FINAL INVESTIGATION REPORT
ON ACCIDENT TO BELL 206 L4
HELICOPTER VT-PHD
AT KURGIAKH ON 03 OCTOBER 2018.

GOVERNMENT OF INDIA
MINISTRY OF CIVIL AVIATION
AIRCRAFT ACCIDENT INVESTIGATION BUREAU

FOREWORD

In accordance with Annex 13 to the Convention on International Civil Aviation Organization (ICAO) and Rule 3 of Aircraft (Investigation of Accidents and Incidents), Rules 2017, the sole objective of the investigation of an accident/serious incident is prevention of accidents and incidents and not to apportion blame or liability. The investigation conducted in accordance with the provisions of the above said rules is therefore separate from any judicial or administrative proceedings to apportion blame or liability. This document has been prepared based upon the evidences collected during the investigation and opinion obtained from the experts. Consequently, the use of this report for any purpose other than for the prevention of future accidents or incidents could lead to erroneous interpretations.

INDEX

FINAL INVESTIGATION REPORT ON ACCIDENT TO
Pawan Hans Limited BELL 206 L4 HELICOPTER VT-PHD
AT KURGIAKH ON 03 OCTOBER 2018

1.	Aircraft	Type	BELL 206 L4
		Nationality	Indian
		Registration	VT-PHD
2.	Owner		Pawan Hans Limited
3.	Operator		Pawan Hans Limited
4.	Pilot		CPL(H) Holder
	Extent of Injuries		NIL
5.	No. of Passengers on board		3
	Extent of Injuries		NIL
6.	Date & Time of Accident		03 October 2018
7.	Place of Accident		Kurgiakh (Altitude 14268 feet)
8.	Last point of Departure		Padum
9.	Intended landing place		Shinkun LA
10.	Type of Operation		Non-Scheduled
11.	Phase of operation		In flight / touchdown
12.	Damage to the helicopter		Substantial

(All the timings in this report are in UTC unless otherwise specified)

SYNOPSIS

On 03.10.2018, Pawan Hans Limited BELL 206 L4 Helicopter VT-PHD met with an accident during landing. The helicopter was carrying out search and rescue flight. The flight was under the command of a CHPL holder. There were 4 persons on board including the PIC. The helicopter suffered substantial damages. There was no injury to any person.

Director General, AAIB appointed Sh. R. S. Passi, Director, AAIB as Investigator – In – Charge & Ms. Shilpy Satiya, ADAS, AAIB, as Investigator to investigate into the probable cause(s) of the accident, vide Order No. INV.11011/06/2018-AAIB dated 15th October 2018 under Rule 11 (1) of Aircraft (Investigation of Accidents and Incidents), Rules 2017.

The helicopter was on search & rescue mission (Density altitude 14000 feet). PIC, after seeing some people decided to land. During landing, as the tail rotor had reached its design limits at high altitude and tail rotor thrust was not sufficient to maintain directional control; the helicopter encountered LTE (Yaw). PIC decided to immediately put the helicopter down on ground by reducing collective pitch. Though he could arrest the yaw but in the bargain, ended up with a very hard landing. The tail portion impacted the rocky irregular edge and the helicopter suffered substantial damages.

The probable cause given is "During hover, prior to landing in valley, the helicopter had suffered avoidable loss of tail rotor effectiveness (LTE), which PIC could not control effectively resulting in severe heavy landing."

The report contains following recommendation to obviate the occurrence of such accidents in future: -

> "PHL should develop, a quantifiably auditable robust system, to ensure that the laid down DGCA regulations and in-house procedures of PHL concerning procedural safety, risk analysis & mitigation, operational discipline are meticulously followed."

1 FACTUAL INFORMATION

1.1 History of Flight

On 03.10.2018, Pawan Hans Limited (PHL) BELL 206 L4 Helicopter VT-PHD met with an accident during landing. The helicopter was carrying out search and rescue flight. The flight was under the command of a CHPL holder. There were 4 persons on board including the PIC. The helicopter suffered substantial damages. There was no injury to any person.

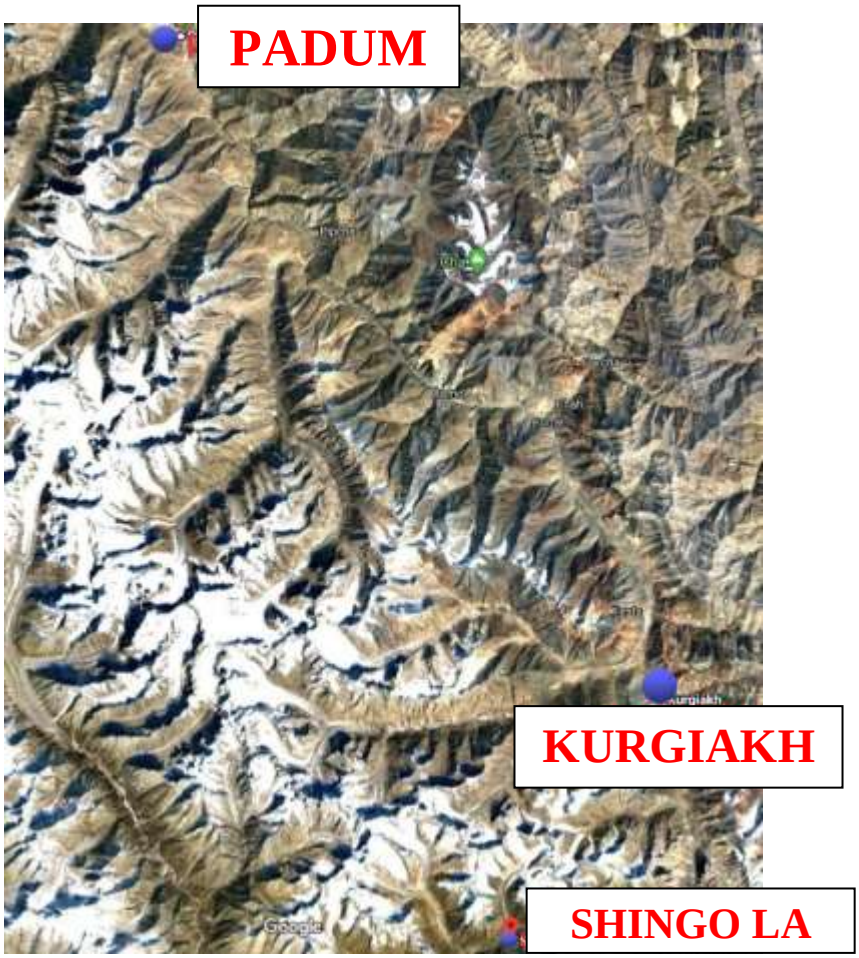
Pawan Hans Limited (PHL) has established 3 bases to conduct flights in the hilly region, for the Government of J&K. Accordingly, BELL 206 L4 helicopter (VT-PHA) was positioned at Leh base, to execute flights for the purposes of Promotion of Tourism, Medical evacuation, Search and Rescue etc. The nodal officer, Government of J&K, depending on the requirement requisitioned the helicopter. While helicopter VT-PHA was undergoing 100 hrs Inspection at Srinagar (Maintenance Base), a message was received that Deputy Commissioner Kargil required a helicopter at Leh for search & rescue purposes in the area of Kurgiakh. Helicopter (VT-PHD) which was at Jammu was ferried from Jammu to Srinagar on 2nd Oct 2018.

On 3rd Oct 2018, VT-PHD was flown from Srinagar to Padum by the PIC. There was no passenger except an engineer on board. The flight from Srinagar to Padum was uneventful. The helicopter landed at Padum around 11:30 hrs. The engine was shut down and the engineer de-boarded the helicopter. The helicopter was refuelled (370 pounds) and after carrying out visual inspection by the engineer, it was offered for flight.

PIC accepted the helicopter and at 1250 hrs IST, he along with 03 J&K Government officials took off from Padam for a search & rescue sortie. The helicopter was supposed to search till Shinkun La and come back. No person was seen on the route and the PIC decided to return to Padum.

As per the PIC,

> "While returning to Padum, he saw a party of three persons walking back on foot track close to Kurgiakh village. He decided to land at Kurgiakh village to get the exact picture.



Accordingly, he did a high and low recce of the landing area followed by an approach into winds. He terminated the smooth approach into a hover in ground effect.

While in the process of touch down, he heard a sudden “THUD” sound in the rear of the helicopter and saw a dark and large fabric like object flying on his left side, on the left side of the helicopter. At that very moment, the helicopter yawed viciously to the right. He recognized this immediately as the symptom of a tail rotor failure probably due to a foreign object hitting the same. The helicopter thereafter started spinning to the right. He controlled the rate of yaw to certain extent by reducing collective pitch immediately. He kept the cabin level and landed the helicopter safely on a flat mountain terrace.”

Around 1500 hrs, the PIC informed Base Manager about the occurrence. It was also informed that tail rotor and tail boom have been damaged. There was no injury to anybody.

Though, helicopter carried out hard landing causing substantial damages to tail portion & skid of the helicopter, but there was no evidence of in-flight soft body impact as claimed by the PIC.

1.2 Injuries to Persons

Injuries	Crew	Passengers	Others
Fatal	NIL	NIL	NIL
Serious	NIL	NIL	NIL
Minor/ None	01	03	NIL

1.3 Damage to Aircraft

Both skids buckled sideways. Both cross tubes bowed down resulting in huge reduction of ground clearance of the cabin floor

Tail boom dented and cracked at two places. Tail boom buckled downwards from the tail boom joint.

Both tail rotor blades sheared off identically at about 150 mm from tip of the blade.

1.4 Other Damage

Nil

1.5 Personnel Information

1.5.1 Pilot – In – Command

Age	54 years
License	CPL (H)
Date of Issue	25 March 2010
Valid up to	24 March 2020
Category	Helicopter, Single Engine
Date of Class I Med. Exam.	10 May 2018
Class I Medical Valid up to	09 Nov 2018
Date of issue FRTOL License	25 March 2010
FRTO License Valid up to	24 March 2020
Endorsements as PIC	BELL 206

Total flying experience	5439 : 35
On type	2491 : 35
during last 1 year	552 : 40
during last 180 days	332 : 40
during last 30 days	76 : 35
during last 07 Days	27 : 20
during last 24 Hours	02 : 35
Rest period before flight	64 Hrs.
Involved in Accident/ Incident earlier	No.

1.6 Helicopter Information

1.6.1 General

The helicopter was a single engine, seven seater helicopter designed to take-off and land on any reasonably level terrain. It was certificated for a minimum crew of one pilot in the starboard seat.

The fuselage consisted of three main sections: the Forward Section which extended from the cabin nose to the bulkhead aft of the passenger compartment, the Intermediate Section which extended from the bulkhead aft of the passenger compartment to the tail boom, and the Tail boom Section.

The tail boom consisted of an aluminum alloy monocoque tailboom which supported the tail rotor drive train as well as a horizontal stabilizer with end plates, vertical fin, and fairings.

The helicopter was equipped with skid type of landing gear (standard).

The main rotor was a semi-rigid, seesaw, two blade design that employed a pre-coned and under slung feathering axis to ensure smooth operation.

The tail rotor was a semi-rigid, delta hinged, two blade design. The drive train system provided means of transmitting power from the engine to the main and tail rotor assemblies

The flight controls were mechanical linkages that were actuated by conventional controls and were used to control flight attitude and direction. Both the cyclic and the collective controls incorporated hydraulic servo actuators. The main rotor controls consisted of the swash plate, drive link and pitch links.

The helicopter was powered by a Rolls-Royce Model 250 engine.

1.6.2 Specific

Helicopter Model	BELL 206 L4
Helicopter MSN	52142
Year of Manufacturer	1995
Name of Owner	Pawan Hans Limited
C of R	2757
C of A	211
A R C issued on	28.12.2017
ARC valid up to	28.12.2018
Total Helicopter Hours	7999:40
Last inspection (50 hrs/ 30 days)	15.09.2018
Engine Type	RR 250C30P
Engine Sl. No.	CAE 895969
Last major inspection	15.09.2018
Total Engine Hours Since New	3044: 54

High Altitude Tail Rotor Kit: The manufacturer had come out with high altitude kit for the helicopter which included wide-chord main rotor blades and increased authority tail rotor. Bell 206 L4 fitted with High Altitude Tail Rotor Kit is better suited for high altitude operations and can take-off with higher AUW loading. (as per performance graphs).

Though the helicopter has an AUW capability of 2019 Kgs, the manufacturer has limited the max AUW of Bell 206 L4 helicopter to 1882 kgs, beyond 10000 feet Density Altitude. In case of a Bell 206 L4 Helicopter fitted with High Altitude Tail Rotor Kit, loading can well be beyond 1882 kgs up to the max AUW of 2019 kgs.

The helicopter VT-PHA which was earlier flying from Leh Base was fitted with high altitude tail rotor kit, but the accidented helicopter VT-PHD was not fitted with the high-altitude tail rotor kit. The AUW of the helicopter for the flight was 1731 kgs.

1.6.3 Hovering Performance

For a pilot, ability to predict the performance of the helicopter he is flying is extremely important. It helps in calculating the maximum take-off weight with which the helicopter can takeoff, specific altitude and temperature at which the helicopter can safely hover, etc.

Helicopter performance revolves around whether or not the helicopter can be hovered. More power is required during the hover than in any other flight regime. Hover charts are provided for in ground effect (IGE) hover and out of ground effect (OGE) hover under various conditions of gross weight, altitude,

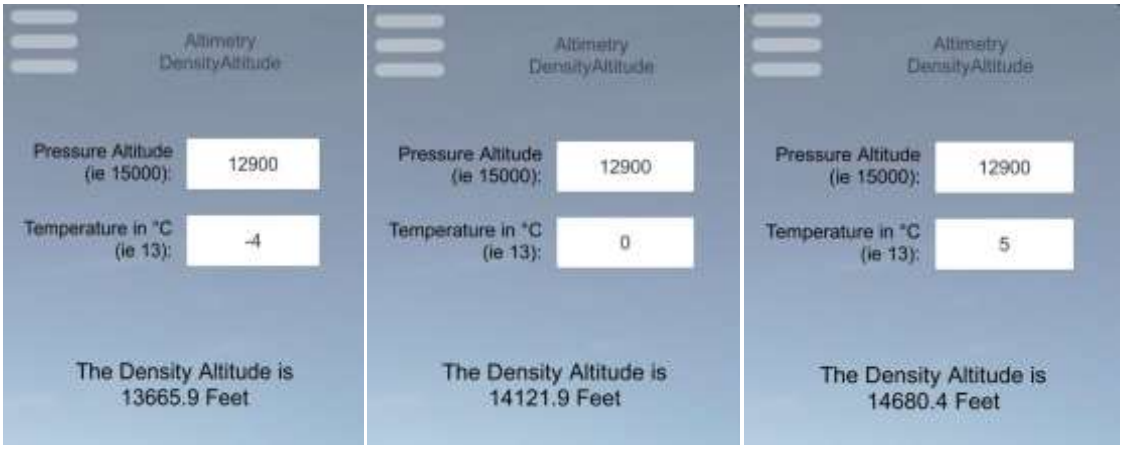
temperature, and power. A pilot, therefore, should plan an OGE hover when landing in an area that is uncertain or unverified. As density altitude increases, more power is required to hover.

As per the information available, pressure and temperature at the time of accident was as follows: -

- Pressure Altitude - 12,900 ft

- OAT - – 4^{o} C, (269.17 K)

Density Altitude, therefore was 13666 feet. For temperature of 0 and 5^{o} C, the density altitude comes out to be 14122 & 14680 feet respectively.



Maximum Gross Weight permissible (as per graph) comes out to be 1,780 Kgs.

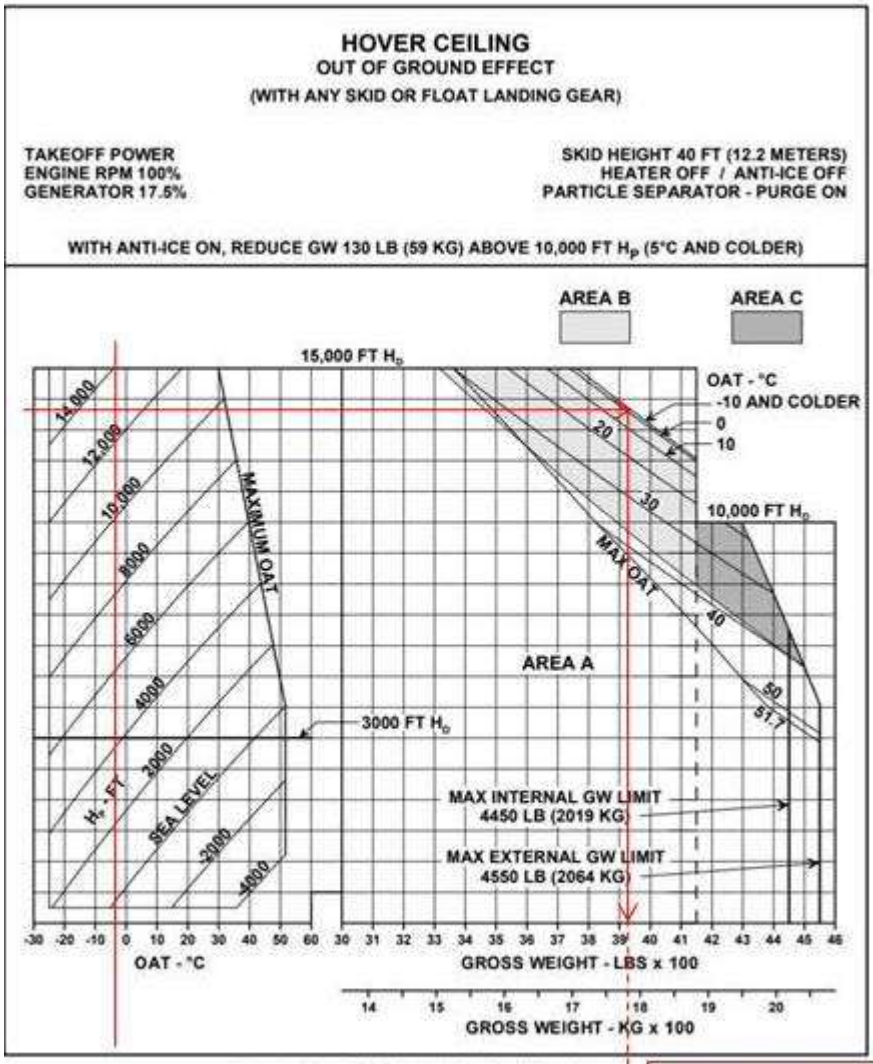


Figure 4-7. OGE Hover Ceiling (Sheet 2 of 2)

Max Permissible Gross Weight = 1,730 Kgs

Take-off weight as per L&T Sheet was 1,732 Kgs. The helicopter has flown for about 45 minutes so landing weight was 1,642 Kgs.

1.7 Meterological Information

Local weather and local area forecast was obtained from either Leh, Srinagar or Kargil Met department. On the day of accident, it was obtained from Srinagar. The weather forecast was fine.

1.8 Aids to Navigation

Nil

1.9 Communication

The helicopter was not in contact with any of the ground stations/ ATC units at the time of accident.

1.10 Aerodrome Information

Not Applicable.

1.11 Flight Recorders

Neither required, nor installed

1.12 Wreckage and Impact Information

Barring the shearing off of the tail rotor blade portions as mentioned in the “Damage to Aircraft”, the wreckage was self contained. Both skids had buckled sideways. Both cross tubes bowed down leaving very less ground clearance of the cabin floor. The damage indicates that the helicopter had impacted the ground very heavily (falling vertically) though in a straight & horizontal attitude. The sheared off tip portion of the tail rotor blades were found around the helicopter. It appears, whatever damage has occurred was during the landing phase. There was no inflight breakup of structure.

Shearing of Tail Drive Shaft

Damage to the Vertical fin

1.13 Medical & Pathological Information

PIC had undergone pre flight medical examination including Breathalyser (BA) test at Srinagar. He was found fit and BA test was negative.

1.14 Fire

NIL

1.15 Survival Aspects

The accident was survivable.

1.16 Test & Research

The damaged Tail Rotor blades and the fractured tips along with the mounting attachment with the rotor were sent to National Aerospace Laboratories (NAL), Bangalore for failure analysis purposes and to find out what could have caused the damages. The report on "Analysis of Damages to Tail Rotor Blades – Accident Helicopter BELL 206 L4 VT-PHD) was provided by NAL (CSIR-NAL Report No: MSD-FA-1659-06-2020). Laboratory investigation carried out by NAL is discussed below: -

Both the TR blades were found damaged in a similar manner.

Visual and stereo-binocular examination

Examination revealed that in both blades, the fracture occurred at a similar location which was about 150 mm from the tip. For ease of identification, the blades are designated as 'L' and 'R'.

Blade-R

At the fracture location, the honeycomb structure of the airfoil was found collapsed. In the vicinity of the fracture, there was cracking of the blade on the outboard surface and collapse at corresponding location on the inboard surface. Damage in the form of dent /impact was also observed on the leading edge at the tip. At the impact region, grazing

marks were observed on the airfoil surface as well as the leading edge. The impact resulted in bending and deformation at the tip leading to cracking of the erosion protection strip. The nature of impact and the bending direction suggest that the outboard surface of the blade hit a solid object close to the tip.

Blade-L

The airfoil towards the tip of blade-L had similar damages as those seen on blade-R. In this blade, the leading edge had relatively minor damages compared to blade-R. Graze marks were observed on the outboard surface of this blade as well close to the leading edge. In addition to damages close to the tip, the blade had collapsed in the honeycomb structure in the vicinity of the attachment region with the rotor.

To identify the impacting object, the leading edges of the blades containing the damages were cut, cleaned ultrasonically in ethanol, and examined under an SEM. Grazing marks and smeared external deposits were observed in the vicinity of the crack.

In-situ composition analysis on the smeared external material on the surface of the erosion protection strip by Energy Dispersive X-ray (EDX) analyser was also carried out. Deposits rich in oxides of one or more elements of Si, Al and Ca were observed on the graze marks on the surface of the blade as well. Examination of the surface of the blade-L also showed presence of oxides of Si, Al, Ca.

1.17 Organisation & Management Information

PAWAN HANS LIMITED (PHL) was incorporated as a company in October, 1985. It is a Non-Scheduled Air Transport Operator with valid NSOP and is engaged in helicopter charter operations. It gives support to petroleum sector mainly ONGC; connecting areas in the North and North East; travel tourism and intra city transportation. The company carries out operations and maintenance contract of helicopters across the country. The Board of Directors is the apex body headed by a CMD.

In addition, PHL also provides helicopter for medical causality evacuation. As per the PHL Operations Manual, functioning of GM (Regions) includes

supervision of all operations on all types of helicopters operated by the company in his region, coordination of the maintenances activities and engineering support services and supervision of training program for pilots, examiner/ instructor/ check pilot/ check air crew in consultation with DGM (Ops) and DGM (Training). At the time of accident, Northern Region was headed by a GM level officer.

- Surveillance of PHL (NR) was carried out by DGCA on 15 Nov 18 (after accident). The relevant issues brought out were: -
  a) In view of continued operations of VT-PHD (despite serious concerns raised during PHL internal audit in Jan 2018), the risk assessment is inadequate for the size of the organization. It also points to organizational culture which needs to be looked into.
  b) The organizational structure is too diffuse and spread out. Base managers are usually AMEs. They cannot be expected to supervise the pilots who practically manage the show on their own.
  c) The report referred to management weaknesses pointed out during surveillance on 23 May 18. The CMD was not the accountable manager but he had signed the Foreword in place of the Accountable Manager in the OM (reasons not known).
  d) Single Pilot Operations of Bell 206 L4 in Srinagar and Leh had been objected to by supervisors but had been turned down by the senior management.
  e) Internal audit reports are not adequately addressed. The issue of operational control is addressed in a rudimentary manner in chapter 16 of the OM and needs to be more detailed. It was felt (during surveillance) that there was difficulty in addressing issues (safety) by PHL mid level management.

1.18 Additional Information

1.18.1 Loss of Tail Rotor Effectiveness (LTE)

The phenomena of LTE, also known as unanticipated right yaw (for accidented helicopter), have been identified as a contributing factor in several helicopter accidents. Bell 206 series, in the past were susceptible to LTE under certain low speed manoeuvres. LTE is not related to a maintenance

malfunction and is associated with single main rotor, tail rotor configured helicopters. LTE is a result of the tail rotor losing aerodynamic efficiency due to a combination of several factors. These factors include main rotor vortex interference and tail rotor vortex ring state (related to airflow disruption over the tail rotor), helicopter weathercock stability, and the loss of translational lift. The regimes in which LTE may be encountered include low airspeed (less than 30 knots) when translational lift is lost or reduced, high power, operating in a left crosswind or tailwind or with a high yaw rate to the right.

There is greater susceptibility for LTE in right turns. This is especially true during flight at low airspeeds when the pilot is looking out the right window (not viewing the instrument panel) and is unaware of the airspeed dropping to a low value. The turn is commonly done with reference to the ground where the pilot attempts to keep a constant groundspeed by referencing ground cues.

In turbine powered helicopters, the frame of reference for the engine power governor is the main rotor RPM (Nr) with reference to the airframe. Once the helicopter begins spinning rapidly to the right as during the onset of LTE, the governor will sense a false increase in Nr and reduce fuel flow to the engine in order to maintain what it believes to be a constant Nr with reference to the airframe. Any reduction in Nr will result in a corresponding reduction in tail rotor RPM, with an associated reduction in the effectiveness of the tail rotor.

1.18.2 Reducing the Onset of LTE

To help reduce the onset of LTE, it is advised to follow the steps given below:

-

1. Maintain maximum power-on rotor rpm. If the main rotor rpm is allowed to decrease, the antitorque thrust available is decreased proportionally.
2. Avoid tailwinds below airspeeds of 30 knots. If loss of translational lift occurs, it results in an increased power demand and additional anti-torque pressures.
3. Be especially aware of wind direction and velocity when hovering in winds of about 8–12 knots. A loss of translational lift results in an unexpected high power demand and an increased anti-torque requirement.

4. Be aware that if a considerable amount of left pedal is being maintained, a sufficient amount of left pedal may not be available to counteract an unanticipated right yaw.
5. Be alert to changing wind conditions, which may be experienced when flying along ridge lines and around buildings.
6. Execute right turns slowly. This limits the effects of rotating inertia, and decreases loading on the tail rotor to control yawing.

1.18.3 Recommended LTE Recovery Techniques

Correct and timely response to the un-commanded right yaw associated with LTE by immediately applying full left pedal and decreasing power and main rotor blade pitch requirements, will usually counter the condition. However, if the pilot's response is incorrect or slow, the yaw rate may rapidly increase to a point where recovery is not possible. In response to several reports of unanticipated right yaw incidents, the recovery technique recommended is: -

a. If a sudden unanticipated right yaw occurs, the pilot should:
    1) Apply full left pedal. Simultaneously, move cyclic forward to increase speed. If altitude permits, reduce power.
    2) As recovery is effected, adjust controls for normal forward flight.
b. Collective pitch reduction will aid in arresting the yaw rate but may cause an increase in the rate of descent. Any large, rapid increase in collective to prevent ground or obstacle contact may further increase the yaw rate and decrease rotor rpm.
c. The amount of collective reduction should be based on the height above obstructions or surface, gross weight of the aircraft, and the existing atmospheric conditions.
d. If the rotation cannot be stopped and ground contact is imminent, an autorotation may be the best course of action. The pilot should maintain full left pedal until rotation stops, then adjust to maintain heading.

1.18.4 LTE at Altitude

At higher altitudes where the air is thinner, tail rotor thrust and efficiency are reduced. Because of the high-density altitude, powerplants may be much slower to respond to power changes. When operating at high altitudes and

high gross weights, especially while hovering, the tail rotor thrust may not be sufficient to maintain directional control, and LTE can occur. In this case, the hovering ceiling is limited by tail rotor thrust and not necessarily power available. In these conditions, gross weights need to be reduced and/ or operations need to be limited to lower density altitudes. This may not be given as criteria on the performance charts.

1.19 Useful or Effective Investigation Techniques

Nil

2 ANALYSIS

2.1 General

- The helicopter was having a valid Certificate of Registration (C of R) at the time of accident. It was holding a valid Indian Certificate of Airworthiness (C of A) under Normal category with Passenger/ Aerial as Sub-Division. The C of A was valid for lifetime. Airworthiness Review Certificate (ARC) was valid at the time of accident. There was no snag reported by the pilot before the accidented flight.
- All concerned Airworthiness Directives, mandatory Service Bulletins, and DGCA Mandatory Modifications were complied with as on date of accident.
- The weather at the time of accident was fine.
- The Pilot – In – Command was qualified to operate the flight. His medical and all trainings were current as on the date of occurrence. The PIC had sufficient experience in Hill flying. As per the records available, he fulfilled all qualifications and recurrent training requirements for hill flying operations as per DGCA CAR.

2.2 Investigation of damaged tail rotor blades

Laboratory studies (carried out by NAL Bangalore) confirmed that the tail rotor blades fractured as a result of impact with a solid object. The impact occurred on the outboard surface close to the leading edge and the tip in both blades. The impact resulted in localized deformation and flow of material on the

erosion strip. The bending force generated on the blade during impact resulted in fracture in the airfoil of both blades at about 150 mm from the blade tip. Also, there was buckling in the blades close to the root.

At the impacted regions of the blade, there was transfer of material from the object to the erosion strip. In-situ composition analysis showed that the transferred material contained oxides of Si, Al and Ca in substantial quantities. These oxides are generally found in soil or stone. There was not even an iota of trace which could have been considered from the blanket/ soft material.

Considering identical damage pattern and damage location on both blades, it is evident that the rotating blades had impacted a solid object. The damages seen on the TR blades, therefore, were nothing but impact damages. Based on the nature of damages and locations, it appears that the TR blades had hit solid objects such as hard soil or stone. This resulted in fracture in the TR blades close to the tip and other associated damages such as buckling, kinking and cracking close to the root or in the airfoil.

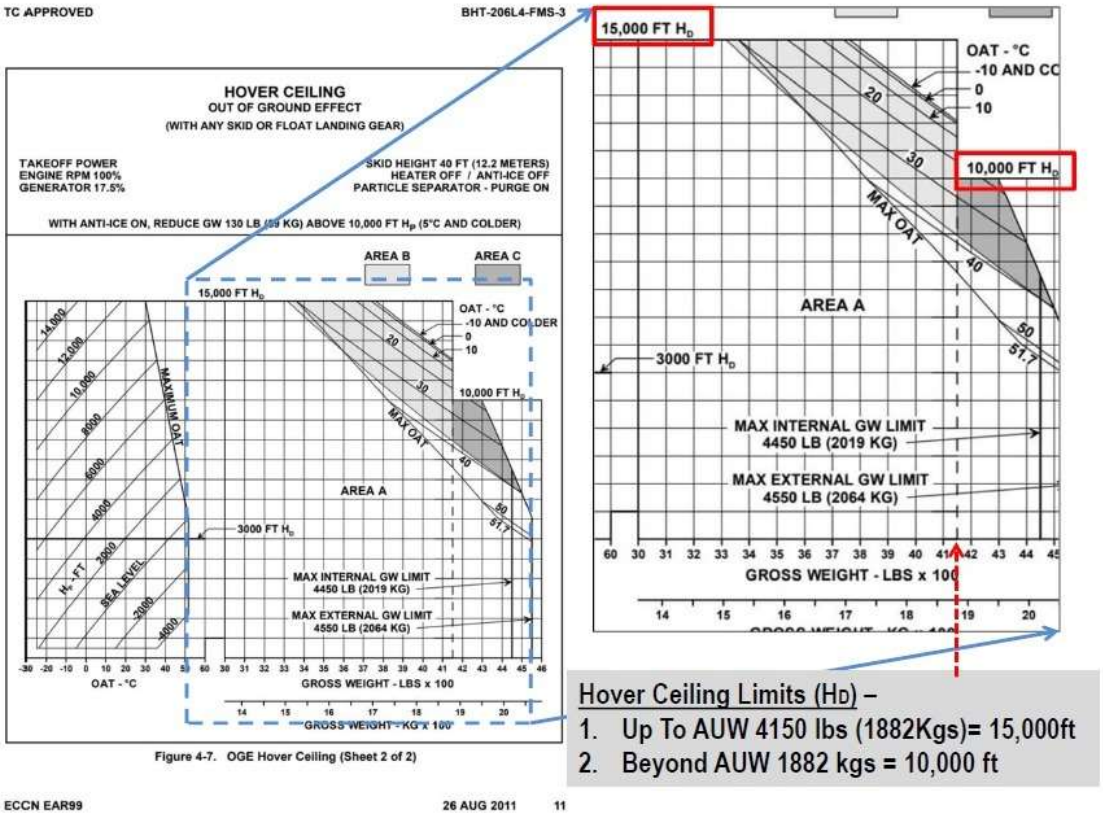
2.3 Other Damages to Helicopter

The relevant damages to helicopter from the analysis point of view are as follows:

- The helicopter tail skid (longitudinal view) had buckled more on the left hand side than on the right hand side. The flattening of cross tube is more on the left side.
- The tail boom had got damages due impact with hard surface. The irregular puncture type of damage on the bottom portion is due to some protruding (not sharp) hard surface.
- The sheared off tip pieces of the tail rotor blades were found near the helicopter.
- There was no indication of any rubbing of soft material on the tail boom, tail rotor or tail fin.
- The tail drive shaft had given way and failed under excessive contra rotational loads.

2.4 OGE Hovering limits for VT-PHD

The pressure altitude of the landing place is 12,900 feet and for an OAT of -4 deg C, the calculated density altitude is 13,665.9. The landing weight was 1642 kgs. Maximum Gross Weight permissible was 1780 Kgs with anti ice OFF. Assuming that the anti ice was ON, the permissible landing weight becomes 1721 kgs. There is not much reduction in the permissible landing weight, assuming the temperature variation of +5 deg C. Accordingly the hover altitude, in the extreme case could have been 14680 feet which was within the hover limit of 15000 feet



The helicopter was therefore within the OGE hover limits (altitude) but had reached extremity with half of pay load. The operation of the helicopter (without tail rotor kit modification) should have been avoided at higher altitudes as was also advised during risk analysis carried out by the Operator.

2.5 Leh Base Operations by PHL

Leh base operations for the Government of J & K were started by PHL by positioning a Bell 206 L4 helicopter which was fitted with a high altitude tail rotor kit (which includes wide-chord main rotor blades and increased authority

tail rotor). At that time there were four Bell 206 qualified pilots (on regular rolls) available with the operator and the involved pilot was on contract. As per the evidences on record, in spite of serious concerns raised during Internal Safety Audit, the operations were continued with Bell 206 helicopter. Sufficient evidences are also available to believe that single pilot operations of Bell 206 L4 in Leh had been objected to by supervisors but had been turned down by the senior management. The risk assessment and mitigation was not properly carried out, particularly when VT-PHD was sent to Leh.

2.6 Circumstances Leading to the Accident

Helicopter was moved from Jammu to Srinagar on 2nd October 2018. PIC, who was on contract with PHL had flown the helicopter from Srinagar to Padum along with an AME (also on contract) on board. At Padum, the AME disembarked. PIC again took off with 03 persons on board for rescue operations. The flight was planned from Padum to Shingo La and back. Being a search & rescue flight to evacuate a group of 15 to 20 people, taking 03 persons on board was not justified particularly when the AUW was very much restrictive because of altitude and topography of the area. As no person could be located during the outward leg of the search & rescue, the PIC decided to return to Padum. During return leg, as per the PIC, he had seen 03 people near village Kurgiakh. Accordingly, PIC carried out a recce and decided to land.

Exact direction or magnitude of winds at the time of landing is not known. The area was not very much level. In between the places where PIC intended to land (higher) and the main valley level (lower), there was a sharp vertical raise of around 7 feet in the ground level. PIC had made an approach at slower speed and then initiated a hover prior to landing. It appears that he had initiated a turn also to align in the direction of intended landing. At this very juncture, the recipe for LTE was ready, i.e. high power, low airspeed and a turn to the right. Definitely PIC was looking outside as he has to land at a field without any markings thereby becoming unaware of the loss in airspeed.

As the altitude (landing place) was higher (14000 feet), tail rotor thrust and efficiency were reduced and it would have been operating close to its design

limit. While flying forward, due to weathercock effect the helicopter direction was maintained with the assistance of tail rotor force. As the speed was reduced, for landing, the main rotor required more force to maintain height (reduction in forward velocity), the pilot had to increase collective pitch. At the same time, however, due to loss of weathercock effect, there was additional tail rotor thrust requirement causing tail rotor to reach its design limit. This caused onset of LTE with yaw to the right. Now, theoretically, it was possible to recover from the spin. The options available with the pilot at this stage were as follows: -

a. Apply left pedal to the full along with forward cyclic control to increase speed and if altitude permits, reduce power. Once the helicopter recovers from LTE, adjust the controls for normal forward flight.
b. If the rotation cannot be stopped and ground contact is imminent, an autorotation may be the best course of action. Maintain full left pedal until the rotation stops, then adjust to maintain heading.

In this situation, the PIC had no option, but to reduce the collective pitch setting, as he was at high altitude, loaded close to the max AUW for that altitude, helicopter already yawing to the right, any increase in collective would have caused uncontrolled yaw causing toppling of the helicopter. The place (raised portion) where the pilot had decided to land was at a height of around 7 feet above from the ground level below the flight just prior to landing. PIC, as he had got into an un-retrievable situation, took a lesser harmful decision to immediately put the helicopter down on ground by reducing collective pitch. Though he could arrest the yaw but in the bargain, ended up with a very hard landing just at the edge of the raised portion. The tail portion impacted the rocky irregular edge. The tail boom got bent downwards almost from middle and portion of the rotating tail rotor blades from tips got sheared off.

To conclude, during landing, as the tail rotor had reached its design limits at high altitude and rotor thrust was not sufficient to maintain directional control, the helicopter suffered LTE. These conditions are not given as criteria on the performance charts and one has to avoid the onset of LTE. PIC could not recover the helicopter from the LTE condition (control the yaw), and carried

out a very hard landing by reducing collective pitch, causing substantial damages to tail portion and skid.

The helicopter, purportedly hit by a blanket, as claimed by the PIC is not acceptable as there was no material evidence to support his statement.

3 CONCLUSION

3.1 Findings

3.1.1 The operator was holding a valid AOP for Non-Scheduled Air Transport Services.

3.1.2 The Certificate of Airworthiness, Certificate of Registration and Airworthiness Review Certificate of the helicopter were valid on the date of accident. There was no reported snag pending rectification.

3.1.3 PIC was fully qualified and experienced to operate the flight. He had sufficient hill flying experience and was on contract employment with PHL.

3.1.4 Though theoretically it is possible to carry out single pilot operations of Bell 206 L4 in Srinagar and Leh, supervisors at PHL had objected to the proposal taking risk analysis into account. PIC was the only PHL helicopter pilot who had flown Bell 206 helicopter in the area.

3.1.5 Serious concerns were raised during PHL internal audit carried out in January 2018 for utilizing VT-PHD, with drastic reduction in payload for hill operations in J & K.

3.1.6 The Bell 206 helicopter (not VT-PHD) being flown in the area and undergoing scheduled maintenance was fitted with a high altitude tail rotor kit.

3.1.7 Though, it is agreed that there was a requirement of a helicopter for search & rescue operation in Kurgiakh area which has an density altitude of more than 14000 feet, it is inferred that PIC showed an extraordinary haste to take the helicopter to the area.

3.1.8 The accidented flight was the first flight of the helicopter (without high altitude tail rotor kit installed) in the area.

3.1.9 While carrying out search & rescue flight and after sighting few people, PIC decided to land near village Kurgiakh (density altitude 14000 feet).

3.1.10 The area chosen to land was approx. 7 feet higher than the surrounding area (as a table top on the side of valley)

3.1.11 While flying forward, the helicopter direction was maintained with the assistance of tail rotor force and weather cock effect as tail rotor thrust and efficiency were reduced.

3.1.12 Exact direction or magnitude of winds at the time of landing is not known.

3.1.13 As the speed was reduced, for landing, the main rotor required more force to maintain height (reduction in forward velocity) and the pilot had to increase collective pitch to maintain height.

3.1.14 Due to loss of weather cock effect, there was additional tail rotor thrust requirement causing tail rotor to reach its design limit. This caused onset of LTE with yaw to the right.

3.1.15 As PIC had got into an un-retrievable situation, he put the helicopter down on ground immediately by reducing collective pitch.

3.1.16 Though he could arrest the yaw but in the bargain, ended up with a very hard landing just at the edge of the raised portion.

3.1.17 The tail portion impacted the rocky irregular edge of the raised ground.

3.1.18 The tail boom got bent downwards almost from middle and portion of the rotating tail rotor blades from tips got sheared off.

3.1.19 The fracture in the tail rotor blades occurred due to impact with a hard, solid object. The solid object was found made of oxides of Si, Al and Ca. These oxides are generally found in soil or stone.

3.1.20 Identical damages in both rotor blades suggested that the rotating blades had impacted on hard soil or stone rather than foreign objects hitting the blades.

3.1.21 The helicopter, purportedly hit by a blanket, as claimed by the PIC is not acceptable as there was no material evidence to support his statement.

3.2 Probable Cause of the Accident

During hover, prior to landing in valley, the helicopter had suffered avoidable loss of tail rotor effectiveness (LTE), which PIC could not control effectively resulting in severe heavy landing.

4 SAFETY RECOMMENDATIONS

PHL should develop, a quantifiably auditable robust system, to ensure that the laid down DGCA regulations and in-house procedures of PHL concerning procedural safety, risk analysis & mitigation, operational discipline are meticulously followed.

(R S Passi)
Investigator – In – Charge

(Shilpy Satiya)
Investigator

Date: 21.08.2020
Place: New Delhi