SOUTH AFRICAN CIVIL AVIATION AUTHORITY

Section/division **Accident and Incident Investigations Division** Form Number: CA 12-12a

AIRCRAFT ACCIDENT REPORT AND EXECUTIVE SUMMARY

				Reference:	CA18/2/3/9432
Aircraft Registration	ZS-RBS	**Date of Accident**	17 April 2015	**Time of Accident**	1230Z
Type of Aircraft	Robinson R22 Beta		**Type of Operation**	Commercial	
Pilot-in-command Licence Type	Commercial (H)	**Age**	41	**Licence Valid**	Yes
Pilot-in-command Flying Experience	Total Flying Hours	7825.2		Hours on Type	3998.5
Last point of departure	Grahamstown aerodrome (FAGT): Eastern Cape province				
Next point of intended landing	Private air strip in Somerset East: Eastern Cape province				
Location of the accident site with reference to easily defined geographical points (GPS readings if possible)					
On a game farm south of Somerset East at GPS Co-ordinates: S32º 54' 56", E025º 21' 31"					
Meteorological Information	Wind direction: 180º at 10kts; Visibility: 10000ft; Cloud base: 8000ft				
Number of people on board	1+1	**No. of people injured**	2	**No. of people killed**	0

Synopsis

The pilot, accompanied by a passenger, was conducting a darting flight at a Somerset East game farm when the accident occurred. The pilot was watching the fourth animal (a springbok) and directing the recovery vehicle when his focus was interrupted by a motor bike rider who was heading towards the herd of springboks. The pilot reported that at the height of approximately 130 feet above ground level (AGL), the helicopter started shaking. This was followed by the warning horn sounding, indicating a low rotor RPM/blade stall. The pilot instantly lowered the collective lever in an attempt to recover the RPM to the green arc, but without success. The helicopter impacted the ground heavily and was destroyed during the accident sequence. The occupants got out of the wreck with minor injuries. Both occupants were later rushed to a nearby hospital for medical assessment but were later released.

The investigation revealed that the cause of the accident was insufficient power available to sustain hover, following an interruption of the pilot’s operational focus.

Probable Cause

The helicopter entered into a vortex ring state during hover out-of-ground effect at a height of approximately 130ft above ground level and the pilot was unable to recover.

Contributing Factor/s

1. Insufficient power available to sustain hover.

2. Induced power coordination as a result of pilot diverting his attention.

IARC Date		Release Date	

AIRCRAFT ACCIDENT REPORT

Name of Owner	: ESCAPE AIRTOURS AND TRANSFERS CC
Name of Operator	: ESCAPE AIRTOURS AND TRANSFERS CC
Manufacturer	: Robinson Helicopter Company
Model	: R22 Beta
Nationality	: South African
Registration Marks	: ZS-RBS
Place	: Game farm near Somerset East with GPS Co-ordinates: S32º54'56", E025º21'31"
Date	: 17 April 2015
Time	: 1230Z

All times given in this report are Co-ordinated Universal Time (UTC) and will be denoted by (Z). South African Standard Time is UTC plus 2 hours.

Purpose of the Investigation:

*In terms of Regulation 12.03.1 of the Civil Aviation Regulations (1997) this report was compiled in the interest of the promotion of aviation safety and the reduction of the risk of aviation accidents or incidents and **not to establish legal liability**.*

Disclaimer:

This report is produced without prejudice to the rights of the CAA, which are reserved.

1. FACTUAL INFORMATION

1.1 History of Flight

1.1.1 The pilot stated that he departed from Grahamstown airport and flew to his destination which was a game farm south of Somerset East. He collected a passenger (darter) and they started to dart springboks. A ground vehicle crew was helping to load the springboks into a vehicle. Three springboks were successfully darted, and after darting the fourth one, the pilot climbed to a height of approximately 130ft AGL to watch the darted animal and to direct the ground vehicle towards its position.

1.1.2 The pilot hovered while watching the animal and during this time he noticed that somebody on a motor bike was about to drive into the herd of springboks. The pilot then diverted his focus and began to communicate with the ground vehicle driver advising him to stop the motor bike rider. The pilot stated that at that point he noticed that the helicopter had started to shudder and he realised it could be entering into a vortex ring state.

1.1.3 The helicopter started vibrating and this was followed by the annunciator warning horn, warning of low main rotor RPM. He instantly lowered the collective lever in an attempt to recover the rotor RPM to the green arc, but was unsuccessful. The pilot further lowered the nose, intending to gain forward speed, but the helicopter did not have sufficient height and it collided heavily with the ground; it was destroyed during the accident sequence. Both occupants of the helicopter sustained minor injuries during the accident sequence.

1.1.4 The accident occurred in daylight conditions at a game farm with GPS co-ordinates: S32º54ˈ56ˈˈ, E025º21ˈ31ˈˈ and a field elevation of 2554 ft above mean sea level (AMSL).

1.2 Injuries to Persons

1.2.1 The pilot and his passenger experienced minor injuries during the accident sequence.

Injuries	Pilot	Crew	Pass.	Other
Fatal	-	-	-	-
Serious	1	-	1	-
Minor	-	-	-	-
None	-	-	-	-

1.3 Damage to Aircraft

1.3.1 The helicopter was destroyed by impact forces during the accident sequence.

The photograph in Figure 1 below shows the damage sustained during the accident sequence.

Figure 1: The condition of the helicopter at the accident site

1.4 Other Damage

1.4.1 None

1.5 Personnel Information

Nationality	South African	Gender	Male	Age	41
Licence Number	0270484272	Licence Type	Commercial H		
Licence valid	Yes	Type Endorsed	Yes		
Ratings	Instructor grade II, Flight test, Test pilot class 2, Night, Cull, Under-sling/ winch				
Medical Expiry Date	31 March 2016				
Restrictions	Corrective lenses				
Previous Accidents	None				

Flying Experience:

Total Hours	7825.2
Total Past 90 Days	138.3
Total on Type Past 90 Days	47.5
Total on Type	3998.5

1.6 Aircraft Information

Airframe

Information extracted from the Robinson Helicopter company website www.robinson**helicopter**.com/r22

1.6.1 The R22 is a light, two-place, single reciprocating-engine helicopter with a semi-rigid two-bladed main rotor and a two-bladed tail rotor. The main rotor has a teetering hinge and two coning hinges; the tail rotor has only a teetering hinge. The normal production variant has skid landing gear. The basic structure is welded chromyl steel tubing. The forward fuselage is made of fiberglass and aluminum with a Plexiglas canopy. The tail cone, vertical and horizontal stabilizers are aluminum. The helicopter has an enclosed cabin with side-by-side seating for a pilot and passenger. The doors may be removed for flight, and this is often done; for example, in photographic flights, or to improve interior cooling in high temperatures or to obtain a saving of 10.4lb in weight.

1.6.2 Instead of having floor-mounted cyclic sticks between the pilot's knees, the R22 uses a unique teetering "T-Bar" control connected to a stick that emerges from the console between the seats. This makes it easier for occupants to enter and exit the cabin and reduces the chance of injury in the event of a hard landing. The teeter bar has a hand grip on both sides that hangs down between the pilots' legs. Thus, if teetered to the right, the right-side pilot would be flying and the left grip would be about 12 inches above the left pilot's lap. R22 flight instructors quickly learn how to fly with their hand in the air. The left part of the bar, left collective control, and left tail rotor pedals can be removed if the occupant in the left seat is not certificated to fly the R22 or if the space is needed for technical or observer duties.

1.6.3 A floor-mounted foot activated push-to-talk switch facilitates intercom communications for the left seat occupant, although some later models may be equipped with a voice-activated intercom system. The helicopter rotor system consists of a two-bladed main rotor and two-bladed anti-torque rotor on the tail, each equipped with a teetering hinge. The main rotor is equipped with two coning hinges. Collective and cyclic pitch inputs to the main rotor are transmitted through pushrods and a conventional swashplate mechanism. Control inputs to the pre-coned tail rotor are transmitted through a single pushrod inside the aluminum tail cone. To ease the pilot's workload, a mechanical throttle correlator adjusts the throttle as the collective pitch control is raised or lowered.

The pilot only needs to make small adjustments by twisting the throttle grip on the collective throughout the flight regime. Later models are also equipped with an electronic governor which works to maintain RPM within normal operating limits (between 97 and 104% RPM); the governor is only active when the engine is running above 80% RPM, and is most effective in normal flight conditions. The governor can be switched on or off with a toggle switch located at the end of the pilot's collective pitch control; when the governor is not engaged, a yellow caution light glows on the instrument panel.

Type	R22 Beta	
Serial Number	4050	
Manufacturer	Robinson Helicopter Company	
Date of Manufacture	2006	
Total Airframe Hours (At time of Accident)	1274.1	
Last MPI (Date & Hours)	8 March 2015	1262.4
Hours since Last MPI	11.7	
C of A (Issue Date)	25 October 2012	
C of A (Expiry Date)	24 October 2015	
C of R (Issue Date) (Present owner)	10 April 2013	
Operating Categories	Part 127	

Engine:

Type	Lycoming O-360-J2A
Serial Number	L-40409-J2A
Hours since New	1274.1
Hours since Overhaul	TBO not yet reached

NB: Both main and tail rotor blades are given a retirement time (RT) per blade functional

Main Rotor:

Type	RHC A016-4
Serial Numbers	5741C & 5751C
Hours since New	1612.1hrs
Hours since Overhaul	RT not yet reached 2200 CRT

Tail Rotor:

Type	RHC A029-2
Serial Numbers	4764 & 0744
Hours since New	939.2hrs & 1262.4hrs
Hours since Overhaul	RT not yet reached 2200 CRT

1.6.4 Aircraft documentation was studied and reviewed: these documents included maintenance records, certificates and service bulletin letters. The information in these documents provides a record of how the aircraft was equipped and indicates the maintenance procedures. All service bulletins published by the engine and aircraft manufacturer were adhered to by the AMO. A further study of the most recent mandatory periodic inspection, at 1262.4 hours, was conducted; this indicated that the helicopter was maintained in accordance with existing approved procedures.

1.7 Meteorological Information

1.7.1 Meteorological information as obtained from the South African Weather Service website:

Wind direction	180º	Wind speed	10 kts	Visibility	10000 ft
Temperature	17ºC	Cloud cover	Overcast	Cloud base	8000 ft
Dew point	None				

1.8 Aids to Navigation

1.8.1 The helicopter was equipped with the standard factory-fitted navigational equipment approved by the Regulator. There were no recorded defects to the navigational equipment prior to the flight.

1.9 Communications.

1.9.1 The helicopter was equipped with one VHF (very high frequency) radio approved by the Regulator. There were no recorded defects regarding the communication equipment prior to the flight.

1.10 Aerodrome Information

1.10.1 The accident occurred on a game farm south of Somerset East during an animal darting operation. The terrain where the helicopter crashed is an open uneven surface with many anthills: GPS co-ordinates: S32º 54' 56", E025º 21' 31"

1.11 Flight Recorders

1.11.1 The helicopter was not equipped with a flight data recorder or a cockpit voice recorder. Neither of these is required by the relevant aviation regulations.

1.12 Wreckage and Impact Information

1.12.1 The area where the helicopter crashed is an open uneven surface with many anthills. Ground marks were made during the post-impact sequence and these were identified and accounted for to obtain information on the accident sequence. The wreckage distribution was located within a radius of approximately 20 metres.

The picture below provides the Google Map view of the terrain in the region of the accident.

Figure 2: Google Map view of the terrain in the region of the accident site

Figure 2: The accident site terrain

1.12.2 During game darting, the helicopter experienced loss of main rotor RPM, followed by a loss of height whilst at a hovering configuration. The pilot attempted to arrest the rate of descent by initiating the recovery procedure. He then pushed the helicopter nose forward with the cyclic control to gain lift but was unsuccessful. Because of the high rate of descent he realised that impact with the ground was imminent and he pulled the nose up to avoid a nose-first collision with the ground.

In the ensuing investigation, the ground marks resulting from the accident were studied. It was found that the tail boom of the helicopter first made a hard contact with the ground and this was followed by an impact by the skid which was hard enough to break it off. The main rotor severed the tail boom during the hard impact. The helicopter continued to roll over and was destroyed during the post-impact sequence.

Figure 3: Ground marks that show the sequence of impact

1.12.3 The damage to the main rotor was in consistent with the engine producing power at the time of impact. The tail rotor blades assembly was intact with the aft section of the tail boom, which was several meters from the main wreckage. The damage on the tail rotor blade was in consistent with damages while engine producing power.

1.13 Medical and Pathological Information

1.13.1 The two occupants sustained minor injuries during the accident sequence which was declared after the injury assessment in the nearby local hospital.

1.14 Fire

1.14.1 There was no pre- or post-impact fire reported during the accident sequence.

1.15 Survival Aspects

1.15.1 The accident was considered to be survivable because of the low kinetic energy during impact. The helicopter is fitted with shoulder and harness which the occupants were making use of; these did not fail during the accident.

1.16 Tests and Research

1.16.1 Tests were not considered to be necessary for this accident investigation. The helicopter was in a good working condition.

1.16.2 Flight Control System

Information is extracted from: NTSB/SIR-96/03 PB96-917003: Special Investigation Report R22: Loss of main rotor control accidents. See https://app.ntsb.gov/doclib/safetystudies/SIR9603.pdf

Flight Control Responsiveness

The Robinson Helicopter Company, many R22 pilots, and some test pilots have indicated that the flight controls on the R22 are more sensitive than on other light helicopters. Thus, the R22 is highly responsive in pitch and roll to small flight control inputs. In a memo dated February 13, 1984 from an FAA helicopter test pilot to the FAA Supervisor, Flight Test Section, ANM-176W, the writer stated that: "The aircraft in general is very quick. The aircraft reaction per inch of control input is high, making pilot-induced oscillations (PIO) and over-controlling tendencies much more noticeable than in other helicopters." Furthermore, a 1994 report on a special certification review (SCR)12 by the FAA stated that: "Informal interviews were conducted with individuals from the operational community who were familiar with the R22. These individuals, who consisted of FAA flight standards pilots, FAA certification test pilots and operators of the R22, frequently expressed the opinion that this helicopter is very sensitive, requiring the pilots to be attentive at all times.

However, those individuals interviewed stated that the aircraft did not have any unusual handling characteristics." Some pilots have stated that this greater responsiveness to control inputs causes R22 pilots to be highly alert, sharpening their piloting skills. However, the sensitivity of the R22 flight controls suggests that the greater responsiveness combined with limited pilot skills, proficiency, or alertness could be a factor in some of the 31 accidents that the Safety Board reviewed. The Board was unable to compare the response rates of the R22 to cyclic control input with the response rates of other helicopters because the data in the flight regimes of importance to this investigation for other helicopters were not readily available. In fact, such data are difficult to obtain. Flight tests and computer simulations, which are quite extensive, are the best source of such data, and because of the lack of an FAA requirement for such data, they are not always available.

The Safety Board compared flight control response rate data of the R22 to Department of Defense helicopter military specification MIL-H-8501A requirements. The data showed that although the R22 is very responsive, it could meet the military's standards for flight control response during instrument approaches.

Exceeding power limits can be fatal

Information extracted from the R22 & R44 Safety alert issued: 20 December 2004.

See http://www.robinsonheli.com/service_library/

safety_alerts /r22_r44_sa_exceeding_power_limits_can_be_fatal.pdf

The rightmost bottom gauge is the Manifold Pressure gauge. The pilot uses this gauge to determine the throttle setting. In the R22 the pilot calculates a maximum manifold pressure, taking into account the current temperature and pressure. By calculating this maximum and not exceeding it, the pilot derates the engine from the 160 horsepower which is actually available, to the derated maximum of 124 horsepower (continuous) or 131 horsepower (for up to 5 minutes). Derating the engine prolongs its useful life, making it more reliable than if full power were being used on a regular basis. It also means that full power is available to a higher altitude, just as if the engine were turbocharged.

Figure 4: The manifold pressure gauge

Some pilots continue to exceed engine manifold pressure limits. The engine is significantly derated from full-throttle power to provide a margin for altitude performance and for momentary emergencies. Pilots must monitor manifold pressure to avoid exceeding limits. Exceeding power limits has caused failures of several rotor blades and drive systems.

At standard sea level conditions, the maximum continuous manifold pressure limit is 22.4 inches for the R22 Beta. The manifold pressure limits are even less at higher altitude or lower temperatures. Operation above these limits may produce fatigue damage in rotor blades or drive system components which can result in a catastrophic in-flight failure.

The manifold pressure of the helicopter type Beta (0-320-B2C Engine)

Yellow arc: 21.0 to 25.2 in. Hg. Red line: 25.2 in. Hg

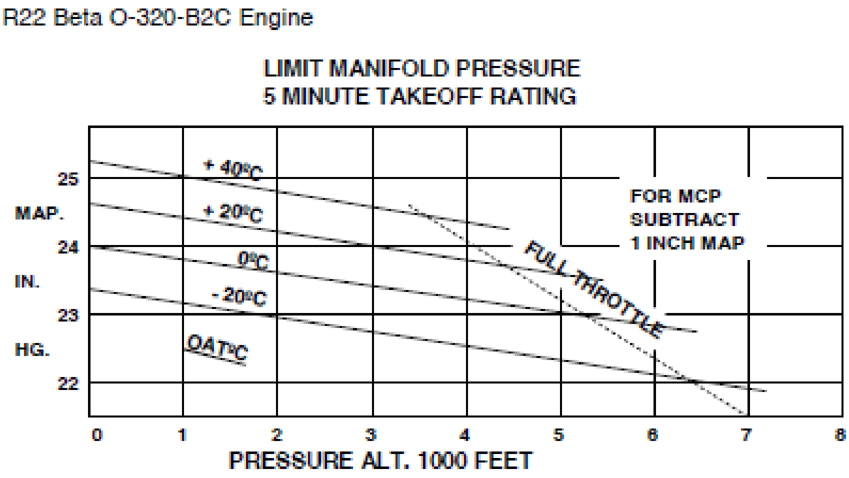

Figure 5: Manifold limitation

Warnings:

1. Never exceed limit takeoff power.
2. Never exceed maximum continuous power in forward flight.
3. Never exceed maximum gross weight limit.

1.16.3 <u>Game darting</u>

Reference: *What does it really take*? Written by John Bassi, as published in the SA-Flyer magazine, April 2004.

During a game darting flight, the helicopter is manoeuvred among the obstacles. Many instances of hovering are conducted when positioning the animals and guiding them. Flying the Robinson R22 helicopter calls for a skilled and experienced operator in this type of game darting operation. The pilot is the person responsible for the overall safety of the flight although all personnel on board must also ensure safety at all times. The manoeuvres executed must always be within the flight envelope.

1.17 Organizational and Management Information

1.17.1 This was a commercial flight operation G10 under an AOC guided by Part 127 which was issued on 13 April 2014 and had expired on 13 April 2015

1.17.2 The maintenance record indicates that the helicopter was maintained by an AMO approved by the Regulator and in accordance with approved procedures. The last mandatory periodic inspection was conducted on 8 March 2014.

1.18 Additional Information

1.18.1 According to the pilot's response in the CA 12-03 Pilot Questionnaire, the manifold pressure was observed to be 21 inches. Control of a helicopter during an animal darting operation calls for much co-ordination during manoeuvring. This subjects the helicopter into variable pitch changing and adjustments to power required.

1.18.2 The pilot stated that the helicopter was entering into a vortex ring state.
The information below is extracted from: Rotorcraft Flying Handbook, Chapter 11

Settling With Power (Vortex Ring State)

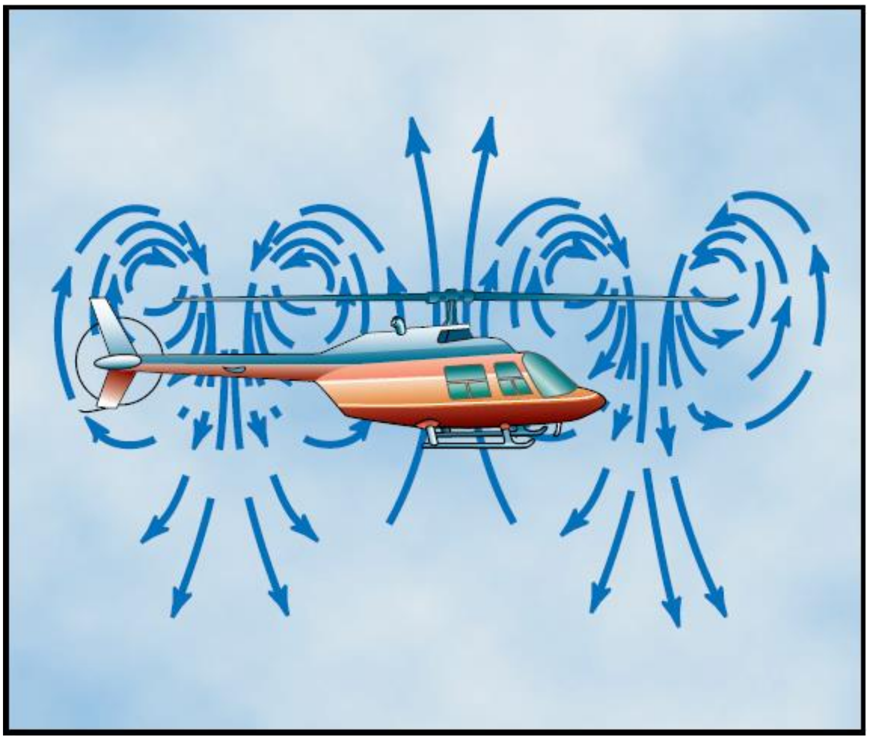

Figure 7: The vortex ring state

The term "vortex ring state" refers to an aerodynamic condition in which a helicopter may be in a vertical descent with the application of between 20 percent and maximum power, and little or no climb performance. The term "settling with power" arises from the fact that the helicopter keeps settling even though full engine power is applied. In a normal out-of-ground-effect (OGE) hover, the helicopter is able to remain stationary by propelling a large mass of air down through the main rotor. Some of the air is recirculated near the tips of the blades, curling up from the bottom of the rotor system and re-joining the air entering the rotor from the top. This phenomenon is common to all air-foils and is known as tip vortices. Tip vortices generate drag and degrade air-foil efficiency.

For as long as the tip vortices are small, their only effect is a small loss in rotor efficiency. However, when the helicopter begins to descend vertically, it settles into its own downwash, which greatly enlarges the tip vortices. In this vortex ring state, most of the power developed by the engine is wasted in circulating the air in a doughnut pattern around the rotor. In addition, the helicopter may descend at a rate that exceeds the normal downward induced-flow rate of the inner blade sections. As a result, the airflow of the inner blade sections is upward relative to the disk. This produces a secondary vortex ring in addition to the normal tip vortices. The secondary vortex ring is generated about the point on the blade where the airflow changes from up to down. The result is an unsteady turbulent flow over a large area of the disk. Rotor efficiency is lost even though power is still being supplied from the engine.

A fully developed vortex ring state is characterised by an unstable condition in which the helicopter experiences uncommanded pitch and roll oscillations, has little or no collective authority, and achieves a descent rate that may approach 6,000 feet per minute (fpm) if allowed to develop.

A vortex ring state may be entered during any manoeuvre that places the main rotor in a condition of descending in a column of disturbed air and low forward airspeed. Airspeeds that are below translational lift airspeeds are within this region of susceptibility to settling with power aerodynamics. This condition is sometimes seen during quick-stop type manoeuvres or during recovery from autorotation.

The following combination of conditions is likely to cause settling in a vortex ring state in any helicopter:

- A vertical or nearly vertical descent of at least 300 feet per minute. (Actual critical rate depends on the gross weight, RPM, density altitude, and other pertinent factors.)

- The rotor system must be using some of the available engine power (20–100 percent).
- The horizontal velocity must be slower than effective translational lift.

Some of the situations that are conducive to a settling with power condition are: any hover above ground effect altitude; specifically attempting to hover OGE at altitudes above the hovering ceiling of the helicopter; attempting to hover OGE without maintaining precise altitude control; pinnacle or rooftop helipads when the wind is not aligned with the landing direction; and, downwind and steep power approaches in which airspeed is permitted to drop below ten knots depending on the type of helicopter. When recovering from a settling with power condition, the pilot first tends to try to stop the descent by increasing collective pitch. However, this only results in increasing the stalled area of the rotor, thereby increasing the rate of descent. Since inboard portions of the blades are stalled, cyclic control may be limited.

Recovery is accomplished by increasing airspeed, and/or partially lowering collective pitch. In many helicopters, lateral cyclic combined with lateral tail-rotor thrust will produce the quickest exit from the hazard assuming that there are no barriers in that direction. In a fully developed vortex ring state, the only recovery may be to enter autorotation to break the vortex ring state. Tandem rotor helicopters should manoeuvre laterally to achieve clean air in both rotors at the same time. For settling with power demonstrations and training in recognition of vortex ring state conditions, all manoeuvres should be performed at an altitude of 2000–3000 feet AGL to allow sufficient altitude for entry and recovery.

To enter the manoeuvre, come to an OGE hover, maintaining little or no airspeed (any direction), decrease collective to begin a vertical descent, and as the turbulence begins, increase collective. Then allow the sink rate to increase to 300 fpm or more as the attitude is adjusted to obtain airspeed of less than ten knots. When the aircraft begins to shudder, the application of additional up collective increases the vibration and sink rate. As the power is increased, the rate of sink of the aircraft in the column of air will increase. If altitude is sufficient, it can be spent in the vortices to enable the pilot to develop a healthy knowledge of the maneuver.

However, helicopter pilots would normally initiate recovery at the first indication of settling with power. Recovery should be initiated at the first sign of vortex ring state by applying forward cyclic to increase airspeed and/ or simultaneously reducing collective. The recovery is complete when the aircraft passes through effective translational lift and a normal climb is established.

Common Errors

1. Too much lateral speed for entry into settling with power.
2. Excessive decrease of collective pitch.

1.19 Useful or Effective Investigation Techniques

1.19.1 None

2. ANALYSIS

Man

2.1 The pilot holds a valid commercial helicopter licence and was qualified and rated for the flight, with the helicopter type endorsed.

2.2 The pilot was familiar with game darting operations and was also familiar with the limitations of the helicopter type, especially when manoeuvring in such operations. The fact that the pilot decided to ascend to a height of approximately 130 ft AGL to hover in order to observe the recovery of the animal, indicates that the helicopter was operating at a low height above ground level prior to the accident.

Machine

2.3 The helicopter had a valid certificate of airworthiness. According to the maintenance records, the helicopter was maintained and equipped in accordance with the approved procedures. This was done by an AMO approved by the Regulator. The helicopter had operated for approximately 11.7 hours since the last mandatory periodic inspection. However the AOC was not valid at the time of the flight as it had expired on 13 April 2015.

2.4 The pilot stated that he was at approximately 130ft AGL and hovering in order to watch the darted springbok and direct the ground vehicle to its position; at that point his focus on flying the helicopter was interrupted by a person on a motor bike who was driving towards the herd of springboks. He then initiated communication with the driver of the ground vehicle and advised him to stop the biker from riding towards that herd. The helicopter started shaking and was this followed by a loss of engine RPM that led to a stall, resulting in a descent followed by impact with the ground.

Thus, the pilot's focus was distracted while he paid attention to the person on the motor bike and to alerting the driver of the ground vehicle. At that point the pilot felt the helicopter shaking and so he attempted to correct the situation. The helicopter throttle and collective co-ordination control are manually adjusted; for any inputs in either control the pilot is required to compensate for the other. The helicopter is known to be sensitive to controls input. The pilot, by not monitoring his adjustments inputs, might have affected the engine power and the main rotor pitch by falling below the required manifold pressure unaware. Under those conditions the helicopter lost height because of insufficient lift generated to sustain hover.

2.5 The helicopter was hovering in a position where it was out-of-ground effect. Because the pilot was not monitoring engine power to sustain lift, the helicopter entered into a vortex ring state in which the available power could not sustain hover and this caused the helicopter to lose height. As stated above, this model of helicopter is very sensitive to control inputs and the wrong power and pitch co-ordination occurred. The pilot then dropped collective instantly with the cyclic pushed forward to gain forward speed for recovery of both the main rotor and engine power; unfortunately this response was unsuccessful. The pilot then noticed that impact with the ground was imminent and so he pulled the nose up to avoid a nose-first collision with the ground. However, because the helicopter had insufficient height together with a high sink rate, the helicopter impacted the ground hard, with the tail first. This was followed by impact of the skid gear with the ground, which was heavy enough to break it off on impact. If a pilot is to recover from a vortex ring state then sufficient height, approximately 2000 ft, is needed.

Mission

2.6 The purpose of the flight was to dart springboks and four had already been darted when the accident occurred. It was not clear how many animals were supposed to be darted on the day but the accident brought the darting operation to a halt.

3. CONCLUSION

3.1 Findings

3.1.1 The pilot was qualified and licenced for the flight in accordance with the existing regulatory procedures and he had a valid medical certificate.

3.1.2 The helicopter was maintained and equipped in accordance with regulatory procedures; this was done by an approved AMO with a valid certificate of airworthiness.

3.1.3 The helicopter was being used to conduct game darting at the time of the accident.

3.1.4 The ambient air temperature was not considered to be a contributing factor to the accident.

3.1.5 The flight controls of the helicopter type have been proven to be very sensitive, when compared to other light helicopters. The R22 is highly responsive in pitch and roll to small flight control inputs.

3.1.6 The helicopter experienced a vortex ring state at a restricted height during operation.

3.1.7 The pilot did not monitor the helicopter power input prior to the accident; this was because the pilot's attention was distracted by a person riding a motor bike towards the herd of springbok and so the pilot lost focus on operating the helicopter.

3.1.8 The operation was illegal due to an expired AOC which was on 13 April 2015.

3.1.9 The weight of the helicopter during the operation was not considered to be a contributing factor to the accident.

3.2 Probable Cause/s

3.2.1 The helicopter entered into a vortex ring state during hover out-of-ground effect at a height of approximately 130ft above ground level and the pilot was unable to recover.

3.3 Contributing Factor/s

3.3.1 Insufficient power available to sustain hover

3.3.2 Induced power coordination as a result of pilot diverting his attention

4. SAFETY RECOMMENDATIONS

4.1 None

5. APPENDICES

5.1 None