Sikorsky S76C, G-SSSE

AAIB Bulletin No: 7/2003	Ref: EW/G2002/12/09	Category: 2.2
INCIDENT		
Aircraft Type and Registration:	Sikorsky S76C, G-SSSE	
No & Type of Engines:	2 Turbomeca Arriel 1S1 turboshaft engines	
Year of Manufacture:	1993	
Date & Time (UTC):	12 December 2002 at 1737 hrs	
Location:	Trent Platform, North Sea	
Type of Flight:	Public Transport	
Persons on Board:	Crew - 2	Passengers - 10
Injuries:	Crew - None	Passengers - None
Nature of Damage:	Nil	
Commander's Licence:	Airline Transport Pilot's Licence	
Commander's Age:	48 years	
Commander's Flying Experience:	7,305 hours (of which 950 were on type)	
	Last 90 days - 104 hours	
	Last 28 days - 44 hours	
Information Source:	Aircraft Accident Report Form submitted by the pilot, a report by the operating company and AAIB inquiries	

Synopsis

On a night departure from the Trent Oil Platform, with the commander as handling pilot, the co-pilot became concerned at a reduction in airspeed coupled with the Vertical Speed Indicator (VSI) indicating a slight descent. After two requests to assume control, the co-pilot executed a positive recovery to regain the normal departure flight profile. As the helicopter was climbing through 500 feet, the commander reassumed control. Following interrogation of the on-board Integrated Health and Usage Monitoring System (IHUMS), which indicated that exceedences had been recorded on six systems, the crew decided to return to their base at Humberside in order for the helicopter to be checked. One conclusion resulting from the operating company in-house investigation was that the helicopter was potentially close to entering a 'vortex ring' state, when the recovery to normal flight was effected.

History of flight

The crew had flown an uneventful series of flights from Humberside Airport in support of North Sea offshore operations. Throughout these flights, the co-pilot in the left seat had been the handling pilot; the final two landings and takeoffs, on oil platforms, had been in the dark. At the completion of these flights, the crew returned to Humberside for a 'rotors running refuel'.

With the commander as handling pilot, G-SSSE then departed, with no passengers, for the Trent Platform. The flight was conducted at 2,000 feet amsl, clear of cloud and was uneventful. On arrival at the platform, the co-pilot assumed handling duties for the landing because the surface wind direction of 100° M/ 25 kt, with some gusts, favoured an approach which afforded the best view of the helipad from the co-pilot's seat. Cloud was overcast and there was no discernible horizon. Touchdown was on a heading of 028° M.

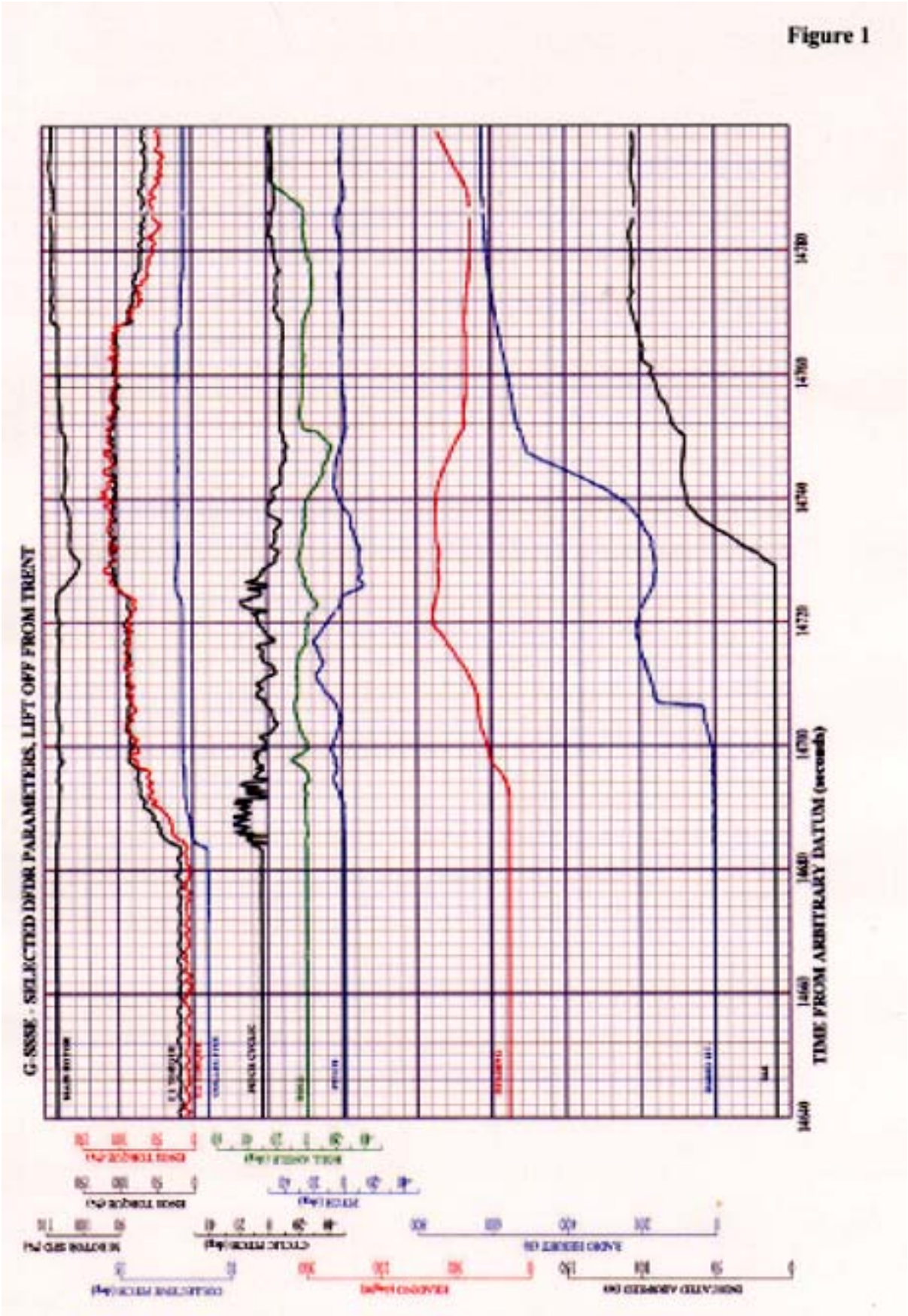
After loading the passengers and their baggage, the commander assumed handling duties for the takeoff. Initially, he lifted into a hover, turned into wind and then began a 'Towering' takeoff. At about 15 feet radio altimeter height above the deck, the commander applied forward cyclic control. The co-pilot considered that G-SSSE made a positive rotation in response to this control input. Both pilots recalled seeing 50 kt indicated on their respective ASIs and the commander saw a momentary indication of 70 kt. In response to this airspeed indication, the commander checked back on the cyclic control. The co-pilot saw the airspeed decreasing and the VSI indicating a slight descent. He called "Airspeed Decreasing" and then "Rate of Descent", and the commander applied more rearward cyclic to arrest the descent. By now, the airspeed was indicating close to zero and the co-pilot called "I have control". He was not aware of any response from the commander and could now see the lights of the platform appear over his left shoulder; the co-pilot's impression was that the platform deck was substantially higher than the helicopter. Aware that the helicopter now appeared to be drifting backwards, he again called "I have control". The commander handed control to the co-pilot, who executed a positive recovery by increasing power, selecting a more nose down attitude, increasing speed and then establishing a climb. As the helicopter passed 500 feet amsl, the commander re-assumed handling duties and levelled G-SSSE at 1,500 feet amsl. The crew then interrogated the IHUMS warning on the Cockpit Display Unit (CDU) and discovered that exceedences had been recorded on six systems. They decided to return to Humberside for the helicopter to be checked and informed the passengers of this decision. An uneventful run-on landing was made at Humberside.

Flight recorder information

No information was available from the Cockpit Voice Recorder (CVR), as it was overwritten by the time the investigation was initiated.

Selected parameters from the Digital Flight Data Recorder (DFDR), produced by the AAIB, are shown in Figure 1. This indicated that G-SSSE lifted into a low hover for about 6 seconds, during which time the pitch attitude remained between approximately 3° and 7° nose-up and the heading changed from 025° M to 050° M. Over the next six seconds, the radio height increased steadily to 31 feet with the pitch attitude decreasing to about 2° to 3° nose-up and the heading changing from 050° M to 068° M. Over the next second, the radio height increased to 160 feet, with the pitch attitude increasing, as the aircraft crossed the boundary of the deck. During the subsequent 5 seconds, the radio height slowly increased to 175 feet, with the pitch attitude reaching 17° nose-up and the heading changing to 080° M. The pitch attitude then reduced momentarily to 12° nose-up, before increasing to 19° over the next six seconds. Heading increased further to 110° M and the radio height reached 210 feet. At this point, the pitch started to reduce and reached 0° after 8 seconds; the aircraft descended to 180 feet and stabilised on a heading of 123° M. The collective pitch was increased and the engine torques increased to approximately 107%. Pitch was then reduced to 15° nose-down. Up to this point, there was no indication of airspeed above the recording cut-off level of 10 kt. However, the airspeed as sensed by the DFDR uses an independent transducer, which in some installations can be regarded as unreliable below about 30 kt, and would not have recorded the actual airspeed displayed to the pilots.

Figure 1



Then, as the aircraft descended to 160 feet radio height, the DFDR recorded airspeed started to register and the main rotor speed reached its minimum value of 100%, with heading remaining constant. Airspeed then increased quickly to 70 kt and radio height increased to 500 feet. At that height, the rate of climb reduced and the airspeed further increased before the aircraft climbed away at approximately 0° pitch attitude and turned left onto a heading of 085° M.

Engineering information

After landing, engineering interrogation of the IHUMS card was inconclusive and so DFDR readings were consulted. The recorded values for engine torque, at 99% (No 1) and 122.4% (No 2), and gas generator speed, at 102.1% (No 1) and 102.3% (No 2), were within the 2.5 minute rating limit but the T4 temperature limit of 885°C, for both engines, had been exceeded at 900°C (No 1) and 913°C (No 2). The main gearbox torque and output torque were both within their respective limits. Maintenance action detailed in the Maintenance Manual was therefore completed for an overtemperature event and, as no faults were found, the helicopter was returned to service.

However, after three days of uneventful flying, the engine manufacturer requested that maintenance inspections be carried out for an overtorque event; this involved the removal of No 2 engine module 5. No faults were found and a successful post maintenance air test was completed before G-SSSE returned to service.

Operational information

The commander was dual qualified, operating both the Sikorsky S76 and the Eurocopter AS365N. In the 28 days prior to the incident, he had flown 7 hours on the AS365N and 38 hours on the S76. Throughout that period, he had recorded a total of 19 hours instrument flying on the S76. At the time of the incident, the commander had been on duty for 6 hours following a rest period of 26 hours.

The co-pilot was also dual qualified, operating both the S76 and AS365N. He had a total flying experience of 1,600 hours, of which 502 hours were on the S76. In the 28 days prior to the incident, he had flown 31 hours on the AS365N and 14 hours on the S76. Throughout that period, he had recorded a total of 4 hours instrument flying on the S76. At the time of the incident, the co-pilot had been on duty for 6 hours.

Following the incident, the company Flight Safety Officer (FSO) flew with another crew, in similar visibility conditions, to evaluate the lighting on the Trent Platform. He considered that the platform was brightly lit and that there would have been a marked contrast for the incident crew lifting off at night with an overcast cloud base. Under these conditions, it was not possible to see the surface of the sea. He also confirmed that there was no fixed installation or any 'Oil Rig' located in the direction of the incident departure. This meant that the crew of the incident departure had no visual reference in that direction.

The company procedure for a 'Towering' departure would be for the handling pilot to lift into a low hover. Once stable, he would increase collective pitch to establish a vertical climb, whilst maintaining his geographical position over the helideck. At 15 feet radio altimeter height, the non-handling pilot would call the height and this would be the signal for the handling pilot to select a nose-down attitude of 10 to 15° to accelerate away. The subsequent climb would be made at an airspeed of at least 74 kt (single-engine climb out speed).

Discussion

The crew were qualified and well rested for the incident flight and there were no unserviceabilities detected with G-SSSE prior to the incident. Although the conditions were such that this was a demanding manoeuvre, the operation was familiar to the crew and the commander, as handling pilot, had completed similar manoeuvres many times. However, on departure the aircraft entered an unexpected and hazardous situation, which caused the co-pilot to take control. The Operating Company flight safety personnel investigated this incident to identify possible causal factors. One of their conclusions was that the helicopter was potentially close to a vortex ring state when recovery action was taken.

Without CVR evidence, the recollection of the crew was important in establishing the exchange of information between the two pilots during the incident. Additionally, the DFDR was vital in quantifying the aircraft parameters.

Both pilots considered that the departure was normal until just after a nose-down attitude was selected at about 30 feet. Both pilots described the selection of the nose-down attitude as a positive manoeuvre but the pitch attitude of the helicopter during this rotation did not go below 0° nose down, compared to the normal target of 10° to 15°. Then, with an airspeed of 50 kt noted by both pilots and called by the co-pilot, the commander raised the nose of the helicopter to initiate a climb. Evidence from the DFDR, however, was that the airspeed was unlikely to have exceeded 10 kt and, with a surface wind of 100°/25 kt in that condition, the helicopter would have been travelling in a rearward direction. With the co-pilot confirming a rate of descent, it was obvious that positive correction action was required. There was a short delay following the initial call from the co-pilot that he wanted to take control. The commander was still trying to evaluate the instrument information but the co-pilot could see the platform close to the left side of the helicopter. The co-pilot had a much clearer appreciation of the potential dangers of the developing situation and made a correct and positive move to assume control; although the co-pilot considered that the helicopter was lower than the platform deck, DFDR evidence indicated that the helicopter always remained above this level. Sensibly and in accordance with two crew procedures, the commander handed over control. The subsequent recovery manoeuvre was positive. Once G-SSSE was established at a safe altitude, the crew evaluated the situation. The helicopter appeared serviceable but, with indications that some system parameters had been exceeded, the commander made the correct decision to recover to Humberside Airport for a full examination.

There was some confliction between the nose-down attitude during the rotation of the 'Towering' takeoff as recalled by both pilots, who described it as positive, and the DFDR evidence which showed that it was at least 10° less than normal. This may be an indication that neither pilot was referring to the primary attitude instrument sufficiently during the rotation phase. Both pilots were also certain that their respective ASIs indicated at least 50 kt, whereas the DFDR recorded that the airspeed remained below 10 kt until the pitch attitude had been lowered below 10° nose down for some two to three seconds. This anomaly could not be resolved. Post incident checks of the ASI sources and instrumentation revealed no faults. Additionally, the DFDR airspeed appeared accurate during the subsequent flight of G-SSSE following the incident. The performance of the helicopter during the incident would also indicate that the airspeed as recorded by the DFDR was accurate.

The commander stated that he turned the helicopter into wind during the initial low hover. However, DFDR information indicated that the helicopter was turning right at a fairly constant rate from initial lift-off up to about when the co-pilot took control. This continual movement over a period of about 28 seconds could have contributed to some spatial disorientation in the handling pilot. The co-pilot reportedly made no comment during the takeoff of this change in heading.

Follow-up action

Following the incident and investigation, the company conducted a review of their procedures and training to identify possible shortcomings and improvements. Amongst other aspects, this included the importance of the handling pilot selecting and maintaining the correct attitude and heading during night departures and for the non-handling pilot to closely monitor and call any divergence.