Aviation Investigation Final Report

Location:	Hayward, California	**Accident Number:**	LAX01TA119
Date & Time:	March 17, 2001, 21:34 Local	**Registration:**	N996PD
Aircraft:	Eurocopter France AS350-B2	**Aircraft Damage:**	Substantial
Defining Event:		**Injuries:**	3 None
Flight Conducted Under:	Public aircraft		

Analysis

The airline transport certificated helicopter pilot was conducting nighttime aerial surveillance in support of law enforcement activities over a densely populated residential area. As he orbited the helicopter about 600 feet above a residential area, all engine power was lost. The pilot entered an autorotation, and attempted to make an emergency landing on a residential lawn, located within the dimly lit residential area. The helicopter struck a small gauge residential power supply line that was stretched across the emergency glide path. After striking the power line, the helicopter landed hard and nosed down, coming to rest in the front lawn of a residence. The helicopter sustained substantial damage to the main rotor hub assembly (starflex), tail boom, and fuselage. Postaccident examination of the Turbomeca Arriel 1D1 turbo shaft engine revealed a fractured bevel gear, part number 0292107960, located in the engine accessory gearbox. A metallurgical examination of the fractured bevel gear disclosed evidence of radial cracks between the teeth of the gear, consistent with high cycle fatigue (HCF) phenomenon. As a result, Turbomeca issued a service letter to all operators of Arriel engines outlining an inspection method for engines currently in service, suggesting that the bevel gear will be checked systematically. The service letter reported, in part: "The fracture was the result of a fatigue propagation. Metallurgical and dimensional analyses have not revealed any defect." The failure of the accessory bevel gear will result in the failure of the fuel pump and fuel control unit, and a loss of engine power.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: The fatigue fracture of the engine accessory drive gear while maneuvering, which resulted in a loss of engine power and collision with a residential transmission line during the ensuing forced landing. A factor associated with the accident was the residential transmission line.

Findings

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

Findings
1. (C) ACCESSORY DRIVE ASSY,DRIVE GEAR - FATIGUE
2. (C) ACCESSORY DRIVE ASSY,DRIVE GEAR - FRACTURED

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

Occurrence #3: IN FLIGHT COLLISION WITH OBJECT
Phase of Operation: EMERGENCY DESCENT/LANDING

Findings
3. (F) OBJECT - WIRE,TRANSMISSION

Occurrence #4: HARD LANDING
Phase of Operation: EMERGENCY LANDING

Findings
4. TERRAIN CONDITION - GROUND

Factual Information

On March 17, 2001, about 2134 pacific standard time, an American Eurocopter AS350-B2 helicopter, N996PD, sustained substantial damage following a loss of engine power, and a forced landing in a residential area in Hayward, California. The helicopter collided with a set of small gauge power lines during the emergency descent. The helicopter was being operated as a visual flight rules (VFR) public use law enforcement flight under Title 14, CFR Part 91 when the accident occurred. The East Bay Regional Park District police department operated the helicopter. The airline transport certificated pilot and the two passengers were not injured. Visual meteorological conditions prevailed at the time of the accident, and company flight following procedures were in effect. The accident occurred during dark night conditions. The flight originated at the Hayward Executive Airport, Hayward, about 1955.

According to the operator's written report, the purpose of the flight was to conduct nighttime aerial surveillance in support of law enforcement activities over the city of Hayward. The operator reported that as the pilot orbited the helicopter about 600 feet above a residential area while in search of a suspect, all engine power was lost. The pilot entered an autorotation and attempted an emergency landing on a residential lawn, located within the dimly lit residential area. During the emergency descent, just before touchdown, the helicopter struck a small gauge residential power supply line that was stretched across the glide path. After striking the power line the pilot attempted to cushion the landing, but the helicopter landed hard, and nosed down. The helicopter came to rest upright, in the front lawn of a residence. It sustained substantial damage to the main rotor hub assembly (starflex), tail boom, and fuselage.

The accident helicopter was subsequently recovered from the accident site, and transported to the operator's maintenance facility. The engine was removed and shipped to the engine manufacturer.

The accident helicopter was equipped with a Turbomeca Arriel 1D1 turbo shaft engine, which is comprised of several modules/components. Module 1 includes the accessory gearbox section, the fuel control unit, which is a hydro-mechanical design, and the freewheeling unit shaft and power shaft housed in a liaison tube that runs longitudinally under the engine between the accessory case and the reduction gearbox. Module 2 is comprised of the axial compressor wheel. Module 3 includes the centrifugal compressor, combustion chamber, and two gas generator turbines. Module 4 is the power (free) turbine wheel and shaft. Module 5 is the reduction gearbox.

TEST AND RESEARCH

On March 27, 2001, a postaccident disassembly and examination of the accident engine was conducted at Turbomeca's analytical facility in Grand Prairie, Texas. In attendance was a Federal Aviation Administration inspector from the Rotorcraft Directorate, Ft. Worth, Texas, and air safety investigators from American Eurocopter Corporation and Turbomeca. The inspection revealed a fractured bevel gear, part number 0292107960, located in the engine's accessory gearbox, in Module 1. According to an air safety investigator from Turbomeca, the fracture of the bevel gear will disable all mechanically driven accessories, including the fuel control unit and the fuel pump, resulting in a loss of engine power.

The operator reported that the fractured bevel gear had accumulated about 1,025 hours in operation.

During the course of the investigation, Turbomeca disclosed that they had experienced three separate events of bevel gear fractures in Arriel series engines.

At the direction of the National Transportation Safety Board (NTSB) investigator-in-charge (IIC) the fractured bevel gear was removed from the accident engine and sent to Turbomeca's materials laboratory in France for examination.

Metallurgical Examination

A Turbomeca metallurgist stated in a written report dated May 29, 2001, that the material used to construct the bevel gear met the specification requirements for hardness and microstructure. Additionally, the metallurgist reported that the fractured bevel gear displayed evidence of radial cracks between the teeth of the gear, which was consistent with high cycle fatigue (HCF) phenomenon.

A complete copy of Turbomeca's metallurgical examination report is included in the public docket for this accident.

Additional Information

On June 28, 2001, Turbomeca issued a service letter to all operators of Arriel engines. The service letter reported on the four previous bevel gear failures, and outlined an inspection method for engines currently in service, suggesting: At each return to a Turbomeca approved service repair center, the bevel gear will be checked systematically. The service letter reported, in part: "The fracture was the result of a fatigue propagation. Metallurgical and dimensional analyses have not revealed any defect."

The helicopter was released to the operator on March 17, 2001, and the engine was released to the operator on July 9, 2001.

Pilot Information

Certificate:	Airline transport	**Age:**	43,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):	Airplane multi-engine; Airplane single-engine; Helicopter; Instrument airplane; Instrument helicopter	**Toxicology Performed:**	No
Medical Certification:	Class 2 With waivers/limitations	**Last FAA Medical Exam:**	April 14, 2002
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	December 10, 1999
Flight Time:	5293 hours (Total, all aircraft), 1576 hours (Total, this make and model), 5036 hours (Pilot In Command, all aircraft), 64 hours (Last 90 days, all aircraft), 31 hours (Last 30 days, all aircraft), 6 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	Eurocopter France	**Registration:**	N996PD
Model/Series:	AS350-B2	**Aircraft Category:**	Helicopter
Year of Manufacture:		**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	3168
Landing Gear Type:	Skid	**Seats:**	6
Date/Type of Last Inspection:	January 1, 2001 100 hour	**Certified Max Gross Wt.:**	4961 lbs
Time Since Last Inspection:	77 Hrs	**Engines:**	1 Turbo shaft
Airframe Total Time:	1025 Hrs at time of accident	**Engine Manufacturer:**	Turbomeca
ELT:	Not installed	**Engine Model/Series:**	Arriel 1D1
Registered Owner:	EAST BAY REGIONAL PARK DISTRICT	**Rated Power:**	732 Horsepower
Operator:	EAST BAY REGIONAL PARK DISTRICT	**Operating Certificate(s) Held:**	None

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Night/dark
Observation Facility, Elevation:	OAK,6 ft msl	**Distance from Accident Site:**	5 Nautical Miles
Observation Time:	21:53 Local	**Direction from Accident Site:**	270°
Lowest Cloud Condition:	Clear	**Visibility**	10 miles
Lowest Ceiling:	None	**Visibility (RVR):**	
Wind Speed/Gusts:	5 knots /	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	350°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	30.14 inches Hg	**Temperature/Dew Point:**	9°C / 9°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Hayward, CA (HWD)	**Type of Flight Plan Filed:**	None
Destination:		**Type of Clearance:**	None
Departure Time:	19:55 Local	**Type of Airspace:**	Class B

Wreckage and Impact Information

Crew Injuries:	2 None	**Aircraft Damage:**	Substantial
Passenger Injuries:	1 None	**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	3 None	**Latitude, Longitude:**	37.630676,-122.040351(est)

Administrative Information

Investigator In Charge (IIC):	Parker, Richard
Additional Participating Persons:	Archie Whitten; Turbomeca Engine Corporation; Grand Prairie, TX Ken Arnold; American Eurocopter; Grand Prairie, TX Randy F Parent; East Bay Regional Park District; Oakland, CA James Carver; American Eurocopter; Grand Prairie, TX Haskell Wells ; Federal Aviation Administration ; Fort Worth, TX
Original Publish Date:	November 29, 2006
Last Revision Date:	
Investigation Class:	Class
Note:	The NTSB traveled to the scene of this accident.
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=51928