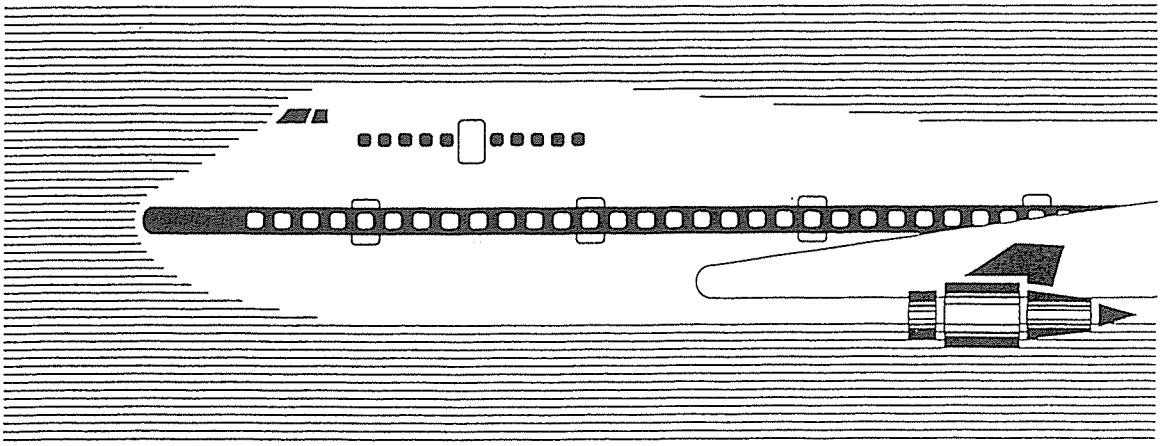


AVIATION OCCURRENCE REPORT

NO. 93-014

GOVERNMENT AIRCRAFT FACTORIES N22 NOMAD

ZK-NOM

FRANZ JOSEF GLACIER

25 OCTOBER 1993

TRANSPORT ACCIDENT INVESTIGATION COMMISSION

WELLINGTON • NEW ZEALAND

TRANSPORT ACCIDENT INVESTIGATION COMMISSION

ERRATUM SLIP

AIRCRAFT ACCIDENT REPORT No 93-014

Please amend: Paragraph 1.6.4 line 6 to read: "Inspection carried out at Ardmore in August 1993 at a ..."

pc2;c:\pm5\erratum.pm5

NO. 93-014

GOVERNMENT AIRCRAFT FACTORIES N22 NOMAD

ZK-NOM

FRANZ JOSEF GLACIER

25 OCTOBER 1993

(Reprinted March 1996)

AIRCRAFT:	Government Aircraft Factories N22 Nomad	OPERATOR:	Hibiscus Air Services Ltd
REGISTRATION:	ZK-NOM	PILOT:	Mr P C Klaassen
PLACE OF ACCIDENT:	Franz Josef Glacier	OTHER CREW:	Mr L M Broughton
DATE AND TIME:	25 October 1993	PASSENGERS:	Seven (including Mrs M Klaassen)

SYNOPSIS:

The Duty Inspector of the Transport Accident Investigation Commission was notified of the accident at 1515 hours. Mr D G Graham was appointed Investigator in Charge and commenced the investigation later that evening. The aircraft had been chartered to fly a German group to a number of tourist destinations in New Zealand. It had departed from Glentanner on a VFR flight to Queenstown. The flight was to include scenic flying in the Mount Cook region. A "taxiing" call was received at 1153 hours but later attempts by Christchurch Flight Information to communicate with the aircraft were unsuccessful. Aircraft wreckage, which proved to be that of ZK-NOM, was sighted during the afternoon in a severely crevassed and pinnacled area of Franz Josef Glacier, at an elevation of 4,500 feet amsl. The crew and passengers had all sustained fatal injuries on impact.

1.1 History of the Flight: See page 3	1.2 Injuries to Persons: Crew: 2 Fatal Passenger: 7 Fatal	1.3 Damage to Aircraft: The aircraft was destroyed	1.4 Other Damage: Nil
1.5 Personnel Information: See page 8			
1.6 Aircraft Information: See page 11			
1.7 Meteorological Information: See page 13	1.8 Aids to Navigation: Not applicable	1.9 Communications: See page 14	
1.10 Aerodrome Information: Not applicable	1.11 Flight Recorders: See page 15	1.12 Wreckage and Impact Information: See page 15	
1.13 Medical and Pathological Information: See page 17	1.14 Fire: Fire did not occur	1.15 Survival Aspects See page 18	
1.16 Tests and Research: See page 19	1.17 Additional Information See page 21	1.18 Useful or Effective Investigation Techniques: Nil	
2. Analysis: See page 23	3. Findings: See page 28	4. Safety Recommendations See page 29	

*All times in this report are NZDT (UTC + 13 hours)

1. FACTUAL INFORMATION

1.1 History of the Flight

1.1.1 Hibiscus Air Services Ltd, based at Ardmore Aerodrome near Auckland, offered Air Charter and Air Taxi flights throughout New Zealand, and local Instrument and Multi-engine training flights. The company operated a Partenavia P68B, a Cessna 337, and ZK-NOM, a Nomad N22.

1.1.2 Much of the Charter flying conducted by Hibiscus Air Services Ltd was to the Bay of Islands, Great Barrier Island, or destinations serving the North Island east coast beaches, Rotorua and Taupo. However, a developing area of the company's business involved the provision of "scenic tour" charters within New Zealand for small groups, particularly visitors from overseas. The operational flexibility and readily adaptable cabin configuration of the Nomad aircraft rendered it suitable for this type of charter.

1.1.3 Arrangements had been confirmed from an early date for the Chairman of a prominent multi-national company headquartered in Germany, his wife, son and daughter-in-law, and two close family friends, to make a concentrated but wide-ranging tour of North and South Island during October 1993. The Managing Director of the New Zealand branch of the German parent company, himself German, had assisted in the preparation of a detailed itinerary for the tour which included the opportunity to visit some of the most renowned areas and attractions of both Islands.

1.1.4 Hibiscus Air Services Ltd had made ZK-NOM available on charter between 20 and 28 October 1993. The flight programme was arranged as follows (reproduced in summary form only, with pertinent details included):

Day 2: Wednesday 20 October

1630 hours
Briefing at Ardmore Aerodrome with crew of ZK-NOM
1700 - 1750 hours
Ardmore - Kerikeri

Day 4: Friday 22 October
0930 - 1040 hours
Kerikeri - Pauanui

Day 5: Saturday 23 October
0930 - 1035 hours
Pauanui - Rotorua (including scenic overflight of White Island and Mount Tarawera)

Day 6: Sunday 24 October
0930 - 1000 hours
Rotorua - Te Kuiti
1400 - 1715 hours
Te Kuiti - Mount Cook Aerodrome

Day 7: Monday 25 October
Ski-plane landing on Tasman Glacier (weather permitting). Forty minute flight to Queenstown

Day 9: Wednesday 27 October
0930 - 1015 hours
Queenstown - Milford Sound
1415 - 1500 hours
Milford Sound - Wanaka
1700 - 1835 hours
Wanaka - Christchurch

1.1.5 The flight crew of ZK-NOM, during the charter, comprised Mr Leroy Broughton, the Chief Pilot and Operations Manager of Hibiscus Air Services who was also the Company's Owner/Operator, and Mr Philip Klaassen who was well known to Mr Broughton, and who flew for the Company as and when required. In the printed programme for the charter tour Mr Klaassen was indicated as Chief Pilot and Mr Broughton as co-pilot. Mr Klaassen who had assisted, administratively, in setting up the Company, was seeking opportunities to build up and further expand his flying experience, and did not receive remuneration for his services. Surplus seating was available in ZK-NOM on this occasion, enabling Mr Klaassen's wife to accompany the flight.

1.1.6 After departing Ardmore for Northland and the Bay of Islands on 20 October, the tour schedule had been followed successfully in regard to accommodation, sight seeing, and the flight sectors. On several occasions the crew of ZK-NOM had joined with the passengers for meals and in various activities. Reports

suggested that a good rapport had been established as the tour progressed.

1.1.7 On Sunday 24 October 1993 (the day before the accident) a stop-over at Te Kuiti had enabled the group to visit the Waitomo Caves before departing for South Island. A flight plan covering the route Rotorua-Te Kuiti-Nelson-Glentanner had been submitted before departure from Rotorua. Notam information for Rotorua, New Plymouth, Wellington, Nelson, Hokitika and Queenstown had been transmitted by facsimile to the crew, together with the current General Aviation South Island weather information. The flight plan contained information that the Te Kuiti-Nelson sector would be flown via the Marlborough Sounds and included the notation "scenic 30 minutes". The aircraft was to be refuelled at Nelson and fuel endurance for the onward sector Nelson to Glentanner was specified as four hours. The aircraft's callsign was "Hibiscus One Mike".

1.1.8 During the flight from Te Kuiti to Nelson, as anticipated, the crew did not follow a direct track but flew over the Marlborough Sounds. Photographs taken from the cabin showed that during the scenic diversion ZK-NOM had descended to provide the passengers with a closer view of items of interest, including a mussel farm and typical headlands and bays, than would have been available from an overflight at higher level.

1.1.9 At Nelson, the aircraft was refuelled with 500 litres of Jet A1 turbine fuel (250 litres being added to each wing tank). Departure was at 1600 hours and the crew initially climbed ZK-NOM to 10,500 feet en route for Glentanner. A short time later Christchurch Radar observed a target, identified as ZK-NOM, within the Upper Terminal Control Area (UTA). No clearance had been issued for the aircraft to enter this airspace and when advised by Christchurch Control the crew promptly adjusted their flight path and altitude to remain clear of the area. (In a later telephoned conversation with the Air Traffic Control Supervisor, the pilot explained that the inadvertent infringement was due to mis-reading the distance from Nelson and the type of airspace depicted on the chart).

1.1.10 Subsequently the flight route flown by the crew of ZK-NOM followed the line of the Southern Alps. Photographs taken en-route showed that while the sky to the east of the Main Divide was completely clear, a solid layer of cloud covered the West Coast, obscuring the valleys and snow-fields on the western side, with some cloud spilling to the east over the lower saddles and cols of the divide. Such a pattern was typical in the prevailing conditions. The extensive cloud cover precluded any view by the passengers of the Tasman Sea, the glaciers, their upper snowfields, or other significant features of the West Coast, during the afternoon flight.

1.1.11 The passengers and crew were met on landing at Glentanner and transported by road to their accommodation at the Hermitage, arriving at approximately 1815 hours. During the road journey Mr Broughton discussed with the driver of the courtesy van details concerning the locally operated ski-plane flights and the capacity of the available aircraft for a group such as theirs. The driver was aware that the party might make a ski-plane flight the next morning. It was arranged that a message for the driver would be left at the Hermitage in the morning regarding the required pick-up time for their onward departure for Queenstown. During the evening, in a telephone conversation with the New Zealand Managing Director of the Company, the Chairman indicated that the passengers had enjoyed the flights during the two previous days. No suggestion was given of any change to the itinerary, or any intention to fly over the West Coast or glaciers the next day.

1.1.12 On the morning of 25 October 1993, the courtesy van driver received a message requesting that the party be picked up at 1100 hours. When the driver met the crew shortly before this time, and asked about their activities, Mr Broughton indicated that after consideration they had not taken a ski-plane flight, but proposed instead to add half an hour to their own flight for scenic purposes.

1.1.13 This prompted some discussion regarding procedures. Although they had made

reference to the Air Traffic Control rules, it appeared to the driver that Mr Broughton and Mr Klaassen were not familiar with the locally established flight patterns and he drew their attention to the necessity to inform Mt Cook Radio (on 118.6 MHz) of their position and intentions and, in the Tasman Valley, to maintain a flight path up the right side of the valley, the Liebig Range side, and down the Mt Cook side. The pilots thanked him for providing the local knowledge.

1.1.14 At Glentanner the passengers' heavy luggage was loaded into the nose compartment of ZK-NOM. (This was in accordance with the recommendations of the manufacturer in terms of aircraft loading, and was the practice which had been followed throughout the tour) [See paragraph 1.6.9 and Finding 3.7 regarding the aircraft's weight and balance]. In response to the driver's suggestion that turbine fuel could be made available from a local helicopter operator's supply, Mr Broughton indicated that ZK-NOM had sufficient fuel on board. The driver asked Mr Broughton if he would be flying, to which he responded "No, I'm having the day off", and indicated that Mr Klaassen was to be Pilot in Command. The driver left to return to the Hermitage before the passengers or crew boarded ZK-NOM. He confirmed that as a part of the pre-flight preparation the crew had drawn samples of fuel from the aircraft's wing tanks.

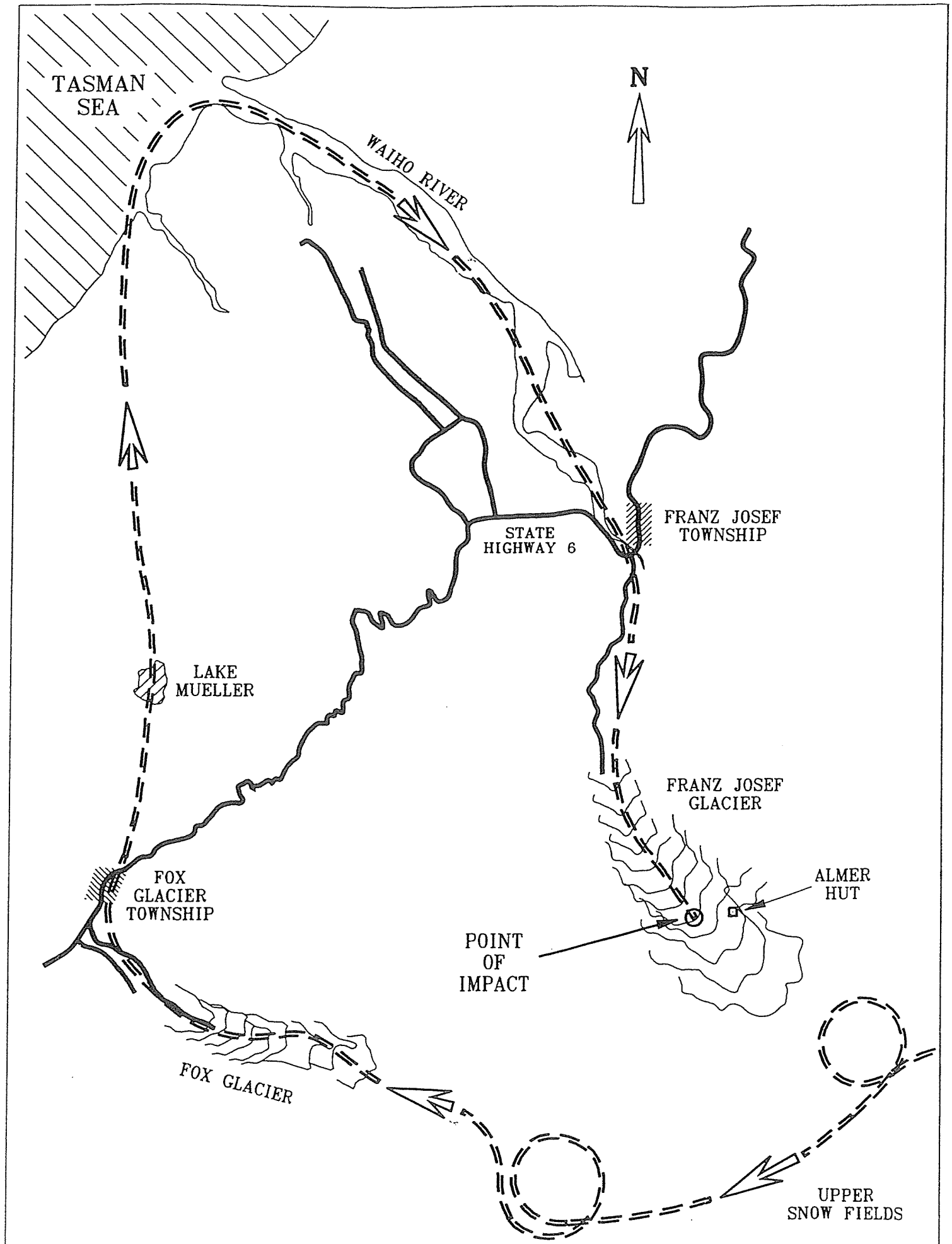
1.1.15 ZK-NOM took off from Glentanner at approximately 1155 hours. After departure the aircraft followed a route skirting Mt Cook Aerodrome and climbing up the Tasman Valley on the eastern side. Between 1205 and 1210 hours Mr Broughton held a radio conversation with the pilot of a Nomad aircraft descending the Tasman Glacier inbound to Glentanner. (See Section 1.9 Communications).

1.1.16 Witness reports of radio calls from ZK-NOM on 118.6 MHz between approximately 1210 hrs and 1230 hrs indicated that after climbing to a suitable height over the Tasman Glacier the aircraft crossed the Main Divide and flew above the snowfields of the Franz Josef Glacier, then proceeded in a south-westerly direction to the Fox Glacier névé. One report, believed to have been from ZK-NOM, indicated "circling top of Franz Josef". Photographs from the cabin confirmed the aircraft flew an orbit over the head of Fox Glacier.

1.1.17 The pilot of a helicopter which had landed on the snow of Chancellor Shelf observed ZK-NOM descending over the middle of Fox Glacier from the upper snowfields. The aircraft attracted his attention as local operators on scenic flights normally flew in the area at about 9,000 feet. The cloud cover over the West Coast commenced with a broken layer in the vicinity of the glacier's base. ZK-NOM flew towards the Victoria Falls region of the glacier and was lost to view, seemingly descending through a break in the cloud, to continue under the layer in a westerly direction.

1.1.18 Several pilot witnesses at Fox Glacier Village saw ZK-NOM flying in a north to north-west direction, having emerged from the Fox Valley. Estimates of its height ranged from 2,500 feet to 3,500 feet. The aircraft proceeded towards Lake Mueller flying just beneath the cloud base. Subsequently a helicopter pilot, listening on 118.6 MHz, heard ZK-NOM report position as "Waiho River mouth", and a pilot, located 4 km west of Franz Josef, watched the aircraft as it came from the direction of the Waiho Bluff and entered the Franz Josef Valley, in steady flight, cruising under the cloud which had increased during the morning to a solid layer. The cloud base was estimated as approximately 3,500 feet.

1.1.19 A glacier guide, leading a group half-way between the ice and the car-park, observed ZK-NOM as it progressed up the valley. The size of the aircraft, the different sound, and the unusual flight path, following the northern side of the valley rather than the southern side, surprised him. He reported that "he looked reasonably low for a big plane flying up the glacier" and estimated that in the vicinity of Roberts Point (a prominent landmark on the northern side of the glacier) the aircraft would have been flying at a height of between 2,500 and 3,000 feet.



ZK-NOM PROBABLE FLIGHT PATH

1.1.20 A visitor to Franz Josef, with aviation experience, who was making her way from the base of the glacier shortly before 1245 hours, noted ZK-NOM. The aircraft's position and its heading, more or less directly up the centre-line of the glacier, drew her attention and prompted her to take a photograph (see Section 1.7, Paragraph 6). Just after taking the photograph, she recalled seeing the aircraft "right against the top (the highest area of the glacier ice-fall visible from her position) and turning to the left". She clearly recalled the sun shining on the aircraft's inclined wings. She estimated the angle of bank as about 20° to 30°.

1.1.21 A party of tourists had earlier landed by helicopter for a guided "hike" on the glacier at an elevation of about 3,200 feet amsl. They were on a plateau, approximately in the centre of the glacier, located below the "top ice fall" which rose steeply for about 1500 feet above them. The "Heli-Hike" guide, who was familiar with the aircraft normally operating in the region, reported "... this machine flew above me at what I thought was a surprisingly low height for the area ... I took a second look at him because his engines were "labouring". He was obviously trying to get as much altitude as he could ... he was working hard to get up the ice-fall. The machine would have been 400 feet or maybe 500 feet above me which I thought was lower than what I had normally seen. There was nothing wrong with the aircraft ... he wasn't wobbling about ... the engines weren't missing or anything like that. He looked as if he knew where he was going and he was going there ...". This was the last known in-flight sighting of ZK-NOM. (See Paragraph 1.7.7 for further details of information derived from photographs taken by one of the passengers on board ZK-NOM during the accident flight).

Approximate final flight path and accident area ZK-NOM

Photograph: By kind permission of Craig Potton Publishing, Nelson

1.1.22 The Flight Service Officer who had received the "taxiing" call from Hibiscus One Mike prior to the aircraft's departure from Glentanner, attempted to contact ZK-NOM on a number of occasions subsequently, but without success. At 1320 hours the aircraft was declared overdue, and the Rescue Coordination Centre in Wellington was notified. Other aircraft operating in the Mt Cook/Franz Josef area were asked to try to contact ZK-NOM but no response was received.

1.1.23 A helicopter pilot returning from a scenic flight over Franz Josef Glacier during the afternoon made a brief sighting of some wreckage, thought initially to relate to an accident on the glacier in 1943. However, once it was realised that attempts were being made to locate ZK-NOM, a helicopter reconnaissance of the area was carried out and at 1440 hours the wreckage was identified as that of the Nomad aircraft.

1.1.24 Police, Department of Conservation, and other appropriate authorities were informed without delay. Due to the hazardous nature of the terrain, a team of experienced mountaineers from Mt Cook and Franz Josef were flown by helicopter and lowered on strops to the site. The team leader confirmed to Police at 1635 hours that all the occupants of ZK-NOM had perished in the accident.

1.1.25 The accident took place in daylight at about 1245 hours. The accident site was on the severely crevassed and pinnacled upper ice-fall of Franz Josef Glacier, approximately on the centre-line at an elevation of 4,500 feet. Grid reference 833443 NZMS 260 G35, H35 "Franz Josef", latitude 43°29'S, longitude 170°12'E.

1.5 Personnel Information

1.5.1 The pilot occupying the left crew seat of ZK-NOM during the accident flight was Philip Cornelus Klaassen (35). He had earlier filed a flight plan by telephone to Christchurch Flight Information designating himself as Pilot in Command. Leroy Mansfield Broughton (37), the owner/operator of Hibiscus Air Services Ltd, occupied the right crew seat. Mr Broughton had confirmed prior to departure that Mr Klaassen would be Pilot in Command, and that he was "having the day off".

MR P C KLAASSEN:

1.5.2 Mr Klaassen commenced his flying training with the Auckland Aero Club in 1974 at the age of 16 and obtained a New Zealand Private Pilot Licence a year later. While studying and working in Dunedin between 1976 and 1980 he had flown locally with the Otago Aero Club. He had regularly renewed his Private Pilot Licence and had flown periodically in Auckland in 1981 and again locally while in Dunedin during 1982.

1.5.3 Throughout the period 1983 to 1989 Mr Klaassen had maintained his Private Pilot Licence, flying regularly in the Auckland area. During 1989, while based in Australia he completed a course of instrument training, and qualified for an Australian Unrestricted Private Pilot Licence in 1990.

1.5.4 By this time Mr Klaassen had accumulated 223 hours flying. On returning to New Zealand he commenced definitive training in July 1990 towards a Commercial Pilot Licence. At Ardmore he flew various types of single-engined aircraft regularly and obtained a multi-engine rating on the Partenavia P68B type. Having completed the required training and Flight Test satisfactorily he was issued with a New Zealand Commercial Pilot Licence in February 1991.

1.5.5 In March 1991 he obtained a multi-engine Instrument Rating - Single Pilot, and in April 1991 was issued with a 'C' Category Instructor Rating. He subsequently carried out banner towing from Ardmore Aerodrome, as well as instructional duties, charter and general flying as opportunity arose.

1.5.6 In December 1991 Mr Klaassen began flying in the Cessna 337 aircraft owned and operated by Mr Broughton. On various occasions thereafter, but on an irregular basis, he conducted charter flights for Hibiscus Air

Services Ltd, or acted as co-pilot for Mr Broughton as and when required. Some flights were conducted in the Partenavia P68 aircraft operated by Hibiscus Air Services Ltd, and he also flew the Piper PA 31 Navajo Chieftain which was operated by the company for a period during 1991 and 1992.

1.5.7 Entries in Mr Klaassen's Pilot Logbook showed that on 7 November 1992 he accompanied Mr Broughton on a 5 hour flight from Queenstown to Whitianga in Nomad N22 ZK-NOM. (See also paragraph 1.5.18). The following day "training circuits" were carried out at Pauanui before flying to Ardmore (total flight time 1.5 hours) and on 13 November 1992 Mr Klaassen recorded 0.9 hours, flown on ZK-NOM at Ardmore under Mr Broughton's supervision, as "Type Rating Completion".

1.5.8 The Type-Rating Certificate in Mr Klaassen's Pilot Logbook indicated that he had completed a ground school course on the Nomad N22 conducted by the previous owner of the aircraft. He had completed a Basic Gas Turbine Course in 1990. Mr Broughton had signed the Type Rating Certificate as Supervising Flight Instructor certifying the Type Rating, on 13 November 1992.

1.5.9 A review of the flights recorded by Mr Klaassen in Nomad N22 ZK-NOM showed that as at the last logbook entry (17 October 1993) he had flown a total of 25.2 hours on the type. This comprised 7.4 hours dual, 5.2 hours Pilot in Command and 12.6 hours as Co-pilot. Including the flights on the charter tour from 20 October 1993 to the accident flight, Mr Klaassen's total experience on the N22 was likely to have been some 33.2 hours. Whether he had acted as Pilot in Command during earlier sectors of the charter itinerary was not established. (Passenger photographs on one earlier sector showed Mr Broughton occupying the left crew seat).

1.5.10 Mr Klaassen's total aeroplane flying hours at the time of the accident amounted to approximately 902 hours. 717 hours of this total were in single-engined aircraft and 185 hours on multi-engined types. He had recorded 148.6 hours instructing. Within the last 90 days he had flown approximately 25.5 hours on all types and approximately 15.4 hours on the Nomad N22 type.

1.5.11 Following an earlier familiarisation flight in New Zealand Mr Klaassen had undertaken some helicopter instructional flying while in Australia in 1990 and from July 1990 to March 1991 had continued regular helicopter training at Ardmore Aerodrome. In January 1991, in conjunction with his training toward the New Zealand Private Pilot Licence (Helicopter), he had recorded two separate flights, one dual and one solo, as "Port Jackson-Coromandel mountain flying confined areas". A further solo flight was recorded as "Port Jackson-Coromandel Ridge flying confined areas". His last recorded helicopter flight was 4 January 1992 at which time he had accumulated a total of 38.3 hours dual and 5.8 hours solo helicopter flying.

1.5.12 Mr Klaassen held lifetime New Zealand Commercial Pilot Licence No. 20086. The Class 1 Medical Certificate associated with his Pilot Licence was valid from 22 February 1993 to 21 February 1994. Restrictions applicable were:

001 Spectacles (distant vision) must be worn

007 Spare spectacles must be readily available

He held the following ratings:

Flight Radio Telephone Operator

Instructor Category C (limited to single-engined aircraft)

Instrument Rating (Aeroplane): ADF/ILS/VOR

His most recent Instructor Rating 'C' Category Annual Check was carried out on 28 February 1993, and he had satisfactorily completed a Regulation 76 Instrument Currency Check in a Partenavia P68B aircraft, on 14 October 1993. He was regarded as meticulous and cautious in his flying.

1.5.13 A large portion of Mr Klaassen's early training and experience had involved local flights from Ardmore, near Auckland, and Taieri Aerodrome, near Dunedin. More recently his commercial flying operations had included flights to a variety of North Island aerodromes, particularly in the Auckland region. He had very limited experience in South Island. In March 1992 he had flown a Hibiscus Air Services Ltd charter in the Cessna 337 visiting Hokitika, Gore and Timaru, and he had assisted in ferrying ZK-NOM direct from Queenstown to Whitianga in November 1992. Apart from a brief reference related to his helicopter training (see Paragraph 1.5.11), no record was found to indicate that Mr Klaassen had received either introductory or more advanced mountain flying experience. His Pilot's Logbook contained no reference to specific flights in the Mt Cook and/or glacier region of the Southern Alps.

MR L M BROUGHTON:

1.5.14 Mr Broughton commenced flying training in December 1978 and obtained his Private Pilot Licence at Ardmore in 1980. After moving to Australia in 1982 he continued to build up flying hours and in 1984 purchased a Cessna 337 aircraft. Thereafter, while based in Australia until 1990, he accumulated considerable charter and ferry flight experience including 12 Trans-Tasman flights. The majority of round-trip flights to New Zealand were in the Cessna 337 aircraft but in this period Mr Broughton also flew various single engined aircraft, and ferried several Piper and Cessna types from New Zealand to Australia.

1.5.15 He had been issued with an Australian Unrestricted Private Pilot Licence in 1984. During 1987 he obtained an Australian Command Instrument Rating and an Australian Commercial Pilot Licence. In October 1989 he was issued with an Australian Senior Commercial Pilot Licence. Between 1987 and 1990 he flew with Aussie Airlines Ltd, Nautilus Air Ltd, and on his own behalf as Broughton Aviation.

1.5.16 Soon after returning to New Zealand during 1990 Mr Broughton undertook the necessary training and was issued with a New Zealand Instrument Rating and a New Zealand Senior Commercial Pilot Licence. He obtained a 'D' Category Instructor Rating and began to operate a Partenavia P68B aircraft on training and charter flights from Ardmore Aerodrome in addition to the Cessna 337, in connection with his aviation charter business which was in the process of being established. Hibiscus Air Services Ltd was incorporated in February 1991 and received Air Service Certificate No. 34707 in July 1991.

1.5.17 During the latter part of 1991 Mr Broughton began to operate a Piper PA 31 Navajo Chieftain; and used this aircraft on occasion for Hibiscus Air Services Ltd operations over a period of about 12 months. Mr Broughton's Pilot Logbook indicated a flight from Ardmore to Hokitika in this aircraft in March 1992 which continued "Hokitika-scenic-Gore". This was the first reference to flying by Mr Broughton on the West Coast of South Island. It was likely that the scenic element of the flight included the crossing of the main divide. (The Cessna 337 aircraft, flown by Mr Klaassen, had accompanied this flight - see Paragraph 1.5.13).

1.5.18 Mr Broughton had completed a Basic Gas Turbine Course in February 1992, and in November 1992 he and Mr Klaassen completed a ground school course on the Nomad N22 aircraft type. As a part of the on-going development of Hibiscus Air Services Ltd Mr Broughton had purchased Nomad N22 ZK-NOM. The aircraft was located at Dunedin and Mr Broughton's Type-Rating conversion flying, conducted by the previous owner, comprised circuits at Dunedin and a dual flight to Queenstown. (From Queenstown Mr Broughton and Mr Klaassen flew ZK-NOM to Whitianga and subsequently to Ardmore).

1.5.19 Logbook entries and estimation of additional flying indicated that at the time of the accident Mr Broughton had accumulated a total of about 99.5 hours on the Nomad N22 type. All his flying on the type had been in ZK-NOM. 86.5 hours had been recorded as Pilot in Command. 1.9 hours had been recorded as "dual" and one hour as co-pilot. Estimated additional flying amounted to 10 hours, including the flying on the charter tour.

1.5.20 On 23 May 1993 Mr Broughton had flown ZK-NOM to Queenstown, via Rotorua and Kaikoura, returning to Ardmore on 25 May 1993 via Nelson. This was the only recorded flight to South Island destinations since ZK-NOM had been acquired.

1.5.21 At the time of the accident Mr Broughton held lifetime New Zealand Senior Commercial Pilot Licence No. 32042 and the following ratings:

Flight Radio Telephone Operator
Instructor Category D
Instrument Rating (Aeroplane): ADF/ILS/VOR

The Class I Medical Certificate associated with his licence was valid from 21 December 1992 to 21 December 1993. There were no restrictions applicable. He had completed satisfactorily a Regulation 76 instrument currency check in a Partenavia P68 on 18 April 1993.

1.5.22 Mr Broughton had accumulated a total flying time of approximately 2477 hours. About 750 hours had been flown in single engine aircraft and 1100 hours in the centre-line thrust Cessna 337 aircraft type. The balance of about 627 hours had been flown in light twin engined aircraft, mainly the Partenavia P68B, Piper PA 31 and the Nomad N22. He had recorded some 270 hours of instructional flying (relating to instrument training and aircraft type conversions). Mr Broughton's Pilot Logbook contained no reference to mountain flying training or experience.

1.6 Aircraft Information

1.6.1 The Government Aircraft Factories (GAF) Nomad 22 aircraft was an Australian designed and manufactured twin-turbo prop light utility aircraft, fitted with a retractable tricycle undercarriage and capable of seating 14 persons including the pilot. The aircraft was designed for single-pilot operation but the cockpit was arranged to accommodate two crew members in side-by-side seating. VH-AUH, serial number N22-004, was manufactured and test-flown in Australia in 1975. Between 1975 and 1980 it was operated under lease in Europe, and flew in Italy, Sweden and Switzerland. In February 1981 the aircraft was imported to New Zealand, registered as ZK-NOM and operated for six years on mountain scenic and charter flights. It was then sold to another operator and flown mainly from Queenstown before being purchased in November 1992 by Mr Broughton for Hibiscus Air Services Ltd.

1.6.2 ZK-NOM was powered by two 400 shp Allison B17 turbo-prop engines, each driving a Hartzell three blade constant-speed fully feathering reversible pitch metal propeller. The nose compartment, with a large upward opening door on each side, provided a convenient location for baggage, and additional baggage or other items could be stowed within the rear fuselage via internal access, or the rear baggage door. The centre fuselage floor structure incorporated continuous seat tracks and for the charter tour seven individual seats had been installed in the main cabin area of ZK-NOM, a row of three on the left, and four on the right. Passenger entry was through a double door on the left side of the aircraft. Doors on each side of the cockpit provided external crew access to the flight deck. In ZK-NOM, as configured for the tour, the absence of any partition or divider between the crew seats and the main cabin allowed for reasonable conversation or interaction between the pilot on either side and the passengers seated at the front of the cabin.

1.6.3 The engine installations were provided with engine air inlet and compressor inlet anti-icing, utilising hot bleed air from the compressors when the systems were in use. The aircraft flight manual indicated that when the anti-icing was selected ON, with the engines operating at Maximum Cruise Rating, a TOT (turbine outlet temperature) rise of about 50°C was likely with a loss of torque pressure of about 3 psig. (ie. at a given engine setting, with temperature maintained within the appropriate limit, power output to the propellers would be reduced when anti-icing was ON). Indicator lights (one for each engine) located on the main overhead console illuminated when

the inlet anti-ice systems were pressurised by bleed air. The aircraft interior, including the flight deck, had provision for heating and ventilation, the heating ducts also being supplied with bleed air from the engine compressors. Selection of cabin and flight deck heat affected power output to the propellers in a similar manner to the use of engine anti-ice, but to a lesser extent.

1.6.4 ZK-NOM was maintained in accordance with the Manufacturer's Maintenance Manuals for GAF N22 series aircraft with approved variations as detailed in Hibiscus Air Services Ltd Operations Maintenance Manual. The most recent maintenance had comprised an OPS 3 Inspection carried out at Ardmore in August 1993 at a recorded total airframe time of 3830.2 hours. Maintenance Release number A 112766 had been issued following this inspection, and remained valid until 10 February 1994 or 3880.2 airframe hours whichever occurred sooner.

1.6.5 Work carried out during this inspection included replacement of the stub fin plate in accordance with ASTA (Aerospace Technology of Australia) Service Bulletin 53-13, replacement of the right engine oil pressure sender unit, and removal of the right engine compressor assembly for overhaul at an approved facility. The overhauled compressor was subsequently re-installed and the engine ground run. The aircraft was test flown by Mr Broughton and Mr Klaassen on 9 August 1993, to verify the in-flight performance of the right engine.

1.6.6 No detailed records were available from which to assess the airframe, engine and propeller hours accumulated on ZK-NOM between the OPS 3 inspection and the occurrence of the accident. Correlation of the pilot flying hours recorded by Mr Broughton and Mr Klaassen and estimation of hours flown during the charter flight in conjunction with the respective log-book information suggested the following totals:

Airframe Total Time:
3850 hours

Left Engine Total Time in Service:
3623 hours

Right Engine Total Time in Service:
3199 hours

Left Propeller Time Since Overhaul:
183 hours

Right Propeller Time Since Overhaul:
2784 hours

1.6.7 Between the OPS 3 inspection in August, and departure from Ardmore for the charter tour on 20 October 1993, Mr Broughton had operated ZK-NOM on at least nine days. Mr Klaassen had accompanied him, acting as co-pilot or briefly as Pilot in Command, on four of these days. Including flight time on the tour itself, ZK-NOM had accumulated about 20 hours in service, since the OPS 3 inspection, when the accident occurred. There were no reported defects, handling difficulties, or unusual characteristics in relation to the aircraft, its engines or systems, during this period.

1.6.8 The telephoned flight plan information indicated that ZK-NOM had 3 hours fuel on board on departure from Glentanner. No copy of a Load/Trim Sheet dated 25 October 1993 was recovered, but copies of Load/Trim Sheets prepared for ZK-NOM for the flights on the three preceding days were found. Information from these sheets, together with weights determined during the investigation, assisted in assessment of the aircraft's weight and balance configuration.

1.6.9 The weight of ZK-NOM at the time of the accident was estimated as 3750 kg (maximum permitted take-off weight 3856 kg). The CG (centre of gravity) was estimated as 4856 mm (191.2 inches) aft of the datum. The CG aft limit was defined as 5070 mm (199.6 inches) aft of datum, with the forward limit varying from 4736 mm (187.5 inches) to 4790 mm (188.6 inches) aft of datum according to the all-up weight of the aircraft. At 3750 kg the forward limit was approximately 4777 mm (188.1 inches). (The datum was defined as

4365 mm (171.86 inches) in front of the wing leading edge).

1.7 Meteorological Information

1.7.1 The Manager, Meteorological Standards, of the Meteorological Service of New Zealand Limited, provided the following information:

> Situation: At 1200 hours an anticyclone, centred over the Tasman Sea, extended across New Zealand. Within the anticyclone a shallow trough, containing a number of small cyclonic circulations and convergence lines covered the country. These features did not appear to affect the Franz Josef area.
>
> Weather: At Hokitika, 100 km north-east of Franz Josef, wind speeds were less than 8 knots, initially north-west but backing south-west during the day, probably a light sea breeze with some gradient influence later. Upper winds, recorded at Hokitika just after 1100 hours were less than 5 knots up to 5000 feet and 9 knots at 7000 feet mainly from the southerly quarter. There was no evidence of katabatic winds but cloud clearance a little distance from the divide suggested possible downward motion. However, by the time of the accident any katabatic wind would have been weak.
>
> Cloud: Copies of satellite cloud pictures made at hourly intervals on the day of the accident were analyzed. The sequence showed areas of stratocumulus covering South Island during the morning. By the time the picture at 1232 to 1255 hours was taken the cloud over the West Coast had broken to a banded structure with the bands lying roughly north-west to south-east. The bands were fairly short, starting just off-shore and finishing short of the main divide. A patch of cloud north-west of Franz Josef Glacier appeared to have covered the terminal face of the glacier with the accident site clear of cloud.
>
> Cloud base of the stratocumulus at Hokitika was reported as follows:
>
> | | |
> |---|---|
> | 1200 hours | 4500 feet |
> | 1300 hours | 4000 feet |
> | 1400 hours | 3500 feet |
>
> Cloud tops were at about 6000 feet, being cut off by a sharp inversion.
>
> Temperatures: At 1245 hours temperature at sea level was about 12°C. In the free air (ie, not affected by any cooling due to contact with the glacier surface) the temperatures were estimated to be:
>
> | | |
> |---|---|
> | 1000 feet | 9°C |
> | 2000 feet | 6°C |
> | 3000 feet | 3°C |
>
> Freezing level was estimated as about 4,200 feet, and again just over 6000 feet due to the inversion.

1.7.2 The pilot of a light aircraft operating from Franz Josef who had been engaged in scenic flights over the Franz Josef and Fox Glaciers reported that the morning had been "quite reasonable, with the stratocumulus sitting away from the hills". A number of scenic flights had been carried out. The cloud cover had gradually increased, however, and at about 1220 hours, as a request for a further flight had been received, the pilot went outside to check conditions visually. He reported that it was 8/8 cover, with a cloud base of about 3,000 to 3,500 feet. "Looking up into the (Franz Josef) valley there wasn't a lot of light, which generally gives a good idea of the extent of stratocumulus into the valley. A couple of lower bits were starting to form on the south side of the valley ...". As a result of the continuing deterioration in conditions, the operator suspended scenic flights for the day.

1.7.3 A helicopter pilot who had been operating during the morning described conditions as "... a general type situation, the same over the last two or three days, in that you have an 8/8 cloud cover towards the west, and as you get up (into the valley and further up the glacier) you have what looks like a blue line in front of you with the odd little bit of cloud in places ... totally blue out the back ..." (at the upper part of the glacier).

1.7.4 A glacier guide who had been leading a party on the ice at the base of the glacier at about 1230 hours reported that the cloud above him was "... coming and going ... for a few minutes it would be clear, next minute right down toward the ice ...".

1.7.5 The guide in charge of the "Heli Hike" group at an elevation of about 3,200 feet on the glacier described conditions at the time ZK-NOM passed overhead, as follows: "Cloud cover in the lower reaches of the valley was a good solid layer. The plane was flying underneath that and heading up the ice-fall, and up at the top of the ice-fall in the back of the valley visibility was fine. So he was underneath the cloud ... he had no problem with cloud ... There was no wind to speak of ... nothing ... although 500 feet to 600 feet can make a difference ...".

1.7.6 A series of photographs taken by a visitor to Franz Josef showed that the valley was cloud free at 1100 hours although there were patches of stratocumulus on the surrounding ridges. Photos at the glacier base at 1200 hours and 1230 hours showed stratocumulus above the southern flank of the glacier. Her final photograph captured ZK-NOM flying up the centre of the glacier. A narrow band of cloud had developed across the lower part of the glacier, but ZK-NOM was well beyond any cloud patches, climbing in clear conditions towards an open expanse of blue sky.

1.7.7 A photograph taken by a passenger in the aircraft, as the aircraft flew toward the north above the upper part of Fox Glacier, confirmed the banded and broken cloud layer extending over the West Coast and covering the lower portion of Fox Glacier. A subsequent photograph taken as the aircraft flew past Franz Josef township confirmed that ZK-NOM was being flown beneath the cloud base, at about 2,500 to 3,000 feet. The final photograph on the passenger's film was taken at a probable elevation of about 3,700 feet amsl. ZK-NOM was close to the glacier surface. The photograph showed some cloud at about 4,000 feet or higher extending toward the snow slopes on the north side of the glacier. No cloud existed in the vicinity of the aircraft. The aircraft's flaps were up. At the time the photograph was taken, while some minor left bank may have been applied, the aircraft appeared to be continuing in flight up the glacier.

1.9 Communications

1.9.1 ZK-NOM was equipped with a King KX175 very high frequency (VHF) navigation and communication (nav/com) transceiver and a King KX175B VHF nav/com transceiver. The aircraft was also equipped with a Sunair 100A high frequency (HF) single sideband communications transceiver.

1.9.2 At 1014 hours on 25 October 1993, Mr Klaassen telephoned the Airways Corporation of New Zealand/Christchurch Centre to submit a VFR flight plan for Glentanner-Queenstown. Estimated time of departure was 1130 hours. Mr Klaassen advised that flight time would be split between "30 minutes scenic Mt Cook" and then "tracking to Queenstown" which would take 45 minutes, for a total en-route flight time of 1 hour 15 minutes. Fuel endurance was given as 3 hours. Mr Klaassen indicated that the route to Queenstown would be flown at 8,500 feet via Makarora. He also advised "We've had a Notam and weather briefing". (The source of this briefing was not established. It was possible Mr Klaassen was referring to Notam and weather information received by facsimile the previous day.)

1.9.3 Some discussion ensued between Mr Klaassen and the Briefing Officer concerning upper airspace in the Mt Cook area as depicted on the 1:500,000 New Zealand Aeronautical Chart which Mr Klaassen had been consulting,

and the appropriate radio procedure to be employed, and/or Control Centre to be addressed dependent on the height flown. Mr Klaassen confirmed that despite some difficulty in VHF transmission and reception the previous day, due to the mountainous terrain, both VHF communication transceivers in ZK-NOM were operating satisfactorily.

1.9.4 The general import of the conversation suggested that during the "30 minute scenic flying" which was to comprise the initial portion of the flight, Mr Klaassen intended to climb ZK-NOM to a height of 9,500 feet or above, and then descend to a lower cruising altitude for the onward flight to Queenstown. No reference was made to overflight or descent on the West Coast nor was there any reference to operation of the aircraft in the region of Fox or Franz Josef Glaciers.

1.9.5 At 1153 hours Christchurch Flight Information received a VHF call on 123.5 MHz from "Hibiscus One Mike", indicating that the aircraft was "taxiing Glentanner". The Flight Information Officer acknowledged the transmission and advised the area QNH was 1020 hPa. No further calls from ZK-NOM on VHF or HF, were received by Christchurch Flight Information, or Christchurch Approach Control.

1.9.6 Just prior to 1200 hours, the pilot of a scenic flight in another Nomad aircraft heard "Hibiscus One Mike" advise on 118.6 MHz that he was departing the Glentanner area and climbing up the Tasman Valley. After several general calls, "Hibiscus One Mike" reported in the vicinity of Mt Cook Aerodrome, between 1205 hours and 1210 hours. The pilot of the other Nomad, who was by then over the Ball Pass area and descending towards Glentanner, decided to establish contact with ZK-NOM to confirm that the latter intended to climb up the eastern side of the Tasman, thus avoiding potential conflict.

1.9.7 There was little radio traffic on 118.6 MHz at the time, and the other pilot, who had been the first New Zealand owner/operator of ZK-NOM, and who was acquainted with Mr Broughton through earlier telephone conversations concerning the Nomad, held a brief conversation, asking how the aircraft was going. The radio operator in ZK-NOM identified himself as Roy Broughton and responded that the aircraft was going really well. He sounded in good spirits and seemed very happy about the aircraft, the good weather, and his passengers enjoyment of the scenery. The transmission quality was very clear. Mr Broughton mentioned that his aircraft was en-route to Queenstown. He gave no indication of any intention to descend to the Franz Josef area and made no request concerning West Coast weather or for any other information.

1.9.8 The pilot of the other Nomad recalled hearing a later position report from ZK-NOM indicating that the aircraft was in the vicinity of Mt Cook and crossing to the West Coast side. Another pilot heard a further report from the aircraft when it was above one of the West Coast névés.

1.11 Flight Recorders

1.11.1 The aircraft was not fitted with a flight data recorder or a cockpit voice recorder nor were these required to be fitted.

1.11.2 Had either of these aids to any investigation been fitted it was likely that they would have provided useful information and assisted materially in the resolution of the circumstances surrounding the accident.

1.12 Wreckage and Impact Information

1.12.1 The wreckage of ZK-NOM was located approximately in the centre of the upper ice-fall of Franz Josef Glacier. The accident site, at an elevation of 4,500 feet, was in an extremely split and cracked region close to the brow of the steep glacial flow known to glacier guides as the "Top Ice-fall". The surface comprised an imposing array of seracs and pinnacles of ice interspersed with deep crevasses, slots, and melt holes, covered to a varying degree by drifted snow. The vast scale of the ice-fall, and its contorted surface, was difficult to appreciate unless reference was available to an object of known size such as an overflying aeroplane or helicopter.

1.12.2 Franz Josef Glacier descended to an elevation of approximately 1000 feet at its terminal face from a height of 6,500 feet and more at the lower levels of the Geike, Chamberlin, Davis, and other snowbasins (névés) from which it flowed. This loss of height occurred over a horizontal distance of less than 7,000 m. The accident site was approximately 3,600 m up the glacier from the terminal face. Steep-sided high mountain ridges flanked the glacier to the north and south, constraining the glacial ice within a narrow valley some 400 m to 500 m wide at the glacier base, widening to 1,000 m or more at the elevation of the accident site and becoming progressively wider thereafter to the broad expanses of the upper névés. The glacier descended in a north-westerly direction. ZK-NOM was likely to have been flying a heading of 125° to 130°M to track the glacier centre-line as observed during the final portion of the flight.

1.12.3 The wreckage of ZK-NOM was lying at the base of a range of ice-pinnacles, with the fuselage on a heading of 100°M. Similar pinnacles, seracs, and tumbled snow covered blocks of ice surrounded the area, forming a crevassed hollow into which the aircraft had fallen. Inspection of the surrounding features from the ground and by helicopter revealed no marks or other signs to suggest that any part of the aircraft had contacted the surface prior to the major impact. Given the height and proximity of ice-mounds and pinnacles over which ZK-NOM would have flown, and the convex profile of the glacier ice-fall in the region of the accident site, this indicated that the aircraft's flight path involved a rapid descent or sink of at least 50 feet in its final stage.

1.12.4 The left and right propellers of ZK-NOM had sheared from their respective reduction gearboxes and were embedded in the steep frozen snowslope about 8 m above the main wreckage. Extensive local discolouration of the surface by oil which had spattered from ruptured tanks in the engine nacelles showed that initial impact had occurred close to where the propellers lay. After impact the aircraft had slid rearwards downslope before being arrested against the undulating snow.

1.12.5 The nose cone and front bulkhead had been dislodged on impact and the luggage stowed in the nose compartment, together with the sills and floor of the compartment, had been ejected forwards, coming to rest in a scattered arc on a snow col upslope of the left propeller.

1.12.6 The forward and central understructure of the aircraft, including the stubwing and undercarriage assembly, had been forced upwards and disrupted extensively by the severe impact. Both wing spars and their attachments had failed at the wing roots and the left strut had broken off and lay to the left of the wreckage. The rear fuselage lower attachment had failed. As a result of the structural damage to the lower fuselage and wing centre section the integrity of the cabin area had been destroyed.

1.12.7 The severity of damage to the left wing and lower stubwing suggested that initial impact was taken on the aircraft's left side. Whether this resulted from the transverse ice-slope which fell away to the right, a bank angle to the left, or a combination of such factors, was not established. No clear witness marks existed on the icy surface to determine the lateral attitude at impact. The sum of general evidence suggested the aircraft was wings level, or only slightly banked on a heading of about 95°M, when impact occurred. The rear fuselage and empennage had remained intact apart from downward bending of the outboard section of the right horizontal stabiliser, and upward compression of the lower fuselage skins.

1.12.8 The extensive compression damage to the lower nose structure and the aircraft's underside, and severe downward and forward deflection of both crew seats indicated a likely nose-up attitude at impact of about 45°. Both control columns had been bent while fully extended suggesting that the pilots had attempted to flare the aircraft to a maximum before impact occurred. The crew seat inertia-reel harnesses and lap belt attachments were intact but the seat pans had collapsed

downwards, and the seat back structures had bent forward some 60°.

1.12.9 In the aircraft cabin area, the severe impact had fractured and deformed the intercostal members of the robustly constructed lower fuselage/stub wing structure which also supported the floor mounted seat tracks. Consequent failure of the tracks had occurred with the result that the individual seats, with their integral lap-belt installations, had broken loose during the impact sequence.

1.12.10 All major components of ZK-NOM were accounted for during the on-site investigation, and were found in locations consistent with the nature of the impact which occurred. The undercarriage was in the retracted position. Integrity of the primary control systems was established as far as was practicable with the severe disruption to the cabin and wing centre-section. Elevator and rudder integrity was determined as far as mid-cabin. Cable failures matched the break pattern of the fuselage and wings. The flaps were up. The autopilot clutches were disengaged.

1.12.11 The flight deck overhead control panel was damaged, and had been dislodged, falling across the engine control console during the impact sequence. The following observations and readings of possible significance were obtained from the instrument panel, the overhead panel, and the engine control

	Captains Instruments	Co-pilot's Instruments
Altimeter QNH Setting	1022 hPa	1025 hPa
Vertical Speed Indicator	0	+200feet/min
Turn Co-ordinator	Rate 3/4 left, ball to right	Needle central ball to right
Direction Indicator	104°M	
Flap indicator	0	
Undercarriage selector	UP	
Elevator trim	Full nose-up	
Transponder	Selected to "ALT", Code 1200	

RADIOS:

COMM 1	118.57 selected "ON"
COMM 2	123.50 selected "ON"
HF	selected "OFF"

ENGINE INSTRUMENTS:

Torque Pressure	Left 62, Right 79
Oil Pressure	Left 115, Right 118

(All other engine instrument indications were zero).

ENGINE CONTROLS:

Left Power Lever	Almost full forward
Right Power Lever	Full forward
Left Condition Lever	Full Forward (100%)
Right Condition Lever	Mid position (min RPM detent 80%). (The position of this lever was likely to have been affected by the overhead panel which fell across it)

OVERHEAD PANEL CONTROLS AND SWITCHES:

Prop de-ice	OFF
Fuel Shut-off's	ON
IGNS	Both ON
Engine De-ice	Both controls OFF
Left Fuel Pump	OFF
Right Fuel Pump	ON
Pitot Heat	OFF
Cabin Heat Control	ON

1.12.12 Charts located in the aircraft wreckage included Sheet 4 of the New Zealand Aeronautical Chart 1:500,000 series effective 17 September 1992. On this chart Glentanner and Mt Cook Aerodromes had been highlighted, together with Wanaka, Queenstown and Milford Sound. No proposed tracks or distances, or significant features, had been highlighted or marked in the Fox Glacier/Franz Josef Glacier region, nor further en-route towards Queenstown. A current issue of the Visual Flight Guide (dated 24 June 1993) was recovered from the wreckage. A damaged pair of prescription lens sunglasses was found on the flight deck in the vicinity of the left crew seat [see paragraph 1.13.2].

1.13 Medical and Pathological Information

1.13.1 Post mortem and toxicological examination did not reveal any medical

condition which was likely to have affected significantly Mr Klaassen's ability as Pilot in Command, to control the aircraft.

1.13.2 A photograph taken in flight the previous day showed Mr Klaassen in the co-pilot's seat, wearing his sunglasses. Mr Klaassen's family confirmed that Mr Klaassen had a pair of prescription sunglasses and always wore them when flying. It was probable he wore them during the accident flight. The restrictions noted on his medical certificate relating to visual requirements were considered unlikely to have had any bearing on the accident.

1.13.3 Mr Klaassen and Mr Broughton were both reported to be in good mental and physical health at the time the accident flight was undertaken.

1.13.4 The available evidence suggested Mr Klaassen and Mr Broughton were holding the aircraft's control columns, and had their feet on the rudder pedals when impact occurred.

1.13.5 The results of toxicological analysis, in Mr Broughton's case, indicated the presence of significant concentrations of cannabis metabolites. There was a possibility of impaired cognitive function as a result, the effects of which may have been enhanced by exposure to mild hypoxia during the accident flight. Toxicological, pathological and aeromedical expert comment indicated that there was a significant potential for functional impairment of Mr Broughton, the non-flying pilot. The likelihood of serious mental impairment due to cannabis ingestion and the severity of such impairment could not be extrapolated from the toxicology result.

1.13.6 Pathological evidence showed that all occupants of the aircraft sustained similar injuries indicative of the severity of impact. The evidence indicated that, with the exception of Mrs Klaassen, the passengers were seated, with seatbelts fastened. Whether Mrs Klaassen was standing or seated was not established but her seatbelt was unfastened.

1.15 Survival Aspects

1.15.1 The extensive disruption to the nose, wings, centre-section and lower fuselage structure of ZK-NOM demonstrated the severe impact forces involved in the accident. The loss of structural integrity as the wing attachments and centre section failed and the deformation of the lower fuselage in compression and bending was likely to have reduced the occupiable cabin volume during the impact sequence. In addition, fracture and deformation of the cabin floor structure resulted in the passenger seats breaking loose under impact loads.

1.15.2 Pathological evidence confirmed that the aircraft struck the steep and unyielding ice surface heavily, both forwards and downwards. The evidence indicated that the occupants all sustained fatal injuries on impact.

1.15.3 The Nomad N22 crew seats were designed to afford protection to the crew in the event of an impact involving forces up to 9 g. While both crew seats remained attached to the structure and the safety harness remained intact the seats were deformed severely. It was evident that the magnitude and direction of the impact forces involved in the accident to ZK-NOM exceeded the design capability of the seat belt installations, and seat attachment structure, to provide effective restraint for either the passengers or the crew.

1.15.4 ZK-NOM was equipped with an emergency locator transmitter (ELT) which activated, as designed, on impact. However, the external antenna had fractured and signals from the ELT were weak and directional, being masked by the terrain surrounding the accident site. In the event, the wreckage was located visually, and confirmed as ZK-NOM approximately two hours after the occurrence of the accident.

1.15.5 When it became known that an accident had occurred, Police, medical, and rescue personnel were alerted and an initial aerial observation was carried out, without delay. Experienced mountaineers were flown to the area and lowered to the site less than two

hours after the aircraft had been located, but it was found that all on board had perished at the time of the accident. Difficult access to the site, and deterioration in weather conditions forced the Mountain Rescue Team to bivouac overnight in the aircraft. The recovery of bodies was completed the following morning. Owing to the crevassed and fissured terrain and the scattering of items from the aircraft on impact some personal effects and items of equipment were not recovered. Final clearing of the accident site and recovery of remaining articles took place when all accessible wreckage was removed from the glacier three weeks after the occurrence.

1.16 Tests and Research

1.16.1 The wreckage of ZK-NOM was lifted by helicopter from the accident site and stored in the Department of Conservation workshops at Franz Josef. Engineering examination at this location confirmed the pre-impact integrity of the aircraft's control systems, and determined the presence of fuel in the wing tanks and the fuel lines to both engines.

1.16.2 The engines, in the nacelles, were removed from the wings and transported, together with the propellers, to an approved overhaul facility. Both engines were subjected to a detailed strip examination under the supervision of the engine manufacturer's representative. The engines exhibited close similarity in regard to external damage sustained on impact and internal component damage and wear. Internal damage to both engines was consistent with a sudden stoppage while delivering substantial power. No evidence was found to indicate pre-impact mechanical malfunction or anomaly in either engine.

1.16.3 The manner in which the left and right propellers had sheared from their gearbox output shafts, and the mode of failure of the reduction gear boxes was similar in each case. The damage pattern was typical of that resulting from severe propeller impact at a high power setting. Strip examination of the propellers disclosed no evidence of a pre-existing defect or operational anomaly. Blade damage and hub internal damage was consistent with the mode of impact.

1.16.4 The engine and air intake anti-icing valves were operated by flexible cables connected to control levers mounted in the flight deck overhead panel. Due to the disruption to the engine installations, the wings, and the overhead panel; the pre-impact position of the anti-icing valves or controls could not be established with certainty. Examination of the filaments of the engine anti-ice lamp bulbs, however, indicated that these lamps were probably not illuminated when impact occurred. This evidence together with the position of the control levers in the "OFF" position, as found, suggested that the engine anti-ice system was not in use at the time of the accident.

1.16.5 The cable operation of the heater valve, located in the lower centre fuselage which had been disrupted severely, rendered the pre-impact position of the valve assembly inconclusive. Disassembly of the valve after the accident showed it to be closed. The cabin heat control on the overhead panel was found "ON". With the prevailing outside air temperatures and the flight route involving prior operation at higher altitude it was probable that some cabin heat was likely to have been selected, with a resultant minor decrease in available climb power.

1.16.6 The Nomad engines' main oil pressure and torque pressure indicating systems were of the Autosyn synchro type. The aircraft manufacturer confirmed that the instruments retained their indication should a loss of electrical power occur while they were pressurised. No conclusive reason was found to explain the discrepancy between the torque pressure readings of the left engine and right engine which had been preserved. The engine strip examination, and propeller inspection, disclosed no evidence to suggest that at initial impact the power being developed by the left engine differed by any substantial degree from that of the right engine.

1.16.7 The engine manufacturer's representative provided the following

information regarding the instrumentation readings:

Left and Right Oil Pressure:	Both within the normal operating range
Right Engine Torque:	When related to the United States Standard day conditions at 5,000 feet amsl, the torque equated to a power setting just below Maximum Continuous Power. This power setting corresponded to a TOT of 732°C. Instrument "Top of Green Arc" on ZK-NOM was 737°C.
Left Engine Torque:	Equated to just below 75% Maximum Continuous Power

On balance of evidence, it was considered that the torque reading preserved on the right engine instrumentation was likely to be the most accurate in representing the power selected on the engines at the time of impact.

1.16.8 The approved Flight Manual for ZK-NOM contained the following information in Section 3.12

> "Climb: The speed for best climb gradient at maximum take-off weight is 82 knots IAS and for best rate of climb, 90 knots IAS. A more comfortable attitude is maintained however at 100 knots IAS. Climb power corresponds to Maximum Cruise Rating of 737 deg C TOT. Maximum Cruise Rating may be further limited in low ambient temperatures by an 85 psig torque limit."

1.16.9 The aircraft manufacturer provided the following data regarding Nomad N22 Climb Performance - All Engines Operating. The data was based on the N22 (Basic) Certification Performance model with Allison Gas Turbine 250-B17 engines.

"Associated Conditions:

Power	Max. Cruise (737 deg. C/85 psi)
Airspeed	82 KIAS
Flaps	UP
Undercarriage	UP
Weught	3855 kg (85001b)

Pressure Altitude (ft)	Air Temperature (deg. C)	Rate of Climb (ft/min)	Gradient of Climb (%)
300O	0	1130	13.1
3000	5	1090	12.5
3000	10	1020	11.6
3500	0	1110	12.9
3500	5	1050	12.0
3500	10	980	11.1
4000	0	1080	12.3
4000	5	1010	11.5
4000	10	950	10.6
4500	0	1040	11.8
4500	5	980	11.0
4500	10	910	10.1

* A reduction in AUW of 200 kg increases the rate of climb by approximately 110 ft/min and gradient of climb by approximately 1.3%.

* Increasing airspeed to 90 KIAS increases rate of climb by approximately 20 ft/min and reduces gradient of climb by approximately 0.8%.

* An increase in power equivalent to 5 psi torque on both engines increases rate of climb by approximately 80 ft/min and gradient of climb by approximately 1.0%.

* When engine anti-icing is operative on both engines, rate of climb is reduced by approximately 300 ft/min and gradient of climb by approximately 3.5%."

1.16.10 A profile of Franz Josef Glacier was prepared using data from Department of Survey and Land Information 1:25,000 Map Franz Josef Sheet 270 - H35D (August 1991). This showed that the overall gradient for the glacier surface from the terminal face to the accident site was about 28%. An assessment was made of the gradient to the accident site from different commencement altitudes above the terminal face, varying between 2,500 feet and 4,000 feet amsl. The measured gradients ranged from 17.1% to 4.3%. The sum of evidence suggested that ZK-NOM was likely to have been flying at about 3,000 feet in the Franz Josef Valley. If a climb had been commenced at this altitude over the glacier base the achieved climb gradient to the location where the accident occurred was approximately 12.8%. (From a commencement altitude of 3050 feet the achieved climb gradient was approximately 12.4%).

1.16.11 Calculations using the aircraft manufacturer's N22 Climb Performance data, with appropriate corrections for the probable operating conditions during the accident flight indicated an average rate of climb of 1180 feet per minute, and climb gradient of 12.6% for a climb from 3,000 feet to 4,500 feet amsl. The height at which ZK-NOM commenced the climb could not be known with certainty but these calculations showed that the achieved climb gradient from a height of about 3,000 feet correlated reasonably closely with the aircraft's climb performance to have been expected at the time.

1.16.12 The profile of the glacier surface demonstrated that the average climb gradient required to parallel the surface between 3,000 and 4,500 feet amsl was probably more than twice the maximum climb gradient of which the aircraft was capable.

1.16.13 The likelihood that ZK-NOM achieved a climb gradient approximating that predicted by the manufacturer for Maximum Performance Operation, supported a conclusion that the aircraft and its engines and propellers were functioning normally during the accident flight.

1.17 Additional Information

1.17.1 In relation to the circumstances of the accident to ZK-NOM, a senior pilot with considerable experience of operating Nomad aircraft in the mountainous area made the following observation:

> "Descending and climbing in the valley over the Franz and Fox icefalls is a demanding and tricky operation when a cloud layer is shelving up over the valley because of the deceptive amount of slope involved on the glacier surface and the "shelving" nature of what may appear to be a uniform base against a cloud layer edge. Climbing over the sloping icefall and névé is potentially very demanding when confined by a cloud layer. A descent down the icefall under a layer of cloud could induce a false sense of security in an ability to reverse the procedure back up the glacier. Climbing towards the expansive upper névé areas from below can provide the impression that they are relatively flat when in fact they slope quite steeply - beyond the ability to outclimb in a laden aircraft."

PILOT FLYING, PILOT NON-FLYING, AND DIVISION OF RESPONSIBILITY CONSIDERATIONS IN REGARD TO THE ACCIDENT FLIGHT

1.17.2 Mr Klaassen was the designated Pilot in Command on the accident flight. He was rated on the aircraft type and was operating ZK-NOM from the left seat, the normal command position. The Nomad N22 was designed for single pilot operation and the type was flown regularly in New Zealand by one pilot, on air transport VFR scenic operations, aerial work, and private flights. No legal requirement

existed for a co-pilot to be carried on the accident flight. Technically, Mr Klaassen, as Pilot in Command, was regarded as having complete and sole charge of the flight.

1.17.3 The programme which had been prepared for the charter tour indicated that ZK-NOM was equipped for Instrument Flight Rules (IFR) flight, and that the aircraft was crewed by two pilots. Mr Klaassen was shown as Chief Pilot, and Mr Broughton as co-pilot. The aircraft was fitted with dual controls rendering it capable of being flown from either crew seat.

1.17.4 During the charter tour, flight plan information and in-flight photographs had shown Mr Broughton acting in the capacity of Pilot in Command. On the day of the accident, however, Mr Broughton was "having the day off". He nevertheless occupied the co-pilot position in ZK-NOM, and operated the aircraft's radio on at least one occasion, probably undertaking some non-flying pilot duties to assist Mr Klaassen.

1.17.5 The Hibiscus Air Services Ltd Operations Manual contained the following information in Section 4 Route Guide:

"4.10 Two Pilot Operation

4.10.1 It may be desirable or necessary to operate with two pilots on certain flights. To optimise the presence of a second qualified crew member in the aircraft, an operational system is included.

4.10.2 It is recognised that in operations conducted by pilots who normally fly single-pilot there is a reluctance to discuss actions in flight, and to verbally communicate. However, successful two crew operation is dependent on good communication.

4.10.3 The pilot in command may occupy either seat, but the pilot flying will always occupy the left hand seat.

4.10.4 The pilot occupying the right hand seat will be responsible for navigation, communications, and engine and general monitoring.

4.10.5 The items comprising the check system remain unchanged, but they shall be conducted in the form of a challenge and response in the case of:

(a) Pre take-off checks
(b) After take-off checks
(c) Approach checks
(d) Final checks

4.10.6 The left hand seat pilot will request the appropriate Check-list, eg. "Pre take-off checks". The right hand seat pilot will provide the challenge, and the left hand seat pilot will complete the action. It is the duty of the right hand seat pilot to ensure that the required action has been completed prior to moving to the next item.

4.10.7 At the conclusion of any check-list the right hand seat pilot will advise"Check-list complete"."

1.17.6 Whether or not the operational system for two pilot operation, as above, was considered by Mr Klaassen and Mr Broughton to be applicable on the accident flight remains unknown. If the system was, in fact, rigorously adhered to, Paragraph 4.10.2 indicated that the two pilots would have maintained good communication in terms of discussing possible actions in flight. Paragraph 4.10.4 suggested that Mr Broughton would have taken responsibility for the navigation of the flight in addition to communications and engine and general monitoring.

1.17.7 It could be expected that Mr Broughton was relaxed and not intending to exercise any major function during the accident flight. The available evidence, however, suggested that the decision to descend Fox Glacier and return to altitude via Franz Josef occurred in flight, and the descent was implemented within a few minutes. In the circumstances it was unlikely that a decision of this nature, involving a

significant diversion to the flight route and a descent to fly beneath cloud, would be made without discussion between Mr Klaassen and Mr Broughton, irrespective of whether the "two pilot" operational principles were being applied.

1.17.8 The extent of the flight deck discussion which may have taken place, or the extent to which either Mr Klaassen or Mr Broughton may have influenced the decision itself cannot be known. Neither could it be established whether a particular interest, or request, on the part of the passengers was involved, taking into account the fact that the West Coast had been totally obscured by cloud the previous day, and Franz Josef Glacier, with its Austrian associations, was a well advertised and spectacular feature of the West Coast scene. (In this respect alone evidence of flight deck conversation if recorded and preserved by a cockpit voice recording of suitable duration would have been of major assistance in considering the human factors aspects of this accident. See Section 1.11 Flight Recorders).

1.17.9 Mr Broughton was Chief Pilot and Operations Manager of Hibiscus Air Services Ltd and essentially the owner/operator of the Company and of ZK-NOM. He was senior in age and flying experience to Mr Klaassen, and regularly provided instrument-flight and type-conversion training to other pilots in his capacity as a D Category Instructor. Despite Mr Broughton's "off-duty" status, and probable relaxation during the accident flight, these factors rendered it likely that Mr Klaassen would invite his comment and participation in any major in-flight decision. In a similar manner, in the event of the safety of the flight being jeopardised for any reason, although Mr Broughton was the non-flying pilot, he could have been expected to react promptly to any untoward situation, whether by verbal advice to Mr Klaassen, or in a dire emergency, by taking control of the aircraft.

2. ANALYSIS

2.1 Hibiscus Air Services Ltd charter tour of North and South Islands had been planned carefully to enable the German passengers to visit some of the major tourist attractions of New Zealand within the limited time at their disposal. A detailed itinerary had been prepared and arrangements had been made well in advance regarding accommodation, and most sight seeing activities, with the flight schedule suitably dovetailed into the general framework of the tour.

2.2 Reports indicated that the tour had progressed very satisfactorily. The planned flight schedule was not demanding and good weather had contributed to added enjoyment of the flight sectors by the passengers. The available evidence suggested that throughout the tour the various activities, accommodation, and the performance of the aircraft and crew had effectively fulfilled the expectations of the group.

2.3 Some of the flying sectors had offered opportunity for pre-planned sight seeing en-route. This was evident in the North Island flights over White Island and Mt Tarawera, and also on the day prior to the accident when the crew had descended the aircraft over the Marlborough Sounds to provide the passengers with a closer view of the general region, and specific items of interest. Passenger photographs taken during these flights showed that while the aircraft had been operated at a lower height than normal cruise, as might be expected over areas of particular scenic interest, descent had been limited to a prudent level, commensurate with the terrain and conditions.

2.4 The tour itinerary allowed a measure of flexibility in the duration of the individual flights. The nature of the flights, conducted in accordance with Visual Flight Rules, with consequent latitude at the pilot's discretion in regard to precise route and height, enabled each flight to be tailored to the route being flown, the existing conditions, and the passengers' requirements in terms of areas of special interest. The available evidence suggested that the passengers on ZK-NOM had enjoyed the relative informality of the flights already made, and the opportunity for interaction with the crew.

2.5 There was no indication that during the tour the aircraft had developed any significant abnormality or malfunction. On the contrary, all arrangements appeared to have worked out smoothly and no necessity had arisen, for any reason, for the flight time-table, or activities scheduled in the group's itinerary, to be changed or modified.

2.6 The programme outlined for Monday 25 October 1993 included a possible ski-plane flight (weather permitting) during the morning, followed by the sector to Queenstown, specified as a 40 minute flight. Thus the day was relatively unstructured. In contrast to the previous days on which flights had taken place, no time had been scheduled for the departure from Glentanner or arrival at Queenstown.

2.7 On Monday morning the weather at Mt Cook was sunny and clear. Ski-plane flights were available. No conclusive reason could be advanced as to why the group did not take a ski-plane flight. However, planning for the day had been generally minimal and it had been left open for crew and passengers to discuss suitable activities and timing. A free morning and a later departure allowing time to be spent leisurely in the Mt Cook area may well have suited the passengers following their concentrated range of activities during the preceding five days.

2.8 Mr Klaassen's telephone call at 1014 hours to the Airways Corporation Flight Planning Office in Christchurch confirmed that a decision had been made prior to that time, to forego the morning ski-plane flight and depart for Queenstown in ZK-NOM at approximately 1130 hours. Mr Broughton had indicated to the courtesy van driver that in lieu of the ski-plane flight some scenic flying would be incorporated during the flight from Glentanner to Queenstown, and Mr Klaassen had included in the flight planned information "30 minutes scenic flying" in the Mt Cook region.

2.9 The telephoned details provided to the Flight Briefing Officer by Mr Klaassen, and their subsequent conversation, suggested that he would climb the aircraft, probably to 9,500 feet or higher, during the scenic phase of the flight, and then descend to their planned altitude of 8,500 feet, or lower as appropriate, for the onward stage, via Makarora to Queenstown. There was no known indication from the passengers the previous evening or from Mr Broughton or Mr Klaassen during the morning, to suggest that any major diversion would be made from the flight route Glentanner-Mt Cook region-Makarora-Queenstown, as generally proposed.

2.10 The courtesy van driver noted nothing unusual in the pre-departure activities of the crew and passengers. However it was apparent to him that Mr Broughton and Mr Klaassen were unfamiliar with the local area and he drew their attention to the flight routes and procedures employed in the Tasman Glacier region. A review of Mr Klaassen's and Mr Broughton's Pilots Logbooks confirmed that neither pilot had operated from Mt Cook or Glentanner Aerodromes previously, and that their flight experience in the area of Mt Cook itself was limited to possible overflight on one or two occasions. Neither pilot had operated from airfields at Fox Glacier or Franz Josef or recorded any flying in their vicinity.

2.11 The crew of ZK-NOM called Christchurch Flight Information to advise "taxiing Glentanner", as anticipated. (The absence of a subsequent departure call to Flight Information, did not cause undue concern, as the Briefing Officer was aware that the crew would be operating on 118.6 MHz for some time. Nevertheless, attempts were made to establish later contact with the aircraft and the absence of response led to the aircraft being declared overdue).

2.12 After departure, as the flight proceeded, the crew of ZK-NOM endeavoured to advise position and intentions on 118.6 MHz, as required, albeit without the benefit of an intimate knowledge of the area. The content of Mr Broughton's radio conversation with another pilot shortly after 1200 hours confirmed that the aircraft was performing satisfactorily. This conversation was the last known two-way radio contact with the crew of ZK-NOM. No mention was made of any intention to fly over Franz Josef.

2.13 The precise flight route of ZK-NOM at this stage, and any manoeuvring, could not be established, but position reports on 118.6 MHz suggested that after climbing to a suitable altitude the aircraft crossed the Main Divide and having circled above Franz Josef Glacier proceeded to fly to the Fox Névé. The distances and times involved were consistent with the aircraft's likely performance following such a route.

2.14 The meteorological evidence indicated that although the extent of the stratocumulus cloud on the West Coast gradually increased during the late morning, the weather pattern was such that the crew and passengers of ZK-NOM would have been able to see almost the full length of Franz Josef Glacier while circling above it. It was likely that sufficient clear space could be seen beneath layer cloud in the Franz Josef Valley and covering the glacier base, to allow the crew of ZK-NOM to assess the approximate cloud base and make a judgement as to the feasibility of flying underneath the cloud. A photograph, probably taken a few minutes later by a passenger on board ZK-NOM, showing Fox Glacier and the cloud cover at its base and in the Fox Valley, confirmed the general weather pattern that existed. While the extent of cloud may have differed in the Franz Josef Valley, the photograph lent support to the foregoing conclusion.

2.15 The absence of any prior indication that ZK-NOM would descend and fly over the West Coast, and the lack of any known inquiry to ascertain local weather conditions in advance, suggested that the decision to do so was unpremeditated and made in flight, probably at the time that the Franz Josef and Fox Glaciers were overflown. It was not until this stage that the practicality or otherwise of a visual descent and flight beneath the cloud layer could have been foreseen. The evidence suggested that little time elapsed between a decision being made, and the commencement of descent.

2.16 Witness observations confirmed that the aircraft was flown down Fox Glacier without apparent difficulty and once beneath the cloud was navigated successfully to the Waiho River Mouth. Subsequent events indicated that it was the crew's intention, having descended Fox Glacier, to complete a circuit embracing both glaciers, by ascending Franz Josef Glacier, with the probability that having reached cruise altitude the flight would then have continued on to Queenstown.

2.17 A round-trip flight of this nature would have presented little problem in clear weather and undertaken at sufficient altitude. However, in less favourable conditions, particularly if the height or position at which the return climb would be commenced was likely to be constrained for any reason, it was essential for the crew to have an adequate preparedness and appreciation of the physical profile of the terrain, in this case Franz Josef Glacier, over which the climb route was proposed. Suitable advance planning would have allowed time for research and discussion and enabled prior consideration of the aircraft's climb performance in relation to the glacier's profile taking into account aircraft weight, wind, temperature, altitude and other factors which might have affected overall performance. A sudden decision, or one taken at short notice, to conduct such a flight involving a subsequent climb from beneath the cloud that existed on the day of the accident, held a potential for exposure to unexpected hazard.

2.18 The purpose of the route followed by ZK-NOM after emerging from the Fox Valley (See Diagram, page ...) could not be determined with certainty. It would have provided the passengers with a brief overview of the coastal scenery and Tasman Sea, and in the overcast conditions, have facilitated accurate navigation by enabling the crew to follow the full course of the Waiho River to the base of Franz Josef Glacier, minimising possible conflict with local traffic operating at Franz Josef. The flight route allowed opportunity for ZK-NOM to have landed at Franz Josef, but the aircraft's steady cruising flight through the area confirmed that it was the crew's express purpose to continue via Franz Josef Glacier.

2.19 Witness observations indicated that ZK-NOM was flying in the glacier valley at a

height of 2,500 feet to 3,000 feet amsl. It was likely that the aircraft was being flown as high as practicable commensurate with remaining beneath the cloud base. Pilot reports of the increase of cloud cover during the morning, and assessment of conditions observed at the time indicated that a visual tunnel effect was probable as the aircraft proceeded up the valley, with bright sunlight illuminating the higher portion of the glacier and blue sky beyond. The cloud was coming and going and the position, in relation to the glacier, at which the layer cloud terminated could not be established precisely, but meteorological evidence, including a photograph taken at 1230 hours, suggested that complete cloud cover did not extend beyond the glacier base at the time. It was likely, however, that the existing cloud did constrain the crew of ZK-NOM to remain at a lower height for a longer period in the valley than would have been the case had conditions been clear.

2.20 The photograph of ZK-NOM taken from the base of the glacier, together with the observations of the Heli-Hike Guide, at about 3,200 feet, showed that the aircraft continued in climbing flight, following the centre of the glacier and flying in clear conditions. The Heli-Hike Guide gained the impression that ZK-NOM was being operated at its maximum capability. Despite seeming to be at a low height for the location the aircraft did not waver from its upward flight. The witness report that the aircraft banked to the left just after being photographed in flight may have indicated the initiation of an intended turn during the flight up the glacier. However, while some minor heading alterations probably occurred, events proved that no major change of direction took place that could have been construed as an attempt to abort the climb by turning away from the Glacier surface, or to gain height by making an orbit within the confines of the glacial valley.

2.21 No witnesses observed the final flight path of ZK-NOM. A passenger's photograph showed that at a probable elevation of 3,700 feet, the aircraft was in an essentially wings level attitude and continuing up the glacier at a relatively low height. There was no cloud over the northern surface of the glacier and it appeared that within the limitations of an adequate margin of airspeed a 180° turn to the left could have been executed in safety at an earlier stage, had the crew considered it imprudent to continue the aircraft's climb. The position of the aircraft in the centre of the valley rather than on the right hand side reinforced the conclusion that the crew were unfamiliar with the area and with mountain flying. It also limited the space available to turn.

2.22 Had the crew been aware that the safety of the flight was compromised by continuation of a climb above the glacier, it was reasonable to conclude that an attempt would have been made, either to turn through 180°, assess the situation, and descend and exit the valley, or if conditions allowed, orbit to gain height. The northern edge of the glacier, slightly lower in elevation than the central region might have assisted in providing a possible escape route in the case of a turn to the left. But any such attempt would have required a turn within the confines of the mountain ranges on each side, and their proximity and forbidding aspect, especially in the lower part of the glacier, was likely to have discouraged such a manoeuvre by pilots unfamiliar with mountain operations. The existence of layer cloud behind the aircraft may also have discouraged a turn-back manoeuvre during the earlier portion of the climb.

2.23 However, the absence of evidence to suggest any sustained attempt to discontinue the climb, strengthened the probability that both Mr Klaassen and Mr Broughton were under a false perception of the steepness of the glacier, or had an optimistic impression of the aircraft's climb performance. One of these factors, or a combination of both, could have led to a fixed belief that the upper snow slopes, toward which they were heading, could be reached safely. The deceptive impressions likely to be obtained when climbing in the Franz Josef Valley toward the upper névés were likely to have been significant causal factors in the accident. (See paragraph 1.17.1)

2.24 ZK-NOM struck the glacier surface at an elevation of 4,500 feet. Impact occurred with significant downwards velocity in addition to forward momentum. The location of the wreckage and severity of structural damage was consistent with a sinking or mushing flight path, suggesting that airspeed had decayed leading to a semi-stalled condition and rapid height loss during the final stages of the flight. Heading at the time of the impact was about 30° to the left of the probable climb heading. If a turn had been initiated at a late stage there was increased potential at low airspeed for a loss of height or sink to ensue. In either event, if the aircraft was close to the surface and the terrain still rose ahead, the crew's options would have been limited to raising the aircraft's nose to absorb impact and a possible attempt to level the wings. It was probable such action had been taken.

2.25 No evidence was found to indicate that mechanical failure or malfunction of the aircraft, its engines, propellers or equipment contributed to the accident. The circumstances suggested that the crew had persisted in climbing ZK-NOM above Franz Josef Glacier until the aircraft could no longer outclimb the terrain. If this had not been recognised until a late stage, a rapid rate of final closure toward the still rising surface would have afforded little opportunity for the situation to be retrieved, or ameliorated. Once the aircraft was too low in height, and at too low an airspeed to be manoeuvred safely, an accident was inevitable.

2.26 Flying in mountainous terrain involved a variety of hazards. Some of these were unique to mountain flying and some also experienced in other areas of flying, were likely to be accentuated in the mountain environment. Particularly relevant in this accident was the likelihood that both crew members of ZK-NOM, who were unused to mountain flying and operations in confined valleys, misjudged the steepness of the glacier ice-fall due to the rising ground on each side, and the lack of a visible horizon. In addition to the hazard of attempting and continuing in a climb beyond the aircraft's capability, the false perceptions likely to be induced by a rising valley floor and surrounding mountainous terrain held the potential for an insidious decay of airspeed and an unexpected stall onset and/or ensuing loss of height. A number of aircraft accidents in mountainous areas of New Zealand had occurred from such a cause. Whether or not a gradual loss of airspeed unperceived by Mr Klaassen occurred during the climb to compound an existing critical situation, or whether airspeed decayed below the Nomad N22's best climb gradient speed (82 knots) only in the final stages of ZK-NOM's flight was not established.

2.27 The division of crew responsibilities between Mr Klaassen and Mr Broughton for the operation of ZK-NOM during the accident flight, and the extent of Mr Broughton's participation in decision-making and possible influence or action in flight, in his capacity as non-flying pilot, has been addressed in Section 1.17 Additional Information. The role of Mr Broughton in the decision to adopt a flight path that took the aircraft in a descent down Fox Glacier and a climb up the valley over Franz Josef Glacier at a relatively low altitude could not be determined. If the decision was made prior to the descent when the cabin altitude might well have been 8,000 feet there was a greater potential for any interaction between cannabis and hypoxia to have occurred at this time than during the last moments of the flight over the glacier.

2.28 The level of cannabis metabolites detected in Mr Broughton's toxicology results were unlikely to have been caused by passive ingestion of sidestream smoke. Therefore the possibility that Mr Broughton may have smoked or consumed cannabis at some time before the flight cannot be excluded. While there is no direct relationship between the blood/urine levels of cannabis metabolites and the degree of functional impairment, the levels suggest an active consumption that would be associated potentially with some effect on his mental performance. Research indicates that this effect might be enhanced by cerebral hypoxia associated with exposure to elevated cabin altitudes. This effect had a potential to influence Mr Broughton's consideration of the advisability of flying low over the glaciers. Other effects of cannabis ingestion included

degradation of perception as well as cognitive and psychomotor performance. Such effects may have made it more difficult for Mr Broughton to recognise the perceptual illusions associated with flying close to the surface of the glaciers. As Mr Broughton was not acting as Pilot in Command, the likely result of any such effects, if they had occurred, on the conduct of the flight could not be estimated without further information on Mr Broughton's role on the flight deck and the nature of any cannabis ingestion.

2.29 The final circumstances leading to the accident were explainable in terms of known hazards associated with mountain flying, allied to the lack of mountain flying experience of both crew members. Even though the toxicological evidence cast some doubt upon Mr Broughton's level of judgement and awareness at the time of the flight, there was no indication of similar impairment in regard to Mr Klaassen who was Pilot in Command. Although less experienced overall than Mr Broughton, Mr Klaassen was not inexperienced and had already accumulated a total of about 33 hours on the Nomad N22, all in ZK-NOM. He was in current flying practice, and could be considered familiar with the aircraft. The available evidence suggested that Mr Klaassen, who had a reputation for caution in his flying, was probably misled by deceptive visual aspects of the attempted climb. The conclusion had to stand that if either Mr Klaassen or Mr Broughton had recognised at a sufficiently early stage the potential danger to which the aircraft and its occupants were exposed, action would have been taken to avert the accident.

3. FINDINGS

3.1 The Pilot in Command held a valid Commercial Pilot Licence (Aeroplane), and a Class 1 Instrument Rating and Category C Instructor Rating (limited to single engined aircraft).

3.2 The pilot, non-flying, held a valid Senior Commercial Pilot Licence (Aeroplane), and a Class 1 Instrument Rating and Category 'D' Instructor Rating.

3.3 Both pilots were type-rated on the Nomad N22 aircraft type.

3.4 Neither pilot had received training in aeroplane mountain flying aspects.

3.5 The pilots had little previous experience in flying in the Mt Cook and West Coast Glacier region.

3.6 Neither pilot had flown previously within the confines of Franz Josef Glacier valley.

3.7 The aircraft's weight and centre of gravity were within the prescribed limits.

3.8 No significant defects or malfunctions in relation to the aircraft's operation or performance had been reported by the pilots prior to the accident.

3.9 During the course of a charter tour flight from Glentanner to Queenstown the aircraft descended beneath cloud and subsequently commenced a climb above Franz Josef Glacier.

3.10 Layer cloud in the Franz Josef Valley limited the altitude and position at which the climb could be commenced to about 3,000 feet amsl above the glacier base.

3.11 At the time of the accident, although fluctuating cloud had existed over the lower portion of the glacier, the aircraft's climb path at higher altitude was in clear skies.

3.12 A deceptive visual impression due to the rising surface of the ice-fall beneath the aircraft, the surrounding rising terrain and the absence of a visible horizon probably convinced the pilots that the aircraft could out climb the glacier safely.

3.13 A successful descent in the vicinity of Fox Glacier, the vast scale of the area, and deceiving flatness of the upper snow slopes may have contributed to initiation and continuation of the climb.

3.14 An optimistic assessment of the aircraft's climb performance and/or the confined nature of the glacial valley may have dissuaded either pilot from taking timely action to avert the accident.

3.15 In the circumstances, delay in recognising the aircraft's inability to surmount the glacier until a low height had been reached rendered an accident inevitable.

3.16 The aircraft was not capable of achieving a climb gradient sufficiently steep to negotiate the glacier successfully from the probable altitude and position at which the climb commenced.

3.17 The aircraft had achieved a climb gradient likely to be expected in the existing conditions.

3.18 There was no evidence that any malfunction of the aircraft, its engines, or propellers contributed to the accident.

3.19 The effect upon the conduct of the flight, and its outcome, of the non-flying pilot's ingestion of cannabis, could not be established.

3.20 The probable cause of this accident was the decision to attempt to climb above the lower region of Franz Josef Glacier which had an average slope steeper than the aircraft could outclimb. A causal factor was the crew's lack of training and experience in mountain flying rendering them vulnerable to visual misperception. Probable contributing factors included a cloud layer limiting the position and altitude at which climb could be commenced and an optimistic assessment of the aircraft's capability and progress during the climb.

5. SAFETY RECOMMENDATIONS

4.1 It was recommended to the Civil Aviation Authority that:

4.1.1 The published information concerning VFR Operations in areas such as Mt Cook, Franz Josef/Fox Glacier, Milford Sound, Mt Ruapehu, Rotorua and other "tourist designated areas" should be revised and expanded to give all pilots ready access to as much relevant information as practicable regarding items such as promulgated flight routes, designated Reporting Points, minimum heights above recognised geographic features and other specific detail regarding procedures followed by local operators in the particular area, in addition to the requirement concerning radio frequencies to be used or monitored. Examples of suitably concise radio communication should also be included to minimise "radio clutter" by pilots unfamiliar with the area as such clutter can be a source of confusion or disruption when a number of aircraft are operating in one region (077/93).

4.1.2 The training syllabus for the New Zealand Commercial Pilot Licence (Aeroplane) be amended to include "Mountainous-terrain flight training" and the extent of training required be similar to that already specified in the case of Commercial Pilot Licence (Helicopter), and the requirement be applicable prior to the validation or conversion of foreign Pilot Licences to equivalent New Zealand Pilot Licence (078/93).

4.1.3 The requirement for the carriage of flight data recorders be extended to include a basic FDR or CVR (where the aircraft is operated with more than one pilot) on all multi-engined aircraft used principally for Air Transport Operations with seats for nine or more passengers (079/93).

4.1.4 It reviews its Medical Standards and Certification, (Civil Aviation Rule Par 67) to consider the advisability of urine screening for THC* to be included as a discretionary component of all medical examinations if the medical examiner suspects the applicant of illicit drug use (034/94).

4.1.5 It develops detailed educational material for all pilots and air traffic controllers covering the hazards of illicit drug use, especially THC* (035/95).

* THC is the abbreviated term for 9Δ Tetra Hydro

Cannabinol, the principal active metabolite of marijuana or hashish.

4.2 The Civil Aviation Authority responded:

4.1.1 "Action has been initiated to reflect this recommendation. The information suggested has been incorporated into a Special Procedures Section of the NZAIP Visual Flight Guide which relates to flight within areas of high density tourist scenic flying activities. The edition concerned becomes effective on 26 May 1994. Additional activity areas have already been established and more will be added as and when they develop."

4.1.2/3 "These recommendations will be given due consideration during a review of CAR Part 61 and the development of new CAR Part 135."

4.1.4 "The CAA intends reviewing CAR Part 67 and will take into account this safety recommendation. When CAR Part 91 is written it is intended to review all aspects of drug and alcohol testing."

4.1.5 "We note that educational material on the effects of drugs and alcohol is widely disseminated to the public at large. The CAA has already published some educational material of the kind suggested. We agree that there is always potential for achieving gains in flight safety through publication of more educational material on a range of subjects."

3 May 1994

M F Dunphy
Chief Commissioner

GLOSSARY OF ABBREVIATIONS USED IN THIS REPORT

ADF	Automatic direction finding equipment
amsl	Above mean sea level
AUW	All up weight
C	Celsius
CG	Centre of gravity
ELT	Emergency location transmitter
HF	High frequency
hPa	hecto Pascals
IAS	Indicated airspeed
IFR	Instrument flight rules
ILS	Instrument landing system
kg	Kilogram(s)
KIAS	Knots indicated airspeed
km	Kilometre(s)
°M	Degrees magnetic
MHz	Megahertz
psi	Pounds per square inch
QNH	Pressure setting to indicate elevation above mean sea level
RPM	Revolutions per minute
TOT	Turbine outlet temperature
UTC	Universal Coordinated Time

VOR	VHF omni range
VHF	Very high frequency
VFR	Visual flight rules

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