06-006	**ZK-MYF, Partenavia P68B, loss of engine power, Takapau**	**2 December 2006**

The Transport Accident Investigation Commission is an independent Crown entity established to determine the circumstances and causes of accidents and incidents with a view to avoiding similar occurrences in the future. Accordingly it is inappropriate that reports should be used to assign fault or blame or determine liability, since neither the investigation nor the reporting process has been undertaken for that purpose.

The Commission may make recommendations to improve transport safety. The cost of implementing any recommendation must always be balanced against its benefits. Such analysis is a matter for the regulator and the industry.

Report 06-006

Partenavia P68B

ZK-MYF

engine power loss and subsequent forced landing during training flight

Takapau, 30 kilometres west of Waipukurau

2 December 2006

Abstract

On Saturday 2 December 2006, Partenavia P68B ZK-MYF, a light twin-engine aeroplane, was being flown on a cross-country training flight from Napier to Palmerston North, when it had a power loss near Waipukurau. The instructor completed a forced landing into a paddock resulting in moderate damage to the aircraft. There were no injuries.

The power loss was caused by fuel starvation to the left engine. The instructor should have been able to recover from the situation and make a safe landing at an alternative aerodrome. However, evidence indicated that his actions contributed to a partial power loss of the right engine, after which a forced landing became inevitable.

The investigation identified that the instructor's minimal experience on the aircraft, combined with inadequate fuel management procedures, contributed to the aircraft departing Napier with less than the minimum required fuel on board. They also influenced the instructor's actions once the initial power loss occurred. Safety recommendations were made to the Director of Civil Aviation to address these issues.

ZK-MYF after the forced landing

Contents

Figures

Abbreviations

AC	Advisory Circular
CAA	Civil Aviation Authority of New Zealand
CARs	Civil Aviation Rules
cm	centimetre(s)
CPL	Commercial Pilot Licence
ft	feet
IFR	instrument flight rules
kg	kilogram(s)
km	kilometre(s)
m	metre(s)
°M	degrees magnetic
MDAC	Manawatu Districts Aero Club
NPRM	Notice of Proposed Rule Making
NZQA	New Zealand Qualifications Authority
RNZAC	Royal New Zealand Aero Club
UTC	co-ordinated universal time
VFR	visual flight rules

Glossary

Hobbs meter	A meter fitted to an aircraft that can measure engine running or flight time depending on how fitted.
Feathering	The turning of a blade until minimum resistance is established. This condition is useful on a multi-engine aircraft for reducing drag and stopping rotation or windmilling, thus preventing possible further damage to the engine.
General handling	A range of flying exercises that may include manoeuvres such as climbing and descending, turning, stalling and practice forced landings.

Data Summary

Aircraft registration:	ZK-MYF
Type and serial number:	Partenavia P68B, 123
Number and type of engines:	2 Lycoming IO-360-A1B6
Year of manufacture:	1977
Operator:	Wings Flight Training, training arm of Manawatu Districts Aero Club
Date and time:	2 December 2006**,** 1110[1]
Location:	Takapau, 30 kilometres west of Waipukurau latitude: 40° 01´ south longitude: 176° 16´ east
Type of flight:	flight instruction
Persons on board:	instructor: 1 students: 4
Injuries:	instructor: nil students: 1 minor
Nature of damage:	Moderate
Pilot's licence:	Commercial Pilot Licence (Aeroplane)
Pilot's age:	59
Pilot's total flying experience:	10 700 hours (6 hours on type)
Investigator-in-charge:	I R M^{c}Clelland

[1] Times in this report are New Zealand Daylight Time (UTC + 13 hours) and are expressed in the 24-hour mode.

1 Factual Information

1.1 History of the flight

1.1.1 On the morning of Saturday 2 December 2006, the chief flying instructor (the instructor) for Wings Flight Training (the operator), briefed 2 students for a training flight from Palmerston North Aerodrome to Napier. The aircraft to be used was the operator's recently acquired twin engine Partenavia P68B, registration ZK-MYF. The intention was to take the students from Palmerston North and give multi-engine and instrument-tracking instruction to one of them. The second student was to observe the flight from the centre row of seats.

1.1.2 After landing at Napier, a further 2 students would be on board for the return leg to Palmerston North. The total flight time was expected to be about 1.5 hours. The students had flown between 125 hours and 200 hours each, and this was their first flight in a multi-engine aircraft.

1.1.3 The aircraft had been parked overnight on an undulating grassed area outside the operator's premises. This was the only available parking area for the operator. The instructor, in conjunction with one of the students, conducted the pre-flight inspection of ZK-MYF. During the inspection the instructor used a stepladder to gain access to the fuel filler caps located on top of the wings. The stepladder had been purchased the previous day and was stored inside the operator's premises.

1.1.4 The instructor reported that because the right fuel gauge was inoperative, he placed emphasis on the fuel assessment. He said he used a metal dip stick calibrated in quarters to dip the first fuel tank and got a reading of about half full. He then "peeped inside" the tank, observed the fuel and again used the dip stick to confirm the quantity. This was repeated on the fuel tank on the other wing and he reported that this tank was also half full.

1.1.5 The instructor commented that the fuel readings made sense to him, as he estimated he had flown about 2.5 hours in ZK-MYF since filling the tanks 3 days earlier. The instructor calculated that at an average fuel consumption of 40 litres per hour per engine, he had sufficient fuel for the estimated 1.5 hours' flying plus 45 minutes of reserve fuel. The minimum reserve requirement was 30 minutes.

1.1.6 They departed Palmerston North Aerodrome at 0916 for Napier under visual flight rules (VFR).[2] During the flight the instructor gave the students instruction on instrument navigation and multi-engine aircraft handling, and demonstrated a simulated engine failure. ZK-MYF landed at Napier Aerodrome at 0958.

1.1.7 After about 30 minutes on the ground, the instructor conducted a pre-flight inspection of ZK-MYF in preparation for the return flight to Palmerston North. No check of the aircraft's fuel state was done because the instructor did not have a ladder with which to gain access to the fuel filler caps. Further, he said he was satisfied that sufficient fuel remained after the approximately 45-minute flight from Palmerston North.

1.1.8 At 1043, ZK-MYF departed from Napier Aerodrome and was initially climbed to 6500 feet (ft) in controlled airspace on track to Palmerston North. A short time later the instructor called Napier Tower and requested to be able to operate up to 7500 ft to remain in visual meteorological conditions and so be able to continue under VFR. However, increasing cloud forced the instructor to start gradually descending. During this time the instructor gave the students instruction on instrument navigation and simulated an engine failure on the left engine by closing the throttle.

[2] VFR meteorological minima were contained in Civil Aviation Rules and for the majority of the flight required a minimum visibility of 5 km, and the aircraft to remain at least 2 km horizontally and 1000 ft vertically from cloud.

1.1.9 About 30 nautical miles (55 km) from Napier, and shortly after power was restored to the left engine, the instructor and students felt and heard a series of surges on the left engine. The instructor increased the mixture levers for both engines to full rich, but the surges continued.

1.1.10 At 1109, the instructor made a radio call to Napier Tower and advised the controller of the situation and his intention to return to Napier. The controller acknowledged the radio call and suggested the aerodrome at Dannevirke might be a closer alternative at which to land. He asked the pilot of ZK-MYF if a distress call was being made. The instructor replied that a distress call was not required and they were diverting to Dannevirke (see Figure 1).

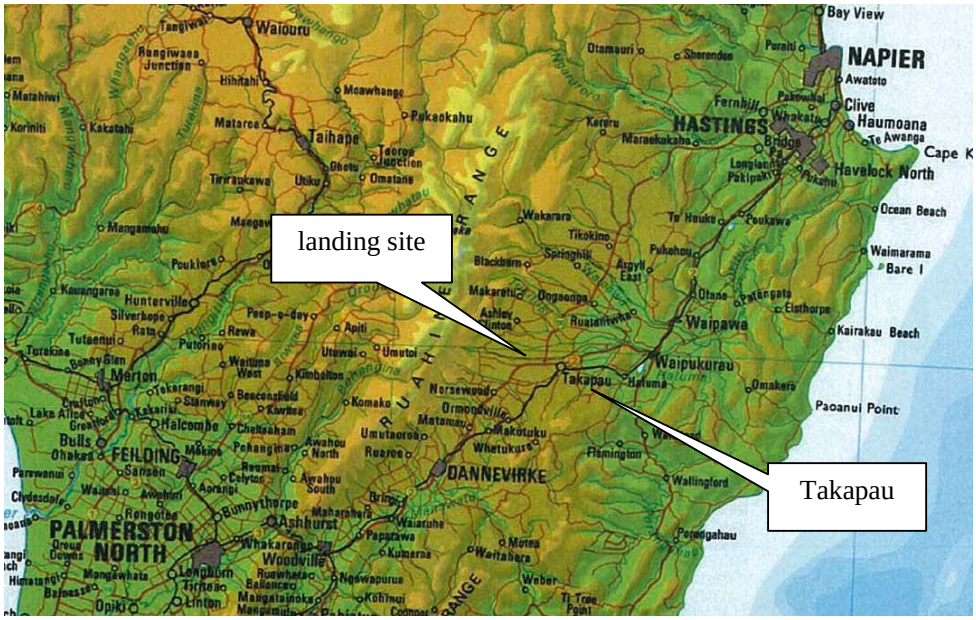

Figure 1
Location map

1.1.11 The instructor turned ZK-MYF towards Dannevirke. The aircraft had by then descended to about 2000 feet above sea level, or about 1000 feet above ground level. The instructor could not recall his exact actions but reported that during this time he changed the fuel tank selectors from tank-to-engine flow to crossfeed flow, then back again. The surging did not stop and was by this time occurring on both engines. He turned on the fuel boost pumps for both engines and selected the alternative engine air supply. The mixtures were confirmed as being full rich and both throttles were exercised in an attempt to regain full power.

1.1.12 The instructor became aware that the aeroplane would not make Dannevirke, so transmitted an emergency radio call and directed the student under instruction to select the emergency code on the aircraft transponder. He then focused on finding a suitable area to land.

1.1.13 The instructor reported that by then there was little time to manoeuvre the aircraft, so he selected a grassed paddock adjacent to a road running across the direction of flight. To ensure he made the paddock, the instructor held the aircraft speed at about 80 knots (150 km per hour) and did not extend any flap. ZK-MYF clipped 2 fences adjacent to the road before travelling across the paddock and through a third fence, coming to a stop about 20 m into a second paddock.

1.1.14 The instructor turned off all the electrical switches and fuel selectors and checked the state of the students before directing everyone to vacate the aircraft. Assistance arrived shortly afterwards.

1.2 Injuries to persons

1.2.1 One of the students suffered a minor scrape to a knee.

1.3 Damage to aircraft

1.3.1 ZK-MYF sustained moderate damage, mainly to the nose fairing area and underside of the aircraft. A helicopter lifted the aircraft to a maintenance facility at Palmerston North for repair and return to service.

1.4 Other damage

1.4.1 Two fences and some batons of a third fence were broken.

1.5 Personnel information

1.5.1 The instructor was aged 59. He held a Commercial Pilot Licence (CPL), a category B flight instructor rating and a single-engine instrument rating. The instructor rating was endorsed for multi-engine instruction.

1.5.2 The instructor held a class 2 medical certificate valid until 16 March 2007. His class 1 medical certificate had expired on 14 September 2006.[3] The instructor was under the impression that as he was not receiving direct financial reward at the time, he was able to continue giving instruction provided he held a valid class 2 medical certificate. The instructor was advised of the requirements under Civil Aviation Rules (CARs), which stated that a B category flight instructor must hold "at least a current commercial pilot licence[4] and therefore a current class 1 medical certificate. The instructor subsequently revalidated his class 1 and 2 medical certification on 20 December 2006.

1.5.3 The instructor had accrued the majority of his flying experience overseas and obtained a New Zealand CPL in March 1993. He migrated to New Zealand in early 1999 and joined the operator's parent company in July 2005 as the chief flying instructor. Although credited with the CPL (Aeroplane) based on his previous experience, the instructor was required to pass ground and flight tests for his B category flight instructor rating before commencing instructional duties. He was also required to sit an instrument rating test before being allowed to fly under instrument flight rules (IFR) in New Zealand.

1.5.4 The instructor's flight test report for his multi-engine instructional endorsement, flown on 19 October 2005 using a PA34 aircraft, recorded that he gave a briefing on asymmetric flight. The air exercises included an engine failure after take-off, an engine failure in flight and an asymmetric circuit, overshoot and landing. This was assessed as being of B category flight instructor standard.

1.5.5 On 20 November 2006, the instructor completed his type rating on the Partenavia P68 aircraft. The type rating form recorded that a technical knowledge exam on the aircraft's systems was completed, followed by a pre-flight check and test flight. During the flight the instructor completed an intentional engine shutdown, propeller feathering, single-engine manoeuvring and air start. The flight instructor who managed the type rating later commented that the fuel system, including crossfeed, was discussed and used during the flight.

1.5.6 The instructor's last annual instructor competency check was completed on 23 November 2006 and examined the instructor's flying ability, as well as air and ground instructional assessments. The air assessment was flown in a single-engine C152 aircraft. The report recorded the

[3] Medical standards and requirements are contained in CARs Part 61 Pilot Licences and Ratings, and Part 67 Medical Standards and Certification.
[4] CARs Part 61.303 Pilot Licences and Ratings, effective 11 May 2006.

instructor's flying ability and "theory and practice of flight instruction" as of B category standard.

1.5.7 The instructor's records showed that he had flown about 10 700 hours in total, including about 7000 hours as pilot in command. He had accrued some 5000 instructional hours, including about 750 hours instructing on twin-engine aircraft. His total multi-engine flying experience was about 4200 hours and at the time of the occurrence he had flown 6 hours in the Partenavia P68. He had flown about 100 hours in the previous 90 days and considered himself to be well rested before the flight.

1.5.8 As well as the Partenavia P68, the instructor held current ratings for Cessna C152 and C172 and Piper PA38 and PA34 aircraft. The PA34 was also a twin-engine aircraft while the others had a single engine.

1.6 Aircraft information

1.6.1 ZK-MYF was a Partenavia P68B, serial number 123, constructed in Italy in 1977. The aircraft was a light, twin-engine, high-wing aeroplane, fitted with a fixed tricycle undercarriage. It had seating for 6 people, arranged in 3 rows of 2 seats each row. The aircraft was powered by 2 Lycoming IO-360-A1B6 engines with fuel injection.

1.6.2 The Civil Aviation Authority of New Zealand (CAA) had issued ZK-MYF with a non-terminating Certificate of Airworthiness. The Certificate directed that the aircraft be maintained and operated in accordance with the manufacturer's manuals. A review of the maintenance records for ZK-MYF indicated that the aircraft was being maintained in accordance with the prescribed documentation.

1.6.3 Between December 2004 and August 2006, ZK-MYF underwent a 500-hour inspection plus significant repair work, including the replacement of both wings and the removal of corrosion. The aircraft had since flown 6 hours and at the time of the accident had flown a total of 8760.5 hours. It had 44 hours to run to the next scheduled servicing, a 50-hour check. The next Annual Review of Airworthiness was due on 13 September 2007.

1.6.4 The aircraft technical log for ZK-MYF recorded in the "Permitted Inoperative Equipment" section an inoperative autopilot pitch trim and an inoperative right-hand-side fuel gauge. There were no other recorded defects. No additional actions for the pilot were stated as a result of the inoperative fuel gauge. At the time of the event the operator was still waiting for spare parts to repair the faulty fuel indicator system.

1.6.5 ZK-MYF was fitted with 2 integral fuel tanks, one in each wing, with a total capacity of 410 litres. Of this, 18 litres were considered unusable, giving a useful fuel load of 196 litres per tank. Two 3-position fuel selector knobs, one for each engine, controlled the fuel flow. The selector knobs enabled a pilot to select which tank fed which engine. Normally the knobs would be selected for direct tank-to-engine flow; that is, the right engine fuel selector knob would be set to the right tank and the left engine selector knob to the left tank. Alternatively, crossfeed could be selected allowing for flow from a tank to the opposite engine, or if required from one tank to both engines. For example, if the left engine selector knob was rotated to its right tank setting, fuel from the right tank fed both engines. The left tank setting on the right engine selector allowed fuel from the left fuel tank to also feed both engines. The final position was for fuel shut-off (see Figures 2 and 3).

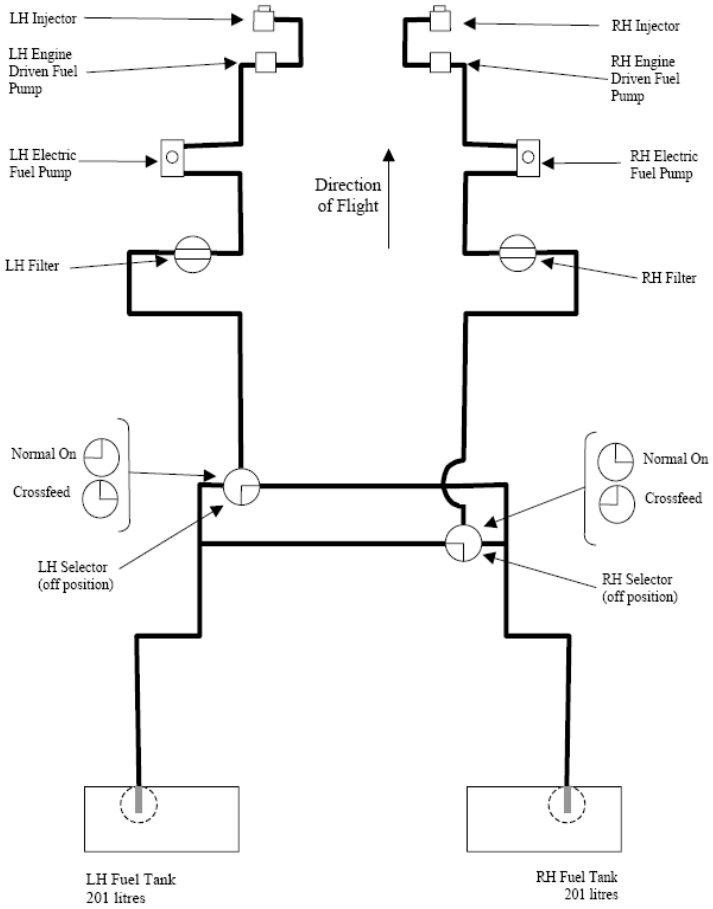

Figure 2
Fuel system schematic

1.6.6 The weight and balance for ZK-MYF at the time of the reported engine surging were calculated using the recorded basic aircraft weight and centre of gravity, the estimated weights of the occupants and an estimated fuel load of 60 litres. ZK-MYF was calculated to have a total weight of 1665 kg. The maximum allowable certified weight was 1990 kg. The centre of gravity was calculated to be within limits.

1.6.7 A review of the performance charts for the Partenavia P68B indicated that at a weight of 1665 kg, ZK-MYF should have been able to maintain level flight with one engine inoperative and its propeller feathered at altitudes up to about 7000 ft (2300 m) in standard atmosphere.[5]

1.6.8 According to the engine manufacturer's representative, the IO-360-A1B6 engine would consume between 40 and 41 litres per hour at a normal 65% cruise power setting at 2000 feet.

[5] The standard atmosphere was defined as having the following sea level values: temperature 15º Celsius, pressure 1013 hectopascals.

Figure 3
Overhead Fuel Control Panel for ZK-MYF

1.6.9 The "Emergency Operations" section of the Partenavia checklist contained 2 checklists for engine failure, depending on the circumstances. The checks are detailed below:

ENGINE FAILURE AFTER TAKEOFF OR TERRAIN CRITICAL

CONTROL ……..……..YAW
AIRSPEED……..BLUE LINE[6]
POWER…….RICH, PITCH, POWER
UNDERCARRIAGE……..UP
FLAPS……UP
IDENTIFY…….DEAD LEG – DEAD ENGINE
CONFIRM……..CLOSE THROTTLE
FEATHER…….DEAD ENGINE

ADVISE INTENTIONS TO ATC
LOOK AFTER LIVE ENGINE

ENGINE FAILURE IN CRUISE

CONTROL…… ……YAW
AIRSPEED……ABOVE BLUE LINE
POWER…… RICH, PITCH, POWER
UNDERCARRIAGE… ……..UP
FLAPS…….UP
IDENTIFY…..DEAD LEG – DEAD ENGINE
CONFIRM……..CLOSE DEAD THROTTLE
TRIM……..RUDDER & ELEVATOR

TROUBLE CHECKS ON **DEAD ENGINE**

[6] Blue line refers to the one engine inoperative minimum control speed. For the Partenavia P68B ZK-MYF this was 88 knots.

ALTERNATE AIR …….ON
FUEL……..ON, CONTENTS, PUMP, FLOW
MAGNETOS…..……..CHECK L & R
INSTRUMENTS…….CHECK
POWER…….....CHECK IF RESTORED

IF POWER NOT RESTORED

FEATHER…….**DEAD ENGINE**

1.6.10 The operator took over management of ZK-MYF on 20 November 2006, when the instructor completed a type rating on the aircraft. The operator and instructor commented that when they commenced operating the aircraft they started a flight log that recorded, among other things, Hobbs meter readings, taxi times and fuel uplifted. The instructor stated that given the lack of knowledge of the aircraft, the recent major maintenance and an inoperative fuel quantity gauge, the log was expected to be useful in establishing a record of the performance of the aircraft and its engines.

1.6.11 The log information recorded for the 5 previous flights was as follows:

DATE	***FLIGHT EXERCISE***	***HOBBS (1747.11)***	***TIME***	***TAXI OUT***	***TAXI IN***	***FUEL UPLIFT***	***FUEL START***
20/11	*Type rating*	*1749.27*	*2.16*	*-*	*-*	*-*	*-*
28/11	*GH/CTS*	*1750.03*	*0.76*	*1417*	*1508*	*-*	*270*
29/11	*CTS/GH*	*1750.95*	*0.92*	*1445*	*1553*	*166*	*Full*
30/11	*STA/CTS*	*1751.74*	*[0.79]*	*1715*	*1830*	*-*	*-*
1/12	*STA/CTS*	*1752.45*	*[0.71]*	*0910*	*1000*	*-*	*-*

No intermediate landings were recorded or reported for any of the flights.

1.6.12 The accident flight details are summarised as follows:

2/12 NAV/GH 1753.61 1.16 c0910 1109 (call to Napier Tower)

(Key: GH – General handling, CTS – Circuits, STA – South Training Area[7], NAV – Navigation)

1.7 Meteorological information

1.7.1 The weather conditions were reported to be a light south-easterly wind with the cloud above 2500 ft (820 m) varying between "few and scattered". [8] There was no forecast or reported significant weather during the conduct of the flight.

1.8 Flight recorders

1.8.1 ZK-MYF was not equipped with any flight recorders, nor was it required to be.

[7] STA – a general handling training located to the south of Palmerston North.
[8] Cloud reported in oktas or eights, with few being 1 – 2 eights of the sky covered, and scattered being 3 – 4 eights.

1.9 Wreckage and impact information

1.9.1 ZK-MYF was flying on a heading of about 200° magnetic (°M) when it struck the top of a fence located on the northern side of a sealed road. The road was about 15° off being perpendicular to the flight path of the aircraft. Tyre marks on the road matched the dimensions of the main undercarriage wheels (see Figure 4).

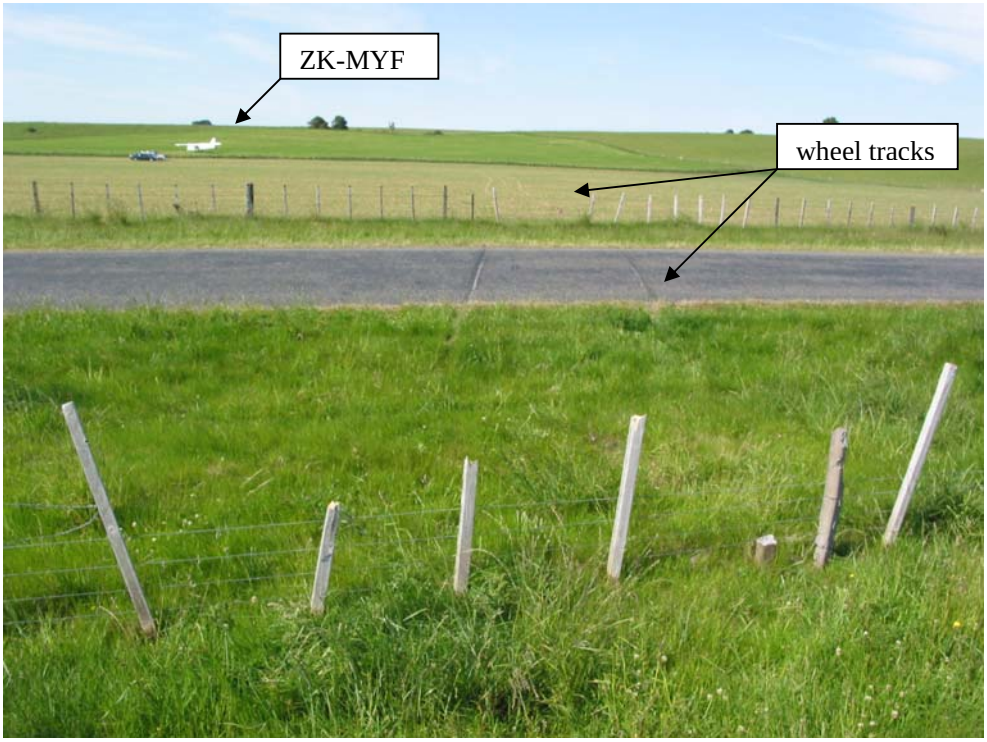

Figure 4
Landing Site

1.9.2 After crossing the road, ZK-MYF broke through a second fence before starting a turn to the left through about 70°. About 230 m from the first fence, ZK-MYF penetrated a third fence before coming to rest after a further 20 m on a heading of 125°M. The site was about 1100 feet above mean sea level.

1.9.3 The damage to the nose area and underside of the aircraft, including a broken right brake line, was consistent with the aircraft travelling through the 3 fences. Three strands of fence wire were found wrapped around the hub of the right engine and there were some associated marks on the propeller blades. The engines appeared to be otherwise undamaged.

1.9.4 The aircraft flaps were found in the retracted position and all electrical switches and both fuel tank selectors were turned to OFF. The pilot later confirmed that flap had not been used during the approach and landing, and that he had turned off all the switches as the aircraft was vacated.

1.9.5 The Hobbs meter used for recording the aircraft's flight times indicated 1753.61. Both throttles were about 2 cm forward of the idle position and the propeller condition levers were in the full increase position. Both mixture levers were selected to full rich. A decal beside the fuel quantity indicators read "INOPERATIVE RH FUEL GAUGE".

1.9.6 Inspection of the aircraft fuel tanks showed the left fuel tank was empty and the right tank to have some fuel remaining. Obtaining an accurate fuel quantity was not possible at the time because of the resources available and the aircraft resting on a slope of about 5°.

1.10 Tests and research

1.10.1 After the removal of ZK-MYF to a maintenance repair facility, a fuel systems check was completed before the commencement of any repair work. The check was performed under the supervision of independent licensed aircraft engineers familiar with the Partenavia aircraft, and done in accordance with the relevant aircraft manuals and airworthiness directives current at the time.

1.10.2 No defects were found during an initial visual inspection. The left tank was confirmed dry and the right tank was found to contain 60 litres of fuel. The fuel was of the correct specification. The fuel system filters were examined and found to be clear of contaminants. The fuel selector valves, fuel lines and pumps were also examined and, other than a "slight weep" on the crossfeed line from the right tank to the left engine, no faults were found.

1.10.3 Fuel was added to the tanks and fuel flow checks were completed for tank-to-engine and tank-to-crossfeed, and considered satisfactory. The fuel selectors were determined to be correctly rigged. The engines were started without difficulty and an operational check of the fuel system was completed. Direct tank-to-engine flow and tank-to-crossfeed flow was tested and found to be satisfactory.

1.11 Organisational and management information

1.11.1 The operator, Wings Flight Training (WFT), was established on 1 November 2006, as the training arm of Manawatu Districts Aero Club (MDAC), with a 50/50 shareholding between MDAC and the instructor. Based at Palmerston North Aerodrome, the aim of the operator was to offer a more formalised academy-style operation for pilot training than that provided up to that time by MDAC. One of the objectives of the operator was to attract international students for basic, instrument and multi-engine training, up to CPL standard. The operator acquired ZK-MYF to help achieve this objective.

1.11.2 Training organisations in New Zealand were required to be registered and certified by the New Zealand Qualifications Authority (NZQA) to permit international students to qualify for New Zealand visas when undertaking training. At the time of the event concerning ZK-MYF, WFT was not registered with NZQA so had an arrangement with another flying school to provide the supervision and ensure NZQA requirements were met, in particular "pastoral care" of students. However, the distance between the 2 organisations reportedly made the arrangement unsatisfactory, so in February 2007 WFT gained NZQA registration, some 4 month after the occurence.

1.11.3 Flight training at MDAC was carried out under CARs Part 61, Pilot Licences and Ratings. Following the accident on 2 December 2006, the CAA conducted a safety inspection of MDAC on 20 December 2006. The inspection of MDAC was performed against the requirements of Part 61. The inspection made 3 findings against MDAC, including:

- *The inspection dates for an Emergency Locator Beacon on one of the aircraft did not match up.*
- *Signatures were missing from a loose leaf maintenance log entry.*
- *The instructor did not hold the required class 1 medical certificate.*

1.12 Additional information

Flight instructor qualifications

1.12.1 CARs Part 61, Pilot Licences and Ratings, prescribed the eligibility requirements for the issue of flight instructor and aircraft type ratings. The Rule described the various flight instructor categories and associated privileges.

1.12.2 There were 5 categories of flight instructor, A to E, with the categories recognising particular requirements within aviation. For example, E category was specific to agricultural operations, while D category catered for more experienced 700-hour-plus pilots who perhaps wished to focus on aircraft type ratings and not *ab initio* or initial flight instruction including first solos. All instructors were required to hold current CPLs for the appropriate category of aircraft regardless of their instructor category and, if instructing on multi-engine aircraft, had to have acceptable multi-engine experience.[9]

1.12.3 Pilots who sought to instruct would normally obtain a C category flight instructor rating before progressing to a B or A category rating if they wished to remain actively instructing. For each upgrade in flight instructor rating the pilot was required to:

> ·*pass an oral examination on:*
>
> ·*aeroplane or helicopter principles of flight and performance, as appropriate,*
> ·*meteorology,*
> ·*cross-country navigation techniques, and*
> ·*the practice and theory of flight instruction.*
>
> ·*demonstrate the ability to give instruction in the appropriate category of aircraft in all normal and emergency flight manoeuvres by passing an oral examination and a flight test that was acceptable to the Director.*[10]

1.12.4 Specific requirements for each flight instructor rating were also stated. For example, to be eligible for the issue of a C category qualification, pilots were required to meet the following:

> ·*a minimum of 200 hours of flight time, including experience acceptable to the Director,*
>
> ·*completed an approved course in the practice and theory of flight instruction and passed, and*
>
> ·*have a minimum of 25 hours dual flight instructor training or approved equivalent.*

To be eligible for the issue of a B category flight instructor rating, a pilot was required to meet the following:

> ·*be the holder of a C category flight instructor rating or approved equivalent for the appropriate category of aircraft, and*
>
> ·*have a minimum of 500 hours flight time experience as a pilot in the appropriate category of aircraft comprising flight experience that was acceptable to the Director.*

To be eligible for the issue of an A category flight instructor rating, a pilot was required to meet the following:

> ·*be the holder of a B category flight instructor rating or approved equivalent for the appropriate category of aircraft,*
>
> ·*in the case of an aeroplane, be the holder of a current instrument rating, and*
>
> ·*have a minimum of 1250 hours experience in the appropriate category of aircraft comprising specific flight experience that is acceptable to the Director.*

[9] CAR Part 61, Subpart G, 61.303 Eligibility requirements, effective 11 May 2006.
[10] The Director of Civil Aviation.

1.12.5 The Director, through the CAA licensing staff and approved testing organisations, would assess a pilot's training and experience before issuing a flight instructor rating qualification. On being awarded a flight instructor rating, an instructor was permitted to give instruction within the limitations of their rating. For example, a B category flight instructor was authorised to:

- *give flight instruction,*
- *authorise solo flight,*
- *record in a pilot's logbook that the pilot had complied with any requirements prescribed for pilots that require logbook certification,*
- *conduct aircraft type ratings, and*
- *conduct biennial flight reviews.*

1.12.6 The Rules stated that an instructor could not give instrument flight instruction in instrument meteorological conditions or on an IFR flight plan, unless the instructor held a current instrument rating for the aircraft type.

1.12.7 CARs Part 61, Pilot Licences and Ratings, prescribed the eligibility requirements for the issue of aircraft type ratings. These included:

- *hold a current pilot licence for the appropriate category of aircraft,*

- *have conversion instruction flight experience acceptable to the Director of Civil Aviation (the Director),*

- *demonstrate to an appropriate qualified flight instructor a satisfactory technical knowledge of the aircraft type for which the rating is required, and*

- *demonstrate to an appropriately qualified flight instructor in a type competency demonstration the ability to perform competently all normal, abnormal, and emergency manoeuvres appropriate to the aircraft type for which the rating is required.*

1.12.8 CARs Part 141 Aviation Training Organisations – Certification prescribed the rules governing the certification and operation of organisations conducting aviation training and assessments. Certification under Part 141 was not required for training generally. For example, type rating courses for aircraft exceeding 5700 kg, human factors courses and dangerous goods courses all required the training provider to be certified under CARs Part 141.

1.12.9 In support of CARs, the CAA had issued a range of documents that amplified the relevant rule and provided more specific assessment criteria. These included Advisory Circulars (ACs) and Flight Test Standards Guides. ACs contained "guidance material" and provided information on standards, practices and procedures that the Director of Civil Aviation had found to be "an acceptable means of compliance with the associated rule".

1.12.10 AC 61-1.10 Pilot Licences and Ratings – Type Ratings, Revision 2 issued on 26 May 2006 and effective at the time of the incident, recorded at Appendix I that pilots should have a minimum of 5 hours' flight experience before an initial type rating for a multi-engine (non-centreline thrust) aeroplane not exceeding 5700 kg maximum certified take-off weight, could be issued. This reduced to one hour for subsequent types.

1.12.11 AC 61-1.18 Pilot Licences and Ratings – Flight Instructor Ratings, Revision 2 issued on 11 May 2006 and effective at the time of the incident, recorded that pilots before being issued with a B category flight instructor rating should have the following:

At least 500 hours in aeroplanes and include the following minimum flight experience requirements:

- *450 hours as pilot-in-command,*
- *250 hours flight instructional experience, with at least 150 hours in aeroplanes,*
- *20 hours instrument flight time,*
- *a minimum of 1 hour dual instruction on spin recovery,*
- *30 hours cross-country flight instruction, and*
- *to instruct on multi-engine aircraft, 50 hours multi-engine flight experience, including 25 hours as pilot-in-command in multi-engine aeroplanes.**

**Prior to giving instruction in multi-engine aeroplanes, pilots were required to demonstrate instructional and flying competence in a multi-engine aeroplane to a flight examiner.*

1.12.12 The Flight Test Standards Guides were available for the various pilot licences, including CPL issue and renewal, and flight instructor ratings. The Guides described acceptable means of compliance with the CARs and could be used in conjunction with the applicable ACs. The B Category Flight Instructor Rating Guide, for example, contained material for the issue, continued competency and additional instructional privileges of night, spinning, aerobatic and multi-engine instruction.

1.12.13 A CAA document titled Type Rating, Demonstration of Competency, Single Pilot Certified – Aeroplane, was also available. The guide detailed the procedures, techniques and marking criteria for the issue of aeroplane type ratings. For multi-engine aircraft the pilot was required to complete an intentional engine shutdown and air start. A second simulated engine failure in cruise flight was also to be completed. For this exercise, the pilot was expected to be able to:

- *identify the failed engine,*
- *perform the cause checks,*
- *simulate feathering the propeller, and*
- *shut down the failed engine in accordance with the checklist.*

1.12.14 At the time of writing the report, the CAA was reviewing Part 61 and drafting a Notice of Proposed Rule Making (NPRM) to be issued to the industry for consultation. The review was to look at flying instructor standards, including experience and competency requirements.

2 Analysis

The forced landing

2.1 The surging and power loss on the left engine of ZK-MYF was caused by fuel starvation. There was no evidence that any mechanical problem contributed to the power loss. The available evidence suggested that the instructor incorrectly turned the right engine fuel selector knob to the "Left Tank" position in his attempts to restore power. This resulted in air being induced into the fuel system for the right engine from the now-dry left tank, which caused associated surging on the right engine. With the initial problem being on the left engine, the instructor should have turned the left engine fuel selector to the "Right Tank" only, thereby re-establishing a good fuel flow. Once the instructor determined that a forced landing was inevitable, he correctly focused on flying the aircraft and made a controlled forced landing with minimal damage and injury.

2.2 ZK-MYF had adequate single-engine performance to allow continued flight on one engine and either land at a nearby diversion airfield, such as Dannevirke, or continue to Palmerston North. Had the instructor performed more structured troubleshooting checks or simply feathered the left propeller early, he should have been able to avoid making a forced landing. However, having descended to remain clear of cloud, and having not immediately identified the fault, the instructor manipulated the fuel controls and induced surging on the right engine, leaving him with no option other than to make a quick radio call and alert the students before landing.

2.3 The operator had recently taken possession of ZK-MYF following major rectification work. The aircraft was in good condition and was serviceable to fly with some limitations. One of these limitations was an inoperative right fuel gauge. The operator and instructor were aware of this limitation and put in place defences. The dipping of fuel tanks was an essential element of any pre-flight check, but had become critical when considering the limitations of ZK-MYF's fuel quantity indicator system.

2.4 The dip stick used by the instructor was of metal construction. When removed from the tank the level mark would quickly evaporate and not leave a stain or tide mark that would have been present on a wooden dip stick for several seconds after removal.

2.5 The flight log enabled the instructor to record flight times from the Hobbs meter and also taxi times more accurately. The log did not, nor was it required to, record total engine running times. The accident flight was the instructor's sixth flight in the aircraft, so he was still becoming familiar with the finer points of its operation and possibly taking slightly longer than a more experienced pilot to run through the various checklists. This, when combined with the aircraft being used for student instruction, meant that the taxi and unrecorded ground running times were probably becoming significant.

2.6 With full fuel tanks, ZK-MYF should have had a total flying endurance of about 4.9 hours. This was based on an average total fuel consumption of 80 litres per hour with both engines running. Because the instructor calculated the aircraft had flown 2.42 hours since being fuelled to full tanks, he estimated that the tanks should still have been about half full, enough for the 1.5 hours' flying to Napier and return with the required 30 minutes of reserve fuel.

2.7 The "Flight Detail" form for ZK-MYF recorded the aircraft had flown 2.42 hours since being refuelled to full tanks. The "Taxi out" and "Taxi in" columns recorded ZK-MYF had accumulated a total of 3.2 hours of taxi and flight time – an additional 0.78 hours of engine running time.

2.8 Based on the Hobbs meter, ZK-MYF had accumulated 3.58 hours between the last refuel and the power loss. The 60 litres of fuel found in the right tank should have provided for about another 0.75 hours of flight time. The 2 combined gave a total of 4.33 hours' flying, which was about 0.57 hours short of the possible total endurance capability of 4.9 hours. However, when taxi times were included, the total flight and taxi time amounted to 5.15 hours. Additional time

could also be added to each flight to allow for engine starting and completing checklists with the students before taxiing.

2.9 The instructor was being conscientious in the conduct of his pre-flight inspection of ZK-MYF at Palmerston North, including the fuel tank examination. However, he had a preconception that the fuel tanks should both still have been about half full. Considering the above, it is likely that the instructor correctly observed the right tank to be about half full, but incorrectly estimated the fuel in the left tank – which was probably about a quarter full. The limitations of the metal dip stick meant that the instructor's mindset was not broken.

2.10 The fuel imbalance possibly had its origins in the conduct of the previous flights. For example the left engine may have been started first on more occasions than the right giving a longer engine running time and more fuel consumption for the left engine and tank. However, a more likely reason was the positioning of the aircraft between flights, with the aircraft being parked on a rough grassed area outside the operator's premises. Even the slightest slope could have initiated a fuel transfer between tanks that, left unchecked, had became significant overnight. [11]

2.11 The design of the aircraft dictated that a stepladder or similar equipment be used to gain access to the upper surface of the wing, including for refuelling the aircraft. The operator did not ensure the ladder was carried onboard the aircraft at all times, especially for cross-country flights with away landings. This would have easily allowed the instructor to check the fuel quantity at Napier for the return flight. In hindsight this was a critical omission. When considering the management of the inoperative fuel gauge, this alone should have dictated a positive check of the fuel quantity before every flight, and the instructor should have made every attempt to do so. Had he done a fuel check at Napier, the instructor would probably have observed that less than 20 litres remained in the left fuel tank.

2.12 Regardless of the above, the left fuel gauge was still functional and should have given an indication of low fuel quantity. That the instructor appeared to have ignored this indication emphasised his mindset that there was sufficient fuel for the flight.

2.13 Once the left engine starting surging and a power loss resulted, the instructor had 2 courses of action open to him. Firstly, he could have determined that terrain was critical so immediately closed the throttle for the affected engine and feathered the propeller. This would have enabled a safe diversion to be completed on the remaining good engine. The same actions would have applied if he thought there had been a catastrophic engine failure with no hope of restoring power.

2.14 Secondly, if there was sufficient height and no immediate danger to the aircraft, the instructor could have initiated the actions for an engine failure in the cruise, then started the fault finding in a controlled logical manner as described in the aircraft's emergency checklist. The instructor did not follow the checklist guidelines and persisted in trying to restore power while placing the aircraft in an unrecoverable position. By rotating the right engine selector to left tank, air from the empty left tank was able to enter the fuel lines to the right engine and cause surging.

2.15 The instructor's class 1 medical certificate had expired some 11 weeks prior to the accident. He promptly revalidated the certificates when made aware of the regulatory requirements. There was no evidence that the instructor's medical status contributed to the accident. However, it did demonstrate a surprising lack of understanding of the medical requirements by a B category instructor.

2.16 Because the instructor did not hold a multi-engine instrument rating for the Partenavia P68B type of aircraft, he was not permitted to fly under IFR. The instructor was therefore required to operate under VFR and needed to remain in visual conditions when giving instruction, including multi-engine and instrument tracking instruction.

[11] TAIC Report 02-006 related to a Partenavia P68B, in which 38 litres of fuel transferred between tanks overnight.

2.17 On 2 December the weather conditions were such that the instructor was forced to manoeuvre the aircraft often to avoid flying into or near cloud and so remain in visual conditions. Although the instructor had significant instructional and multi-engine experience, the need to manoeuvre the aircraft continually was less than optimum for student instruction as it increased the workload for both the student and the newly type-rated instructor.

Pilot training

2.18 The instructor was an experienced pilot, having flown more than 10 000 hours, including about 4200 hours on multi-engine aircraft. He met the CARs requirements for multi-engine and instructor training experience for the issue of a CPL B category instructor rating with a multi-engine endorsement. During his time instructing in New Zealand, he had completed several instructor validation assessments and on each occasion was assessed to be B category standard. It was therefore of concern that a person of his qualifications and experience allowed a fuel starvation condition to arise then mishandle the occurrence causing a forced landing.

2.19 The CARs and associated documents provided good guidance on the issue of licences and ratings. According to the records the instructor completed the range of ground and air exercises that were required to be undertaken, including the intentional engine shutdown in flight and restart. However, after completing his type rating, the instructor started instructing on the aircraft with no consolidating experience. By 2 December he had accrued less than 6 hours on the aircraft.

2.20 The instructor was also trying to manage the newly established business which would have impacted on his ability to concentrate fully on his flying duties. An instructor with more type experience should have managed the situation more effectively and identified and corrected the cause of the power loss before a forced landing became inevitable, or immediately feathered the affected engine propeller and diverted to a suitable aerodrome.

2.21 Despite the Director of Civil Aviation having the ability to exercise discretion, the various documents defined minimum criteria. Therefore, there was a risk that competency levels could slowly degrade. For example, a recently qualified instructor who obtained a new aircraft type rating had minimal experience to draw upon to ensure students were fully conversant with all the quirks of the aircraft type. Combine this with the range of weather and geographical conditions and situations encountered in New Zealand, and even a small technical fault could have had severe repercussions.

2.22 The review of CARs Part 61, Pilot Licences and Ratings, needs to address the issue of pilot and instructor standards. Appropriate experience and competency standards need to be reviewed and set to ensure the training of pilots meets minimum industry requirements. An initial 5 hours for the first multi-engine type rating, with one hour for each subsequent type may be insufficient. Additional consolidation should be required before an instructor starts giving instruction on the type.

2.23 CARs Part 141 certification provided an operator with the opportunity to assess themselves against an industry benchmark. The certification process would help to ensure that an operator's facilities, personnel and procedures were of an appropriate standard. A new organisation, like WFT, would benefit from pursuing certification, either directly or through the Royal New Zealand Aero Club (RNZAC).

3 Findings

Findings are listed in order of development and not in order of priority.

3.1 ZK-MYF was airworthy, its records indicated it had been correctly maintained, and there was no evidence that any mechanical fault contributed to the forced landing.

3.2 The inoperative right fuel gauge did not render the aircraft unserviceable, but did require extra vigilance to ensure the continued safe operation of the aircraft. A positive fuel check should have been completed at Napier before the return flight.

3.3 The system used for monitoring fuel on ZK-MYF was not effective because:

- the instructor relied on the aircraft Hobbs meter to monitor fuel consumption and did not make appropriate allowance for additional engine running time.
- the use of a metal fuel dip stick allowed rapid evaporation from the stick and a greater potential for inaccurate fuel readings.
- the step ladder was not carried on board the aircraft to allow ready access to the fuel tanks when away from the operator's base.

3.4 ZK-MYF departed Napier with insufficient fuel to complete the return flight with the required reserve, resulting in the left engine failing due to fuel starvation.

3.5 The instructor induced air to the right engine fuel system by incorrectly selecting the engine to the empty left tank, effectively causing a double engine failure.

3.6 Had the instructor promptly feathered the left propeller or restored power to the left engine by the correct positioning of the fuel selectors, he could have flown the aircraft to a suitable alternative aerodrome.

3.7 The instructor's mindset of having sufficient fuel, his high workload and low experience on the aircraft contributed to his being unable to identify promptly the cause of the initial power loss, and rectify the problem.

3.8 The instructor was correctly qualified to conduct the flight, but his minimal experience on the aircraft type contributed to his mishandling of the emergency.

3.9 Instructor experience and competency requirements need to be set at a higher level to ensure training is to the highest standard possible.

4. Safety Actions

4.1 Following the accident, MDAC requested the RNZAC, the parent body representing about 45 flying clubs around New Zealand, to undertake an audit of MDAC activities. The audit and a briefing on its findings were completed by March 2007.

4.2 The audit reviewed the structure of MDAC and WFT and supported the employment of a second B category instructor. This would enable the instructor to "concentrate on the management of the organisation". The audit noted that the instructor was in the process of "drafting a manual suite to comply with CARs Part 141". The auditor passed on a copy of the CARs Part 141 Exposition Assessment Guide to assist with this process.

4.3 The operator advised the Commission that following the receipt of the audit report, a B category instructor with flight training organisation experience was appointed to the position of chief flying instructor. The appointment allowed the instructor to become the managing director of WFT.

5 Safety Recommendations

Safety recommendations are listed in order of development and not in order of priority.

5.1 On 24 July 2006 the Commission recommended to the Director of Civil Aviation that he:

use this accident to educate pilots on fuel management techniques, including the use of dip sticks, and engine failure checklists for multi-engine aircraft. (027/07)

ensure the proposed NPRM on CARs Part 61Pilot Licences and Ratings raises the minimum aircraft type-specific experience and competency requirements, especially for multi-engine aircraft, before an instructor is able to instruct on that type. (028/07)

5.2 On 17 August 2007, the CAA replied:

The Director will accept this recommendation and will use this accident to educate pilots in the next round of Av-Kiwi training seminars. In addition the CAA has already published a Good Aviation Practice booklet relating to Fuel Management on our web site which we will continue to promote. (027/07)

The Director will accept this recommendation and will ensure the proposed NPRM on CARs Part 61 Pilot Licences and Ratings raises the minimum aircraft type-specific experience and competency requirements, especially for multi-engine aircraft, before an instructor is able to instruct on that type. The NPRM process will commence in January 2008.

Approved on 20 September 2007 for publication

Hon W P Jeffries
Chief Commissioner

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04-006	Boeing 777, HL 7497, landed short of displaced threshold, Auckland International Airport, 16 November 2004

Price $24.00 ISSN 0112-6962