SERIOUS INCIDENT

Aircraft Type and Registration:	Sikorsky S-92A, EI- ICU	
No & Type of Engines:	2 General Electric CT7-8A turboshaft engines	
Year of Manufacture:	2006	
Date & Time (UTC):	5 February 2023 at 1453 hrs	
Location:	5 nm east-northeast of City of Derry Airport, Eglinton, Londonderry	
Type of Flight:	Training	
Persons on Board:	Crew - 4	Passengers - None
Injuries:	Crew - None	Passengers - N/A
Nature of Damage:	Damage (possibly pre-existing) resulting in replacement of stabilizer strut, aft tail drive shaft bearing support and forward tail drive bearing support	
Commander's Licence:	Airline Transport Pilot's Licence	
Commander's Age:	47 years	
Commander's Flying Experience:	8,080 hours (of which 2,400 were on type) Last 90 days - 45 hours Last 28 days - 13 hours	
Information Source:	Aircraft Accident Report Form submitted by the pilot	

Synopsis

A search and rescue training flight encountered turbulence without any visual indication which resulted in the helicopter exceeding its maximum speed. The flight subsequently diverted to the City of Derry Airport.

An overspeed inspection of the helicopter identified three items which were rectified by the replacement of components. The helicopter returned to service two days later. The manufacturer's representative believed the findings likely pre-existed the overspeed event.

Analysis of meteorological reports suggested that EI-ICU probably flew through mountain waves associated with the Sperrin Mountains, creating the turbulence which affected the helicopter. Moderate turbulence was forecast in the region and discussed in the pre-flight briefing, but analysis of subsequent meteorological information suggested that mountain wave activity was present at the time of the event.

History of the flight

The flight was part of a training exercise which departed from Sligo, Ireland, to rendezvous with a lifeboat near Portrush at approximately 1500 hrs. It was operated by two pilots and two rear crew members. The departure from Sligo was uneventful, and the helicopter cruised north-east toward its intended destination, at 2,000 ft amsl. The flight was operating under VMC. The weather forecast indicated occasional moderate turbulence up to 6,000 ft amsl, mainly along the north coast.

During the cruise, the helicopter encountered unexpected severe turbulence approximately 5 nm east-northeast of the City of Derry Airport. The pilot reported that the helicopter pitch increased slightly before reducing, and the helicopter began to accelerate. During this time the airspeed reached 175 KIAS, exceeding V_{NE} (165 kt), and an aural "AIRSPEED" warning sounded. The pilot raised the pitch attitude, reduced the collective and slowed the helicopter to around 100 KIAS. The pilot maintained this speed and subsequently climbed to 2,800 ft amsl.

The commander reported that all crew members felt a noticeable increase in airframe vibration after the overspeed event. The pilots discussed diverting to the City of Derry Airport then notified ATC of their intention. The aircraft diverted and landed without further incident.

Recorded information

The helicopter was fitted with a combined CVR and FDR which captured the full duration of the event flight. A Health Usage Monitoring System (HUMS) also recorded data. The FDR parameters included the helicopter's indicated airspeed, ground speed, altitude, and pilot control inputs (Figure 1).

Wind speed and direction are calculated by the Flight Management System (FMS) and can be displayed to the pilots on the Navigation Displays. The calculated wind data is a result of an algorithm in the FMS which smooths the data and introduces a time lag to avoid large instantaneous changes being displayed to the pilots which may not be reflective of the actual conditions. The recorded wind speed and direction are calculated using estimated ground speed, estimated ground track, heading and true air speed. Any wind changes will only be picked up when those data inputs begin to change. This means that the recorded wind changes may lag the environmental conditions being experienced by the helicopter. The time lag included in the algorithm also increases the delay in recorded wind changes in the FMS data. The FMS calculated windspeed and direction were recorded on the FDR, which indicated that there was a tailwind.

FDR data showed that at Point A in Figure 1, the aircraft experienced an oscillation in pitch over approximately eight seconds with the cyclic control moving in the opposite sense to the pitch. At the end of this period, at Point B, the airspeed began to increase sharply, and the pilot made a nose-up cyclic input (Point C), which increased the pitch attitude, and lowered the collective control (Point D). During the 10 seconds after the indicated airspeed began to increase, the wind speed dropped significantly (Point E) although there was no change in direction.

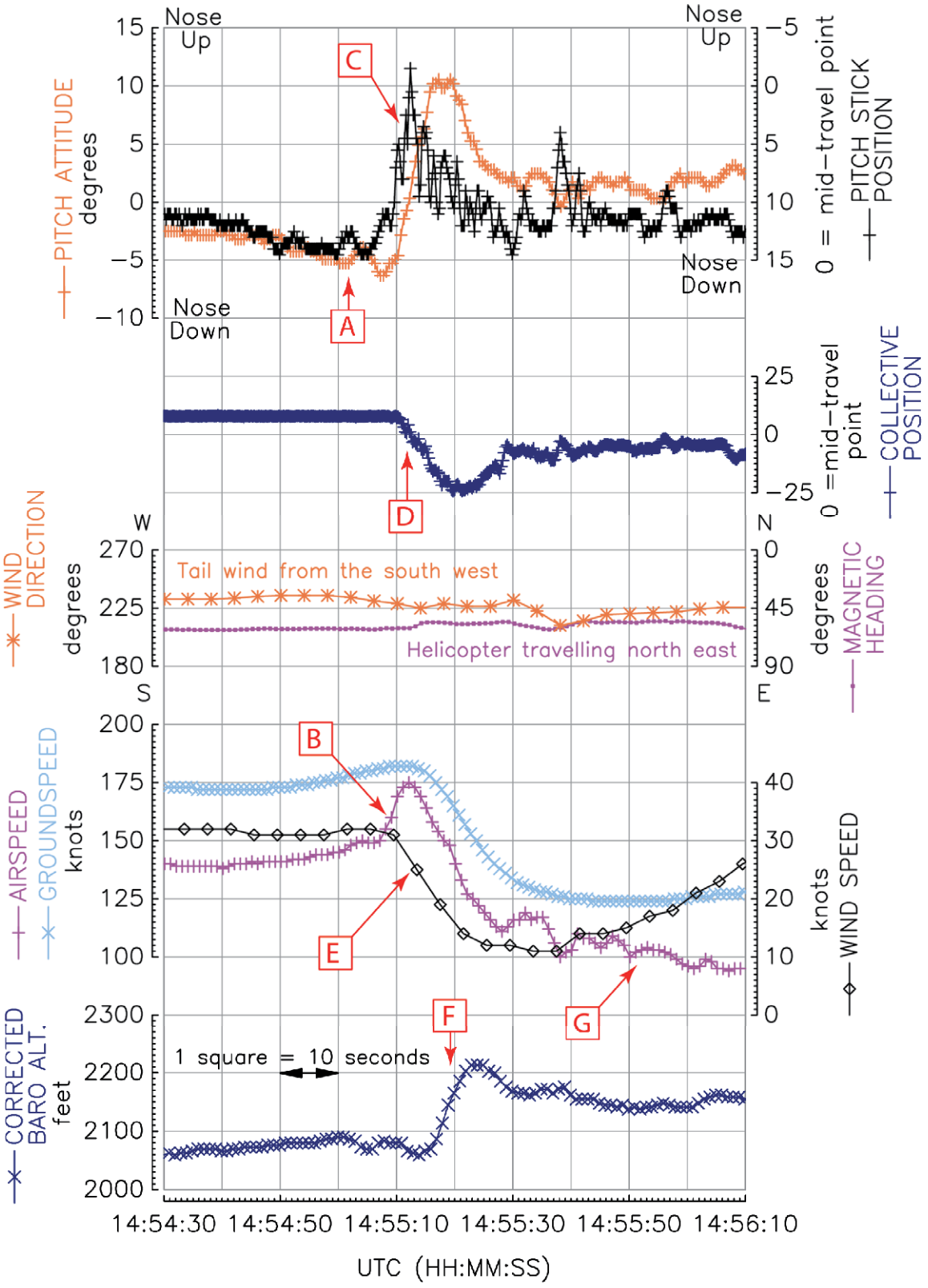

Figure 1

FDR data from EI-ICU at the time of the weather encounter

Approximately eight seconds after the speed began to increase the altitude began to increase, and the pilot responded by making a nose-down cyclic input while continuing to lower the collective. The airspeed peaked approximately 25 kt above its initial value, and the altitude increased by approximately 150 ft (Point F) as the pilot made these inputs.

The helicopter subsequently slowed to around 100 KIAS (Point G), which was maintained until the pilot later elected to climb to a higher altitude.

Engine torque, turbine rpm and rotor speed parameters were recorded and indicated normal behaviour throughout the flight.

Aircraft information

The Sikorsky S-92A is a twin gas turbine engine medium-lift transport and utility helicopter, used in both civil and military operations. The S-92A is widely used for Coastguard Search and Rescue operations.

Figure 2

EI-ICU at the City of Derry Airport. Image used with permission

Meteorology

The crew had reviewed the weather before the flight and the conditions were more than adequate for the planned sortie. The weather was clear and there were no signs of convective activity or low cloud.

On the day of the flight high pressure was centred over the UK and there was a decaying frontal system, which at the time of the event was situated around the west coast of Ireland. The frontal system was moving slowly to the east-southeast. The skies of Northern Ireland were largely clear with some high cirrus but no detected precipitation. The winds were south-westerly and forecast to increase during the day, with the strongest winds in the northwest of the region. The low-level significant weather chart provided to the crew

contained a warning of occasional moderate turbulence up to 6,000 ft amsl in the north of the forecast region.

An aftercast was obtained which included further information on the possibility of turbulence and mountain wave activity. This suggested that in Northern Ireland there was the possibility of moderate mountain waves with the height of the strongest activity at 3,000 ft amsl, although there was no risk of rotor streaming. There was also a widespread elevated inversion which would have further promoted the formation of mountain wave activity.

At 2,000 ft amsl in the area where the turbulence encounter occurred, the crew were directly in the lee of the Sperrin Mountains, a range of hills to the east of Strabane. The highest point on these hills is around 2,200 ft amsl. At the height the helicopter was flying, the wind was approximately 210° at 40 kt. This meant that the wind was flowing almost perpendicular to the ridge of hills and the helicopter was approximately 8 nm downwind. The UK Met office concluded from a satellite image taken at 1530 hrs that there were areas of mountain wave activity over western Ireland with some weak activity in the area of the event.

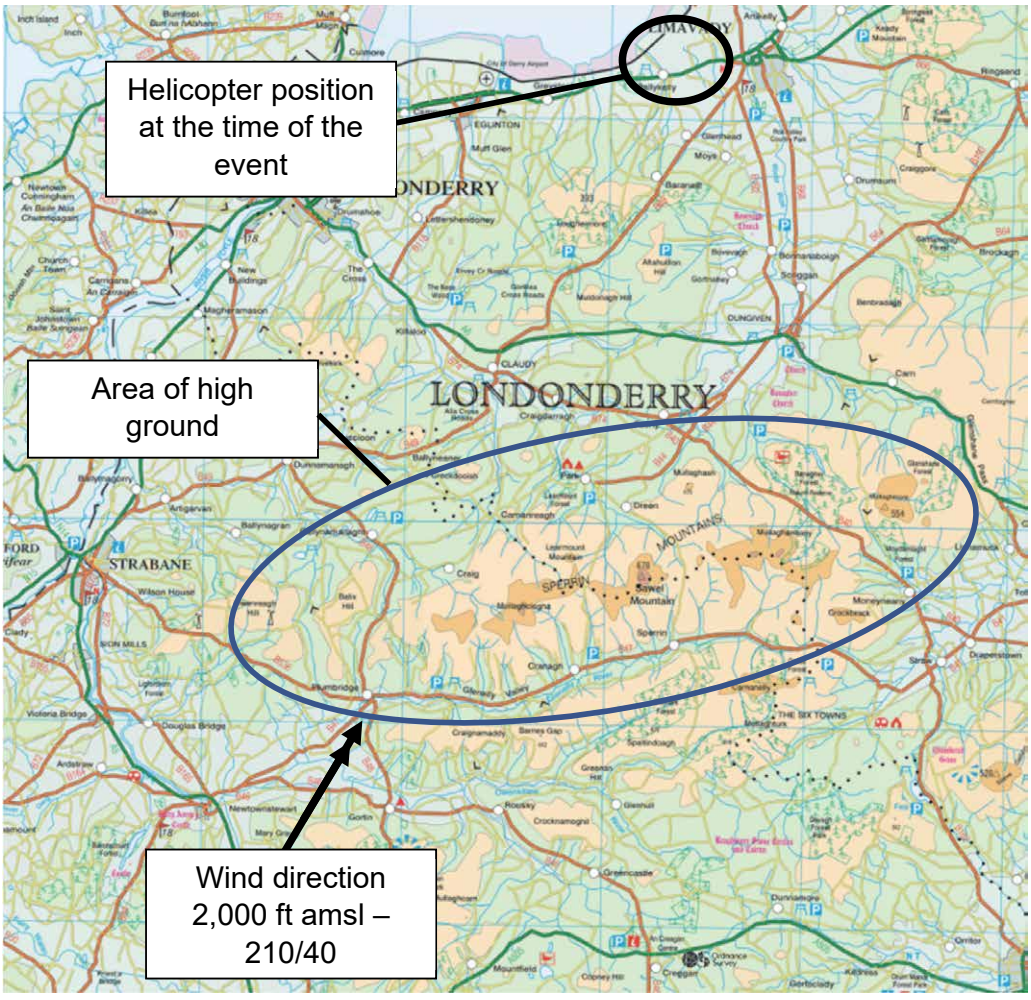

Figure 3

Helicopter position at the time of the event © Ordinance Survey

Mountain waves, although most often associated with much higher terrain, can occur downwind of any hills. They are oscillations as a result of the horizontal airflow being disturbed by the high ground.

An aircraft on approach into the City of Derry Airport had reported windshear on the approach and had conducted a go-around before making a further approach and landing. This had been approximately two hours before EI-ICU encountered turbulence. No other reports from aircraft in the area had been received by ATC.

Other information

Post-flight inspection

After the helicopter was shut down, the commander performed a visual inspection, but he saw no obvious damage to the helicopter. The overspeed event was reported to the operator and an overspeed inspection was conducted, which identified three findings. These were rectified via replacement of components, and the helicopter was returned to service two days after the event flight. The operator also checked the helicopter's HUMS, which monitors the vibration of rotor drive shaft bearings. The HUMS did not show any increase in vibration during the flight.

The operator's findings were shared with the helicopter manufacturer's Field Service Representative. The representative felt that the defects were probably pre-existing and not related to the V_{NE} exceedance.

Analysis

As the helicopter approached a point approximately 5 nm east-northeast of the City of Derry Airport it suddenly encountered severe turbulence. FDR parameters indicate that the pitch of the helicopter varied gradually until a sudden change in windspeed was experienced, when the pitch began to oscillate. The built-in time lag and the method of calculation used to generate the FMS wind speed means that although the FMS data indicates that the wind speed reduction occurred after the initial pitch oscillations (Points A and E in Figure 1), it is likely that this change in wind occurred close to or prior to the oscillations beginning.

The crew described the helicopter pitching up momentarily before pitching down and accelerating. The airspeed reached 175 KIAS which exceeded V_{NE}. The commander reduced the collective and increased the pitch attitude to reduce the speed, with the helicopter climbing 150 ft in this time. The relatively constant groundspeed recorded suggests that the change in airspeed was due to a sudden change in wind conditions.

The crew noted what they felt was an increase in vibration levels in the aircraft after the event and after a discussion decided to divert the City of Derry Airport. The approach and landing were uneventful. The helicopter was inspected by the operator and findings were rectified with the replacement of components. The helicopter was returned to service two days after the event.

It is likely that EI-ICU flew through an area of mountain wave activity associated with the Sperrin Mountains. Flying through this activity created the turbulence which affected the helicopter. There were no visual indications for the crew of the presence of mountain wave activity. Moderate turbulence was forecast for the north of the region in the crew briefing but subsequent analysis of forecasts not available to the crew would have suggested that mountain wave activity was a possibility in Northern Ireland. Observations by satellite taken near the time of the event did show weak activity in the area.

Conclusion

The helicopter encountered unexpected turbulence, probably mountain wave activity, which caused an exceedance of V_{NE}. The crew felt a change in vibration and decided to make a precautionary diversion to the City of Derry Airport.

Inspection of the helicopter after the event resulted in the identification of some defects which were rectified by the replacement of components. The helicopter returned to service two days after the event flight.