

No. 2

Braathens SAFE, DH 114, Heron, MK II, LN-SUR, crashed at Hommelfjell, Tolga, Norway, on 7 November 1956, while attempting to reach a suitable place for an emergency landing. Report of the Directorate of Civil Aviation, Norway, released 2 May 1957.

Circumstances

LN-SUR departed from Vaernes Airport, Trondheim, at 0830 hours local time on a scheduled flight to Oslo, carrying a crew of two and ten passengers. The aircraft entered clouds (at 2 500 ft) right after take-off and did not have visual contact with the ground thereafter. The co-pilot later stated that between Vaernes and Tolga when the aircraft reached cruising altitude, normal cruise power was set up but the resultant indicated airspeed was 20 knots below normal. The aircraft reported that at 0912 hours it had passed Tolga radio beacon at 8 000 ft (2 438 m), and that it was experiencing light icing. This was the last radio contact with the aircraft. From this point on it appears that the icing increased rapidly and the aircraft started to lose altitude, even though the de-icing system for wing and tail planes was in use. At 0925 hours it was decided to return to Vaernes Airport. The aircraft, when approximately abeam Tolga and to the east, altered its course 25 to 30 degrees northeast. This manoeuvre, carried out by the captain, was interpreted by the co-pilot to mean that he had decided to divert to Røros. The controls were taken over by the co-pilot while the captain continued to try to establish radio contact with the ground on frequency 126,7 mc/s. No signals were picked up. At approximately 0950 hours the aircraft hit Hommelfjell at a height of approximately 1 350 metres. At the time of the crash the aircraft was in heavy fog, with cockpit windows covered with ice to an extent which drastically reduced the crew's visibility. The force of the impact was somewhat reduced in that the aircraft

touched down in a bowl in the terrain and made two bounces on the snow, which covered the mountain to a depth of 40 cm, before settling down. The captain and one passenger died instantly.

Investigation and Evidence

At the time of the accident, Braathens' SAFE was operating provisionally certain domestic air routes, including the route Oslo-Trondheim, with a view to determining their potential from a traffic point of view and at the same time, to evaluate the, at the time, new de Havilland Heron's performance and suitability for that particular traffic. It had already been established that the aircraft's technical characteristics were well suited for this kind of operation and that it fulfilled all safety requirements as laid down by the civil aeronautics authorities.

Operating procedures, manuals, etc. for the route had, in accordance with normal practice, been approved. It is not clear, however, whether any control had been carried out by the authorities to ensure compliance with all relevant directives and regulations. Although there is no evidence that such compliance was lacking in practice, it was noted that, whereas the civil aviation regulations stipulate that a pilot shall, in preparing his flight plan, personally examine all relevant meteorological reports and forecasts, crews of the operator, while at Vaernes, had obtained such meteorological information by telephone rather than by a personal visit to the meteorological office. The Commission considered that had the crew gone to the office, it would, in all

likelihood, have obtained more accurate information and might thereby have been in a better position to evaluate the conditions it encountered.

The Wreckage

The wreckage showed signs of severe damage. The nose section had been pushed under the fuselage. The wings had been forced approximately 30 degrees out of position, with the left wing pointing forward and the right wing rearward, with resultant damage to the passenger cabin over the centre section. The fuselage showed large dents at the root of the forward beam on the right side, and behind the trailing edge of the wing on the left side. The tip of the left wing was broken off. All engines except the inside right were scattered throughout the terrain. The tail section aft of the passenger cabin was practically intact, apart from the fuselage having been broken up underneath.

The following observations were made in the cockpit:

- a) one radio compass in position "automatic" was tuned to 394 kg (frequency Tolga), indicating a bearing of 315 degrees, the other in position "tuning" was set at 380 kc;
- b) the lever for "cross feeding system" was in position "normal";
- c) altimeter setting in the captain's seat showed 1016 millibars, in the co-pilot's seat 1017 millibars;
- d) the throttle lever for the inside right engine was in a half open position, with all others fully open; in the case of the former, the casing on the starter button was open;
- e) all magnetos were turned off;
- f) carburettor heating was turned off;
- g) selectors for flaps and under-carriage were in the "up" position;
- h) rudder trim one quarter of fully left.

Inside the aircraft all seats were loose; the Commission was aware, however, that several seats were torn loose by the passengers after the crash had taken place. None of the safety belts had broken during the crash. The seats which came loose during the crash had, no doubt, added to the injuries of some of the passengers, although the evidence obtained by the Commission was not conclusive in this respect.

As for the one passenger who was killed, it appears that his seat came loose on impact and that he was thrown forward in the cabin, with the left wing root coming into the cabin and hitting him on the left side above the shoulders.

Later tests on the safety belts showed them to withstand approximately 10 G. In this connection, the Commission pointed out that it would appear that the belts withstood a relatively greater stress than the chair mountings.

Weather

Meteorological briefing before departure had been obtained by telephone by the co-pilot who testified that no special warning against icing was given. He was informed that landing conditions at both Hamar and Fornebu were bad due to the weather, but that they were above the stipulated minimum. Similar conditions prevailed at the first alternate, Gardermoen, but conditions were reasonably good at the second alternate, Kjevik. The briefing also mentioned that there would be a wind of 333°/40 knots at 8 000 ft and that the aircraft would be flying through cloud all the way, and that the forecast made reference to a warm front moving from W - S - W with resulting higher temperatures after the aircraft had passed it.

In so far as the method of returning to the point of departure is both a much used and a natural one, the Commission was inclined to believe that such a method would have been the safest and pointed out that a more thorough orientation with the weather situation might possibly have resulted in greater caution being exercised by the crew and might have led to a decision to turn around at an earlier stage.

Icing

When the Investigating Commission arrived at the scene of the accident, signs of heavy icing were still visible on the aircraft. Its distribution, however, seemed to indicate that the de-icing equipment had been functioning.

It was not clear what the exact thickness of the ice and its nature had been, apart from it having been stated that it was rough and partly clustered. The leading edges of the wings were heavily covered with ice as far back as the ailerons with a distinct piling up in front of them, and ice rings approximately 15 cm thick had formed on the propeller hubs; there was no indication of carburettor icing.

It was pointed out to the Commission that icing of the air intakes for the flight instruments could have resulted in incorrect instrument readings, and thus have resulted in reduced utilization of the aircraft's flight characteristics. Such a view could not be substantiated from an investigation of the wreckage since there were no indications of accumulated ice on the nose section where these intakes are located, although heavy formations of ice were found on other parts of the aircraft. The Commission did not completely rule out this possibility, however, and considered that this might have been a contributory factor. The Commission did point out that the drop in indicated airspeed on the segment Vaernes - Tolga could in no way be connected with this theory, as no

serious icing had occurred at that stage of the flight.

It was clear that at the time of the crash the crew did not know the exact position of the aircraft and the hazard which Hommelfjell represented. The Commission was of the opinion, however, that the heavy icing which prevented normal navigation from being carried out could easily lead to such a situation. Under the circumstances, there was little reason to believe that the aircraft could have avoided an emergency landing, or a crash for that matter, even if it had been able to steer clear of Hommelfjell. The absence of any attempt of the crew to turn around or take other dispositions before icing caused the aircraft to lose altitude must also be looked upon in the light of the rapidity with which ice was forming on the aircraft.

The Commission was aware of some criticism having been raised against the de Havilland Heron, as being particularly vulnerable to icing, and, for that reason, not particularly well suited for the climatic conditions in Norway. It did not, however, share this view, and noted in this connection that the operator, Braathens SAFE, had given this problem special attention.

The de Havilland Heron is equipped with de-icing equipment of a stronger type and on a larger scale than that usually employed by aircraft of similar type. The Commission noted that pneumatic de-icing systems, e.g. the Goodrich system with which the aircraft was equipped, are not as effective as the thermal de-icing systems used by heavier aircraft, and wished to point out that hardly any type of de-icing equipment could have coped with the heavy icing which occurred. On the other hand, one must, of course, also take into account the flight altitude limits imposed by lack of pressurisation. Instructions for the route also included directives that flights should be cancelled when there was reason to believe that moderate or severe degrees of icing would be encountered.

Radio Facilities

The Commission was aware that LN-SUR, with its VHF equipment, could not count on reliable radio connections for the whole of the segment Koppang - Tolga, and believed that this was the main reason why the aircraft, during the critical phases of the flight, could not obtain contact with the ground. With the present installations the aircraft would, according to the report from the communications specialist, on this segment of the flight, have had to maintain an altitude of 3 000 m, in order to maintain reliable connections with the ground. Due to loss in altitude, LN-SUR was considerably lower than this altitude and at the same time, there was the possibility that icing on the antennae had reduced the effectiveness of the transmission. The Commission was of the opinion that, under the circumstances, satisfactory radio contact with the ground would hardly have had any appreciable effect on the final outcome, although it did not wish to minimize its effect upon the crew's ability to determine the position of the aircraft.

As regards the radio facilities on the route, it appears obvious that both the airborne equipment and ground installations could be improved. Utilization of higher flight altitudes would be a help in itself, but the Commission was aware that this would involve problems in respect of non-pressurized passenger aircraft.

Crew

The crew consisted of captain and co-pilot. The captain's total flight time as pilot was approximately 10 000 hours. The co-pilot had flown a total of 8 000 hours, of which approximately 2 000 hours were

as pilot. They were both well acquainted with the route.

Probable Cause

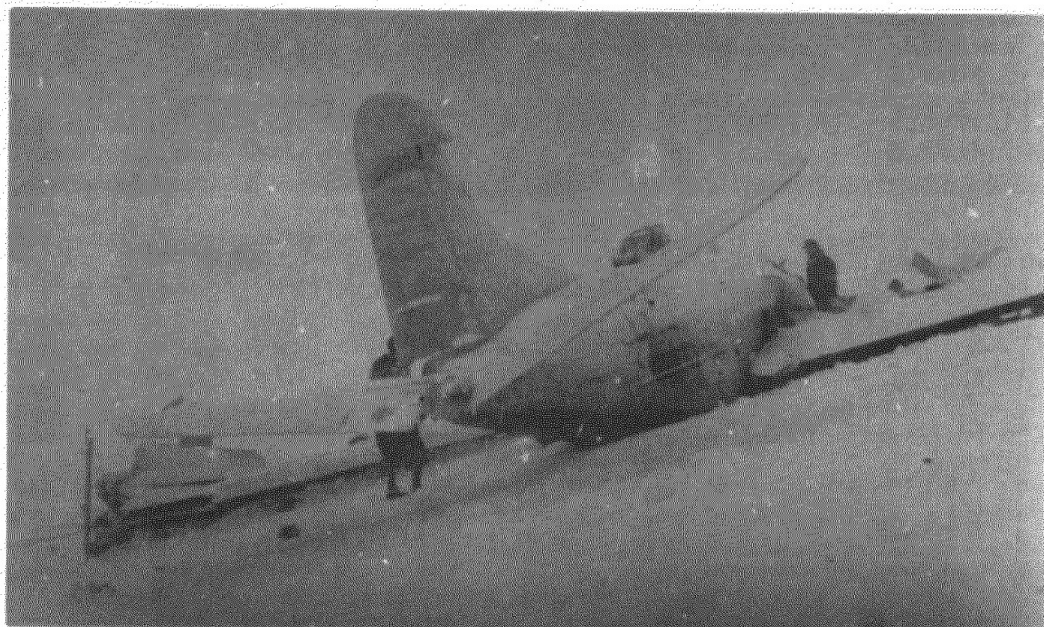
The accident was due to the unusually heavy icing which the aircraft encountered. Severe downdraft immediately prior to the crash may have been a contributing factor.

Recommendations

The Commission recommended that:

- 1) operators engaged in the transport of passengers be instructed to make it mandatory that crews, in preparing for a flight, appear in person for weather briefing;
- 2) relevant air regulations be enforced which provide that aircraft engaged in regular air services shall maintain radio contact with the ground during flight;
- 3) the civil aviation authorities review their route inspection procedures with a view to determining whether existing procedures provide effective control;
- 4) the civil aviation authorities stress-test chair mountings on the Heron and ascertain that chair mountings and seat belts are correctly adjusted in relation to each other;
- 5) the civil aviation authorities consider whether operators engaged in regular air services should, in addition to first aid equipment, also carry emergency equipment such as blankets, emergency rations, flares, etc.

FIGURE 1



General views of the wreckage of Braathens SAFE Heron which crashed at Hommelfjell, Tolga, Norway on 7 November 1956 while trying to reach a suitable place for an emergency landing.

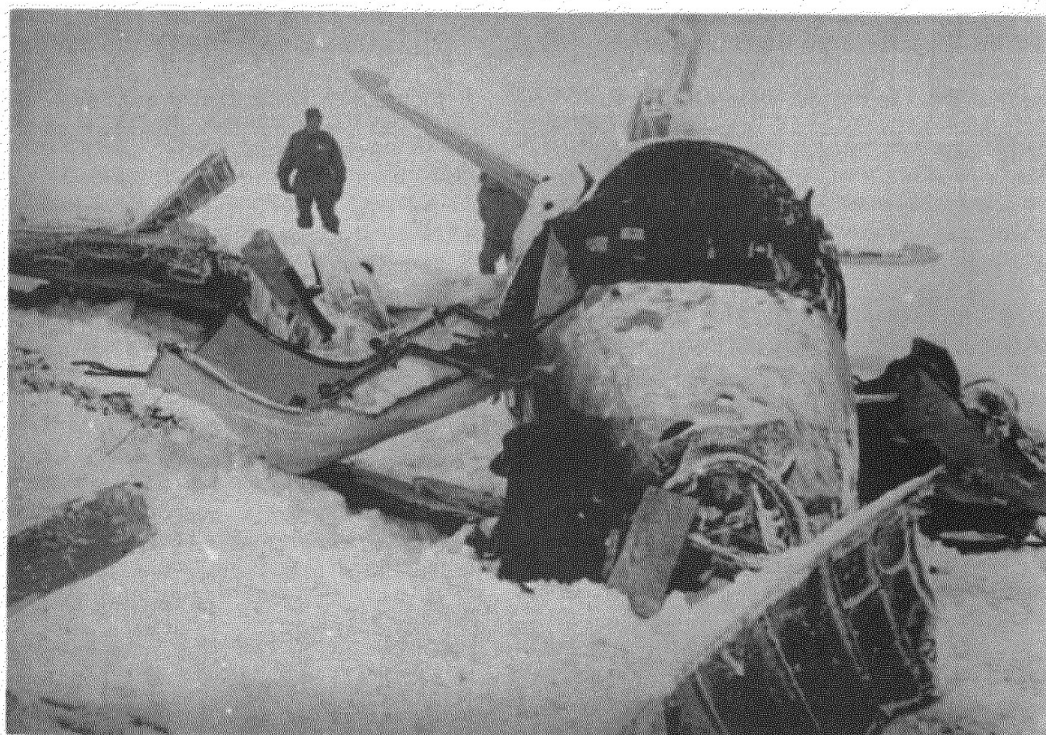


FIGURE 2