



National Transportation Safety Board

Washington, D.C. 20594
Safety Recommendation

Log 2457

Date: July 19, 1994

In reply refer to: A-94-139 through -142

Honorable David R. Hinson
Administrator
Federal Aviation Administration
Washington, D.C. 20591

On May 20, 1994, a Bell 206B helicopter, N206HS, crashed while the pilot was executing an approach to a landing at a private helipad, near Ukiah, California. The pilot stated that the winds were gusting to an estimated 20 knots when he encountered an uncommanded yaw. He said he lost control and the helicopter crashed with no apparent control malfunction. The pilot received minor injuries. Although the Safety Board has not yet determined the probable cause of the accident, the circumstances of the accident indicate the involvement of an aerodynamic phenomenon of single main rotor/anti-torque rotor helicopters known as "loss of tail rotor effectiveness" (LTE), or "unanticipated yaw."

On April 14, 1993, at 0347 eastern daylight time, another Bell 206B helicopter, N72HP, crashed during a descent for landing at a remote landing site near Lucasville, Ohio. The helicopter had been making a descending turn from an easterly heading toward the south for the final portion of the approach. The wind was reported to be from the east at about 12 knots. When the helicopter was 150 to 200 feet above the ground at a slow forward airspeed, it started to rotate clockwise. The pilot stated that as the helicopter started to yaw to the right, he applied left anti-torque pedal (opposite the turn) with no results. The pilot was unable to arrest the rotation, and the helicopter continued to rotate until it struck the ground. The helicopter was destroyed, and the pilot and one passenger received minor injuries. Investigators examined the main rotor and tail rotor, gearboxes, rotor drive trains, and the engine and could find no evidence of preimpact discrepancies.

Comparison of the helicopter's performance and the characteristics of LTE revealed similarities. As the helicopter approached a southerly heading, it would have been susceptible to uncommanded right yaw by the crosswind, right turn, and slow forward airspeed conditions that existed at the time of the accident. The Safety Board determined that the probable cause of the accident was LTE, which resulted in loss of control of the helicopter. Unfavorable wind was cited as a contributing factor.¹

¹For more detailed information, read Brief of Accident File #0167, Lucasville, Ohio, April 14, 1993 (attached).

The Safety Board has investigated several other single main rotor/anti-torque rotor helicopter accidents resulting from uncommanded right yaw and issued recommendations to the Federal Aviation Administration (FAA) concerning some of those accidents. On August 2, 1982, a Bell 206B helicopter crashed during a power line inspection flight. The helicopter was being operated at a slow forward airspeed when the pilot reported that the helicopter entered an uncommanded right rotation. The pilot applied left anti-torque pedal to arrest the turn with no success. Subsequently, the helicopter crashed and was substantially damaged. The pilot later stated that he had encountered LTE. The Safety Board found that the probable cause of the accident was the loss of tail rotor control for an unknown reason. Safety Board investigators found that the LTE was an aerodynamic occurrence related to the loss of control.

The Safety Board is aware of two studies of LTE in single main rotor/anti-torque rotor helicopters. One study was done by the Bell Helicopter Company in conjunction with the U.S. Army Safety Center (USAAVS). USAAVS was concerned about the high number of accidents attributed to LTE in the OH-58, the military version of the Bell 206B. The other study was done by the Royal Australian Air Force, Aircraft Research and Development Unit, and had findings similar to those stated in the USAAVS report. Bell Helicopter subsequently reported that unanticipated right yaw (LTE) is the occurrence of an "uncommanded right yaw rate which does not subside of its own accord and which, if not corrected, can result in the loss of aircraft control." The studies found that there are four distinct aerodynamic conditions associated with LTE: weathercocking, vortex ring state, main rotor disc vortex interference, and loss of translational lift. Both studies found that these four characteristics were relevant to the Bell 206 style tail rotor, and suggested a recovery technique and the importance of adequately training pilots in the recognition of and recovery from the LTE phenomenon. Bell Helicopter issued pertinent safety information to pilots and helicopter operators in Operations Safety Notice (OSN) 206-83-10 and Information Letter (IL) 206-84-41.

As a result of the cited 1982 accident and the aforementioned studies, on July 13, 1984, the Safety Board made the following recommendations to the FAA:

Require the manufacturer to revise the FAA-approved flight manual for the Bell 206 model helicopter to include the information on loss of tail rotor effectiveness provided in [Bell Helicopter] Operations Safety Notice 206-83-10. (A-84-67)

Review and evaluate the substantiation data for the Bell 206 model helicopter, collected in flight testing, to show compliance with 14 CFR 27.143 - Controllability and Maneuverability, to verify that the rotorcraft is safely controllable and maneuverable during steady-state flight and during any maneuver appropriate to the type; if compliance is not verified, require appropriate modifications or limitations of the helicopter's flight envelope. (A-84-68)

In response to Safety Recommendation A-84-67, the FAA stated that it did not consider the information provided by OSN 206-83-10 to be appropriate for inclusion in the FAA-approved Bell 206 flight manual. The FAA responded further that the information provided in the OSN is not unique to Bell 206 helicopters but is generally applicable to all rotorcraft of the single main rotor/anti-torque rotor type. The FAA took several actions in 1984-1985 to assure that LTE information was given broad dissemination. The FAA distributed Bell Helicopter OSN 206-83-10 and IL 206-84-41 to all Flight Standards field offices for further dissemination of the information to helicopter pilots and operators through the FAA's accident prevention program. The FAA separately distributed the contents of the Bell IL to airmen holding FAA-issued helicopter pilot ratings. The FAA did not revise any of the advisory circulars (ACs) that addressed helicopter performance.

The FAA reported that in the case of Safety Recommendation A-84-68, it did not consider a review of the Bell 206 flight test data substantiating compliance with the 14 CFR 27.143 controllability requirements to be warranted because the Model 206 helicopter had been evaluated for compliance with the controllability and maneuverability requirements numerous times between 1963 and 1977, as the series evolved. The FAA did not interpret the Bell OSN or IL as an implication that the Bell 206 tail rotor margin was inadequate. Based upon the FAA response, the Safety Board classified Safety Recommendation A-84-67 "Closed--Alternate Action" and Safety Recommendation A-84-68 "Closed--Acceptable Action".

In a recent review of the FAA publications describing helicopter aerodynamics, the Safety Board has been unable to find adequate descriptions of LTE. The Safety Board believes that the flying public looks to the FAA for guidance in such matters and believes that the FAA AC program should address LTE. As a minimum, the Safety Board believes that the ACs should define and discuss LTE and describe the four conditions of the aerodynamic phenomenon, the proper recognition procedures, and the recommended recovery techniques. The Safety Board feels that these facts should be disseminated to the helicopter community so that the information will be readily available to current and future airmen to prepare them for and enable them to recognize the LTE, reducing the potential for future LTE accidents.

The Safety Board has found no civilian helicopter flight manuals that contained information on LTE. The U.S. Army OH-58 flight manual thoroughly discusses the aerodynamic characteristics of LTE, the four aerodynamic conditions of LTE, warnings appropriate to LTE conditions, and emergency recovery techniques. The Safety Board considers proper documentation of this phenomenon in the flight manual to be vital to the safe operation of the Bell 206B and other similar helicopters.

The Safety Board is aware that the U.S. Army plans to remove all OH-58 aircraft (about 1,800 helicopters) from its inventory. As these aircraft are placed into surplus status, many will be converted to public (law enforcement, parks, local governments, etc.) and private use. The Safety Board is concerned that civilian pilots unfamiliar with LTE may be vulnerable to LTE accidents when they begin to operate these aircraft.

Recent accidents indicate that there is a continuing need to educate and train helicopter pilots to prevent future LTE accidents. The Safety Board is concerned that in the 10 years since the FAA disseminated LTE information to pilots, the applicable flight and owners manuals and FAA ACs have not been revised to educate pilots about the phenomenon. In reviews of the pertinent regulations appropriate to pilots' skills, knowledge, or experience, including the Practical Test Standards, the Safety Board has found that references to LTE are lacking or nonexistent. The Safety Board feels that each helicopter susceptible to LTE should have in its FAA-approved flight manual adequate discussions, warnings, and recovery steps appropriate to the LTE phenomenon.

Therefore, the National Transportation Safety Board recommends that the Federal Aviation Administration:

Issue to all owners, operators, and pilots of single main rotor/anti-torque rotor helicopters a Flight Safety Notice to convey the information contained in Bell Operations Safety Notice 206-83-10 and Information Letter 206-84-41. (Class II, Priority Action)(A-94-139).

Strongly encourage the manufacturers of single main rotor/anti-torque rotor helicopters to include in the operator's handbook and flight manual discussions of the characteristics of and recovery techniques from the phenomenon known as loss of tail rotor effectiveness (unanticipated yaw). (Class II, Priority Action) (A-94-140)

Amend the Helicopter Practical Test Standards to include appropriate references and questions addressing loss of tail rotor effectiveness (unanticipated yaw). (Class II, Priority Action)(A-94-141)

Include in the next revision to the Basic Helicopter Handbook (AC 61-13), a thorough discussion of loss of tail rotor effectiveness (unanticipated yaw) and recommended recovery techniques. (Class II, Priority Action)(A-94-142)

Acting Chairman HALL, and Members LAUBER, HAMMERSCHMIDT, and VOGT concurred in these recommendations.

By: 
Jim Hall
Acting Chairman

Brief of Accident

File No. - 0167 4/14/93 LUCASVILLE, OH A/C Reg. No. N72HP Time (Lcl) - 0347 EDT

---Basic Information---
Type Operating Certificate-NONE (GENERAL AVIATION)

Type of Operation -PUBLIC USE
Flight Conducted Under -14 CFR 91
Accident Occurred During -APPROACH

---Aircraft Information---
Make/Model - BELL 206B
Landing Gear - SKID
Max Gross Wt - 3200
No. of Seats - 5

---Environment/Operations Information---
Weather Data - NO RECORD OF BRIEFING
Wx Briefing - N/A
Method - N/A
Completeness - N/A
Basic Weather - VMC
Wind Dir/Speed- UNK/NR
Visibility - 5.0 SM
Lowest Sky/Clouds - UNK/NR
Lowest Ceiling - UNK/NR
Obstructions to Vision- UNK/NR
Precipitation - UNK/NR
Condition of Light - NIGHT(DARK)

Airport Proximity
OFF AIRPORT/STRIP

Airport Data

Runway Ident - N/A
Runway Lth/Wid - N/A
Runway Surface - N/A
Runway Status - N/A

Aircraft Damage
DESTROYED
Fire
NONE

ELT Installed/Activated - YES/YES
Stall Warning System - NO

Fatal 0 Serious 0 Minor 1 None 0
Crew 0 Pass 0 Injuries 1 0 1 0

Eng Make/Model - ALLISON 250-C20
Number Engines - 1
Engine Type - TURBOSHIFT
Rated Power - 450 HP

Itinerary
Last Departure Point
SAME AS ACC/INC
Destination
LOCAL

ATC/Airspace
Type of Flight Plan - NONE
Type of Clearance - UNK/NR
Type Appch/Lndg - FULL STOP

---Personnel Information---
Pilot-In-Command
Certificate(s)/Rating(s)
PRIVATE
SE LAND
HELICOPTER

Medical Certificate - VALID MEDICAL-WAIVERS/LIMIT
Age - 48
Biennial Flight Review - YES
Current - 13344
Months Since - 5
Aircraft Type - 206B
Total Flight Time (Hours) - 13344
Make/Model- 441
Instrument- 0
Multi-Eng - 4
Rotorcraft - 441

Instrument Rating(s) - NONE

---Narrative---
THE PILOT WAS ON APPROACH AT ABOUT 150-200 FT AGL WHEN THE HELICOPTER BEGAN ROTATING CLOCKWISE ABOUT THE NOSE IN A NOSE-DOWN ATTITUDE. IT DESCENDED TO THE GROUND AND LANDED HARD IN A LEVEL ATTITUDE COLLAPSING THE LANDING SKIDS. THE HELICOPTER THEN ROLLED OVER ON ITS RIGHT SIDE, AND THE MAIN ROTOR BLADES STRUCK THE GROUND. ACCORDING TO THE PILOT, HE MADE A WIDE RIGHT TURN TO ALIGN WITH THE LANDING AREA WHEN THE NOSE YAWED RIGHT ABOUT 45 DEG. THE HELICOPTER ROTATED TWICE DESPITE THE PILOT'S ATTEMPT TO CORRECT WITH FULL LEFT PEDAL AND LESS COLLECTIVE. HE STATED THE ENGINE APPEARED TO BE OPERATING AT FULL POWER AFTER THE COLLISION. THE INVESTIGATION DID NOT DISCLOSE EVIDENCE OF MECHANICAL MALFUNCTION. BASED ON ARMY AND BELL HELICOPTER DATA, THE AIRSPEED AND WIND COMBINATION WERE CONDITIONS CONDUCTIVE FOR THE OCCURENCE OF THE LOSS OF TAIL ROTOR EFFECTIVENESS.

Brief of Accident (Continued)

File No. - 0167

4/14/93

LUCASVILLE, OH

A/C Reg. No. N72HP

Time (Lcl) - 0347 EDT

Occurrence #1 LOSS OF CONTROL - IN FLIGHT
Phase of Operation APPROACH

Finding(s)

1. AIRCRAFT PERFORMANCE - DETERIORATED
2. DIRECTIONAL CONTROL - NOT POSSIBLE - PILOT IN COMMAND
3. WEATHER CONDITION - UNFAVORABLE WIND

Occurrence #2 IN FLIGHT COLLISION WITH TERRAIN/WATER
Phase of Operation APPROACH

-----Probable Cause-----

The National Transportation Safety Board determines that the Probable Cause(s) of this accident was:
LOSS OF TAIL ROTOR EFFECTIVENESS WHICH RESULTED IN THE LOSS OF AIRCRAFT CONTROL. A FACTOR WHICH CONTRIBUTED TO THE
ACCIDENT WERE UNFAVORABLE WINDS.