Adopted 8/3/90

Log # 2227

National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: August 14, 1990
In reply refer to A-90-112 thru A-90-114

Honorable James B. Busey
Administrator
Federal Aviation Administration
Washington, D.C. 20591

On March 8, 1990, following an engine failure, an Aerospatiale AS350D helicopter, N5778W, executed an emergency autorotational landing into the Atlantic Ocean 3 miles off the coast of Miami, Florida. Immediately after the successful water landing, with the emergency floatation bags deployed, a large wave upended the helicopter. The pilot and two passengers exited the helicopter and remained with the overturned fuselage. The helicopter was not located for some 17 hours, and the two passengers drowned. The seriously injured pilot was rescued.

The examination of the Textron Lycoming LTS-101-600A2 engine, after the helicopter was recovered from the ocean, revealed that several blades of the power turbine wheel had failed. The blades, which had separated because of fatigue cracks near the root, penetrated the exhaust shroud and exited through the engine cowling. A more detailed examination of the power turbine showed that two additional blades were cracked in the root area of the trailing edge. The engine log card revealed that the power turbine wheel, PN 4-141-070-32, had been operated a total of 404 hours.

In 1986, this power turbine wheel was installed in another engine that had failed because of a fuel control problem. At the time, the engine had accumulated about 28 hours. That helicopter had also been ditched in the ocean but was recovered upright and in good condition. The engine was subsequently traded to the operator of N5578W with the stipulation that the engine was unserviceable but that some of the components might be determined airworthy if they passed inspection. In 1989, the power turbine wheel was placed in another engine and installed in N5778W. The blades had been inspected using fluorescent dye penetrant per Airworthiness Directive (AD) 87-11-09. This AD had been issued in May 1987 following reports of 12 blade fracture occurrences on the LTS-101 engine, one of which was an uncontained failure. The subject power turbine wheel blades were subsequently inspected for cracks, in accordance with the AD, 26 flight hours prior to the blade failures. The AD currently requires a fluorescent dye penetrant inspection for blade cracks every 50 operating hours.

The Textron Lycoming LTS-101 series engine is installed in the single engine Aerospatiale AS350D, the twin engine Bell 222, the Bolkow-Kawasaki BK117, and in the United States Coast Guard (USCG) Aerospatiale HH-65A search

and rescue helicopter. Several turboprop (LTP-101) versions are also in use. About 1500 LTS/LTP-101 engines are in service worldwide. The LTS-101 series engine has had a service history of recurring problems of blade cracks in the power turbine wheel in the trailing-edge root area. The PN 4-141-070-xx wheel contains 27 blades and is a one piece cast construction. The engine manufacturer has made many engineering and manufacturing changes to the wheel in an effort to improve its reliability.

A review of the FAA Service Difficulty Reports (SDR) from 1984 to the present has revealed 154 reports of LTS-101 power turbine wheel cracks. The USCG experience with the wheel has not been much better considering the limited number of helicopters in its HH-65 fleet. Recently, 153 Coast Guard engines were inspected and 24 power turbines were rejected for cracked blades.

The Coast Guard's inspection criteria differ from the airworthiness directive as follows. The inspection takes place every 30 operating hours or 20 cycles, whichever comes first. A cycle is accomplished after the power turbine speed exceeds 83 per cent. An eddy current inspection is conducted on the blades prior to the fluorescent dye penetrant inspection.

In 1987, the engine manufacturer introduced the PN 4-141-070-39 power turbine wheel into service. In addition to incorporating all previous engineering design changes, this wheel was manufactured to closer tolerances during the heat treating process. This activity was expected to eliminate or reduce the blade cracking problem. However, the Safety Board found that the SDRs list 16 wheels of this configuration that have also been found to have cracked blades. Operating times to crack detection range from as low as 41 hours to a high of 1,595 hours.

The Safety Board believes that, based on the above service history, the engine certification data should be reviewed to verify that the engine vibratory characteristics or the engine/airframe vibratory characteristics are not contributing to the premature fatigue failures of the power turbine blade.

The engine manufacturer recently designed and produced in limited quantity a power turbine wheel that incorporates insertable blades in lieu of a single piece casting. In an effort to accumulate sufficient operating time to establish reliability, about 30 of these wheels are in use by operators worldwide. If the operational testing is successful, the PN 4-141-170-xx series wheels will be replaced. The Safety Board commends the efforts of the manufacturer to solve the LTS-101 turbine wheel problem and believes that the new turbine wheel installation should be made mandatory as soon it can be made available to all operators of the engine. In the interim, the Board is concerned that the existing 50-hour inspection interval may be too great to be certain that fatigue cracks will be discovered before a blade can separate from the PN 4-141-070-39 and previous turbine wheels. The Board believes that the inspection interval used by the USCG is more appropriate.

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

Revise Airworthiness Directive (AD) 87-11-09 to decrease the existing 50-hour inspection interval for blade cracks on the LTS-101, PN 4-141-070-xx, power turbine wheel to an interval similar to that being used by the USCG. (Class II, Priority Action) (A-90-112).

Require replacement of the PN 4-141-070-xx power turbine wheels in LTS/LTP-101 series engines when the reliability of the newly designed wheel with insertable blades is proven, with the time of replacement contingent upon the engine manufacturers capability of manufacturing the new wheels in sufficient numbers. (Class III, Long Range Action) (A-90-113).

Review the certification data for the LTS/LTP-101 to verify that the vibratory characteristics of the engine rotor discs, rotor blades, and rotor shafts are not detrimental to the fatigue lives of the components when the engine is operated in its normal range of rotor speeds under both steady state and transient conditions. In addition, verify that the fatigue lives of engine components are not adversely affected by the vibratory characteristics of the helicopter. (Class III, Long Range Action). (A-90-114).

KOLSTAD, Chairman, COUGHLIN, Vice Chairman, and LAUBER and BURNETT, Members concurred in these recommendations.

By: James Kolstad
Chairman