

INCIDENT

Aircraft Type and Registration:	Aerospatale AS332L Super Puma, G-BTCT	
No & Type of Engines:	2 Turbomeca Makila 1A turboshaft engines	
Year of Manufacture:	1984	
Date & Time (UTC):	22 December 1993 at 1109 hrs	
Location:	Gryphon 'A' Platform, North Sea	
Type of Flight:	Public Transport (Offshore Oil Support Charter)	
Persons on Board:	Crew - 2	Passengers - 16
Injuries:	Crew - None	Passengers - None
Nature of Damage:	None	
Commander's Licence:	Airline Transport Pilot's Licence (Helicopters)	
Commander's Age:	52 years	
Commander's Flying Experience:	11,664 hours (of which 5,075 were on type) Last 90 days - 146 hours Last 28 days - 3 hours	
Information Source:	AAIB Field Investigation	

History of the flight

The helicopter departed from Aberdeen at 0835 hrs on the morning of the incident for a flight to the Gryphon 'A' Floating Production Platform, which is situated in the North Sea some 177 nm north east of Aberdeen, in the Beryl Oil Field. The outbound flight, with freight but no passengers, was uneventful, although the crew decided to descend from a 3,000 feet amsl cruise down to 1,000 feet in order to remain in clear air below scattered cumulus and stratocumulus cloud. Approximately 30 minutes before landing, a large area of weather return was noted on the weather radar, later to be encountered as a sleet/snow shower. The crew considered that this shower would be in a position to affect their approach to the vessel, and elected to make an instrument rig radar approach in accordance with normal practice. This was successfully completed, and the helicopter landed on the vessel at 0955 hrs. Shortly afterwards, the visibility had reduced to approximately 0.5 nm, and it was snowing heavily. The crew reported that in the shower, there was a northerly wind gusting up to around 30 kt. The aircraft was fitted with the electric heating mats system for grid-type engine air intakes, and these remained on and serviceable for the duration of the outbound flight, and throughout the time on the helideck of the vessel with the engines running.

After landing, the commander elected not to shut down the engines, because of the vessels movement and the strong gusty wind conditions during the shower activity. A rotor running refuel was carried out, uplifting 809 litres of fuel. Sixteen passengers were boarded, and their baggage loaded. The commander completed an external pre-flight inspection, but there were no significant deposits of snow or slush around the engine intakes. He made a point of checking under the intake baskets, by climbing up onto each side of the helicopter at the cockpit doors, but did not note any significant deposits in that area. He did however remove small quantities of slush from the periphery of the baskets, and from the area below them with his hand. On returning to the cockpit the commander elected not to depart immediately but to wait on the deck, with the rotor running at flat pitch, until the snow shower had passed. A radio call was made to the Beryl Platform, which was located upwind of the Gryphon A, and it was ascertained that the shower had passed and the weather had improved considerably at that location. The commander decided to remain on the platform and await the weather clearance to reach the vessel.

At approximately 1055 hrs, the weather began to improve, and the commander decided to uplift a further 248 litres of fuel into the forward tank group, in order to supplement the reserves on board. This was completed, and the first officer completed a walk round at around 1100 hrs, removing some slushy deposits from the airframe and centre windscreen. He observed the engine intakes from a position forward of the nose of the helicopter, but there were no significant deposits of snow or slush visible, either around the intake mouths or on the protective baskets.

The first officer was the handling pilot, and the helicopter lifted off at 1109 hrs into a low hover, around 8 feet above the helideck. The commander suggested that the helicopter be held in this position for a short period, in order to confirm that the engines were operating correctly, prior to the transition to forward flight. After some 4 seconds in the hover both pilots heard a loud bang and both engines failed and ran down. The first officer applied additional collective pitch in order to cushion the touchdown. The helicopter landed firmly on the deck, but was undamaged, and there were no injuries to the occupants. A quantity of unburnt fuel produced smoke which swirled around the rotor head briefly, but there was no fire. The passengers were all aware of the loud bang, the landing, and the smoke, but were quickly reassured by the commander that the situation was under control. The deck crew were requested to rapidly deplane the passengers and return them to the waiting area.

During a subsequent inspection by the commander, there was little evidence of snow or slush build-up around the engine intakes. There was a small annular deposit around the root joint between the intake baskets and the engine, and about 2 mm around the edge of the metal ring at the front end of each basket. The commander commented that the accretion at the forward end was of clear ice deposit, still frozen. There was subsequent frequent snow/sleet shower activity during the day.

Inspection of the aircraft

The operator sent a relief helicopter to the Gryphon 'A', which arrived at around 1430 hrs, bringing company engineering staff to inspect 'CT', perform some checks and assess the possibility of its returning to Aberdeen for more detailed examination. During their inspection, on sliding forward the front engine intake door, significant deposits of snow were observed, but this was after the prolonged period with the helicopter shut down on the vessel. Both engines were checked for freedom of rotation or damage visible down the intake and exhausts and a boroscope examination for internal damage was carried out. The condition of the intake heater mats and throttle rigging were assessed as satisfactory. Fuel samples were taken, all of which proved to be free from water contamination and the fuel filters were checked and found satisfactory. After ground running and hover checks had been completed, the aircraft was flown back to Aberdeen where further investigation revealed no deficiencies in the intake anti-icing heater mats or any other system.

Meteorological information

An aftercast was obtained from the Meteorological Office at Bracknell, indicating that at the time of the incident, there was a trough of low pressure crossing the Beryl Field area at around 1100 hrs, giving occasional showers of hail, rain/snow or snow. Visibility varied between 30 km to around 800 metres in the showers. The mean sea level pressure was 984 mb. The surface wind was generally 360°/5 to 12 kt, temperature +2°C, dewpoint -3°C, and the wind at 2,000 feet was 290°/20 kt, temperature -2°C.

Further analysis of the likely precipitation rates attained, and the ice water content (IWC) of the air was performed by the Meteorological Office. This indicated that the maximum precipitation rate in the area at the time was approximately 0.5 g per square metre per second. A typical average descent rate for snow is 1 m/s, giving an average IWC of 0.5 g per cubic metre with a possible peak value of 1.0 g per cubic metre.

The fullest available meteorological data was passed to the manufacturer, and to the CAA, for their consideration.

Original certification

When the aircraft was originally certificated in 1981, the requirement specified for snow clearance of the intake system was in FAR 29 § 1093(b)(1)(ii). This was entirely non-specific about the quantity and quality of snow which the intake system had to be proof against, and appeared to leave it to a manufacturer to determine how well his aircraft could cope with snow and to state the conditions under which it had performed satisfactorily .

Included amongst the conditions under which the Super Puma was tested were some in natural icing, in falling and recirculating snow, which had been proposed as guidelines by the UK, in § 5.2.8 of the AGARD Advisory Report No 166 (A NATO document, Published August 1981). One of the factors identified as being amongst those which should be considered when testing in natural snow was ambient air temperature, including particularly temperatures about 0°C. However, the wording did not make clear whether 'about' was intended to mean 'close to' or 'either side of' and in the event, all testing in snow was performed at sub-zero temperatures.

Previous occurrence

On 14 December 1984, another AS332L Super Puma suffered a double engine failure incident whilst in-flight in icing conditions at an altitude of 4,000 feet (see AAIB Bulletin 2/85). These failures were established to have been caused by a build-up of ice on, and its subsequent shedding from, the unheated portion of the engine air intakes. As a result of tests carried out during that investigation, the electric intake heating mat system was developed to prevent the build-up of ice in the portion of the inlet between the screen and the continuously oil heated engine front frame structure. The test regime for the qualification of the mats was at least as stringent as the currently required acceptance criteria as specified by AC29-2A CHG 2 § 532, 1st Edition dated 16 September 1987. These criteria can be seen to correspond well with the conditions proposed in paragraph 6.4.1.9 B of the AGARD Advisory Report No 223 (published September 1986) for testing in natural falling, blowing or recirculating snow provided that the interpretation of the temperature range requirement is that any temperature within the specified range is adequate.

The incident on the 14 December 1984 was recognised as very serious and the response of both the manufacturers and airworthiness authorities was prompt and, after much work, resulted in the realignment of the engine air intake to the stubframe, the fitting of the gutter to the stubframe, and the qualification of the intake heater mats modification. Since that time the aircraft has been operated for many hours in the North Sea environment without occurrences involving engine intake icing, however, there can be little doubt that the incident of 22 December 1993 was caused by the simultaneous ingestion of snow/slush/ice by both engines.

Tests following the incident of December 1993

Having been supplied with the data available from the 22 December 1993 incident, the manufacturer carried out a brief test programme of ground running and hovering in ground effect. In those tests, the engine failures could not be reproduced, even with quite large quantities of snow placed in the proximity of the intake grids. However, most of these tests, in common with those performed to gain certification clearance for operations in icing conditions, were carried out at temperatures below freezing. No testing in falling or blowing snow has been carried out in the temperature range between 0°C and +3°C, the prevailing conditions at the time of this incident.

Flight Manual limitations

At the time of the incident on 22 December 1993, there were no limitations relating to the operation of the helicopter for ground running in snow conditions. Immediately after this incident, the operator issued a notice to crews giving detailed guidance on inspection for ice, slush or snow build-up around the engine intakes after prolonged ground operations in icing conditions. This notes that crews should inspect the area around and under the intake baskets, and clear any deposits accumulating in these areas prior to lift-off. Initially, they also required crews to lift off to the hover for confidence checks on the engine performance for a period of 3 minutes before transitioning to forward flight, but in the light of evidence obtained during this investigation, the hover period was reduced to 30 seconds. The operator also informed other operators of the same aircraft type of the circumstances of the incident and the action they were taking. Following the incident the manufacturer sent a telex to all operators on 27 December 1993 giving information on the incident and including recommendations concerning, in particular, the inspection of the air intake area.

As a result of the investigations since the incident, the Airworthiness Authorities, DGAC and CAA with the co-operation of the manufacturer, are in the process of formulating and approving instructions, very similar to the operator's, for operations in snow to be incorporated into the Flight Manual.

Safety Recommendations

- 94-19 It is recommended that, in order to understand the incident phenomenon, the airworthiness authorities require Eurocopter to commission further work to determine the areas in which deposits accumulate and the nature of the accumulation throughout the critical temperature range described in paragraph 6.4.1.9B of the AGARD Advisory Report No 223.
- 94-20 It is recommended that the airworthiness authorities ensure that future certification of engine/airframe intake combinations includes testing throughout the critical temperature range described in paragraph 6.4.1.9B of the AGARD Advisory Report No 223 in representative conditions of falling and recirculating snow.