



National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: June 12, 2008

In reply refer to: A-08-32 through -35

The Honorable Robert A. Sturgell
Acting Administrator
Federal Aviation Administration
Washington, D.C. 20591

On March 8, 2007, about 1502 Hawaii standard time, an Aérospatiale AS350BA,¹ N354NT, serial number 1168, operated by Heli-USA Airways, Inc., crashed into terrain following a loss of control while landing at Princeville Airport, Princeville, Hawaii.² The certificated airline transport rotorcraft rated pilot and three passengers were killed, three passengers were seriously injured, and the helicopter was destroyed. The helicopter was operated under the provisions of 14 *Code of Federal Regulations* (CFR) Part 135 as an air tour flight. Visual meteorological conditions (VMC) prevailed, and a company flight plan was filed.

According to an interview with the Heli-USA dispatcher, the accident helicopter departed about 1415 for the 45-minute air tour flight. When the accident pilot contacted the base by radio shortly before landing, the pilot announced, "I'm having hydraulic problems, and I'm probably going to have to do a run-on landing."³ Witnesses stated that, as the helicopter traveled toward the base, it suddenly dipped and became uncontrollable; the main rotor blades struck the ground, and the helicopter crashed. The helicopter broke into several pieces before coming to rest on a grassy area next to the runway.

The helicopter's flight control system is a mechanical flight control system assisted by hydraulic actuators. The system is controlled by pilot-actuated flight control inputs using the cyclic, the collective, and anti-torque pedals. A transmission-mounted hydraulic servo system (consisting of three main servos) controls the helicopter's lateral, longitudinal, and collective movement. The three main servos are anchored to the transmission case by clevis bolts. The

¹ In 1992, the helicopter divisions of French aircraft manufacturer Aérospatiale and German aircraft manufacturer Messerschmitt-Bölkow-Blohm merged to form Eurocopter. Helicopters under the Aérospatiale name, like the accident helicopter, are still flying today.

² More information about this accident, NYC07MA073, is available on the National Transportation Safety Board's website at <<http://www.ntsb.gov/ntsb/query.asp>>.

³ According to the helicopter's flight manual, the emergency procedures for a hydraulic failure include slowing the helicopter's forward airspeed, activating the hydraulic accumulator off switch, then accomplishing a running landing to a suitable landing area, followed by shutdown of the engine. There is no emergency procedure for the disconnection of a control servo.

primary means of locking the piston end of each servo to its rod end bearing (clevis) is by applying the proper torque to the clevis nut and the servo piston shaft. The lock washer, located between the clevis nut and the servo piston end, has a tang and castellation that serve as a secondary means of securing the servo to the clevis bolt. During the on-site examination of the helicopter, National Transportation Safety Board investigators found that the left lateral servo had become detached from its clevis mounting bolt. Staff also found a severely worn locking washer with a severely worn tang and lack of torque on the locking nut used to secure the servo to the mounting clevis.

Under normal loads, the servo experiences a slight twisting motion that may have contributed to the servo-piston-to-clevis locking nut coming loose, if the lock washer was not properly installed. Maintenance records indicate that the servo was installed 131 hours before the accident flight. If the locking nut had been installed properly, it would not have become loose in such a short period of time. Therefore, it is probable that maintenance personnel did not properly torque the locking nut when the servo was installed. This accident is still under investigation, and a probable cause has not yet been determined.

On September 11, 2002, about 1700 mountain standard time, an Aérospatiale AS350BA, N357NT, also operated by Heli-USA, experienced a hydraulic failure while on its return from the Grand Canyon to McCarran International Airport, Las Vegas, Nevada.⁴ The helicopter diverted to Grand Canyon West Airport, Peach Springs, Arizona, and landed hard. The helicopter sustained substantial damage, one passenger received minor injuries, and the pilot and five other passengers on board were not injured. The helicopter was operated under the provisions of 14 CFR Part 135 as an air tour flight. VMC prevailed, and a company visual flight rules flight plan was filed.

Examination of the hydraulic pump revealed that it had failed because of excessive coupling spline wear that was caused by insufficient lubrication. Review of maintenance records revealed that the hydraulic pump had been installed less than 75 hours before the accident flight.

The Safety Board determined that the probable cause of the Peach Springs accident was the pilot's failure to maintain adequate airspeed and main rotor speed during the landing approach as prescribed in the hydraulic pump failure emergency procedures found in the rotorcraft flight manual. Contributing to the accident was the failure of the hydraulic pump due to excessive coupling spline wear, which was caused by the application of insufficient lubrication by the operator's maintenance personnel during pump installation.

The investigative findings from these two accidents revealed safety issues related to Heli-USA's ineffective maintenance, inadequate quality assurance programs, model-specific maintenance training, and the Federal Aviation Administration's (FAA) lack of surveillance (either on site or through maintenance record review) to identify maintenance nonconformance. As part of the investigation, the Safety Board reviewed other air tour operators' maintenance programs and found similar issues with most of the operators.

⁴ More information about this accident, LAX02FA281, is available on the Safety Board's website at <<http://www.nts.gov/nts/query.asp>>.

Maintenance and Inspection Quality Assurance Programs

Air tour flights are operated either as Part 135 on-demand flights or Part 91 sightseeing flights.⁵ Title 14 CFR 135.411 requires Part 135 on-demand operators operating aircraft with 10 or more seats to comply with 14 CFR 135.431 to establish and maintain a system “for the continuing analysis and surveillance of the performance and effectiveness of the inspection program” (that is, a continuing analysis and surveillance system or CASS) and for the maintenance program.⁶ Air tour operators flying smaller helicopters, such as Heli-USA, are exempt from the requirement to have such a maintenance quality assurance program.

Heli-USA’s general operating manual (GOM) showed that 20 safety critical maintenance items required a separate inspection and signature by a mechanic other than the one doing the maintenance. One of these tasks was the installation of any of the main servos. According to the aircraft logbook entries for the Princeville accident helicopter, the main servos’ installation was not signed off as being inspected after the task was completed. Furthermore, the accident helicopter had undergone several extensive and detailed inspections after the servo was installed, including a 100-hour and several 30-hour inspections, in which the areas where the clevis and servo were attached should have been inspected and any abnormalities corrected before further flight.⁷ It was visually apparent that the clevis-to-servo attach area was not secure. The most recent 30-hour inspection was performed just 4 days and about 6 flight hours before the accident. Similarly, in the Peach Springs accident, the lack of sufficient lubrication of the hydraulic pump pulley was not detected by inspections. Because there was no effective quality assurance program in place at Heli-USA, maintenance errors were not detected, which led to accidents. The Safety Board notes that, although Heli-USA had a quality assurance program in its GOM, the program was not used properly. Furthermore, the Board found that most air tour operations do not have any quality assurance program.

The Safety Board’s review of air tour accident data found that there were 165 air tour accidents between January 1, 1996, and October 1, 2007; 88 of those accidents involved helicopters. To date, the Board has determined the causes and factors in 71 of those air tour helicopter accidents; the remaining accidents are still under investigation. Twenty-five (35 percent) of the air tour helicopter accidents involved mechanical failures or malfunctions in which correctly performed maintenance inspections or procedures could have prevented the accidents.

For example, on March 10, 2001, an Enstrom F-28C helicopter, operated by Helicopter Resources, Inc., under the provisions of 14 CFR Part 91 as an air tour flight, experienced an in-flight fire due to a cracked exhaust pipe that allowed high-temperature fumes from the turbo section to ignite other components. The Safety Board investigation indicated that, had the helicopter been closely inspected before the accident, the cracked exhaust would have been

⁵ Part 91 sightseeing flights are nonstop flights for hire that are conducted within a 25-mile radius of the base of operations.

⁶ The details of the maintenance quality assurance program requirements are found in 14 CFR 135.431.

⁷ Title 14 CFR Part 43, Appendix D, states that each 100-hour inspection requires the inspection of “All systems-for proper installation, poor general condition, defects, and insecure attachment.” In a 30-hour inspection, the mechanic visually inspects the condition, security, and operation of all components in the engine compartment.

identified.⁸ Also, on January 21, 2005, a McDonnell Douglas Helicopters, Inc., 369E, operated by K&S Helicopters (doing business as Paradise Helicopters) under the provisions of 14 CFR Part 135 as an air tour flight, crashed after a tail rotor abrasion strip separated from one of the tail rotor blades. The investigation revealed that the abrasion strip had been separating for some time before the accident. The Safety Board concluded that proper examination during scheduled, manufacturer-recommended inspections would have revealed the separation.⁹

Effective quality assurance programs can identify and prevent maintenance issues, as indicated by past Safety Board investigations of three Part 135 charter operators in the oil and gas industry¹⁰ that voluntarily instituted quality assurance departments for their fleet of small helicopters. According to these operators, when quality assurance programs were put in place to analyze the performance and effectiveness of maintenance and inspection programs, maintenance errors were dramatically reduced, and unscheduled maintenance failures diminished after adding their quality assurance programs. In each of the accidents mentioned in this letter, there was no quality assurance program in place for the maintenance and inspection practices; had there been, the poor maintenance may have been detected and corrected before the accidents. The Safety Board concludes that a strong and effective quality assurance program, in which qualified and experienced personnel continuously monitor the inspection and maintenance program, can reduce and catch maintenance procedural errors and maintenance program deficiencies, thus, reducing the number of maintenance-related accidents and incidents. Therefore, the Safety Board believes that the FAA should require that all air tour operators (Parts 91 and 135) establish and maintain a system for continuously analyzing the performance and effectiveness of their inspection and maintenance programs to ensure that all maintenance is performed with the utmost regard for quality and safety.

Formal Maintenance Training

Review of the mechanics' training requirements outlined in Heli-USA's FAA-approved GOM revealed that mechanics are required to attend airframe, powerplant, and equipment manufacturers training courses needed to fulfill task requirements. The GOM also stated that Heli-USA promotes maintenance training but makes it the responsibility of certified mechanics to ensure that they are adequately trained. However, the mechanic who performed the maintenance on the Princeville accident helicopter had been an employee for almost a year and had not been to formal AS-350 maintenance training. Furthermore, the training records showed that none of the line mechanics for Heli-USA's Hawaiian base had been to a model-specific maintenance training course.

Additionally, investigators asked four other Hawaiian air tour operators who fly Eurocopter aircraft what training their mechanics had received, and all of the operators indicated

⁸ For more information about this accident, see MIA01LA097 at the Safety Board's website at <<http://www.nts.gov/ntsb/query.asp>>.

⁹ For more information about this accident, see LAX05LA074 at the Safety Board's website at <<http://www.nts.gov/ntsb/query.asp>>.

¹⁰ Safety Board staff reviewed the maintenance programs of several of the large oil service helicopter operators and found that they used quality assurance programs similar to the airline industry and military programs.

that their mechanics had not attended the Eurocopter-sponsored school.¹¹ According to Eurocopter, most of the attendees at its AS-350 maintenance training school were from airborne law enforcement, medical, or corporate helicopter operators. Safety Board investigators who attended the AS-350 maintenance training school noted that formal, model-specific maintenance training provides mechanics with crucial information about how the helicopter operates and also provides them with an understanding of why procedures need to be done. In addition, it provides a foundation on which on-the-job experience can be built. The Safety Board concludes that formal, model-specific maintenance training is a valuable tool and is crucial to the conduct of proper maintenance actions. Therefore, the Safety Board believes that the FAA should require air tour operators to provide formal, model-specific helicopter maintenance training for their mechanics to ensure an adequate level of competency.

FAA Surveillance Requirements for Part 135 Maintenance Operations

The Princeville accident revealed the need for better and consistent on-site FAA surveillance of air tour operators to effectively assess the operators' maintenance operations. During their investigation of the Princeville accident, Safety Board investigators interviewed the FAA principal maintenance inspector (PMI) who was assigned to oversee Heli-USA's maintenance operation. The PMI, who was located in Las Vegas, Nevada, stated that, although he was authorized to conduct maintenance surveillance at any time, workload and time constraints limited his activities to only occasional visits to Heli-USA's main operations base in Las Vegas and that he had not visited the Hawaiian base within the previous year. He relied on feedback from the Hawaiian flight standards district office (FSDO) inspectors, who performed infrequent ramp checks and oversight visits of the Heli-USA maintenance facility;¹² the Hawaiian FSDO inspector last visited Heli-USA's maintenance facility on April 27, 2006. Because of workload and time constraints, the PMI rarely reviewed the maintenance records that were forwarded from the Hawaiian operation to the Heli-USA main maintenance facility in Las Vegas. The PMI informed Board staff that, because he knew that other operators included a required inspection item (RII) section to their GOMs, he did request that Heli-USA add an RII section to its GOM. The RII for Heli-USA included an inspection for main servo replacement, but the PMI was unaware that those inspection items were not being performed. Therefore, the PMI was ill-equipped to determine how best to focus his surveillance activities to direct and guide Heli-USA how to reduce the likelihood of maintenance-related accidents.

FAA Order 1800.56, "National Flight Standards Work Program Guidelines," defines basic inspection requirements and identifies special emphasis areas for actions that FAA inspectors should take; however, it does not require that FAA inspectors perform on-site surveillance, provide guidance on how often operators should visit sites, or specify the minimum allotted time that inspectors should spend at an operator's maintenance facility. Because of the lack of clarity in these critical areas, PMIs are not expected or required to provide on-site surveillance.

¹¹ Staff reviewed only Eurocopter-based training records because (based on aviation service company Helicas' database of operating helicopters), as of November 2007, 70 percent of air tours in the United States fly Eurocopters, and 58 percent of air tours worldwide fly Eurocopters. The remaining operators fly Bell and McDonnell Douglas helicopters.

¹² The oversight visits comprised mostly paperwork; general maintenance activity was not occurring during the inspection times.

Regular FAA maintenance surveillance visits provide inspectors both the opportunity to observe mechanics perform their duties and to detect deficiencies before they result in serious airworthiness shortcomings. Furthermore, improved surveillance would likely foster better adherence to maintenance manual requirements if operators knew that the FAA inspector would be conducting regular maintenance surveillance visits.

The Safety Board concludes that, if the FAA had provided regular on-site surveillance of Heli-USA's maintenance operations in Hawaii and a more vigilant review of Heli-USA's maintenance records, the maintenance program would likely have been improved, and the errors that led to the servo disconnect either may not have occurred or may have been detected before the accident. Therefore, the Safety Board believes that the FAA should develop a mechanism to provide direct surveillance of air tour maintenance at all locations where a company's maintenance is conducted.

Independent Safety Program Audits

The Safety Board's investigation indicated that the FAA could supplement its surveillance efforts by partnering with industry safety groups that could provide independent oversight; this partnership would provide valuable safety resources to help ensure that air tour operators develop and implement quality assurance programs and improve their maintenance training. One such industry group is Tour Operators Program of Safety (TOPS); TOPS' mission is to enhance and promote air tour safety and to "provide the public with access to scenic areas while in the care of good, safe, and professional air tour operators." The TOPS program outlines management requirements, pilot qualifications and training, maintenance practices, ground support personnel training, and minimum equipment for aircraft and requires members to "establish and enforce standards to ensure that safety is the primary consideration for all air tour operations." These TOPS requirements go beyond the current requirements applicable to most air tour flights because nearly all helicopters used for air tour operations have 10 or fewer seats, which exempts them from a substantial portion of the Part 135 maintenance program requirements.¹³

Under the TOPS program, members agree to annual independent safety audits, which are conducted by independent evaluators who are paid by TOPS through members' annual fees. These annual safety audits primarily focus on operational issues and do not focus on whether individual aircraft, mechanics, or separate inspection programs meet maintenance compliance requirements. If TOPS were to expand its safety audits into the maintenance areas, it could be a viable resource for improving air tour operators' maintenance practices. As a result, the Safety Board has encouraged TOPS to expand its safety audit program to ensure that member operators have an effective maintenance quality assurance program and that mechanics and maintenance programs are complying with industry standards and practices.

Independent maintenance checks provided by organizations like TOPS would supplement FAA surveillance activities and help operators detect and correct any maintenance deficiencies.

¹³ According to 14 CFR 135.1, for many air tour operations that are conducted as non-stop sightseeing flights, only Part 91 maintenance regulations are applicable. Furthermore, many maintenance requirements exist in Part 135 that apply only to helicopters with 10 or more seats.

Therefore, the Safety Board believes that the FAA should work with independent safety programs, such as TOPS, to establish appropriate guidance for their members on how to develop and implement appropriate inspection and maintenance quality assurance programs and to encourage operators to participate in these voluntary programs.

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

Require that all air tour operators (14 *Code of Federal Regulations* Parts 91 and 135) establish and maintain a system for continuously analyzing the performance and effectiveness of their inspection and maintenance program to ensure that all maintenance is performed with the utmost regard for quality and safety. (A-08-32)

Require air tour operators to provide formal, model-specific helicopter maintenance training for their mechanics to ensure an adequate level of competency. (A-08-33)

Develop a mechanism to provide direct surveillance of air tour maintenance at all locations where a company's maintenance is conducted. (A-08-34)

Work with independent safety programs, such as the Tour Operators Program of Safety, to establish appropriate guidance for their members on how to develop and implement appropriate inspection and maintenance quality assurance programs and to encourage operators to participate in these voluntary programs. (A-08-35)

The Safety Board also issued safety recommendations to the Tour Operators Program of Safety.

In response to the recommendations in this letter, please refer to Safety Recommendations A-08-32 through -35. If you would like to submit your response electronically rather than in hard copy, you may send it to the following e-mail address: correspondence@ntsb.gov. If your response includes attachments that exceed 5 megabytes, please e-mail us asking for instructions on how to use our Tumbleweed secure mailbox procedures. To avoid confusion, please use only one method of submission (that is, do not submit both an electronic copy and a hard copy of the same response letter).

Chairman ROSENKER, Vice Chairman SUMWALT, and Members HERSMAN, HIGGINS, and CHEALANDER concurred with these recommendations.

[Original Signed]

By: Mark V. Rosenker
Chairman