# Aviation Investigation Final Report

| | | | |
|---|---|---|---|
| **Location:** | CAMERON, Missouri | **Accident Number:** | CHI93FA182 |
| **Date & Time:** | May 27, 1993, 06:26 Local | **Registration:** | N782LF |
| **Aircraft:** | AEROSPATIALE AS-350B | **Aircraft Damage:** | Destroyed |
| **Defining Event:** | | **Injuries:** | 2 Fatal, 2 Serious |
| **Flight Conducted Under:** | Part 135: Air taxi & commuter - Non-scheduled - Air Medical (Unspecified) | | |

## Analysis

LIFEFLIGHT HELICOPTER WAS EN ROUTE WITH PATIENT WHEN NURSE HEARD LOUD 'POP' FOLLOWED BY 'CLATTERING' & HORN ALARM. SOON THEREAFTER, HELICOPTER IMPACTED A FIELD ON SOUTHERLY HEADING ABOUT 70' SOUTH OF TALL TREES. GROUND SCARS & DEBRIS WERE LOCATED ALONG 150' BY 80' PATH. WITNESSES SAID WIND WAS STRONG/GUSTY FROM SOUTH. HELICOPTER WAS EQUIPPED WITH TURBOMECA ARRIEL 1B ENGINE WITH TU-76 MODIFICATION. IT HAD TOTAL FLIGHT TIME OF 2482 HOURS. RECOMMENDED TIME BETWEEN OVERHAUL WAS 2500 HOURS. INVESTIGATION REVEALED ENGINE LOST POWER DUE TO FAILURE OF LABYRINTH SEAL IN 2ND STAGE TURBINE NOZZLE GUIDE VANE. TUBOMECA PERSONNEL PROPOSED THAT UNDER THERMAL LOW CYCLE FATIGUE, A CRACK COULD INITIATE ON 2ND TURBINE NOZZLE GUIDE VANE HUB, WHICH COULD LEAD TO RUB BETWEEN INNER DIAMETER OF HUB & INNER TURBINE LABYRINTH LIPS. THERE WERE 7 ENGINE FAILURES OF SIMILAR NATURE, ALL RELATED TO TU-76 STANDARD NOZZLES. TURBOMECA SERVICE BULLETIN 292 72 0153 WAS ISSUED TO IMPROVE MECHANICAL STRENGTH OF INTERNAL ENVELOPE OF 2ND STAGE NOZZLE GUIDE VANE.

## Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: THE LOSS OF ENGINE POWER DUE TO FAILURE OF THE SECOND STAGE TURBINE LABYRINTH SEAL. FACTORS RELATED TO THE ACCIDENT WERE: THE UNFAVORABLE WIND AND TALL TREES BORDERING THE EMERGENCY LANDING AREA.

## Findings

Occurrence #1: LOSS OF ENGINE POWER(TOTAL) - MECH FAILURE/MALF
Phase of Operation: CRUISE - NORMAL

Findings
1. (C) TURBINE ASSEMBLY,AIR SEAL - FAILURE,TOTAL
2. TURBOSHAFT ENGINE,GAS GENERATOR TURBINE - FAILURE,TOTAL
---

Occurrence #2: FORCED LANDING
Phase of Operation: DESCENT - EMERGENCY

Findings
3. AUTOROTATION - PERFORMED - PILOT IN COMMAND
---

Occurrence #3: IN FLIGHT COLLISION WITH TERRAIN/WATER
Phase of Operation: LANDING

Findings
4. (F) WEATHER CONDITION - UNFAVORABLE WIND
5. (F) OBJECT - TREE(S)
6. MANEUVER - PERFORMED - PILOT IN COMMAND
7. FLARE - NOT ATTAINED - PILOT IN COMMAND

## Factual Information

HISTORY OF FLIGHT

On May 27, 1993, at 0626 central daylight time, an Aerospatiale AS 350B helicopter, N782LF, operated in emergency medical service by Rocky Mountain Helicopters, Inc. (dba Life Flight), impacted terrain during an emergency procedure in the vicinity of Cameron, Missouri. The helicopter was destroyed. The ATP pilot and the patient were fatally injured. The flight nurse (FN) and respiratory therapist (RT) received serious injuries. Visual meteorological conditions prevailed for the flight, no flight plan was filed. The flight operated under 14 CFR Part 135, and originated from Harrison County Hospital in Bethany, Missouri, approximately 0607. The intended destination was St. Luke's Hospital in Kansas City, Missouri.

Records indicate the accident flight originated when two Life Flight company helicopters launched from St. Luke's Hospital helipad on an "Air Standby" status. The accident helicopter lifted off at 0424 and was airborne when company dispatch personnel relayed the message that there would be one patient in critical condition to pick up at the hospital in Bethany, Missouri. The helicopter landed at Executive Beech Airport at 0428, took on fuel, and departed the airport bound for Bethany, Missouri at 0442.

Flight following records indicate the pilot made a routine position report with company dispatch at 0458. The pilot reported a heading of eighteen degrees, 39 Nautical Miles (NM) to destination, a ground speed of 163 knots, and 15 minutes estimated time en route. The dispatcher stated the pilot commented it would be "slow going coming back" due to headwinds.

The helicopter arrived at Bethany at 0513. Upon arrival at Bethany, the FN and RT entered the hospital to stabilize and prepare the patient for transport. The FN estimated this process took about 40 to 50 minutes, during which time the pilot remained with the helicopter. She stated after the patient was loaded and secured in the helicopter, the pilot performed a "walk around" inspection of the helicopter.

The helicopter departed Bethany approximately 0607. The FN reported the pilot had alerted them to the headwinds, and told them to expect the return trip to take longer. She stated the flight was smooth and uneventful until a couple of minutes after the pilot issued a position report at 0622. At that time she "...heard and could almost feel a loud "pop" and almost immediately after a "clattering" sound coming from behind our seats...we could hear the Horn alarm...and I noticed a bright white light in the lower left area of the instrument panel."

The FN stated she saw the pilot "...working with the collective and cyclic and the nose of the aircraft coming up...I remember a line of trees that we were approaching...I remember feeling

the sudden impact and then feeling a large amount of dirt and debris fly into my face." The FN estimated about 10 to 15 seconds elapsed between the "pop" and ground impact. She did not recall any discussion during the emergency procedure. The helicopter impacted terrain approximately 0626. Records indicate the wreckage was discovered by local residents about 0715.

Although it was not possible to determine the exact altitude at which the pilot conducted the accident flight, Life Flight personnel indicated they typically operated about 1,000 feet above ground level (AGL), with occasional variations based on weather, winds, obstacles, etc. One witness stated the helicopter flew past her house "...in a southerly direction at low altitude - 400 to 500 feet AGL... ." Witnesses and rescue personnel stated the winds were strong (estimated at 25 to 30 knots) out of the south the morning of the accident. Witness statements and the FN's statements are appended to this report.

CREW INFORMATION

The pilot held of Airline Transport Pilot Certificate #2197255, with airplane multi engine land privileges, commercial priveleges in airplane single engine land and rotorcraft/helicopter, and an instrument-helicopter rating, issued March 31, 1989. He held a Second Class medical certificate with no limitations, issued March 2, 1993. Copies of these forms are appended.

The pilot's flight logbook was not located during the course of the investigation. According to FAA records, the pilot had approximately 4,970 hours total flight time, including about 1,400 hours of military flight time. Records also indicated the pilot had averaged about 100 to 120 flight hours per year for the preceding three years. Life Flight records indicate the pilot had flown 5.5 hours during the month of May, 1993, with the most recent flight on May 25. Copies of FAA and Life Flight records are appended to this report.

Life Flight records indicate the pilot completed his most recent FAR Part 135 proficiency check on August 29, 1992, with the next check due in July, 1993. The FAA Form 8410-3, FAR 135 Airman Competency/Proficiency Check, indicated the flight check was accomplished in 0.8 hours, with all tested flight maneuvers graded satisfactory ("S"). Under the title "Helicopter", simulated engine failure, autorotations, and hover rotations were marked "S". A copy of the proficiency check form is appended to this report.

Life Flight's Aviation Manager reported the company did not perform practice autorotations to touchdown. He stated they simulated autorotations with no power reduction, and terminated in a hover at three feet above the ground. They would then transition to a nearby area for hover autorotation practice. He indicated the pilot had probably not performed an autorotation to actual touchdown during the seven years he had been employed by Life Flight.

AIRCRAFT INFORMATION

A review of maintenance records revealed the helicopter was maintained in accordance with

Federal Regulations and manufacturer's guidelines.

COMMUNICATIONS

Company dispatch personnel provide "flight following" services for Life Flight operations. Company procedure calls for pilots to transmit departure and arrival reports, as well as position reports every 15 minutes. At 0458, the pilot radioed a position report to dispatch personnel which included an en route ground speed of 163 knots. He commented it would be "...slow going coming back." The pilot transmitted a position report at 0513, indicating the helicopter was on final approach to the hospital at Bethany.

Records indicate the helicopter departed Bethany at 0607. Dispatch did not receive a departure report from the pilot, but did receive a standard position report at 0622. Dispatch personnel regarded the failure to receive a departure report as "unusual, but not real remarkable," and attributed it to distance and altitude. The 0622 position report indicated a heading of 195 degrees, 52 nautical miles (NM) to destination, 93 knots ground speed, and an estimated time en route of 34 minutes.

According to Life Flight personnel, when the pilot failed to make his next routine position report at 0637, Dispatch personnel initiated the preaccident plan. Attempts to reestablish ground-air radio communication with the helicopter were unsuccessful. Another Life Flight helicopter, airborne in the vicinity, was unable to establish radio or visual contact with the accident helicopter.

In accordance with company policy, when the pilot missed the second consecutive position report at 0652, dispatch initiated a ground search. The dispatcher stated this involved telephone calls to en route/area hospitals, police and fire departments, other EMS aircraft, the FAA, etc. At 0656, when the helicopter was overdue at the destination hospital, Life Flight personnel initiated a full (air and ground) Law Enforcement search.

WRECKAGE/IMPACT INFORMATION

The helicopter impacted terrain in a field located three miles northwest of Cameron, Missouri. It impacted the ground on a south-southwesterly heading, in a field seeded with corn. A small wooded area was located on the north edge of the cornfield, populated with trees approximately 60 feet tall. There was no evidence of impact with trees. The initial impact mark was located about 70 feet south of the wooded area. Ground scars and debris were located along a 150 foot long, 80 foot wide path, which extended in a southerly direction from the northernmost impact mark. Photographs and a wreckage diagram are appended to this report.

The helicopter was removed from the field and transferred to a hangar at the Cameron Airport for reconstruction and further examination. Flight control continuity was established, and there was no evidence of preimpact airframe anomaly. Damage to the engine precluded a field

teardown, so the engine was crated and shipped to Turbomeca Engine Corporation for disassembly. Engine teardown revealed the labyrinth seal which is part of the second stage nozzle guide vane had separated from the nozzle. The total time on the part was 2,482 hours, and the manufacturer's recommended time between overhaul (TBO) of 2,500 hours. Copies of the teardown report and subsequent metallurgical examination factual report are appended to this report.

MEDICAL/PATHOLOGICAL INFORMATION

Autopsy and toxicological examinations revealed no evidence of preimpact anomaly. The autopsy (#93 ME 416) was conducted on May 28, 1993, by Dr. John Overman, Chief Medical Examiner of the Jackson County Medical Examiner's Office, 2301 Holmes Street, Kansas City, Missouri, 64108.

ADDITIONAL INFORMATION

Turbomeca personnel described the proposed failure mode as follows: "Under thermal low cycle fatigue a crack may initiate on the 2nd turbine nozzle guide vane hub...After initiation the crack develops as the subsequent distortion leads to rub between the inner diameter of the hub and the inner turbine labyrinth lips."

Turbomeca representatives reported "There is no possibility to inspect with enough assurance the presence of crack by endoscope but the deterioration is indicated by noise at [coastdown]. If not detected by noise at auto-rotation or by check of the free rotation of the gas generator...the crack may develop up to complete opening. The rub between the nozzle hub and the 2nd stage turbine rotor leads to the destruction of the hub and deterioration of the downstream gas generator and free turbine components."

According to Turbomeca records, there were 7 known previous incidents/accidents due to engine failures of a similar nature. The manufacturer also reported numerous cracks discovered during repair/overhaul. Manufacturer's representatives reported all known events have been related to the TU 76 standard nozzle, which was installed on the accident helicopter. Turbomeca indicated service history on the TU 76 revealed "...that the front end of the hub was not enough damage tolerant to possible small manufacturing deviations of the inner radius."

Turbomeca has two modified nozzles available, the TU 197 and TU 202. Manufacturer's representatives stated "...The TU 197 design has the same function of accepting radial movements of the hub through a flexible assembly on the same basic principle as the TU 76...," but there are fewer sharp corners and the front and rear rings were repositioned to contact the lower faces of the nozzle. Diagrams are appended. The TU 202 modification retained the TU 76 standard design, "...with enhanced precautions for the inner radius manufacture and inspection and with a change of material (NC 20T to INCO 718) in order to have higher resistance to fatigue." Diagrams and statements are appended.

As a result of these occurrences, Turbomeca issued two Service Letters, #1406 dated December 18, 1992, and #1526 dated April 13, 1993. These letters suggested rub (crack) detection actions. Turbomeca Service Bulletin #292 72 0181 (mandatory) dated July 13, 1993, also addresses rub detection actions. Federal Aviation Administration (FAA) Airworthiness Directive (AD) 93-23-09, effective December 15, 1993, made rub detection actions mandatory. Turbomeca also issued two Service Bulletins, #292 72 0150 (recommended) dated March 31, 1992, and #292 72 0153 (optional) dated January 25, 1993, addressing modifications TU 197 and TU 202. Copies of these Service Letters/Bulletins/ADs are appended.

The checklist used by Life Flight personnel for the Model AS350 Daily Preflight/Postflight Airworthiness inspections contained the instruction: "Perform compulsory check of the noise at rundown - After the last flight of the day or at least once a day in accordance with Service Letter 1406/91/ARL/1 2nd issue." Excerpts from the checklist are appended.

## Pilot Information

| | | | |
|---|---|---|---|
| **Certificate:** | Airline transport; Commercial | **Age:** | 40,Male |
| **Airplane Rating(s):** | Single-engine land; Multi-engine land | **Seat Occupied:** | Right |
| **Other Aircraft Rating(s):** | Helicopter | **Restraint Used:** | |
| **Instrument Rating(s):** | Airplane; Helicopter | **Second Pilot Present:** | No |
| **Instructor Rating(s):** | None | **Toxicology Performed:** | Yes |
| **Medical Certification:** | Class 2 Valid Medical--no waivers/lim. | **Last FAA Medical Exam:** | March 2, 1993 |
| **Occupational Pilot:** | Yes | **Last Flight Review or Equivalent:** | |
| **Flight Time:** | 4970 hours (Total, all aircraft), 764 hours (Total, this make and model), 17 hours (Last 90 days, all aircraft), 10 hours (Last 30 days, all aircraft), 1 hours (Last 24 hours, all aircraft) | | |

## Aircraft and Owner/Operator Information

| | | | |
|---|---|---|---|
| **Aircraft Make:** | AEROSPATIALE | **Registration:** | N782LF |
| **Model/Series:** | AS-350B AS-350B | **Aircraft Category:** | Helicopter |
| **Year of Manufacture:** | | **Amateur Built:** | |
| **Airworthiness Certificate:** | Normal | **Serial Number:** | 1487 |
| **Landing Gear Type:** | Skid | **Seats:** | 4 |
| **Date/Type of Last Inspection:** | May 16, 1993 AAIP | **Certified Max Gross Wt.:** | 4630 lbs |
| **Time Since Last Inspection:** | 13 Hrs | **Engines:** | 1 Turbo shaft |
| **Airframe Total Time:** | 6064 Hrs | **Engine Manufacturer:** | TURBOMECA |
| **ELT:** | Installed, activated, did not aid in locating accident | **Engine Model/Series:** | ARRIEL 1B |
| **Registered Owner:** | ROCKY MOUNTAIN HELICOPTERS, IN | **Rated Power:** | 684 Horsepower |
| **Operator:** | ROCKY MOUNTAIN HELICOPTERS | **Operating Certificate(s) Held:** | On-demand air taxi (135) |
| **Operator Does Business As:** | LIFE FLIGHT | **Operator Designator Code:** | DYRA |

## Meteorological Information and Flight Plan

| | | | |
|---|---|---|---|
| **Conditions at Accident Site:** | Visual (VMC) | **Condition of Light:** | Day |
| **Observation Facility, Elevation:** | | **Distance from Accident Site:** | |
| **Observation Time:** | | **Direction from Accident Site:** | |
| **Lowest Cloud Condition:** | Unknown | **Visibility** | 15 miles |
| **Lowest Ceiling:** | Broken / 12000 ft AGL | **Visibility (RVR):** | |
| **Wind Speed/Gusts:** | 20 knots / 30 knots | **Turbulence Type Forecast/Actual:** | / |
| **Wind Direction:** | 210° | **Turbulence Severity Forecast/Actual:** | / |
| **Altimeter Setting:** | 29 inches Hg | **Temperature/Dew Point:** | 13°C |
| **Precipitation and Obscuration:** | No Obscuration; No Precipitation | | |
| **Departure Point:** | BETHANY , MO (NONE) | **Type of Flight Plan Filed:** | Company VFR |
| **Destination:** | KANSAS CITY , MO (MO21) | **Type of Clearance:** | None |
| **Departure Time:** | 06:07 Local | **Type of Airspace:** | Class G |

## Airport Information

| | | | |
|---|---|---|---|
| **Airport:** | | **Runway Surface Type:** | |
| **Airport Elevation:** | | **Runway Surface Condition:** | |
| **Runway Used:** | 0 | **IFR Approach:** | |
| **Runway Length/Width:** | | **VFR Approach/Landing:** | Forced landing |

## Wreckage and Impact Information

| | | | |
|---|---|---|---|
| **Crew Injuries:** | 1 Fatal, 2 Serious | **Aircraft Damage:** | Destroyed |
| **Passenger Injuries:** | 1 Fatal | **Aircraft Fire:** | None |
| **Ground Injuries:** | N/A | **Aircraft Explosion:** | None |
| **Total Injuries:** | 2 Fatal, 2 Serious | **Latitude, Longitude:** | 39.739589,-94.230873(est) |

## Administrative Information

| | |
|---|---|
| **Investigator In Charge (IIC):** | Reeves, Jodi |
| **Additional Participating Persons:** | DICK CODDINGTON; KANSAS CITY , MO<br>STEVE DAVIS; KANSAS CITY , MO<br>JAMES R ARNOLD; FORT WORTH , TX |
| **Original Publish Date:** | June 24, 1994 |
| **Last Revision Date:** | |
| **Investigation Class:** | Class |
| **Note:** | |
| **Investigation Docket:** | https://data.ntsb.gov/Docket?ProjectID=9165 |