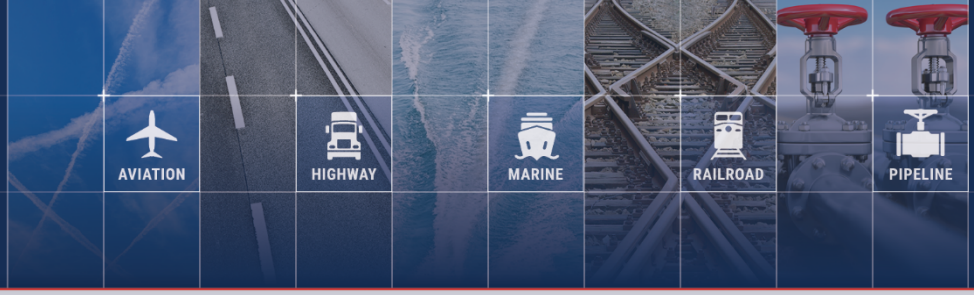

Aviation Investigation Final Report

Location:	Dallas, Texas	**Accident Number:**	FTW03FA211
Date & Time:	September 3, 2003, 19:59 Local	**Registration:**	N143CF
Aircraft:	Agusta A109E	**Aircraft Damage:**	Substantial
Defining Event:		**Injuries:**	1 Minor, 2 None
Flight Conducted Under:	Part 91: General aviation - Positioning		

Analysis

During departure from a rooftop helipad, the pilot reported the helicopter sustained a loss of engine power and he aborted the takeoff. During the aborted takeoff, a main landing gear struck a safety fence, the main rotor blades contacted the helipad, the helicopter rolled over and came to rest on the helipad. According to the pilot and medical crew, the engine start-up and before takeoff checks were normal. While in a 3 to 4-foot hover above the helipad, the pilot verified the engine and systems prior to departure. As the helicopter transitioned over the edge of the rooftop, the engine warning horn sounded and warning and caution lights illuminated. The medical crew reported the engine and rotor noise suddenly decreased, and noticed a slight drop in altitude. After the helicopter came to rest, the engines were still running at an unknown power level, and the pilot and medical crew shutdown the engines. No anomalies were noted during the functional tests and examinations of the engines and helicopter systems. The reason for the reported loss of engine power was not determined.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: The reported loss of engine power for undetermined reasons. A contributing factor was the failure to maintain clearance with the safety fence during the aborted takeoff, which resulted in a dynamic rollover of the helicopter.

Findings

Occurrence #1: LOSS OF ENGINE POWER
Phase of Operation: TAKEOFF

Findings
1. (C) REASON FOR OCCURRENCE UNDETERMINED

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

Occurrence #3: IN FLIGHT COLLISION WITH OBJECT
Phase of Operation: TAKEOFF - ABORTED

Findings
2. ABORTED TAKEOFF - INITIATED - PILOT IN COMMAND
3. OBJECT - FENCE
4. (F) CLEARANCE - NOT MAINTAINED - PILOT IN COMMAND
5. (F) DYNAMIC ROLLOVER - ENCOUNTERED - PILOT IN COMMAND

Factual Information

HISTORY OF FLIGHT

On September 3, 2003, approximately 1959 central daylight time, an Agusta A109E twin-engine helicopter, N143CF, sustained substantial damage when it impacted a safety fence and rolled over during an aborted takeoff following a partial loss of engine power from the Methodist Dallas Medical Center helipad, near Dallas, Texas. The commercial pilot sustained minor injuries, the flight paramedic and flight nurse were not injured. The helicopter was registered to and operated by North Central Texas Services, Inc., Grand Prairie, Texas, doing business as (d.b.a.) CareFlite. Night visual meteorological conditions prevailed, and a company flight plan was filed for the 14 Code of Federal Regulations Part 91 positioning flight. The flight was originating at the time of the accident and was responding to a medical emergency near Crowley, Texas.

Prior to departure, the pilot performed his normal walk around inspection and no anomalies were noted. After boarding the helicopter, the pilot turned the #2 engine Power Management Switch (PMS) to the IDLE position, the #2 engine stabilized, and the pilot turned the switch to FLT (100 percent) position. The pilot then completed the same engine start sequence with the #1 engine. After the engine starts and before takeoff checks were complete, the pilot brought the helicopter to a hover.

While in a 3 to 4-foot hover above the helipad, the pilot verified "all pressure and temps normal." After the nurse and paramedic stated they were ready for takeoff, the pilot applied power for takeoff, and "the [RPM selector switch] was applied to 102 percent at the same time." The pilot stated, "just as we were going over the edge [of] the helipad (to the north), we started a slight climb, but had not reached CDP (critical decision point). As the fuselage cleared the helipad, the engine out warning horn sounded, accompanied by both yellow and red warning lights on the instrument panel. [The pilot] quickly glanced at the power settings and stats were going down, "red and yellow lights were flashing," and he heard "ding-dongs, bells and whistles."

The pilot aborted the takeoff and attempted to land back onto the helipad. During the attempted landing, one of the main landing gears struck a safety fence, and subsequently, the helicopter rolled over. The main rotor blades contacted the helipad, and the helicopter came to rest on its right side on the helipad. After the helicopter came to rest, the engines were running at an unknown power level; and the pilot turned both engine mode switches to the IDLE position, and the #2 PMS to the OFF position. Due to the pilot partially pinned by the helicopter, he was unable to turn the #1 PMS from the IDLE to the OFF position and was assisted by the flight nurse. The flight nurse turned the switch to the OFF position, and the pilot turned off the fuel switches.

The flight nurse, who was seated in the left front, stated that after she entered the helicopter, the pilot turned the #2 PMS to the fly position, and the #1 PMS to the idle position. The flight nurse obtained the destination coordinates from the communication center and entered them into the global positioning system (GPS). While in the hover and prior to transitioning forward, the nurse heard the pilot say "102 percent (RPM selector switch), three in the green (landing gear)." As the helicopter transitioned forward,

the flight nurse "could hear the engines powering back and a slight drop in altitude." The pilot stated they had a problem, and the nurse noted "red lights" on the instrument panel. The flight nurse turned off the left (#1) PMS, and the pilot turned off the right (#2) PMS.

The flight paramedic, who was seated in the right forward-facing rear seat, stated that prior to takeoff, "all engine noise sounded as though [the engines] both were at flight RPM... As we came over the net and walkway, building edge, [the paramedic] heard a sudden decrease in the noise that [he] would associate with the engines and main rotor, and felt the aircraft start to descend." The paramedic looked at the instrument panel and saw two warning indicator lights flashing.

PERSONNEL INFORMATION

The pilot was hired by CareFlite on April 17, 1996. On July 31, 2002, the pilot completed the Agusta A109E initial flight course and pilot transition ground course, which was administered by Agusta Aerospace Corporation, Grand Prairie, Texas. On September 18, 2002, he satisfactorily completed his most recent annual recurrent ground and flight training for the A109E. According to the flight maneuver grade sheet (Federal Aviation Administration (FAA) Form 8410-3), the pilot received a satisfactory rating for simulated engine failure, and landing with simulated power plant (s) failure.

The pilot held a commercial certificate with a rotorcraft helicopter and instrument helicopter ratings. The pilot was issued a second class medical certificate with a limitation for corrective lenses. According to the Pilot/Operator Aircraft Accident Report (NTSB Form 6120.1/2) completed by CareFlite, the pilot had accumulated approximately 8,000 rotorcraft flight hours. In an interview with the NTSB investigator-in-charge, the pilot stated he had accumulated approximately 200 flight hours in the accident helicopter make and model.

The two flight crewmembers, a flight nurse and flight paramedic, were employed by CareFlite.

AIRCRAFT INFORMATION

The 2002-model orange, blue and white helicopter, serial number 11142, was powered by two 561-horsepower Pratt and Whitney Canada, Inc. (PWC) PW206C turbo shaft engines, serial numbers PC-E BC0315 and PC-E BC0320, left and right respectively, and equipped with a four bladed main rotor system, and a two bladed tail rotor.

The two engines are controlled by the PW206C Engine Control System, which controls the engine power plant by scheduling fuel flow in response to the load demanded by the helicopter's rotor system. The Engine Control System is comprised of two major components, an engine mounted Fuel Metering Module (FMM) and an off-mounted Electronic Engine Control (EEC). The system was also comprised of sensors, wiring harnesses, and ancillary components. The FMM is an electro-hydromechanical unit to modulate the engine fuel flow over the operational envelope of the engine. The unit has automatic and mechanical backup modes of operation.

According to PWC, the EEC is a single channel digital Electronic Engine Control used in conjunction with the FMM and a network of sensors to control the engine gas generator and power turbine speeds. The EEC is a full authority as it controls fuel from start to full power within the established limits. The EEC controls the engine for normal flight, with selection provided through the console mounted PMS switches. The 3 modes are as follows: OFF: Fuel shutoff by the shutoff solenoid; IDLE: Control governs

the power turbine (Npt) at a speed of approximately 65 percent Npt; FLT: Control provides power turbine/main rotor speed governing at the nominal governing speed (100 percent or 102 percent). A Limit Override switch, located on the collective, is available for emergency situations to allow the EEC to operate the engine above pre-determined limits. The system is also equipped with a one engine inoperative (OEI) toggle switch, which simulates OEI that is governed approximately 90 percent Npt.

There are two cockpit indications to warn the pilot that the EEC is not operating normally. A "Caution" (yellow) annunciator indicates that the control system is operating with a system fault (non-critical fault) which may result in degraded engine operation. Full governing by the EEC is maintained during this mode, and a fault code is stored by the EEC. A "Warning" (red) annunciator indicated that the control system is not operating (critical fault), and the control reverts to the manual mode of operation. The EEC Warning indication will illuminate, the torque motor will be inhibited and the Ng governor will take over control and maintain the same fuel flow as that at the time of the malfunction. The pilot then has the option of leaving the fuel flow fixed, or using an overhead power lever (PLA) to adjust fuel flow.

According to Agusta, the flight crew is alerted to airframe and engine warnings and cautions by flashing master red warning and yellow caution lights located on the instrument panel. The warnings are accompanied by an audio warning tone and by a vocal warning. The warnings and cautions are also displayed on the electronic display units (EDUs) in a text format.

The RPM selector switch is a toggle switch located on the collective, which can be selected to 100 percent or 102 percent. The switch adjusts the tail rotor RPM from 100 percent to 102 percent. Agusta recommends the 102 percent position during takeoff, landing and hovering.

The helicopter was maintained in accordance with the approved aircraft inspection program on a continuous basis. The A109E standard 150-hour/annual inspection was started on July 22, 2003, at a total airframe and engine time of 601.1 hours. At the time of the accident, the airframe and engines had accumulated a total of 683.3 hours since new.

A review of the engine logbooks revealed the 12 month engine inspection was started on April 28, 2003, at a total time of 436.8 hours on both engines. On August 8, 2003, the aircraft logbook revealed the following discrepancy and corrective action, "#1 engine oil hot light illuminated in flight. Removed [engine] 1 thermostatic valve...installed serviceable [engine] 1 thermostatic valve...[engine] 1 oil temp airworthy...[aircraft] returned to service." According to the aircraft logbook, on September 3, 2003, at a total of 682.5 hours, a 200-hour performance recovery wash was completed on both engines in accordance with the PWC maintenance manual. No uncorrected maintenance discrepancies were noted in the maintenance logbooks. A review of "Engine Trend Monitoring Data," an engine analysis program which CareFlite started on July 18, 2003, revealed no anomalies with the left or right engines.

AERDOME INFORMATION

The hospital helipad was comprised of two concrete rooftop helipads, with one helipad identified as "1", and the other identified as "2" and "3". The helipad surfaces were constructed of concrete, with the #1 helipad identified with a medical symbol painted in blue and lights, and #2 and #3 identified with white paint. The two helipad surfaces were surrounded by a horizontally installed chain link fence. The chain link fence served as a safety shelf, and no objects were designed to protrude above the landing area. A

concrete sub-walkway, located below the chain link fence, surrounded the two helipad surfaces. The two helipads were separated by the concrete sub-walkway and then connected by a flat concrete walkway.

METEOROLOGICAL INFORMATION

At 1953, the Dallas Executive Airport automated surface observing system, located approximately 2 miles south of the accident site, reported the wind from 010 degrees at 6 knots, 10 statute miles visibility, scattered clouds at 8,000 feet, temperature 81 degrees Fahrenheit, dew point 70 degrees Fahrenheit, and an altimeter setting of 30.01 inches of mercury.

WRECKAGE AND IMPACT INFORMATION

The helicopter came to rest on its right side on the helipad identified as "2". The chain link fence, which surrounded helipad 1 and 2, was damaged near the concrete sub-walkway. Fractured main rotor blades sections were found scattered throughout the helipad and the surrounding streets and rooftops. White, blue, and orange paint transfers were located on the steel chain link fence structure and the concrete walls and helipad surfaces. The helicopter was recovered to the facilities of Air Salvage of Dallas (ASOD), near Lancaster, Texas, for further examination.

On September 5th, the wreckage was examined at Air Salvage of Dallas under the supervision of the NTSB investigator-in-charge and representatives from the Federal Aviation Administration, Agusta Aerospace, Pratt and Whitney, CareFlite, and Omniflight. The right side of the fuselage displayed scratches and damaged fiberglass, the right horizontal stabilizer and vertical stabilizer were damaged, and the three landing gears were in the extended and locked position.

All four blade grips were sheared from their respective elastomeric bearings. The outboard rod end of damper was connected, and the damper was open. The main rotor blades were fragmented and destroyed, and all main blade spars were fractured. One tail rotor blade displayed tip damage, and the other tail rotor blade appeared undamaged.

The main transmission and tail rotor gearbox were intact and free to rotate. The two main and tail rotor drive shafts were intact. The tail rotor drive system bearings were intact and no evidence of slippage was noted. Flight control continuity was noted from the cyclic and collective to the mixing unit and from the anti-torque pedals to the tail rotor. The three mixing to swash plate servo fittings were sheared at the bottom fittings, and the swash plate bearing was intact.

The cockpit and cabin area displayed minor damage. The PMSs were in the OFF position, the PLAs were in flight position, and the collective power switch was at 102 percent. The two engine governor switches were in the AUTO position.

The two engines appeared intact and were subsequently removed for further examination at the manufacturer's facility. The EEC's fault code data was downloaded by Pratt and Whitney personnel, and the data was electronically sent to PWC for analysis by PWC engineers.

Analysis of the EEC's data by PWC engineers revealed the right engine reverted to manual mode due to a NF/Q (torque) fault, which was recorded at 94.2 percent Ng speed. According to PWC, this reversion may have occurred during the sequence where the pilot was trying to control the aircraft or at impact of

the rotor with the helipad. The following faults and corresponding Ng speeds were recorded for the right engine:

EEC Fail Solenoid W/A - 91.4 percent
PLA Brake W/A - 91.6 percent
NF/Q Probe A - 91.0 percent
NF/Q Probe B - 90.6 percent
LCF counting disable - 90.6 percent
Inlet Temperature Cross Check - 85.6 percent
NF/Q Fault - 94.2 percent

The left engine did not indicate a reversion to manual mode; however, a Nr (rotor speed) fault was recorded at the time the engine was at 63.7 percent Ng speed. The following faults and corresponding Ng speeds were recorded for the left engine:

Rotor Speed Fault - 63.7 percent
Inlet Temperature Crosscheck - 15.8 percent

PATHOLOGICAL INFORMATION

On September 4, 2003, after the accident, the pilot was administered a toxicological test by Quest Diagnostics, near Irving, Texas. The test was negative for all screened substances.

TEST AND RESEARCH

On September 12, 2003, at the facilities of ASOD under the supervision of the NTSB IIC, Agusta representatives functionally tested the electrical to power plant system interface. The functional checks were conducted in accordance with Agusta Technical Note AAC-PSE-03-0912A, obtained as a translation of the pertinent paragraphs of Agusta Engineering Report 109-75-179 Rev. C. "A109E electrical system test procedure specification." According to Agusta's conclusions, "The test can be considered satisfactory, with all examined systems and functions performed correctly. The only discrepancy found, the deviation in the TOT indication circuit, while it cannot be explained at this time, is considered minor, and certainly without any noticeable impact on the capability of the engines to develop flying power."

On October 6th and 7th, 2003, the engines were examined at the facilities of PWC, near Longueuil, Quebec, under the supervision of the Transportation Safety Board of Canada (TSB). The engines were tested in accordance with the PWC Overhaul Manual. Both engines and their respective components performance test runs were normal. According to the TSB investigator, if a minor engine adjustment was completed, the engine performance would meet new specifications.

On October 8, 2003, the engines were disassembled by PWC under the supervision of the TSB. According to PWC, examination of the engines revealed no significant deterioration or distress except for deterioration of the compressor turbine (CT) shroud segments retention ring. The deterioration was due to erosion and fretting during the normal engine operation. Broken particles of the ring entered the hot gas path consistent with the evidence of metal spray to the CT shroud segment and rub damage to the CT blade profile. The damage would not have caused operation dysfunction of the engines.

Contaminant was noted in engine #2's P3 air system. A sample of the contaminant and particles collected from the fuel system were retained for analysis. Analysis of the elements ranged from metal particles to environmental dirt. The EECs, the FMMs and fuel flow divider valves were retained for further examination at the manufacturer's facilities.

On October 28, 2003, at the facilities of Hamilton Sundstrand, near Windsor Locks, Connecticut, under the supervision of a FAA inspector, the two EECs, serial numbers 01043914 (#1 Engine) and 0109584 (#2 Engine) were examined and tested. Initial examination of the #1 engine EEC noted no anomalies. The #1 engine EEC successfully completed the full functional test in accordance with the HS14108 test procedure. The unit had not been returned to Hamilton since the initial production shipment. Initial examination of the #2 engine EEC revealed the seal on the unit was broken, and no additional anomalies were noted. The #2 engine EEC successfully completed the full functional test in accordance with the HS14108 test procedure. The EEC had been returned to Hamilton in July 2001 for a inspection Service Bulletin.

On November 18, 2003, at the facilities of Woodward Governor Company, near Rockford, Illinois, under the supervision of the NTSB IIC, the FMMs and flow dividers were examined and functionally tested. Prior to the functional test, a hole was observed in the shipping box, and the #2 engine FMM's pump drive shaft was separated and prior to the functional test, a new pump drive spline was installed (The drive shaft was observed intact at the PWC engine performance runs). According to Woodward, the FMMs functioned as required, and eight test points for the #1 engine FMM were slightly out of Test Specification Procedure (TSP) limits, and four test points for the #2 engine FMM were slightly out of TSP limits. These points were deemed inconsequential to the operation of the FMM and would not have contributed to the reported loss of power. No anomalies were noted with the examination and testing of the flow divider valves.

On March 25, 2004, at the facilities of AMETEK, near Mukilteo, Washington, under the supervision of a NTSB investigator, the two cockpit electronic display units (EDUs), serial numbers 02010918 and 01120901, were examined and functionally tested. Serial number 02010918 unit failed a case bonding test from inside of front flange to main connector shell. The test requirements are a reading of less than or equal to 0.025 ohms, and the actual reading was 0.100 ohms. AMETEK engineers stated this is not an unusual failure for units that have been out in the field for awhile. No failures were noted on the display functions. Serial number 01120901 unit failed a reduced power test due to display flashing. Normal test results produce a steady but dim display. No failures were noted on the display functions at normal operating voltage.

The reason for the reported loss of engine power was not determined.

ADDITIONAL INFORMATION

On March 6, 2001, near Rome, Italy, an Agusta A-109E, I-CLRM, serial number 11042, equipped with two PW206C engines, serial numbers BC0089 and BC0090, was involved in an accident with a reported loss of engine power. According to a PWC EEC data report, during the accident sequence, the main rotor contacted the ground causing a sudden stoppage to the aircraft transmission. The transmission moved and both main drive shafts fractured. The #1 engine power turbine (PT) blades fractured consistent with an over-speed condition, and the #2 PT blades did not fracture. The report states, "If both engines had been operating at a high power level when the main rotor first contacted the ground, the

sudden stoppage would have caused a sharp rise in torque to both units. The #1 engine was certainly operating at a significant power level at that time (approximately 80 to 85 percent Ng - Fault Codes Nos. 1 - 4)." The following faults and corresponding Ng speeds were recorded for the #1 engine:

NF/Q A - 83.7 percent
NF/Q B - 84.7 percent
NF/Q A & NF/Q B - 80 percent
LCF Cycle counting - 85.6 percent
EEC Fail Solenoid - 76 percent
Rotor Speed - 5 percent

The following faults and corresponding Ng speeds were recording for the #2 engine:

Rotor Speed - 5 percent
ARINC Input Failure - 19.5 percent
DCU Fault - 9.6 percent
DCU Block 5 - 9.4 percent
T1 Crosscheck Fault - 53 percent

According to PWC conclusions, "Both engines were not operating at a similar power level when the accident occurred, otherwise similar fault codes would have been recorded for both engines."

The wreckage was released to the owner's representative on June 10, 2004.

Pilot Information

Certificate:	Commercial	**Age:**	53,Male
Airplane Rating(s):	None	**Seat Occupied:**	Right
Other Aircraft Rating(s):	Helicopter	**Restraint Used:**	
Instrument Rating(s):	Helicopter	**Second Pilot Present:**	No
Instructor Rating(s):	None	**Toxicology Performed:**	No
Medical Certification:	Class 2 Valid Medical--w/ waivers/lim	**Last FAA Medical Exam:**	August 19, 2003
Occupational Pilot:	UNK	**Last Flight Review or Equivalent:**	March 10, 2003
Flight Time:	8000 hours (Total, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	Agusta	**Registration:**	N143CF
Model/Series:	A109E	**Aircraft Category:**	Helicopter
Year of Manufacture:		**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	11142
Landing Gear Type:	Retractable - Tricycle	**Seats:**	5
Date/Type of Last Inspection:	September 3, 2003 AAIP	**Certified Max Gross Wt.:**	6283 lbs
Time Since Last Inspection:	0.8 Hrs	**Engines:**	2 Turbo shaft
Airframe Total Time:	683.3 Hrs at time of accident	**Engine Manufacturer:**	Pratt & Whitney Canada
ELT:	Installed, not activated	**Engine Model/Series:**	P & W 206C
Registered Owner:	North Central Texas Services, Inc.	**Rated Power:**	561 Horsepower
Operator:		**Operating Certificate(s) Held:**	On-demand air taxi (135)
Operator Does Business As:	CareFlite	**Operator Designator Code:**	NXTA

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Dusk
Observation Facility, Elevation:		**Distance from Accident Site:**	
Observation Time:		**Direction from Accident Site:**	
Lowest Cloud Condition:	Scattered / 6000 ft AGL	**Visibility**	10 miles
Lowest Ceiling:	Overcast / 8000 ft AGL	**Visibility (RVR):**	
Wind Speed/Gusts:	7 knots / 0 knots	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	30°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	30.01 inches Hg	**Temperature/Dew Point:**	27°C / 21°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Dallas, TX	**Type of Flight Plan Filed:**	Company VFR
Destination:	Crowley, TX	**Type of Clearance:**	None
Departure Time:	19:51 UTC	**Type of Airspace:**	Class D

Wreckage and Impact Information

Crew Injuries:	1 Minor	**Aircraft Damage:**	Substantial
Passenger Injuries:	2 None	**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	1 Minor, 2 None	**Latitude, Longitude:**	32.683334,-96.869163

Administrative Information

Investigator In Charge (IIC):	Sauer, Aaron
Additional Participating Persons:	Earl A Baumgard; Federal Aviation Administration; Dallas, TX Paolo Ferreri; Agusta Aerospace Corporation; Philadelphia, PA Doug Hardy; Pratt & Whitney Canada; Longueuil, Quebec Raymond K Dauphinais; CareFlite; Grand Prairie, TX
Original Publish Date:	January 24, 2005
Last Revision Date:	
Investigation Class:	Class
Note:	The NTSB traveled to the scene of this accident.
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=57853