the occurrence and can be described as latent failures. However, when combined with local events and human failures, the resulting sequence of factors may be sufficient to result in a safety hazard. Should the safety defences be inadequate, a safety occurrence is inevitable.

An insight into the safety health of an organisation can be gained by an examination of its safety history and of the environment within which it operates. A series of apparently unrelated safety events may be regarded as tokens of an underlying systemic failure of the overall safety system.

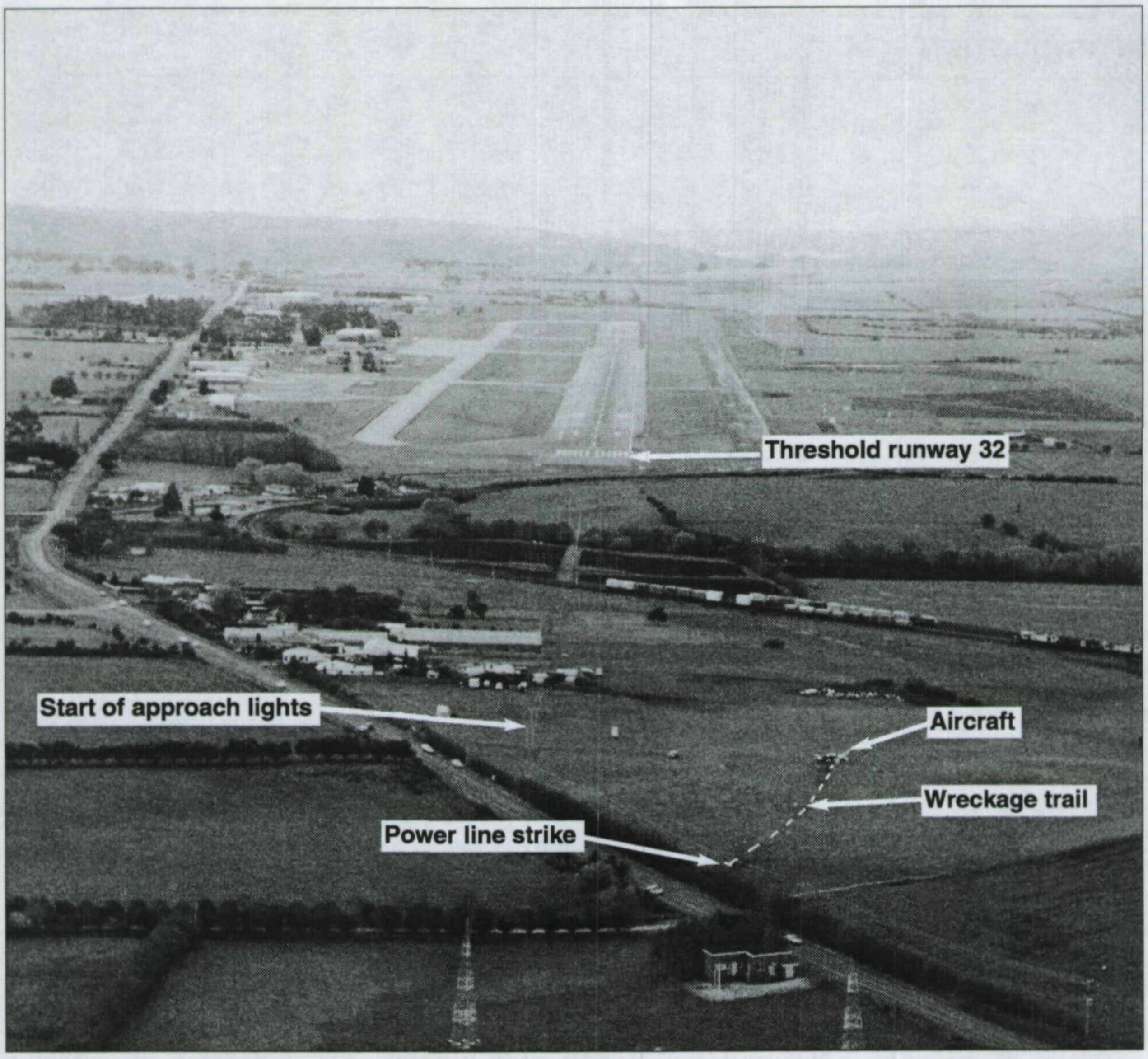

Figure 1 View towards threshold of runway 32, the NDB antenna towers are in the foreground. The aircraft had been flown on a left base leg but crashed while turning onto final approach. For a diagram of the approximate flight path see fig. 5.

SYNOPSIS

At 1943 hours on Friday, 17 September 1993, a Piper Chieftain PA-31-350 aircraft, registered VH-WGI, crashed while on a night landing approach to Launceston Airport, Tasmania.

VH-WGI was being operated by one pilot and carried nine passengers. Six passengers received fatal injuries. The pilot and three passengers sustained serious injuries. The aircraft was substantially damaged as a result of impact forces and fire.

The accident occurred while the pilot was making a visual circling approach to land on runway 32 at Launceston. Some low cloud was present and the aircraft passed through patches of cloud on the approach. Late on a left base leg the aircraft entered a steep left bank. Shortly after, at a height of about 200 ft, the aircraft developed a rapid rate of descent. This descent culminated in collision with the ground.

Significant factors in this occurrence included minimal endorsement training and pilot experience on type, inadequate operator supervision, and pilot decision making adversely influenced by the carriage of noisy, alcohol-affected passengers. Organisational factors included an absence of standards prescribed by the CAA for aircraft type endorsement. The investigation found indications of significant confusion over the interpretation of AIP DAP instructions on visual circling approaches, particularly at night.

The report concludes with a number of safety recommendations.

1. FACTUAL INFORMATION

1.1 History of the flight

Members of a football club had planned to visit Launceston, travelling by light aircraft. Three aircraft were needed to carry the group, with all passengers and pilots contributing to the cost of the aircraft hire. One of the club members, who was a pilot, organised the required aircraft and additional pilots for departure from Moorabbin Airport on the afternoon of 17 September 1993. The operator from whom the aircraft were hired, who also employed the organising pilot as an instructor, arranged for one Piper PA-23 (VH-PAC), a Piper PA-31-310 (VH-NOS) and a Piper PA-31-350 (VH-WGI) to be available for the trip, with the organising pilot to fly VH-WGI.

On the day of the flight the pilot of VH-WGI carried out pre-flight inspections, obtained the weather forecasts and submitted flight plans for all three aircraft. The flight plans for the two PA-31 aircraft were for flights operated in accordance with IFR procedures. The PA-23 was to operate in accordance with VFR procedures. The TAF for Launceston predicted 2 octas of stratocumulus cloud, base 2,000 ft and 3 octas of stratocumulus cloud, base 3,500 ft.

The flight plan for VH-WGI (see fig. 2) indicated that the aircraft would track Moorabbin–Wonthaggi–Bass–Launceston and cruise at an altitude of 9,000 ft. A cruise TAS of 160 kts, total plan flight time of 90 minutes, endurance 155 minutes and Type of Operation 'G' (private category flight) were specified. No alternate aerodrome was nominated and none was required. The estimated time of departure was 1730. The flight plan was submitted to the CAA by facsimile at 1529. Last light at Launceston was 1919.

VH-WGI departed Moorabbin at 1817 and climbed to an en-route cruise altitude of 9,000 ft. The pilot was required to report at Wonthaggi but passed this position at 1832 without reporting. Melbourne ATC tried unsuccessfully to contact the pilot because of this missed report. Later, the Melbourne radar controller noticed the aircraft deviating left of track but was unable to make contact. Communications were re-established at 1858 when the pilot called Melbourne FS saying he had experienced a radio problem. By this time the aircraft heading had been corrected to regain track.

At 1927 the pilot called Launceston Tower and was cleared for a DME arrival along the inbound track of the Launceston VOR 325 radial. The Launceston ATIS indicated 2 octas of cloud at 800 ft, QNH 1,012 hPa, wind 320° at 5–10 kts, temperature +10° and runway 32 in use. At 1930 the ADC advised the pilot that the 2 octas of cloud were clear of the inbound track, but that there was some lower cloud forming just north of the field, possibly on track. He informed the pilot that there was a chance he might not be visual by the VOR, in which case he would need to perform an ILS approach via the Nile locator beacon.

The ADC contacted the airport meteorological observer at 1933, inquiring as to what the 1930 searchlight check of cloud height had revealed. He was told the observation indicated 7 octas of cloud at about 800 ft. At 1935.52 (time in hours, minutes and seconds) the ADC asked the pilot for his DME (distance) and level. The pilot responded that he was at 12 DME and 3,300 ft. The ADC told the pilot that conditions were deteriorating with probably 4 octas at 800 ft at the field. He then told the pilot he would hopefully get a break in the cloud, but then restated that if he was not visual by the VOR to make a missed approach, track to Nile and climb to 3,000 ft. At 1939.45 the pilot was again asked for his DME and level. He indicated that he was at 1,450 ft and 2–3 DME. He then also confirmed that he was still in IMC. There were three other aircraft inbound for Launceston and the ADC made an all-stations broadcast that conditions were deteriorating at Launceston, with 4 octas at 800 ft, and to expect an ILS approach.

At 1940.56 the pilot stated that he was overhead the field, but did not have it sighted and was going around. At 1941.07 the pilot reported that he had the airfield in sight and at 1941.16 that he was positioned above the final approach for runway 32. Fifteen seconds later the pilot reported that he was opposite the tower and was advised by the ADC that he was cleared for a visual approach, or a missed approach to Nile as preferred. The pilot indicated he would take the visual approach and was then told to manoeuvre as preferred for runway 32. This was acknowledged at 1941.48. No further communications were received from the pilot.

The ADC made a broadcast to two other inbound aircraft at 1942.32, advising that VH-WGI was in the circuit ahead of them, that it had become visual about half a mile south of the VOR, that it was manoeuvring for a visual approach and was just in and out of the base of the cloud.

After the pilot of VH-WGI reported over the field, and the aircraft first appeared out of cloud, witnesses observed it track to about the south-east end of the aerodrome at a height of about 500–800 ft. It then turned left to track north-west on the north-east side of the main runway and approximately over the grass runway. The aircraft was seen to be travelling at high speed, and passing through small areas of cloud. North of the main terminal building a left turn was initiated onto a close downwind leg for runway 32. The aircraft appeared to descend while on this leg. As the base turn was started, at a height estimated as 300–500 ft, the aircraft briefly went through cloud. Some of the witnesses reported that the engine noise from the aircraft during the approach was fairly loud, suggestive of a high power setting.

Late on a left base leg the aircraft was observed to be in a steep left bank, probably in the order of 60°, at a height of about 200 ft. It then descended rapidly and struck a powerline with the right wing, approximately 28 ft AGL, resulting in an airport electrical power failure at 1943.02. Almost simultaneously the left wing struck bushes. A short distance beyond the powerlines the aircraft struck the ground and slid to a stop. A fierce fire broke out immediately. Airport fire services responded to the accident and the fire was quickly extinguished. Six of the occupants received fatal injuries and the others, including the pilot, were seriously injured.

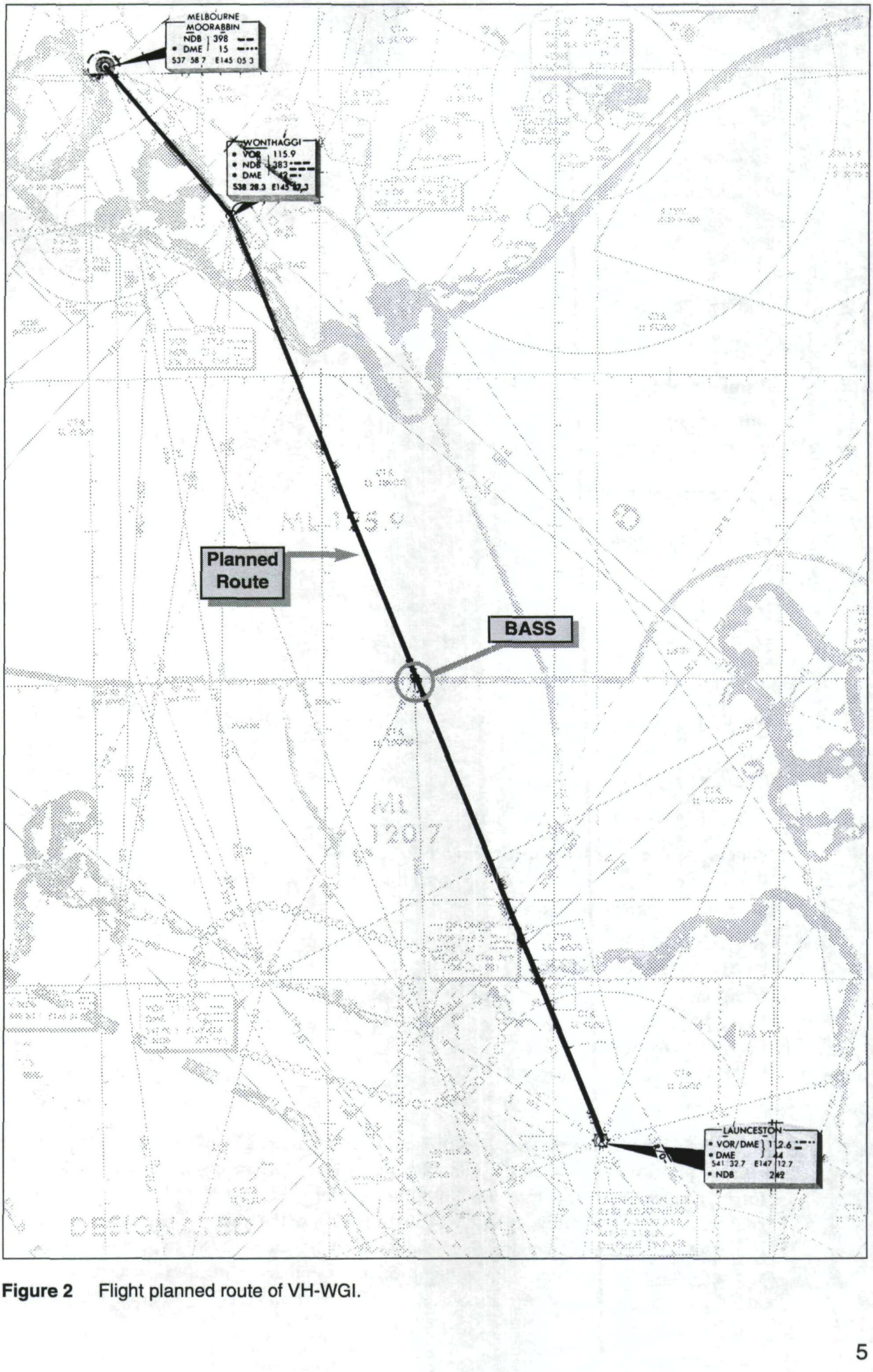

Figure 2 Flight planned route of VH-WGI.

1.2 Injuries to persons

	Crew	Passengers	Others	Total
Fatal	–	6	–	6
Serious	1	3	–	4
Minor/none	–	–	–	0
TOTAL	1	9	0	10

1.3 Damage to aircraft

The aircraft sustained substantial damage as a result of impact forces and fire.

1.4 Other damage

Three Hydro-electric Commission high-voltage aluminium conductors, diameter 16.25 mm, and four low voltage copper conductors, diameter 4.88 mm, were severed.

1.5 Personnel information

1.5.1 Pilot in command

Sex/age	Male, aged 23 years
Highest licence	Commercial Pilot Licence
Medical certificate	Class One, valid to 5 July 1994
Medical restriction	Vision correction required (glasses worn)
Instrument rating	Multi-engine Command, initial instrument rating issued 6 May 1993, valid to 31 May 1994
Instructor rating	Grade 3, valid to 31 August 1994

Pilot logbook entries to 16 September 1993
(For the first three lines a time of 1.6 hours for the flight to Launceston has been added to the times shown in the logbook.)

Total hours	701	Last 90 days	82
PA-31	3.4		3.4
Multi-engine	46		3.4
Night	63		2.3
Instrument flying	36.7		2.7
Last check	16 Sept. 1993		

The pilot's initial twin engine aircraft training was conducted on a Piper PA-44. Eighteen months prior to the accident the pilot completed an endorsement for the Piper PA-23. The total flying done on this type was 3.2 hours. In May 1993 he completed a multi-engine command instrument rating using PA-44 aircraft. Most of the training for this rating had been conducted at night. A Partenavia PN68 endorsement, which included instrument approaches, was completed in early June 1993. A flight to Launceston and return was made in the period 11–14 June 1993 in a PN68. At Launceston, a DME arrival was carried out at night, followed by a circling approach for a landing on runway 32. The pilot's total experience on the PN68 was 5.3 hours.

Since then the pilot had logged 2.7 hours of instrument flight in single engine aircraft. Also, 3.4 hours accumulated by his students operating a synthetic trainer had been entered by the pilot in his logbook, as simulated instrument flying carried out by him. Part of this synthetic trainer time was in early July 1993. It totalled 2 hours, and was conducted by two students in preparation for their GFPT. It consisted of straight and level flight, medium level turns, climbs and descents, and stall recognition. Two other synthetic trainer sessions were completed on 6 and 13 August 1993 with a student starting his navigation training. These sessions consisted of ADF and VOR orientation.

Under CAO 40.1.0, para. 10.9, the synthetic trainer time on these exercises could not be logged by the pilot as the students were manipulating the controls. CAO 40.2.1, para. 11.2 specifies options for meeting the minimum experience levels for recency before acting in command on an IFR flight. The instrument flight time recorded by the pilot, which met the requirements for the logging of instrument flight time, was 2.7 hours. This did not meet the 3-hour minimum.

It is a requirement under CAR 5.52 (1)(c) that time spent practising simulated instrument flight in an approved synthetic trainer be recorded in the pilot's logbook. The pilot's logbook did not record any instrument approaches during the 90 days prior to the accident. He said he had conducted a simulated ILS approach in a synthetic trainer in the month before the accident while working with one of his students. He was unable to state either when or with which student this was done, and no pilot or company records could be found to substantiate the statement.

To meet the ILS approach recent experience requirements stipulated in CAO 40.2.1 the pilot must have completed at least one such approach within the preceding 35 days. There was a 90-day currency requirement for ADF and VOR. An ILS approach would also have renewed the pilot's VOR currency and could have been flown in an approved synthetic trainer. The last recorded ILS approach in the pilot's logbook was flown early in June 1993.

On 13 and 16 September 1993 the pilot received type endorsement training on the PA-31-350 aircraft. This training consisted of upper air work and circuits, by day, in VH-WGI. The pilot recorded a total of 1.8 hours in his logbook. Company documents recorded an air switch total (i.e. the time that the aircraft was airborne) of 1.2 hours for the training. No instrument approaches, night flying, low-level circuits or maximum weight/aft CG flying were conducted as part of the pilot's training on the PA-31-350 aircraft. Prior to commencing the flight to Launceston on 17 September 1993 the pilot had no other experience on PA-31 aircraft.

The pilot stated that in the past he had experienced problems with aircraft navigation instruments giving unreliable indications, an example of which was an oscillating glide slope. Because of this type of problem he preferred to make a visual approach if he could. There was no evidence to suggest such an instrument problem existed during the accident flight.

1.5.2 Previous 72 hours history

The pilot worked as an instructor at the operator's flying school and was rostered off duty from Thursday 16 September to Monday 20 September to provide for the trip to Launceston. On Thursday 16 September he went to the flying school to complete his PA-31 endorsement training. He also continued to make arrangements for the flight to Launceston. Because of complications with these arrangements, the pilot did not arrive home until between 2200 and 2300. On 17 September he arrived at the school office at about 0830–0900 and spent the day concentrating on matters related to the flight to Launceston.

1.6 Aircraft information

1.6.1 Significant particulars

Registration	VH-WGI
Manufacturer	Piper Aircraft Corporation
Model	PA-31-350
Common name	Chieftain
Serial no.	31-7305075
Country of manufacture	USA
Year of manufacture	1973
Engines	2 Lycoming TIO-540-J2BD
Engine type	Reciprocating
Date of issue of certificate of registration	21 May 1991
Maintenance release	No. 211402, issued 11 December 1992 at 8,622 hours and valid to 11 December 1993 or 8,722 hours (whichever was attained first)
Total aircraft hours at time of accident	8,712.6

1.6.2 Aircraft history

The aircraft was placed on the Australian Register on 6 May 1974. After several changes of certificate holder it was transferred to the present holder on 21 May 1991. For part of the time since then it was operated in New Zealand.

The last periodic inspection was carried out at Moorabbin Airport and a maintenance release was issued on 11 December 1992. Three ADs were not called up on the current maintenance release at the time of issue. However, one was subsequently completed prior to the accident and the other two had no effect on the operation of the aircraft during the accident flight.

There were two outstanding entries on the maintenance release. These had been entered on 16 January 1993. Although the entries had not been signed off, documentation was obtained that indicated maintenance required to render the items serviceable had been completed during June and July 1993.

1.6.3 Weight and balance

Maximum permissible take-off weight	3,178 kg
Estimated	
– take-off weight (TOW)	3,273 kg
– TOW centre of gravity	3,392 mm aft of datum
– fuel burn taxi, and in flight	151 kg
– accident weight	3,122 kg (weight reduced in flight by fuel burn)
– centre-of-gravity at accident	3,400 mm aft of datum

Centre of gravity limits	
– forward	3,200 mm aft of datum at 3,178 kg
	3,099 mm aft of datum at 2,815 kg
	3,048 mm aft of datum at 2,361 kg or less, with linear variation between 2,361 kg, 2,815 kg and 3,178 kg
– rear	3,429 mm aft of datum at all weights
Datum	3,480 mm forward of the main spar centreline

Prior to the flight the pilot completed a loading form to calculate the load and CG position. This incorrectly indicated that the take-off weight was 3,178 kg. The fuel and passenger weights were underestimated and luggage weight was slightly overestimated. At the time of takeoff the aircraft was approximately 95 kg above the maximum permissible take-off weight. BASI calculations were made using information from the aircraft flight manual and included data based on full main fuel tanks, luggage weighed at the scene, weight data provided by the pilot and surviving passengers, and passenger post-mortem weights. Although the maximum take-off weight was exceeded, the aircraft was within weight and balance limitations at the time of the accident due to the amount of fuel consumed during the flight.

1.7 Meteorological information

1.7.1 Introduction

As the flight was to be operated under IFR, the pilot in command was required to obtain either a flight forecast for the route being flown, or an ARFOR and a TAF. For ARFORs the heights given for cloud are AMSL, whereas TAFs provide cloud heights above aerodrome elevation. Similarly, aerodrome weather observations as made by either meteorological observers or ATC, and broadcast on the ATIS, also measure cloud heights above the aerodrome elevation.

The planned route from Moorabbin to Launceston was within the area 32 (northern half of the flight) and area 70 (southern half of the flight) forecast regions. Commonly, areas 30/31/32 (mainly Victoria) and areas 70/71 (Tasmania) are issued as combined forecasts for the respective areas. At 1354 on 17 September 1993 the pilot received facsimile copies of the area 30/31/32 forecast valid from 1330 to 0300, and the area 70/71 forecast valid 1300 to 0300, along with an amended area 70/71 forecast valid 1500 to 0300. TAFs were also obtained for Wynyard, Devonport and Launceston, valid from 1200 to 2400. All of these forecasts were recovered from the wreckage.

1.7.2 Forecasts

The area 70/71 forecast predicted broken stratus cloud developing after 1800 on the north coast of Tasmania, with the base at 1,500–2,000 ft; cumulus and stratocumulus cloud with broken coverage on the north coast and Bass Strait, base 2,500 ft, tops 4,000 ft; and cumulus and stratocumulus cloud with scattered coverage inland, base 2,500 ft, tops 8,000 ft. Isolated rain was forecast in the north-west and northern areas. The Launceston TAF predicted 2 octas of stratocumulus cloud at 2,000 ft and 3 octas of stratocumulus cloud at 3,500 ft. The forecast surface wind was 150°T at 10 kts. Visibility was forecast to be 10 km or greater, QNH 1,013–1,012 hPa.

An amended TAF for Launceston was issued at 1628, valid from 1800 to 0600. This predicted the surface wind as variable at 5 kts, visibility 10 km or greater, drizzle, 2 octas of stratocumulus at 2,500 ft, 5 octas of stratocumulus at 3,000 ft, QNH 1,011–1,012 hPa. This forecast did not affect the operational planning of the flight.

A later amended TAF was issued at 1932, valid until 0600. This predicted the surface wind of 330°T at 5 kts, visibility 10 km or greater, drizzle, 6 octas of stratus at 800 ft, 8 octas of stratocumulus at 2,000 ft, QNH 1,011–1,012 hPa. At the time of issue of this forecast the aircraft was on descent into Launceston.

1.7.3 Weather conditions at Launceston

In the 1900 Metar the cloud base was reported as 1 octa of stratus at 1,000 ft and 3 octas of cumulus at 2,000 ft above the aerodrome elevation. The weather conditions were deteriorating as VH-WGI was on descent into Launceston. Observations by the meteorological observer at 1930 indicated there were 7 octas of cloud at 800 ft. The ADC separately assessed the cloud cover as 4 octas of cloud at 800 ft. Visibility clear of cloud was good. The pilot later indicated that the aircraft did not pass through any rain on the approach. However, during the circling approach at the aerodrome the aircraft went through patches of cloud, some of which may have been below 800 ft. After the accident the weather deteriorated and some rain/drizzle occurred. In the 2000 observation the meteorological observer reported the cloud as 7 octas of stratus at 600 ft.

The observation points for the ADC and the observer were different, with the observer being located about 450 m north-west of the tower. The cloud searchlight, which was used to establish cloud height, was a further 274.3 m north-west of the observation point. The searchlight was a fixed installation which directed a narrow beam of light at an angle of 63° 26' up, towards the south-east.

1.8 Aids to navigation and instrument approaches

1.8.1 Aids to navigation

The aerodrome is equipped with an NDB, a VOR, and a DME. There is also an ILS installed for approaches to runway 32. A locator beacon (a low-powered NDB), Nile, positioned 13 km south-east of the threshold of runway 32, is an additional tracking aid, primarily for use in conjunction with the ILS approach.

The aids are monitored by ATC and were serviceable at the time of the accident.

1.8.2 Instrument approaches

Instrument approach procedures are published in AIP DAPS. At Launceston, instrument approaches are published for runway 14 VOR or VOR/DME, runway 32 ILS (fig. 3) or LLZ, runway 32 VOR/DME, and runway 32 NDB/L. These procedures enable pilots to descend in a prescribed pattern to the MDA/DA for each type of approach at the airport. The DA for the ILS was lower than for the other approach options.

The runway 32 ILS approach commences from the Nile locator beacon at an altitude of 3,000 ft. The aircraft descends on a 3° glide path, aligned with the extended runway centreline. When 32 is the active runway this approach allows the pilot to descend on the ILS glide slope to an altitude of 750 ft, which is a height of 202 ft above the runway threshold. If conditions are visual at or before this stage the pilot can continue the approach straight ahead to land on runway 32.

For aircraft approaching the airport from the north-west there is a time penalty in using the ILS approach due to the requirement to position the aircraft south-east of the airfield for the approach from Nile.

Instrument approaches provide for aircraft performance categories based on 1.3 times the stall speed in the landing configuration at maximum landing weight. For the PA-31-350, category B is applicable. DAPS also lists handling speeds for aircraft categories during instrument approach procedures. For category B aircraft the initial approach speed range is 120/180 kts, the final approach speed range is 85/130 kts and for visual manoeuvring (circling) the maximum speed is 135 kts.

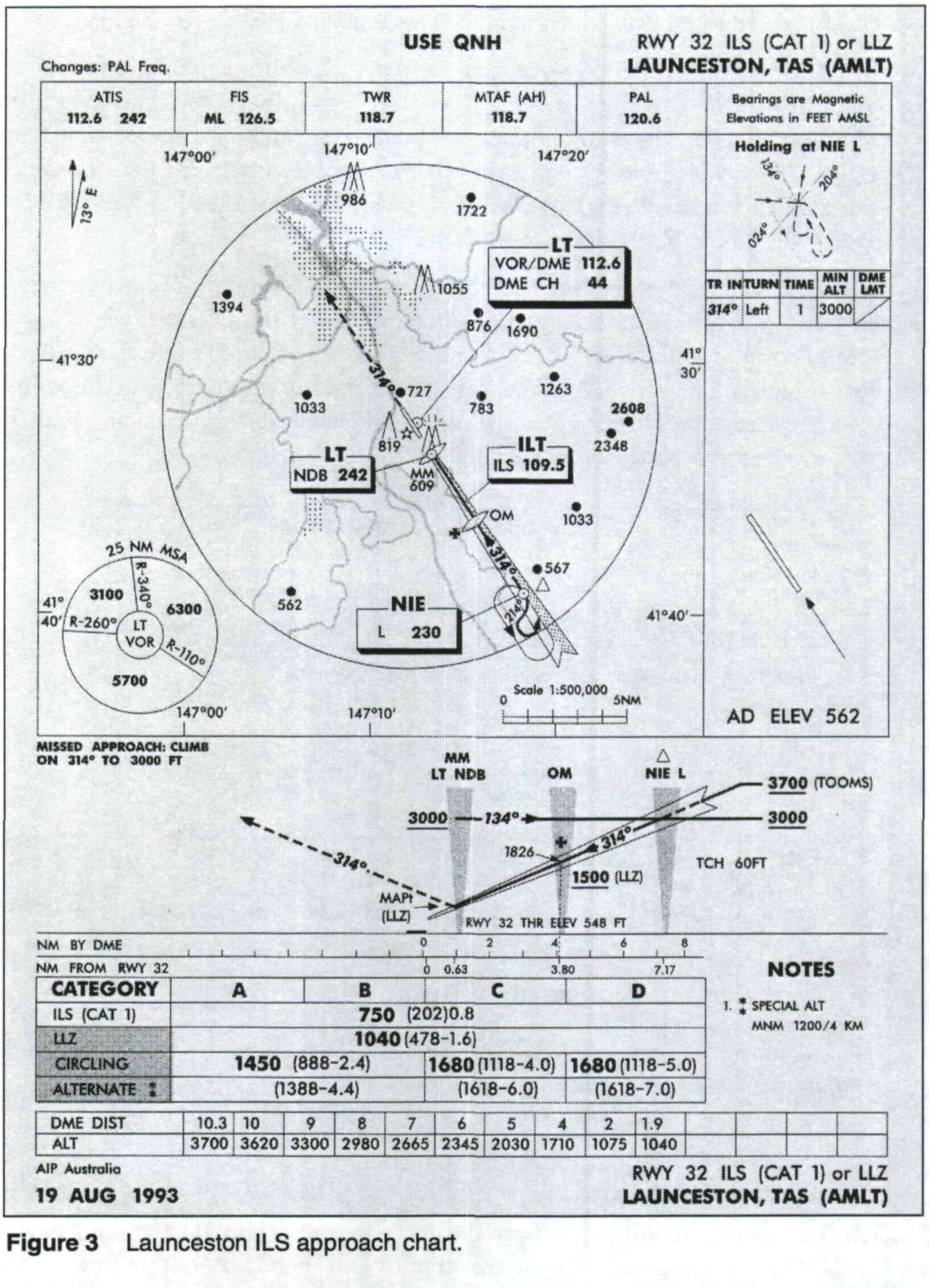

Figure 3 Launceston ILS approach chart.

1.8.3 DME arrivals

The DME arrival procedure is an instrument approach which provides descent guidance from either a CTA step in controlled airspace, or an en-route or specific sector lowest safe altitude in uncontrolled airspace, to the visual circling area of an aerodrome. Azimuth guidance is required from the radionavigation aid specified. The procedure is designed as a series of descending steps on particular tracks or within a specified sector. In this case the inbound track from the north-west was not aligned with the runway in use and the pilot was required to make a visual circling approach to land towards the north-west on runway 32.

The DME arrival procedures for Launceston are published in AIP DAP EAST. For the track the pilot was flying, the procedure showed progressive descent steps in the table 'Sector A' (see fig. 4). This showed that at 6 DME the aircraft could descend to 2,000 ft and at 3 DME the aircraft could descend to 1,450 ft, which was 888 ft above the ARP.

AIP DAP heading 'QNH Sources' states that the landing, circling and alternate minima published in the DME arrival procedures (see fig. 4), have been calculated using forecast aerodrome QNH. Those minima may be reduced by 100 ft whenever an actual aerodrome QNH is obtainable from ATS or some other source specifically approved by the CAA. For the track the aircraft was flying, the DME arrival chart indicated the IAF was at 15 DME, the FAF at 5 DME and the MAPT at the NDB/VOR.

AIP DAPS states that if upon reaching the MAPT the required visual reference is not established, a missed approach shall be executed. The missed approach instructions on the DME arrival procedure were to climb on a track of 134° to 3,000 ft. AIP DAPS also requires that if 'an aircraft which is conducting an instrument approach procedure and establishes visual reference should subsequently lose visual reference while at or below the DA, MDA or RH, a missed approach shall be executed.'

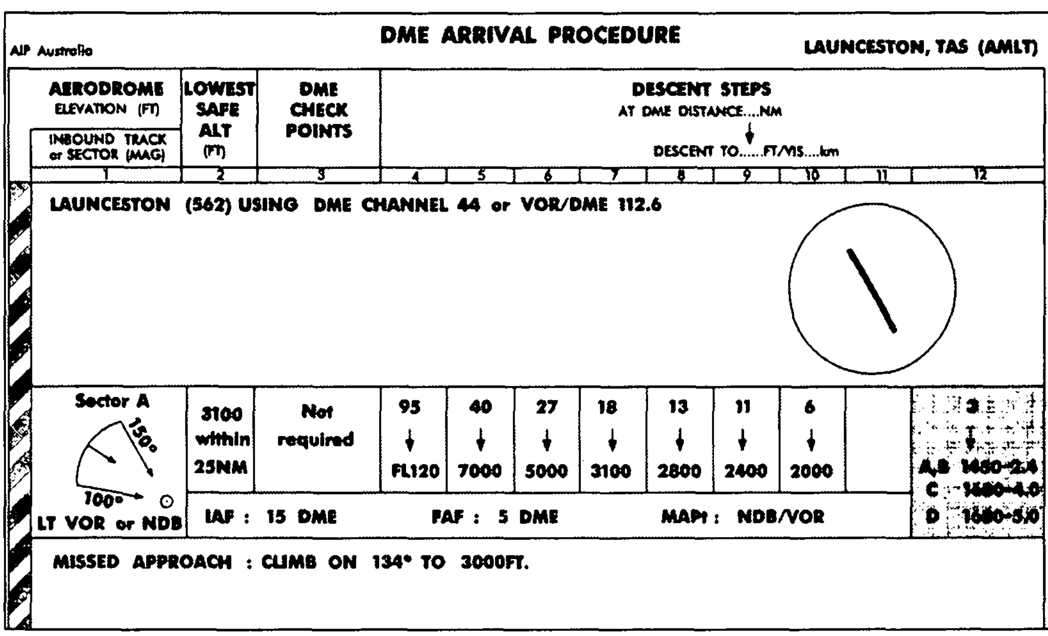

Figure 4 DME arrival procedure.

1.8.4 Circling approaches

At Launceston, a DME arrival from the north-west requires a pilot wishing to land on runway 32 to become visual at or before the minima and then carry out a visual circling approach. Visual circling information is published in AIP DAPS. Section IAL 1.5 states:

> Visual Circling. When visual reference has been established within the circling area at, or above the MDA, further descent below the MDA may occur provided that:
>
> a. the aircraft is maintained within the circling area;
>
> b. visual reference can be maintained;

c. the approach threshold or approach lights or other markings identifiable with the approach end of the runway to be used are visible during the subsequent visual flight; and

d. obstacle clearance of at least 300 feet (categories A and B) or 400 feet (categories C and D) or 500 feet (category E) is maintained along the flight path until the aircraft is aligned with the runway, strip or landing direction to be used.

Note 1 follows this and states:

For the purpose of this paragraph 'visual reference' means clear of cloud, in sight of ground or water and with a flight visibility not less than the minimum specified for circling.

The pilot said that in his approach planning he used the spot height of 819 ft as a reference for the highest terrain, and that he was using an obstacle clearance of 400 ft, which indicated he could descend to an altitude of 1,220 ft, which was 660 ft above the aerodrome elevation. (As the aircraft was category B an obstacle clearance of 300 ft was permitted.) The pilot said that hearing the report of cloud at 800 ft AGL indicated to him that there would not be any cloud below this level.

1.9 Communications

The aircraft was equipped with two VHF and one HF radio communication systems. For this flight the pilot was required to maintain continuous two-way communications.

Shortly after departing Moorabbin the pilot was in contact with Melbourne Radar Advisory Service and was then transferred to Melbourne Control on 135.3 MHz. The aircraft temporarily lost two-way communications. For most of the subsequent en-route portion of the flight the aircraft was in uncontrolled airspace and communications were with Melbourne FS. Approaching the Launceston area the pilot was transferred to Melbourne Control at 1919. At 1927 he was transferred to Launceston Tower.

1.9.1 Summary of communications

Time	From	To	Summary of transmission
1927.16	WGI	TWR	First contact with Launceston Tower. Aircraft at 7,000 ft and 25 DME. Analysis of other DME reports indicated the aircraft was probably at 35 DME.
	TWR	WGI	Pilot given a DME arrival to track inbound on the 325 radial.
1928.09	SEC 3	TWR	Sector 3 and tower coordinate the arrival of VH-NOS, VH-WZI and VH-FKA.
1930.03	TWR	WGI	Tower confirms that the pilot of WGI has ATIS information Golf.
	TWR	WGI	Latest actual weather passed to pilot; 2 octas at 800 ft clear of the aircraft inbound track with some lower cloud forming just north of the field, possibly on the aircraft inbound track. The pilot was advised that if he was not visual by the omni he would need to carry out an ILS via the Nile locator.
	WGI	TWR	Acknowledged by pilot.

Time	From	To	Summary of transmission
1933.39	TWR	MET	Request latest searchlight reading.
	MET	TWR	Cloud passed as 7 octas at 800 ft. Tower was also advised that the dew point was dropping and that there was a likelihood of fog later in the evening.
1934.36	NOS	TWR	First contact with Launceston Tower. Reported position as 55 DME on the 326R, level at 9,000 ft and having received ATIS Golf.
	TWR	NOS	NOS was cleared to enter controlled airspace on descent to 8,000 ft on the 326R. QNH 1,012.
	NOS	TWR	Acknowledged by pilot.
	TWR	NOS	Pilot of NOS advised of the deteriorating conditions and the possibility of being required to conduct an ILS on arrival.
1935.52	TWR	WGI	Requested to report present DME and level.
	WGI	TWR	Reported at 12 DME and 3,300 ft.
	TWR	WGI	Pilot of WGI was advised that weather conditions were deteriorating and that the weather was 4 octas at 800 ft. The pilot was also advised that if he was not visual by the omni he was to make a missed approach, track to Nile, climb to 3,000 ft and report visual or making the missed approach.
	WGI	TWR	Acknowledged by the pilot.
1936.33	NOS	TWR	NOS left 9,000 ft on descent to 8,000 ft.
	TWR	NOS	Tower acknowledged and advised NOS that there would be a delay prior to descent from 8,000 ft due to a Dash 8 which was inbound to Launceston.
1938.36	WZI	TWR	WZI advised Tower that it was at 10,000 ft, 30 DME on the 320 radial and had information Golf.
	TWR	NOS	Requested a position relative to DME.
	NOS	TWR	NOS reported at 45 DME.
1939.00	TWR	WZI	Given a descent to 5,000 ft to track inbound on the 320 radial and to report approaching 5,000 ft with a DME. This was acknowledged by WZI.
1939.18	FKA	TWR	Initial call to Tower giving position as approaching FL110 at 32 DME, on the 289 radial with information Golf.
	TWR	FKA	FKA given a descent to 7,000 ft and QNH 1,012. Acknowledged by FKA.
1939.45	TWR	WGI	Requested DME and altitude.
1939.50	WGI	TWR	Reported at 1,450 ft and 2–3 DME. (It appeared the pilot was correcting himself and meant he was at 3 DME.)

Time	From	To	Summary of transmission
1939.59	TWR	WGI	Acknowledged and asked if WGI was still IMC. WGI responded in the affirmative.
1940.07	TWR		An all-stations broadcast was made advising that conditions at the airport were deteriorating. Weather reported as 4 octas at 800 ft in the vicinity of the field and that arriving aircraft should expect an ILS approach.
1940.56	WGI	TWR	WGI reported over the field that the field was not in sight and that he was going around.
1941.01	TWR	WGI	Requested confirmation that WGI was on climb to 3,000 ft, tracking to the Nile locator for an ILS approach.
1941.07	WGI	TWR	Pilot of WGI reported he had the airfield in sight.
1941.10	TWR	WGI	Cleared for a visual approach to runway 32.
1941.16	WGI	TWR	Reported over the final approach to runway 32 (background sound on tape identified as the stall-warning horn).
1941.22	TWR	WGI	Requested confirmation that WGI was conducting a visual approach.
1941.26	WGI	TWR	The pilot replied, but did not confirm that he was conducting a visual approach.
1941.34	TWR	WGI	Cleared WGI for a visual approach or a missed approach to Nile.
1941.41	WGI	TWR	Acknowledged the visual approach and Tower cleared WGI to manoeuvre as preferred for runway 32 (background sound on tape identified as the landing gear warning horn).
1941.48	WGI	TWR	The pilot of WGI acknowledged the clearance. (This was his last transmission.)
1941.52	FKA WZI NOS	TWR TWR TWR	FKA reported approaching 7,000 ft, 20 DME and WZI reported at 16 DME and 5,000 ft. Tower cleared FKA to descend to 6,000 ft. WZI was cleared to 4,000 ft. NOS was cleared to descend to 7,000 ft and report DME. NOS reported out of 8,000 ft at 35 DME.
1942.32	TWR	FKA WZI	Tower advised WZI and FKA that WGI became visual about 0.5 NM south of the omni and that WZI could try a DME. FKA was advised that the DME could not be given. (Transmission broken.)

DURING THIS TRANSMISSION A 15-SECOND BREAK IN THE RECORDING OCCURS BEFORE RESUMING AT 1943.17.

1943.17	TWR		(Recording starts up part way through a transmission.) The lights are back. Requests (WGI) if the runway is in sight.

Time	From	To	Summary of transmission
1943.25	FKA	TWR	Advised Tower that they had lost communications and requested confirmation that FKA was cleared for an ILS approach.
1943.32	TWR	WGI	Requested if runway was in sight as the lights had failed momentarily.
1943.50	RFFS	TWR	Discussed probability that WGI had crashed and need to dispatch someone to site.
1943.56	TWR		Final call by Tower to contact WGI. Tower then made an all-stations broadcast that an aircraft had crashed on final approach to runway 32. The controller then began sorting the aircraft out for approaches and completed the crash response.

1.10 Aerodrome information

1.10.1 General

Launceston is a controlled aerodrome during the hours of tower operation. At the time of the accident these were from 0630–2300, and the CAA control tower was active with one controller on duty.

The airport has one sealed runway, 14/32, which is 1,981 m in length. The aerodrome elevation is 562 ft at the ARP near the centre of the runway. The surface elevation varies, with the threshold of runway 32 having an elevation of 548 ft, while at the other end the northern threshold elevation is 560 ft.

The terrain in the immediate vicinity is predominantly flat. A line of low hills, approximately parallel to the runway, is situated just over 1 km to the south-west of the runway. The Launceston Aerodrome Chart (see fig. 5) shows a spot height in this area of 819 ft. The antenna for the NDB, elevation 609 ft, was located about 1 km south-east of the runway.

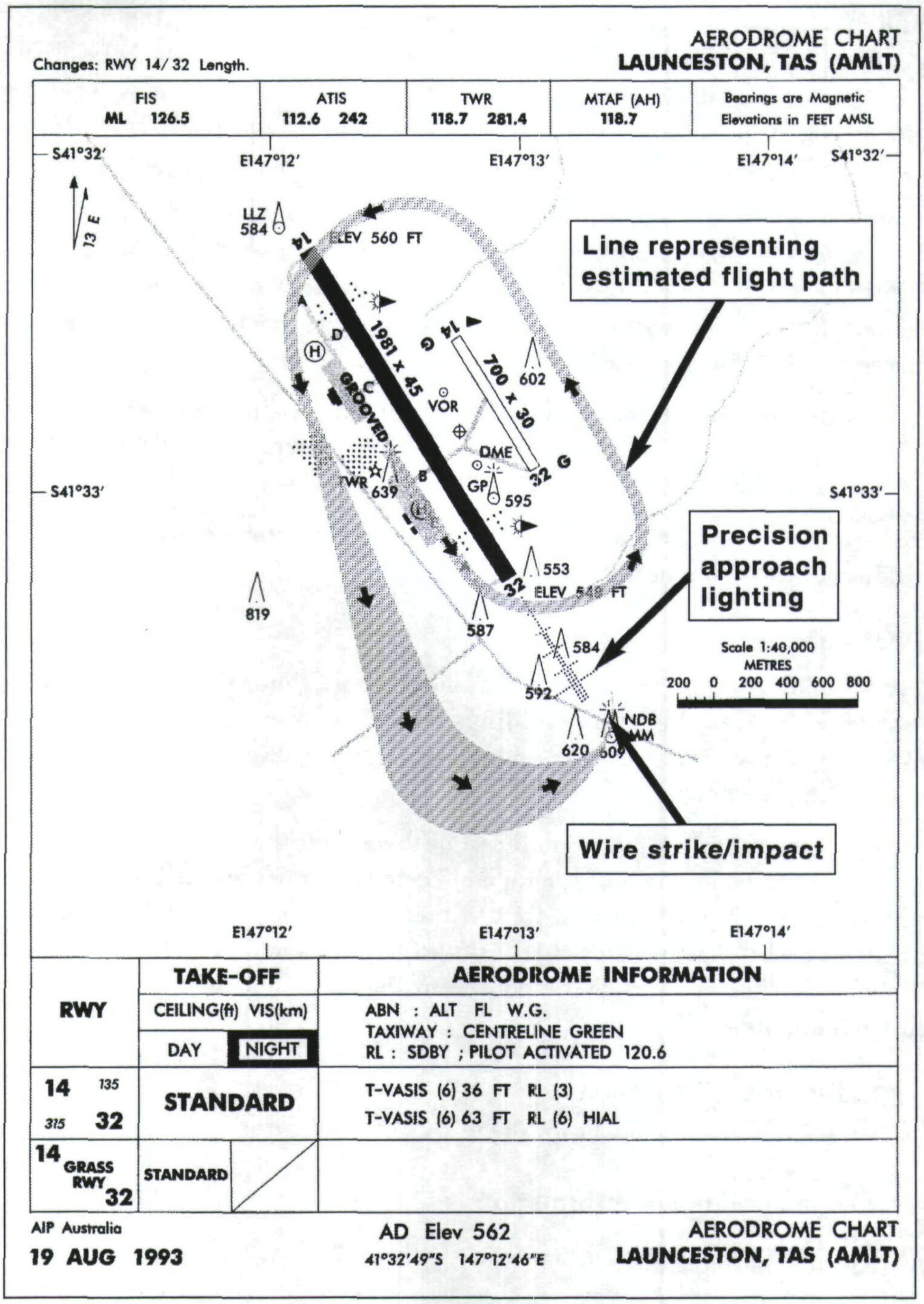

Figure 5 Launceston Aerodrome Chart and diagram of approximate flight path at Launceston of VH-WGI, 17th September, 1993.

1.10.2 Lighting

Runway 32 is equipped with 6-stage runway edge lights which are omni-directional when selected to intensity stages 1, 2 and 3. When stages 4, 5 or 6 are selected the lights are uni-directional.

Category 1 precision approach lighting is installed on the final approach path for runway 32. The lights are uni-directional and provide assistance to aircraft on ILS approaches in poor visibility as a visual lead-in path to the runway threshold. The lights cannot be seen north of the threshold of runway 32. On the downwind leg they cannot be seen until passing abeam the start of the runway, and then only very faintly, in the form of a narrow crescent. They cannot be fully seen until an aircraft is well into a normal base-leg position, and even then the level of light intensity is relatively low in comparison to the appearance of the lights when on or close to final approach. They also have six stages of light intensity settings. The layout of these approach lights forms a distinctive pattern which is considerably different in appearance to the runway lighting layout.

Runway 32 is also equipped with a T-Vasis. This is for use by aircraft on final approach and is designed to be visible within 7.5° either side of the runway centreline for a distance of 5 NM from the runway threshold. By T-Vasis reference a pilot can obtain a visual indication of whether the aircraft is on the correct glide slope, or too high or low. There are six stages of intensity settings for the T-Vasis.

At the time the aircraft was approaching to land, the intensity settings for the runway, approach and T-Vasis were set at stage 2. Three other aircraft landed shortly after the accident and none reported any problems with the aerodrome lighting.

The aerodrome was equipped with two illuminated wind indicators and an operating aerodrome beacon was positioned on the control tower.

1.10.3 Other lighting

Several buildings on the airport complex had external lighting switched on. Outside the airport boundary there are lights on buildings near the approach path for runway 32. Also, a distinctive line of lights on an east-west section of a railway line crosses the approach light pattern in a straight line.

The town of Evandale is 3 km south-east of the airport and the town of Perth is 4 km west-south-west of the threshold of runway 32. There are houses on the line of low hills parallel to runway 32 just over 1 km south-west of the airport. The surrounding area is mainly open farmland and it was possible that farm house lights and vehicle lights could have been illuminated. The pilot said he did not see any lights outside the runway/aerodrome complex during the approach.

1.11 Flight recorders/GPWS

The aircraft was not equipped with a FDR, a CVR, or a GPWS, nor was it required to be.

1.12 Wreckage and impact information

1.12.1 Accident site description

The accident site (see fig. 6) was located on a property adjacent to the Evandale Road, Launceston, Tasmania. The main body of the wreckage was situated about 900 m from the threshold of runway 32, on a bearing of 138°. It lay in the middle of a relatively flat grass field which was free of any trees or other obstacles. The geographic coordinates of the accident site were: latitude 41°33.5'S, longitude 147°13.3'E.

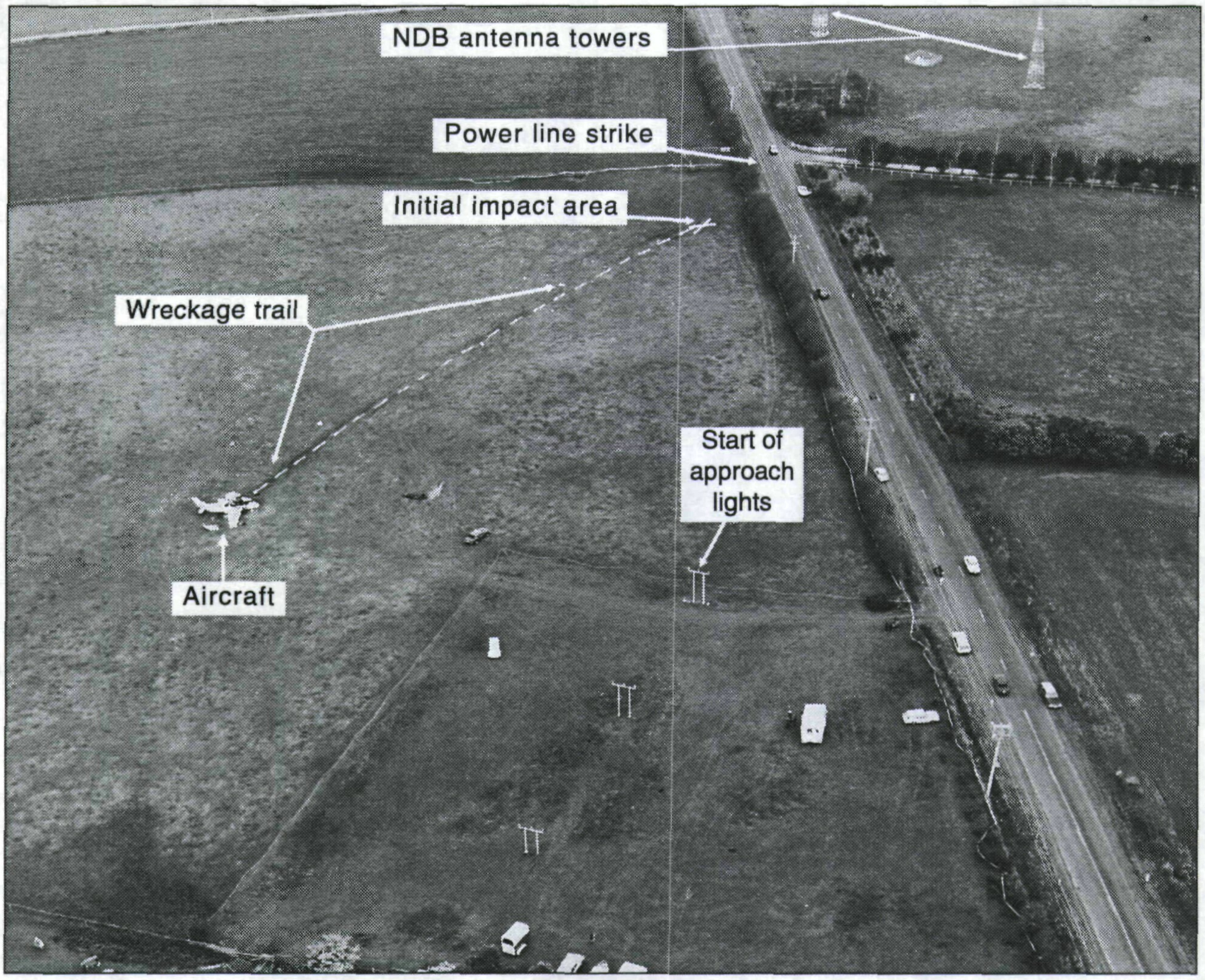

Figure 6 Aerial view of the wreckage trail.

1.12.2 Aircraft path/wreckage trail

The aircraft's final approach path was on a track of 330°M. The aircraft was descending at an angle of about 20° and impacted the ground with about 28° of left bank at a ground speed of approximately 107 kts. The landing gear extension cycle was incomplete and the flaps were set symmetrically to about 9–10°. The aircraft contacted powerlines with the right propeller, while the left wing tip cut into bushes below the powerlines. The bottom of the cut in the bushes was about 11.5 ft above the ground and about 16 ft above the threshold of runway 32.

The wreckage trail commenced about 13 m past the powerlines. The initial impact marks were about 11 m long. The aircraft became airborne again for some 20 m before sliding along the ground to a point approximately 150 m beyond the powerlines. During the ground slide the track changed from 330° to 315° as the aircraft yawed to the left, coming to rest on a heading of 190°. A number of components such as landing gear doors, right landing gear leg, part of the right elevator and the right propeller were torn off, or became separated, and lay scattered along the wreckage trail. The emergency exit panel detached from the aircraft during the ground slide.

The main body of the wreckage rested on the lower fuselage with the wings, tail, engines and control surfaces remaining in their respective positions relative to the fuselage. The left wing, fuselage and cockpit areas were substantially damaged by fire.

1.12.3 Structure

The main structure and control surfaces were accounted for on the site. Fire had severely damaged the cockpit and cabin areas and destroyed the top of the cockpit and cabin. The damage was consistent with the application of excessive loads during the impact sequence and the effects of the subsequent fire (see fig. 7). No pre-existing defects likely to have contributed to the accident were found. There was no evidence that any of the aircraft doors had been open prior to the impact.

Figure 7 View of wreckage showing extent of fire damage to the cabin area.

1.12.4 Flight controls

All control surfaces were found with their respective hinges, cable and push-pull attachments correctly assembled and secured. With the exception of the wing flaps system, where an electric motor drives flexible shafts, all remaining aircraft control surfaces are cable operated. During the break-up sequence, the individual cable runs were probably subjected to random tension loads resulting in uncommanded movement of the individual control surfaces. Thus, the positions in which the primary and trim control surfaces were found did not necessarily represent their positions at the time of impact. No impact-related marks allowing the determination of the position of the control surfaces at the time of impact were found.

The flap selection switch was in the neutral position, with the flap position indicator showing 0°. The aileron, rudder and elevator trim position indicators were in their normal electrical power supply off positions.

1.12.5 Power plants

The on-site examination of the engines revealed only superficial impact-related mechanical damage, with the left engine having sustained some additional fire damage. No indication of any fault likely to cause their malfunction prior to the accident was apparent.

The left engine ignition harness had been burnt away in numerous locations, making a comprehensive examination impossible. Examination of the magneto remains found all components within the manufacturer's limits. The turbocharger compressor shaft was rotated with some difficulty, consistent with it having been subjected to fire.

During the wreckage examination the engine throttle levers were found in about the mid-range position, the left lever being slightly more advanced. Both mixture levers were in the mid-range setting. With the exception of the manifold pressure gauge, where the left pointer was at 28 inches Hg and the right at 29 inches Hg, the remaining engine instrument indicators were either on zero or, due to fire damage, gave no discernible information.

Both engines were removed for further examination to determine their pre-impact status. All mechanical and fire-damaged components essential to the engine operation were replaced. Other non-essential components such as the turbocharger and the hydraulic and vacuum pumps, were disconnected. Both engines were test run and found to be capable of normal operation, with performance parameters being within the manufacturer's limits.

1.12.6 Propellers

The right propeller had separated from the engine; the left propeller remained attached to the engine. The blades on both propellers sustained different degrees of deformation and their tips contained deep round marks, some of which exhibited arcing and local metal melting, indicating contact with an electrical conductor. The right propeller blade pre-load plates each contained an indentation consistent with the pitch pin's separation. The location of the indentation was almost identical on all blades and was consistent with the blades having been in the fine pitch range at that time. The left propeller had latches locked with the pitch change rod flats indicating that the blades were in fine pitch at impact.

Neither propeller's internal working components exhibited pre-existing damage or any abnormality likely to have affected the propeller's function. Imprints of the pre-load plates on the matching hub faces indicated that the blades had been driven under power.

The right propeller pitch lever was in about a mid-range setting and the left lever was advanced towards the fine pitch setting.

1.12.7 Landing gear and hydraulic power

The landing gear extension cycle is initiated by moving the selector handle to the down position. The sequence first initiates unlocking and opening of the doors followed by unlocking of the gear. After the gear has moved to the full down position, the sequence continues with closure of the main landing gear inboard doors. On their full closure, the build-up of hydraulic pressure in a delay valve returns the handle to the down-neutral position indicating to the pilot, together with three green landing lights, that the extension cycle has been successfully completed. The landing gear extension cycle is completed in approximately 5–7 seconds.

The gear selector handle was found in the down position, and the main landing gear inboard doors were found to have been torn off in the early stages of the impact sequence. Examination of the landing gear, doors and their mechanisms found nothing which might have interfered with their normal function. The emergency extension handle was in the stowed position.

1.12.8 Fuel system

The aircraft fuel system has a capacity of 730 litres. It consists of independent left and right systems interconnected by a cross-feed valve located on the left side of the aircraft. Each system consists of inboard and outboard fuel tanks, a fuel filter, a fuel tank selector, electric boost fuel pumps and a shut-off valve.

A quantity of fuel was present in the right-wing main tank (the left-wing tanks were destroyed by fire). A sample was tested and met the required specifications. Both systems' shut-off and cross-feed valves were closed, and both selector valve main tank ports were closed. The auxiliary tank ports were partially opened. The fuel filters were clear. All fuel pumps were free of faults and capable of normal operation.

The valve positions did not correspond with the positions of the fuel selector panel control levers. The fuel selector panel levers were in positions consistent with a configuration of shut-off valves open, both systems on main tanks, and cross-feed valve open. In the impact sequence the fuselage lower surface was significantly deformed. The impact forces resulted in random loads being applied to the cables connecting the valves with the control levers and changed their original relative positions.

1.12.9 Instruments

Only a small number of cockpit instruments were recovered for examination, most having been badly damaged by fire. Nothing was found to preclude their normal operation. Marks on the left altimeter indicated that it read 570 ft at the time of impact; its pressure subscale was set at 1,010 hPa. The right altimeter pressure sub-scale was also set to 1,010 hPa. Most of the instruments provided no meaningful information.

1.12.10 Remaining systems

Due to the extent of fire damage it was not possible to determine the pre-impact status of the heat and ventilation, pitot-static and electrical systems. However, examination of the recovered components found no fault likely to have affected their normal operation.

1.12.11 Maintenance history

A review of the aircraft, engine and propeller logbooks found nothing suggesting any irregularity likely to have affected the airworthiness of the aircraft.

1.13 Medical and pathological information

1.13.1 Post-mortem examinations

Post-mortem examinations were conducted on all the deceased passengers. None of them received fatal injuries in the accident impact sequence. All died from fire effects. Toxicological analysis did not reveal the presence of any drugs other than alcohol. Blood alcohol levels ranged from 0.041 to 0.218. Urine alcohol samples showed generally similar but slightly higher results.

1.13.2 Alcohol levels/passenger behaviour

The blood alcohol results for the fatally injured persons were provided by the Tasmanian Government Analyst Laboratory. The blood alcohol concentration is expressed as a percentage of milligrams of alcohol in each millilitre of blood. By reference to seat numbers the post-mortem blood alcohol and urine alcohol analysis results were as follows:

Seat 2	Ba 0.131	Ua 0.183
Seat 3	Ba 0.207	Ua 0.290
Seat 4	Ba 0.104	Ua 0.156
Seat 6	Ba 0.041	Ua 0.062
Seat 8	Ba 0.055	Ua 0.085
Seat 10	Ba 0.218	Ua 0.283

The pilot voluntarily gave a blood sample at about 0020 on 18 September 1994. No alcohol was detected in this specimen. No blood alcohol samples were obtained from the three seriously injured passengers.

Small levels of carbon monoxide were found in four of the fatally injured passengers. Specialist medical opinion obtained by the Bureau was that the amount was insignificant.

VH-WGI was expected to be available for departure at 1600, but was not obtained until after 1700. VH-NOS was also not obtained until much later than expected. Passengers and well-wishers started arriving at the school at about 1430. The pilot of VH-NOS and the pilot of VH-PAC told the pilot of VH-WGI they only wanted to carry passengers who were not noisy. In response they were told there weren't any, but that the pilot of VH-WGI would carry the noisiest.

Some of the passengers remained inside the school building during the long wait for departure. Others stayed outside, kicking a football nearby, looking at aircraft parked in front of the building or simply passing the time while waiting to leave. Behaviour varied between individuals but some were noisy and boisterous. The attention of the pilot of VH-NOS was drawn to two noisy passengers who were consuming alcohol inside the school building. He told them he would not take them on his aircraft due to their alcohol-affected state. These two passengers later travelled to Launceston in VH-WGI.

An observer later reported seeing the passengers at the time of loading, some with cans of beer in hand, moving back and forwards between the two PA-31 aircraft. People were getting in and out of the aircraft and luggage was being put in the wing lockers and then taken out again. This was accompanied by occasional loud voices. The CP, although not rostered for duty, had been at the operator's premises during the day. He later went out to VH-WGI during the loading for departure and gave the pilot advice on where to seat the heavier passengers. The CP said that once the passengers were finally seated in VH-WGI he had given them a briefing.

The pilot in command is required by CAR 256 (1) to ensure that a person in a state of intoxication does not enter the aircraft. It is probable that some of the passengers were intoxicated at the time of loading. A practical difficulty in interpreting this requirement is in assessing whether persons are intoxicated. Alcohol was carried onto VH-WGI for the flight to Launceston and consumed while the aircraft was en route. Toilet facilities were not available on the aircraft. During the flight some of the passengers used bags to hold their urine.

During the flight the passengers were noisy and the pilot said he was constantly interrupted by passenger questions. While making the circling approach he was interrupted by questions from the passenger in the front right hand seat and the pilot told him clearly he was unhappy with the interruptions. When interviewed in hospital following the accident the pilot's first comment, which was in relation to passenger behaviour, was to the effect that 'it was a pig of a trip.'

None of the survivors could recall the final moments of the flight.

1.14 Fire

The fire appeared to have been started by sparks accompanying the aircraft battery separation igniting fuel spilled from the ruptured wing or engine fuel lines. An intense fire broke out almost instantly. The fire was extinguished by the airport fire service approximately six minutes after the impact.

No evidence of in-flight fire was found.

1.15 Survival aspects

1.15.1 Crashworthiness and survivability

Prior to departure, the pilot conducted a briefing on the use of seat belts and the location and operation of the normal exit door and the emergency exit. In addition to the normal entrance door at the left rear side of the fuselage, an emergency window exit was located at the third side window from the front on the right. A diagram of the aircraft showing the approximate location of the seats and the exits is included at fig. 8.

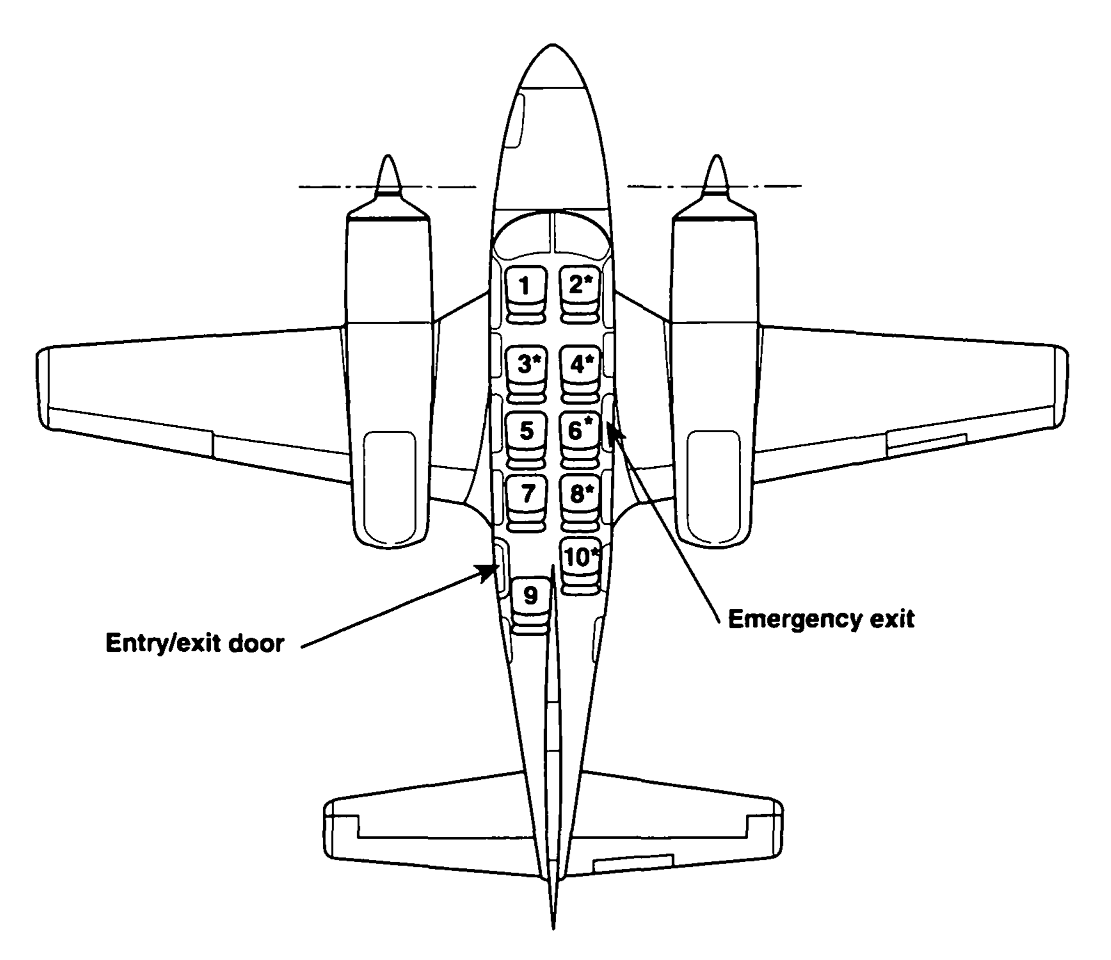

Figure 8 Plan view of the aircraft showing the location of the normal and emergency exits. Seat numbers are also shown. Positions occupied by the deceased passengers are indicated by an asterisk.

The aircraft was not equipped with emergency lighting. Each seat position was equipped with a personal reading light mounted in the roof of the aircraft. Because of the loss of the battery in the impact sequence, no aircraft lighting was available to assist the occupants in locating the exits or in seeing the operating mechanism for normal opening of the rear door.

Crashworthiness calculations indicated that the occupants were exposed to 12g deceleration both in vertical and horizontal directions for a period of 0.212 seconds. That result is supported by the limited damage to the seats and their attachments: only two seats became detached.

The limited deformation of the aircraft cabin left the occupants with survivable space. The emergency exit on the right side and a number of windows popped out during the impact sequence. The main door was found open on site.

Two passengers exited through the left main door. The pilot and one passenger exited through the right emergency exit.

1.15.2 Emergency services response

A total electrical power failure occurred at the aerodrome when the aircraft struck the powerlines. This caused a failure of the runway and approach lighting together with the control tower lighting and communication equipment. Emergency power restored all lighting and communications after 15 seconds. A fireman on duty in the fire control tower saw electrical arcing as the aircraft struck the powerlines. Three fire vehicles were dispatched to the scene. At 1948.48 fire vehicle 'Tender One' reported that it had located the aircraft. Using foam, the RFFS extinguished the fire almost immediately.

The common crash call facility connected the ADC only to the airport fire service, the civil fire service and the hospital. It was therefore necessary for the tower controller to contact the police, ambulance and CAA SAR service by making separate phone calls. Another person was visiting the tower when the accident occurred and was able to assist with the phone calls. An ambulance was requested at 1949. It arrived at approximately 2002.

1.16 CAA/operator/industry

1.16.1 CAA responsibilities

The functions of the CAA are specified in Part II Section 9 of the Civil Aviation Act 1988. In part, Section 9 (1) states that the function of the Authority, as provided by the Act and regulations, is to conduct safety regulation of civil air operations in Australian territory. A number of other functions are also described.

At the time of the accident, safety regulation of civil air operations fell within the responsibility of the Safety Regulation and Standards (SR&S) Division of the CAA.

The stated vision of SR&S was 'A safe and viable industry'.

The CAA SR&S district office responsible for the operator was located at Moorabbin Airport. In the 2.5 months since the operator had opened for business, the assigned FOI had visited the organisation at least three times. These visits included a discussion at the request of the operator, made shortly after he commenced operations, to ascertain whether company procedures were satisfactory. Other visits were to assess the standard of training and testing conducted by the operator.

(a) Aircraft endorsement requirements

CAO 40.1.0, issue 5, commencement date 4 April 1993, refers to aircraft endorsements—aeroplanes. This CAO refers to two kinds of endorsement, a 'type endorsement' and a 'class endorsement.' In this case a type endorsement was given.

Para. 6.1 (a) of this CAO, in relation to a type endorsement, states that the person seeking an endorsement must:

(i) hold a student pilot licence or an aeroplane pilot licence; and

(ii) undertake training in operating limitations, procedures and systems on the type of aeroplane for which the endorsement is sought; and

(iii) undertake flying training, or training in an approved synthetic flight trainer appropriate to the type of aeroplane, in normal and emergency flight manoeuvres and procedures in that type of aeroplane; and

(iv) satisfy the person who conducted the training mentioned in sub-paragraphs (ii) and (iii) that the first-mentioned person can safely fly that type of aeroplane.

Nothing is specified in terms of a requirement for a minimum number of flight hours for the endorsement nor for the need to conduct either night flying or instrument flying.

(b) Minimum experience requirements to act as pilot in command

The CAOs do not specify any minimum experience level requirement to conduct a private IFR flight in an aircraft not exceeding 5,700 kg.

To be able to conduct an IFR charter flight on multi-engine aeroplanes not exceeding 5,700 kg maximum take-off weight, the pilot must have a minimum of 10 hours experience on type. This can be as pilot in command of the type and may include time accrued during endorsement training and in command under supervision (CAO 82.1).

(c) Class of operation

The flight was an IFR operation. It had been organised on the basis that the passengers and crew would contribute towards the cost. CAR 2 (7A) states that an aircraft that carries persons on a flight, otherwise than in accordance with a fixed schedule between terminals, is employed in a private operation if:

(a) public notice of flight has not been given by any form of public advertisement or announcement; and

(b) the number of persons on the flight, including the operating crew, does not exceed 6; and

(c) no payment is made for the service of the operating crew; and

(d) the persons on the flight, including the operating crew, share equally in the costs of the flight; and

(e) no payment is required for a person on the flight other than a payment under paragraph (d).

Both the pilot and the operator stated that they were not aware of the CAR 2 (7A) 'six person' limitation and that the flight had been arranged on the basis of 'cost sharing'. While all the passengers made a payment, the pilot said he was to pay a larger amount than the passengers.

Under CAR 206 (b) charter purposes include:

> The carriage of passengers for hire or reward to or from any place otherwise than in accordance with fixed schedules.

(d) Decision-making training

Aircrew decision-making training has been a major area of safety research in several countries. Evaluations of such training were conducted in the early to mid-1980s in Canada, the USA and Australia, with sponsorship from the US FAA, Transport Canada, US Air Force (USAF) and the Australian Department of Aviation.

The evaluations indicated that decision-making training could result in significant improvements in pilot decision-making skills. The Australian researchers, after flight-test evaluations of students who had completed a judgement training program, concluded that training recipients regularly outperformed the control group when responding to interferences and hazards initiated by the flight tester (e.g. those affecting the serviceablity of the aircraft, terrain and cloud clearance, and controlled airspace).

However, despite the initial success of this program, the then Australian Department of Aviation (whose regulatory role was subsequently assumed by the CAA) did not support the development of pilot judgement training in Australia.

Following the success of the multinational evaluations, the US FAA sponsored the release of a series of training manuals designed to address the decision-making skills of pilots. Separate manuals were released for student and private pilots, commercial pilots, instrument rated pilots, instructor pilots and helicopter pilots. These manuals were advertised in FAA AC 60-21. The FAA Flight Standard Service also released an advisory circular on Aeronautical Decision-Making (AC 60-22) which dealt extensively with judgement concepts.

The current Day VFR Syllabus—Aeroplanes for student, private and commercial pilots lists 'Human Performance and Limitations' (subsection 11) as part of the syllabus. Within this subsection, part 11.13 titled 'Human Factors Considerations' includes a requirement to know the basic concepts of information processing and decision-making. It lists various factors influencing the decision-making process. However, para. 1.5 'CAA Examinations' states that subsection 11 will not be tested and that the subject is to be covered by the student completing, under supervision, a self-learning text available from the CAA Publications Centre.

The text is to be studied under the supervision of the training organisation's CFI and may be completed at any stage of the pilot's training before the PPL test. The book is titled *Aircraft Human Performance & Limitation* and its contents page divides the topics covered into the various pilot licences, ranging from the student to the commercial licence. There appears to be a contradiction between the Day VFR Syllabus and the study text in that many of the topics covered in the syllabus are included in the CPL part of the text, despite the syllabus stating that all topics should be known before the PPL test. The decision-making section of the book is included in the CPL part.

1.16.2 Operator history/responsibilities

The operator's initial application to the CAA for an AOC was dated 31 May 1993. Following processing of the application an AOC was issued on 24 June 1993. Initially the organisation nominated the same person as the CFI and CP. Prior to becoming involved in setting up the new organisation the CFI/CP had operated for several years as the CFI at another Moorabbin-based organisation. The operator commenced business at Moorabbin Airport on 1 July 1993.

On 27 August 1993 another person was approved as CP for the organisation. This person had spent the previous three years as CP of an RPT organisation operating PA-31-350 aircraft. In that capacity he had been approved to carry out check-and-training, instrument rating renewals, and endorsements on PA-31-350 aircraft. In August 1993 he obtained a grade-3 instructor rating and was given multi-engine aircraft training approval. Since receiving his initial approval to carry out endorsements on the PA-31-350 the CP had carried out 10–15 PA-31 aircraft endorsements. About two thirds of these involved pilots with limited experience. The endorsement training for the pilot of VH-WGI was carried out by the CP.

The company operations manual contained a section on multi-engine endorsement. A note included with this stated:

> The suggested endorsement flight time for experienced multi-engine pilots is 2 hours. This may be varied as required depending on the rate of progress of the individual student.

It also included a section on instrument and night flying endorsement training, which was stated to be optional. The operations manual also indicated that the CP was responsible for

> [t]he implementation of company policy and ensuring that all company air operations are conducted in full compliance with the CAR's and CAO's.

The company maintained a set of flight authorisation sheets providing for the entry of details of company authorised flights. This included the name of the pilot in command, the intended departure and destination details and the signature of acceptance by the pilot. Details for the 17-September flights of VH-PAC and VH-NOS had been entered and signed for. No details had been entered for the accident flight of VH-WGI.

1.16.3 Industry endorsement procedures

In the absence of a clear specification by the CAA as to how long a type endorsement must take, or the detail of what has to be covered, 12 experienced flying instructors were contacted by the investigation team and their opinions obtained. Discussions also covered aircraft configuration and operational aspects during the conduct of instrument approaches and visual circling approaches. The outcomes of these discussions are summarised below.

(a) Experience level and estimates of endorsement time required

The aptitude and experience of pilots attempting endorsements varies. Hence, the time taken to achieve a satisfactory standard also varies. The pilot of VH-WGI was considered inexperienced on multi-engine operations. Moreover, the PA-44 and Partenavia types on which he had accumulated most of his limited twin-engine time were considered relatively simple types to fly. The PA-23, which the pilot had flown for 3.2 hours 18 months previously, was a step up, but would have been less demanding for the inexperienced pilot than the PA-31-350. Also, his flight time on the PA-23 was insufficient to allow him to be considered experienced on the type.

With regard to training and endorsement requirements for particular types of aircraft, most agreed that a person who had a significant background on a comparable type would normally require only a relatively brief period of training prior to endorsement. For the training of an inexperienced multi-engine pilot without a background on comparable types most indicated that 3–5 hours would be needed. (The replies ranged from 2 to 7 hours.) For an IFR-qualified trainee most of the experienced instructors would include instrument flying, which would normally include one or more instrument approaches. For someone who was to perform night operations and did not have significant experience at night on an equivalent type, they would consider including some night training. Only one instructor indicated that he liked to ensure that pilots also received training which involved the aircraft being at or near maximum take-off weight with an aft CG position.

Commercial organisations employing the pilots they have trained normally give them a graduated introduction to operation on the type. A common method for this is ICUS operation. Under this procedure, pilots who have received endorsement training then fly with another pilot until they are assessed as having reached the required standard to safely conduct company operations on their own as pilot in command.

(b) Conduct of DME arrivals

Most of the instructors stated that, when conducting DME arrivals with a circling approach, they would have the first stage of flap extended by the FAF. Some also would have the landing gear extended at this stage and the power set to maintain the desired speed of around 120 kts. This allows the pilot to concentrate his attention on flying the aircraft for a stable, accurate circling approach, with a minimum of variables. Bank angles would normally be limited to 20°, with 30° being the maximum. The general view was that once the pilot had descended to the

OCA, no further descent would be made until interception of the normal landing descent path. If a T-Vasis were available it would be used for glide slope guidance on final approach. There are no recent experience requirements specified for conduct of a DME arrival.

(c) **Circling**

The AIP does not specify how to determine the location and elevation of critical terrain. Some spot heights are shown on IAL charts produced by the CAA, but the text includes a caution: 'Spot heights on IAL charts do not necessarily indicate the highest terrain or obstacle in the immediate area'. At night it is usually impractical to ascertain by visual reference the location and elevation of terrain to maintain the required separation.

Most experienced pilots stated that they used the spot heights published on the approach and landing charts to establish the height of the highest obstacle, and added the required obstacle clearance to establish the OCA for their circling approach. (This procedure is included in a widely used reference published by a private training organisation.) However, some said they would not descend below MDA unless they were familiar with the local terrain. Two said they would not descend below the MDA at night until lined up on final approach. Some considered that the instruction on visual circling allowed the specified terrain clearance, in this case 300 ft, to be applied in a lateral sense in lieu of vertical clearance. Concerning ATC or observer reports on cloud base height, they considered this to be a guide rather than providing precise information. This was due to the difficulty of accurately determining a cloud base and predicting fluctuations.

With regard to the need to be able to see critical terrain as part of the requirement to descend to OCA, some pilots did not consider they had to be able to see the terrain outside the airport boundary. At night for example, they would descend to OCA, even though they could not see the surrounding terrain. A point not clear from the instruction is whether a pilot who has passed the critical obstacle can then in effect calculate a new OCA and descend to the new altitude.

1.17 Pilot procedures

On departure from Moorabbin the pilot engaged the autopilot and left it engaged until he commenced descent into Launceston. This was the pilot's first attempt at a visual circling approach at night in the PA-31-350. The pilot stated that he did not re-trim the aircraft in turns as it meant that he had to re-trim again at the end of the turn. He also said that, on the circling approach, he was concentrating on reducing the airspeed to the landing gear extension speed by late downwind. He did not provide information on the progression of the airspeed during the circling approach. Moreover, he was not closely monitoring his altitude and was unable to give significant information about this.

The pilot said he had been told by the instructor who carried out his instrument rating training that for visual circling approaches it was acceptable to use bank angles up to 45° to be able to keep close in to the runway and keep it in sight. He also said that if the steep bank angle blocked his view of the runway, he would simply put his head down to keep the runway in sight.

1.18 Other aircraft en route Moorabbin–Launceston

VH-PAC departed Moorabbin at about 1630 operating under VFR procedures. The Launceston TAF had indicated that the weather at Launceston would be suitable for a VFR arrival. En route the pilot encountered cloud and climbed above it. At 1718 he obtained the 1700 Launceston Metar from Melbourne FS. This indicated wind from 330° at 8 kts, visibility 10 km or greater, rain showers, 2 octas of stratus 1,000 ft, 6 octas of cumulus cloud at 2,000 ft and heavy showers to the north and east. Following receipt of this report the pilot elected to divert to Flinders Island and remained there overnight.

VH-NOS departed Moorabbin at 1828, some 11 minutes after VH-WGI. This aircraft made an unsuccessful ILS approach at Launceston shortly after the accident. The aircraft had been very high at the start of the approach and probably never achieved acceptable glide slope indications, due to being too high on the approach slope. The pilot was upset by the news of VH-WGI's accident. A second ILS approach was successfully completed and the aircraft landed at 2005.

1.19 Recorded radar data

Launceston is not equipped with radar. On departure from Moorabbin the aircraft was within range of radar sensors used to supply data to Melbourne ATC. A readout of the data showed that after departing Wonthaggi the aircraft deviated left of track for some time. The radar coverage was lost near reporting position Bass (see fig. 9).

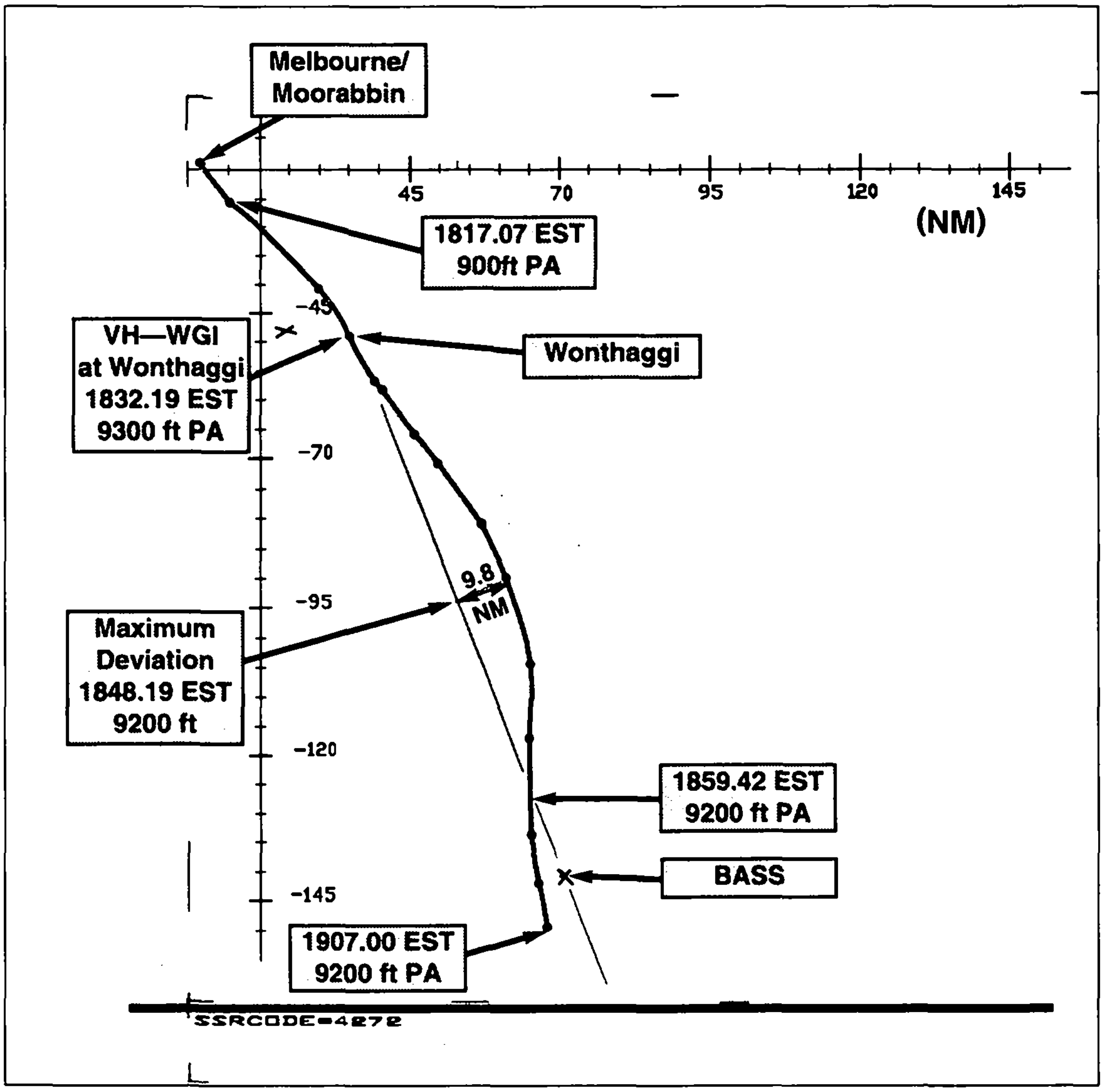

Figure 9 Readout of radar data for VH-WGI, showing the track of the aircraft until it left radar coverage just beyond Bass.

1.20 Visual illusions/vision obstruction

Some pilots operating into Launceston reported that on approach to runway 32 they had experienced an illusion of being higher than they actually were. Others who had operated there for many years said they had not noticed any such effect.

Banking the aircraft steeply may result in the view to the left from the left seat being partly or almost completely blocked by the cabin roof line. Given the same distance from the runway, this becomes more pronounced at lower heights. Also, when the aircraft is at a low height on base leg, the difference between the visual angle from the cockpit to the runway and the angle at ground level is small. Thus, with the limited ability of the eye to detect small changes, the task of the pilot becomes fairly difficult in terms of detecting small changes in altitude. The sensing of small altitude changes is made more difficult if there are limited visual cues available.

1.21 ATS-related matters

Although peripheral to the accident a number of ATS-related issues were identified during the investigation.

The ADC reported that the Airport Emergency Procedures Manual was cumbersome and difficult to read, and that no emergency response quick-reference checklist was available.

The ADC received post-incident stress counselling after the accident. However, he stated that he had not received any pre-incident counselling in his training. It appears that most controllers receive information about emergency situations such as accidents through the passing on of peer group knowledge.

The tower cab overhead lighting system illuminated only the console area. As part of the emergency response, the controller was required to use items situated away from this overhead light source. Such items included the telephone and telephone books. There was a telephone keypad situated on the console. However, controllers suggested that they did not like to use this as it utilises the Ericaphon handset. This handset is normally used for operational communications. Controllers stated that when it is used for the external telephone conversations it can prove distracting and confusing, especially during critical, high-stress situations.

During the power failure air-ground communications ceased. This was due to the loss of both the primary and secondary air-ground communications systems. A tertiary system linked to the SPS was available. The SPS is a battery fed power supply which activates when the normal supply fails. The tertiary communication system is activated manually by the controller physically selecting a switch on his console. It remains on line until power is regained from either the normal supply or the emergency generator. However, the controller must identify that power has been lost and then activate the switch. On this occasion the controller did not select the tertiary system. Even if he had done so, the time spent identifying the problem and then activating the system would have reduced its effectiveness. Communications returned when the emergency generator began supplying power 15 seconds after the main power failure.

The AVR did not record for approximately 15 seconds after the power failed. It was not connected to the SPS and was without power from the time of the aircraft's collision with the powerlines until the emergency generator came on line.

1.22 Tests and research

1.22.1 Flight test

During the investigation an experienced PA-31 pilot/flight operations inspector indicated that PA-31-350 handling characteristics may have been a factor contributing to the accident. To explore this aspect, three test flights were carried out using the services of an experienced test pilot. The test aircraft was a Piper PA-31-350. For purposes of comparison it was flown in both a light and a heavily loaded state. This was done in an attempt to simulate closely both the weight and CG situations during the pilot's endorsement training (light weight forward CG) and at the time of the accident (heavy weight aft CG) flight.

Pertinent results were as follows:

(a) Longitudinal stability was assessed with the aircraft at lighter weights, to simulate the loading at the time of the endorsement training and at the accident weight and CG position. To conduct this test the aircraft was flown with the landing gear and flap up, with speed starting at 170 kts and reducing to 110 kts. The aircraft was trimmed to remove control forces at the start of the run. As the speed reduced, the elevator control forces were held manually and measured using a calibrated spring balance. A similar test was conducted at the accident weight in the circling configuration with the landing gear up, 10° of flap set, and speed reducing from 140 kts to 100 kts

    This test showed that the elevator control forces on the heavy aft CG aircraft were much less than those of the light aircraft. This change was brought about by the CG on the heavy aircraft being much further aft than that on the lightly loaded aircraft.

    The test pilot concluded that with the two CG positions used, considerably more piloting attention was required to control the aircraft in pitch in the cruise and circling configuration with the CG in the aft (accident) position.

(b) A test (at aft CG) was conducted to ascertain the elevator control force and engine power required to maintain altitude in a turn with increasing bank angle. Indicated airspeed was maintained at 120 kts and engine RPM was 2,300. Starting with the elevator loads trimmed out, 22 inches of manifold pressure at zero bank angle, the aircraft was progressively rolled to 45° of bank and the additional elevator control forces held manually. It was necessary to increase MAP to just over 29 inches to maintain speed and altitude at a 45° bank angle. This indicated that if MAP was not increased in a level steep turn the speed could be expected to decrease. The required elevator control force to maintain altitude at 45° of bank was approximately 5.2 kg.

(c) Tests were conducted to assess the aircraft handling qualities at and near the stall in turning flight, at about the accident AUW and CG. This was initially done with wings level, where no unusual handling problems were detected, and then at 30° angle of left bank. Stall warning was found to be adequate. In the wings-level situation, the stall was accompanied by a slight left-wing drop. In turning flight (i.e. 30° bank) the manoeuvring characteristics at the aft (approximate accident) CG position caused the aircraft to 'tuck' into the stall as the maximum angle of attack (near stall situation) was approached. Height loss accompanied the stalls, the extent depending on the stage at which recovery was initiated.

Consideration was given to examining the stall characteristics for 45° and 60° of bank. Because of observed changes in handling characteristics between 0° and 30° angle of bank, the risk of restrained ballast moving, post-stall bank angles exceeding 90°, and the aircraft being overstressed, this manoeuvre was considered unsafe and was not carried out.

1.22.2 Audio tape monitor/analysis

In the recording of the radio transmission from the pilot at 1941.16 in which he reported being over the final approach for runway 32 as he commenced the circling approach, a background sound could be heard. Analysis of this transmission identified this sound as the stall warning horn operating. The flight manual indicated that the stall warning system operated at a speed of 4–9 kts above the stall.

A further sound was heard in the transmission from the pilot at 1941.48. This was identified as the landing gear warning horn operating. This horn is intended to operate when at least one of the throttle levers is retarded to a position of 12 inches of MAP or less with the landing gear up. However, the CP advised that the horn setting was inaccurate and operated at a setting of 17–18 inches of MAP.

Analysis of the recording of transmissions made during the time the pilot was conducting the circling approach revealed, in some transmissions, background sounds indicative of noise activity from the passengers.

1.22.3 Assessment of bank angles at night

At night, the only distinguishing features normally seen by a person viewing an aircraft are the lights displayed. The aircraft was equipped with red and green wing tip and white tail navigation lights, a rotating beacon and strobe lights. The navigation lights were on. The strobe lights were not on. While the rotating beacon probably was on, some witnesses were unsure whether this was so.

With increasing distance it becomes impractical to reliably estimate aircraft bank angles at night. Conversely, provided the aircraft is not too far away and the general position and direction of travel of the aircraft are kept in mind, it is possible to visually estimate the bank angle when at least two of its navigation lights can be seen. Where the aircraft is significantly banked, and its relative position is such that both wing lights can be seen, a reasonable estimate can be made. At the time the aircraft was on late base leg, where it was reported to be at a steep bank angle, the red and green navigation lights could both be seen by witnesses.

1.22.4 Flight path on the circling approach

Information was obtained from the communications transcript and witnesses on the aircraft flight path during the circling approach. A reconstruction flight was also flown at Launceston with some of these witnesses observing. Opinions of witnesses varied on the precise flight path the aircraft followed, hence only a general estimate can be made of its flight path (see fig. 5).

2. ANALYSIS

2.1 Introduction

The investigation established that the aircraft was capable of normal operation at the time of impact. There was no evidence found to indicate that the performance of the pilot in command was affected by any physical condition which may have adversely influenced his ability to carry out his task. An analysis of the events leading to this occurrence indicates that, in addition to active failures involving the pilot and others which contributed to system defences being breached or bypassed, latent failures in the aviation system were also factors in the accident.

2.2 Defences

Complex socio-technical systems, such as the civil aviation system, normally incorporate defences (sometimes called the safety net) which are designed to detect and provide protection from hazards resulting from human or technical failures, and to eliminate or reduce their possible effects. When an accident occurs, an important first step in determining why it occurred is to identify what aspects of the system's defences were absent, had failed, or were circumvented.

2.2.1 Absent defences

Two system defences with the potential to prevent this accident were absent.

Firstly, the aircraft was not fitted with any terrain-alerting equipment, such as a radio altimeter, which might have warned the pilot of his less than adequate terrain clearance at the critical stage of his approach.

Secondly, the pilot had not received any formal decision-making training. Studies conducted in Australia and overseas have clearly shown that substantial accident prevention benefits result from including decision-making training in pilot training programs. Had the pilot of VH-WGI undergone formal decision-making training he would have been better prepared to decide on the most appropriate low-risk course of action in the difficult and unexpected circumstances he faced at Launceston.

2.2.2 Failed defences

Failure of at least two system defences contributed to the accident.

The first defence which failed was the protection provided by the procedures and practices for endorsing pilots on new aircraft types. In the case of this accident, that defence clearly failed to meet its objective of providing a pilot who could operate the PA-31-350 aircraft safely under all circumstances.

The second defence which failed was the protection inherent in an operator effectively supervising the planning and proposed conduct of a flight in one of their aircraft by a pilot with very low experience on that particular type of aircraft.

2.2.3 Circumvented defences

Two main defences that existed to help prevent this type of accident were circumvented.

The first was the protection that is intended in the DAP instructions concerning the conduct of visual circling approaches, especially those relating to descent below MDA. Breaching of this defence was due in part to the pilot circumventing these procedures by not observing some of their provisions. However, another important factor contributing to the breaching of this defence was that the pilot in this accident misinterpreted some of the provisions of the visual circling approach procedures. Had he interpreted them correctly, his choice between a visual or an instrument approach would have been greatly simplified.

The second defence which was circumvented was the requirement, promulgated by the CAA, to establish recency in instrument flying and certain instrument approach procedures before conducting a flight under IFR. No evidence has been found to indicate that the pilot fully met the recency requirements for IFR flight or instrument approaches.

2.3 Active failures

Active failures are unsafe acts which invariably involve the actions of operational personnel. Such failures can be divided into two distinct groups— errors and violations. Errors may be of two basic kinds (James Reason, *Human Error*, 1990) and involve attentional slips or memory lapses, and mistakes. Violations involve deliberate deviations from a regulated practice or prescribed procedure.

2.3.1 Errors

(a) Continuing the circling approach

The pre-disposing active failure in this accident was the pilot's error in deciding to continue a circling approach at night in weather conditions which witnesses indicated were at the least marginal, and probably unsuitable, for a visual approach. The evidence indicates that the pilot, on reaching the MAPT, had decided to conduct a missed approach and proceed to the Nile locator for an ILS approach. However, he subsequently changed that decision after sighting the airfield in marginal weather conditions. If, during his circling approach, he found that he could no longer meet the requirements to continue with such an approach, he had the option of reverting to a missed approach and then conducting an ILS. He did not exercise that option, choosing instead to carry out a low, close-in circuit to maintain visual contact with the runway. He thus circumvented the defence built into the instrument approach procedures.

(b) Conduct of tight descending circuit

The second error involved was a knowledge-based mistake. By choosing to attempt a very tight, descending, circling approach at night, the pilot placed himself in a novel situation for which his training had not prepared him. Evidence from eye witnesses indicated that the approach was started at what appeared to be an unusually high speed, and that engine power sounded unusually high. This would have given the pilot the difficult task of reducing speed while descending to maintain visual conditions, and at the same time configuring the aircraft for landing. Also, in attempting to stay very close-in to the runway, the pilot compounded his difficulty in achieving the desired aircraft performance and a stabilised approach, because he used large angles of bank to maintain his chosen ground track.

The stall warning heard when the pilot reported that he was over the approach end of the runway may have been the effect of a steep bank during the first turn onto the upwind leg. The subsequent landing gear warning horn heard was estimated to have activated late on the upwind leg, indicating that the throttles were at least partially retarded at that time. A power reduction would have caused a pitch-down tendency and added to the difficulty that the inexperienced PA-31 pilot would have had in controlling the aircraft in the pitching plane. It is possible that power was reduced for the purpose of descending clear of the cloud.

Once the pilot had made the mistake of opting for a course of action for which his training had not adequately prepared him (i.e. a tight, descending, close-in circling approach at night) the resulting heavy workload almost certainly led to the final error described below.

(c) Attention failure

The available evidence, unfortunately without confirmation from the surviving pilot, suggests that the final error was a 'slip' (i.e. an attention failure) at a critical stage of the approach, resulting in the nose dropping and the aircraft flying into the ground before the pilot was able to recognise and recover from the situation.

Evidence from several eyewitnesses was consistent in indicating that, late on base leg for runway 32, the aircraft entered a steep bank, probably of the order of 60°, at a height of about 200 ft above the level of the runway threshold, and commenced a rapid descent. This descent continued until the aircraft collided, almost simultaneously, with powerlines and the ground. The impact with the powerlines was of little significance to the accident in that the aircraft would have struck the ground irrespective of whether or not it had contacted the powerlines.

Why the aircraft developed a steep angle of bank could not be positively determined and, after the accident, the pilot could not explain why this happened. However, the aircraft was not aligned with the runway at impact, having overshot the runway centreline. This suggests that the pilot may have increased the bank angle in an attempt to line up with the runway. The reduction in bank angle at impact was consistent with the pilot intentionally reducing the bank angle late in the turn, as the aircraft was being lined up on final approach.

Examination of the evidence indicates two principal ways in which the rapid descent which led to the accident could have developed. These were either a stall during the steeply-banked base turn, or some cockpit action which allowed an inadvertent descent to develop. The in-flight tests conducted for BASI showed a tendency for the aircraft to nose-tuck into the stall while banking (see 1.22.1), and that the nose tuck could be expected to increase the severity of a stall. Also, from a steep bank angle the stall could develop very rapidly and be expected to culminate in a non-survivable accident, resulting from the aircraft impacting at a bank angle beyond the vertical and steeply nose-down. This did not happen. The aircraft descent path was of the order of 15–22°, with the angle of bank at impact being about 28° to the left. Therefore, it is unlikely that a stall was the cause of the rapid height loss.

A second possibility is the inadvertent development of a descent while the pilot was distracted. While the control forces required to hold the steeply banked aircraft at a constant altitude were much lighter for the heavily loaded aft CG situation, back elevator control pressure was still required. If the pilot allowed his attention to be distracted at this critical stage—for example, while selecting the landing gear to down—relaxation of the elevator control pressure would lead to the nose dropping. (There was evidence that the landing gear extension cycle was not fully completed at impact, indicating it had been selected down only a few seconds earlier.) Being under a high workload, the pilot may not have been immediately aware of the nose dropping and of a consequent increase in rate of descent. From a height of about 200 ft, the onset of a rapid descent would have given him very little time to interpret what was happening and to apply timely correction.

Visual cues at night from late on base leg for runway 32, when looking towards the north-east, were virtually non-existent. While the visibility from the pilot's seat is normally very good, steep banking of the aircraft would have restricted the pilot's view to the left, with the extent of the restriction being dependent on the angle of bank. The aircraft entered the steep bank late on base leg and this may have limited the pilot's view of the runway and most of the approach lighting. Instead of having a large visual reference area of lights from which he could reasonably estimate the aircraft's height, the pilot may have seen a smaller, localised group of lights, which would have made height judgement much more difficult. The absence of the larger area of lights as a reference would have deprived the pilot of vital external visual cues at a critical stage of the approach.

During discussions after the accident, the pilot said that if he had lost the view of the runway due to the bank angle, he would have put his head down to be able to see the runway. Such an action, if performed, may have led to a relaxation in elevator control pressure and accentuated any nose-down pitch. The use of a steep bank angle at low altitude is a relatively high-risk manoeuvre. This risk is accentuated at night, especially if visual cues are limited. The degree of difficulty in accurately maintaining altitude, which is achieved by changing the aircraft attitude with the elevator pitch control, increases significantly as the bank angle increases above 30°. It is for this reason that experienced instructors recommend that bank angles on a circling approach be limited to an absolute maximum of 30°.

2.3.2 Violations

The investigation identified two other active failures. These involved the carriage of alcohol-affected passengers, and the undertaking of an IFR flight as pilot in command without having met recency requirements.

(a) Carriage of alcohol-affected passengers

The first active failure in this group concerned both the pilot and the operator accepting the carriage of alcohol-affected passengers. In practice it can be difficult to ascertain whether a person is intoxicated by alcohol, as some individuals mask the effects better than others by their demeanour and behaviour. However, there is considerable evidence to support the conclusion that some of the passengers were alcohol-affected and noisy (see 1.13.2 and 1.22.2). Although the surviving pilot has been unable to confirm its effect, the passengers' behaviour probably contributed to the accident in two ways. Firstly, the noisy activity in the cabin would have acted to distract the pilot's attention. Secondly, some of the passengers had filled bags with urine but may have still been keen to get on the ground for toilet reasons, resulting in the pilot feeling under pressure to land as soon as possible.

(b) Lack of required recent flight experience

The second active failure involved the pilot operating the aircraft on an IFR flight without the required recent flight experience. In addition, he did not meet the recency requirements for ILS, ADF or VOR instrument approaches. Despite being given every opportunity, the pilot has been unable to substantiate his claim of having had recent simulator instrument approach experience. The conclusion therefore drawn by the investigation team was that there was no such experience. The absence of recent practice in instrument approaches appears to have been a factor in the pilot preferring to conduct a visual circling approach.

2.4 Preconditions

Preconditions are task, situational or environmental factors which promoted the occurrence of active failures.

2.4.1 Weather conditions

The evidence clearly indicates that the actual weather that prevailed at Launceston at the time of arrival of VH-WGI was significantly worse than that indicated by the TAF obtained by the pilot. It was not until he was established on the DME arrival procedure that that information was passed to the pilot. This difference in actual versus forecast weather conditions probably contributed to the development of the unsafe acts described above in two principal ways.

The first concerns the errors which culminated in flight into terrain during the circling approach. Once the pilot had arrived at Launceston, the unforecast weather deterioration placed him in a situation of having to contemplate an ILS approach. This was a procedure for which he probably was not adequately prepared, as evidenced by his lack of recent ILS experience. However, when he suddenly broke clear of cloud and sighted the airfield he was presented with an opportunity to revert to his preferred plan of carrying out a visual approach.

During the visual circling approach the weather conditions, particularly the low cloud ceiling, appear to have influenced the pilot to descend below the OCA and to fly his circuit close-in to the runway. This is evidenced by statements from witnesses concerning the aircraft's track and altitude in the circuit area, and the fact that they reported that it flew through patches of cloud during its circling approach. The resulting low, close-in circuit would have led to a high pilot workload and probably affected the pilot's judgement of his base turn, contributing to a situation where he found himself needing to use high angles of bank during a grossly unstabilised approach.

The second consideration is the effect that the forecast of good weather may have had on the planning and dispatch of the flight, and some of the violations associated with it. It is possible that the Launceston forecast indicating conditions suitable for visual flight in the Launceston area may have been a factor in the operator's apparent lack of concern regarding the overloading, the carriage of alcohol-affected passengers, or the pilot's inexperience. However, the investigation could not confirm this.

2.4.2 Visual illusions

Consideration was given to whether a visual illusion might have contributed to the accident, particularly because some pilots had suggested that there was a visual effect from the runway slope which indicated that they should approach below the correct glide slope. Because of the small slope involved, any such illusion on this runway is thought to be small. No evidence was found of any surrounding lights that would have affected the situation. The rapid aircraft descent from late on base leg was an outcome inconsistent with a simple height misjudgment causing the pilot to fly lower than normal. Based on the evidence it is doubtful if this type of illusion had any bearing on the outcome.

2.4.3 Pilot inexperience

The evidence suggests that the pilot's inexperience promoted the occurrence of the active failures involved in this accident in two ways. These were:

(a) Lack of decision making/judgement experience

The decision of the pilot on this flight to persist with a circling approach in conditions of marginal visibility suggests that his decision-making/judgement skills were not well developed. A better decision under the circumstances would have been to continue with the missed approach and then conduct an ILS approach. This course of action would have minimised the risk of initiating the errors involved in the accident.

Pilots with limited total flying experience, such as the pilot on this flight, generally have had little opportunity to develop their decision-making/judgement skills through exposure to difficult decision-making situations in flight. This situation has been recognised by aviation authorities in some countries as being a potential safety hazard which needs to be addressed by the inclusion of specific decision-making/judgement training as part of a human performance and limitations segment of pilot training syllabi. However, the pilot on this flight had not undergone any formal decision-making/judgement training.

(b) Lack of assertiveness

The pilot's total experience, particularly his experience on the PA-31-350, was much less than that of the CP who was present during the pre-departure preparations. Under these circumstances, the pilot probably rationalised that violations, such as overloading or the carriage of alcohol-affected passengers, were acceptable because the CP had not commented on these matters and, with his experience, 'should know'. Had the pilot been more experienced, he may have been less influenced by the presence of the CP and displayed the necessary assertiveness required of a pilot in command. In particular, he may have established better control of the passengers, pre-departure, with the objective of limiting their alcohol consumption. Had he done so, he probably would have avoided the in-flight pressures which may have influenced his decision to try to land the aircraft as quickly as possible.

2.4.4 Instructions or procedures

In conducting the circling approach in the way he did, the pilot was using a common industry interpretation of the DAP instructions on circling approaches to calculate OCA. However, after starting the circling approach, he abandoned the OCA he had calculated. Instead, he descended lower, apparently for the purpose of trying to maintain visual reference with the runway lights. This was despite having no assurance of being able to maintain the necessary visual contact with terrain along his flight path to maintain the required obstacle clearance.

This pilot, and other experienced pilots interviewed during this investigation, demonstrated that the DAP instructions on visual circling approaches were commonly being misinterpreted. If the DAP instructions had been clearer, particularly with regard to better explaining the obstacle clearance provisions, this pilot's understanding of options available to him would probably also have been clearer.

Had this pilot correctly interpreted DAP instructions, his decision task would have been simplified. The only option open to him once he found that he had to descend below MDA to remain below the cloud base, particularly after he began passing through patches of cloud, would have been to initiate a missed approach and position the aircraft for a further instrument approach.

2.4.5 Unfamiliarity with task/high workload

A circling approach at low altitude, at night, in conditions of marginal visibility, is one of the most difficult flying tasks, and requires a high degree of concentration. At night the circuit is flown by reference to external visual cues such as the runway lights and markings identifiable with the approach end of the runway, to confirm that the desired position of the aircraft relative to the runway is being maintained, and by reference to the flight instruments. At the low heights generally involved there is little time to detect and correct any altitude errors before collision with terrain occurs. Particular attention must therefore be given to the altimeter during the instrument scan. Airspeed must also be monitored. Vital actions, such as carrying out checks and lowering the landing gear and flaps, all add to the workload. For an experienced pilot, current on the type, this may not be a major problem. For an inexperienced pilot on what is for him/her a moderately difficult type of aircraft to fly, it probably would be.

With experience on a particular aircraft type, pilots become familiar with its handling characteristics, appropriate configuration for the phase of flight and procedures for the type. This familiarity has the effect of providing the pilot with more time to concentrate on other critical matters such as aircraft orientation, as he/she does not have to be constantly checking and adjusting power settings and aircraft attitude to achieve a desired performance. Experienced pilots also adopt procedural methods to minimise workload during a circling approach, e.g. selecting the landing gear down early (to remove one potentially distracting task from the high workload segment) and using a pre-determined, constant reference speed (to minimise the attention that must be devoted to power and attitude changes).

In the case of the accident flight, the pilot was operating an aircraft of a significantly greater weight and higher performance than those which he normally flew, or in which he had conducted the majority of his limited multi-engine flying. His brief endorsement training on the PA-31-350 did not encompass instrument flying, night flying or low-level circling approaches. Moreover, the pilot had conducted very few circling approaches in any aircraft.

Consequently, he was conducting an approach with which he was not familiar, in an aircraft with which he also had very limited familiarity (i.e. 1.2 hours flight time during his endorsement training, plus the time on this flight). Also, because most of the flight to Launceston was flown with the auto-pilot engaged, he had little opportunity to become familiar with the feel of a heavily loaded aircraft. Therefore, once the pilot began hand-flying the aircraft for the approach, the task would have demanded a high level of concentration and would have resulted in him experiencing a very high workload. This workload could be expected to have increased even further when the pilot encountered conditions which forced him to make rapid decisions and probably to modify the aircraft's flight path from that with which he was familiar in order to maintain visual contact with the runway.

Although ground witness perceptions of aircraft travelling through cloud can be deceptive, the information obtained from witnesses suggested that the aircraft may have entered cloud during the visual approach segment more often than the 2–3 times suggested by the pilot. A difficulty with flying at night, particularly on a dark night, is that cloud generally cannot be seen by the pilot until it is entered. Unexpectedly entering cloud would have caused the pilot concern, further adding to his workload, and probably encouraged him to reduce height and remain close to the runway. The evidence indicated that the pilot descended below the OCA he had calculated. This may have been associated with attempts to remain clear of cloud, consistent with his intention of making a visual approach. The high power and high speed mentioned in witness evidence would have complicated the task.

The above, taken as a whole, develops a picture of a pilot experiencing a very high workload, due mainly to him being unfamiliar with the task of flying a night circling approach, in conditions of marginal visibility, in an aircraft with which he had only limited experience. This almost certainly resulted in him being a long way 'behind' the aircraft and thus greatly increased the probability of his committing the errors that led to the accident.

2.4.6 Time pressures

Analysis of the evidence does not identify any operational reasons for the pilot to feel under pressure to land the aircraft as quickly as possible. The fuel remaining in the aircraft on arrival at Launceston should have allowed at least another 65 minutes flying or more, depending on the power settings adopted. This gave the pilot the options of holding and/or conducting an ILS approach. When interviewed after the accident, the pilot indicated that he had not been concerned about the weather deterioration at Launceston as he was confident that at worst he would have been able to land off an ILS approach, and that he had adequate fuel for this.

Nevertheless, some of the evidence indicates that the pilot may have felt under pressure to land the aircraft with a minimum of delay. Flying an ILS approach should have been a relatively straightforward task. It would, however, have added several minutes to the flying time, and increased the aircraft hire cost. Also, the pilot indicated that he had been concerned about the diversion of VH-PAC to Flinders Island and had considered the possibility of picking up the stranded passengers after he had deplaned his passengers at Launceston. Moreover, he was aware that some of his passengers had filled bags with urine. Because of this and passenger noise, he may have wanted to terminate the flight with minimum delay.

These issues probably intruded upon the pilot's mental processes and may have influenced his decision to initiate and continue with the circling approach.

2.5 Organisational factors

Organisational factors are weaknesses or inadequacies within organisations which are not apparent, and can remain dormant for extended periods. These latent failures become apparent when combined with active failures, resulting in a breakdown of safety.

2.5.1 Training

(a) Inadequate endorsement training standards

That the pilot's training did not adequately prepare him for the situation in which he found himself at Launceston is apparent from the evidence pertaining to his decision to conduct a circling approach and the way in which he attempted unsuccessfully to complete that approach.

The instructor who conducted the endorsement training stated that he had been satisfied with the pilot's level of competency. The endorsement would have given the pilot a basic knowledge and feel of the aircraft for handling at lighter weights on visual daylight flights. However, the pilot did not have any depth of experience on this or similar types. Instrument flying with circling approaches and night flying, as part of the endorsement, would have enhanced his skills. Also, his overall competence might better have been developed by a graduated introduction to more complex flying tasks on the type.

A method used by RPT and charter operators, where further experience on type is mandated, is to give pilots exposure to that type by flying ICUS. This often includes instrument flying and instrument approaches. However, this is not always a practicable approach as the cost of aircraft operation is high, and suitable commercial tasks that could be used to minimise costs are not often available in sufficient numbers. As an alternative, the pilot could be given further solo local area experience and/or a short VFR travel flight(s) before the operator allowed him to progress to more difficult and/or complex single-pilot IFR day or night flights.

Adding to operators' problems in determining the amount and type of endorsement training that should be provided, are the minimal standards for a type endorsement in this class of aircraft that have been set by the CAA. This creates an environment where operators, who are in a situation of competing for endorsement work, may be tempted to shorten training times in order to offer the most competitive rates to obtain the work. This is potentially incompatible with the goal of ensuring that the minimum safety standards are met.

The available evidence indicates that in this case, the operator had complied with the substance of the CAA's current standards and regulations on endorsement training by satisfying himself that the pilot could 'safely fly that type of aeroplane'. However, there was no requirement for him to check specifically that, for example, the pilot could safely conduct an ILS or a circling approach at night while flying this aircraft which was significantly heavier and of higher performance than those with which he was more familiar.

In the event, the present standards having been met did not ensure that the pilot on the accident aircraft could safely operate the aircraft in the conditions that prevailed at Launceston. This indicates that an organisational factor, which probably contributed to the accident, was the lack of adequate CAA endorsement training standards.

(b) Decision making/judgement training

Some poor decisions were made during the preparation and conduct of the flight. Examples already discussed include the pilot agreeing to carry alcohol-affected passengers, and his poor decision-making related to initiating and persisting with a visual circling approach in marginal weather conditions. As already indicated, these poor decisions probably stemmed largely from the pilot's inexperience.

Formal studies conducted overseas and in Australia (by the University of Newcastle, in conjunction with the CAA) have proven that decision-making/judgement training is beneficial in improving the ability of inexperienced pilots to make good decisions when placed in difficult situations. For example, one of the world's largest offshore helicopter operators has experienced a marked reduction in its accident rate after having introduced a decision-making/judgement training program for its pilots.

Consequently, there is little doubt that, had this pilot undergone a well-structured and assessed decision-making/judgement training program, he would have been more likely to have made decisions which would have reduced the likelihood of the errors that led to this accident.

Although CAA training syllabi have included a requirement for pilots to know the basic concepts of information processing and decision-making, there is presently no requirement to test the knowledge and understanding of individual pilots. Therefore, even if the pilot had reportedly met the syllabus requirement for this type of training (which he had not, despite holding a commercial pilot's licence), the present arrangements would be unable to provide any measure of whether he had properly assimilated that training.

In summary, a comprehensive, well structured and assessed decision-making/judgement training program probably would have given the accident flight pilot the knowledge and understanding he needed to make decisions that may have prevented the accident. Such programs exist elsewhere. The lack of an adequate decision-making/judgement training standard promulgated by the CAA is therefore seen as an organisational factor which contributed to this accident.

2.5.2 Instructions or procedures

Evidence gained during this investigation on industry interpretation of DAP instructions on circling approaches correlated well with similar evidence obtained during the investigation into the accident to Monarch Airlines PA-31-350, VH-NDU. Both investigations confirmed that there have been varying interpretations of the meaning of CAA instructions on visual circling approaches (see 1.16.3).

The misinterpretations most prevalent, which were factors in this accident, concern when descent below MDA is permitted, and what procedures should be followed to ensure obstacle clearance along the flight path.

In its response to a BASI recommendation on circling approaches, the CAA stated:

> If the pilot cannot see the obstacles because it is dark and he does not have a detailed knowledge of all relevant obstacles, then he may not descend below MDA until he is certain there are no obstacles in or below his flight path.

However, at time of writing, no changes have yet been made to remove any ambiguity from the DAP instructions on circling approaches and further evidence has come to light of differences of opinion on their meaning within the CAA.

In summary, the factual evidence gathered on this investigation supports the conclusion that poorly worded DAP instructions were an organisational factor contributing to this accident in that they are capable of being misinterpreted, either deliberately or accidentally. As a consequence, they are not providing the system defence that is intended by their promulgation.

2.5.3 Safety regulation

Previous analysis has indicated that the pilot's inexperience was a factor leading to this accident, as was his unfamiliarity with a demanding task in an aircraft of the performance and weight of the PA-31-350. Although the aircraft was a significant step up from that of the types he normally flew, it is treated, for purposes of endorsement, in the same way as other twin piston-engined aircraft in the category of below 5,700 kg maximum AUW. There are other similar 'advanced types' in this same category.

The PA-31-350 is not a type commonly used for private hire. It has predominantly been utilised for charter and RPT operations. For charter and RPT operations the CAA specified minimum experience levels for pilots to act in command, but not where the aircraft is used privately. Consequently, had the pilot been conducting a charter flight in the same aircraft, he would have had to meet a minimum requirement for experience on type.

As this aircraft is a type capable of carrying a relatively large number of passengers, there appears to be an inconsistency in having a minimum experience on type requirement for some classes of operation but not others. Given that the pilot's inexperience on type was a factor contributing to this accident, such an inadequacy in regulation is seen as being a CAA organisational factor which had a bearing on the accident.

2.5.4 Control and monitoring by operator

Three pieces of evidence support the conclusion that inadequate control and monitoring by the operator was an organisational factor in this accident.

Firstly, because of his presence during the afternoon and at the aircraft pre-departure, the CP was aware of the details of the flight and assisted the pilot with the loading of the alcohol-affected passengers. From his extensive experience on PA-31-350 aircraft, the CP would have had a very good idea of the potential for overloading on departure with ten persons on board, and with full main fuel tanks. Yet the aircraft departed in an overloaded condition.

Secondly, the operator had a responsibility to ensure the operation was conducted in accordance with the appropriate safety standards and regulations. This responsibility was not met in regard to the operator allowing the flight to proceed on a cost sharing basis, with ten persons on board versus the six that regulations allow. When questioned after the accident, the operator was unaware that the regulation limited cost-sharing operations to a maximum of six persons on board.

Thirdly, closer checking by the operator would have revealed that the pilot had insufficient recent instrument flying and type experience and did not have any recent instrument approach practice. However, the operator dispatched the pilot on the accident flight without ensuring compliance with such important details.

In summary, the safety net of having the CP well acquainted with the general details of the proposed operation, and present at the time of departure, did not work. Possibly, in part, this was because he was focusing his attention on assisting the pilot to depart. Had he adequately checked, considered and resolved the recency aspects and also fully considered the potentially distracting effects of the alcohol-affected passengers, he might well have reached a decision to stop the flight.

Thus, inadequacies in the organisational factor of control and monitoring by the operator resulted in the failure of one of the defences which may have prevented the accident. The defence which failed was that of effective supervision and checking by the operator.

2.6 Other matters

2.6.1 Emergency services response

There was only one person on duty in the control tower and the emergency telephone line did not provide a single contact line to all emergency services simultaneously. For those not connected there was scope for delays in the call-out of emergency personnel.

The initial response by the CAA fire service was prompt and effective. Because the accident scene was off the airport, a short delay occurred while the exact location and suitable access to the scene was determined. The crew extinguished the fire as expeditiously as could reasonably be expected. There is no evidence to suggest that any quicker response by any of the emergency services would have changed the outcome in any way.

2.6.2 Survival

In the initial impact sequence the aircraft struck the ground left wing tip first. It then rotated right onto the nose and right engine. The ground contact by the right engine appears to have abruptly stopped the rotation around the nose to the right and this in turn probably resulted in the persons in the right-side seats being thrown against the right side of the aircraft. A possible consequence of this was that they were stunned in the initial impact and were unable to escape before being overcome by the very intense fire in the cabin area.

None of the occupants received fatal injuries in the impact sequence, and if fire had not broken out all would have survived. Five of the six fatally injured passengers were found with their seat belt buckle still fastened. It appeared that the sixth passenger had moved from his seat after the impact sequence, but was unable to escape before being overcome. Five of the six fatally injured persons were seated on the right side. The fatally injured person on the left side received chest injuries which may have disabled him.

The four survivors escaped from the wreckage largely without help. During the impact the right window exit detached. The pilot and one passenger evacuated through this opening. The other two passengers evacuated via the main door. One of the locks on this door had been broken. It was not possible to say with certainty whether this was due to deformation of the fuselage during the impact sequence or if the lock was forced during the evacuation. People living nearby or passing the scene came to try and help. They were able to do little other than assist those who were already partially or fully out of the aircraft.

The effects of alcohol vary with individual tolerance, habituation and addiction to alcohol. Hence it is difficult to make specific statements on the effects on each individual. However, broad generalisations may be made. Alcohol exerts a depressant effect on the brain. At below 0.05% mental changes with varying degrees of disinhibition and minor incoordination of muscle movements may be evident. As the alcohol level rises there is a gradual loss of manual dexterity, a slowing of reaction time and impairment of alertness and judgement. Visual perception is affected by narrowing of visual fields and difficulty in focusing. Some deterioration in physical and mental ability would be evident at levels above 0.150%. In summary, the alcohol levels of at least some of the passengers were such that they could have had a detrimental effect on the passengers' ability to escape from the wreckage.

3. CONCLUSIONS

3.1 Findings

1. The aircraft was hired from the flying school at which the pilot was employed as an instructor.
2. The pilot held a commercial pilot licence with a multi-engine command instrument rating, and had received a Piper PA-31 type endorsement on 16 September 1993.
3. The pilot's PA-31-350 endorsement training was carried out by the CP of the flying school.
4. To meet the recent experience requirement for carrying out an ILS approach, the pilot was required to have made an actual or simulated ILS approach within the preceding 35 days. There was no record in the pilot's logbook of any ILS approach within the 35 days before the accident. His logbook did not contain evidence of any instrument approaches in the preceding 90 days. The pilot also did not have the required recent experience to conduct an IFR flight.
5. There was no evidence of any medical or other problem affecting the pilot's performance. He was required to wear glasses and did so.
6. There was no evidence that any aircraft mechanical malfunction existed that might have contributed to the accident.
7. At takeoff the aircraft weight exceeded the maximum permissible take-off weight specified in the aircraft flight manual.
8. At the time of the accident the aircraft weight had been reduced by fuel burn-off to less than the maximum landing weight. The position of the centre of gravity was within limits.
9. The aircraft carried sufficient fuel for the flight.
10. The TAF obtained for the flight was inaccurate.
11. The pilot was inexperienced on the PA-31-350 type. Prior to commencing the flight he did not have any instrument flight, IFR approach, or low-level circling approach experience on that type of aircraft.
12. The flight did not meet the requirements for operation as a private flight.
13. The pilot did not have the required experience level on type to conduct a charter flight.
14. Despite flying through cloud below the MDA during the visual circling approach, a missed approach was not carried out in accordance with the provisions of AIP/DAP-IAL.
15. The pilot descended below the OCA during the circling approach.
16. Late on the circling approach a rapid descent developed which culminated in the aircraft colliding with powerlines and the ground.
17. The CAA Common Crash Call facility was not connected to all relevant emergency services.
18. The CAA Airport Fire Service responded in a prompt and efficient manner to the emergency. The necessary time taken for the fire vehicles and other services to reach the scene did not affect the survivability of the occupants.

19. Organisational factors identified in relation to the CAA included:

- the absence of adequate specific requirements for type endorsement training, and for such training to also include instrument and night-flying requirements;
- the lack of an adequate requirement for comprehensive and assessable decision-making/ judgement training in pilot training programs;
- inadequate AIP/DAP-IAL instructions concerning circling approaches (reflected in varying industry interpretations of the instructions, including differences in post-accident advice from the CAA on what the interpretations should be); and
- the absence of requirements for a minimum pilot experience level on the PA-31-350 type before acting in command on a private IFR flight.

20. An organisational factor identified in relation to the operator was the inadequate control and monitoring of the planning and proposed conduct of the flight by the CP.

21. The ATC on duty acted in a sound and competent manner, both during the events leading up to and subsequent to the accident.

3.2 Significant factors

1. The actual weather at Launceston at the time of arrival of VH-WGI was significantly worse than forecast.
2. The pilot did not have the required recent experience to conduct either an IFR flight or an ILS approach. The operator's procedures did not detect this deficiency.
3. The pilot's inexperience and limited endorsement training did not adequately prepare him for IFR flight in the conditions encountered.
4. The CAA did not specify adequate endorsement training or minimum endorsement time requirements for aircraft of the class of the PA-31-350, particularly in regard to the endorsement of inexperienced pilots.
5. An absence of significant decision-making training requirements contributed to the poor decision-making action by the pilot who decided to continue with a visual circling approach at Launceston in conditions that were unsuitable for such an approach.
6. As a consequence of continuing the approach, the pilot subjected himself to an overwhelming workload. This was due to a combination of adverse weather conditions, his lack of training and experience in IFR approach procedures on the type, and a misinterpretation of (or non-compliance with) the AIP/DAP-IAL instructions, a combination which appears to have influenced the pilot to fly a close-in, descending circuit at low altitude. The carriage of alcohol-affected passengers may have also added to the level of difficulty.
7. Because of workload, and possibly also due to distractions, the pilot inadvertently allowed the aircraft to enter a rapid descent at a critical stage of the approach, at an altitude from which recovery could not be effected.

4. SAFETY ACTIONS

4.1 Interim recommendations

During the course of this investigation a number of interim recommendations were made. The IR documents included a 'Summary of Deficiency' section in addition to the actual interim recommendation. The unedited text of the interim recommendations is detailed below, with each IR commencing with its BASI reference number. The pertinent comments from the CAA in response to the recommendations are also reproduced as received by the Bureau.

IR930231 **The Bureau of Air Safety Investigation recommends that the Civil Aviation Authority review:**

(a) the adequacy of instructions to flight crew for maintaining a safe height above terrain at night.

(b) the phraseology used in AIP/DAPS IAL-2, 1.5 with a view to making it less susceptible to misinterpretation.

BASI note
This interim recommendation was made as a result of this investigation and the investigation of an accident at Young in June 1993; therefore, IR930231 and the CAA response also appear in that accident report.

CAA response

The Interim Recommendations of IR930231 question the phraseology of AIP DAPS IAL 1.5 and the adequacy of instructions to flight crew relating to the visual segment of an instrument approach procedure at night.

The Authority does not agree with the recommendation. Similar concerns were answered recently in response to CAIR Report FYI 930297 regarding circling approaches at night.

The basis of both the CAIR and IR 930231 is the differing opinions of pilot's on the circumstances in which descent below minimum descent altitude (MDA) may be initiated. That some of these pilot's were ignorant of, or misunderstood the procedure, does not necessarily mean that the procedure is poorly documented. What it does mean is that some pilot's do not know the procedure and that annual instrument rating tests have not, by way of the mandatory pre-flight examination, highlighted this lack of knowledge. This is despite the fact that item 11 of the Instrument Rating Test requires the candidate to "Know the rules governing descent below approach minimum altitude".

There are only two sets of procedures which govern the way an aircraft may be flown - instrument and visual. On all published instrument approach procedures there is a published altitude below which an aircraft may not descend when being flown in accordance with instrument procedures. To descend further the pilot must continue the flight using visual procedures. These procedures are clearly spelt out in DAPS IAL paragraphs 1.5.

The text of IAL 1.5 is based on the ICAO publication Document 8168, Procedures - Aircraft Operations (PANS OPS). This procedure requires the pilot to remain in the circling area and to maintain visual reference (i.e. remain clear of cloud and in sight of the ground or water) when descending below MDA. The term "visual reference" is further amplified. It requires the pilot to keep the approach threshold lights or other markings identifiable with the approach end of the runway visual during this visual part of the flight. This advice is of particular relevance to night operations.

The final requirement is that the pilot is to maintain an obstacle clearance of at least 300 feet or more depending on the category of aircraft. If the pilot cannot see the obstacles because it is dark and he does not have a detailed knowledge of all relevant obstacles, then he may not descend below MDA until he is certain there are no obstacles in or below his flight path. This is most likely to occur only when he is lined up with the runway and able to rely on the required obstacle clearance for a runway approach.

In the Young accident the aircraft struck an obstacle 275 feet above the elevation of the aerodrome. If the final report confirms that the aircraft was in controlled flight at the time of impact, and that there were no flight instrument malfunctions it would be reasonable to assume that the pilot deliberately descended 870 feet below the MDA without visual reference. It is difficult to accept that this was merely the result of a misunderstanding of the terrain protection afforded by the procedure, and not a flagrant disregard of the published minima. As to the suggestion that pilot's may have been relying on IAL chart spot heights for terrain clearance despite the warning in DAP 1.1, it is relevant to point out that on the Young NDB chart, south-east of the aerodrome, numerous spot heights are depicted which are higher than the impact point. Documented obstacle height may not be used as a reference for descent below MDA unless specifically approved by the Authority. The requirement to maintain 300 feet obstacle clearance can only be met using visual reference. The pilot must be able to see where his aircraft is going to ensure that it avoids all obstacles, lit or unlit until on final approach.

The Authority believes that the requirements for descent below MDA specified in AIP DAPS IAL 1.5 are clearly enunciated and notes that it is more comprehensive than the guidance provided in ICAO documentation or by either the UK or USA. The Authority will be monitoring more closely the conduct of Instrument Rating Tests and renewals to ensure that where incorrect training is occurring that it is corrected. The subject will also be covered by an educational article in Aviation Bulletin.

Response status: OPEN

Further BASI correspondence to the CAA stated:

'The Bureau believes that the DAPS IAL 1.5 "Note 1" does not adequately describe where visual reference must be maintained. To achieve the required obstacle clearance along the flight path it would follow that visual reference must be maintained along that path. Note 1 specifies that "visual reference" means in sight of ground or water, however it does not specify where this ground or water is to be. The Bureau believes that visual reference to ground or water directly along the aircraft's flight path must be maintained and recommends that Note 1 be expanded to state that "visual reference" means clear of cloud, in sight of ground or water *along the flight path* and with a flight visibility not less than the minimum specified for circling'.

The CAA response in part stated:

There is no objection to the addition of the words " along the flight path" to note 1 as you suggest, and this will be done as part of the next AIP amendment.

Response status: CLOSED – ACCEPTED

IR930292 The Bureau of Air Safety Investigation recommends that the Civil Aviation Authority review its procedures with respect to information contained in ATC/emergency service communications. This review should emphasise that discretion should be used when broadcasting sensitive and disturbing information which could be heard by flight crew.

CAA response

This is to advise that we have reviewed our procedures with respect to information contained in ATC/emergency service communications.

As a result of previous recommendations we have amended our documents stating that the "appropriate ground control frequency should normally be used for communication between a pilot and the RFFS vehicles".

The incident that generated this recommendation occurred at a single-person facility. In this case, and indeed in all other situations, I feel that the concept of having a separate frequency for emergency services would exacerbate the situation. It is generally undesirable for controllers to handle more than one frequency (without re-transmission) during busy periods or times of added stress.

In conclusion, in the light of the seemingly unusual circumstances associated with this incident, I do not believe that procedures need to be changed, nor additional facilities be provided.

Response status: CLOSED – NOT ACCEPTED

IR930313 The Bureau of Air Safety Investigation recommends that the Civil Aviation Authority review;

a) the Common Crash Call System with a view to ensuring that the activation of the call accesses all agencies identified as necessary for an emergency response.

b) the operational communication systems to ensure that continuous air/ground communications are available automatically in the event of a mains power supply failure.

c) the AVR power supply system with a view to ensuring that continuous voice recording is available in the event of a mains power supply failure.

CAA response

The BASI interim recommendations have been reviewed and the following action has been taken:

1. *The Common Crash Call function has been removed and a dedicated phone line has been installed between Launceston Tower and Tasmania Police Northern District. Effective from Monday 31 January emergency procedures have changed, and in the event of a need for Launceston city emergency services to be notified, the tower will contact the Police. The police are responsible for notifying the Launceston Fire Brigade, hospital and ambulance service. The new system is similar to the emergency procedures in operation at Hobart Airport with Tasmania Police and at Melbourne Airports with Victoria Police.*

2. *The failure to connect the Automatic Voice Recorder to standby power was an oversight which resulted when the recorders were moved from the Launceston Terminal building a couple of years ago. The AVR power supply was modified immediately after the crash when it was apparent the system had failed and is now connected to the tower equipment room SPS, which is a battery backup system which through an inverter converts 72V DC to 240V AC, and results in a no break supply to the AVR.*

3. *The present procedure whereby the tertiary system can be brought on line by the tower controllers is considered to provide an operationally acceptable means of maintaining communications. Tower controllers have been reminded of the need to select the airport based tertiary system in the event of an emergency situation coinciding with a power failure which may cause microwave link failures.*

Response status: CLOSED – ACCEPTED

IR940017 **The Bureau of Air Safety Investigation recommends that the Civil Aviation Authority review the requirements for issue of type endorsement as specified in CAO 40.1.0. This review should be conducted to ensure that:**

(1) a minimum syllabus is specified for an initial multi-engine rating and for endorsements on multi-engine aircraft below 5700 kg MTOW of a higher Performance Category. The syllabus should include:

(a) General Handling, including stalling;

(b) Takeoff, circuit and landing;

(c) Instrument flying, including an instrument and circling approach;

(d) Asymmetric flight;

(e) Night flying.

(2) the Performance Category of each aircraft type is clearly defined in CAO 40.1.0, appendix I.

CAA response

The Authority agrees with the recommendations and has proceeded to implement them.

A comprehensive multi-engine aeroplane training syllabus has been drafted and has received comment from experts both from industry and from within the Authority. The syllabus has been designed to cater particularly for the pilot who is converting for the first time to a multi-engine craft. It also calls up training at night and under the IFR if applicable, and addresses training in gas turbine powered craft and multi-crew operations. I expect that it will be in print as the official CAA syllabus by year's end, though its use will not be mandatory until the relevant amendments to legislation have been approved.

Accordingly, a proposal has been raised to amend CAO 40.1.0 such that training and experience for initial and follow-on multi-engine endorsements will have to be completed in accordance with a new set of requirements. These would include training to be completed in accordance with the syllabus, dual flight time requirements to depend on the aeroplane performance category and possible additional training in gas turbine powered, pressurised aircraft. Comment is currently being sought from Authority technical specialists on this proposal, but gauging from initial reactions I feel there is strong support for the change.

Though I would hope that the review and subsequent amendment action will be complete by March 1995, I must caution that there are a considerable number of high priority tasks awaiting legislative drafting. As a result, this task may slip depending on the progression of tasks ahead of it on the task list.

Nevertheless, the syllabus production will go ahead and its existence will be widely publicised. Training organisations will be encouraged to use it to ensure standardised and hopefully high quality training.

Response status: CLOSED – ACCEPTED

4.2 Final Recommendations

With the conclusion of the investigation into this occurrence, the following final recommendation is made:

R940209 **The Bureau of Air Safety Investigation recommends that the Civil Aviation Authority review the "Day VFR Syllabus" to ensure that the study of "Human Performance and Limitations" is formalised to encompass a structured assessment process in line with other subjects covered by the syllabus.**

4.3 Safety Advisory Notice

The following Safety Advisory Notice was issued:

SAN940007 **The Bureau of Air Safety Investigation suggests that the Civil Aviation Authority review:**

a) The Airport Emergency Procedures Manuals and assess the need for a Quick Reference Checklist to be used in conjunction with the Manual.

b) The controller emergency response training and counselling procedures and assess the need for including pre-incident stress information in training regimes.

c) The Tower Cab equipment locations, with a view to ensuring that all equipment identified as critical to emergency response action is:
– situated within reach of the controller's position;
– in a well lit area.

This is particularly important for control towers where single controller shifts are rostered.

CAA response

This is to advise the CAA's response to the above Safety Advisory Notice:

a) The Airport Emergency Plan for Launceston is a matter for the Federal Airports Corporation (FAC). An AIP SUPP (H1/94) and various other aviation related publications, deals with a new standardised format for such plans. It is the intention of the FAC to introduce the new plans throughout 1994. In the meantime, and following an ATS Quality Assurance visit in October 1993, a recommendation was made that a "Quick Reference Checklist" be made for Launceston. Such a list for the "crash' situation has been introduced. This checklist is readily available to the controller and provides concise, easily understood guidance pertaining to critical occurrence response in relation to a crash.

b) Tower Air Traffic controllers are trained, as part of on the-job training, in Aerodrome Emergency Procedures. This training is by nature generally of a read, discuss and understand basis, occasionally supplemented by airport-owner organised emergency exercises.

Counselling processes include staff counsellor services, external counselling services, and CISD counselling where local reactions identify the requirement.

In this event, local support was provided within an hour by the local association representative and shortly after by the local manager. The acting AGM (normal role is Human Resources Manager) flew to Launceston the next day and arranged for counselling services with local staff. The controller involved chose initially to use his family doctor and eventually accepted some counselling from the offered services.

The suggested "pre accident stress information" as part of an ATC training course has been referred to the ATS AGM Human Resources for further investigation. He will be requesting an expanded explanation of the suggestion from BASI.

c) *Equipment identified as critical to emergency response action in the "Summary of Deficiency" can be taken as telephone and "telephone books" (presumably AEP documents).*

Specifically in the Launceston Tower case, which is equipped to be a single person tower operation:

- *the Erichaphon handset and keyboard pad in the console, which enables PABX and external telephone access, is deliberately designed to facilitate single person operation, and enables use of air ground communication, intercom, and telephone services through a single hand piece. Rather than distracting, it is expected that with one hand piece the controller can regulate all calls. BASI comments are noted and an extension cord will be provided for a PABX extension which can be used at the console.*
- *the AEP Manual is kept in a specially designed holder under the front of the work surface.*
- *night lighting in the Tower is specifically designed to ensure controller night vision is not impaired, to maximise the potential to observe events outside the Tower. Alternative light sources are available for all work areas using standard switches.*

In conclusion it needs to be said that the incident that lead to these "Deficiencies" was handled by the controller on duty both professionally and capably. He handled a situation which was highly stressful with Aerodrome Emergency Procedures in operation, a power failure, a number of other inbound aircraft, and more-than-forecast low cloud requiring ILS approaches by subsequent aircraft.

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