



AIRCRAFT ACCIDENT REPORT

(Cf. the Aircraft Accident Investigation Act, No. 59/1996)

Private aircraft

N272BB

Rockwell Aero Commander 500S

Near Vestmannaeyjar Isles (approximately 63°31'40''N 020°35'21''W), Iceland

6 March 2001, at about 08:56 hrs UTC

The aim of aircraft accident investigation is solely to identify mistakes and/or deficiencies capable of undermining flight safety, whether contributing factors or not to the accident in question, and to prevent further occurrences of similar cause(s). It is not up to the investigation authority to determine or divide blame or responsibility. This report shall not be used for purposes other than preventive ones. (Law on Aircraft Accident Investigation, No 59/1996, para 1 and para 14.)

Aircraft: Rockwell Aero Commander 500S.	Registration: N272BB	Category: Private.
Registered owner: Gwen Bloomingdale, 13 Pilgrim Heights Rd. Provincetown, MA., USA.	Operator/user: Private owner.	
Crew: Two.	Number of passengers: None.	
Place of accident: 8 NM off the south coast of Iceland, near Vestmannaeyjar Isles (Last radar plot at 63°32'04"N 020°39'36"W)	Date and time: 6 March 2001, at about 08:56 hrs. *)	

SYNOPSIS.

The accident was notified to the Icelandic Aircraft Accident Investigation Board on 6 March 2001 at 11:35 hrs. The NTSB of the United States, which was the State of Registry, appointed an Accredited Representative to the investigation.

This was a private flight from the United States to London, England, via Greenland, Iceland and Scotland, arriving at Keflavik Airport, Iceland 5 March 2001 where the aircraft stayed overnight. In the morning the two pilots filed a flight plan and prepared their onward flight to Stornoway, Scotland. The take-off from Keflavik was at 08:19 hrs. The departure and communication with the aircraft was normal. The aircraft climbed gradually up to 15,000 feet (Flight level 150), the assigned cruising level, when the radar contact was lost. The crew did not report any difficulties and there was no further communication.

A subsequent replay of the Air Traffic Control (ATC) radar data showed that the aircraft target disappeared from the radar screen at 08:56 hrs.

An extensive search was initiated but only small fragments, personal belongings and human remains were found floating on the ocean, spread in a line north-westwards over a distance of about 5 NM from the point the target disappeared from radar.

A cause of the accident was not positively determined during the investigation. However the investigation indicates that most probably the aircraft was climbing in icing conditions when it entered into an uncontrolled descent followed by an in-flight break-up during an attempted recovery.

One safety recommendation is made during the course of the investigation.

1.1 History of the flight: See page 3.	1.2 Injuries to persons: Fatal.	1.3 Damage to Aircraft: Destroyed.	1.4 Other damage: Not applicable.
1.5 Personnel info.: See page 4.	1.6 Aircraft info.: See page 4.	1.7 Meteorological info.: See page 6.	1.8 Aids to navigation: Not applicable.
1.10 Aerodrome info.: Not applicable.	1.9 Communications: The communication between the aircraft and ATC was normal. See Appendix 5.2.		
1.11 Flight recorders: N272BB was not equipped, nor was it required to be equipped, with either Cockpit Voice Recorder or a Flight Data Recorder.	1.12 Wreckage and impact info.: See page 8.	1.14 Fire: There was no evidence of an in-flight fire.	
1.14 Medical and pathological info.: It is apparent that both occupants received fatal multiple injuries at the time of the disintegration of the aircraft. A post-mortem toxicological examination was carried out on the human remains found from both victims. In neither case was there any evidence of pre-existing disease, alcohol, drugs or any toxic substance which may have caused or contributed to the cause of the accident.			
1.15 Survival aspects: The accident was non-survivable.	1.16 Tests and research: See page 8.	1.17 Organisational and management information: Not applicable.	
1.18 Additional info.: See page 8.	1.19 Useful and effective investigation techniques: Not applicable.	2. ANALYSIS: See page 10 .	

3. CONCLUSIONS:

Probable causal factors marked with an asterisk. *

- 3.1 The aircraft had a valid "Special Airworthiness Certificate" issued by the State of Registry.
- 3.2 The pilots were both holding a valid Pilot's Licences with appropriate ratings, including Instrument Rating, issued by the Federal Aviation Administration (FAA) of the United States.
- 3.3 The aircraft Weight and the Centre of Gravity were within the authorised limits. The aircraft was operated in overweight conditions.
- 3.4 * The flight departed Iceland into unfavourable weather conditions.
- 3.5 * The aircraft was climbing in icing conditions prior to it went out of control.
- 3.6 The reason for the departure from a normal flight could not be positively determined.
- 3.7 The aircraft went into an uncontrolled descent, followed by an overstress and possible in-flight break-up during an attempted recovery.

4. SAFETY RECOMMENDATIONS:

See page 12.

5. APPENDICES:

- 5.1 Radio Navigation Chart - Iceland.
- 5.2 Transcript of the Radio Communication with N272BB.

*) All times in this report are Icelandic time which is the UTC.

1. FACTUAL INFORMATION.

1.1 The history of the flight.

Two private pilots, citizens of the United States, who intended to participate in the "London-Sidney Air Race" set to take place 11 March to 7 April 2001, were operating the private aircraft, N272BB. The flight originated at Cape Cod in the United States and the aircraft was to be flown via Greenland, Iceland and Scotland to London, England, where the air-race was to commence.

The aircraft arrived at Narsarsuaq, Greenland, on 4 March 2001 at 01:35 hrs. The next morning the pilots requested fuel and according to a statement by the Narsarsuaq airport personnel, 338 litres of LL100 avgas were put on the main fuel tanks that were filled. No fuel was put on the aircraft internal ferry-tank. The pilots received weather briefing and en-route information before departure and there was no anomalies noted by the airport personnel. The flight was planned at FI-130 from Narsarsuaq, over the Greenland ice cap, to 62°N 040°W and then at FI-110 to the border between the Greenland Soendrestrom Flight Information Region and the Reykjavik Flight Information Region.

The take-off from Narsarsuaq airport was at 14:29 hrs. The flight from Narsarsuaq Airport to Iceland was uneventful and the aircraft landed at Keflavik Airport Iceland at 18:59 hrs. Initially the pilots planned to continue the flight from Iceland that night but after studying the weather forecast they decided to stay overnight. At 19:50 hrs 447 litres of LL100 was put in the aircraft main tanks and the aircraft was then placed in a hangar.

In the morning of 6 March 2001 the pilots arrived at Flight Operations Office at Keflavik Airport. The pilots were provided with current weather information and weather maps for the planned route and flight planning preparations for the flight to Stornoway, Scotland and onwards to London, England was completed. The plan was from Keflavik Airport (KEF) VOR, direct to ALDAN reporting point (62°58'49"N 018°45'50"W), direct to 61°N 012°34'W, direct to 60°N 010°W, and direct to Stornoway. The flight level was 150 and the True Air Speed (TAS) was 145 kts. Prestwick in Scotland was filed as the alternate airport.

The instrument flight plan was filed with the Air Traffic Control Centre in Reykjavik. The estimated flying time from KEF-VOR to ALDAN was 0:30 hrs, to 61°N 012°34'W total 2:00 hrs and 02:30 hrs to 60°N 010°W. The planned time from Keflavik Airport to Stornoway was 4:00 hrs or the estimated time of arrival was at 12:19 hrs. The fuel endurance was given 10 hrs.

The aircraft was cleared by ATC in accordance with the submitted instrument flight plan and assigned transponder code was 3575.

The aircraft taxied out from the ramp at 08:08 hrs towards runway 11 and the take-off was at 08:19 hrs.

After take-off the communication with Keflavik Approach Control was normal. The flight was then changed over to Reykjavik Area Control Centre (OACC) at 08:46 hrs and normal communication was established.

The track to Aldan will take the aircraft overhead VM-NDB, 53 NM from KEF VOR, and then to Aldan, 120 NM from KEF VOR. Error was on the ATC slip indicating 30 minutes to Aldan. The controller changed that to 1:01, or estimate for Aldan at 09:20.

The last communication with the crew took place at 08:49:50 when the aircraft was climbing slowly through about 14400 feet towards the planned cruising level, FI 150.

At 09:24:55 hrs Reykjavik OACC called N272BB in order to confirm the position, but there was no answer and repeated calls were in vain. The Shanwick Air Traffic Control Centre was notified at 09:29:15 hrs of the N272BB estimates and again at 09:38:01 hrs that ATC had lost contact with the aircraft.

A subsequent replay of the ATC radar data showed that at 08:56 hrs the aircrafts target was lost from radar. The last plotted position was at 63°32'04"N 020°39'36"W, or about 8 NM from the south coast of Iceland.

At 12:12 hrs a decision was taken to initiate a search in the area by available ships and fishing vessels in the area. An Icelandic Coast Guard helicopter was launched from Reykjavik into the search area at 12:32 hrs.

At 13:49 hrs a debris from the missing aircraft and human remains were subsequently found floating on the ocean in a line spread north-westwards over a distance of about 5 NM from the point the target disappeared from radar.

1.5 Personnel information.

1.5.1 Captain. A 52 year old female, a United States citizen. She was holding a Commercial Pilot Certificate, issued by FAA 29 February 1992. Ratings: Aeroplane Single and Multiengine Land and Instrument Aeroplane. She held a valid Second Class Medical Certificate, issued 13 April 2000. Limitations: "Must wear corrective lenses".

She was also holding an Aircraft Mechanic Licence issued by FAA on 29 April 1990. Ratings: Airframe and Powerplant.

Her pilot log-book was not recovered, but according to information she submitted on 5 January 2001 to the insurer of the aircraft, her total flying time was 2456:36 hrs, of which 120 hrs were flown during the last 90 days. She had 151:08 hrs on a multi-engine aircraft of which 120 hrs were on type. She had recorded 68:06 hrs rotorwing flying time. According to information submitted to the FAA, she had 1953:10 hrs total time and 140:50 hrs instrument flying experience 2 June 1998.

She gave the date of her last biennial Flight Review as of January 2000.

1.5.2 Co-pilot. A 59 year old female, a United States citizen. She was holding a Private Pilot Certificate, issued by FAA 4 November 2000. Ratings: Aeroplane Single and Multiengine Land and Instrument Aeroplane. Last Medical Certificate was a Third Class, issued 21 December 2000. Limitations: "Must wear corrective lenses".

Her pilot log-book was not recovered, but according to information she submitted on 5th January 2001 to the insurers of the aircraft, her total flying time was 704:00 hrs, of which 35 hrs were flown during the last 90 days. She had 30 hrs on a multi-engine aircraft of which 13 hrs were on type. According to information submitted for her AC 500S training, she had 56:10 hrs, simulated instruments and 1:20 hrs, actual instrument flying experience 1 December 2000.

She gave the date of her last biennial Flight Review as of 4 November 2000.

1.6 Aircraft information

1.6.1 General. Rockwell International Corp. manufactured the aircraft N272BB, a Rockwell Aero Commander AC-500S, in 1973 and the manufacturer's Serial Number was 3173. It had dual controls and a maximum seating capacity of seven. Minimum crew was one pilot. The aircraft was a high wing, light alloy structure and the landing gear was a retractable tricycle type. It was fitted with two 290 horsepower, normally aspirated, Lycoming IO-540-E1B5 engines.

Date of issue of the Certificate of Registration for the aircraft was 25 April 2000.

The aircraft was holding a Special Airworthiness Certificate, issued 3 March 2001. Category: Special Flight Permit. Purpose: Operation in excess of Max. Certificated take-off weight (MTOW) of 6750 pounds, up to 7425 pounds.

The use of Auto-Pilot was not permitted while in overweight condition.

There was an approved 150 US gallons internal long range fuel tank installed in N272BB on 2 March 2001, in accordance with approved instructions. The document for proper installation as per FAA form 337 and the operating instructions were available. After the installation the aircraft compass was swung and this work was completed and signed for.

The Maintenance Records for N272BB were not found and there were indications that the records had been aboard the aircraft at the time of the accident. The only records available were for the internal fuel tank installation and also records for maintenance work performed by company in Ohio, USA, which the registered owner requested just after purchasing the aircraft. Therefore the total hrs of the aircraft, the hours of each engine and propeller as well as other details concerning the maintenance history of the aircraft are unknown. Handwritten note was found indicating that last annual check of the aircraft was carried out 14 January 2001, left engine at 100 hrs and right engine at 485 hrs. Tachometer was 1963,8

The Tachometer was 2001,6 when the auxiliary ferry tank was installed 2 March 2001.

The following limitations are listed in the N272BB Aircraft Flight Manual (AFM)

(Ref. to FAA approved Model 500S Aeroplane Flight Manual):

Never exceed speed (V_{NE}) - 250 kts CAS.
Maneuvering airspeed (V_P) - 141 kts CAS.
Stall speed clean (V_{st}) - 71 kts CAS.
Maximum positive load factor - 4,40 G.

A new Weight and Balance computation authorisation for the ferry flight operation was also issued, where the allowable aircraft gross weight was increased by 10% from 6750 lbs to 7425 lb. The aft and forward Centre of Gravity limits for the ferry flight configuration was also confirmed within limits.

Since the aircraft was being operated in overweight condition and outside of the AFM performance figures there were no performance data readily available. By extrapolating the climb performance information in the AFM it can be determined that the aircraft would climb approximately 250 feet per minute at FI-150 with Maximum Continuous Power on both engines, wing flaps extended $\frac{1}{4}$ (10°), landing gear retracted and cowl flaps full open. However if power is lost on one engine the aircraft would not be able to maintain altitude at FI-150 and would most likely decent 200-300 feet per minute.

According to the AFM the aircraft is approved for flight in icing conditions. This approval is based on tests conducted in natural and simulated icing conditions. These conditions do not include, nor was the aircraft tested in all icing conditions that may be encountered such as freezing rain. Therefore, flight into icing condition that lie outside those tested is not prohibited; however, prolonged flight in these conditions is prohibited. Hence, pilots must be able to identify when the aeroplane has entered icing condition more severe than the tested and promptly exit the condition before hazardous ice accumulations occur.

The following warning is published in the AFM:

- "Ice accumulation on an airfoil surface causes distortion of the airfoil. This can lead to significant loss in rate of climb and in speed performance, as well as increases in stall speed. Even after cycling the de-icing boots, the ice accumulation remaining on the boots and unprotected areas of the aeroplane can cause large performance losses. For the same reason, the stall warning system may not be accurate and should not be relied upon."
- "In some icing conditions, aerodynamic stall may occur suddenly at an angle of attack below the normal stall angle without pre-stall buffet or stall protection; therefore, maintain 25 knots above the normal stall airspeed or stall warning when ice is visible anywhere on the aeroplane. To minimise ice accumulation on unprotected surfaces of the wing, maintain a minimum of 113 KCAS during operations in sustained icing conditions."

1.6.2 Weight and balance. A load sheet for this flight was not recovered. The AAIB has estimated the weight and balance calculations for N272BB, based on the known and estimated figures applicable for this last flight.

The following facts should be considered:

- The maximum allowable take-off gross weight of the aircraft was 7425 lbs.
- The Centre of Gravity limits: Forward: 166 inches (20% MAC), Aft: 175.1 inches (32% MAC).
- Mean Aerodynamic Chord: 70.05 inches.

Estimated weight and balance calculation for takeoff from Keflavik, Iceland.

ITEM	WEIGHT (lbs.)	ARM	MOMENT
Aircraft empty	4841	172,29	834037
Pilots	386	94	36284
Baggage	100 *)	170 *)	17000
Baggage	100 *)	200 *)	20000
Survival gear	200 *)	170 *)	34000
Flyaway kit	200 *)	170 *)	34000
Fuel, main tanks	951 *)	187	177837
Fuel, ferry tank	600 *)	155	93000
TOTAL	7378	168.9	1246158

*) Estimated figures.

According to these calculations the estimate take-off weight of the aircraft at Keflavik airport was 7378 lbs. and the Centre of Gravity was 168.9 inches aft of the Datum Line.

Estimated weight and balance calculation at time of accident.

ITEM	WEIGHT (lbs.)	ARM	MOMENT
Take-off weight	7378		1246158
Gear retracted			10073
Fuel burn-off	-155	187	- 28985
TOTAL	7223	169.9	1227246

According to these calculations the estimated weight of the aircraft at the time of the accident was 7223 lbs. and the Centre of Gravity was 169,9 inches aft of the Datum Line.

1.7 Meteorological information

1.7.1 General. The Icelandic Meteorological Office (IMO) carried out a special study of the weather at the time of the accident.

In general, there was a high pressure area (1025 hPa) over Greenland and an extensive low (975 hPa) some 1300 km SSW of Iceland. To the west of the British Isles there was a strong advection of warm air towards Iceland. A warm front was generated where the warm air suppressed the much colder air associated with the high pressure over Greenland.

At the time of the accident, this warm front was extending from SW to NE across southern Iceland in the Vestmannaeyjar area, moving towards west and north-west. The flight track of N272BB did cross this warm front very close to the actual accident site. There was a strong temperature gradient and warm advection associated with the front. The frontal zone was sharp in the lower levels and the warm advection seems to have extended up to at least FL-180 according to the IMO report.

A satellite images taken in the morning of 6 March shows that the cloud cover close to the warm front off the SW coast of Iceland was growing thicker very fast and the IMO report considers that within this area, the warm air was ascending over the frontal surface. Also that the cloud deck was rather solid and without dry layers in between.

The precipitation ahead of the front and in the front itself was rather continuous and uniform. This precipitation band was also moving slowly towards NW, approaching Keflavik at about 10:00 hrs.

1.7.2 The weather at Keflavik Airport (BIKF). An area with continuous frontal precipitation reached BIKF by 6:30 hrs.

At 08:00 hrs :

Wind 060°/11 kts, visibility 4 km, snow, scattered at 2500 feet, broken at 3800 feet, overcast at 6000 feet. Temperature -1°C, dewpoint -4°C, QNH 1000 hPa.

At 08:30 hrs:

Wind 040°/10 kts, visibility 4 km, snow, few at 300 feet, broken at 1400 feet, overcast at 5000 feet, temperature -1°C, dewpoint -4°C and QNH 999 hPa.

At 09:00 hrs:

Wind 040°/11 kts, visibility 2 km, snow, stratocumulus at 300 feet, broken at 900 feet, overcast at 2500 feet, temperature -1°C, dewpoint -3°C and QNH 999 hPa.

From the upper air observation at Keflavik Airport at 12:00 hrs, the temperature was just below zero degree celsius from surface to a altitude of approximately 4000 feet.

1.7.3 The weather at Vestmannaeyjar Isles (BIVM). At BIVM the weather was as follows:

At 08:00 hrs:

Wind 080°/35G45 kts, visibility more than 10 km, rain, few at 700 feet, broken at 1500 feet, broken at 3000 feet. Temperature +2°C, dewpoint -0°C, QNH 998 hPa.

At 09:30 hrs:

Wind 080°/35G45 kts, visibility 7 km, rain, few at 700 feet, broken at 1500 feet, overcast at 3000 feet. Temperature +3°C, dewpoint +1°C, QNH 997 hPa.

1.7.4 The weather conditions during the flight. According to the available upper air observations and surface maps, it can be estimated that the slope of the frontal surface was of the order of 1:150. By the time of departure the frontal surface would then have been in an altitude of approximately 3000 feet over Keflavík (BIKF), descending towards the SE. The aircraft has therefore penetrated the frontal surface already after less than 10 minutes flight and after that it has been climbing in the relatively warm and moist air ascending over and behind the front.

The Icelandic Meteorological Office (IMO) report considers that there was a typical layer for icing existing from 4000 to 12000 feet in the frontal system. Above this layer, up to 16000 feet, the formation of enhanced precipitation bands associated with instability rolls was embedded in the massive warm front cloud and a warm conveyor belt ascending along the frontal surface.

Radar images shows the precipitation band very well and it is considered very likely that the aircraft passed through the convection line shortly before the accident occurred. It has been suggested that within such lines of convection the vertical motion may be five or even ten times stronger than generally within the frontal system. The IMO report also states, that these convection lines are good candidates for spots where one could expect icing much more severe than in other parts of the frontal clouds.

The winds at 15000 feet were south-westerly 210°/40 kts. Below 15000 feet the velocities gradually decreased and turned easterly. At 10000 feet the winds were 190°/35 kts, at 5000 feet the winds were 170°/20 kts and at sea level the winds were 080/25 kts.

1.7.5 Pilot reports. The AAIB collected reports from other aircraft flying in the same area as N272BB this morning.

- Icelandair Flight, ICE-450, a Boeing 757, departed Keflavik Airport at 09:02 hrs. The cleared track was via Aldan, 61°N010°W, Stornoway. According to a report submitted by the Captain, the climb was normal and there was no turbulence and no icing conditions experienced during the climb. The tops of clouds were between FL-170 and FL-180 and clear above. The aircraft passed FL-150 at about 09:09 hrs, about 25 NM east of Keflavik. The OAT was then -20° and the wind at that level was recorded 175°/42 kts.
- Icelandair Flight, ICE-320, a Boeing 757, departed Keflavik Airport at 07:46 hrs. The cleared track was direct ING VOR. According to a report submitted by the Captain, the climb was normal and there was icing experienced between flight level 140 and 180 on the windscreen..
- A private aircraft, N4303R, type Beechcraft B-300 left Keflavik Airport at about 09:00 hrs, climbing to FL-270 towards ALDAN. The pilot reported that he experienced light icing all the way to the tops of clouds at FL-250.

1.12 Wreckage and impact information.

The aircraft disappeared from the ATC radar screen over the North Atlantic ocean south of Iceland close to position 63°32'04''N 020°39'36''W. This point is approximately 10,9 NM from VM-NDB and 2,9 NM from Thridrangar a small rock island in the Vestmannaeyjar isles group off the south coast of Iceland. The depth of the ocean in the area is 80 to 90 meters (270 - 300 feet). The aircraft was flying the planned track when it disappeared.

The first debris from N272BB was found at 13:49 hrs, at 63°35'N 020°45,4'W 8,7 NM from Thridrangar rock. More debris was soon found on the ocean and a considerable amount of small debris was spread over an area of about 1 NM in diameter from where the first debris was found. Most of the debris was insulation material from the aircraft airframe, seat cushions, emergency equipment, personal belongings and human remains. The drift of the debris in the ocean was about 0,5-1 NM to the NW or NNW.

There was no indication or evidence of an in-flight fire or fire-explosion found on the debris or human remains.

Three day search with an underwater camera was carried out in June 2001 with no results.

1.16 Tests and research.

1.16.1 Testing of the fuel depot at Keflavik Airport. Samples were taken immediately after the accident from the fuel tank and the fuel pump used to refuel N272BB at Keflavik Airport. The samples were examined in a laboratory and showed no anomalies.

1.18 Additional information.

1.18.1 Fuelling of the aircraft. The aircraft fuel tank system included five interconnected rubber cells in the inboard and centre wing sections. The total capacity of these fuel cells was 159 US gallons. There was one filler neck located on top of the wing, between the right engine and the fuselage. There was also an internal 150 US gallons long-range fuel tank installed and carried in the cabin, aft of the right hand front seat.

118 US-gallons (447 liters) of 100LL avgas was put on the main tanks only. The fuelling was completed at 19:50 hrs. At about 20:00 hrs Maintenance personnel and a ground service personnel assisted the pilots to put the aircraft in a hangar where it was standing overnight.

At 22:34 hrs the pilot-in-command called ground service personnel at the airport and said she wanted to go to the aircraft and transfer some fuel from a wing tank to the internal ferry tank. Then she called a taxi and went from the hotel to the airport. She told the taxi-driver that she had "forgotten to close one of the valves". She only had a brief stop and returned shortly to the hotel.

1.18.1.1 The Auxiliary fuel system of the aircraft. The main tanks were serviced separately from the auxiliary tank, that had its own fuel port.

If the auxiliary fuel tank valve was left open, fuel would flow from the main tanks to the auxiliary tank and then out of the auxiliary fuel tank vent, that was located outside the airplane.

There was no evidence of fuel leak from the aircraft on the hangar floor,

1.18.2 The Air Traffic Control. The Reykjavik Area Control Centre (OACC) is using a Procedural Air Traffic Control in the Oceanic area. The Procedural Air Traffic Control is Radar assisted and the Air Traffic Controllers are using the radar as a reference.

The Air Traffic Controller handling an IFR flight in the area is using a progress strip, where he marks the position reports given by the aircraft. According to the procedure applied, if the aircraft fails to transmit a position report at a planned time, the controller is supposed to start calling the aircraft within three or four minutes.

The Search and Rescue (SAR) activity is initiated by a "Uncertainty Phase" when an aircraft fails to arrive within thirty minutes of the estimated time of arrival last notified to or estimated by the air traffic services units, whichever is later.

1.18.3 Radar data.

The radar recording replay was initiated at 09:49 hrs and it was confirmed that the N272BB target disappeared at 08:56 hrs.

By request of the AAIB, the radar data was analysed by the National Transportation Safety Board (NTSB) in Washington DC, USA.

The aircraft was fitted with a "C-mode" radar transponder, thus enabling the altitude of the aircraft to be transmitted by the radar transponder,

The Reykjavik Oceanic Area Control Centre (OACC) utilised AN/FPS 117 (V) radar to track aircraft. The radar facility is located at 64°01'18,392''N and 022°39'20,742''W. The AN/FPS 117 (V) has a theoretical 250 NM limit for primary and tracking data. The radar transponder code used by N272BB was 3575. The time interval between target reports is related to the rotation rate of the antennas. The AN/FPS 117 (V) has one revolution per 12 seconds. The radar data include range, altitude, azimuth, latitude and longitude format.

The aircraft climbed gradually up to 15,000 feet (FL -150) and reached FL-150 at about 08:53 hrs. The rate of climb for the last 2000 feet was calculated, according to radar data, to be around 200 feet per minutes.

1.18.4 The Search and Rescue.

1.18.4.1 General. ICAO-Annex 11 (Air Traffic Services – Paragraph 5.2) stipulates that Air Traffic Units shall notify rescue co-ordination centres immediately an aircraft is considered to be in a state of emergency, in accordance with:

a) Uncertainty-phase - when:

No communication has been received from an aircraft within a period of thirty minutes after the time a communication should have been received, or from the time an unsuccessful attempt to establish communication with such aircraft was first made, whichever is earlier, e.t.c.

b) Alert-phase, when:

Following the uncertainty phase, subsequent attempts to establish communication with the aircraft or inquiries to other relevant sources have failed to reveal any news of the aircraft, e.t.c.

c) Distress-phase, when:

- 1) Following the alert-phase, further unsuccessful attempts, to establish communication with the aircraft and more widespread unsuccessful inquiries point to the probability that the aircraft is in distress, or when;
- 2) the fuel on board is considered to be exhausted, or to be insufficient to enable the aircraft to reach safety, e.t.c.

1.18.4.2 The Search and Rescue (SAR) operation. The aircraft was on an IFR flight plan and had been cleared from Keflavik VOR (63°59'13''N 022°36'52''W) direct to ALDAN (62°58'49''N 018°45'50''W). The aircraft was radar identified by the controller at Reykjavik Oceanic Area Control Centre (OACC) at 08:46:59 hrs and the last communication took place at 08:49:50 hrs.

The estimated time at ALDAN was at 08:49 hrs. However due to the obvious error in the flight plan and the actual time when approaching VM-NDB, the estimated time at ALDAN was very likely at about 09:20 hrs.

At 09:24:55 the OACC tried several times to call N272BB on working frequency with no response. The Shanwick Air Traffic Control Centre was notified at 09:29:15 hrs of the N272BB estimates for co-ordination. Other aircraft were requested to call N272BB, both on the working frequency 132.2 and on the emergency frequency 121.5. This also was unsuccessful and at 09:38:01 hrs Shanwick Air Traffic Control Centre was notified that both communication and radar contact was lost with N272BB.

The SAR Operation was directed by the CAA from within the OACC.

At 09:43:40 hrs Shanwick informed OACC that they had been calling N272BB on all frequencies including the emergency frequency and there was no response.

The Icelandic CAA SAR aircraft was put on standby at 09:45 hrs.

The OACC radar recording was replayed at 09:48 hrs. This showed that the N272BB target had disappeared from the radar at about 08:56 hrs then level at FL 150.

The Icelandic Coast Guard (ICG) was notified of the situation at 10:12 hrs and also that there was not an emergency (distress phase) yet and a search was not requested. At this time one ICG vessel was located in the area.

Uncertainty-phase (Incerfa) message was sent out at 11:40 hrs. The Icelandic Coast Guard was contacted at 12:08 hrs and decision was made to initiate a search for N272BB. Subsequently a Distress-phase (Detresfa) was declared at 12:32 hrs.

At 12:12 hrs the ICG launched a vessel on a search in the area. Ships in the area were alerted, including "Herjolfur" the Vestmannaeyjar isles ferry that was approaching the area en-route to the isles. The ICG launched a helicopter to the search and it was at the scene at 13:19 hrs.

At 13:30 hrs the radar data was again played and analysed. During this replay two additional plots were seen showing N272BB departing FI 150 and descending rapidly.

The first debris was found in the area by the ferry "Herjolfur", at 13:49 hrs.

2. ANALYSIS.

2.1 General.

Both N272BB pilots had a considerable flying experience. On the 15 of February 2001, their total flying time was 2456:36 hrs and 704 hrs respectively and both were instrument rated. Their flying experience in the arctic environment and their experience in evaluating weather situations as they were faced with when planning the flight from Iceland to Scotland, is not known.

The first leg of the flight plan they filed and submitted to the Icelandair Flight Operations Office at Keflavik Airport was "Keflavik VOR - direct - ALDAN". The planned track took the aircraft overhead the VM-NDB at the Vestmannaeyjar isles. The distance Keflavik-VOR to VM-NDB is 71 NM and the distance onwards to ALDAN is 49 NM. Thus the distance Keflavik VOR to ALDAN is 120 NM. According to the flight plan the estimated flying time from Keflavik-VOR to ALDAN was 30 minutes. The winds at 15,000 feet were south-westerly 210°/40 kts. Below 15,000 feet the velocities gradually decreased and turned easterly. At 10,000 feet the winds were 190°/35 kts, at 5,000 feet the winds were 170°/20 kts and at sea level the winds were 080/25 kts.

With the True Air Speed of 145 kts, the actual total flying time Keflavik to ALDAN, including climb and cruise would very likely be about 1:00 hour instead of 30 minutes as indicated on the flight plan. It is possible that they did calculate the flight to the VM-NDB as 30 minutes and erroneously entered it as the flying time to ALDAN.

2.2 The weather en-route.

At the time of departure from Keflavik, a warm front was located south of Iceland extending from the south-west to north-east over the southern part of Iceland and the planned track of the aircraft was crossing the frontal system. There was a strong temperature gradient and warm advection associated with the front.

By the time N272BB departed Keflavik, the frontal surface would then have been in an altitude of approximately 3000 feet over the airport. The aircraft did therefore penetrate the frontal surface already after less than 10 minutes after departure from Keflavik and been in moist air and clouds after that.

This is consistent with the communication by the N272BB pilot at 08:49:50 hrs as she was inquiring about reports of the height of the tops of clouds. The pilots did not report any difficulties during the flight, however this report indicates some concern :

"A .. we are at a... just left through fourteen and we haven't even seen a layer yet".

This is also consistent with a pilot's report (N4303R), of icing in clouds on flying the same route as N272BB.

It must be considered likely that the aircraft was flying in icing conditions from 4000 to 12000 feet in the frontal system. Above this layer, up to 16000 feet, the formation of enhanced precipitation bands associated with instability rolls was embedded in the massive warm front cloud and a warm conveyor belt ascending along the frontal surface.

It is very likely that the aircraft had passed through a convection line shortly before the accident. It has been suggested that within such lines of convection the vertical motion may be five or even ten times stronger than generally within the frontal system. These convection lines are good candidates for spots where one could expect icing much more severe than in other parts of the frontal clouds.

2.3 The weight and performance of the aircraft.

The aircraft was holding a Special Airworthiness Certificate, issued 3 March 2001. Category: Special Flight Permit. Purpose: Operation in excess of Max. Certificated take-off weight (MTOW) of 6750 pounds, up to 7425 pounds.

The use of Auto-Pilot was not permitted while in overweight condition.

The weight and balance of the aircraft was estimated and it indicates that at the time of the accident, the weight of the aircraft was 7223 lbs and that the Center of Gravity was within the certified limit.

The AFM specially warns about flying characteristics, inaccurate stall warning system and increased stalling speed of the aircraft with icing on the airfoils. It says also:

“In some icing conditions, aerodynamic stall may occur suddenly at an angle of attack below the normal stall angle without pre-stall buffet or stall protection; therefore, maintain 25 knots above the normal stall airspeed or stall warning when ice is visible anywhere on the aeroplane. To minimise ice accumulation on unprotected surfaces of the wing, maintain a minimum of 113 KCAS during operations in sustained icing conditions.”

2.4 The radar track and altitude information.

The radar recording shows that the aircraft was maintaining the cleared track towards ALDAN reporting point (62°58'49"N 018°45'50"W).

The radar recording shows that the aircraft was at 15,200 feet and 12.6 NM from VM NDB at 08:55:51 when it disappeared from the radarscreen. It took the aircraft 37 minutes to climb to 15000 feet which is approximately 390 feet per minutes average climb rate from takeoff. When evaluating the radar data two returns or plots was recorded by the radar receiver, at 08:56:05 passing 14100 feet and at 08:56:18 passing 10700 feet. The ground speed was calculated and recorded by the radar as 96 knots at 15200 feet.

2.5 Break-up of the aircraft structure.

It is evident that the aircraft was climbing in a solid cloud mass and it is very likely that it was in icing conditions for at least 20 minutes of the flight prior to the accident.

The reason for the sudden loss of control is unknown, but ice accumulation on the wings, stabilizer and the fuselage will increase the stalling speed. A loss of power on one of the engine cannot either be excluded.

It must be considered very likely, that the aircraft suffered a major in-flight structural failure during attempted recovery. Considering the distribution and condition of the debris and human remains, it is also very likely that the aircraft did disintegrate in the air.

2.6 Search and Rescue.

At the time when an “Uncertainty-phase” is initiated a SAR coordination centre is active within the CAA. The aircraft was cleared direct to ALDAN and the first position report from N272BB was therefore expected at the time the aircraft reached that point. According to the current flight plan, the aircraft should be at ALDAN at 08:49 hrs. The OACC started calling the aircraft at 09:24:55 hrs and an uncertainty phase was initiated in accordance with the current operating procedures.

The radar recording replay was initiated at 09:48 hrs and directed by the SAR Centre administrator. Another replay was done at 13:30 hrs.

As earlier mentioned in the report, there were boats and ships in the area where the aircraft was lost, including a Coast Guard (ICG) vessel. The ICG was notified 24 minutes following the first radar replay or at 10:12 hrs that a communication search had been initiated for N272BB. At this stage emergency (Distress-phase) was not declared. At 12:08 hrs decision was made by the SAR centre to initiate a search for N272BB and ICG was then contacted. The ICG launched vessel on the search in the area at 12:12 hrs.

It is likely that if radar data (radar plot) had been analysed in detail at an earlier state the two plots at 14100 feet and at 10700 feet would have been observed and a search for the aircraft would have been initiated earlier.

The AAIB wants to emphasise that the Icelandic Coast Guard (ICG) plays a significant role in search and rescue at sea. Good co-ordination between CAA SAR centre and ICG SAR centre is therefore important during search for lost aircraft.

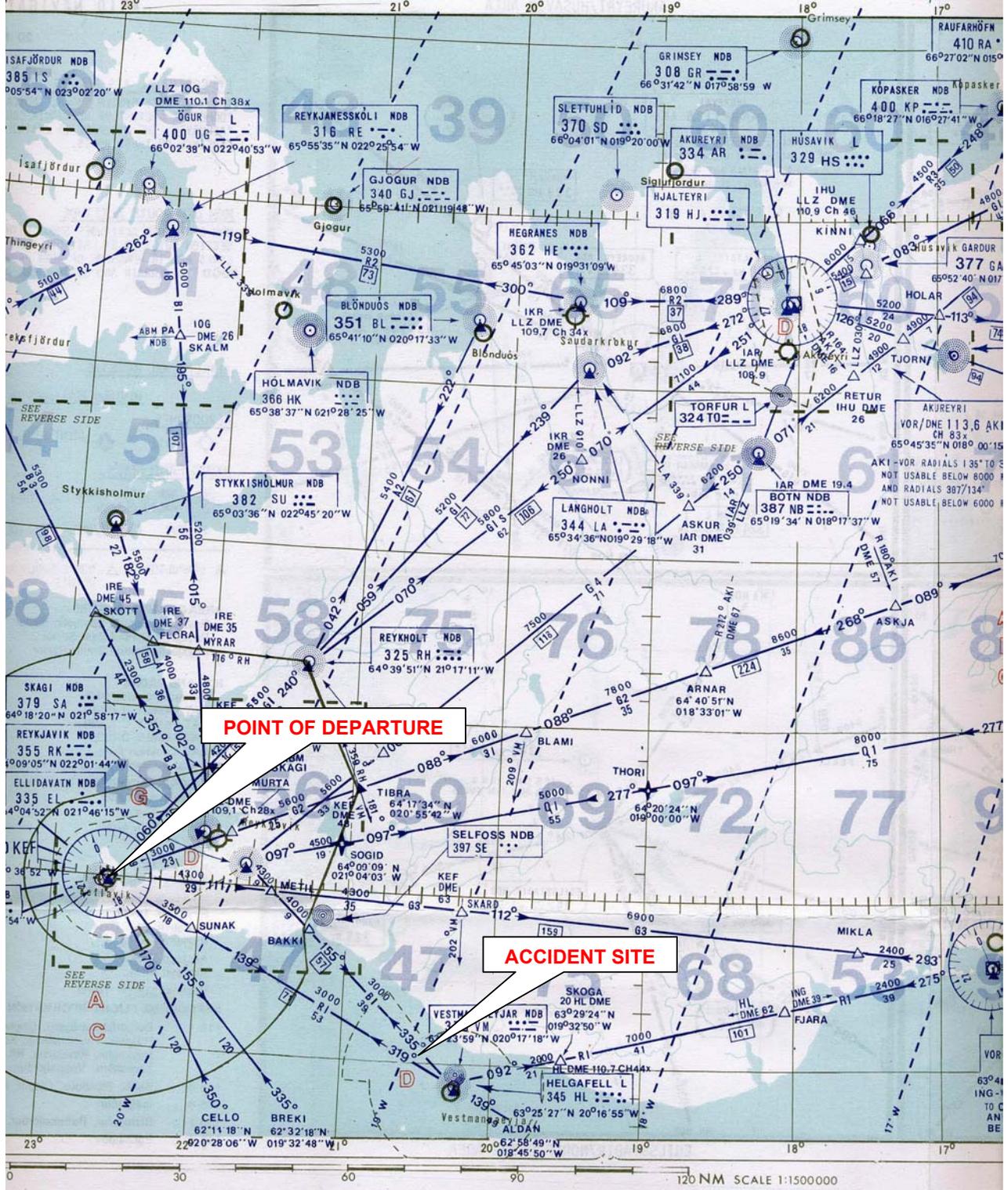
4. Safety Recommendations.

- 4.1. The Icelandic Civil Aviation Administration reviews its search and rescue procedures for utilising radar data when searching for lost aircraft.

Reykjavík, 9 December, 2002

Aircraft Accident Investigation Board, Iceland

APPENDIX 5.1



APPENDIX 5.2

Transcript of the radio communication with N272BB

LEGEND:

GND = Keflavik Airport Ground Control
KEF = Keflavik Airport Control Tower
APP = Keflavik Approach Control
OACC = Reykjavik Oceanic Area Control Centre.
PHONE = Telephone between OACC and GND/APP.

Note:

1) All times are UTC.

Time: Unit: Message:

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Keflavik Airport Ground Control, frequency 121,9 MHz

08:02:16 N272BB: Keflavik Ground, November-Two-Seven-Two-Bravo-Bravo.
Request clearance.

08:03:30 GND: Station calling Ground, come again.
N272BB: Two-Seven-Two-Bravo-Bravo. Requesting clearance.
GND: Two-Seven-Two-Bravo-Bravo. Standby one check on your clearance.

08:07:10 N272BB: November-Two-Seven-Two-Bravo-Bravo ready to taxi.
GND: November-Two-Seven-Two-Bravo-Bravo taxi via Charlie Kilo to holding
runway One One.
N272BB: Charlie Kilo to holding runway One One, Two-Bravo-Bravo.

08:08:20 GND: November-Two-Seven-Two-Bravo-Bravo ready to copy clearance.
N272BB: Two-Seven-Two-Bravo-Bravo ready.
GND: November-Two-Seven-Two-Bravo-Bravo cleared to ECHO GOLF
PAPA OSCAR, via ALDAN, SIX ONE NORTH ONE TWO THREE FOUR
WEST, SIX ZERO NORTH ONE ZERO WEST, STORNOWAY. FLIGHT
LEVEL TWO THREE ZERO, SQUACK THREE FIVE SEVEN FIVE,
standby one for read back.

08:10:13 GND: November-Two-Seven-Two-Bravo-Bravo go-ahead with your read back.
N272BB: Two-Seven-Two-Bravo-Bravo ah... is cleared to EGPO via ALDAN, ah..
NORTH SIX ONE WEST TWELVE, NORTH SIXTY NORTH TEN, excuse
me WEST TEN to EGPO SQUACK THREE FIVE SEVEN FIVE.
GND: November-Two-Seven-Two-Bravo-Bravo is cleared to Aldan, then Six
One North One Two Three Four West, Six Zero North One Zero West,
Stornoway, flight level two three zero.
GND: November-Two-Seven-Two-Bravo-Bravo. Your route is Aldan, then Six
One North One Two Three Four West, Six Zero North One Zero West,
Stornoway, flight level two three zero.
N272BB: OK ah.. Two-Seven-Two-Bravo-Bravo is cleared to Aldan then North
Six One West One Two Three Four, North Six Zero West Ten, direct
Stornoway, squawking three five seven five and we are unable flight
level two three we are requesting one five over.
GND: November-Two-Seven-Two-Bravo-Bravo flight level one five zero, read

back correct.

N272BB: Two-Seven-Two-Bravo-Bravo ah..... Two-Seven-Two-Bravo-Bravo, also I am unfamiliar with the airport I am currently sitting at intersection November Five over.

GND: Two-Seven-Two-Bravo-Bravo turn right at the intersection Charlie Three then right again for Kilo Three.

N272BB: I have no idea were Charlie Three is ma'am.

GND: Are you at intersection November Five and West entry?

N272BB: I am on at intersection November Five and..... Charlie Three. All right I could not see the Charlie Three sign alright, right on Charlie Three then right again.

GND: Affirm.

08:16:45 GND: November-Two-Seven-Two-Bravo-Bravo, Ground.

N272BB: Two-Seven-Two-Bravo-Bravo.

GND: Two-Seven-Two-Bravo-Bravo, report your position now.

N272BB: Two-Seven-Two-Bravo-Bravo is at Kilo Four holding at number two hold line.

GND: Two-Seven-Two-Bravo-Bravo line up on One One and switch to tower frequency, one one eight decimal three.

N272BB: Two-Seven-Two-Bravo-Bravo.

Keflavik Airport Tower, frequency 118,3 MHz.

08:17:30 N272BB: Keflavik Tower November-Two-Seven-Two-Bravo-Bravo is with you.

TWR: Two-Seven-Two-Bravo-Bravo line up One One.

N272BB: Two-Seven-Two taxing into position.

08:18:20 TWR: November- Two-Seven-Two-Bravo-Bravo wind zero four zero degrees at one zero. When airborne contact Approach on one one niner decimal three .

Cleared for take off, runway One One.

N272BB: Two-Seven-Two-Bravo-Bravo One One niner point three cleared for take off.

Keflavik Approach Control, frequency 119,3 MHz.

08:20:00 N272BB: Departure Control, November-Two-Seven-Two-Bravo-Bravo with you at one thousand feet.

APP: November-Two-Seven-Two-Bravo-Bravo, Approach, good morning, identified, cleared right turn direct Aldan.

N272BB: Right turn direct Aldan. Two-Seven-Two-Bravo-Bravo.

08:46:40 APP: November-Two-Seven-Two-Bravo-Bravo, contact Reykjavik Control on one three two decimal three.

Have a nice flight.

N272BB: One three two decimal three, Two-Bravo-Bravo.

Reykjavik Oceanic Area Control Centre, frequency 132,3 MHz.

08:25:00 PHONE/
GND Control... Take-off on November-Two-Seven-Two-Bravo-Bravo. Time one niner. Yes and Charlie Golf Tango Delta Echo, time two three, two three thank you.

08:28:15 PHONE/
APP Control, tips, yes, Charlie Golf Tango Delta Echo passing through Aldan, track twenty miles on track direct Breki. He is identified, and five miles behind him November Two Seven Two Bravo Bravo climbing slowly and going slowly. Okidokie - identified

also, I send you Tango Delta Echo over now and Bravo Bravo shortly after. OK.

08:46:57 N272BB Reykjavik Control, Two-Seven-Two-Bravo-Bravo with you at thirteen point five.
OACC November-Two-Seven-Two-Bravo-Bravo, Reykjavik, Roger, identified.
N272BB Say again please.

08:49:50 N272BB Reykjavik .. Reykjavik Control. Two-Seven-Two-Bravo Bravo with a request.
OACC Bravo-Bravo, go-ahead.
N272BB Do you have any report of tops over here? Over.

OACC Well over Iceland about - uh - thirty miles north of you, tops were at nineteen to twenty three thousand in layers.
N272BB A .. we are at a... just left through fourteen and we haven't even seen a layer yet. Over.
OACC No, you can probably expect it at around nineteen thousand or above.

09:24:55 OACC November Two Seven Two Bravo Bravo Reykjavik!
November Two Seven Two Bravo Bravo Reykjavik!
November Two Seven Two Bravo Bravo Reykjavik!

-- END --