SENATE REFERNCES COMMITTEE ON
RURAL AND REGIONAL AFFAIRS & TRANSPORT

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Inquiry into the Aviation Accident Investigation (Pel-Air)

CANBERRA, ACT – MONDAY, 22 OCTOBER 2012

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Australian Government

Civil Aviation Safety Authority

Regulatory Policy – CEO-PN001-2004

CASA's Industry Sector Priorities and Classification of Civil Aviation Activities

Sponsor:	Director of Aviation Safety
Policy Issue No:	Three
Policy Issue Date:	April 2009
Policy Review Date:	October 2010
Regulatory Provision:	All CASR Parts, Civil Aviation Regulations and subordinate instruments

1. Reason for the Policy

1.1 The main object of the *Civil Aviation Act 1988* is to establish a regulatory framework for maintaining, enhancing and promoting the safety of civil aviation, with particular emphasis on preventing aviation accidents and incidents [see section 3A of the Civil Aviation Act].

1.2 To that end, CASA's primary function under the Civil Aviation Act is to conduct the safety regulation of civil air operations in Australian territory and the operation of Australian aircraft outside Australian territory [see subsection 9(1) of the Civil Aviation Act]. In performing its functions and exercising its powers, CASA must recognise the safety of air navigation as the most important consideration [see subsection 9A(1) of the Civil Aviation Act].

1.3 Consistent with these obligations, it is necessary and appropriate for CASA to prioritise its activities with a view to ensuring that its resources and regulatory efforts are allocated in a rational, effective and efficient manner, having regard to the management of real and significant risks to safety.

1.4 This policy document is based on the recognition that these principles are optimally supported by focusing on the safety of members of the public who travel by air. Further to that recognition, this document sets out CASA's policy on classifying aviation activities conducted by civil aircraft in Australian territory and by Australian aircraft outside Australian territory, based on aircraft use and who or what is carried in the aircraft, and with a view to providing a risk-based framework for establishing safety rules under the Civil Aviation Act.

1.5 This policy is a departure from the classification of operations scheme currently specified in subregulations 2(6) and 2(7), and regulation 206 of the *Civil Aviation Regulations 1988*, and lays the foundation for the regulatory reclassification of civil air operations that will be specified in Part 119 of the *Civil Aviation Safety Regulations 1998*.

1.6 Although there are a number of other factors that may need to be considered, this policy reflects CASA's view that the level of safety oversight applied should properly depend largely on the categorisation of occupants carried in the aircraft. On that basis, this policy document also sets out the reasons why CASA may apply different levels of safety oversight to different kinds of activities.

2. Policy

For the purposes of this policy, aircraft occupants are categorised as follows:

a. *Passengers* are occupants who are not expected or assumed to have knowledge of the safety risks to which they are exposed, and who have little or no control over those risks (other than choosing not to fly);

b. *Task specialists* are occupants who have assigned in-flight duties related to a specialised use of the aircraft, and are informed of, understand and accept the associated safety risks;

c. *Participants* are occupants who voluntarily engage in an aviation activity and accept, on an informed basis, the risks of their involvement in that activity; and

d. *Crew* are occupants who have assigned in-flight duties related to the safe operation of the aircraft during flight time.

2.1 Primary Factors Determining a Hierarchy of Priorities

2.1.1 In establishing a risk-based hierarchy of priorities, CASA will, in the first instance, have regard to the degree of risk to members of the public. This in turn will be based on factors that include:

a. Extent of control of risk by aircraft occupants;

b. Safety expectations (public perception/concern) and acceptance of risk;

c. Potential for multiple fatalities;

d. Aircraft occupant characteristics; and

e. The potential effect on other airspace users and people and property on the ground.

2.1.2 In identifying and addressing risk, CASA's prime tool is based on AS/NZS 4360:2004 – the Australia/New Zealand standard for risk management. It is expected that this standard will eventually form a large portion of an international standard for risk management, to be published as ISO 31000.

2.2 Initial Hierarchy of Priorities

2.2.1 Subject to the considerations discussed in paragraph 2.2.3 below, CASA will allocate its resources in line with the following hierarchy of aviation activities:

1st Priority: Aviation activities involving passengers	Regulatory oversight of activities involving large aircraft carrying *passengers*. Regulatory oversight of activities involving small aircraft carrying *passengers*.
2nd Priority: Aviation activities involving task specialists	Regulatory oversight of activities involving the carriage of *task specialists* and *participants*. Regulatory oversight of activities involving the carriage of *task specialists* without *participants*.
3rd Priority: Aviation activities involving participants	Regulatory oversight of organisations that administer activities involving *participants*. Regulatory oversight of activities involving *participants* that are available to the public. Regulatory oversight of activities involving *participants* that are not available to the public.
4th Priority: Aviation activities involving crew only	Protection of persons and property on the ground and other airspace users through regulatory oversight of: • cargo-only flights; • other crew-only flights; and • unmanned aerial vehicles.

2.2.2 In dealing with infrastructure and support activities subject to regulation by CASA (e.g. maintenance organisations, aerodromes, airspace issues, etc.), resource allocation priorities will normally be determined by the proportion of their functions servicing these various types of activities. For example, a maintenance organisation that primarily services large passenger-carrying aircraft would generally be assigned a higher priority than one that primarily services aircraft engaged in specialised non-passenger carrying activities, such as agricultural operations.

2.2.3 Aviation activities within each of the groupings identified above are very diverse and each can present particular risk considerations that require adjustments in their priority. Modifying factors can include aircraft size and CASA's duty to ensure that Australia fufills its obligations and duties under the Convention on International Civil Aviation. For example, all-cargo operations in large aircraft, or all-cargo operations in aircraft engaged in international flights may be given elevated priority compared to domestic all-cargo flights in small aircraft.

2.3 Resource Implications

2.3.1 CASA is moving towards a regulatory approach whereby:

a. the relative allocation of CASA resources to an aviation activity broadly corresponds with the activity's position in the hierarchy; and

b. the major proportion of CASA's resources will be allocated to contributing to the safety of passengers, i.e. those occupants who are not expected or assumed to have knowledge of the safety risks to which they are exposed, and who have little or no control over those risks (other than choosing not to fly).

2.4 Classification of Aviation Activities Framework

2.4.1 In developing this policy, CASA has taken into consideration how aircraft and operations were classified by the International Civil Aviation Organization (ICAO) in 1987 (see section 2.6), as well as by foreign civil aviation authorities since then. The reasons why previous attempts by CASA and its predecessors to redefine the classification of operations have been unsuccessful have also been taken into account, along with the recommendations made in the Report of the Commission of Inquiry into the Relations between the Civil Aviation Authority and Seaview Air in 1996.

2.4.2 Broad policy advice on CASA's approach to a classification system was provided by the Program Advisory Panel (PAP). The PAP was established in September 1996 to provide advice and guidance to the CASA Review Programs which sought to revise the Australian aviation regulatory framework and the role of CASA in the delivery of its regulatory responsibilities.

2.4.3 This current policy acknowledges that, in 2000, reference in section 27 of the *Civil Aviation Act* to "commercial" operations was removed to put paid to the assumption that the nature of the operations for which an Air Operator's Certificate – and an attendant level of regulatory scrutiny – was required would necessarily be limited to commercial operations. For each activity, CASA's application of regulatory oversight and its consideration of risk treatments are based on:

a. the safety risks involved;

b. the likelihood and potential consequences of an accident; and

c. the mitigators applied to that activity.

2.4.4 Certain fundamental principles have been adopted by CASA in developing a policy for classifying civil aviation activities:

a. The first principle recognises that CASA's responsibility under the *Civil Aviation Act* is for the safety regulation of Australian civil aviation activities. A corollary to this is the principle that the safety of people must have a higher priority than the safety of property.

   Because CASA's resources are limited, it must perform its functions under the Act in such a manner as to minimise the risks of harm, injury or damage to people and property to the greatest extent practicable. This objective is most likely to be achieved by implementing a risk management approach to safety regulation.

b. Another principle is that the level of safety provided should reflect the degree to which persons who are intending to participate in an aviation activity are reasonably informed about the nature and extent of the risks involved, CASA's safety oversight of the activity and the risk mitigators in place.

   To persons who are adequately informed of the risks inherent in an aviation activity — and who voluntarily accept those risks — CASA's responsibilities are significantly different to (and of a lower order) than its responsibilities to those who have only limited knowledge or control of the risks to which they are exposed. At the same time, the public does not generally view as acceptable situations in which large numbers of persons are left exposed to risk of serious injury or death, even when those persons have voluntarily accepted the risks.

c. The classification policy also takes into account CASA's responsibilities to those who are only indirectly involved in, or affected by, aviation activities. Persons on the ground expect to be protected from the risks associated with aircraft, aircraft components or the contents of aircraft "falling from the sky".

d. CASA's statutory mandate is limited to safety regulation. Economic and commercial considerations cannot be ignored, but they must not drive, or in any case override, important safety related considerations.

2.4.5 CASA's regulatory activities are focussed on ensuring the risks to safety inherent in specific aviation activities are recognised and addressed in a meaningful, rational and efficient way. Activities that fall into any particular class or grouping are diverse and warrant the application of different risk mitigation strategies and practices. The means by which CASA may act to mitigate safety risks include:

a. Air Operators' Certificates (AOCs);

b. certificates of airworthiness and special flight permits;

c. competency-based licences, ratings and endorsements;

d. other permissions and approvals and related Acceptable Means of Compliance (AMCs) and Guidance Material (GM); and

e. general and particular operational limitations.

2.4.6 The definitions and attributes of, inclusions in, exclusions from and other requirements governing activities in all classifications will be determined and expressed primarily in the Civil Aviation Safety Regulations (CASRs) that implement the policy underpinning the classification of activities.

2.5 Classification System

2.5.1 Three broad classes of aviation activities are established under this policy:

a. The first class (**Passenger Transport**) comprises passenger-carrying activities that:

- are conducted in balloons and in large and small aircraft that are certified in the transport, commuter or normal category; and
- involve the carriage of passengers, i.e. occupants who have limited or no knowledge of the risks to which they are exposed and little or no control over the risks.

The Passenger Transport class includes, but is not limited to, passenger operations in scheduled and non-scheduled air services that are available to the public.

Activities classified as Passenger Transport will require an Air Operator's Certificate (AOC).

b. The second class (**Aerial Work**) comprises activities in which:

- the aircraft is being used for specialised in-flight purposes; and
- the activity presents elevated operational and/or organisational risks or

the potential for significant consequences if there is an accident (by virtue of the number of occupants and/or the area of operation).

Aerial work activities usually involve specially trained and/or qualified task specialists who perform duties in relation to the specialised use of the aircraft. In some cases, the aircraft crew may also act as task specialists.

The activities in the Aerial Work class are very diverse. Some may require an AOC or some other kind of permission, authorisation or approval from CASA, or be subject to general or particular operational limitations.

c. The third class (**General and Cargo-only Activities**) comprises:

- activities involving the carriage of participants who have, on an informed basis, accepted the risks to which they are exposed;
- cargo-only activities; and
- other aviation activities (e.g. crew-only) that do not fall into one of the other two classes.

Note: Limits will establish the maximum number of participants that can be involved before an activity triggers increased regulatory oversight. In the case of cargo-only activities, the size of the aircraft and area of operation will trigger increased regulatory oversight.

Some activities in General and Cargo-only activities may require an AOC, some other kind of permission, authorisation or approval from CASA, or be subject to general or particular operational limitations.

2.5.2 The three classifications can be represented as shown below:

<table>
<tr><th>Passenger Transport</th><th>Aerial Work</th><th>General & Cargo-only Activities</th></tr>
<tr><td>Carriage of passengers in large aeroplanes</td><td rowspan="4">Specialised activities involving task specialists that present elevated risks or significant consequences</td><td rowspan="2">Activities involving participants</td></tr>
<tr><td>Carriage of passengers in small aeroplanes</td></tr>
<tr><td>Carriage of passengers in rotorcraft</td><td>Cargo-only activities</td></tr>
<tr><td>Carriage of passengers in balloons</td><td>Other crew-only activities</td></tr>
</table>

The classification of aviation activities involving a mixture of passengers, task specialists and/or participants will generally be determined on the basis of the hierarchy of aircraft occupants and the priority given to them by CASA, in accordance with the table in paragraph 2.2.1.

Note 1: It is CASA policy to regulate sport and recreational aircraft, regardless of the activities in which they are engaged, under specific sport and recreational CASR Parts.

Note 2: The activity groupings in the table above are not wholly indicative of their regulatory coverage, e.g. cargo-only transport operations in large aeroplanes and rotorcraft would be regulated under the same rules as those for combined passenger/cargo transport operations in large aeroplanes and rotorcraft, because of the heightened risk to people on the ground and to ensure compliance with Australia's international obligations under the Convention on International Civil Aviation.

2.6 ICAO vs. Australian Classification System

2.6.1 The ICAO classification scheme (Doc 9388-AN/918, last updated in 1987) identifies three types of operations:

- *Commercial Air Transport* services,
- *Aerial Work* activities, and
- *General Aviation.*

2.6.2 The ICAO system relies primarily on distinguishing operations carried out in return for payment or promise of payment in respect of a flight. By contrast, Australia's new classification system is more specifically risk-based and depends on aircraft use, who or what is carried in the aircraft, and the size of the aircraft.

2.6.3 ICAO defines an Air Operator's Certificate (AOC) as a certificate authorising an operator to carry out specified Air Transport operations. In Australia, AOCs are also currently required for Aerial Work operations.

2.6.4 For comparison purposes:

- the ICAO classification of *Commercial Air Transport* can generally be aligned with Australia's new **Passenger Transport** class above, but would also include commercial cargo-only activities in Australia's new **General and Cargo-only Activities** class.
- the ICAO classification of *Aerial Work* can generally be aligned with Australia's new Aerial Work class above.
- the ICAO classification of *General Aviation* can generally be aligned with Australia's new **General and Cargo-only Activities** class above, but the ICAO classification excludes activities conducted on a commercial basis except for paid flight instruction.

2.6.5 Aircraft operations are regulated to common baseline rules, supplemented by additional requirements that are necessary to mitigate specific risks. Regulatory requirements within each classification vary, depending on aircraft size, complexity, number of aircraft occupants, area of operation and a number of other factors that collectively determine the risks to safety posed by a particular activity. These risks are managed jointly by CASA and the aviation community. CASA establishes appropriate regulations and standards in respect of aircraft certification, continuing airworthiness, operational restrictions, and personnel licensing requirements and it is for the aviation community to ensure that the risks of their activities are identified and adequately mitigated.

2.7 Other Classification Systems

2.7.1 New regulations to be made under the *Civil Aviation Act* will focus more on specific aviation activities than on regulating any particular class of operation in a homogeneous way. This will enable CASA to identify any number of classes or groupings of aviation activities as may be required or appropriate for regulatory purposes, risk analysis, accident investigation purposes, safety purposes and statistical and other purposes. For example, CASA will be able to identify and group all activities that require AOCs.

2.8 Safety Goals by Class, Subclass and Activity

2.8.1 CASA will take an active role in contributing to the safety of passenger-carrying activities. However, for industry oversight purposes, CASA will still intervene in non-passenger-carrying activities through:

a. controlling entry;

b. targeting surveillance, primarily based on key triggers identified by a risk assessment process applied to the sector;

c. educating crew to encourage a greater acceptance and understanding of baseline rules and the competencies necessary to carry out ground and in-flight tasks relating to the safety of flight;

d. educating participants and potential participants so that they are aware of the risks they face and, in some cases, mandating compulsory warnings and waivers; and

e. implementing enforcement strategies to prosecute or remove from the aviation community those who endanger the lives or property of people on the ground or the occupants of other aircraft.

2.9 Modifying Factors

2.9.1 In practice, the kind and quantum of CASA resources allocated to various activities may be modified by a number of factors including:

a. *Likelihood* — Aside from the consequences of an accident (defined in terms of public concern and cost), total risk is also influenced by accident probability. The relative allocation of resources to an activity could be increased if there was a large increase in a particular activity.

b. *Consequences* — Activities involving large numbers of aircraft occupants, regardless of the classification, or having the potential to cause injury to persons or damage to property on the ground, would attract increased attention by CASA.

c. *Availability of Resources* — Since the skills that CASA needs to contribute to safety may differ from one activity to another, there may be situations where there are insufficient numbers of appropriately skilled staff to meet resource allocation guidelines. CASA may apply a range of measures to mitigate safety risks in these circumstances.

Signed

John F. McCormick
Director of Aviation Safety and
Chief Executive Officer

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Flight Date	A/C Rego	Captain	Departure Port	Arrival Port	Fuel On Board	Fuel Burn	Fuel Remaining
28-February-2003	VH-AJJ	BATES N	YSSY	YSNF	8710	4100	4600
21-March-2003	VH-NGA	COCKLE D	YSSY	YSNF	8910	4910	4000
27-March-2003	VH-AJJ	BOWLY M	YSSY	YSNF	8000	3600	4400
30-June-2003	VH-AJJ	SPURRS A	YSSY	YSNF	8700	3300	5400
31-December-2003	VH-AJJ	BOWLY M	YSSY	YSNF	8700	3900	4800
20-January-2004	VH-AJJ	SLATTER J	NSTU	YSNF	8700	6700	2000
20-January-2004	VH-AJJ	SLATTER J	YSSY	YSNF	8700	3500	5200
02-April-2004	VH-AJJ	BOWLY M	NFNF	YSNF	8700	3840	3860
02-April-2004	VH-AJJ	BOWLY M	YSSY	YSNF	7100	3300	3800
21-April-2004	VH-AJJ	SPURRS A	YSSY	YSNF	8710	3910	4800
21-May-2004	VH-AJJ	BATES N	YSSY	YSNF	8600	3400	5200
09-July-2004	VH-AJJ	FLEMING D	YSSY	YSNF	8710	3910	4800
19-July-2004	VH-AJJ	MEYER W	YSSY	YSNF	8650	4250	4400
29-July-2004	VH-AJJ	MEYER W	YSSY	YSNF	8700	2900	5800
31-August-2004	VH-NGA	SPURRS A	NFFN	YSNF	8700	4900	3800
15-December-2004	VH-NGA	MEYER W	YSSY	YSNF	8900	4500	4400
28-December-2004	VH-AJJ	SLATTER J	YSSY	YSNF	8610	3210	5400
06-January-2005	VH-AJJ	BOWLY M	YSSY	YSNF	8700	3100	5600
21-January-2005	VH-AJJ	SPURRS A	NFFN	YSNF	8700	4000	4700
25-January-2005	VH-AJJ	SPURRS A	YSSY	YSNF	8700	2000	4700
25-January-2005	VH-NGA	MEYER W	YSSY	YSNF	8700	4300	4400
10-February-2005	VH-AJJ	BOWLY M	YSSY	YSNF	8700	3600	5100
02-March-2005	VH-NGA	SLATTER J	YSSY	YSNF	8900	4200	4700
13-March-2005	VH-AJJ	SLATTER J	YSSY	YSNF	7170	3570	3600
27-March-2005	VH-AJJ	SLATTER J	YSSY	YSNF	7100	3500	3600
12-June-2005	VH-EEB	JACKLIN G	NSTU	YSNF	9000	6500	2500
21-June-2005	VH-NGA	SLATTER J	YSSY	YSNF	8400	3300	5100
24-June-2005	VH-AJJ	BIAL A	YSSY	YSNF	8700	3500	5200
12-August-2005	VH-AJJ	BIAL A	YSSY	YSNF	8710	3710	5000
16-October-2005	VH-NGA	BIAL A	YSSY	YSNF	8700	4000	4700
03-December-2005	VH-AJJ	BOWLY M	YSSY	YSNF	8700	3600	5100
30-December-2005	VH-AJJ	SLATTER J	YSSY	YSNF	7800	3700	4100
05-January-2006	VH-AJJ	MEYER W	YSSY	YSNF	8710	3310	5400
27-February-2006	VH-AJJ	BOWLY M	YSSY	YSNF	8710	3410	5300
20-May-2006	VH-AJJ	BIAL A	YPAD	YSNF	8700	5300	3400
06-June-2006	VH-AJJ	MEYER W	NFNA	YSNF	8700	4400	4300
23-June-2006	VH-SLD	NOWLAND P	YSNW	YSNF	5800	2700	3100
05-July-2006	VH-NGA	MEYER W	YSSY	YSNF	8710	4100	4600
08-July-2006	VH-AJJ	ARNOTT D	YSSY	YSNF	8700	3500	5200
17-July-2006	VH-SLD	MIROW C	NFFN	YSNF	5600	3800	1800
02-October-2006	VH-AJJ	BIAL A	YSSY	YSNF	8710	3500	5200
14-October-2006	VH-AJJ	BIAL A	YSSY	YSNF	8210	3910	4800
24-October-2006	VH-AJJ	BOWLY M	YSSY	YSNF	8700	3500	5200
27-November-2006	VH-AJG	HAILES C	NFTF	YSNF	8200	5600	2600
01-December-2006	VH-AJJ	HAILES C	YSSY	YSNF	7169	3169	4000
02-December-2006	VH-KNU	POWELL B	YSCB	YSNF	8400	3800	4600
14-December-2006	VH-AJJ	MEYER W	YSSY	YSNF	8710	3410	5300
16-December-2006	VH-AJJ	BOWLY M	YSCB	YSNF	8700	3800	4900
16-December-2006	VH-NGA	POWELL B	NFNA	YSNF	8700	4300	4400
17-December-2006	VH-NGA	BOWLY M	YSSY	YSNF	8700	4100	4600
19-January-2007	VH-AJJ	BOWLY M	YSSY	YSNF	8700	3700	5000
25-April-2007	VH-AJG	BIAL A	NSFA	YSNF	8700	6100	2600
26-June-2007	VH-NGA	MEYER W	NFFN	YSNF	8700	4700	4000
18-August-2007	VH-NGA	BOWLY M	YSSY	YSNF	8710	2990	5720
19-October-2007	VH-KNS	POWELL B	YSSY	YSNF	8600	3700	4900
28-October-2007	VH-NGA	BOWLY M	NFNA	YSNF	8700	5000	3700
30-October-2007	VH-AJG	BADHAM S	YSSY	YSNF	7100	3600	3500
15-November-2007	VH-NGA	POWELL B	NFFN	YSNF	8700	5700	3300
28-January-2008	VH-NGA	MEYER W	YSSY	YSNF	7100	3920	3180
03-March-2008	VH-AJV	MEYER W	NFNA	YSNF	8700	4500	4200
15-April-2008	VH-NGA	BADHAM S	YSSY	YSNF	7100	3600	3500
28-June-2008	VH-AJV	MEYER, WALLY	NFNA	YSNF	8700	4500	4200
29-June-2008	VH-AJV	BADHAM, SCOTT	YSSY	YSNF	8700	3500	5200
30-June-2008	VH-SLE	NOWLAND, PAUL	YSNW	YSNF	6000	2900	3100
22-August-2008	VH-AJJ	YOUNG, DEAN	YSSY	YSNF	8700	3400	5300
27-August-2008	VH-AJV	MEYER, WALLY	YSSY	YSNF	8400	3600	4800
21-September-2008	VH-AJV	BADHAM, SCOTT	NFFN	YSNF	8700	4000	4700
03-October-2008	VH-NGA	BADHAM, SCOTT	YSSY	YSNF	8700	3800	4900
10-December-2008	VH-NGA	JAMES, DOMONIC	YSSY	YSNF	8700	3800	4900
18-December-2008	VH-NGA	MEYER, WALLY	YSSY	YSNF	8700	3100	5600
29-September-2009	VH-NGA	JAMES, DOMONIC	YSSY	YSNF	6600	3100	3500
30-September-2009	VH-NGA	JAMES, DOMONIC	NSFA	YSNF	8700	7200	1500
30-September-2009	VH-KNR	MEYER, WALLY	YSSY	YSNF	8800	3300	5500
05-October-2009	VH-KNR	MEYER, WALLY	NSFA	YSNF	8800	7000	1800
07-October-2009	VH-NGA	WINYARD, DAVID	YSSY	YSNF	7200	3500	3700
23-October-2009	VH-NGA	MEYER, WALLY	YSSY	YSNF	8700	3700	5000
19-November-2009	VH-KNR	SANDFORD RICHARD	YSSY	YSNF	8800	4200	4600

BUREAU OF AIR SAFETY INVESTIGATION REPORT

Investigation Report 9301743

Piper PA31-350 Chieftain
Young, NSW,
11 June 1993

BASI
Bureau of Air Safety Investigation

Transport and Regional Development

Department of Transport

Bureau of Air Safety Investigation

INVESTIGATION REPORT

9301743

Piper PA31-350 Chieftain VH-NDU
Young, NSW
11 June 1993

Released by the Director of the Bureau of Air Safety Investigation
under the provisions of Air Navigation Regulation 283

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

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CONTENTS

A/DAM	Acting District Airworthiness Manager
ADF	Automatic Direction Finder
ADI	Attitude Director Indicator
AGL	Above Ground Level
AIP	Aeronautical Information Publication
AIP/IAL	AIP Instrument Approach and Landing procedures
Altitude	Height above mean sea level in feet
AME	Aircraft Maintenance Engineer
AOC	Air Operators Certificate
ARP	Aerodrome Reference Point
AVDATA	The company name of a communications recording service for assessing landing charges
AVFAX	Aviation Meteorological and NOTAM Facsimile Service
AVR	Automatic Voice Recording
BASI	Bureau of Air Safety Investigation
BOM	Bureau of Meteorology
CAA	Civil Aviation Authority
CAO	Civil Aviation Order
Ceiling	Height of lowest cloud base above the ground
CFIT	Controlled flight into terrain
Circling area	An area of 3 NM radius from the ARP providing for visual manoeuvring when visual reference has been established
CTAF	Common Traffic Advisory Frequency
DAPS	Departure and Approach Procedures
DAM	District Airworthiness Manager
DFOM	District Flight Operations Manager
DI	Direction Indicator
E&I	Electrical and Instruments
ERSA	Enroute Supplement Australia (AIP)
EST	Eastern Standard Time
FIS	Flight Information Service
FOI	Flight Operations Inspector
FYI	For your information
GM	General Manager

Height	Vertical distance in feet above a fixed point.
High capacity aircraft	An aircraft that is certified as having a maximum seating capacity exceeding 38 seats or a maximum payload exceeding 4,200 kilograms
hPa	Hectopascals
HSI	Horizontal Situation Indicator
Hz	Hertz
IAL	Instrument Approach and Landing
IBM	Investigation Branch Manager
ICAO	International Civil Aviation Organisation
IFR	Instrument Flight Rules
IIC	Investigator-in-Charge
ILS	Instrument Landing System
IMC	Instrument Meteorological Conditions
IR	Interim recommendation
KHz	Kilohertz
KSA	Sydney (Kingsford-Smith) Airport
kt	Knot(s)
LAME	Licenced Aircraft Maintenance Engineer
MAOC	Manual of Air Operator Certification
MCM	Maintenance Control Manual
ME	Multi-engine
MEL	Minimum Equipment List
MHz	Megahertz
Monarch	Can mean Monarch Air Services Pty Limited, Monarch Air Pty Limited, Monarch Airlines, Monarch Air
NASS	National Airworthiness Surveillance System
NDB	Non-Directional Beacon
NM	Nautical mile
Octa	Cloud amount expressed in eighths
OPS	Operations
PAL	Pilot Activated Lighting
PANS	Procedures for air navigation services
PUS	Permissible Unserviceability
QNH	An altimeter sub-scale setting to show height above sea level
RMI	Radio Magnetic Indicator
RPT	Regular Public Transport

RSR	Route Surveillance Radar
SADN	Safety Advisory Deficiency Notification
SAN	Safety Advisory Notification
SARWATCH	Search and Rescue Watch
SDM	Safety Deficiency Manager
SES	State Emergency Services
SR&S	CAA Safety Regulation and Standards
SSR	Secondary Surveillance Radar
TAF	Aerodrome forecast
TAR	Terminal Area Radar
TBO	Time between overhauls
VAC	Volts, Alternating Current
VDC	Volts, Direct Current

Note 1. All bearings are in degrees magnetic unless otherwise indicated.

Note 2. All times are Australian Eastern Standard time (Co-ordinated Universal Time + 10 hours) unless otherwise stated.

INTRODUCTION

Australia is a signatory to the Convention on International Civil Aviation (Chicago 1944), which established the International Civil Aviation Organisation. Article 26 of the Chicago Convention obligates the governments of countries that are signatories to the Convention to conduct investigations into aircraft accidents in their territories which involve specific aircraft from other countries which are signatories to the Convention. Article 37 (k) of the Convention recommends that, as far as the law of individual countries permit, member countries should adopt uniform international standards and practices for aircraft accident investigation. The international standards and practices for aircraft accident investigation are described in Annex 13 to the Convention.

Australia has given domestic legal effect to its international obligations under the Convention by incorporating the articles of the Convention within the Air Navigation Act of 1920. Part XVI of the Air Navigation Regulations (ANRs) of that Act provides the legal authority for the Secretary of the Commonwealth Department of Transport to require the investigation of aircraft accidents and incidents occurring within Australia. The authority to conduct aircraft accident and incident investigations is delegated by the Secretary to the Director and other designated officers of the Bureau of Air Safety Investigation.

Australia has by historical practice applied the standards and practices of Annex 13 to all aircraft accident and incident investigations. In doing so, the fundamental objective of the investigation is the prevention of aircraft accidents and incidents.

In accordance with the principles of Annex 13, it is not the purpose of this activity to apportion blame or liability. The sole purpose of the Bureau's operations is the maintenance and enhancement of flight safety.

The Bureau does not attempt to determine the cause(s) of an occurrence. Most air safety occurrences are the result of a complex interaction of many factors. The objective of the investigation is to identify all of the significant factors contributing to the occurrence, together with any associated safety deficiencies which may become apparent during the investigation. Throughout the investigation process, safety recommendations are issued, where necessary, to relevant authorities in a timely manner, in accordance with the primary objective of preventing accidents and incidents. This report follows the standard ICAO format as prescribed in the Appendix to Annex 13.

Paragraph 5.12 of Annex 13 states:

> When the State conducting the investigation of an accident or incident, wherever it occurred, considers that disclosure of any of the records, described below, might have an adverse effect on the availability of information in that or any future investigation then such records shall not be made available for purposes other than accident or incident investigation:
>
> (a) statements from persons responsible for the safe operation of the aircraft;
> (b) communications between persons having responsibility for the safe operation of the aircraft;
> (c) medical or private information regarding persons involved in the accident or incident;
> (d) cockpit voice recordings and transcripts from such recordings;
> (e) opinions expressed in the analysis of information, including flight recorder information.

Although the Bureau makes every effort to prevent the disclosure of relevant records for purposes other than accident or incident investigation, under Australian law it is at present necessary to make the records available to any Australian court which issues a valid summons requiring them to be produced as evidence. As a result, Australia has filed a difference to this paragraph with ICAO.

A cockpit voice recording made during the flight of an aircraft operated by an Australian operator is not admissible in evidence in any civil proceedings in an Australian court.

SYNOPSIS

On Friday 11 June 1993, at about 1918 EST, Piper PA31-350 Navajo Chieftain aircraft, VH-NDU, while on a right base leg for a landing approach to runway 01 in conditions of low cloud and darkness, struck trees at a height of 275 feet above the elevation of the aerodrome at Young, New South Wales, and crashed. The aircraft, which was being operated as Monarch Airlines flight OB301 on a regular public transport service from Sydney to Young, was destroyed by impact forces and post crash fire. All seven occupants, including the two pilots, suffered fatal injuries.

The investigation found that the circumstances of the accident were consistent with controlled flight into terrain. Descent below the minimum circling altitude without adequate visual reference was the culminating factor in a combination of local contributing factors and organisational failures. The local contributing factors included poor weather conditions, equipment deficiencies, inadequate procedures, inaccurate visual perception, and possible skill fatigue. Organisational failures were identified relating to the management of the airline by the company, and the regulation and licensing of its operations by the Civil Aviation Authority.

During the investigation a number of interim safety recommendations were issued by the Bureau. The recommendations and responses are summarised in Section 4 of this report.

1. FACTUAL INFORMATION

1.1 History of the flight

At about 1500 hours EST, 11 June 1993, a standard company flight plan held by the CAA at the Melbourne flight briefing facility was activated. The plan indicated that Piper PA31-350 aircraft VH-NDU would be conducting flight OB 301, a regular public transport service from Sydney (Kingsford Smith) airport to Cootamundra NSW, with intermediate landings at Cowra and Young. The flight was planned to be operated in accordance with IFR procedures, with a scheduled departure time from Sydney of 1720. The aircraft was to be crewed by two pilots. Prior to departure, the company scheduled a second aircraft to operate the Sydney–Cowra sector. Consequently, VH-NDU was required to land only at Young and Cootamundra. At that time of the year, the 1720 departure time meant that the flight would be conducted entirely at night.

VH-NDU departed Sydney at 1738 carrying five passengers, with a fuel endurance of about 253 minutes. The pilot-in-command occupied the left cockpit seat. The aircraft initially tracked via the direct Sydney to Cowra route and climbed to a cruising altitude of 8,000 feet. At 1801 the pilot reported to Sydney FIS that the aircraft was now tracking direct to Young, and would report at Riley, an en route reporting point located 62 NM from Young on the Katoomba–Young track (see figure 1). FIS advised the area QNH was 1003 hPa. At 1814 the pilot reported the aircraft was at Riley and estimated arrival at Young at 1835. By 1820 the pilot had reported on descent to Young, with in-flight conditions of cloud and heavy rain. Recorded radar data later showed that the aircraft passed 13.5 NM to the south-east of Riley, south of the direct Katoomba–Young track. At about 18.5 NM north-east of Rugby, the aircraft turned right and initially tracked about 280° before turning left to track direct to Young. When queried by FIS at 1836, the pilot amended the estimate for his arrival at Young to 1838. At 1842, after prompting from FIS, the pilot reported at Young that he was commencing an NDB approach, and would call again on the hour or in the circuit.

Shortly after 1845 witnesses at Young aerodrome saw the lights of an aircraft, which they believed to be VH-NDU, pass low overhead after approaching from the east. Some minutes later the same aircraft was seen to pass over the aerodrome from the opposite direction and appear to climb away towards the east. On both occasions the runway and aerodrome lights were not illuminated, although the aerodrome was equipped with PAL and it was the responsibility of the pilot-in-command to activate it. At 1850 FIS advised VH-NDU of the proximity of Cessna 310 aircraft, VH-XMA, which was estimating arrival at Young at 1900. VH-XMA subsequently reported holding in visual conditions at about 8 NM north of Young. The pilot of VH-NDU reported at 1903 that he was on another overshoot at Young, about to commence another approach, and would report again at 1915. FIS provided additional traffic on Piper PA31 aircraft, VH-XML, which was also estimating Young at 1915. At about this time witnesses reported seeing the runway lights illuminate. VH-XMA then proceeded to Young and landed on runway 01 at about 1912. At 1916 VH-NDU reported in the Young circuit area and cancelled SARWATCH.

A pilot witness said that the aircraft passed over the northern end of the aerodrome from a westerly direction before turning right and taking up a heading consistent with a right downwind leg for a landing on runway 01. The aircraft was then seen to turn right and pass to the south of the aerodrome before entering what appeared to be a right downwind leg for runway 19. When abeam the aerodrome the aircraft again turned right and overflew the aerodrome to enter a second right downwind leg for runway 01. Another witness thought the

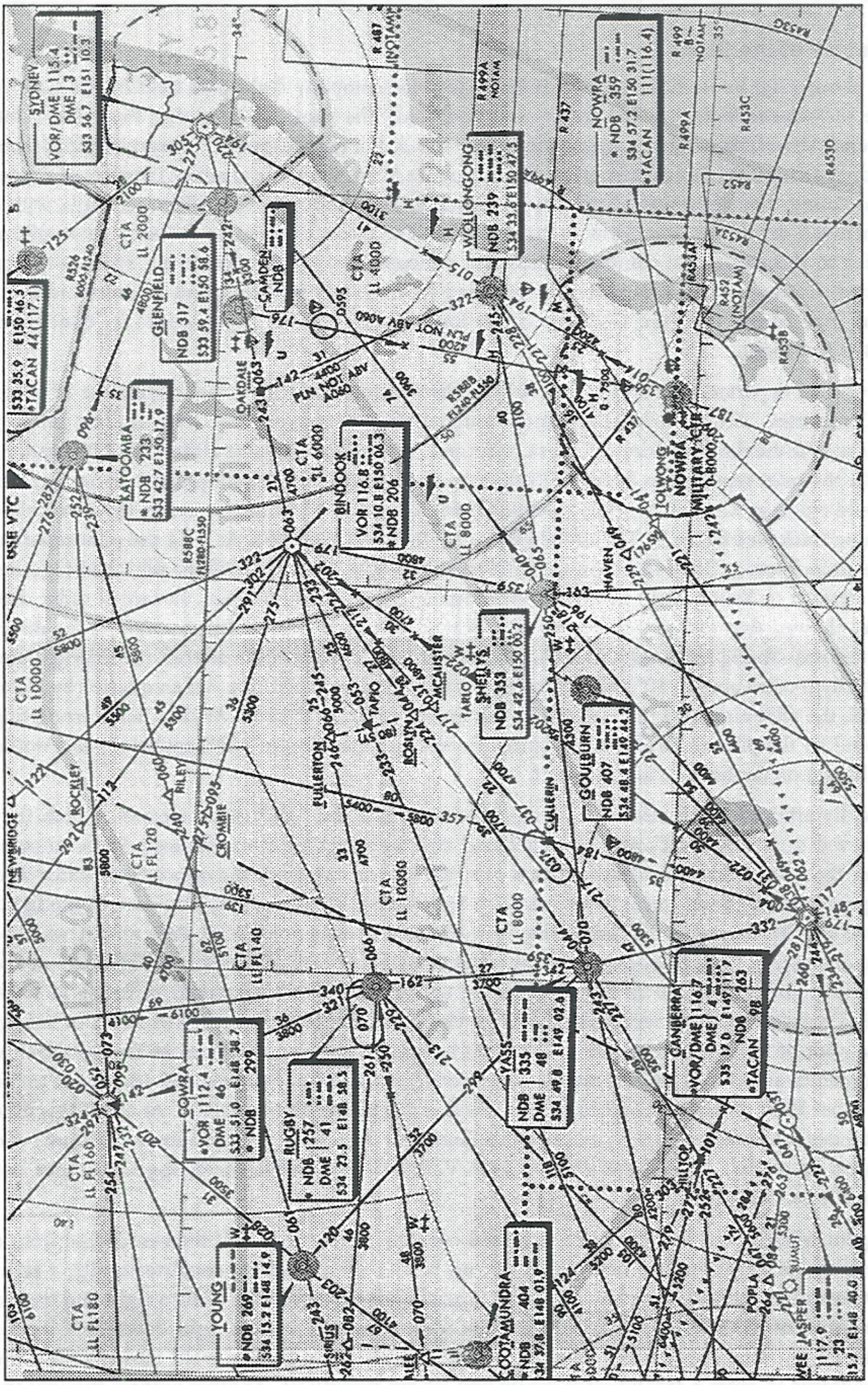

Figure 1. Extract from ERC L2 radio navigation chart

aircraft (VH-NDU) was significantly lower than another aircraft approaching from the east (VH-XML). Shortly after VH-NDU turned onto an apparent base leg the navigation lights were lost to sight. Almost immediately a fireball was observed, consistent with the final position of the aircraft (see figure 2).

At 1918 the pilot of VH-XMA telephoned the 000 emergency services number and reported the accident to the Goulburn Ambulance Control Centre. By 1920 this information had been relayed to the Young Ambulance Service, the Young Police, and the Young SES. An off-duty Fire Brigade officer, who was waiting at the aerodrome, drove into Young and alerted the Fire Brigade at 1930. The emergency services initially travelled to Young Aerodrome but were unable to gain immediate access to the accident site, which was located on a hill some 2.2 km to the south-south-east of the aerodrome, in an area remote from roads and lighting. Access was finally gained from a road located south of the accident site.

An ambulance reached the aircraft wreckage at 1952 and the crew were able to rescue and resuscitate the only survivor, who was critically injured, and transport her to the Young Hospital. She died at Camperdown Children's Hospital at 0510 the next morning.

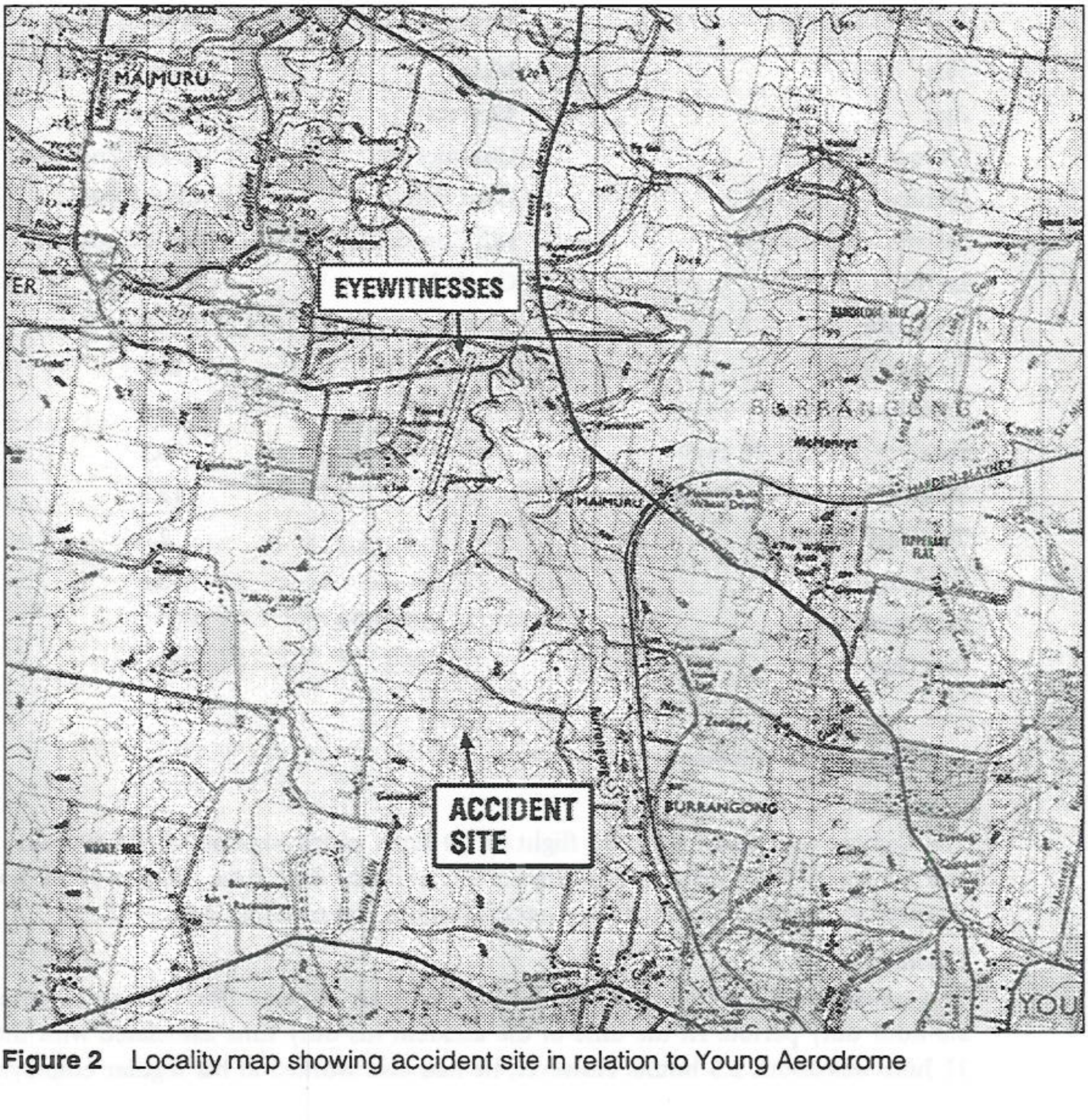

Figure 2 Locality map showing accident site in relation to Young Aerodrome

1.2 Injuries to persons

	Crew	Passengers	Other	Total
Fatal	2	5	–	7
Serious	–	–	–	–
Minor	–	–	–	–
None	–	–	–	–
TOTAL	2	5	–	7

1.3 Damage to aircraft

The aircraft was destroyed as a result of impact forces and post crash fire.

1.4 Other damage

No other damage was reported.

1.5 Personnel

	Captain	Second Pilot
Sex:	Male	Male
Age:	42 years	24 years
Licence category:	Commercial	ATPL (2nd class)
Medical Certificate:	Class One	Class One
Instrument Rating :	ME Command	ME Command
Instructor Rating :	Grade 2	Grade 2
Total Hours:	1,822.4	954.0
Total on type:	337.5	43.5
Total last 90 days:	147.5	67.6
Total on type last 90 days:	121.4	30.1
Total VH-NDU last 90 days:	47.7	17.6
Total last 24 hours:	2.3	2.6
Total night:	187.5	65.6
Last route check:	12/13 Mar 1993.	Nil
Last base check:	28 Jan 1993.	Nil

Previous 72 hours history:

Captain

The Captain conducted a charter flight on 10 June, which required about 10 hours duty time and 2.3 hours flight time. At the time of the accident duty time was about 3.0 hours. He is reported to have had a normal sleep period prior to commencing duty.

Second pilot

The second pilot flew on a Monarch RPT flight on 10 June 1993, which required about a 5.0 hour duty period. At the time of the accident his duty time associated with the flight on 11 June was about 2.5 hours. However, he had also worked at his regular employment from

0500 hours to 1300 hours. There is no evidence to show that he had slept between 1300 hours and commencing duty at about 1630 hours. He was regularly employed in a non-flying capacity as a passenger services officer with a major airline.

Recent operational experience:

Captain

The first logbook record of RPT flight into Young by the Captain was 25 February 1993.

In the 90 days preceding the accident the Captain had conducted three night landings and 15 daylight landings at Young. Of these, two daylight landings were conducted in VH-NDU. During this period he had flown three NDB approaches and one ILS approach, with only the ILS approach flown in VH-NDU. His only other flight with the second pilot had been carried out on 27 May 1993. At the time of the occurrence the Captain was employed by the company as a line pilot and maintenance controller on a daily rate, or casual basis.

Second pilot

In the 90 days preceding the accident the second pilot had landed and taken off at Young on two occasions, including one landing and take-off at night in VH-NDU on 7 June 1993. At the time of the accident he was employed by Monarch as a co-pilot on a casual basis.

1.6 Aircraft information

1.6.1 Significant particulars

Registration:	VH-NDU
Manufacturer:	Piper Aircraft Corporation
Model:	PA31-350
Common name:	Navajo Chieftain
Serial No:	31-8152083
Country of manufacture:	USA
Year of manufacture:	1981
Engines:	2 Lycoming TIO-540-J2BD
Engine type:	Reciprocating
Certificate of Registration Holder:	Tealjet Pty Limited, trading as Monarch Air
– No:	AFD 00355/03
– Issued:	1 March 1993
Aircraft Operator:	Monarch Airlines
Certificate of Airworthiness	
– No:	AF355
– Issued:	17 May 1989
Maintenance Release	
– No:	190509
– Issued:	1 June 1993
– Valid to:	1 June 1994 or 4,036 hours (whichever came first)
Total airframe hours:	3,936 (at 1 June 1993)

1.6.2 Weight and Balance

Maximum take-off weight:	3,178 kg
Estimated	
– take-off weight:	3,196 kg (assumes 100 kg for baggage)
– weight at impact:	2,999 kg
– Centre of Gravity:	3,180.46 mm aft of datum
CG range at 2999 kg:	
– forward limit:	3,150.36 mm aft of datum
– aft limit:	3,429.00 mm aft of datum
– fuel remaining:	366 litres

A Monarch Airlines Load/Trim Sheet for PA31-350 aircraft was prepared by the pilot-in-command for flight OB301. The aircraft operating weight and fuel load was accurately recorded. Standard passenger weights were used in accordance with the company operations manual. The standard was derived from the recommendations contained within CAA Advisory Publication No. 235-1(1). No allowance for passenger baggage was contained on the Load/Trim Sheet, which was not the approved document specified in the aircraft flight manual. This made no significant difference to the weight and balance of the aircraft.

At the time of the accident the aircraft was loaded within the weight and balance limitations specified in the aircraft flight manual.

1.6.3 Aircraft history and significant events:

1981	Aircraft manufactured by Piper Aircraft Corporation, USA
1989	Aircraft exported to Australia.
15 May 1989	Australian Certificates of Airworthiness and Registration issued.
26 September 1992	Aircraft enters service with Monarch Air. Total airframe hours 3,537.
1 March 1993	A Certificate of Registration is re-issued to Tealjet Pty. Ltd. trading as Monarch Air.
29 March 1993	The autopilot is reported unserviceable.
1 April 1993	A Check 1 inspection is performed. A Bankstown-based servicing facility removes the autopilot computer/amplifier for defect rectification and determines that this unit provides a 26VAC power supply to the HSI and RMI. The unit is refitted to the aircraft without rectification and the servicing facility informs the Monarch GM that the HSI and RMI are both affected if the autopilot computer/amplifier is removed from the aircraft. Total airframe hours 3,775.
13 April 1993	The same servicing facility informs the A/DAM of the CAA Bankstown District Office that the removal of the autopilot computer/amplifier affects the operation of the HSI and RMI.
16 April 1993	The Monarch GM writes to the A/DAM at Bankstown to advise that the autopilots in Piper Chieftains VH-TXK and VH-NDU are currently unserviceable. He says that the autopilot components for VH-TXK have

	been sent to a repair facility in Melbourne, but repairs have been delayed due to the unavailability of a technician. Also, as a result of the delay, the components from VH-NDU had not been sent. The GM said he had been assured by the servicing company that the autopilots would be given priority as soon as the technician resumed duty. In the meantime the GM applied for a PUS for both aircraft for 30 days to allow for rectification as parts may be required from overseas.
	The CAA grants approval, with conditions, on the same day. The authorisation is valid to 16 May 1993 or until the required components are 'available for re-fitment', whichever occurs first.
30 April 1993	VH-NDU is flown to Coolangatta where the autopilot controller and computer/amplifier are removed for repair. The aircraft departs Coolangatta without those units and is flown to Kempsey. From there it conducts an RPT flight to Sydney.
14 May 1993	The Coolangatta based servicing facility returns the autopilot controller and computer/amplifier to Monarch at Bankstown, at the request of the Monarch GM. The components are subsequently refitted to VH-NDU without rectification, by persons unknown.
	The GM requests an extension of 30 days to the Permissible Unserviceability approving operations with an inoperative autopilot. The CAA re-issues the authorisation, valid to 16 June 1993 or until the required components are 'available for re-fitment', whichever occurs first.
1 June 1993	A Check 2 inspection is performed and Maintenance Release 190509 is issued by the Monarch certifying LAME. During the inspection, the autopilot controller and computer/amplifier are again removed from the aircraft at the direction of the GM and returned to Coolangatta for repair. The aircraft resumes RPT operations with those components missing. Total airframe hours: 3,936.
11 June 1993	VH-NDU crashes at Young, NSW. Total airframe hours: 3,953 approx.

1.6.4 Additional engine and propeller data

– Lycoming TIO-540-J2BD engine serial number L-1218-61A (left position)

Last overhauled 18 November 1992

Installed in VH-NDU 25 January 1993 at 3,590 airframe hours

Total time since overhaul 363 hours.

– Lycoming LTIO-540-J2BD engine serial number L-185-68A (right position)

Last overhauled 24 May 1990

Installed in VH-NDU 20 February 1991 at 3,327 airframe hours

Total time since overhaul 626 hours.

– Hartzell 3 blade propeller model HC-E3YR-2ATF/FC8468-6R (left position)

Hub serial number DJ6842

Last overhauled 22 November 1989

Installed on left engine VH-NDU 24 November 1989 at 2,950 airframe hours

Total time since overhaul 1,003 hours.

– Hartzell 3 blade propeller model HC-E3YR-2ALTF/FJC8468-6R (right position)

Hub serial number DJ6916

Last overhauled 23 November 1989

Installed on right engine VH-NDU 24 November 1989 at 2,950 airframe hours

Total time since overhaul 1,003 hours.

The propeller and airframe logbooks had a recording error which indicated that the propellers were fitted to the opposite side engines.

1.6.5 Autopilot information

The autopilot fitted to the aircraft at the time of manufacture was a Bendix model FCS-870 Automatic Flight Control System. The system was installed in accordance with Supplemental Type Certificate SA923SO as a customer requested option. There is no evidence in the available aircraft documentation that the system had been modified from the original specification.

The following autopilot components are known to have been missing from the aircraft at the time of the accident:

Autopilot Computer Amplifier

– Model CA871A

– P/N 4000975-7105

– S/N 1284

Flight Controller

– Model FC-872A

– P/N 4000977-7201

– S/N 1219

The computer amplifier is powered by 28VDC from the battery bus via a circuit breaker. It generates a 26 VAC, 400 Hz power supply from the internal inverter. This power is used for many functions, one of which is to drive the heading card in the HSI and simultaneously drive the heading card in the RMI. The computer amplifier also provides a variable power signal for the flight director steering bars. Barometric pressure information is provided to the computer amplifier by a static line connection at the rear of the unit.

The computer amplifier draws power from the battery bus whenever the battery is switched on, and also provides power to other components in the system. If the computer amplifier is removed, however, the 26 VAC power supply to the other components is terminated. As a result the HSI and RMI heading cards and flight director steering bars will not function. The static pressure line at the rear of the unit would also be disconnected which could affect the operation of static instruments unless the line was correctly blanked. The static line had been blanked when the computer amplifier was removed for service on 30 April 1993, but no leak test had been carried out. If the static connection was leaking it could have affected the readings of the airspeed indicators, altimeters, and vertical speed indicators. Flight tests conducted in an aircraft similar to VH-NDU, with the co-pilot altimeter static line disconnected, caused the instrument to overread by about 100 feet in a descent.

1.6.6 Minimum Equipment List

In accordance with the provisions of Civil Aviation Regulation 37, the CAA has the authority to approve the carrying of a defect in an Australian aircraft as a permissible unserviceability.

Airline operators commonly have lists of minimum equipment specific to the aircraft being operated. These lists are approved by the CAA in order to provide the operator with the authority to operate the aircraft with certain items or components inoperative, provided that an equivalent level of safety can be maintained by appropriate operational limitations, transfer of functions to other operating components, or reference to other instruments or components that could provide the required information.

Monarch Airlines had an approved Minimum Equipment List for VH-NDU. Section 2, page 14-2 of the MEL stated in part:

> Owners/Operators are responsible for exercising any necessary operational control to ensure that aircraft are not dispatched or flown with multiple MEL items inoperative without first determining that any interface or inter-relationship between inoperative systems or components will not result in a degradation in the level of safety and/or undue increase in crew workload.

Irrespective the pilot in command may require a defect to be rectified after considering operational implications, multiple unserviceabilities, and additional failures during continued operations with inoperative systems or components.

Operation with an inoperative autopilot for up to 10 days was permitted for IFR, provided:

(a) Two instrument rated pilots endorsed on the aircraft were provided, and

(b) Fully functional dual flight controls were fitted.

One operational gyroscopic directional indicator was also required for dispatch. Of the two normally fitted to the aircraft, the indicator on the right panel could be inoperative, but had to be placarded. The indicator on the left (Captain's) panel had to be fully serviceable. A maximum of three days, excluding the day the malfunction was recorded, was permitted for operation without this item.

1.6.7 Removal of autopilot components

On 30 April 1993 VH-NDU was flown to Coolangatta in order to allow the inoperative autopilot to be serviced. A non-licensed AME removed the autopilot computer amplifier and controller, and fitted a blanking plug to the computer amplifier static line. He did not perform a required static leakage test. The AME was told by the pilot of VH-NDU that the removal of the computer amplifier rendered the HSI inoperative. As a result, the AME checked and found the HSI warning flag in view. He telephoned the GM of Monarch and was subsequently advised to remove the unit as there was a permissible unserviceability to cover it. At no stage was it mentioned to the AME that the RMI was also affected. The aircraft was then flown to Kempsey to operate the RPT service to Sydney. Details of the inoperative HSI were not recorded on the aircraft Maintenance Release.

On 14 May 1993, because the repairer had difficulty in obtaining appropriate wiring diagrams, the computer amplifier and controller were returned to Bankstown unrepaired at the request of the GM. They were subsequently refitted to VH-NDU by an unknown person. No reason for their return was provided by the GM and no certification to cover the re-installation work was recorded.

On 31 May 1993 VH-NDU underwent a Check 2 inspection at Bankstown. During the afternoon, the GM instructed the LAME supervising the maintenance to remove the autopilot computer amplifier so that it could be returned to Coolangatta for repair. The aircraft was to be sold and it was necessary for the autopilot to be made serviceable.

Although unqualified in the Electrical and Instruments Group (E&I), this LAME located and removed the unit. Whilst doing so he noticed a blanked-off static line in the nose compartment. The GM subsequently took the computer amplifier away, as well as the autopilot controller.

The LAME said he placed an entry in the worksheets about the autopilot components being removed for repair, but did not speak about this to the LAME (E&I) who was responsible for conducting and certifying the work in that category. The LAME said he was unaware of what effect the removal of the autopilot components could have had on other instruments.

The LAME said that he issued a Maintenance Release on 1 June 1993, and the aircraft returned to service, after the LAME (E&I) had signed off the relevant sections of the main certification sheet. However, the LAME (E&I), who was carrying out the electrical and instruments inspection on a sub-contract basis, said that he had started his inspection late on 31 May. He had immediately noticed that the computer amplifier and controller were missing from the aircraft, and that the static line to the computer amplifier had a blanking plug fitted. When he queried this with a Monarch maintenance employee he was advised that Monarch had a permissible unserviceability to cover it. He found he was unable to complete his inspection because the HSI had been removed for repair. He requested Monarch advise him when the HSI had been refitted in order to allow him to complete his work.

On 2 June 1993 the LAME (E&I) learned that VH-NDU had already departed. He was told by a Monarch AME that the HSI had been refitted and tested by a LAME (Radio), and an operational check had been conducted by a pilot. As a result, the LAME (E&I) said he had reluctantly certified his work on 2 June 1993, after the aircraft had been returned to service. He said that it was only after the accident that he had learned of the effects of removing the autopilot components.

1.7 Meteorological information

1.7.1 Introduction

For an IFR flight, the pilot-in-command is required to obtain either a flight forecast for the route being flown, or an area forecast and a destination aerodrome forecast.

Meteorological services for civil aviation in Australia are provided by the BOM. Flight forecasts require a minimum of three hours notification, while area and aerodrome forecasts are issued on a routine basis and are available on request. Australia is divided into meteorological forecast regions for the provision of area forecasts. Area forecasts are in narrative form, comprising a statement of the general synoptic situation and the meteorological conditions expected to prevail in a designated area. An aerodrome forecast is a statement of the meteorological conditions expected for a specified period in the airspace within a radius of five nautical miles from the centre of the aerodrome.

The planned route from Sydney to Young and Cootamundra was contained within the Area 21 forecast region.

1.7.2 Area 21 meteorological situation

A low pressure system with a central pressure of 972 hPa was situated just south of Tasmania. At 1800 a cold front extended from the low, through Hobart to Wilsons Promontory, Swan Hill and Mildura. The synoptic situation was reflected in the Area 21 forecast, which included Young Aerodrome, issued for the period 1300 (11 June) to 0300 (12 June). The forecast overview was for areas of low cloud over the western slopes and ranges of south-western NSW, with showers, more widespread in the west. Snow showers were forecast over the ranges above 5,000 ft with isolated areas of hail in the south after 1800. Winds were generally westerly, increasing from 20 kt at 2,000 feet to 40 kt at 10,000 ft. The forecast freezing level was 5,000 ft with moderate icing in cloud between 5,000 ft and 11,000 ft. Turbulence was expected to be moderate below 10,000 ft.

1.7.3 Aerodrome forecast, Young

An amended TAF for Young was issued at 1036 for the period 1200–2400. The forecast conditions were: wind 330°T at 12 kt, 3 octas strato-cumulus at 4,000 ft above aerodrome level and 6 octas alto-stratus at 10,000 ft, visibility 10 km or greater, with light intermittent rain. Barometric pressure over the period was reducing from 1008 to 1004 hPa. Conditions of 5 octas stratus at 1,000 feet with slight continuous rain were forecast for intermittent periods of less than 30 minutes, between 1200–2400.

The pilot-in-command submitted flight details to the Melbourne Briefing Office during the afternoon. Standard company practice was to obtain Notams, and area and terminal weather forecasts for the route being flown, by AVFAX at the time the flight plan was activated. Details of AVFAX transactions were not recorded by the CAA.

At 1658 a new amended TAF for Young was issued for the period 1800–2400. The forecast conditions were: wind 320°T at 10 kt, 5 octas cumulus at 2,000 ft above aerodrome level, visibility 10 km or greater, with slight rain showers. Barometric pressure ranged from 1003–1002 hPa. Conditions of 5 octas stratus at 900 ft with visibility reduced to 5,000 m were forecast for temporary periods of less than 60 minutes, between 1800–2400. The revised Young TAF was available on request. Whether or not the pilot-in-command had obtained the 1658 TAF for Young could not be established.

1.7.4 Estimated aerodrome weather, Young

The BOM estimated that the actual weather conditions at Young Aerodrome at 1920 were: surface wind 310° at 11 kt gusting to 19 kt, 4 octas stratus at 800 feet above aerodrome level, 6 octas stratocumulus at 1,200 ft, and 6 octas cumulus at 1,500 ft. Visibility was 10 km, reduced to 5,000 m in light rain. Temperature and dewpoint were both +9° C, and the barometric pressure 1004 hPa.

Pilot witness accounts of the weather at Young were generally consistent with the assessment provided by the BOM. The cloud base was about 200–300 ft below the minimum circling altitude, and conditions were described as being very dark in the circuit area. Turbulence was reported as being moderate, and windshear was considered to have been insignificant.

1.8 Aids to navigation

1.8.1 NDB approach and landing chart

An NDB instrument approach procedure, and associated landing chart, were published in the AIP by the CAA to provide for instrument approach and landing procedures at Young. That procedure was designed to the criteria contained in the 1971 edition of ICAO Doc 8168-OPS/611 (PANS-OPS). AIP/IAL refers to charts designed to that specification as 'old criteria'. That document was revised in 1986 and charts produced since then conform to the new edition as amended. Those charts are named 'new criteria'. Charts drawn to the old criteria are progressively being replaced.

The significant difference between the two types of instrument approach charts is that new criteria charts have landing minima determined by aircraft performance category. The design of 'old criteria' NDB approach charts, including Young (see figure 3), provided an obstacle clearance of at least 400 ft within the circling area at the circling minima, the circling area being the area within a 3 NM radius of the aerodrome reference point.

With the exception of the 1,255 ft aerodrome elevation, the approach chart did not indicate the height of terrain or obstacles within the circling area. The landing chart (see figure 4) indicated a low intensity, steady red, obstruction light at an elevation of 1,504 ft, about 1,950 m from the ARP,

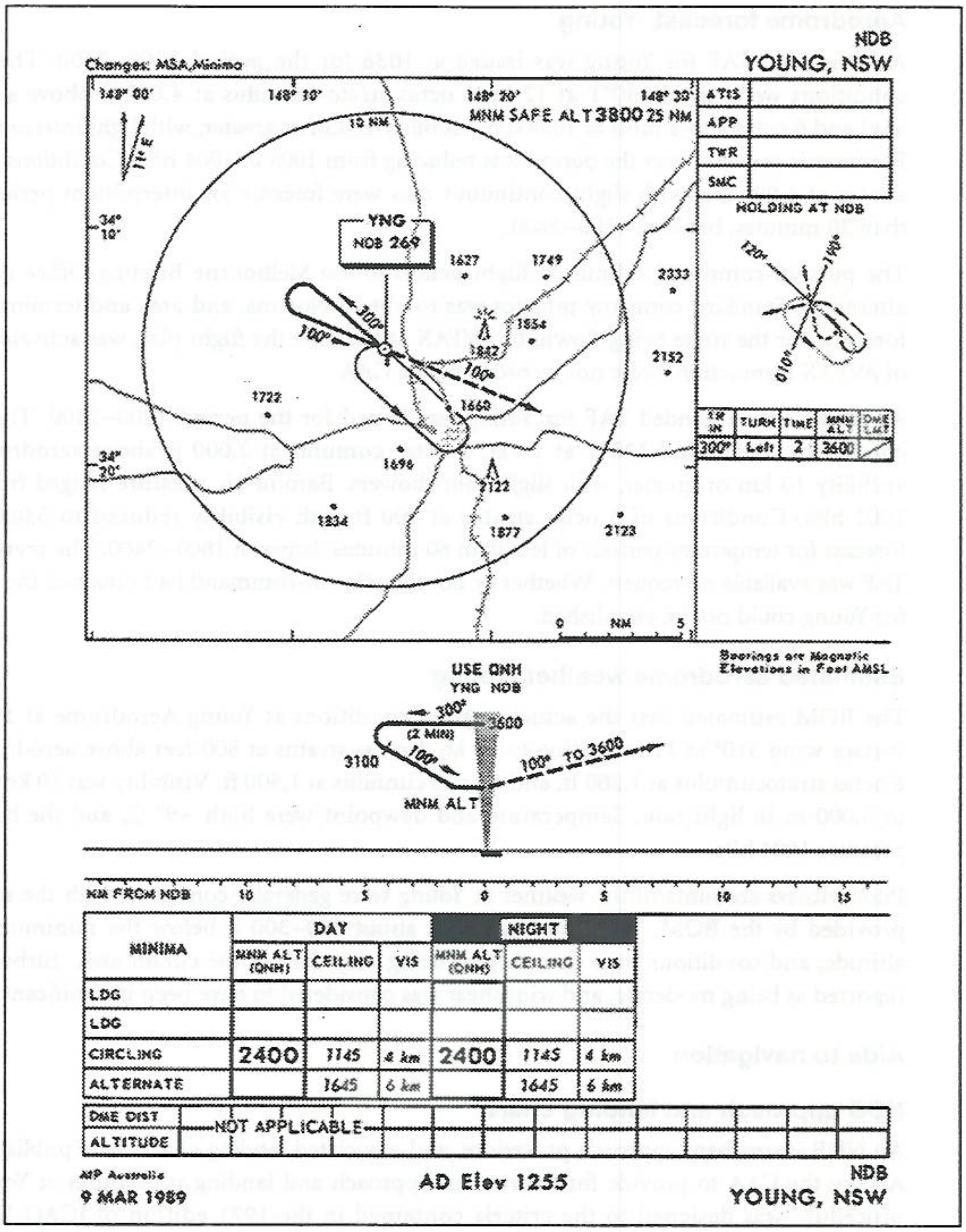

Figure 3 Young NDB Approach Chart

bearing 033°. An unlit spot elevation of 1,431 ft, was also indicated at a distance of about 1,945 m from the ARP, bearing 230°. The IAL chart legend states that a spot elevation does not necessarily indicate the highest terrain in the immediate area. This is repeated with a caution in AIP/DAP 1-1. The terrain struck by the aircraft was not marked on the NDB approach chart, and lay outside the boundary of the landing chart.

1.8.2 NDB approach and landing procedures

The Young NDB approach procedure provides for aircraft to descend to a minimum circling altitude of 2,400 ft (1,145 ft above the aerodrome elevation) by day or night. The meteorological minima required to conduct a circling approach to land is a ceiling of 1,145 ft and a flight visibility of 4 km, within the aerodrome circling area. In accordance with the provisions of

AIP/DAPS IAL - 2.1.5, continued descent below the minimum circling altitude is permitted provided that:

(a) the aircraft is maintained within the circling area;

(b) visual reference can be maintained (meaning clear of cloud, in sight of ground or water and with a flight visibility of not less than the minimum specified for circling);

(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,

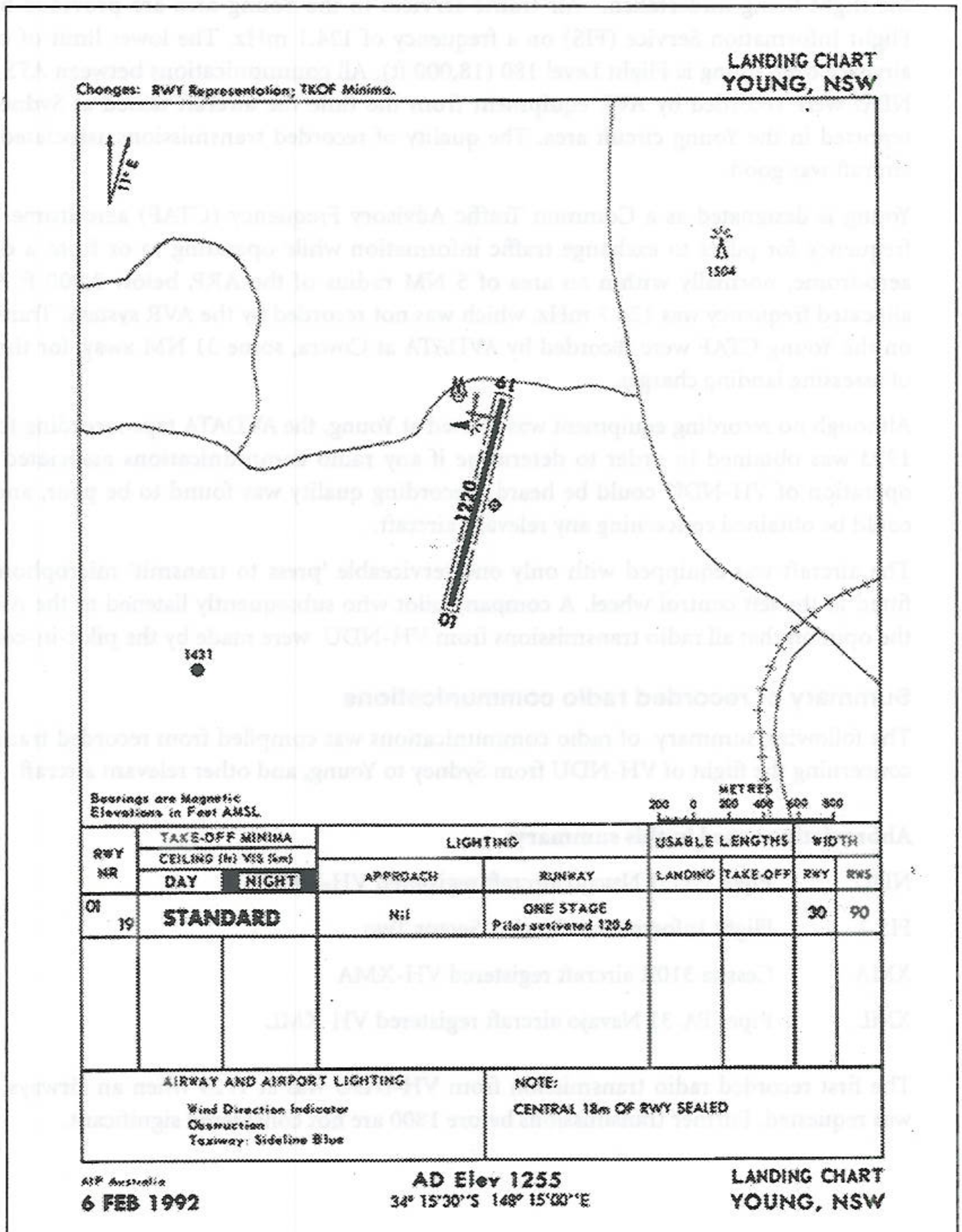

Figure 4 Young Landing Chart

(d) obstacle clearance of at least 300 feet for category B aircraft is maintained along the flight path until the aircraft is aligned with the runway, strip or landing direction to be used.

VH-NDU was a category B performance aircraft for the purpose of assessing obstacle clearance for descent below the circling minima.

1.9 Communications

1.9.1 Communications facilities

The aircraft was fitted with approved two-way radio communications systems appropriate for the flight being undertaken. Air traffic services in the Young area are provided by Sydney Flight Information Service (FIS) on a frequency of 124.1 mHz. The lower limit of controlled airspace over Young is Flight Level 180 (18,000 ft). All communications between ATS and VH-NDU were recorded by AVR equipment from the time the aircraft taxied at Sydney until it reported in the Young circuit area. The quality of recorded transmissions associated with the aircraft was good.

Young is designated as a Common Traffic Advisory Frequency (CTAF) aerodrome. This is a frequency for pilots to exchange traffic information while operating to or from a designated aerodrome, normally within an area of 5 NM radius of the ARP, below 3,000 ft AGL. The allocated frequency was 126.7 mHz, which was not recorded by the AVR system. Transmissions on the Young CTAF were recorded by AVDATA at Cowra, some 31 NM away, for the purpose of assessing landing charges.

Although no recording equipment was located at Young, the AVDATA tape recording for 11 June 1993 was obtained in order to determine if any radio communications associated with the operation of VH-NDU could be heard. Recording quality was found to be poor, and no data could be obtained concerning any relevant aircraft.

The aircraft was equipped with only one serviceable 'press to transmit' microphone switch, fitted to the left control wheel. A company pilot who subsequently listened to the AVR was of the opinion that all radio transmissions from VH-NDU were made by the pilot-in-command.

1.9.2 Summary of recorded radio communications

The following summary of radio communications was compiled from recorded transmissions concerning the flight of VH-NDU from Sydney to Young, and other relevant aircraft.

Abbreviations used in this summary:

NDU	Piper PA-31 Navajo aircraft registered VH-NDU
FIS 2	Flight Information Service, Sector Two
XMA	Cessna 310R aircraft registered VH-XMA
XML	Piper PA-31 Navajo aircraft registered VH-XML

The first recorded radio transmission from VH-NDU was at 1729 when an airways clearance was requested. Further transmissions before 1800 are not considered significant.

Time	From	To	Text summary
1801:07	NDU	FIS 2	The pilot contacts FIS and amends details, now tracking direct to Young, estimating Riley at 1813. Confirms maintaining 8000 feet and is instructed to call on 124.1 mHz at 1805. Indicates terminating flight at Cootamundra. FIS 2 advises area QNH is 1003 hPa.
1814:38	NDU	FIS 2	Riley at 1815 and estimating Young at 1835.
1820:13	NDU	FIS 2	Aircraft commences descent from 8000 feet.
1825:19	NDU	FIS 2	Pilot reports present level as 5500 feet in cloud and in 'pretty heavy' rain.
1836:19	FIS 2	NDU	The pilot is asked if he has reached Young. Replies that he has just slowed down a little. Revised estimate Young 1838.
1842:07	FIS 2	NDU	FIS 2 reminds NDU the time is now 1842. The pilot reports he is just coming up on Young for an NDB approach and will report again at 1900, or in the circuit.
1849:53	FIS 2	NDU	FIS 2 advises NDU of IFR traffic, Cessna 310 VH-XMA, departed Cowra at 1848 for Young, at 4000 feet, estimating Young at 1900.
1855:06	XMA	FIS 2	XMA reports leaving 4000 feet on descent.
1901:16	XMA	FIS 2	XMA advises climbing back to 4000 feet and holding 8 miles north of Young, waiting to see what NDU will do.
1901:33	FIS 2	XMA	FIS 2 advises additional IFR traffic is VH-XML, a Chieftain from Sydney, maintaining 8000 feet and estimating Young at about 1915.
1901:57	FIS 2	XML	FIS 2 advises XML that NDU has been making approaches for the last 20–25 minutes but has not become visual yet.
1903:25	NDU	FIS 2	The pilot reports he is on another overshoot out of Young and will come around for another approach, and will call again at 1915. Also copies additional traffic.
1905:37	XML	FIS 2	XML reports leaving 8000 feet on descent.
1911:10	XMA	FIS 2	XMA reports in the circuit area and cancels SARWATCH.
1914:05	XML	FIS 2	XML revises estimate for Young to 1918.
1915:30	NDU	?	'Just over the top' transmitted. Although no call sign was given, the voice was subsequently identified as probably being the pilot-in-command of VH-NDU.
1916:37	NDU	FIS 2	The pilot reports in the Young circuit area and cancels SARWATCH.
1916:44	NDU	FIS 2	The pilot acknowledges cancellation of SARWATCH. This was the last recorded transmission from the aircraft.
1919:40	XML	FIS 2	XML reports in the Young circuit area, landing runway 01. Cancels SARWATCH.

1.10 Aerodrome information

1.10.1 General

Young aerodrome is non-controlled and is operated by the Young Shire Council. It is located 6.5 km north-west of the town at an elevation of 1,255 ft. The aerodrome is equipped with a single 1,220 m runway designated 01/19, bearing 006°/186°, sloping down to the north at 0.4%. A terminal building and associated apron is located near the northern end of the runway.

An NDB radio navigational aid is located at the aerodrome. The NDB operates on a frequency of 269 kHz, with an effective range of 20 NM. Operation of the NDB is pilot monitored. There were no reports of any abnormal operation of the aid.

The aerodrome lies in a valley surrounded by low hills. Within the 3 NM radius aerodrome circling area the only illuminated obstacle is a hill, at an elevation of 1,504 ft, about 1,950 m from the ARP, bearing 033° (see figure 4). The steady red obstacle light is reported to have been illuminated and functioning normally. No visual approach slope guidance systems are installed.

1.10.2 Pilot activated lighting

Single stage, pilot activated, runway, taxiway and wind indicator lights are provided at Young aerodrome on a frequency of 120.6 KHZ. The operation of PAL is described in ERSA. Arriving aircraft should select the appropriate PAL frequency within 15 NM of the aerodrome and transmit three separate pulses within 25 seconds, each pulse being of between one and five seconds duration. The lights will then illuminate for 60 minutes. Shortly before the lights are due to extinguish, the wind indicator lights will commence to flash. At any time, repeating the activation procedure will provide a further 60 minutes illumination. The runway lights were checked during the afternoon preceding the accident, and at first light after the accident. No faults were reported. Other evidence indicates the lights functioned normally, and were on at the time of the accident.

VH-XMA had flown from Cootamundra to Young, arriving at about 1746. It departed shortly after for Cowra and eventually returned to Young, landing at 1912. The pilot of VH-XMA believes he activated the runway lights approaching Young prior to his first landing, as it was already dark. Without further activation, the lights would have turned off automatically at about 1841. He said that as a part of his normal procedures he would probably have re-activated the lights prior to landing at 1912. At no stage did the pilot of VH-NDU express any concern at the operation of the PAL. During the visual circling approach by VH-NDU the runway lights were observed to have been illuminated.

1.10.3 Aerodrome obstruction lighting

Guidance for the determination and marking of obstacles is contained in the CAA Manual of Operational Standards. That document defines an obstacle (in part) as any fixed or mobile object that extends above a defined surface. This surface is intended to protect aircraft in flight. In Chapter 3, para 2.7 it also specifies that:

> a fixed obstacle penetrating a Horizontal Surface shall be marked and, if the aerodrome is used at night, lighted except that;
>
> a such marking and lighting may be omitted when:
>
> i the object is conspicuous; or
>
> ii The object is shielded by another fixed obstacle; or
>
> iii for a circuit extensively obstructed by immovable objects or terrain, procedures have been established to ensure safe vertical clearance below prescribed flight paths; or
>
> iv an aeronautical study shows the obstacle not to be of operational significance.

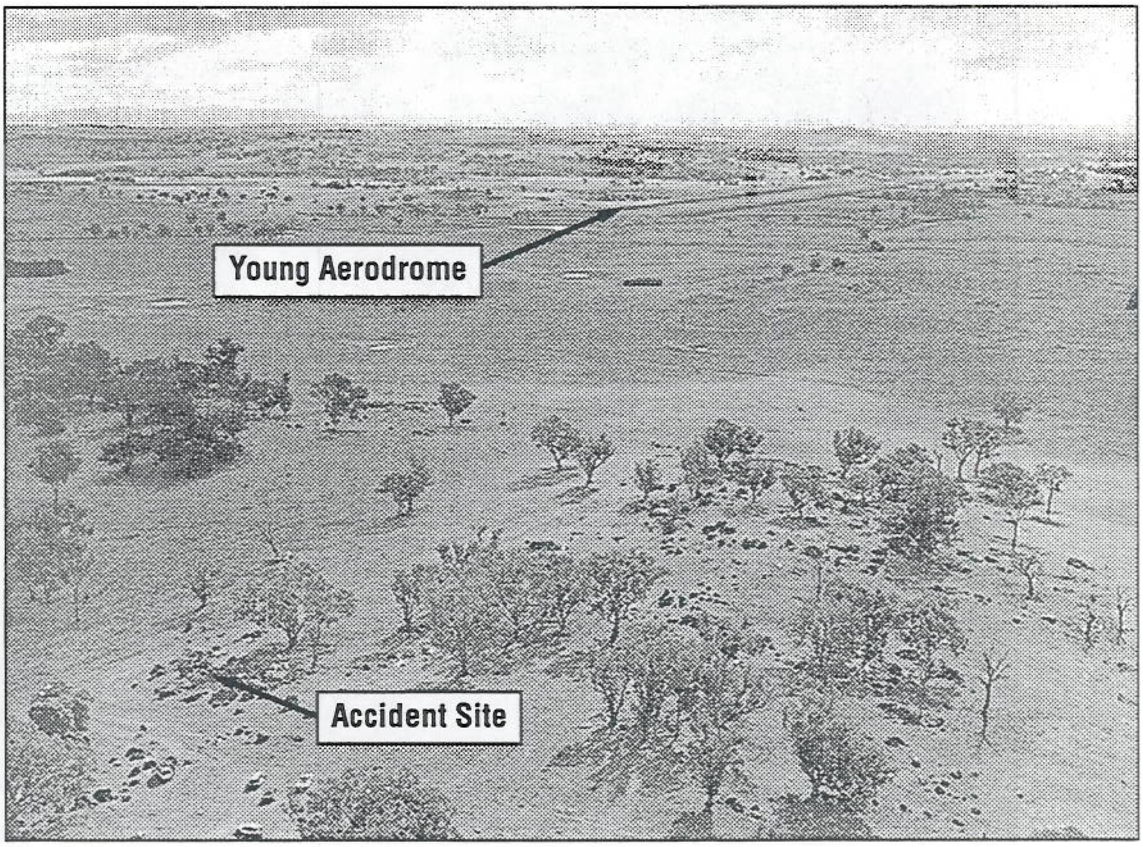

Figure 5 Aerial view (towards NNW) of accident site in relation to Young Aerodrome

Aerodrome standards for RPT aircraft, not above 3,500 kg maximum take-off weight, in the IFR category, are defined in the Civil Aviation Orders and provide for an inner Horizontal Surface surrounding an aerodrome to a radius of 4,000 m, at a height of 45 m.

Although the terrain struck by the aircraft did penetrate the inner Horizontal Surface, there was no obstacle marking or lighting provided. Although no definite reason was obtained, CAA officers suggested that this probably resulted from the application of (a)(iii) due to the extent of shielding by the surrounding terrain. This was reflected in a minimum circling altitude of 2,400 ft to provide a minimum of 400 ft obstacle clearance within the circling area.

1.11 Flight recorders

The aircraft was not equipped with a Flight Data Recorder, or Cockpit Voice Recorder, nor were these required by regulation.

1.12 Wreckage and impact information

1.12.1 Accident site description

The accident site was located on 'Golambo', a property off Milly Milly Lane, Young, NSW. The main body of wreckage lay within a rocky outcrop on a hill, at a height of 209 ft above the elevation of Young aerodrome, bearing 161° from the threshold of runway 01, at a distance of 2,215 m (see figure 5). The height of the initial impact with trees was 275 ft above the aerodrome elevation.The geographical co-ordinates of the accident site were 34° 15' S, 148° 15' E. The hill was lightly timbered with trees to a height of about 20 m.

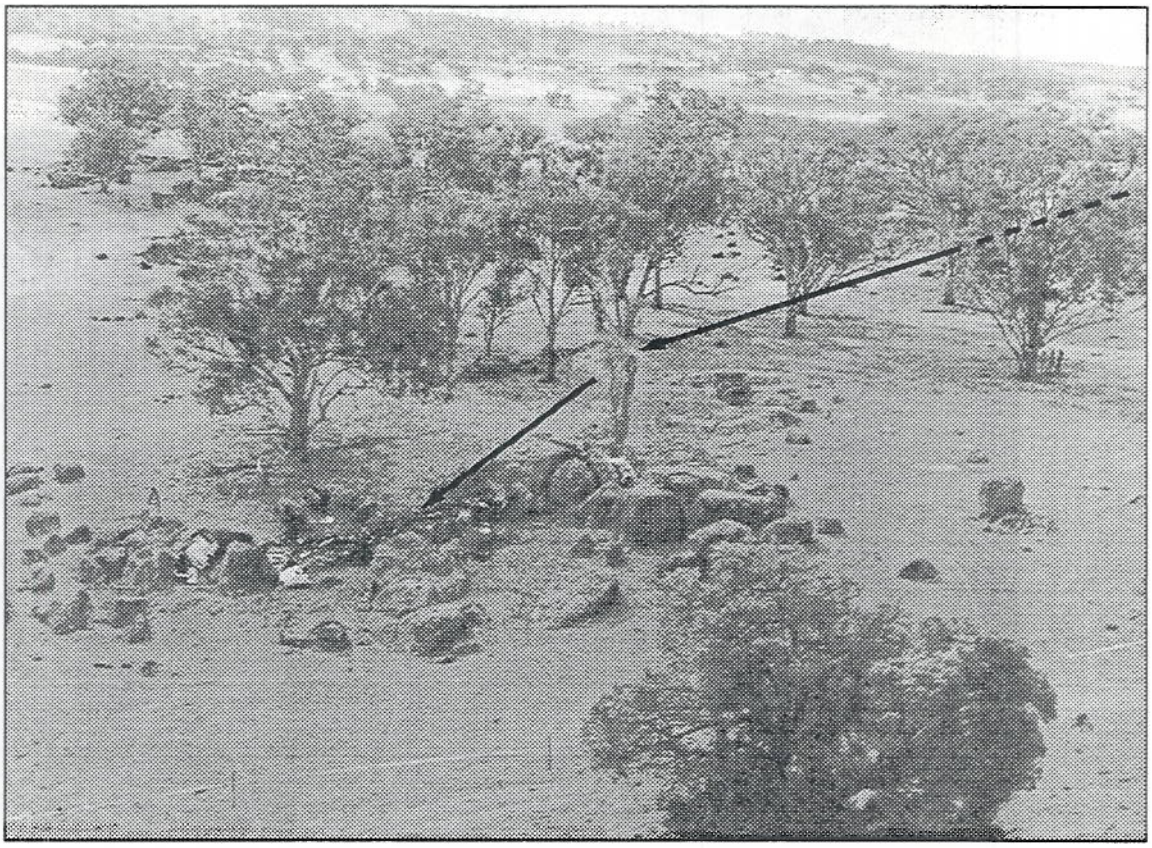

Figure 6 General view (towards NNE) of accident site showing direction of final flight path

Figure 7 Photograph of the first tree struck by the aircraft looking back along the flight path

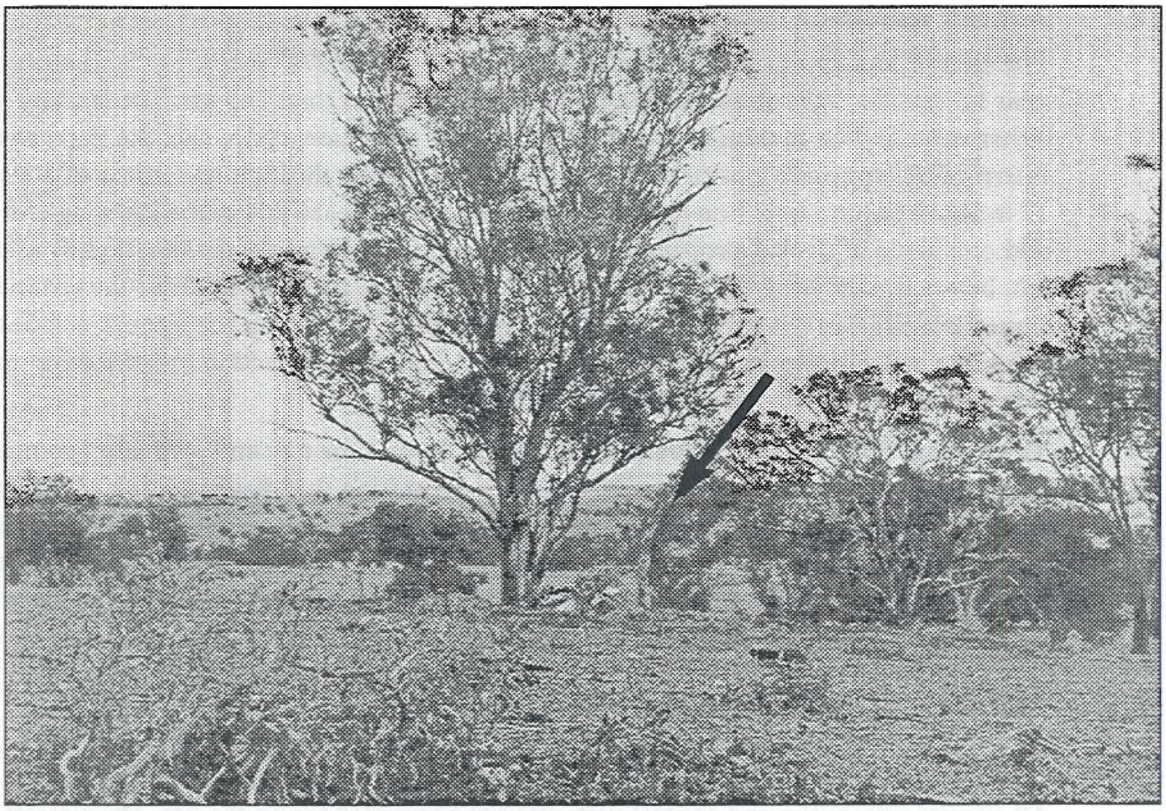

Figure 8 Photograph, looking along the flight path, from the first tree struck by the aircraft. The aircraft brushed against the tree (centre) before colliding with a third tree (arrowed).

Figure 9 The forward section of the aircraft was totally destroyed by impact forces and fire.

1.12.2 Aircraft wreckage description

The aircraft had approached the accident site on a track of 270° in a wings level attitude, in or near horizontal flight at an estimated groundspeed of less than 140 kts. The landing gear was either extended or nearing the completion of the extension cycle, and the flaps were in an intermediate approach position. The aircraft initially flew through the crown of a tree, some 12 m above ground level (see figure 7), removing the outboard end of the left wing and aileron, and one blade of the left propeller. It then continued for 50 m, descending slightly and rolling left, before the left wing brushed the side of a second tree about 13 m above the ground, which sloped downhill in the direction of flight. Some 40 m further on the aircraft collided with a third tree and disintegrated (see figure 8). Both wings, the tail section and the cabin roof were torn off and the left engine separated from the wing.

The fuselage then fell onto a boulder, some 10 m beyond the tree and split into two pieces. The wreckage was confined to a generally small area suggesting that disintegration of the aircraft as a result of tree impact had dissipated most of the aircraft's kinetic energy (see figures 9 and 10). The forward section of the fuselage came to rest on the right wing. Both were subsequently incinerated by a fire fed from an estimated 366 litres of AVGAS remaining in the wing fuel tanks. No evidence of in-flight fire was found.

1.12.3 Technical examination of the wreckage

1.12.3.1 Structure

All aircraft extremities and control surfaces were accounted for on the site. The aircraft damage was consistent with the application of excessive loads during the impact sequence, and the

Figure 10 The tail section of the aircraft was torn from the forward section by impact forces.

effects of the subsequent fire. No pre-existing defects likely to have contributed to the aircraft break-up were found.

1.12.3.2 Flight controls

An examination of the remains of the flight control system was carried out. Disruption of the cockpit controls precluded establishing their positions at the time of impact. With the exception of the wing flap system, in which an electric motor drives flexible shafts, all remaining control surfaces were cable operated. All control surfaces and actuating mechanisms were found to have been capable of normal operation. Due to individual cable runs being subjected to random tension loads during the impact sequence, resulting in uncommanded movement of the individual control surfaces, positive confirmation of the 'as found' position of the flight control surfaces could not be relied upon. No evidence was found of any pre-existing defect or malfunction of any part of the flight control system

1.12.3.3 Powerplants

Both engines were removed for further examination to determine their pre-impact status. The right engine sustained only superficial impact damage and was test run to ascertain its pre-impact status. Some fire damaged components such as the ignition harness and turbocharger unit had to be replaced or disconnected. The impact damaged alternator and hydraulic pump were also disconnected. During the test the engine ran relatively smoothly, without any apparent abnormality. The ignition harness had been burnt away in numerous locations making a comprehensive examination impossible.

The turbocharger compressor shaft rotated freely, the wastegate was in good condition, and there was nothing to suggest that the unit was not functioning normally prior to impact. The engine was run using the oil remaining in the engine after the accident. Following the test run the engine oil filter was examined for evidence of metallic contamination. None was found. It is considered that the right engine was capable of normal operation at the time of impact

The left engine sustained impact damage which precluded it from being test run. A strip examination found nothing likely to prevent normal engine operation or cause any significant degradation of power. It is considered that the left engine was also capable of normal operation at the time of impact.

1.12.3.4 Propellers

Both propeller hubs were disrupted and had separated at the hub to hub extension sections. Upon impact with the third tree the right propeller had broken up, liberating one blade and separating the remainder of the propeller from the engine. The left propeller had commenced to break up after the aircraft collided with the first tree, liberating one blade. The hub separated after the engine had been torn away from the wing and struck a boulder. Both hub extensions remained with their respective engines. Examination found no pre-existing defects or malfunctions likely to have contributed to the propellers breaking up, or to affect their normal operation prior to the impact. It was established that both propellers were under engine power at impact and were set almost identically within the fine pitch range.

1.12.3.5 Landing gear and hydraulic power

All three landing gear legs were extended, and their extension/retraction mechanisms were complete. However, due to their overall disruption, the locking status of each leg could not be positively determined. The cockpit selector handle, the hydraulic power pack selector spool and the shaft return cam were in positions consistent with 'Down' rather than 'Down neutral', suggesting that the extension cycle was not yet completed. The extension cycle is initiated by moving the landing gear selector handle to the 'Down' position. Once selected, the handle is locked in this position until it returns automatically to the 'Down neutral' position by a build up of hydraulic pressure in a delay valve, after extension of the landing gears and closure of wheel well covering doors is completed. Green landing gear indicator lights in the cockpit show the crew that the extension cycle has been completed.

1.12.3.6 Fuel system

The aircraft fuel system has an overall capacity of 727 litres and consists of two independent systems, left and right, comprising inboard and outboard fuel tanks, fuel filter, fuel tank selector and shut off valve. Pressure is provided by electric and engine driven boost pumps. Both systems are interconnected by a cross feed valve located on the left side of the aircraft. Only the selector valve, filter, pumps and shut off valve from the left system were recovered. Nothing was recovered from the right system.. The cross feed valve was also recovered. The fuel selector valve was found positioned so that all ports were covered, the fuel filter was clear, the boost pumps showed no damage likely to affect their normal operation and the shut off and cross feed valves were closed. The abnormal valve settings, which would have deprived the engine of fuel, are considered to have resulted from impact forces and related movement of their respective controls. None of the components showed evidence of anything likely to interfere with normal operation prior to impact. However, it was not possible to positively establish their pre-impact setting. As a result of aircraft disintegration and post crash fire no fuel sample could be collected for analysis. Laboratory analysis of a fuel sample taken from the last refuelling point at Sydney indicated that the fuel supplied to the aircraft was within the required specifications.

1.12.3.7 Instruments

Only a small number of the cockpit instruments were recovered for further examination, most having been badly damaged by fire. Nothing was found which might have precluded normal operation. The one air speed indicator recovered read 133 kts. The left altimeter pressure subscale read 1007.5 hPa and the right altimeter pressure sub-scale read between 1005 and 1006 hPa. It was not possible to positively determine their indications at impact.

Scuff marks were found on rotors of the electrically driven turn and bank indicator, and vacuum driven gyro motors, indicating that electrical power and vacuum were being supplied to appropriate instruments at the time of impact. Stretching of light bulb coiled filaments also confirmed the availability of electrical power at the time of impact.

1.13 Medical and pathological information

A post mortem examination of the flight crew and passengers was conducted by the NSW Institute of Forensic Medicine. The six occupants who were not evacuated from the aircraft were all found to have died as the result of multiple injuries and incineration. The passenger who was evacuated survived for a further 10.5 hours before succumbing to the effects of multiple injuries and burns.

Toxicological analysis by the NSW Health Department Division of Analytical Laboratories did not reveal the presence of any drug , including alcohol, which might have had an adverse effect on the occupants of the aircraft. A small amount of Pholcodine, a cough suppressant, was found in the remains of the pilot-in-command. In the opinion of the CAA Aviation Medicine Branch, this was insufficient to adversely affect his performance. Carbon monoxide saturation levels ranged between 3.0% to 10.0% saturation and are considered to have been within the normal range.

Figure 11 Photograph showing the seat (right) occupied by the sole passenger who survived the initial impact.

There was no evidence found to indicate that the flight crew suffered from any pre-existing condition which could have affected their capacity to function normally. Both pilots held current Class 1 medical certificates issued by the CAA, with nil restrictions.

1.14 Fire

During the final stages of the impact sequence the fuel tanks were completely disrupted, releasing an estimated 366 litres of Avgas. Ignition is considered to have resulted from electrical arcing and/or contact with high temperature engine components.

1.15 Survival Aspects

1.15.1 General

All occupants of the aircraft had suffered injuries consistent with high impact forces, aircraft breakup, and consequent fire. One passenger seated in the detached rear section of the cabin (see figure 11) survived the impact but was unconscious when found by rescuers. Although restrained by a lap type seatbelt she had suffered severe head injuries and was severely burnt in the ensuing fire before being rescued, dying later in hospital. All the other occupants had been located in the forward section of the cabin and were incinerated in the post crash fire, which began during the impact sequence. The speed and intensity of the fire, and the impact injuries suffered by the occupants, prevented any possibility of escape from the aircraft. The circumstances of the impact dynamics and subsequent fire were such that the accident was considered to have been non-survivable. As a result, the investigation of the survival aspects of the accident was limited to the notification and response of the emergency services.

1.15.2 Emergency services response

At about 1918 the pilot of VH-XMA telephoned 000 from the public telephone box at Young airport. He was connected to an operator at the Orange telephone exchange, who asked him which service he wanted and subsequently transferred him to the Goulburn Ambulance Control Centre. At 1920 the control centre notified the Young Ambulance service and then the Young Police Station. Some minutes after the accident, a volunteer firefighter who was at the Young airport drove into town and alerted the Fire Brigade. It was not until 1936 that the Young Fire Brigade was notified by the ambulance control centre, by which time the brigade had already responded to the crash. The Fire Brigade telephoned the Young Police at 1939 to confirm it had been notified of the accident.

1.16 Tests and research

1.16.1 Computer amplifier static line test

The investigation established that the autopilot computer amplifier and flight controller had been removed from the aircraft prior to the accident. The effect of the removal of those components on the primary flight instruments was considered, including whether the static line to the computer amplifier had been blanked off at the time that component was removed from the radio bay in the nose of the aircraft. Evidence was obtained from maintenance personnel that the static line had indeed been blanked off, but no certification to that effect could be found. Wreckage examination could not determine if the static line had or had not been blanked.

A test was devised to measure the effect on the altimeters if the static line had been left open. A PA31 aircraft was used, with the right altimeter disconnected from the static line. The line was carefully blanked in order to ensure the rest of the static dependent instrumentation was unaffected. During the subsequent test flight the aircraft was climbed and descended while the pilot and co-pilot altimeter indications were recorded on videotape. Later analysis showed that opening of the static line into the cockpit resulted in the right altimeter overreading in the order of 90–110 ft, the difference increasing by about 50 ft during climb and decreasing by the same amount during descent. Thus, had the line been left open the maximum difference between the altimeter indication and the true altitude would have been about plus 150 ft during climb and about plus 100 ft during descent. Any difference in static pressure between the cockpit and the nose radio bay is considered to be insignificant.

1.16.2 Computer graphics simulation

Computer graphics simulations of the Young airport runway lighting were prepared by the Bureau using its computer graphics facility.

Three views were provided to simulate the appearance of the runway lights when viewed from the vicinity of the accident site. The simulations represented the view of an observer positioned at or above the accident site at heights of;

(a) 275 ft, the height of the accident site above the aerodrome

(b) 300 ft assumed obstacle clearance height above the elevation of the aerodrome

(c) 1,145 ft, the minimum circling height above the aerodrome.

In each view, the lights appeared as a tight group. The simulation showed that, when viewed from the vicinity of the accident site, the runway lights would have enabled the pilots to judge their lateral position in the circuit, but would not have provided easily interpreted information on their height above the runway.

1.17 Civil Aviation Authority

1.17.1 The functions of the CAA

In his 1987 statement 'Domestic aviation: a new direction for the 1990s', in which he announced the establishment of the CAA, the then Minister for Transport and Communications stated that part of the Government's major reform objective was:

> 'a continuation of Australia's world renowned aviation safety record'.

The Minister also stated '…that the Australian Civil Aviation Authority will be required to give primacy to safety considerations over commercial ones…'

The Civil Aviation Act 1988 was assented to on 15 June 1988 as:

> An Act to establish a Civil Aviation Authority with functions relating to the safety of civil aviation, and for related purposes

The functions of the CAA are specified in Part II Section 9 of the Act. Section 9 (1) states in part 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.

In its 1992/93 Annual Report the CAA outlined its Mission as follows:

> 'The Authority's mission is to enable more people to benefit from safe aviation through a focus on safety, efficiency and service' (p-21).

At the time of the accident the safety regulation of civil air operations fell within the responsibility of the SR&S Division.

At the Bankstown district office of the CAA were displayed the 'Vision' and 'Mission Statement' of the SR&S Division, plus an accompanying 'Quality Policy Statement' signed by the General Manager, SR&S Division on 6 July 1992.

The vision was: *A safe and viable industry.*

The associated mission statement stated:

> Safety Regulation and Standards Division is a customer orientated team, providing consistent, timely and effective regulatory functions, at a minimum cost, to foster a safe and viable industry.
>
> We will, in consultation with industry, government and the community:
>
> - Set and promulgate minimum acceptable standards;
> - Ensure industry compliance through education, surveillance, counselling and enforcement; and
> - Delegate regulatory services to the greatest extent practicable while retaining responsibility.

The areas of responsibility of the SR&S Division at the time of the accident included:

- aviation standard setting and legislative development;
- regulatory services;
- licensing of flight crew and aircraft maintenance engineers;
- aviation medicine;
- safety promotion and training;
- industry surveillance;
- industry certification;
- publications.

1.17.2 CAA air operator certification and surveillance

1.17.2.1 Overview

In accordance with the provisions of Section 27 of the Civil Aviation Act, the CAA may issue AOCs to authorise flying or operation of an aircraft within Australian territory for commercial purposes, subject to conditions specified by the Authority. An AOC will be issued unless the applicant has not complied with, or has not established the capability to comply with, the provisions of the regulations relating to safety, including provisions relating to the competence of persons to conduct operations of the kind to which the application relates.

Section 28 of the Civil Aviation Act provides for the exercise of discretion by the Authority regarding the issue of an AOC. There is no provision to not issue an AOC, or to suspend or cancel an AOC, on grounds relating to the financial circumstances of the applicant or AOC holder.

Tealjet Pty Limited, trading as Monarch Air was issued with CAA Air Operators Certificate, NSW 20, on 6 November 1991 which authorised the conduct of regular public transport operations for an indefinite period between specific aerodromes, including Sydney/Young. The certificate also authorised the use of Piper PA31-350 type aircraft for the carriage of up to 10 passengers. The Certificate was issued by the Bankstown DFOM of SR&S. The AOC was subsequently re-issued as BK 026 when Monarch Airlines was transferred to Natrave Pty Limited.

As noted above, Section 28 of the Civil Aviation Act provides for the exercise of discretion by the Authority with respect to the issue of an AOC. The effect of this section is to prevent the Authority imposing or varying a condition in respect of an AOC, or suspending or cancelling an AOC, except with regard to the establishment of the capability to comply with the provisions of the Civil Aviation Regulations relating to safety, including provisions relating to the competence of persons to conduct operations of the kind specified.

The effect of the requirements of the Civil Aviation Act and Regulations concerning the certification and surveillance of air operators is provided by the MAOC which states:

> The issue of an AOC certifies that the standard of personnel, aircraft, documentation and facilities of an operator were adequate at the time of issue to ensure that the air services of that operator could be conducted safely and in accordance with the regulations.

It then describes the subsequent program of annual surveillance and inspections by the CAA necessary to ensure that the ongoing operation continues to meet the required standards.

In addition, standardised practices and procedures for the conduct of airworthiness surveillance were specified in the NASS Policy and Procedures Manual. Section 1.1 of that manual stated:

> The purpose of this manual is to document standardised practices and procedures by which Airworthiness Officers engaged in airworthiness surveillance activities will be able to plan, conduct, record and report those activities in an effective and efficient manner. This will ensure that safety regulation of the aviation industry is conducted in an equitable manner whilst at the same time providing the Authority with a means to effectively control its surveillance activities.

The CAA SR&S district office for the area in which an operator maintains its main base normally had responsibility for the flight operations and airworthiness surveillance of that operator. The MAOC states:

> When planning individual work schedules, senior examiners and surveyors should ensure that inspections and surveillance are given the necessary priority. If, during the year, it becomes apparent that the minimum level of surveillance may not be achieved in some area, the senior examiner/surveyor should take immediate steps to have resources allocated to the area in question.

Details of specific inspections were provided in the MAOC, and included information on the purpose, frequency, methods, conduct, reporting and follow-up of inspections. The MAOC also provided checklists to facilitate those inspections. Types of specific inspections included, en route, training, facilities, document and records inspections. The target level of coverage for each inspection activity was also listed in the manual.

The purpose of en route flight inspections was specified on page 10-A1-1 and included:

- assessment of the operating proficiency of the crew
- assessment of the operational effectiveness of the current company procedures
- assessment of the operational effectiveness of other elements inter-reacting with the flight.

En route inspection of flight operations had a target level of 0.5% of revenue hours, ie. five hours of en-route inspections per 1,000 hours. A Policy Advisory document issued by the Regional Flying Operations Manager provided for a reduction to 0.25% for operators with an approved Quality Assurance (QA) system. Monarch did not have an approved QA system. Inspection of documents included the provision of 33% of the Operations Manual and 33% of the Check and Training Manual as the annual target level for inspection of those documents, with the proviso that operations specifications contained in each manual must be reviewed each year to confirm continued applicability. Other manuals were to be checked at five year intervals for each manual. Ramp checks were to be planned on the basis of two checks per aircraft type per year.

In addition to the provisions of NASS, procedures for the airworthiness surveillance of operators by the CAA were promulgated in the MAOC. Annual inspections could be conducted as a joint operations/ airworthiness exercise, if required. Airworthiness surveillance of an operator's aircraft, which could be carried out at any time, was to concentrate mainly upon ramp inspections and line aircraft inspections. If the holder of the AOC was also an approved aircraft maintenance organisation then the surveillance should cover all activities specified in the certificate of approval. Airworthiness inspection checklists were also provided in the MAOC and the NASS Policy and Procedures Manual.

1.17.2.2 Division of responsibility

At all but the highest levels of the SR&S Division, responsibility for the standards of regional airlines was divided between operational and airworthiness personnel. At the district office level airworthiness surveillance was conducted by airworthiness inspectors and flight operations surveillance was conducted by FOIs. Those inspectors in turn reported to different district office managers, who in turn reported to different regional managers. Although there were regular discussions between operational and airworthiness personnel concerning SR&S matters, the lowest formal level of management in the CAA at which a single individual became responsible for the entire performance of a regional airline was the General Manager of the SR&S Division.

1.17.2.3 Surveillance of flight operations

The Bankstown DFOM was responsible for the planning and implementation of a surveillance program concerning the flight operations of each operator within that area. Monarch Air fell within the area of responsibility of the Bankstown district. A FOI was assigned to oversee the operations of Monarch Air. The assigned FOI at the time of the accident said he had taken over responsibility for the oversight of Monarch operations in mid-August 1992. He said that as part of his normal duties he had been assigned about 40 AOC holders, which included aerial agriculture, charter and flying school operators. Monarch Air and Southern Airlines were the only RPT operators assigned to him.

The flying experience of the assigned FOI was gained mainly as a military pilot. He had limited experience in civil aviation before joining the CAA in February 1989. He said that the training to cover his required duties had been obtained 'on the job', observing other FOIs carrying out flight tests, and conducting AOC document surveillance. When he had joined the CAA about 90% of his time was directly involved with flight duties, the remaining 10% allocated to paperwork. Since a resources review of the CAA in 1991 it was his belief that about 90% of his time was now devoted to paperwork. He believed that this resulted from fewer people having to carry out the same overall volume of work.

From February 1992 until early April 1993 he had also acted as the Deputy DFOM at Bankstown. For a considerable amount of that time he had relieved the DFOM during absences by that officer. He estimated those duties took up about 75% of his time, the remaining 25% being divided up on a priority basis, as he was expected to administer the AOC holders assigned to him. The assigned FOI said he understood that part of the surveillance program required the en route checking of RPT operations. He said that requirement had initially been 0.5% of revenue hours flown by an operator, but had been 'officially' changed to 0.25% earlier in 1993. He believed that during the past two years no one in the Bankstown office had come anywhere near to meeting the prescribed requirements of the surveillance program, due to the consequences of the resources review providing insufficient staff to carry out the required work.

On 1 September 1992, after being assigned to Monarch, the FOI had a meeting with the Chief Pilot and conducted a document inspection. His next planned visit was to inspect the check and training system during the December 1992/January 1993 period. However, this was not done. Although he had a number of meetings with the GM and Chief Pilot of Monarch, as well as being involved with ramp checks, the assigned FOI did not carry out any surveillance flights with Monarch. He said at no stage was he aware that VH-NDU was being operated with the RMI and HSI inoperative. If he had known he would have stopped the operation.

An examination of flight records for the period 1 July 1992 - 16 June 1993 showed that Monarch PA31-350 aircraft had flown approximately 2,778 hours on RPT services. When averaged on a monthly basis, to take into account variations in the number of aircraft being operated, the expected annual rate of revenue flying was 3,420 hours. This should have resulted in a minimum of approximately 14 hours of en route surveillance during that period, and an expected annual rate of 17 hours. No surveillance of en route flight operations was carried out during that period by the assigned FOI. However, in the latter part of 1992, another FOI did supervise the conduct of a flight for the purpose of assessing the former Chief Pilot for route checking approval.

1.17.2.4 Airworthiness surveillance

An examination of CAA records, and discussions with a Senior Airworthiness Inspector, indicated that CAA Airworthiness had a number of dealings with the company over the 12 months preceding the accident. Monarch had a history of high maintenance staff turnover which generated concern within Airworthiness. As a result, Airworthiness inspectors made a number of visits to check documents and aircraft. Some visits also occurred in response to complaints by other parties. Consequently, the formal airworthiness surveillance program, as called for by NASS and the MAOC, was superseded by an ad hoc series of visits in reaction to events. However, information obtained from CAA and Monarch records, and from interviews, indicated that airworthiness inspectors were actively involved in pursuing Monarch issues.

In early 1993 the then Certifying LAME of Monarch compiled a Maintenance Control Manual and nominated himself as Maintenance Controller, together with a Deputy Maintenance Controller, who was a line pilot. This was approved by the CAA in February 1993. Shortly after, this LAME left Monarch and the deputy took over the position of Maintenance Controller, a position he held until his death in the accident. Another Certifying LAME was appointed, but stayed for only a few weeks. In early April 1993 Airworthiness officers visited Monarch and spoke to the Maintenance Controller and the GM about what maintenance was being performed, and how it was certified. They were advised that another Certifying LAME had been hired. However, he was not on site at the time of the visit, nor was there any work package raised for an aircraft currently undergoing maintenance.

Questions were raised about this, and the CAA Airworthiness officers were given assurances that all would be rectified. A second visit was then made after a Maintenance Release for the aircraft had been issued, but many deficiencies with documentation were found, before finally being rectified. As a result of this, and of the Certifying LAME having notified CAA of his intention to leave Monarch, maintenance activities were suspended until a suitable LAME could be appointed.

The GM of Monarch subsequently notified CAA Airworthiness on 30 April 1993 of the appointment of another LAME, and applied for another person to be appointed as Maintenance Controller. This LAME remained with Monarch for only a short period before being replaced by another LAME in May 1993. This LAME remained with Monarch until shortly after the accident on 11 June 1993. The Maintenance Controller was not replaced.

On 14 April 1993 the acting DAM wrote a Note for File that a LAME from another organisation had been asked by the GM of Monarch on 7 April 1993 if he could supply two suitably licenced LAME's to perform, supervise and certify maintenance on two PA31-350 aircraft. This was agreed and maintenance inspections on VH-RDL and VH-TXK were completed. The LAME declined the offer from the GM that he should carry out all maintenance on Monarch aircraft. However he was obliged to complete two jobs already started, including the rectification of the autopilot in VH-NDU.

The LAME reported that when he removed the autopilot computer amplifier for repair, he found the unit was needed to enable the compass system to function properly. The computer amplifier was refitted and the aircraft dispatched with the autopilot inoperative. As the 10 day maximum period for that item as per the MEL had now expired, the GM of Monarch Airlines wrote to the acting DAM on 16 April 1993 requesting a PUS to allow the continued operation of VH-TXK and VH-NDU with inoperative autopilots. Although the letter stated that autopilot components had been removed from VH-TXK for repair, and that autopilot components from VH-NDU were to be sent for repair, a permissible unserviceability document for VH-NDU was issued, valid to 16 May 1993.

The text of the permissible unserviceability document is shown below:

> Pursuant to Regulation 37 of the Civil Aviation Regulations, INOPERATIVE AUTOPILOT is approved as a permissible unserviceability for Piper PA31-350 aircraft registered VH-NDU, subject to the following conditions:
>
> 1. ALL CONDITIONS DEFINED IN THE MONARCH AIR MINIMUM EQUIPMENT LIST PAGE 22-1 OF APPENDIX 3 MUST BE STRICTLY ADHERED TO;
> 2. THE NAMES OF BOTH PILOTS MUST BE ADVISED TO CAA BY ENTRY ON EACH FLIGHT PLAN PRIOR TO LODGEMENT; AND
> 3. PRIOR TO FURTHER FLIGHT, MONARCH AIRLINES ARE TO ENSURE THAT THIS UNSERVICEABILITY IS ENTERED INTO "DEFECT HOLD - FORM MA7" IN ACCORDANCE WITH THE PROCEDURES OF THE CURRENT ISSUE OF THE MONARCH AIR MAINTENANCE CONTROL MANUAL.
>
> This permissible Unserviceability is valid to midnight Sunday 16 May 1993 E.S.T., or until the required components are available for refitment to the aircraft, WHICHEVER OCCURS FIRST.

A joint Flight Operations/Airworthiness ramp check was conducted by the CAA at KSA on 19 April 1993 to verify that the operator was complying with the terms of the permissible unserviceability document issued for VH-NDU. The following deficiencies were found during the course of the ramp check:

- The autopilot unserviceability had not been entered into Form MA-7 as directed.
- The names of both pilots had not been advised to the CAA as directed.
- The second pilot did not hold an instrument rating as required by the provisions of page 22-1 of the MEL.
- The original copy of the permissible unserviceability document was not carried in the aircraft.
- The approved MEL was not carried in the aircraft. An FAA Master MEL was carried, which did not include the requirement for both pilots to be IFR rated.

An airworthiness inspector reported that, during the course of the ramp check, he had a discussion with the Monarch GM and Chief Pilot concerning the MEL requirement for both pilots to be IFR rated. Both the GM and Chief Pilot claimed the MEL stated 'suitably rated pilots', whereas the airworthiness inspector thought that the MEL called for both pilots to be IFR rated. At that point, an FOI (not the assigned FOI) commented that in the absence of a CAA-approved copy of the MEL, and despite advice from the airworthiness inspector, the responsibility for dispatch of the aircraft was that of the Chief Pilot of Monarch and the pilot-in-command. The aircraft subsequently departed on an RPT service with those deficiencies unchanged. It was later confirmed that the Monarch Air MEL for VH-NDU required two instrument rated pilots, endorsed on the aircraft, to be carried for flight with an inoperative autopilot.

As a result of the ramp check, the Bankstown A/DAM consulted with the DFOM about the circumstances and seriousness of the breaches and recommended that Monarch Air be asked to show cause as to why its AOC should not be varied, suspended or cancelled. The DFOM also was considering action against the Chief Pilot as well as the AOC holder. The A/DAM also referred these matters to the Regional Airworthiness Manager for urgent action.

The DFOM wrote to the Chief Pilot on 21 April 1993 asking him to 'show cause' why his approval as Chief Pilot should not be cancelled. The GM was also asked to 'show cause' why Monarch's AOC should not be suspended, should the approval of the Chief Pilot be cancelled. Responses by the Chief Pilot and GM to the 'show cause' letters were provided to the DFOM on 6 May 1993. A meeting then was held between the CAA and Monarch management at Bankstown on 7 May 1993 to resolve the issues raised by the ramp check, and other airworthiness matters associated with the operations of Monarch. A letter to cancel the approval of the Chief Pilot was subsequently prepared but not sent, as he resigned from that position on 17 May 1993. A new Chief Pilot was approved on the same day.

On 14 May 1993, in response to a letter from the GM of Monarch requesting an extension of the PUS to obtain extra wiring diagrams to facilitate repairs, the autopilot permissible unserviceability document for VH-NDU was re-issued with the following text added:

> THIS DOCUMENT IS TO BE CARRIED ONBOARD AIRCRAFT VH-NDU AT ALL TIMES AND IS TO BE SHOWN ON REQUEST BY AN OFFICER OF THE CIVIL AVIATION AUTHORITY.

The document was valid to midnight on Wednesday 16 June 1993.

During the course of the investigation the A/DAM who had issued the PUS for VH-NDU said the document did not permit the aircraft to be flown on RPT operations with the autopilot components removed.

1.17.2.5 Summary of safety regulation and surveillance of Monarch Airlines

The following is a summary of CAA safety regulation and surveillance of Monarch Airlines during the period, 11 June 1992–11 June 1993. This information was obtained from an examination of CAA files.

28 August 1992 — The FOI assigned to Monarch advised the Wagga DFOM of problems with the company and another operator. The FOI and an Investigations officer 'will monitor things for a while'.

1 September 1992 — The assigned FOI met with the Chief Pilot and inspected documents. The Chief Pilot assured his willingness to ensure compliance with CAA requirements. Staff were going through a learning process.

Issues to be addressed were:

Check and Training
- two checks per year to be conducted
- records to be maintained

Emergency procedures proficiency
- pilots to be certified annually
- Flight and duty records to be kept.

13 October 1992 — Report by assigned FOI on ramp checks conducted at Cowra and Cootamundra on 9 October 1992. The check at Cowra was satisfactory. The check at Cootamundra was cancelled as the Monarch flight did not operate due to lack of passengers.

The FOI proposed to undertake planned en route surveillance of Monarch, commencing this month (October). Would also like to follow up with unannounced surveillance flights. Also intended to organise at least one ramp check along similar lines to those conducted on 9 October, and to conduct specific checks of Monarch passenger manifests, rosters and fuel load. Anecdotal evidence that Monarch were operating overweight.

30 November 1992 — Airworthiness inspectors visited Monarch regarding a complaint concerning engine TBO for VH-WZW.

3 February 1993 — At a meeting between Airworthiness Inspectors and the GM of Monarch, the GM undertook to ensure compliance with the regulatory requirements regarding the Maintenance Controller. The CAA commented to the effect that it considered a line pilot operating for up to 12 hours per day could not be expected also to fulfil the functions of the Maintenance Controller.

9 February 1993 — Airworthiness inspections carried out on VH-WZW and VH-TXK. Some serious non-conformances identified which needed to be addressed as a matter of urgency. Maintenance Controller heavily involved with line flying.

11 February 1993 — At a further meeting with the GM and Chief Pilot, discrepancies identified in maintenance control were discussed, including defect reporting and recording, use of the MEL, and certification procedures. The Maintenance Controller did not appear to be fulfilling that function.

	Pilots were also not recording defects, as found in a review of VH-TXK and VH-WZW maintenance records.
	Monarch was advised that it was clear that their failure to observe all of the requirements of the MCM was in breach of regulatory requirements. The GM was directed to respond in writing by 15 February 1993.
30 March 1993	Monarch was required to surrender all maintenance records of VH-TXK and VH-NDU to Bankstown Airworthiness for examination.
2 April 1993	The LAME responsible for certifying Monarch Air maintenance operations withdrew his services.
8 April 1993	A letter was sent to the GM, Monarch Air, from CAA Airworthiness requesting that no maintenance be carried out by Monarch until a suitable LAME was engaged.
16 April 1993	Monarch GM applies for PUS to permit continued operation of VH-NDU with an inoperative autopilot. PUS issued, valid to 16 May 1993.
19 April 1993	A ramp check was carried out at KSA to verify whether Monarch was complying with the conditions of the PUS for VH-TXK and VH-NDU. A number of deficiencies were found, including identified breaches of the CAR's concerning the operation of VH-NDU. The aircraft was permitted to operate RPT flights on the responsibility of the Chief Pilot and pilot-in-command.
	As a result of the ramp check, a recommendation was made by the acting DAM to DFOM that Monarch be asked to show cause as to why its AOC should not be varied, suspended or cancelled. The DFOM was also to consider taking action against the Chief Pilot.
21 April 1993	A show cause letter was sent by the DFOM to the Chief Pilot asking him to state why his Chief Pilot approval should not be cancelled as a result of the ramp check at KSA on 19 April 1993. If the response is considered to be unsatisfactory the DFOM proposes to suspend Monarch AOCs until such time as a new Chief Pilot is appointed. The Monarch GM was also asked to show cause why action should not be taken. A response was required by 7 May 1993.
29 April 1993	The Chief Pilot was granted route checking approval to cover Southern Airlines operations.
6 May 1993	Both the Chief Pilot and GM respond to the show cause letters.
14 May 1993	PUS for VH-NDU reissued in response to a letter from Monarch GM. PUS valid to 16 June 1993.
17 May 1993	A letter was prepared to permanently withdraw the approval of the Chief Pilot; however, the letter was not sent as the Chief Pilot resigned from that position on the same day.
17 May 1993	A new Chief Pilot was nominated by Monarch.
24 May 1993	A meeting was held between the new Chief Pilot and the assigned FOI to discuss problems with Monarch.
28 May 1993	A letter approving the new Chief Pilot signed by the CAA.

1.18 NSW Air Transport Council

Regular public air transport services within NSW are required to be licenced in accordance with the provisions of the Air Transport Act of NSW. The Act provides for an Air Transport Council consisting of five members. In general, its principal functions are to advise the NSW Minister for Transport on:

- Any application for a licence
- Any proposal to revoke, vary or suspend a licence
- To determine application and licence fees under the Act
- To exercise functions delegated by the Minister under the Act
- To advise the Minister on such matters as the Council thinks fit

An Executive Officer and other staff are employed to enable the Air Transport Council to exercise its functions.

Section 6(3) of the Air Transport Act states:

> In deciding whether to grant or refuse a licence and the conditions, if any, subject to which it should be granted, the Minister shall have regard to such of the following matters as to him seem appropriate and to no other matters:'.

One of those matters is specified in sub-section 6 (3) (d) which states:

> where the applicant is an individual, his character and suitability and fitness to hold the licence applied for and, where the applicant is a corporation, the character of the persons responsible for the management or conduct of the corporation and the suitability and fitness of the corporation to hold the licence applied for.

At the time of the accident, Monarch Airlines was the licence holder of a State of NSW Air Transport Licence No. 92164, expiring on 30 October 1993. The licence authorised Monarch Airlines to carry passengers by air on the Sydney-Cowra-Forbes-Condobolin-West Wyalong route, and the Sydney-Cowra-Young-Cootamundra-Temora-West Wyalong route, subject to general conditions and conditions applying to the routes. Additional licences were issued for other routes serviced by Monarch Airlines.

General conditions applicable to the licence:

1. An appropriate CAA Air Operators Certificate should be maintained together with appropriate insurance cover.
2. Operation of services to fixed schedules is to be in accordance with CAA endorsements.

Conditions applying to the routes:

1. Maintenance of appropriate CAA route endorsements on Air Operators Certificate.
2. This is a non-exclusive route licence.

The Executive Officer of the Air Transport Council said that many routes in NSW were now classed as 'open', or deregulated, and subject to unlimited competition. For open routes any operator who held a CAA AOC endorsed for the routes, and was properly insured, was eligible to hold a licence subject to the matters referred to in section 6(3) of the Air Transport Act. The financial circumstances of a licence applicant intending to operate over an open route, and their implications for air safety, were not matters required to be considered by the Council in deciding whether to grant or refuse a licence. Safety regulation of operators was the legislative responsibility of the CAA.

On 7 December 1992 a letter was sent to the Air Transport Council from a member of the travel industry, concerning the effects of de-regulation of air services in NSW. Concerns about the administration and operation of air services were expressed. They included the ability of operators to provide an acceptable standard of service, and concerns relating to aircraft types, quality and engineering. The letter concluded:

> Certainly fares are somewhat lower, up to 33%, but questions arise as to whether the savings are against administration or as I suspect more than likely they are coming from the operational side. The dangers of this need no further amplification as I am sure you will agree. However at the end of a forty year continuous working life, in the travel industry, I feel that something must be done before someone gets hurt.

A copy of this letter was provided to the Member for Lachlan who also wrote to the Chairman of the Air Transport Council expressing his concerns.

In response to that complaint, the Executive Officer of the Air Transport Council replied in part:

> ... most of the routes through the region served by your business have been opened up to unlimited competition, or effectively de-regulated. While the Air Transport Council does not condone the practices described in your letter, it is unable to interfere with commercial decisions made on open routes. However, it does encourage operators to provide the highest standards of service possible within the competitive environment and some do co-operate in this regard.

The letter also stated:

> The remaining comments in your letter all relate to safety regulation and standards and these are the province of the Civil Aviation Authority. The CAA sets and monitors standards which apply equally to all RPT operations, regardless of whether or not the routes flown have been deregulated in an economic sense.
>
> The incidents you cite should not therefore result from the opening up of routes to competition. Nevertheless, I will ensure that the matters you have raised are conveyed to the CAA for its attention.

Concerns on the level of safety on commuter air services were referred to the CAA by the Air Transport Council. The Regional Manager of SR&S South Eastern Region subsequently replied on 11 February 1993 to the Member for Lachlan stating that:

> I have had those matters you referred to investigated. You would appreciate that in the absence of any direct evidence it is difficult to enforce these requirements.

The letter also stated:

> In relation to your observations of particular aircraft operating on the Cowra/Sydney runs, your observations were referred to the Airworthiness Branch who have informed me that in the main the items identified by yourself are of a cosmetic nature and do not affect the operation of the aircraft.

Elsewhere the letter noted:

> Flying Operations and the Airworthiness Branches of the Authority conduct ongoing surveillance of operators in your electorate. Any detection of a non compliance of mandatory requirements, would be, the subject of immediate action on the part of the Authority.

1.19 Monarch Airlines

1.19.1 Background

Monarch Air Services Pty Limited applied for an AOC on 27 November 1989 to engage in Charter and Aerial Work, including Flying Training, within Australia. AOC, NSW 1342, was duly issued on 16 February 1990. In September 1991, Monarch Air Services attempted to operate a regular charter service between Cowra, Young, Cootamundra and Sydney. This was shortly after a large regional airline had withdrawn from a number of routes in western NSW. The Executive Officer of the NSW Air Transport Council said those routes had been relinquished on commercial grounds. The CAA indicated by letter to Monarch on 16 October 1991 that such a service was illegal and recommended the company vary its AOC to include RPT operations. An application to that effect had already been lodged on 19 September 1991.

The NSW Air Transport Council approved the issue of a NSW Air Transport Licence to Monarch Air on 31 October 1991, subject to the company obtaining an appropriate AOC from the CAA with the necessary route endorsements. On 4 November 1991 Monarch Air was registered as the business name of Tealjet Pty Limited and was granted AOC, NSW 20, on 6 November 1991 to operate PA31-350 and Cessna 441 aircraft on regular public transport services between Cootamundra/Cowra/Forbes/Sydney/West Wyalong and Young aerodromes. Additional aircraft types and aerodromes were subsequently added to the original AOC. On 9 March 1993 control of Tealjet Pty Limited was acquired by Aviation Operations Pty Limited, a part of the Arissa Group of companies. Aviation Operations Pty Limited also owned Southern Airlines and Charter Pty Limited, and Natrave Pty Limited. On 10 March 1993 the business names of Monarch Airlines, Monarch Air and Southern Airlines were transferred to Natrave Pty Limited. As a result, Air Operators Certificate NSW 20 for Monarch Air was cancelled and re-issued as Air Operators Certificate BK 026 on 18 March 1993, to Natrave Pty Limited trading as Monarch Airlines. This arrangement was current at 11 June 1993.

1.19.2 Management structure

Prior to 18 May 1993 the day-to-day management of Monarch Airlines had been under the control of a GM who had been in that position throughout the formation and operation of the airline. Both the Chief Pilot/Operations Manager, and Chief Engineer or certifying LAME, reported to the GM, who in turn was responsible to the Directors of Aviation Operations Pty Ltd.

On 17 May 1993 the Chief Pilot resigned from that position, but remained as Operations Manager. A new Chief Pilot took over on the same day and was occupying that position at the time of the accident .

A former Chief Pilot of Monarch, who had subsequently been retained on a part time basis to conduct Check and Training, resigned to take up a position with another company in early May 1993. The new Chief Pilot also took over the Check and Training responsibilities.

On 18 May 1993 a Consultant GM replaced the previous GM and took over the day to day management of the airline. He was occupying that position at the time of the accident.

1.19.3 Financial aspects

CAA records on 2 March 1993 indicated that Monarch Airlines had been on the CAA 'stop credit' list for several months and had not paid any debts to the CAA since October 1991. Monarch was considered to be one of its most serious defaulters, and was to be treated on a cash only basis. However, this was disputed by a Director of Monarch who claimed that the CAA accounting procedures were very poor, resulting in reconciliation processes during which payments were withheld by Monarch until necessary corrections to accounts were made.

Evidence showed that Monarch was consistently very slow to pay accounts for the provision of aviation fuel at country locations, and for accommodation costs incurred by its pilots. Payment was generally able to be obtained only after numerous requests had been made to the company, including threats to withdraw services. In some cases services were refused or provided on a cash only basis. Similar experiences were also reported by the suppliers of aircraft maintenance services and spare parts. Suppliers said Monarch was generally the slowest to pay its accounts, compared to other clients.

The wife of the pilot-in-command of VH-NDU said that he had not received any payment from Monarch for the three weeks preceding the accident. Records indicated he had flown some 32 hours for Monarch during that period.

There were at least ten letters sent to the CAA, Air Transport Council, the Australian Securities Commission, and other bodies, by a creditor of Southern Airlines, concerning the financial performance of Southern Airlines and Monarch Aviation. The letters included details of an apparent deficiency of assets over liabilities not covered by shareholder's funds to the order of about $789,000, in accordance with the 1991 annual return of Monarch Aviation Pty Limited, lodged with the Australian Securities Commission. In addition, the creditor made allegations concerning the financial capability of Monarch to continue to operate a satisfactory regular public transport service. On 19 April 1993, after consideration of those matters which came within its jurisdiction, the Australian Securities Commission replied that it was not appropriate for any further action to be taken.

Documents lodged with the Securities Commission on 21 January 1993 indicated that Monarch Air Services Pty Limited at the end of the 1991/92 financial year had assets totalling $37,177 and liabilities totalling $1,340,677. For that financial year, the company declared a loss of $573,142.

1.19.4 Flight operations

From 18 May 1993, day to day operations of Monarch were supervised by a Consultant GM. He was aware that VH-NDU had an inoperative autopilot from which components had been removed. However, he was unaware of the effects of the removal of the computer amplifier.

At the time of the accident the company employed about 10 line pilots, eight of whom were employed on a casual basis. A further 14 pilots had been employed on a casual basis as second pilots, in order to facilitate flight operations by aircraft with inoperative autopilots. In accordance with the requirements of CAO Section 82.0.3.3 the company had an operations manual approved by the CAA, to provide guidance to flight crew for the conduct of regular public transport services. The stated objective of the manual was:

> ... to reflect the company policy and outline the operational requirements, procedures and maintain a level of standardization that will ensure maximum safety and efficiency of its flight operations (page AO-2) .

Section A1-20 of the operations manual contained route briefing information on the Monarch route structure and destination airports. Information concerning Young was limited to procedures for engine failure after take-off, and a recommendation to land on runway 01 in light wind conditions. No guidance was provided for terrain avoidance during an approach to land, nor was information provided on the height and extent of obstacles at Young. There was no regulatory requirement for such information to be included in the operations manual.

Section B1-3.1.6 of the Monarch Operations Manual concerning take off and landing by co-pilots stated:

> Monarch Air Low Capacity RPT operations does not have any provisions for co-pilot operations since all flights under RPT are single pilot operations.

1.19.5 Aircraft maintenance

In accordance with the provisions of CAOs, Section 82.3, Monarch was required to provide a system of maintenance and to establish a system of maintenance control.

The operation of maintenance services at Monarch depended on a small core of aircraft maintenance engineers, of whom at least one was required to be licenced to certify maintenance work carried out. At the time of the accident, maintenance activities were being certified by a LAME who had been hired about one month earlier on a short term contract. The scheduling of maintenance work was carried out by a Maintenance Controller whose main activities were concerned with flying as a company line pilot. Although he was in the process of resigning as Maintenance Controller, at the time of the accident he was still regarded by the CAA as retaining that position. He was also the pilot-in-command of VH-NDU at the time of the accident. The Maintenance Controller held no formal aircraft maintenance qualifications, nor was he required to do so. Although Monarch's general maintenance was conducted in-house, most of the specialised maintenance was carried out by sub-contractors or other organisations.

There was a history of a high turnover of maintenance staff at Monarch, especially of certifying LAMEs, who would normally be regarded as the Chief Engineers of the organisation.

For at least the last four months preceding the accident the overall control of maintenance activities appeared to be exercised by the GM. He was the person within Monarch who primarily dealt with CAA airworthiness officers.

1.19.6 Check and Training

In accordance with the provisions of CAOs, Section 82.3, Monarch was required to provide a check and training organisation for its RPT operations.

Instrument rating renewals, base checks and some route checks were carried out until early May 1993 by an approved Check and Training pilot, employed on a part time basis. The Chief Pilot prior to 17 May 1993 was also approved to carry out route checks. The new Chief Pilot took over the Check and Training responsibilities for Monarch from 17 May 1993.

CAO 82.3.3.3 states:

> Each operator must ensure that a person does not act as an operating crew member on a scheduled revenue service unless that person has satisfactorily completed all necessary training programs and proficiency checks and has been certified by a check pilot as being competent to act as an operating crew member.

The Monarch Training and Checking record for the pilot-in-command of VH-NDU at the time of the accident indicated he had satisfactorily completed a base check, comprising normal and emergency procedures, and an emergency procedures proficiency test on 28 January 1993. A route check was conducted on 12–13 March 1993 over the Sydney/Cowra/Forbes/Condobolin sectors.

CAR 218(1) states in part:

> Subject to this regulation, an operator shall not permit a pilot to act, and a pilot shall not act, in the capacity of pilot in command of a regular public transport service unless the pilot is qualified for the particular route to be flown in accordance with the following requirements:
>
> (a) the pilot shall have been certified as competent for the particular route by a pilot who is qualified for that route;
>
> (b) the pilot shall have made at least one trip over that route within the preceding 12 months as a pilot member of the operating crew of an aircraft engaged in any class of operation;
>
> (c) The pilot shall have an adequate knowledge of the route to be flown, the aerodromes which are to be used and the designated alternate aerodromes, including a knowledge of:
>
> (i) the terrain;
>
> (ii) the seasonal meteorological conditions;

(iii) The meteorological, communications and air traffic facilities, services and procedures;

(iv) the search and rescue procedures; and

(v) the navigational facilities;

associated with the route to be flown;

CAR 218(2) states:

> The Authority may grant an exemption from the requirements specified in paragraphs (1) (a) and (b) subject to such conditions as the Authority considers necessary in the interests of safety.

The investigation found no evidence to indicate the pilot-in-command had been certified as having been route checked into Young or Cootamundra during his employment with Monarch, nor had he been granted any exemption from the requirements of CAR 218 (1) (a) and (b).

The previous Monarch Check and Training pilot had known the pilot-in-command for about 10 years and considered him to be a good, steady operator. He indicated that, during the base check, carried out in daylight, simulations of unusual situations during low circling approaches were handled well, with no identifiable weaknesses.

The Monarch Training and Checking record for the second pilot indicated no training or proficiency checks had been carried out by Monarch before he acted as a crew member on RPT services. A file note by the Chief Pilot indicated that the second pilot:

> meets the requirements for co-pilot or PIC on RPT ops.

The previous Monarch Check and Training pilot was of the opinion that during a night circling approach, pilots needed to maintain their correct height/distance by judgement based on their perspective of the runway lights, rather than on the terrain below. He would not normally descend below 500 feet above the aerodrome elevation until the aircraft was aligned on the final approach path. He also regarded the circling approach as dangerous and would prefer to see instrument approach procedures re-surveyed to provide for runway approaches as standard.

No training was provided by Monarch to cater for two-pilot operations, and the Operations Manual did not provide for two pilot operations. The only guidance concerning flights conducted with a second pilot was provided in a memorandum to all Monarch pilots from the Chief Pilot on 20 April 1993. The subject of the memorandum concerned the issue of a permissible unserviceability to permit the operation of VH-TXK and VH-NDU without a serviceable autopilot. The memorandum stated in part:

> the second pilot is there to fulfill the functions of the autopilot, and the PIC is in command of the aircraft at all times.

Although not required by the regulations, there is no evidence that Monarch pilots were provided with any form of decision-making training, or Line Orientated Flight Training (LOFT) in generic type flight simulators.

1.19.7 Flight crew

Interviews were conducted with 10 captains and nine co-pilots who had either been employed by Monarch at the time of the accident, or during the preceding 12 months. The views expressed during those interviews have been summarised as follows:

a. In the period immediately prior to the accident two of the 10 captains rostered for company RPT flights were employed on a permanent basis. The remainder were paid a daily flying rate and were regarded as being employed on a casual basis. The pilot-in-command of VH-NDU was paid a daily rate. All co-pilots were employed on a casual basis.

b. It was found that co-pilots who were called in to crew aircraft with inoperative autopilots generally did not expect to receive payment. Rather, they saw that duty as an opportunity to acquire more experience and perhaps gain more regular employment with the company.

c. Pilots generally believed that approval had been given by the CAA for VH-NDU to be operated with an inoperative RMI and HSI as a result of the granting of the inoperative autopilot permissible unserviceability. Eight of the 10 Captains interviewed said they had flown VH-NDU with the HSI and RMI inoperative. Six said they were aware that a PUS had been issued by the CAA, five said they had read the document, and seven said they believed the aircraft was permitted to be flown with the RMI and HSI inoperative.

d. Most pilots who had flown VH-NDU with an inoperative RMI and HSI had not done so in IMC. They considered that the inoperative heading indicators resulted in an increased workload for the pilots.

e. Pilots were asked to grade the standard of training provided by Monarch in the order:

1. Inadequate
2. Adequate
3. More than adequate.

Most co-pilots were unable to comment because they had received no formal training. Five captains considered the standard to be adequate, four thought the standard inadequate, and one rated the standard as more than adequate.

f. Pilots were asked to grade the standard of checking of Monarch operations in the order:

1. Inadequate
2. Adequate
3. More than adequate.

Most co-pilots were unable to comment because they had received no formal checking. Four captains considered the standard to be adequate, four thought the standard inadequate, and two rated the standard as more than adequate.

g. Route checks were conducted on nine of the 10 captains and two of the nine co-pilots. Route checks on all sectors flown by Monarch were conducted on two of the 10 captains, and on none of the co-pilots.

h. Pilots were asked to grade the standard of Monarch flight operations in the order:

1. Inadequate
2. Adequate
3. More than adequate.

Ten considered the standard to be adequate, five thought the standard inadequate, and three rated the standard as more than adequate. Four of the 10 captains considered the standard to be adequate or better, compared to the same response from seven of the nine co-pilots. One pilot did not comment due to a lack of knowledge of similar operations. Some other operators were considered to be significantly worse than Monarch.

i. There was a perception by a few pilots that to complain to management about operational problems could result in action being taken against them. As a result they did not do so. They believed that if they refused to fly an aircraft, other pilots would. There were many pilots waiting for an opportunity to join Monarch. These inhibitions were reinforced by the fact that most pilots were employed on a casual basis.

j. Some pilots said that there was considerable management interference in the conduct of flight operations. The GM was seen to be the driving force, rather than the Chief Pilot at the time. There were numerous scheduling changes, sometimes resulting in pilots being notified of flights at short notice.

k. There were few pilot meetings. At one meeting the matter of the inoperative autopilot in VH-NDU was raised but pilots stated that 'management' said that it was 'OK' to continue to operate.

l. Aircraft were sometimes dispatched in excess of the maximum allowable weight limits. This was due to a practice of carrying sufficient fuel for the return flight to Sydney, despite having high passenger loadings, because of difficulties in purchasing fuel away from Sydney arising from the financial position of the company.

m. The pilots were of the view that the pilot-in-command of VH-NDU would not have allowed the co-pilot to have conducted the approach into Young. It was considered that this would have been out of character with the operating style of the pilot-in-command. Evidence was obtained that on an earlier flight, the pilot of VH-NDU had discussed the matter of a co-pilot flying the aircraft from the right seat, but had doubts about the legality of such a practice.

n. The pilot-in-command of VH-NDU was considered to have been a level-headed, methodical, and precise pilot, although he may have been more task orientated than other pilots due to his involvement with company management as Maintenance Controller.

o. At the time of the accident the recently appointed Chief Pilot was unaware that VH-NDU was being operated with the HSI and RMI inoperative.

1.19.8 Safety history

An examination was conducted of air safety occurrences reported to BASI involving Monarch RPT operations between 4 November 1991 and 10 June 1993. A total of 12 occurrences had been notified, of which two involved emergency landings due to low fuel states. Both occurrences were investigated by BASI, and were brought to the attention of the CAA. The CAA's investigations resulted in the suspension of one pilot-in-command and a review of the fuel management policy of Monarch. This incident also contributed to the CAA's proposed withdrawal of the Chief Pilot's approval (refer page 30).

BASI had also received a confidential aviation incident (CAIR) report concerning Monarch Airlines, and VH-NDU in particular. The contents of that report were referred to the CAA on 29 March 1993 (FYI930017). The report stated:

> The reporter alleges that Monarch Airlines pilots are required to fly RPT operations in aircraft without a serviceable autopilot, and in one case a pilot was required to fly an aircraft that was overdue for a 100 hour check. It was also alleged that an engineer was sacked because he would not sign an aircraft out as defect free while it had a defective Autopilot. The particular aircraft is VH-NDU a PA31.

The Manager, CAA Airworthiness and Operations responded by letter to BASI on 30 June 1993. With regard to inadequate maintenance he wrote:

> The Airworthiness Inspector assigned to Monarch Airlines has advised he was not aware of the particular incidents as reported. He was, however, aware of one Monarch aircraft that had over run the maintenance release resulting in the issue of a Non-Conformance Notice (NCN). As the Company's reply to the NCN was unsatisfactory, they have been asked to re-address the matter.

On the matter of the autopilot, he stated:

> The company had been granted a Permissible Unserviceability Schedule (PUS) covering

unserviceable autopilots. Following advice that the Company was operating aircraft contrary to the PUS, a ramp check confirmed that, amongst other breaches, the allegations were correct. As a result, the Chief Pilot was requested to explain his actions and subsequently resigned.

The CAA response did not address the allegation relating to the dismissal of the engineer.

1.20 Additional information

1.20.1 Recorded Radar Data

Primary radar returns are produced by radar transmissions which are passively reflected from an aircraft and received by the radar antenna. The received signal is relatively weak and provides only position information.

Secondary radar returns are dependent on a transponder in the aircraft to reply to an interrogation from the ground. The aircraft transmits an encoded pulse train containing the SSR code and other data. Pressure altitude may be encoded with these pulses. As the aircraft transponder directly transmits a reply, the signal received by the antenna is relatively strong. Consequently, an aircraft which has its transponder operating can be more easily and reliably detected by radar. VH-NDU was fitted with transponder equipment which provided altitude information. Aircraft transponders are switched ON and OFF by the pilot as required. At the time of the accident it was normal practice for the transponder to be switched ON when the aircraft was operating within controlled airspace.

Radar data covering the flight of VH-NDU were recorded at Sydney and Melbourne airports. The Sydney recording included secondary data from the Sydney TAR and the Sydney RSR. The Melbourne recording included primary and secondary data from the Canberra RSR and secondary data from the Mount Bobbara RSR, located 29 NM south-east of Young. A diagram of the recorded radar track of VH-NDU is shown in figure 12.

The radar tapes concerning VH-NDU and other aircraft in the immediate area were read out and analysed. The recorded data from VH-NDU were compared with recorded radar data obtained during a test flight conducted by a PA31 aircraft. The test flight included NDB approaches and circuits at Young.

The results were as follows:

a. VH-NDU was observed to take-off from Sydney at 1736 EST and take up a direct track to Cowra.

b. Altitude data from the secondary radar returns were obtained during cruise at 8,000 ft (QNH). These data were consistent with altitude data from the test flight and no anomalies were observed.

c. At approximately 1803, about 50 NM west of Sydney, the aircraft changed track to the left and tracked approximately towards Rugby. From 1803:38 no further secondary radar returns were received from the aircraft, consistent with the transponder being selected to either OFF or STANDBY as the aircraft left controlled airspace.

d. At 1819 the aircraft passed 13.5 NM to the south-east of Riley. At 1824 the aircraft changed track to the right and tracked approximately towards Young. From this time the primary returns from VH-NDU were received intermittently.

e. Radar coverage plots for Canberra RSR show that terrain shielding occurs in the Young area at low altitudes. This was consistent with radar data recorded during the test flight which indicated that an aircraft needed to be at an altitude of at least 3,400 ft for primary returns to be received by Canberra RSR.

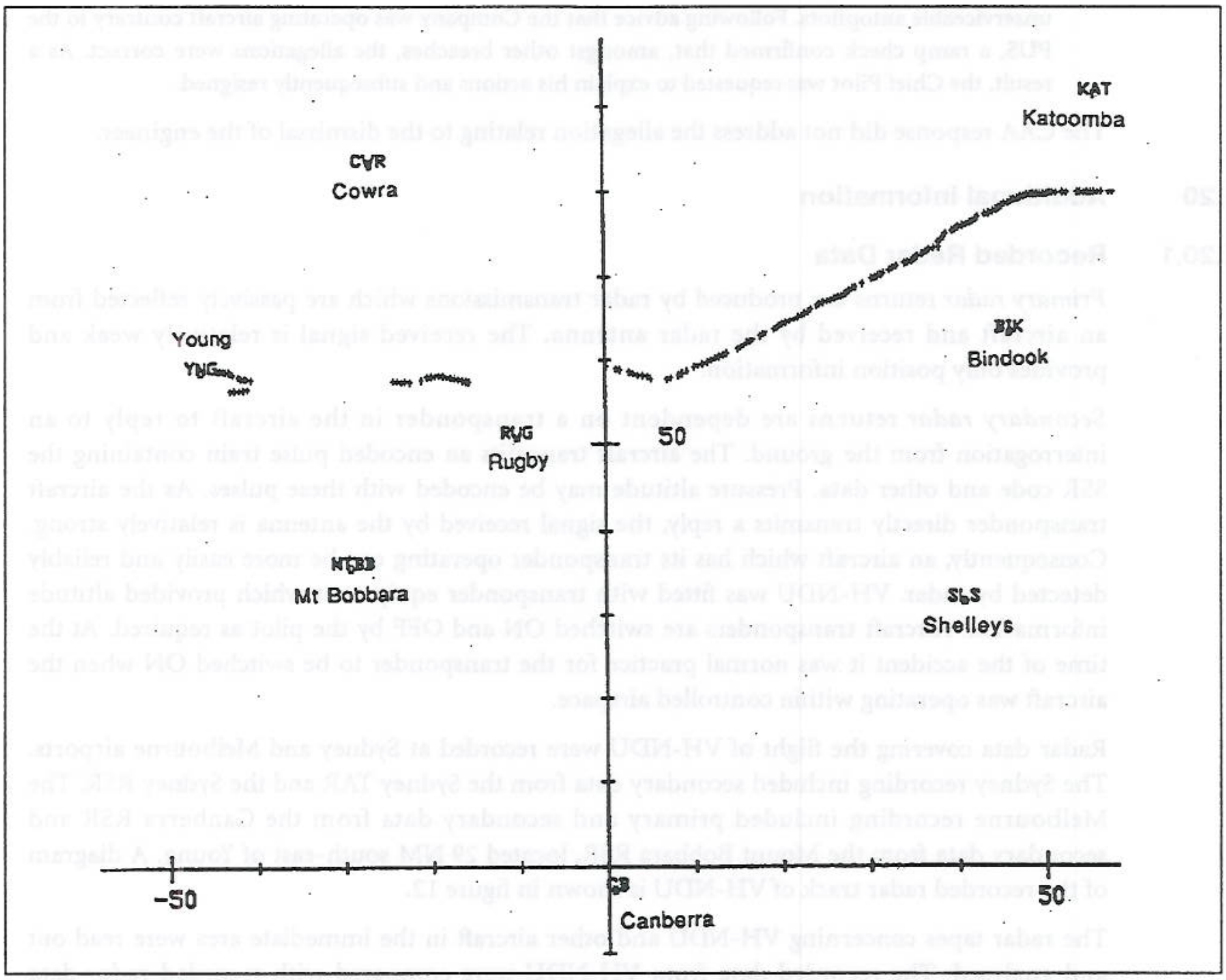

Figure 12 Diagram of plotted radar track of VH-NDU

f. The last radar data received from VH-NDU were eight primary returns which were recorded between 1905:40 and 1907:35. They showed VH-NDU approaching Young on a track of about 270°, consistent with the entry to a NDB approach.

g. Only primary radar data was received from VH-XML and the last recorded return was from a position 12 NM south-east of Young.

h. The transponder of VH-XMA was left selected ON. As a result, secondary radar data was received by Mount Bobbara and showed the aircraft's track inbound from Cowra. The recorded manoeuvres and altitudes were consistent with those described by the pilot of that aircraft. The last recorded return from VH-XMA was consistent with the aircraft tracking on a left base leg for runway 01 at a pressure altitude of 1,900 ft.

1.20.2 Results of flight tests at Young

During the radar data collection flight the test aircraft was landed at Young. The altimeter was reset to indicate the actual aerodrome elevation and a flight was conducted after dark to examine ground lighting, and the practicability of the flight crew maintaining visual reference with the ground within the circling area. The weather was clear with little cloud. The night was very dark, and apart from lighting associated with the town and the aerodrome, little other ground lighting was observed in the vicinity of the circuit area. Observations were also conducted concerning pilot perception of the position and height of the aircraft with reference to the runway lights.

The results of the flight suggested that a pilot could not visually assess aircraft height over obstacles along the flight path during a right downwind or turn onto base leg for runway 01. The township of Young was visible on the left side of the aircraft, but because of the structure of the aircraft, the view of the runway lights was obstructed during the right turn onto base leg. The crew of the test aircraft reported they were unable to ensure adequate visual reference along the flight path during downwind and when turning onto base. Their intention had been to descend to an altitude of 1,800 ft on downwind, but the aircraft was not descended below 1,900 ft until established on base leg due to an absence of ground references along the flight path.

During the final stage of the test flight the left instrument panel directional indicator was covered to simulate an unserviceable indicator. Due to the limitations of the magnetic compass, resulting from turning and acceleration errors, readily useable directional information was only available from the right heading indicator. The handling pilot in the left seat reported an increase in workload, and a decline in general flight accuracy, resulting from disruption to his normal pattern of instrument cross checking (see figure 15, p.50).

1.20.3 Results of previous research on the visual perception of runway lights at night

In daylight, a pilot can judge height above terrain by referring to visual cues such as ground texture, the apparent size of familiar objects on the ground and the relative movement of the ground in relation to the aircraft. At night, however, these cues are either unavailable or degraded. Even in conditions of good night visibility, it can be difficult to judge height visually over dark or sparsely lit terrain.

(a) Focal trap

A paper by Roscoe (*Human Factors* 1985, pp. 624-5) contains a summary of the Mandelbaum effect, or focal trap, which occurs when a textured surface, (such as flyscreen or scratched perspex), screens vision at a distance approximately equal to the resting focal length of the observer's eye. Although resting focus varies between individuals, a typical distance for a person aged in their forties, would be between 50 and 100 cm (O'Hare and Roscoe 1992). A textured surface appearing at this distance will tend to draw in the focus of the eye, making it very difficult to focus on distant objects. The accurate judgement of depth and distance to far objects is made difficult when the eyes are focused on closer objects.

A pilot in the left-hand seat would be more likely to suffer a focal trap effect when looking out the right-hand window than when looking out the left-hand window. This is because the left window is considered to be too close to the eyes to act as an effective focal trap, whereas the right window would be at the right distance to induce a focal trap in many observers. The focal trap effect would be even more pronounced when the window is textured, perhaps with dirt or rain streaking, or illuminated by low level interior lighting. It has been suggested (Roscoe 1979) that an inappropriate focal distance can cause a misperception of runway height, and may account in part for the Black Hole illusion in which pilots descend too low on approach to a brightly lit runway over dark terrain.

(b) Visual Estimation of Height

It was also considered that under certain circumstances, a pilot flying a right circuit may get the impression that the aircraft is higher than normal. This illusion could occur to a pilot who has developed the habit of visually judging circuit height and position by relating the position of the runway lights to some feature of the aircraft, such as a particular position in a side window. Such a rule of thumb which worked satisfactorily for the more typical left circuits could lead a pilot to descend lower to achieve the same picture when making right circuits (See figure 13). Like most habits, such a practice could be carried out unconsciously. In this case it would be an example of negative transfer, where a pilot transfers a habit from a situation

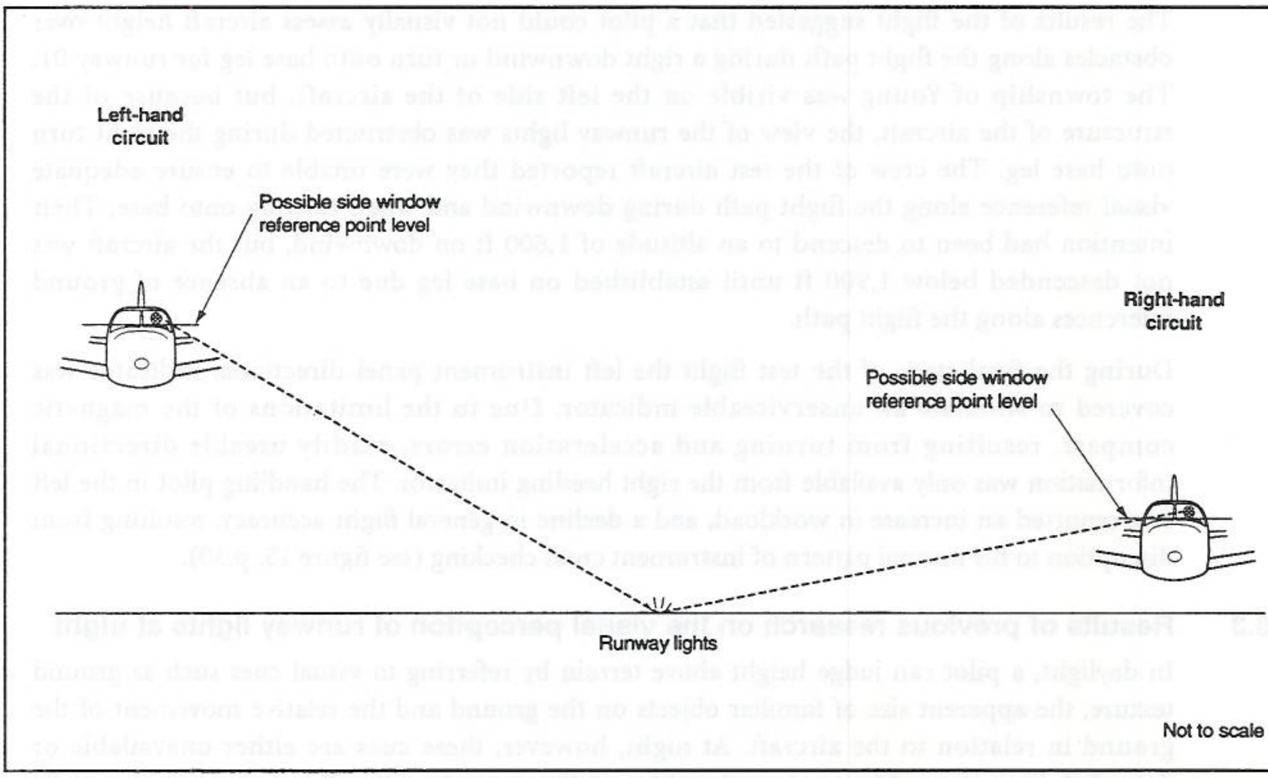

Figure 13 A diagram showing the difference between viewing runway lights from the downwind leg of left and right circuits when positioned in the left cockpit seat.

where it works successfully, to a new situation where it is inappropriate. This phenomenon would not occur on final approach, when the runway appears normally in the front windscreen.

Parallel receding lines (such as runway lights viewed from a point on the extended runway centreline), provide linear perspective, which is one of the depth cues which enable an observer to visually judge height (Wickens 1992). Runway lights viewed from the side do not provide a strong sense of linear perspective. Consequently, in the absence of other height cues such as ground texture, it can be expected that it would be more difficult to judge height visually when runway lights are viewed from the side than when the lights are viewed from a position in line with the extended runway centreline (Wickens C.D. *Engineering Psychology and Human Performance* second edition, 1992 pp 142-143).

It is possible that an instrument approach procedure which led pilots to a position compatible with a straight-in approach would provide pilots with better visual height information than does the existing circling approach procedure.

2. ANALYSIS

The main purpose of the investigation of air safety occurrences is the prevention of aircraft accidents. To that end, a primary objective of such an investigation is to establish what happened, how it happened, and why the occurrence took place. It is of equal and often greater importance for the investigation to determine also what the occurrence reveals about the safety health of the broader aviation system. That 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 overall level of air safety.

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

For the purposes of broad systems analysis, the Bureau uses an analytical model researched and developed by Professor James Reason of the University of Manchester. The principles of the Reason model are described in detail in his book *Human Error* (1990), and further developed in a paper presented to the International Society of Air Safety Investigators 22nd Annual Seminar 1991 (*Identifying the Latent Causes of Aircraft Accidents Before and After the Event*).

The Reason accident causation model is becoming an industry standard, and has been recommended by ICAO for use in investigating the role of management policies and procedures in aircraft accidents and incidents (ICAO Accident Investigation (AIG) Divisional Meeting (1992) Report, para,1.10.2.2).

Central to Reason's approach is the concept of the 'organisational accident',

> in which *latent failures* arising mainly in the managerial and organisational spheres combine adversely with local triggering events (weather, location, etc.) and with the *active failures* of individuals at the 'sharp end' (errors and procedural violations)(Reason, 1991 p. 1).

Common elements in any organisational occurrence are;

a. **latent failures** which arise from deficiencies in managerial policies and actions within one or more organisations. Often these organisational factors are not immediately apparent and may lie dormant for a considerable time

b. **local factors** are conditions which can affect the occurrence of active failures. These include such things as task and environmental conditions

c. **active failures** are errors or violations which have an immediate adverse effect. These unsafe acts are typically associated with operational personnel

d. **inadequate or absent defences** which failed to identify and protect against technical and human failures arising from the three previous elements.

The relationship between these elements in the process of accident causation is shown in the accompanying diagram (figure 14).

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 in safety. Many of those factors can lie hidden within organisations for a considerable time prior to the occurrence, and can be described as latent failures. When combined with local events such as active failures and possibly unusual environmental circumstances, the resulting combination of factors may result in a safety hazard. Should the system's defences be absent, or inadequate, a failure of the system is inevitable.

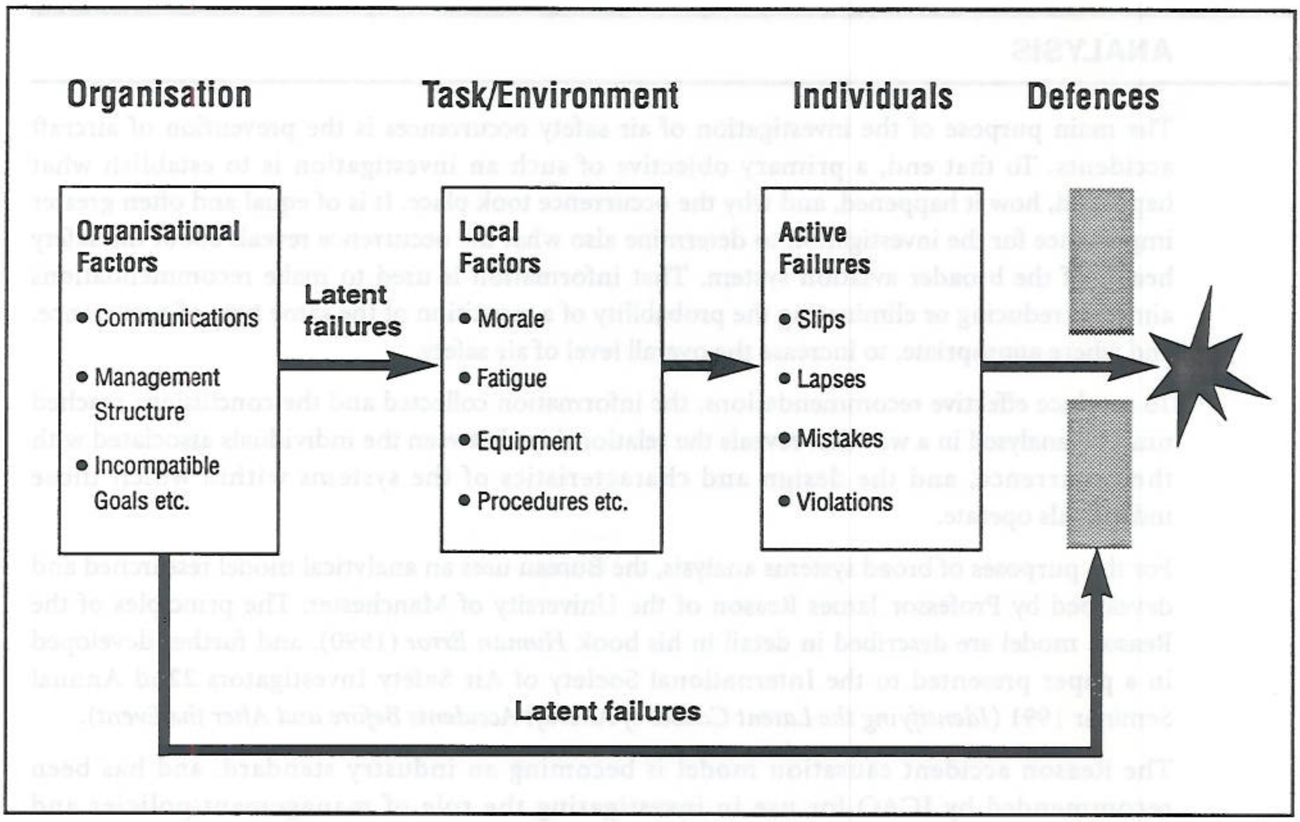

Figure 14 Diagram of the basic Reason model showing the elements of an 'organisational accident'.

An insight into the safety health of an organisation can also 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; typical examples being: training deficiencies; ineffective supervision of flight operations; inadequate aircraft maintenance procedures; etc.

The following analysis is structured in accordance with the Reason model, and utilises its terminology.

2. Introduction

The circumstances of this accident were found to be consistent with controlled flight into terrain. The investigation has established that the aircraft was capable of normal operation, and was in normal flight at the time of impact. There was no evidence found to indicate that the performance of either flight crew member was affected by any physical condition which might have affected their ability to carry out their respective tasks. It was confirmed that the pilot-in-command was seated in the left control seat. He is considered to have been the handling pilot, by reason of his previous conduct of similar flights, and by the operational requirements of the company. An analysis of the events and circumstances leading to this occurrence indicate that this was an 'organisational accident' which represented a failure of the aviation system.

2.2 Active failures

Active failures are unsafe acts which most generally 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 (Reason, 1990) and involve attentional slips or memory lapses, and mistakes. Violations involve deliberate deviations from a regulated practice or prescribed procedure.

The significant unsafe act in this occurrence was that the flight crew did not maintain adequate obstacle clearance whilst conducting a visual circling approach at night.

On becoming clear of cloud at the completion of what was probably his third NDB approach, the pilot-in-command had to decide if the weather conditions in the circuit area were good enough to permit him to maintain 'visual reference' in order to carry out a landing approach. If not, he was required to carry out a missed approach and decide if another approach was warranted, or if the aircraft should be diverted to another suitable aerodrome. The pilot-in-command had already conducted two missed approaches because of non-visual conditions at the minima. The fuel endurance of the aircraft was not considered to have been a restraint in permitting at least one more NDB approach before a diversion became necessary. The investigation team considers that in all probability the pilot-in-command did not attempt to descend below the minimum approach altitude until he became visual during the final NDB approach. This assessment is based upon the fact of his two earlier missed approaches, and on the evidence of other company pilots concerning his previous practices.

Once visual, and having decided to make a landing approach, the pilot-in-command descended below the circling altitude of 2,400 ft in order to maintain visual reference. This was due to low cloud within the circling area, as substantiated by the BOM analysis, and by pilot witness accounts. To remain clear of the actual cloudbase probably required a descent to about 2,000 ft, some 750 ft above the aerodrome elevation. Having descended below 2,400 ft, the 400 ft minimum obstacle clearance provided at the circling altitude was no longer guaranteed. Once below the minimum circling altitude the pilot-in-command was required to maintain a minimum obstacle clearance of 300 ft along the flight path.

Given the weather conditions of the night, and the absence of adequate ground lighting or other visible features within the circling area, it is unlikely that the flight crew would have been able to maintain 'visual reference' in accordance with the provisions of AIP/DAPS IAL - 2.1.5, for continued descent below the minimum circling altitude. In addition, the flight crew had no readily available method of determining minimum obstacle clearance along the flight path. This was due to a lack of detailed terrain information on the NDB approach and landing charts, and in company procedures for operations at Young.

Witness accounts, and an examination of the aircraft wreckage, were consistent with the aircraft being in generally level flight at the time of impact. Nor was there any evidence of a sudden loss of height immediately prior to impact. One witness thought the aircraft, prior to turning base, was significantly lower than another aircraft (VH-XML), which was approaching from the east.

It is possible that the pilot-in-command made a deliberate decision to descend to a minimum obstacle clearance altitude based on a height of 300 ft above the aerodrome elevation. Such a decision would have made a collision with terrain almost inevitable, due to the height and extent of the terrain within the circling area. However, this course of action is considered to have been unlikely as the cloudbase was sufficiently high to allow the aircraft to be flown about 750 ft above the aerodrome elevation. In addition, two other aircraft were able to make successful approaches to the aerodrome, including VH-XMA which was plotted on radar conducting a left circuit to runway 01 at a height above the aerodrome of about 650 ft.

It is therefore more likely that once the pilot-in-command had deliberately descended below the minimum circling altitude to remain clear of cloud, further descent was unintended. This error may well have been due to the flight crew encountering a situation for which their training had not adequately prepared them.

A further possibility is that an unintended descent went unnoticed while the pilots were distracted by having to deal with a landing gear malfunction. Evidence that might support this hypothesis is that, after first overflying the aerodrome, the aircraft was seen to be in a position consistent with a right downwind leg for runway 01. However, instead of completing the approach and landing from that position, the aircraft conducted a further circuit of the aerodrome before entering a right base leg for runway 01. Moreover, although the landing gear legs were extended at impact, the landing gear extension cycle appeared to be not yet completed, indicating that its extension had occurred later than was usual Company practice.

There may have been other reasons for both the extra circuit of the aerodrome and the late extension of the landing gear. In the absence of other confirming evidence, it is not possible to draw a definitive conclusion that a landing gear malfunction may have been a factor contributing to the accident

2.3 Local factors

Local factors are task, situational or environmental factors which affect task performance and the occurrence of errors or violations. The local factors identified in this investigation are considered to have had a direct influence on the performance of the flight crew during the conduct of the flight.

As well as the adverse weather conditions and lack of terrain guidance information, other local factors were present which could have induced errors and/or mistakes. These included: aircraft equipment deficiencies, inadequate flight crew knowledge skills for the task; visual illusions; high cockpit workload; and, skill fatigue.

There follows a discussion of the local factors.

(a) Weather conditions

The prevailing weather conditions probably influenced the pilot-in-command to descend the aircraft below the minimum circling altitude after becoming visual at the conclusion of the final NDB approach. Evidence from other pilots and the BOM established that the cloudbase in the circuit area was below the minimum circling altitude of 2,400 ft. Although the flight visibility was in excess of the circling minima, the ability of the crew to maintain adequate visual reference to the ground was affected by light rain and darkness.

The surface wind was almost a direct crosswind from 310°, gusting to 19 kt, and slightly favoured a landing in the runway 01 direction. It is considered the pilot-in-command may have elected to make a right circuit to 01 to reduce the groundspeed of the aircraft on base in order to provide more time to position the aircraft for a landing.

The Area QNH of 1003 hPa was passed to the aircraft en route to Young, and acknowledged. The forecast QNH for Young was also 1003 hPa, whilst the actual QNH was 1004 hPa. The left altimeter sub-scale was found to read 1007.5 hPa, and the right altimeter sub-scale read between 1005 and 1006 hPa. Although the pre-impact settings of the altimeters could not be determined, the difference between the actual QNH and the setting on the left altimeter was 3.5 hPa. At 30 ft per hPa, this equates to a height difference of about 105 ft, i.e. the aircraft could have been flying 105 ft lower than indicated on the left altimeter. However, due to the fact that both altimeters had different settings, and those settings did not equate to any forecast QNH, it is considered more likely that the altimeters were correctly set to the forecast QNH at the time of impact, and that the anomalous readings were a result of the forces incurred during the impact and breakup of the aircraft.

(b) Aircraft equipment deficiencies

The aircraft was capable of normal flight at the time of the accident, as evidenced by the results of the technical examination of the wreckage and by impact analysis. However, significant aircraft equipment deficiencies were found during the course of the investigation which are considered to have had an adverse effect on the performance of the flight crew.

The wording of the PUS document concerning continued operations with an inoperative autopilot contained the words 'or until the required components are available for refitment to the aircraft' (refer page 29). If taken in isolation from the MEL, it is considered that those words could have been misinterpreted such that they appeared to permit flight operations with autopilot components removed. This conclusion is supported by evidence from other Monarch pilots.

Although specifically prohibited by the terms of the MEL, the aircraft was being operated with inoperative heading indicators on the left flight instrument panel. The only serviceable heading indicators were the directional gyroscopic indicator on the right instrument panel, and the magnetic standby compass. Due to the normal limitations of the magnetic compass, which result from turning and acceleration errors, the only readily usable heading indicator was on the right panel, in front of the second pilot.

As the handling pilot, the pilot-in-command relied on the flight instruments to enable him to fly the aircraft in instrument meteorological conditions. The general principle in scanning the flight instruments is to select an attitude from the ADI and then check for the desired performance response from the other flight instruments. Modern aircraft have the flight instruments grouped in a standard 'T' layout on the instrument panel(s). The optimised scanning patterns developed by pilots are thus a result of this standard instrument layout. During the final flight of VH-NDU the instrument scan of the handling pilot would have been disrupted by the need to look across to the right hand instrument panel for directional information, resulting in an additional workload.

(c) Flight crew knowledge and skills

The adequacy of the knowledge and skills of the flight crew for night operations into Young had not been assessed, as evidenced by:

- the company had not checked and certified the pilot-in-command for operations into Young;
- the second pilot had received no training or proficiency checks by the company prior to acting as a crew member;

In addition:

- there were no established company procedures for terrain avoidance at Young;
- there were no established company procedures for two pilot operations.

(d) Visual illusions

The visual cues available to the flight crew were inadequate as a sole reference to judge terrain clearance accurately during the circling approach at night. The position of the crash site and the aircraft track indicated that the crew were aware of their lateral position in relation to the runway, but were not aware of their true vertical position. Descent below the minimum circling altitude required the maintenance of sufficient visual reference to facilitate terrain avoidance. The visual cues available to the crew on the night were insufficient to provide for this. Those cues which were available could have been misinterpreted, as a result of:

- the position of the aircraft in the circuit;
- the cockpit seating position of the pilot-in-command;
- negative habit transfer;
- focal trap effect .

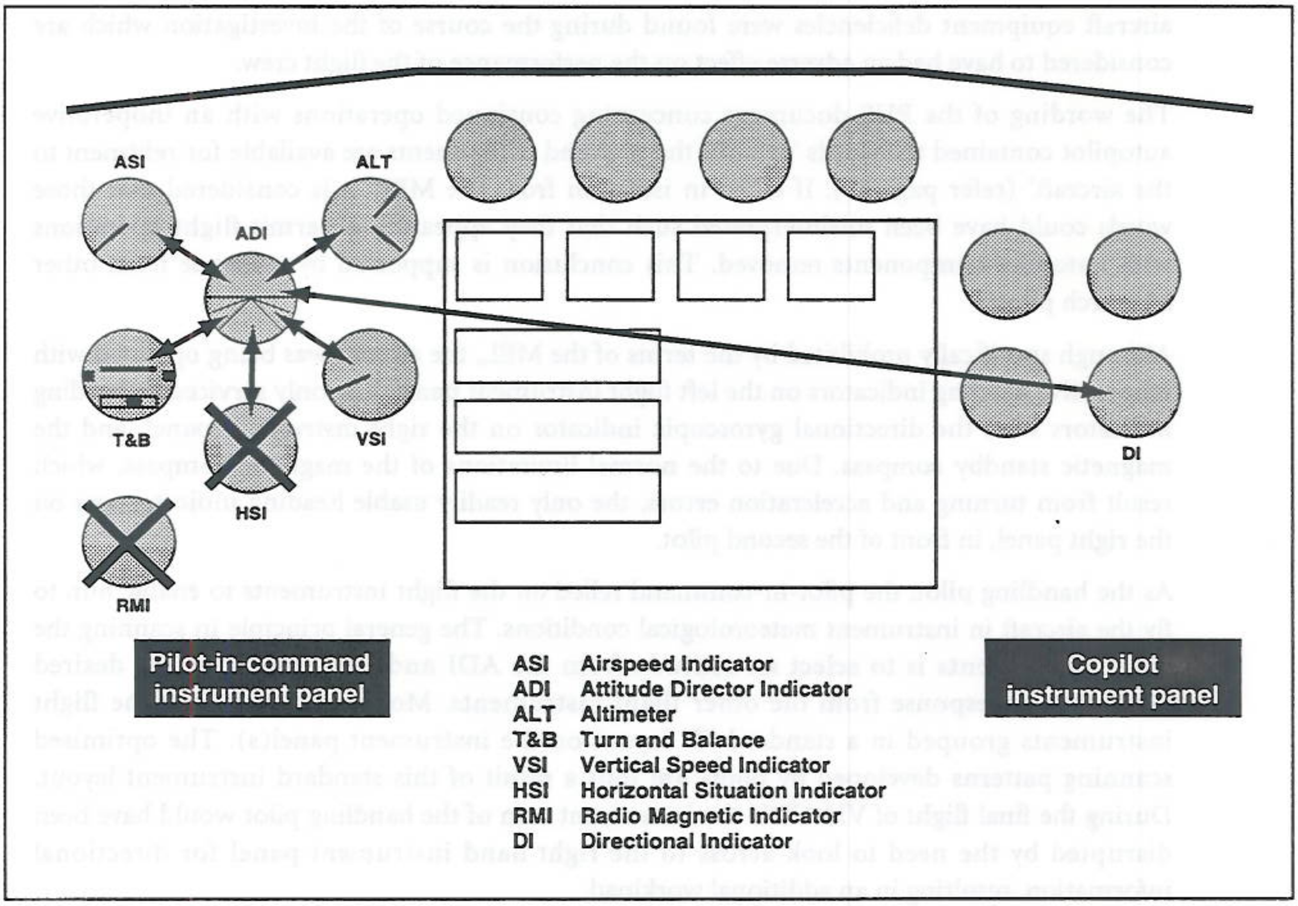

Figure 15 Diagram of the pilot-in-command's flight instrument scan pattern superimposed on a representation of the cockpit instrument panels in VH-NDU.

(e) Cockpit workload and skill fatigue

The pilot-in-command was considered to have been subjected to a higher than normal cockpit workload during the NDB instrument approaches and subsequent circling approach, most of which were conducted in IMC. This extra workload resulted from the absence of serviceable directional indicators on the left instrument panel with a consequential disruption to the pilot's normal instrument scanning pattern. During the visual circling approach, while still having to rely primarily on the flight instruments, his workload would have been significantly increased by the additional tasks of assessing the procedure to be flown, having to look outside the aircraft to maintain circuit orientation with reference to the runway lights, having to change the configuration of the aircraft prior to landing, and looking for the other notified traffic. It is not considered that his workload would have been alleviated by the carriage of a second pilot as no formal company procedures had been implemented for two pilot operations. As a result, it is possible that the performance of the pilot-in-command was degraded due to skill fatigue.

Skill fatigue is defined as:

> the deterioration in performance caused by work that demands persistent concentration and a high degree of skill. It is an insidious phenomenon associated with failure of memory, judgement, integrating ability and presence of mind. Its effects may occur in conjunction with, and be accentuated by, other factors such as sleep loss. —*BASI Human Factors Guide*

The onset of these effects may account for the pilot's apparent lapse in not initially activating the runway lighting. It is also likely his situational awareness would have been adversely affected, as well as his routine instrument monitoring. Such lapses in performance are typical consequences of skill fatigue. The fact that the pilot-in-command needed prompting by FIS to update his earlier ETAs is not considered to be significant for this type of operation under the prevailing conditions.

(f) NDB approach and landing procedure

The operational effect of the design of the Young NDB instrument approach procedure was to position the aircraft at right angles to the runway. Apart from major airports, this type of approach procedure is common in Australia and would have been familiar to the flight crew. However, once visual within the circling area, the procedure then to be adopted in order to place the aircraft safely in a position to land became entirely dependant on the skill and judgement of the pilot. In the present case, this would have meant having to rely mainly on visual cues in adverse weather conditions. Under the circumstances, had the instrument approach procedure been designed to direct the aircraft to a final approach path for a specific runway, the need to conduct a visual circling to land procedure would have been minimised.

Instrument approach procedures provide accurate track guidance information to aircraft. When directed to a runway, that procedure has the effect of accurately positioning the aircraft in relation to the runway, and away from hazardous terrain, particularly when combined with approach slope guidance. In most cases the decision-making requirements of the pilot would be substantially reduced to that of deciding whether to land straight ahead, or to carry out a missed approach, in accordance with the published landing minima.

Continued descent below the minimum circling altitude is permitted in accordance with the provisions of AIP/DAPS IAL-2.1.5. One component of those provisions requires that visual reference be maintained. Obstacle clearances are specified 'along the flight path' in AIP/DAPS IAL-2.1.5, however the definition of 'visual reference' contained in that part does not specify where that reference needs to be maintained. At night, in the absence of extensive ground lighting or other means of seeing the ground or water, the investigation team considered that descent below the minimum circling altitude is not practicable until the aircraft is aligned with the runway to be used.

(g) NDB approach and landing chart presentation

The NDB approach and landing charts did not provide information on the location and height of obstacles which needed to be considered when determining the minimum safe height to which the aircraft could be descended, within the circling area. The caution in AIP/DAPS that 'spot heights on IAL charts do not necessarily indicate the highest terrain in the immediate area' is not considered to have provided the flight crew with any significant guidance in avoiding terrain.

(h) Local company procedures

Although not mandatory, the company operations manual did not specify terrain avoidance procedures for use during visual circling approaches to Young aerodrome, both by day and night. Such guidance material could have assisted the decision making of the pilot-in-command during a period of intense workload in adverse conditions.

2.4 Organisational Factors and Latent Failures

2.4.1 Introduction

Latent failures can be weaknesses or inadequacies within the management of organisations which are not immediately apparent. They can remain dormant for extended periods. Deficiencies in these organisational factors can impact upon the workplace to create an environment or 'corporate culture' which increases the probability of errors or violations, and weakens the system's defences which are designed to minimise the consequences of unsafe acts. These latent failures become apparent when they combine with local triggering events and circumstances such as active failures or unusual environmental forces acting on the system, resulting in a breakdown of the system.

Research has shown (Reason, 1990) that there can be at least twelve possible general failure types relating to organisational processes, regardless of the nature of the organisation. The organisational failures identified by the investigation and described in this part of the report, are factors which contributed to an overall reduction in the safety of the operational environment within which Monarch Airlines conducted regular public transport services. These factors were important in creating a climate which fostered the development of unsafe operating practices, which were not subsequently rectified.

2.4.2 Monarch Airlines

(a) No clear statement of goals

Less than 21 months after being granted their initial AOC for Charter and Aerial Work operations, Monarch Air Services Pty Limited had applied for, and were granted, an AOC to conduct regular public transport services. This course of action had been influenced by changes in the regional airline industry.

Evidence of operational deficiencies and financial problems point to an apparent tension between the ability of the company to provide a safe and reliable standard of service to the fare paying public, and the day to day commercial realities of providing such a service. No evidence was found of any clear statement by the company, for the guidance of its staff, relating to the conflict between commercial considerations and the goal of providing a safe and reliable service to its customers. Such statements are common with larger Australian airlines.

(b) Organisational structure

An examination of the operational structure of the company, and of the conduct of maintenance and flight operations, indicated some organisational deficiencies. These were evident from the GM's heavy involvement in the day to day running of the airline, particularly in the flight operations and aircraft maintenance areas. It seems that many of the decisions made by him concerning operational matters were primarily influenced by commercial considerations, as evidenced by a willingness to permit flight operations with equipment deficiencies, and a reluctance to meet operational standards required by the CAA. Rather than remaining at 'arms length' from the operational areas, a 'hands on' approach seemed more often the norm, resulting in a blurring of responsibilities in those areas.

The scheduling of maintenance was under the control of the Maintenance Controller, while the conduct of maintenance carried out on Monarch aircraft was nominally under the control of either a Chief Engineer, or a certifying LAME. During the four months prior to the accident the Maintenance Controller was also a line pilot, mainly involved in flight operations. The company also experienced a high turn-over of maintenance staff during its period of operation, with the result that the ongoing management of maintenance was undertaken primarily by the GM. Almost all dealings with CAA Airworthiness were undertaken by the GM. The conduct of maintenance at Monarch was a continuing concern for CAA Airworthiness, as evidenced by its dialogue with the company during the previous 12 months.

(c) Financial resources

The influence of the GM in operational matters required him to determine a balance between commercial and safety considerations.

The operation of the airline was apparently inhibited by consistent financial problems. These problems resulted in: a high turnover of maintenance staff, the majority of flight crew being employed on a daily or casual basis, fuel purchasing problems, continuing aircraft equipment deficiencies, and inadequate training. There is considerable evidence from creditors to show that the company apparently had significant difficulties in meeting financial commitments as they became due. There is also evidence from flight crew members concerning the effects of inadequate financial resources on the conduct of flight operations, such as difficulties in purchasing fuel when operating away from Sydney.

The inference could be drawn from the way in which Monarch operations were conducted that there was a significant management bias towards commercial considerations at the expense of safety.

(d) Ineffective communications

Communication can be described as the giving and receiving of information. Although the management structure of Monarch was very shallow, and the number of company employees was relatively small, effective communications were primarily from management to employees, with little in the other direction, from employees to management. The majority of operational personnel were employed on a casual basis, at a time when large numbers of suitably qualified people were unemployed. As a result, staff were inhibited from expressing concerns. Pilots said they believed that Monarch management discouraged them from being critical of the practices adopted by the company.

(e) Poor planning and operational procedures

Operational planning and procedures adopted by the company seemed to be largely driven by financial considerations as evidenced by previously described organisational deficiencies and inadequate financial resources. In addition, the company 'culture' appeared to discourage a conservative approach to the manner in which operations were planned and conducted. This was demonstrated by a long-standing pattern of poor compliance with CAA requirements regarding the conduct of flight operations and airworthiness activities, and a willingness by the company management to accept those deficiencies to facilitate the operation of regular services.

(f) Poor control of the safety of flight operations

The former Chief Pilot was also the Operations Manager. He appeared to lack the authority or willingness to demand that, at the very least, the minimum standards established for regular public transport services should be the basis upon which company flight operations should be conducted. Some company pilots considered that he may not have had adequate influence with the GM on operational matters. Others considered he was task overloaded. As he did not fulfill the responsibilities of Chief Pilot the CAA decided to take action to cancel his Chief Pilot approval. Despite this, he still retained the position of Monarch Operations Manager.

(g) Poor maintenance management

A principal deficiency in the conduct of aircraft maintenance by the company was that maintenance management did not ensure proper programming and control. This was exacerbated by a high turnover of qualified personnel, the need to oversight the use of outside contractors for a large proportion of the work carried out, and a Maintenance Controller whose attention was mainly directed to line flying . The GM exercised significant control in the area of maintenance management, and the extent of his dealings with the CAA as the main spokesman for the company on airworthiness matters reflected this.

(h) Poor training

The training to provide company personnel with the knowledge and skills necessary to operate safely was a management responsibility.

The company's training was generally designed to meet the CAA legal minimum requirements for single pilot operations. There was no provision made for the training of second pilots in support duties, nor for pilot-in-command training in two pilot operations. The pilot-in-command of VH-NDU had not been route checked into Young, and the second pilot had received no formal training by the company for the intended operation.

There appeared to have been no provision for, or thought given to, the training of pilots in decision making skills. Many of the typical scenarios faced by pilots during line operations could have been reviewed in safety by the utilisation of a generic fixed base procedures trainer or simulator, and solutions adopted to enhance the safety of flight operations.

Cockpit Resource Management (CRM) training and Line Orientated Flight Training (LOFT) are two such programs which are routinely and successfully used to enhance the decision making skills of flight crews in airline operations. However, the limited financial capacity of Monarch would have placed such training beyond its reach.

2.4.3 Civil Aviation Authority

The CAA is the competent authority responsible for the safety regulation of civil air operations. As a routine part of the investigation, the role of the CAA was evaluated. Deficiencies in a number of organisational and local factors were identified, and there follows a discussion of those factors.

(a) Organisational Goals

Reason points out that '...organisations and people are generally pursuing several goals at the same time and occasions will arise when the pursuit of safety will conflict with other goals (ie production, profit, etc). Goal conflicts can occur at the organisational level, at the workgroup level or at the level of the individual worker.' (Reason,1991, the PRISM Handbook).

In the case of Monarch the SR&S policy of delegating regulatory functions to the greatest extent practicable, whilst retaining responsibility, was not supported by the allocation of the appropriate level of surveillance and enforcement resources to the monitoring of an RPT operation. It is also noted that, in contrast to the CAA's corporate mission statement, shown earlier in this report (page 25), the safety of the travelling public was not specifically identified by the SR&S Division in its vision or mission statements (also at page 25).

The activities of the Division appeared to be biased towards promoting the viability of the operator rather than on promoting safety.

In the case of Monarch this was evidenced by the seeming reluctance of SR&S to take early and decisive action to ensure compliance with the required airworthiness and operational standards.

This was despite consistent breaches of those standards by the company, and the fact that the company was carrying fare paying passengers throughout this entire period.

(b) Poor division of responsibilities

The lowest level in the CAA at which a single individual became formally responsible for the performance of a regional airline was the GM of the SR&S Division, which was a CAA Head Office position located in Canberra. This arrangement increased the chances of diffusion and blurring of responsibility at lower management levels. It meant that at the regional level, no single person had a comprehensive overview of the total safety health of Monarch.

Although the effects of removing the computer amplifier from VH-NDU were known to CAA Airworthiness staff prior to the granting of a permissible unserviceability, the assigned FOI was unaware of that information. This situation illustrated the effects of an inadequate division of responsibility at the district level, regarding a safety issue which had both significant operational and airworthiness dimensions.

(c) **Poor planning**

A major deficiency identified concerned the failure of the CAA SR&S Division, Bankstown District Office, to formulate and undertake an effective program of operational surveillance of Monarch.

The assigned FOI, probably because of his high workload, did not effectively plan and implement his surveillance efforts. As a consequence, they did not particularly focus on areas that would have produced the maximum safety benefit, such as RPT services. The general thrust of his surveillance was to react to events, rather than carry out a systematic inspection program in accordance with the MAOC. This was evidenced by the fact that his surveillance of flight operations was essentially confined to document inspections and that, in the 12 months prior to the accident, he did not conduct any en route surveillance of Monarch. As a result, the actual standard of Monarch RPT in-flight operations was essentially unknown to the CAA.

Although the level of CAA airworthiness surveillance of Monarch was considerably higher than that achieved by CAA flight operations, the way in which surveillance was conducted was reactive rather than proactive. This was evidenced by the replacement of the annual surveillance plan with irregular inspections, which were mainly triggered by events.

Moreover, the CAA's surveillance planning did not appear to take account of the need to systematically monitor the overall safety health of RPT operators. This would have required the identification and monitoring of valid safety health indicators. Detection of adverse trends in any of the indicators would be expected to trigger more detailed surveillance activity directed at having a closer look at all aspects of the safety of the operation.

One such indicator, which could have acted as a trigger in the case of Monarch, is an airline's financial circumstances. This does not imply that the CAA should have had accountants as part of its surveillance staff, but rather that it needed to take account of more general evidence that the company was under considerable financial duress. Such evidence was available (eg, Monarch being on the CAA's 'stop credit' list). If this had been considered as part of a systematic plan for monitoring safety health, it could have triggered more detailed surveillance of Monarch, especially of the standard of the airline's en route flying operations.

However, at the time of the accident there was no mechanism for the CAA, or any other agency, to consider any possible linkage between the financial circumstances of an operator and its continuing capability to conduct safe operations.

In addition, there was no evidence found of any management system within the CAA designed to enable the overall surveillance of organisations to be co-ordinated, monitored and assessed in order to identify systemic safety deficiencies. Nor was there any effective internal review mechanism whereby the CAA evaluated the efficacy of the surveillance program with regard to the priorities set and the execution of the program.

(d) **Inadequate resources**

At the district level the resources of the SR&S Division were inadequate for the planned task. The assigned FOI for Monarch had responsibility for the supervision of about 40 AOC holders. In addition, his other FOI duties imposed considerable demands. When the surveillance targets specified in the MAOC were taken into account, his taskload was high and probably not achievable. The problem was compounded when he was also required to assume the tasks and responsibilities of DFOM for considerable periods, while still retaining his task of supervising the conduct of the 40 AOC holders assigned to him.

Further evidence that this situation was a problem was provided by the Terrell Study Group report (ref CAA Study Group Report, February/March 1993). This identified the effect of reductions resulting from the Review of Resources as a major issue affecting the functioning of the SR&S Division.

The CAA accepted the recommendations of the Terrell report. It has developed a comprehensive and detailed plan for their implementation, and is presently engaged in that process.

(e) Ineffective communications

Communications between Monarch and the CAA district office were mainly conducted at a formal level with little evidence of a close working relationship between the parties.

Effective safety regulation is enhanced by good communications between the staff of the regulatory authority and the personnel of the organisations for which they are responsible. The underlying principle is that it is necessary to have a good understanding of the organisation before it can be determined whether or not the relevant standards are being complied with, and if necessary, what action might be needed to ensure compliance. To achieve such an understanding can often be difficult, particularly if an organisation is reluctant to allow or provide access to relevant information.

The assigned FOI appeared to have limited contact with Monarch flight operations personnel. Communications between the Airworthiness branch and the company were more regular but were usually in connection with specific maintenance problems associated with the operation of the company. There is considerable evidence that aspects of the flight operations of the company were a cause for concern to the CAA, but there is little evidence that the CAA was prepared to communicate with the company in other than a formal way to help overcome the problems. There appeared to be an inability of both parties to recognise that they needed to communicate more effectively to resolve problems.

(f) Poor control

The available evidence indicated that there was minimal monitoring of the progress of the surveillance program for Monarch, whether or not the plan was working, and whether additional CAA resources needed to be provided. Responsibility for developing and controlling a surveillance program rested with the DFOM and DAM. In accordance with the provisions of the MAOC those officers were required to ensure that individual work schedules for inspections and surveillance were given the necessary priority. If during the year it became apparent that the minimum level of surveillance would not be achieved in some area, the MAOC required immediate steps to be taken by the DFOM or DAM to have resources allocated to the area in question.

The investigation found no evidence of effective control of the surveillance of Monarch by the CAA district office. In the case of flight operations surveillance the assigned FOI was in effect supervising himself for most of the time.

(g) Poor operating procedures

The operating procedures of the SR&S Division were inadequate to ensure that Monarch continued to meet the standards required of an AOC holder for the class of operation being conducted.

At the time of the accident, an AOC was normally issued for an indefinite period. Once an AOC is granted the CAA must then ensure that the minimum operating standards are being complied with. If not, the CAA is required to provide evidence that an operator has failed to meet the required standards before the AOC can be varied, suspended or cancelled.

Where a satisfactory level of co-operation exists between the CAA and an operator, and an effective surveillance program is being conducted, then the policy of issuing an AOC for an indefinite period could be expected to operate satisfactorily. In the case of Monarch the level of surveillance was inadequate, with the result that the actual standard of operations was largely unknown, although suspected to be poor. Even when deficiencies were identified, the CAA appeared reluctant to take action to change the way in which Monarch conducted its operations. This was evidenced by a history of airworthiness and flight operations concerns, numerous meetings with inconclusive results, and the absence of a co-ordinated strategy to follow through and resolve the deficiencies identified.

2.4.4 Air Transport Council

As a routine part of the investigation, the role of the NSW Air Transport Council relating to this accident was evaluated.

As stated in 1.18 of this report the principal functions of the NSW Air Transport Council are to advise the NSW Minister for Transport on matters pertaining to the licensing and operation of air transport services within NSW, but not including safety regulation which is the responsibility of the CAA. In deciding whether to grant or refuse a licence, the suitability and fitness of the applicant or corporation was one of a number of matters which needed to be assessed by the Minister. The financial situation of an applicant, in respect of air safety, was not required to be considered.

The consideration of the relationship between the financial situation of the airline and safety was not the responsibility of the NSW Air Transport Council when issuing a licence. Nor was this dimension the responsibility of the CAA when issuing an AOC.

Consequently, no agency had a responsibility to take into consideration the possible effects on safety of the financial situation of the company.

2.5 Failed or absent defences

Defences are elements of a system which are designed to detect hazards resulting from technical or human failures, and to eliminate or reduce their possible effects, in other words, to provide a 'safety net'. In the case of this accident the following defences were found to have failed, or to have been absent.

a. Obstacle lighting
The terrain struck by the aircraft was not provided with obstacle lighting due to the extensive obstruction of the circuit area by obstacles. However, slightly lower terrain to the north-east of the aerodrome was illuminated and marked on the landing chart, and could have been perceived by the flight crew as representing the highest terrain within the circling area.

b. Two pilot operations
The policy of the company to use a second pilot in an aircraft with an inoperative autopilot met the minimum conditions specified in the CAOs. However, the potential safety benefit provided by the additional crew member was not realised, because the company did not establish training and procedures to promote a proper support pilot role. There was, however, no legal requirement for the company to have provided such training programs and procedures for two pilot operations for the type of aircraft being operated.

c. Terrain alerting
The aircraft was not fitted with a ground proximity warning capability or a radio altimeter, nor was it required to be. The function of such systems, which are legally required in high-capacity, turbine-powered RPT aircraft, is to prevent CFIT occurrences.

d. Surveillance and monitoring of in-flight operations.

The level of in-flight surveillance by the CAA did not meet the minimum requirements specified in the MAOC. As a result there was no opportunity to determine and monitor the standard of Monarch flight operations. Regular in-flight surveillance could have detected deficiencies in flight operational standards, thus providing opportunities for rectification before any such deficiencies contributed to an accident.

2.6 Other matters

2.6.1 Emergency services response

The loss of about 18 minutes in notifying the Young Fire Brigade of the accident highlighted deficiencies in the 000 emergency services notification system.

There is currently no provision available for a caller to the 000 service to be connected simultaneously to a number of emergency services. The caller is required to nominate either the Police, Fire or Ambulance to report an emergency. The system then requires the nominated service to notify other services considered by it to be appropriate. This could result in unnecessary delay, and possible failure to alert other services.

One possible solution could be achieved by the introduction of a system similar to the Common Crash Call (CCC) used at controlled aerodromes. Immediately a situation is identified as requiring the call out of emergency services, the duty air traffic controller activates the CCC. This provides an immediate two-way voice connection to all emergency services in the area. Details of the occurrence can be provided simultaneously and each service can respond as appropriate to the situation. In a similar way, a caller to the 000 service would be connected automatically to all emergency services in the relevant area, thus minimising the possibility of delay, or failure to alert services.

3. CONCLUSIONS

3.1 Findings

1. Monarch Airlines held a valid Air Operators Certificate and NSW State Air Transport Licence, for the route being flown.
2. Both flight crew members held valid pilot licences, endorsed for PA31 type aircraft.
3. Both flight crew members held valid multi-engine command instrument ratings.
4. The pilot-in-command had not been certified by a Monarch check pilot as being route qualified for the particular route being flown.
5. There was no evidence found to indicate that the co-pilot had received any training or proficiency checks in accordance with the provisions of CAO 82.3.3.3.
6. Monarch did not provide training or procedures for two pilot flight operations. Nor was it legally required to do so.
7. The pilot-in-command occupied the left cockpit seat, and the second pilot the right cockpit seat. From the evidence available, the pilot-in-command was the handling pilot at the time of the accident.
8. There was no evidence found to indicate that the performance of either flight crew member might have been affected by abnormal pre-existing physiological or psychological factors.
9. The maintenance release current at the time of the accident had been issued prior to the completion and certification of the electrical and instruments component of the Check 2 inspection.
10. The autopilot was inoperative, and had been for an extended period prior to the flight.
11. The aircraft was being flown with inoperative heading indicators on the pilot-in-command flight instrument panel as a result of the removal of the autopilot computer amplifier.
12. The static air source to the computer amplifier was disconnected and blanked off.
13. A Permissible Unserviceability document had been issued by the CAA for the continued operation of VH-NDU with an inoperative autopilot. The CAA officer who issued the Permissible Unserviceability document knew of the effect of removing the computer amplifier, which was a necessary step in the repair process. The wording of the Permissible Unserviceability document was not intended to authorise flight with the computer amplifier removed.
14. The effect of removing the computer amplifier was widely known to many Monarch personnel, including the ex-GM, the Operations Manager, the pilot-in-command and second pilot of VH-NDU, and most Monarch flight crew.
15. Both the newly appointed Chief Pilot and Consultant GM were unaware that VH-NDU was being operated with the HSI and RMI inoperative.
16. At the time of the accident the weight and balance of the aircraft is considered to have been within specified limits. A Load/Trim sheet completed by the pilot-in-command prior to the flight was not a document specified in the aircraft Flight Manual. The aircraft load calculation did not include the weight of passenger baggage.
17. The aircraft carried sufficient fuel for the flight.

18. Recorded radio communications relevant to the operation of the aircraft were normal.
19. The aerodrome lighting, obstruction lighting and non-directional beacon at Young were operating normally.
20. The design of the instrument approach procedure at Young required aircraft to carry out a visual circling approach at the conclusion of the final instrument approach phase.
21. The aircraft struck trees and then terrain within the Young circling area during controlled flight under power.
22. At the time of impact the aircraft was capable of normal flight.
23. There was no evidence of in-flight fire or pre-impact damage.
24. The terrain struck by the aircraft was not provided with obstruction lighting.
25. The definition of 'visual reference' contained in AIP/DAPS IAL-2.1.5 did not specify whether that reference needed to be maintained along the aircraft flight path.
26. The aircraft was not equipped with any form of ground proximity warning system.
27. The 000 emergency notification service did not provide for simultaneous notifications to all emergency services.
28. Latent organisational failures identified within Monarch included;
    a. management priorities which placed the continuation of revenue operations ahead of safety considerations
    b. organisational factors, relating to management and structural deficiencies in the operation of the airline
    c. inadequate resources allocated to safety, resulting from the financial situation of the airline
    d. ineffective communications which inhibited the expression of concerns about safety by company personnel
    e. poor planning and operational procedures, largely driven by financial considerations
    f. poor control of the safety of flight operations
    g. poor maintenance management and control
    h. poor training of flight crew.
29. Latent organisational failures identified within the CAA included;
    a. a difference between the corporate mission statement of the Authority, which placed a clear primacy on safe air travel, and that of the SR&S Division which appeared to emphasise the viability of the industry as its major concern
    b. poor planning of flight operations surveillance
    c. poor division of responsibility
    d. inadequate resources, which restricted the ability of the CAA to conduct regulatory activities concerning the safety of flight operations
    e. ineffective communications between the local CAA District Office and Monarch
    f. poor control of the management of Monarch surveillance
    g. poor operating procedures, particularly the practice of issuing AOCs for an indefinite period.
30. The NSW Air Transport Council was not required to consider the financial situation of Monarch, in respect of air safety, when granting an Air Transport Licence for the route flown.

31. En route levels of surveillance by the CAA did not meet the targets specified in the MAOC.

32. CAA surveillance activities were primarily carried out in response to events, rather than by following a proactive approach.

33. The CAA had no system for providing an overall assessment of surveillance activities for the purpose of determining the safety health of equivalent AOC holders.

34. There was no mechanism for the CAA, or any other agency, to consider any possible linkage between the financial circumstances of an operator and its continuing capability to conduct safe operations.

3.2 Significant factors

1. The cloudbase in the Young circling area was below the minimum circling altitude, associated with dark night conditions and limited ground lighting.
2. The workload of the pilot-in-command was substantially increased by the effects of aircraft equipment deficiencies, with a possible consequent degrading of his performance as a result of skill fatigue.
3. The instrument approach and landing charts did not provide the flight crew with terrain information adequate for the assessment of obstacle clearance during a circling approach.
4. The Monarch operations manual did not provide the flight crew with guidance or procedures for the safe avoidance of terrain at Young during a night-circling approach.
5. The aircraft descended below the minimum circling altitude without adequate monitoring of obstacle clearance by the crew.
6. The visual cues available to the flight crew were insufficient as a sole source of height judgement.
7. There were organisational deficiencies in the management and operation of RPT services by Monarch.
8. There were organisational deficiencies in the safety regulation of Monarch RPT operations by the CAA.

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 texts of the interim recommendations are 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.

IR930214: The Bureau of Air Safety Investigation recommends to the Civil Aviation Authority that when an operator requests the issue of a Permissible Unserviceability to continue flight operations with inoperative equipment listed as an MEL item, then the terms of the Permissible Unserviceability should provide an extension of all MEL conditions for a specified period.

CAA response:

The recommendation reflects CAA policy. The Authority does not accept the finding in paragraph 5 of the Summary of Deficiency in that the Permissible Unserviceability could be read as permitting "continued operations with a significantly reduced level of safety (ie autopilot components removed) than that provided by the Minimum Equipment List".

IR930223: The Bureau of Air Safety Investigation recommends that the Civil Aviation Authority;

1. Review the need for approved maintenance controllers to hold maintenance qualifications appropriate to the position,
2. Restrict persons acting in the position of maintenance controller from acting in other positions that will detract from their ability to adequately perform their maintenance controller duties, and,
3. Review the need to limit periods of validity for certain approvals, such as maintenance controller, and renew such approvals only when specified criteria are met which demonstrate adequate performance.

The CAA response in part stated:

Interim Recommendation 1 : The Authority has reviewed the need for maintenance controllers to hold maintenance qualifications and we have concluded that this is neither necessary or appropriate. It is essential that anyone approved as a maintenance controller has the ability to plan and co-ordinate maintenance activities but this does not extend to being qualified to carry out the actual work. The Authority believes this would be an unnecessary imposition on industry.

Interim Recommendation 2 and 3 : The Authority agrees in principle and these matters are being addressed.

IR930224: The Bureau of Air Safety Investigation recommends that the Civil Aviation Authority reviews its procedures in respect to the issuing of Air Operators Certificates. This review should be conducted with a view to restricting the validity of Air Operators Certificates to a specified period, with the AOC renewal to depend on the operator's previous performance and the demonstrated capacity of the operator to continue to meet the relevant standards specified in the CAA Manual of Air Operators Certification.

The CAA response in part stated:
While it has been Authority practice in the last few years to issue "open ended" AOCs, recent legal opinion advises that the Authority should issue AOCs for a finite period.

BASI comment:
The CAA "Aviation Bulletin" dated February 1994, states that AOCs issued without a specific period of validity will have to be renewed on 1 July 1994, with all re-issued AOCs being of a fixed term.

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 1.5 with a view to making it less susceptible to misinterpretation.

The CAA response in part stated:
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.

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.

IR930234: The Bureau of Air Safety Investigation recommends that the Civil Aviation Authority review the obstacle terrain guidance information provided for flight crew in 'other than high capacity RPT operations'. This review should ensure that flight crew have adequate knowledge of the terrain associated with the route flown, including the obstacle terrain information for non-precision and circling approaches.

The CAA responses state in part:
CAR 218 (1) (C) details the qualifications required of a pilot conducting RPT operations, regardless of whether high or low capacity aircraft are involved. This includes knowledge of the terrain at the aerodromes to be used. This knowledge is normally acquired by conducting the flight required by CAR 218 (1) (b) supplemented by pre and inflight briefings.

The requirement to avoid obstacles by 300 feet is to be complied with using visual reference only, i.e. the pilot must be able to ensure all obstacles lit or unlit are avoided visually. At night this may not be possible. Thus the pilot may only be able to descend when he is aligned with the landing runway and able to use the documented obstacle limitation surface, and,

The CAA will review the practices of other authorities in respect to the provision of terrain information on instrument approach charts with a view to determining whether our current practices need to be changed.

IR930244: The Bureau of Air Safety Investigation recommends that the Civil Aviation Authority:

1. review the current rates of surveillance to determine whether the target levels of the Annual Surveillance and Inspection Program detailed in the MAOC are being met for all RPT AOC holders; and
2. review the adequacy of the Annual Inspection and Surveillance Program in the MAOC for RPT AOC holders.

CAA Response:
The Authority notes your recommendations and advises that a review of the Annual Surveillance and Inspection Program is currently being conducted.

4.2 Final Recommendations

With the conclusion of the investigation into this occurrence, the following final recommendations are now made:

R940181: The Bureau of Air Safety Investigation recommends that the Civil Aviation Authority:

1. develop a system for CAA officers to advise DASR of known adverse financial situations of AOC holders;
2. ensure that surveillance and inspection action responds to reported adverse financial situations of AOC holders with particular reference to their ability to conduct safe operations; and
3. develop a system to provide an ongoing assessment of the safety health of AOC holders as part of routine surveillance activities.

R940182: The Bureau of Air Safety Investigation recommends that the Civil Aviation Authority implement as a matter of urgency the ICAO PANS-OPS requirement for an instrument approach procedure which provides for a straight-in approach aligned with the runway centreline at all possible locations.

4.3 Safety Advisory Notice

The following Safety Advisory Notice is issued:

SAN940184: The Bureau of Air Safety Investigation suggests that the CAA review the final outcome of the United States National Transportation Safety Board 1994 study of commuter airline safety with a view to assessing the applicability to the Australian industry of the findings and recommendations.

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INVESTIGATION REPORT 9301743

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Senate Standing Committee on Rural and Regional Affairs and Transport
Inquiry into Aviation Accident Investigations (Pel-Air)
22 October 2012

Opening Statement

John McCormick
Director of Aviation Safety
Civil Aviation Safety Authority

I would like to thank the Committee for the opportunity to appear at this hearing, and to respond, as I am able to do, to the questions I expect you will have for CASA.

In the time available, we are obviously not in a position to address the many issues contemplated by the Committee's Terms of Reference as fully as we might.

Nor can we respond in detail to the submissions that have recently been lodged with the Committee, or have been made in the course of this hearing. We will continue to examine all of these matters, however, and will provide you with further relevant comments as soon as possible.

At the outset, I would like to comment briefly and generally on CASA's relationship with the ATSB, as this is something about which there appears perhaps to be some misunderstanding.

CASA and the ATSB perform different, but decidedly complementary roles in the interest of air safety and with a view to the prevention of aircraft accidents.

From the time of CASA's establishment in 1995, it has been one of our statutory functions to cooperate with the ATSB—and its predecessor, the Bureau of Air Safety Investigation (BASI), as it was known at the time—in the ATSB's investigation of aircraft accidents and incidents. Similar functions appeared in the Civil Aviation Act at the time CASA's predecessor, the Civil Aviation Authority, was established in 1988, and corresponding provisions appear in the ATSB's governing legislation.

In keeping with our *complementary* safety-related objectives—and CASA and the ATSB are the *only* government agencies whose organisational objectives relate *exclusively* to the enhancement of aviation safety—CASA has consistently endeavoured to support and assist the ATSB in their investigative efforts, to the extent we can do, remaining cognisant of the differences in our respective roles and functions and in a manner that accords with the applicable legislation.

To that end, CASA and the ATSB—like the CAA and BASI before them—have developed and worked to the terms of a series of *Memoranda of Understanding*, Copies of these Memoranda of Understanding dating back to 1996 have been provided to the Committee.

The ATSB conducts its investigations into aviation accidents subject to the explicit legislative proviso that it must *not* do so with a view to apportioning 'blame or liability'. Thus, whilst the ATSB can and does make *recommendations* about the steps individuals, organisations and other government authorities might take to minimise the likelihood of a recurrence of an accident of the kind they have investigated, they have no authority to *compel* or *require* anyone to do, or to refrain from doing, anything, other than to provide the ATSB with certain kinds of information.

CASA, however, conducts its regulatory investigations into a wide range of occurrences—including, though certainly not limited to, aviation accidents—with the power and the corresponding obligation to take such action as may be appropriate to minimise the likelihood that a *particular* individual, organisation or aircraft may place others at risk of harm. In doing so, we will, where necessary, *require* people and organisations to do, or to refrain from doing, certain things, unless and until it is safe. CASA is the only authority authorised to take action of this kind, and we make no apology for doing so when such action is necessary.

So, whilst both the ATSB and CASA have clear and complementary safety-related objectives, the particular purpose and practical outcomes of our respective investigative activities can be quite different. And it is with those particular differences in mind that the provisions of the MOU governing aspects of relations and exchanges between the two agencies during the course of our respective investigations into the same event have been carefully crafted.

CASA's regulatory investigations may lead to enforcement action of the kind I just described. The ATSB's investigations do not. As a practical matter, however, both CASA and the ATSB may well be conducting their own 'parallel investigations' into the same occurrence at the same time. The same individuals may be approached to provide their views about what happened, how and why; and the same organisations may be approached to provide documentary and other information to clarify and corroborate their claims about the facts and circumstances under investigation.

Without a clear understanding of the nature and purposes of these parallel investigations, there is a potential for confusion about these matters in the minds of those people with whom CASA and the ATSB must deal, and a risk that, in conducting its own investigation, CASA or the ATSB may complicate and possibly compromise the other's investigation. Much of the content of the inter-agency MOU is designed to avoid that confusion and to mitigate that risk.

In the wake of the tragic accident near Lockhart River in 2005, and for reasons that have been canvassed at length in other forums—including this Committee in connection with its 2008 *Inquiry into the Administration of the Civil Aviation Safety Authority*—in 2007 the then Minister for Transport and Regional Services engaged Mr Russell Miller AM to conduct a review to 'consider the respective statutory roles and responsibilities of CASA and the ATSB and the relationship that has developed between the agencies and provide advice on matters' including, amongst other things:

- the adequacy of the current legislative provisions in ensuring that information which may contribute to improved aviation safety can be effectively and promptly obtained by agencies and communicated between the agencies;
- the extent to which the interaction, or any overlay, of the respective Acts creates barriers to effective safety action, communication and interaction between CASA and the ATSB;
- the role and value of the Memorandum of Understanding (MOU) in place between CASA and the ATSB, and areas where the MOU can be strengthened or improved to achieve better working relationships between the agencies; and
- potential areas for improved co-operation and better co-ordination of safety investigation and information sharing.

The Miller Review made 19 specific recommendations, virtually all of which deal, directly or indirectly, with enhancing, expanding and generally improving the exchange of information between CASA and the ATSB. With particular regard to the CASA/ATSB MOU, the Miller Review recommended that 'the agencies should negotiate a new MOU and include matters such as . . . a means of encouraging more day-to-day interaction between the agencies when serious accidents occur'. [Recommendation 17]

Pertinently too, Recommendation 13 provided that '[d]uring an investigation, where CASA has expertise that might be brought to bear on the likely causes of an accident or incident, the ATSB should utilise that expertise as its investigation progresses . . . by regular inter-agency consultations.'

Finalisation of a new MOU consistent with the relevant recommendations of the Miller Review was well advanced at the time of the Pel-Air ditching in November of 2009; and I consider it a credit to both agencies, and to the underpinning interests of aviation safety, that the principles and protocols reflected in that MOU, which Mr Dolan and I formally endorsed in February 2010, effectively governed relations between our agencies over that period, and guided the progress of our respective parallel investigations.

With these considerations in mind, I completely reject any allegation that CASA has in any way colluded with the ATSB or encouraged it to produce a report less critical of CASA or Pel-Air.

CASA's dealings with the ATSB throughout our respective investigations have been entirely appropriate, transparent and consistent with applicable laws and policies. Where there was no legal constraint on our ability to do so on request, CASA has provided the ATSB with all documentation we have been asked to provide, and at no time has CASA asked, suggested or implied to the ATSB that it should focus with more or less severity on any individual or organisation in the conduct of its investigation or the formulation of its findings.

In the case of the Pel-Air investigation, as in any other, CASA's primary concern with ATSB reports is that they are factually accurate, correctly identify and consider the relevant provisions of the applicable civil aviation legislation properly take into account current and forthcoming safety developments (such as new or anticipated regulatory changes) and that the ATSB is aware of and understands the bases for CASA's views on factors likely to be relating to the accident.

CASA has a regulatory policy, issued in August 2011, to guide the action of CASA staff in their interaction with the ATSB. CASA has an Accident Liaison and Investigation Unit (ALIU), headed by a senior manager, to act as the central coordination point for dealings with the ATSB. Regular meetings are held with the ATSB on accident reports (as required) and there is a six-monthly meeting to discuss broader policy and administrative issues.

ATSB draft and preliminary reports are circulated to relevant CASA operational divisions for comment. More complex issues are often discussed with the ATSB to ensure there is a clear and *shared understanding* of—which is *not* necessarily the same thing as *agreement* on—substantive points raised in a report before CASA provides formal comment as a Directly Involved Party. These CASA comments reflect the product of consultations within CASA involving all relevant subject-matter experts. They are then reviewed by the head of the ALIU before being passed to the ATSB.

CASA also provides the ATSB with any documentation we are required to provide under section 32 of the *Transport Safety Investigation Act 2003.* In the case of the Pel-Air accident, CASA provided the ATSB with a copy of the November 2009 special audit report, the aircraft file, flight crew licensing and medical details and other relevant files on this basis. This process too is consistently followed in connection with other ATSB accident investigations.

Safety actions arising from accident reports are monitored by the ATSB and progress is discussed at the formal six-monthly meetings conducted pursuant to the MOU. CASA internally monitors developments with ATSB safety actions and recommendations through its own Accident Investigation Review Committee.

This committee is made up of senior CASA officers and acts to help ensure that CASA's disposition of matters arising out of ATSB reports is complete and proper, with a view to confirming that we have taken the appropriate responsive actions, and conveying that information to the ATSB, which also tracks those actions and publishes status reports on its web site.

Every year, CASA receives between 300 and 400 communications from the ATSB, including a number of accident reports. Whilst CASA's views on various elements of accident reports may on occasion differ from those of the ATSB, the content of the final report on any accident is entirely a matter for the ATSB.

In respect of the Pel-Air accident, the ATSB contacted CASA in February 2010 and briefed CASA on what the ATSB regarded as an emerging safety issue which they categorised as critical. The ATSB identified a lack of regulation or guidance for pilots when exposed to previously un-forecast meteorological conditions on long flights to destinations with no nearby alternates.

CASA agreed to review the safety issue and responded to the ATSB in March 2010, advising that, whilst civil aviation regulations are not prescriptive in relation to such in-flight decision-making, CASA considered that the current legislative regime, combined with sufficient aeronautical knowledge, compliance with applicable training requirements and published guidance material adequately conduced to safe and responsible in-flight decision-making by the pilot-in-command.

CASA indicated it was reviewing the regulations and guidance material relating to fuel planning and the identification of alternate aerodromes, with a view to seeking appropriate amendments to those materials as part of a CASA standards development project.

As CASA had accepted the proposed safety action for rules development as *Project OS 09/13 Fuel and Alternate requirements,* the ATSB were aware of this action and, presumably on that basis, did not issue a formal safety recommendation in connection with that issue.

To the best of my knowledge, CASA has never before been the subject of allegations of collusion with the ATSB in connection with any other accident investigation reports. And in light of the evolving history of relations between CASA and the ATSB, I find it extraordinary, to say the least, that such a claim should have been made in this instance. In the circumstances, I suspect the reason such allegations have been made in respect of this particular report relate to the fact that certain parties with an interest in the substance and implications of the report are simply unhappy with the with the ATSB's findings and conclusions.

Let me to turn to CASA's actions in relation to the pilot-in-command of the Pel-Air flight involved in the accident, Mr Dominic James.

Some submissions made to the Committee maintain that Mr James's conduct at the time was determinatively influenced by a number of 'external factors' over which he had no control, and for which conduct which CASA should not have taken the actions it took in relation to some of Mr James's flight crew authorisations.

CASA does not accept this, and maintains that, on an objective measure of the facts and circumstances, reasonably and fairly considered, we formed the view at the time that, as pilot-in-command, Mr James displayed deficient aeronautical skills and knowledge appropriate to the licences and rating he held.

On that basis, in December 2009, and in the interests of safety, Mr James's Commercial Pilot's Licence (Aeroplane), Airline Transport Pilot Licence and multi-engine Command Instrument Rating were *suspended*, pending his successful completion of specified tests and examinations.

After Mr James met the examination and testing requirements relating to his Commercial Pilot Licence and Command Instrument Rating, the suspension of those authorisations was lifted on 25 July 2011. Once he completed the remaining requirements relating to his Airline Transport Pilot Licence, on 27 March 2012, CASA lifted the suspension of his Airline Transport Pilot Licence, permitting Mr James to seek employment *as a co-pilot* of a multi-crew aeroplane. Unless and until he first passes the aeroplane proficiency check he has been required to undertake, however, he may not conduct a flight as pilot-in-command of a multi-crew aircraft for which an ATPL is required.

I do not consider that Mr James has been treated unfairly by CASA. Pilots acting as Pilot-in-Command have critical safety-related responsibilities, including flight planning and the proficient management of fuel calculations, as well as the assessment of their own level of fatigue, if any.

A number of regulations relating to fuel planning were in force and applicable to Mr James's conduct at the time of the ditching. Principal amongst these is regulation **234** of the Civil Aviation Regulations, which provides that a pilot must not commence a flight unless all reasonable steps have been taken to ensure that sufficient fuel and oil is carried for the planned flight.

Regulation **224** of the Civil Aviation Regulations also imposes a duty on the pilot-in-command to be responsible for:

- the start, continuation, diversion and end of a flight by the aircraft;

- the operation and safety of the aircraft during flight;
- the safety of persons carried on the aircraft; and
- the safety of other members of the crew on the aircraft.

A pilot-in-command who fails to take reasonable steps to ensure an aircraft carries sufficient fuel to enable a proposed flight to be undertaken in safety will contravene regulation 234, and will very likely be in breach of his duties under regulation 224. A pilot-in-command who does not make a careful study of all available information, such as current weather reports and forecasts, will also be in breach of the explicit obligation to do so specified in Civil Aviation Regulation **239**.

Implicit in the obligation to consider the meteorological conditions affecting a flight the pilot-in-command is also required to consider the possibility of a diversion to an alternate aerodrome, engine failure and a loss of pressurisation. A pertinent Civil Aviation Advisory Publication (*Guidelines for Aircraft Fuel Requirements)* was published in 2006 to assist pilots and air operators to understand their regulatory responsibilities in connection with these matters.

CASA's regulatory investigation of the accident flight identified incomplete pre-flight planning and inadequate management of the flight by the pilot-in-command. The circumstances of this flight revealed that the fuel planning which Mr James undertook in arriving at the figures of 3 hours 30 minutes flight time and the amount of fuel required was well below the standard required of an Airline Transport Pilot (Aeroplane) Licence (ATPL) holder.

Five significant deficiencies were identified in Mr James's flight planning.

- First, Mr James did not receive an area forecast for the route he intended to fly (Samoa – Norfolk), nor did he source any information relating to the strength of the prevailing high-level winds along the route. In the absence of this critical data, there was no sound basis for his estimated flight time of 3 hours 30 minutes, nor for his estimate of the fuel required to be carried.
- Second, it does not appear that Mr James took into account contingencies, such as the possibility of a depressurisation and/or an engine failure, in calculating the amount of fuel which he took on board in Samoa.
- Third, Mr James did not take into account the possibility of a forced diversion.
- Fourth, having commenced the flight from Samoa to Norfolk Island, the transcript of the Mr James's communications with Air Traffic Control (ATC) in Fiji revealed that he received a weather report for Norfolk Island at 0801 UTC, which showed that the weather conditions at Norfolk Island had deteriorated from those forecast during his flight planning at Apia.

Further communications with Auckland ATC revealed that Mr James received a weather forecast for Norfolk Airport at 0904 UTC, which showed that the weather conditions at Norfolk Island were deteriorating and were below the minimum criteria at which an alternate aerodrome is required. This information meant that the weather was unlikely to remain suitable for a safe landing at Norfolk Island and Mr James should have diverted the aircraft to Noumea. A further weather report received by Mr James at 0934 UTC indicated that Norfolk Airport was no longer suitable as a destination.

- Fifth, when Mr James received the weather forecast at 0904 UTC, he was approximately 1 hour from Norfolk Island and in a position where it would have still have been a viable option for him to have diverted the aircraft to Noumea . The fact that he elected to pursue a landing at Norfolk Island in light of the weather forecast which he received at 0904 UTC indicates that he may not have the necessary aeronautical skill and knowledge to make appropriate command judgements about the likely effect of weather.

I would now like to turn to the operator, Pel-Air. In this connection, the suggestion has been made that CASA has in some way acted to 'shield' this operator from appropriate regulatory action by CASA. This is manifestly untrue. And here too, the claim seems to be intended, at least in part, to divert attention away from the actual facts of the matter.

Immediately after the accident in November 2009, CASA undertook a multi-disciplinary special audit of Pel-Air's operations under its Air Operator's Certificate. As a result of this audit, CASA placed a condition on Pel-Air's Air Operator's Certificate, requiring the company to implement a Management Action Plan, with 57 action items identified to address deficiencies.

By June 2010, Pel-Air had satisfied CASA that all of the conditions had been met and, following a further audit, CASA removed those conditions from the Air Operator's Certificate.

This course of regulatory action is no different to action CASA has taken with a number of other operators. It predicates on a procedural basis of the same kind as that on which the action taken in relation to Mr James was based.

In neither case did CASA seek or pursue punitive action. Rather, in both cases, certain privileges could not be exercised, or exercised fully, unless and until certain safety-related requirements were satisfied. In both cases, it was a matter for the authorisation holder to take the necessary remedial steps, and to demonstrate to CASA that they had done so. Once those safety-related concerns might be shown to have been adequately addressed, CASA would readily restore the privileges that had been delimited or suspended.

As an AOC holder, Pel-Air was regularly subject to CASA surveillance prior to the accident. Between 1 June 2005 and 18 November 2009, CASA issued a total of 34 Requests for Corrective Action and one Safety Alert to Pel-Air, with the key findings relating to deficiencies in the operator's Fatigue Risk Management and the Training and Checking Systems.

The allegation has been made that CASA has kept these actions secret. That is false and misleading. CASA does not publicise its ongoing regulatory actions in relation to *any* operator, on the assumption—where such an assumption is reasonable—that responsive corrective action will be taken in an effective and timely fashion. To do otherwise would be unfair and would serve no meaningful safety-related interest. If an operator's deficiencies are of a sufficiently serious nature as to make it unsafe to allow operations to continue, appropriate administrative remedies are available to CASA allowing for immediate action to be taken. Although it is rarely necessary to do so, CASA has not hesitated to exercise those powers when such action is required in the interests of safety.

In conclusion, CASA took a corrective and protective approach in dealing with both Mr James and Pel-Air. In both cases, their authorisations were (ultimately, in Mr James's case) varied with conditions imposed pending a demonstration to CASA's satisfaction that specified deficiencies had been addressed.

Finally, without suggesting that CASA accepts or agrees with the other elements of his submission, I would like to conclude with a comment about certain aspects of Mr Mick Quinn's submission to the Committee, which I believe need to be clarified.

In describing his qualifications and experience, Mr Quinn states, on the first page of his submission, that he has held senior executive roles in the regulatory arena at both the State and Federal levels. Subsequently, at page 5 of his submission, Mr Quinn states that CASA 'failed to provide adequate oversight of Pel-Air operations'.

Whilst it is true enough to say that Mr Quinn held a senior executive position in the federal regulatory arena, I find it passing strange that he fails to say that, in fact, he served from December 2007 until June 2009 as CASA's Deputy Chief Executive Officer for Operations, and from 1 July 2009 until he left CASA in January 2010, as Deputy Director. During the entirety of that period, Mr Quinn's position was the most senior in the organisation, below mine, with responsibility for CASA's Operations Division.

I will not discuss here the circumstances of Mr Quinn's departure from CASA in 2010. I do feel obliged to point out, however, that as DCEO, Operations, and as Deputy Director, he would have had penultimate accountability for any shortcomings or deficiencies in CASA's oversight functions during the period preceding and following the accident that has given rise to this inquiry.

Australian Government
Australian Transport Safety Bureau

Aviation safety issues and actions

Recommendation issued to: Bureau Of Meteorology

Output No:	R20000040
Date Issued:	22 February 2000
Safety Action Status:	
Background:	SUBJECT - RELIABILITY OF NORFOLK ISLAND FORECASTS

SAFETY DEFICIENCY

The meteorological forecasts for Norfolk Island are not sufficiently reliable on some occasions to prevent pilots having to carry out unplanned diversions or holding.

FACTUAL INFORMATION

Related Occurrences

During the period 1 January 1998 to 31 March 1999, occurrences involving unforecast or rapidly changing conditions at Norfolk Island reported to the

Bureau included the following:

199801482

A British Aerospace 146 (BAe146) aircraft was conducting a regular public transport (RPT) passenger service from Sydney to Norfolk Island. The terminal area forecast (TAF) for Norfolk Island indicated that cloud cover would be 3 octas with a cloud base of 2,000 ft. Approaching Norfolk Island, the crew found that the area was completely overcast. After conducting an instrument approach, they determined that the cloud base was 600 ft, which was less than the alternate minima. Fuel for diversion to an alternate airfield was not carried on the flight because the forecast had not indicated any requirement.

199802796

Before a Piper Navajo Chieftain aircraft departed for an RPT passenger service from Lord Howe Island to Norfolk Island, the TAF for Norfolk Island did not require the carriage of additional fuel for holding or for diversion to an alternate airfield. Subsequently, the TAF was amended to require 30 minutes holding and then 60 minutes of holding. The pilot later advised that he became aware of the deteriorating weather at his destination only after he had passed the planned point of no return (PNR). However, the aircraft was carrying sufficient fuel to allow it to hold at Norfolk Island for 60 minutes. When the aircraft arrived in the Norfolk Island circuit area, the pilot assessed the conditions as unsuitable to land due to low cloud and rainshowers. After approximately 45 minutes of holding, the weather conditions improved sufficiently for the pilot to make a visual approach and landing.

199804317

A BAe146 aircraft was conducting an RPT passenger service from Brisbane to Norfolk Island. When the crew were planning the flight, the Norfolk Island TAF included a steady wind of 10 kt and thunderstorm conditions for periods of up to 60 minutes. Approximately 30 minutes after the aircraft departed, the TAF was amended to indicate a mean wind speed of 20 kt with gusts to 35 kt. As the aircraft approached its destination, the Unicom operator reported the wind as 36 kt with gusts to 45 kt. The crew attempted two approaches to runway 04 but conducted a go-around on each occasion because of mechanical turbulence and windshear. The pilot in command then elected to divert the aircraft to Auckland. The wind gusts at Norfolk Island did not decrease below 20 kt for a further 3 hours.

199900604

While flight planning for an RPT passenger service from Lord Howe Island to Norfolk Island, the pilot of a Piper Navajo Chieftain found that the TAF required the carriage of fuel sufficient for a diversion to an alternate aerodrome. As the aircraft was unable to carry sufficient fuel for the flight to Norfolk Island and then to an alternate aerodrome, the flight was postponed. Later in the day, the forecast was amended to require the carriage of 60 minutes of holding fuel and the flight departed carrying the additional fuel. Approximately 20 minutes after the aircraft departed Lord Howe Island and more than one hour before it reached its point of no return (PNR), the TAF was amended again to require the carriage of alternate fuel. The pilot did not request or receive this amended forecast and so continued the flight.

Following the flight's arrival overhead Norfolk Island, the pilot conducted a number of instrument approaches but was unable to land the aircraft due to the poor visibility. After being advised of further deteriorations in conditions, the pilot made an approach below the landing minima and landed in foggy conditions with a visibility of 800m. Subsequent investigation determined that the actual conditions at Norfolk Island were continuously below alternate minima for the period from 2.5 hours before the aircraft departed from Lord Howe Island until 6 hours after the aircraft landed.

Meteorological information

The Norfolk Island Meteorological Observing Office, which is staffed by four observers, normally operates every day from 0400 until 2400 Norfolk Island time. When one or more observers are on leave, the hours are reduced to 0700 until 2400 daily. Hourly surface observations by the observers, or by an automatic weather station when the office is unmanned, are transmitted to the Sydney Forecasting Office where they are used as the basis for the production and amendment of TAFs and other forecasts.

Weather conditions are assessed by instrument measurements, for example, wind strength, temperature and rainfall, or by visual observation when observers are on duty, for example, cloud cover and visibility. There is no weather-watch radar to allow the detection and tracking of showers, thunderstorms and frontal systems in the vicinity of the island. The wind-finding radar on Norfolk Island is used to track weather balloons to determine upper level winds six-hourly when observers are on duty. It cannot detect thunderstorms or rainshowers.

Pilots in the Norfolk Island area can contact the Met Office staff on a discrete frequency for information about the current weather conditions.

The reliability of meteorological forecasts is a factor in determining the fuel requirements. As forecasts cannot be 100% reliable, some additional fuel must be carried to cover deviations from forecast conditions.

A delay of one hour or more can exist between a change occurring in the weather conditions and advice of that change reaching a pilot. The change has to be detected by the observer or automatic weather station and the information passed to the Forecasting Office. After some analysis of the new information in conjunction with information from other sources, the forecaster may decide to amend the forecast. The new forecast is then issued to Airservices Australia and disseminated to the Air Traffic Services (ATS) staff who are in radio contact with the pilot. It is then the pilot's responsibility to request the latest forecast from ATS.

Alternate minima

Alternate minima are a set of cloud base and visibility conditions which are published for each airfield that has a published instrument approach procedure. The alternate minima are based on the minimum descent altitude and minimum visibility of each of the available instrument approaches. When the forecast or actual conditions at an airfield decrease below the alternate minima, aircraft flying to that airfield must either carry fuel for flight to an alternate airfield or fuel to allow the aircraft to remain airborne until the weather improves sufficiently for a safe landing to be conducted.

A pilot flying an aircraft that arrives at a destination without alternate or holding fuel and then finds that the weather is below landing and alternate minima is potentially in a hazardous situation. The options available are:

1. to hold until the weather improves; however, the fuel may be exhausted before the conditions improve sufficiently to enable a safe landing to be made;

2. to ditch or force-land the aircraft away from the aerodrome in a area of improved weather conditions, if one exists; or

3. attempt to land in poor weather conditions.

All of these options have an unacceptable level of risk for public transport operations.

The alternate minima for Norfolk Island are:

1. cloud base at or above 1,069 ft above mean sea level (AMSL) and visibility greater than 4.4 km for category A and B aircraft; and

2. cloud base at or above 1,169 ft AMSL and visibility greater than 6 km for category C aircraft.

The available alternate aerodromes for Norfolk Island are La Tontouta in Noumea (431 NM to the north), Lord Howe Island (484 NM to the south-west) and Auckland NZ (690 NM to the south-east). Lord Howe Island may not be suitable for many aircraft due to its short runway. Flight from Norfolk Island to an alternate aerodrome requires a large amount of fuel, which may not be carried unless required by forecast conditions or by regulations.

Australian regulations

Prior to 1991, the then Civil Aviation Authority published specific requirements for flights to island destinations. For example, flights to Lord Howe Island were required to carry fuel for flight to an alternate aerodrome on the mainland Australia, and flights to Norfolk Island and Cocos Island, where no alternate aerodromes were available, were required to carry a minimum of 2 hours of holding fuel.

In 1991, Civil Aviation Regulation (CAR) 234 was enacted. This regulation provided that an aircraft would not commence a flight unless the pilot in command and the operator had taken reasonable steps to ensure that the aircraft was carrying sufficient fuel and oil to enable the proposed flight to be undertaken in safety. The regulation did not specify the method for determining what was sufficient fuel in any particular case. Civil Aviation Advisory Publication (CAAP) 234-1(0) dated March 1991, provided guidelines which set out one method that could be used to calculate fuel requirements that would satisfy CAR 234. CAAP 234-1 did not contain any special considerations or requirements when planning a flight to an island destination.

In August 1999, Civil Aviation Order 82.0 was amended to require all charter passenger-carrying flights to Norfolk Island and other remote islands to carry fuel for the flight to their destination and to an alternate aerodrome. The alternate aerodrome must not be located on a remote island. This requirement to carry additional fuel does not apply to regular public transport flights to a remote island.

European Joint Aviation Regulation

The European Joint Aviation Regulation (Operations) 8.1.7.2 states: "at the planning stage, not all factors which could have an influence on the fuel used to the destination aerodrome can be foreseen. Consequently, contingency fuel is carried to compensate for ... deviations from forecast meteorological conditions."

Traffic levels

In February 2000, approximately 11 regular public transport aircraft land at Norfolk Island every week, including Boeing 737 and Fokker F100 aircraft. An additional 20 instrument flight rules and 12 visual flight rules flights are made to the island every week by a variety of business and general aviation aircraft.

ANALYSIS

Reports to the Bureau, including those detailed in the factual information section above, indicate that the actual weather conditions at Norfolk Island have not been reliably forecast on a number of occasions. Current regulations do not require pilots of regular public transport aircraft to carry fuel reserves other than those dictated by the forecast weather conditions. The safety consequences of an unforecast deterioration in the weather at an isolated aerodrome like Norfolk Island may be serious.

The present level of reliability of meteorological forecasts and the current regulatory requirements are not providing an adequate level of safety for passenger-carrying services to Norfolk Island.

SAFETY ACTION

As a result of these occurrences, the Civil Aviation Safety Authority has commenced a project to review the fuel requirements for flights to remote islands.

Output Text

The Australian Transport Safety Bureau (formerly the Bureau of Air Safety Investigation) recommends that the Bureau of Meteorology should review the methods used and resources allocated to forecasting at Norfolk Island with a view to making the forecasts more reliable.

Initial Response

Date Issued: 27 April 2000
Response from: Bureau Of Meteorology
Response Status: Closed - Accepted
Response Text: In response to your letter of 25 February 2000 relating to Air Safety Recommendation 20000040 and the reliability of meteorological forecasts for Norfolk Island, the Bureau of Meteorology has explored a number of possible ways to increase the reliability of forecasts for flights to the Island.

There are several factors which determine the accuracy and reliability of the forecasts. The first is the quality and timeliness of the baseline observational data from Norfolk Island itself. The second is the information base (including both conventional surface observational data and information from meteorological satellites and other sources) in the larger Eastern Australia-Southwest Pacific region. The third is the overall scientific capability of the Bureau's forecast models and systems and, in particular, their skill in forecasting the behaviour of the highly localised influences which can impact on conditions on Norfolk Island. And the fourth relates to the speed and responsiveness with which critical information on changing weather conditions (forecast or observed) can be conveyed to those who need it for immediate decision making.

As you are aware, the Bureau commits significant resources to maintaining its observing program at Norfolk Island. While the primary purpose of those observations is to support the overall large-scale monitoring and modelling of meteorological conditions in the Western Pacific, and the operation of the observing station is funded by the Bureau on that basis, it is staffed by highly trained observers with long experience in support of aviation. As far as is possible with available staff numbers, the observers are rostered to cover arrivals of regular flights and rosters are adjusted to cover the arrival of notified delayed flights.

The Norfolk Island Terminal Aerodrome Forecast (TAF) is produced by experienced professional meteorologists located in the Bureau's New South Wales Regional Forecasting Centre in Sydney. The terminal forecast provides predictions of wind, visibility, cloud amount and base height and weather routinely every six hours. Weather conditions are continuously monitored and the terminal forecast is amended as necessary in line with air safety requirements. The forecasters have full access to all the Bureau's synoptic meteorological data for the region and guidance material from both Australian and overseas prediction models. As part of the forecasting process, they continuously monitor all available information from the region including the observational data from Norfolk Island itself. When consideration of the latest observational data in the context of the overall meteorological situations suggests the need to modify the terminal forecast, amendments are issued as quickly as possible.

Despite the best efforts of the Bureau's observing and forecasting staff, it is clear that it is not always possible to get vital information to the right place as quickly as it is needed and the inherent scientific complexity of weather forecasting means that occasional serious forecast errors will continue to be unavoidable. That said, the Bureau has carefully reviewed the Norfolk Island situation in order to find ways of improving the accuracy and reliability of its forecasts for aviation through a range of short and longer-term means.

As part of its strategic research effort in forecast improvement, the Bureau of Meteorology Research Centre is undertaking a number of projects aimed at increasing scientific knowledge specifically applied to the provision of aviation weather services. Research projects are focussed on the detection and prediction of fog and low cloud and are based on extensive research into the science of numerical weather prediction. However, with the current level of scientific knowledge, the terminal forecasts for Norfolk Island cannot be expected to be reliable 100 percent of the time. Based on figures available for the period January 1998 to March 2000 (some 12 000 forecast hours), the Bureau's TAF verification system shows that for category A and B aircraft when conditions were forecast to be above the minima, the probability of encountering adverse weather conditions at Norfolk Island airport was 0.6%.

As part of its investigations, the Bureau has considered the installation of a weather watch radar facility at Norfolk Island with remote access in the NSW Regional Forecast Centre. Although routine radar coverage would enable the early detection of precipitation in the vicinity of the Island, investigations suggest that the impact of the radar images in improving forecast accuracy would be on the time-scale of one to two hours. This time frame is outside the point of no return for current aircraft servicing the route. It was concluded that the installation of a weather watch radar would be relatively expensive and would only partially address the forecast deficiencies identified in Air Safety Recommendation R20000040. The Bureau will however keep this option under review.

To increase the responsiveness of the terminal forecasts to changes in conditions at Norfolk Island, the Bureau has issued instructions to observing staff to ensure forecasters at the Sydney RFC are notified directly by telephone of any discrepancies between the current forecast and actual conditions. This arrangement will increase the responsiveness of the system particularly during periods of fluctuating conditions. In addition the Bureau has provided the aerodrome manager with access to a display of the latest observations to ensure the most up to date information is relayed to aircraft.

The Bureau is actively participating in the review of fuel requirements for flights to remote islands being undertaken by the Civil Aviation Safety Authority.

I regret the delay in replying to your letter but the Bureau has felt it important to look carefully at all aspects of the Norfolk Island forecast situation and consider the full range of possibilities for forecast improvement within the resources available to us. We will continue to work on forecast improvement for Norfolk Island as resources permit.

Last update 05 April 2012