HISTORY OF FLIGHT

On November 10, 2011, about 1214 Hawaiian standard time, a Eurocopter EC130 B4 helicopter, N11QV, collided with mountainous terrain near Pukoo, Hawaii, on the island of Molokai. The commercial pilot and four passengers were fatally injured. The helicopter was registered to Nevada Helicopters Leasing, Henderson, Nevada, and operated by Helicopter Consultants of Maui, Inc., dba Blue Hawaiian Helicopters. The flight was operated as a visual flight rules (VFR) sightseeing flight under the provisions of 14 Code of Federal Regulations (CFR) Part 135. Visual meteorological conditions prevailed at the time of departure, and company flight-following procedures were in effect. The flight originated from the Kahului Airport, Kahului, Hawaii, on the island of Maui, about 1144.

The flight departed with four passengers aboard for a scheduled 1 hour and 10 minute roundtrip sightseeing flight. The planned route of flight was to fly north-northwest from the Kahului Airport to the northern tip of Maui before proceeding northwesterly across the waterway between Maui and Molokai. The flight was to proceed to the northeastern shore of Molokai to view the Halawa Valley Waterfall, before continuing westbound along the sea cliffs on the northern shore to view Papalaua Falls. If the weather permitted, the flight was to continue into the Wailau Valley and climb up and over the valley wall to the southern side of Molokai. If weather conditions would not allow the pilot to use the Wailau Valley route, an alternate route was to reverse course and fly back eastbound along the northern shoreline, and then proceed around the eastern tip of the island to the south side.

Pilots of other air tour helicopters in the vicinity of Molokai during the timeframe of the accident reported that overall weather conditions would not have allowed the accident pilot to fly through Wailau Valley. Additionally, they reported seeing the accident helicopter and/or talking with the accident pilot at various times and locations throughout the flight. These locations were near the Papalaua Waterfalls, the Halawa Valley Waterfall, and along the southern side of Molokai.

The last pilot to observe the accident helicopter reported seeing it flying westbound above the mountainous terrain on the southern side of Molokai, just below the cloud ceiling, which he reported was about 2,000 feet mean sea level (msl). He stated that the accident helicopter appeared to be in straight and level flight and did not appear to be in any form of distress. For information about the weather conditions reported by this pilot, see the Meteorological Conditions section of this report.

Ground witnesses reported that their attention was drawn to the helicopter when they heard some form of "woop wooping" sound. One witness observed the helicopter descending from the island's central ridgeline; he reported that he observed pieces falling from the helicopter as it descended. Another witness, who was closest and had the clearest view of the accident helicopter, reported that the helicopter went "straight down" and impacted the ground sideways. Other witnesses reported that they observed a large "fire ball" when the helicopter impacted the ground.

The ground witnesses reported rain showers in the area during the timeframe of the accident. Several witnesses reported that the accident occurred between rain "squalls," and one reported that it occurred

during a heavy rain "squall." Most witnesses interviewed described the weather conditions at the time of the accident as "poor."

PILOT INFORMATION

The pilot, age 30, held a commercial pilot certificate with a rotorcraft helicopter rating and a helicopter instrument rating. He also held a certified flight instructor certificate with a rotorcraft helicopter rating. In addition, he held a private pilot certificate with airplane single-engine land and multi-engine land ratings. His most recent second-class medical certificate was issued on March 14, 2011, with the limitation that he must possess corrective lenses for near and intermediate vision.

Company personnel reported that the pilot's previous helicopter flight experience was gained as a pilot flying Bell 407 and 206B series helicopters for Bristow International Helicopters in the Gulf of Mexico. During his employment with Bristow International, he accrued about 3,300 flight hours; his last flight with Bristow International occurred on June 22, 2011.

The pilot was hired by Blue Hawaiian Helicopters on July 1, 2011; at that time, the pilot had no flight time in an EC130 B4 helicopter and a total helicopter flight time of about 4,500 hours.

On July 10, 2011, the pilot completed initial company training, which included EC130 B4 pilot ground and flight training, and he was subsequently assigned to fly EC130 B4 helicopters at the company's base on Maui. While employed with Blue Hawaiian Helicopters, the pilot accrued about 306 flight hours in EC130 B4 helicopters. On November 9 (the day before the accident), he completed a 14 CFR Part 135.293/299 airman competency check ride, which was administered by the FAA's principal operations inspector (POI) for Blue Hawaiian Helicopters. The check ride included instrument navigation and communications procedures, inadvertent IMC procedures, and unusual attitude recovery. According to the POI, the accident pilot was capable and current in all of his required pilot tasks and training.

The pilot was off duty on November 7 and 8. On November 9, his duty day started at 0700 and ended at 1700, and the only flight time accrued that day was 1.2 hours on the Part 135 check ride.

On the day of the accident, the pilot arrived at the company office about 0730, which was indicated by other company pilots as his typical arrival time. After checking the weather, he completed a preflight inspection on the assigned helicopter and then waited for his first passengers of the day to arrive. The pilot subsequently completed two sightseeing flights without incident.

The accident flight was the pilot's third flight of the day.

Additional pilot/operational information can be found in the Operations/Witness Factual Report located in the public docket for this accident case file.

HELICOPTER INFORMATION

The Eurocopter EC130 B4 is an 8-place single-engine helicopter powered by a Turbomeca Arriel 2B1 turboshaft engine, rated to 730 shaft horsepower and equipped with a Full Authority Digital Engine Control (FADEC) unit. The helicopter has a three-bladed main rotor and a shrouded tail rotor, which is called a Fenestron. The Fenestron is a composite shell structure with the tail rotor mounted in the inner duct.

The accident helicopter, S/N 4909, was manufactured in France in 2010. According to the FAA registry, the aircraft received an FAA certificate of airworthiness on March 2, 2010. It was registered as N11QV on April 16, 2010.

The helicopter was equipped with a Garmin G500H electronic flight display system. The G500H is an electronic flight information system that utilizes the primary flight display (PFD), multi-function display (MFD), air data computer (ADC) and attitude heading reference system (AHRS). The G500H system installed on N11QV included the optional Garmin Terrain - Helicopter Synthetic Vision Technology (HSVT) system. HSVT is primarily comprised of a computer generated, forward looking, attitude aligned view of the topography immediately in front of the aircraft from the pilot's perspective. The HSVT is shown on the pilot's PFD and offers a 3-dimensional view of terrain and obstacles with visual and audio alerts for terrain or obstacles supplied to the pilot. The system provides the pilot with real-time 3-dimensional moving-map graphics, terrain features, chart data, navigation aids, and flight plan routings; the system has the capability to identify threats, such as towers and terrain features. The PFD also depicted, in part, attitude, airspeed, vertical speed, climb rate, and course/heading information.

The helicopter was maintained in accordance with an FAA Approved Aircraft Inspection Program (AAIP). The most recent 100-hour inspection was completed on November 8, 2011, at 2431.4 hours total time since new (TTSN). During this 100-hour inspection, Eurocopter Emergency Alert Service Bulletin # 53A019 (Check of the tail boom / Fenestron junction frame for cracks) was complied with, and no defects were noted.

At the time the helicopter departed for the accident flight, it had accrued 2,439.6 hours TTSN. Based on an estimated time of 0.5 hours accrued during the accident flight, the aircraft TTSN at the time of the accident was about 2,440.1.

The helicopter did not have, and was not required to have, a cockpit voice recorder or flight data recorder.

The helicopter was equipped with a multi-camera digital video and audio recording system that was installed by the operator under an FAA field approval. The system incorporated three externally mounted color cameras and one internally mounted "lipstick" camera that recorded to onboard digital optic disc recorders. Camera selection was controlled by the pilot via a 4-way switch located on the cyclic. The recordings were provided to passengers for entertainment purposes after flightseeing tours. In addition, the recordings were reviewed by the operator for the purpose of operational quality

control. The camera recording system were not hardened or designed to be crash resistant. The video data captured by this system was consumed by post-crash fire and therefore not available to the investigation team.

The helicopter was configured with seven passenger seats and one pilot seat (eight total) arranged in two rows of four; the pilot always occupied the left outboard front seat. According to the Blue Hawaiian Helicopters pre-departure load manifest, the two front seat passengers occupied the right inboard and outboard seats, and the two aft seat passengers occupied the two outboard (window) seats. The load manifest indicated that the helicopter's fuel load at takeoff was 435 pounds (64 gallons), and the helicopter was loaded within weight and balance limits.

METEOROLOGICAL CONDITIONS

The last pilot to see the accident helicopter reported that throughout the morning, the weather conditions were continually deteriorating with a strong northeasterly wind and fast moving rain squalls. The pilot stated that when he had flown in the accident area earlier that day, he had experienced many updrafts, downdrafts, and microbursts, to the point that it scared him. He further reported that the visibility was "great" below the clouds and out of the heavy rain. The pilot reported that he departed Maui about 1130-1135 and was conducting a sightseeing flight around Molokai at the time of the accident. He estimated that during the flight, the cloud bases around the island were about 2,000 to 2,100 feet msl. His route of flight was southbound along the eastern side of the island and then westbound along the southern shore, where he experienced a "little bit of a bumpy ride." As noted previously, while flying along the south side of the island, he briefly observed the accident helicopter flying westbound along the south side of the island's central mountain ridges just below the clouds.

Kapalua Airport (PHJH) in Lahaina, Hawaii, was located about 11 miles to the southeast of the accident site at an elevation of 256 feet, and was equipped with an Automated Weather Observing System (AWOS). The following observations were recorded on November 10, 2011:

At 1150, PHJH reported wind from 070 degrees at 12 knots gusting to 20 knots, visibility of 7 miles, light rain showers, scattered clouds at 2,500 feet, ceiling broken at 4,000 feet, temperature 23 degrees Celsius(C), dew point temperature 19 degrees C, altimeter setting 30.00 inches of mercury. Remarks: visibility lower to the north.

At 1250, PHJH reported wind from 050 degrees at 17 knots gusting to 23 knots, visibility of 12 miles, showers in the vicinity, few clouds at 1,200 feet, scattered clouds at 2,500 feet, ceiling broken at 4,000 feet, temperature 23 degrees C, dew point temperature 19 degrees C, altimeter setting 30.04 inches of mercury. Remarks: showers in the vicinity to the north, southeast and west.

Molokai Airport (PHMK) in Kaunakakai, Hawaii, was located about 15 miles to the west-northwest of the accident site at an elevation of 454 feet, and was equipped with an Automated Surface Observing Station (ASOS). The following observations were recorded on November 10, 2011:

At 1154, PHMK reported wind from 040 degrees at 17 knots gusting to 27 knots, visibility of 8 miles, scattered clouds at 2,600 feet, scattered clouds at 3,100 feet, ceiling broken at 4,500 feet, temperature 24 degrees C, dew point temperature 19 degrees C, altimeter setting 30.08 inches of mercury.

At 1232, PHMK reported wind from 030 degrees at 12 knots gusting to 24 knots, visibility of 4 miles with haze, scattered clouds at 2,400 feet, ceiling broken at 2,900 feet, broken clouds at 5,000 feet, temperature 23 degrees C, dew point temperature 20 degrees C, altimeter setting 30.07 inches of mercury.

An Area Forecast that included the Molokai area was issued at 0535 and was valid until 1800. It advised of a surface wind from the east-northeast with a magnitude of 25-30 knots over mountain ridges and through valleys. In addition, for the north through east sections of mountainous areas, as well as the waters adjacent to Molokai, the following conditions were forecasted: scattered clouds at 2,500 feet, ceiling broken at 4,500 feet, cloud tops to 9,000 feet; temporary conditions: ceiling broken at 2,000 feet and visibility 3 to 5 miles with rain showers and mist; isolated conditions: ceiling broken at 1,500 feet with cloud tops to 12,000 feet, visibility at or below 3 miles, heavy rain showers and mist.

An updated Area Forecast that included the Molokai area was issued at 1140 and was valid until 0000 on November 11, 2011. It advised of a surface wind from the east-northeast with a magnitude of 25-30 knots over mountain ridges and through valleys. In addition, for the north through east sections of mountainous areas, as well as the waters adjacent to Molokai, the following conditions were forecasted: scattered clouds at 2,500 feet, ceiling broken at 4,500 feet, cloud tops to 9,000 feet; temporary conditions of ceiling broken at 2,000 feet and visibility 3 to 5 miles with rain showers and mist; isolated conditions of ceiling broken at 1,500 feet with cloud tops to 12,000 feet, visibility at or below 3 miles, heavy rain showers and mist.

An AIRMET TANGO for temporary moderate turbulence below 10,000 feet was issued at 0530 for areas over and immediately south through west of mountains on all Hawaiian Islands. An updated AIRMET TANGO for temporary moderate turbulence below 10,000 feet was issued at 1145 for areas over and immediately south through west of mountains on all Hawaiian Islands.

At 0736, a weather briefing was provided to the pilot by Lockheed Martin Flight Service. The weather briefing included the 0530 AIRMET TANGO and the 0535 Area Forecast.

Additional weather information can be found in the Meteorology Factual Report located in the public docket.

COMMUNICATIONS

The pilot was not in radio contact with air traffic control, and no distress calls were heard by other pilots during the timeframe of the accident.

WRECKAGE AND IMPACT INFORMATION

The helicopter impacted mountainous terrain about 5 miles west of Pukoo, Hawaii. It came to rest on the apex of a north-south oriented ridgeline bordered by heavy vegetation that primarily consisted of thorny trees. The ridgeline was one of several in the area that led from the higher elevations of Molokai's central peaks south toward lower elevations near the shore. The elevation at the main wreckage was about 530 feet msl, and the terrain angle varied between 25-30 degrees.

The overall wreckage debris field measured approximately 1,330 feet in length. The lower main wreckage debris field (from upper Fenestron to burn area) encompassed an area approximately 400 feet in length (northwest to southeast). The main wreckage came to rest inverted on a heading of about 260 degrees and was located in the confines of a large burn area. A majority of the wreckage was located in the immediate area of the main wreckage and was mostly consumed by postimpact fire. (Fire extinguishing efforts were attempted; however, fire personnel were unable to immediately access the accident site with fire equipment due to the steep mountainous terrain.)

A number of aircraft components including pieces of the Fenestron, a main rotor blade trim tab, Fenestron rotor and gearbox, and the aft vertical flanges of the aft junction frame were located outside the area of the main wreckage. A detailed wreckage diagram is located in the public docket for this case file.

Cockpit/Cabin and Flight Controls

The cockpit/cabin and instrument panel came to rest inverted and were consumed by post impact fire. The pilot's collective and cyclic controls were identified in the main wreckage; however, flight control continuity could not be confirmed due to fire and impact damage. The swashplate, control servos, mixing unit, control torque tubes and associated bell cranks were located in the wreckage but had sustained extensive impact and thermal damage.

Main Gearbox (MGB)

The MGB assembly sustained extensive impact and thermal related damage. The main rotor shaft remained coupled to the MGB and the main rotor assembly. The magnesium MGB casing was consumed by postimpact fire. All MGB transmission gears appeared to be in place, and no preimpact anomalies were noted. The engine side coupling flange remained attached to the engine output flange. Small fragments of the forward flex coupling were found near the main rotor hub. The flange ear bolt holes exhibited some elongation in the drive direction. The input pinion, rotor brake, and input flange separated and were found adjacent to the MGB assembly.

Main Rotor System

The main rotor hub exhibited impact and thermal damage. All three main rotor blades remained attached to the hub. The main rotor blades and respective components were not identifiable by color coding due to the thermal damage; therefore, the blades and corresponding components were labeled as "A", "B", and "C". The main rotor blades exhibited overall thermal damage (with less thermal damage observed on blade C). All blades exhibited leading edge impact damage, especially toward the outboard tips of the blades.

Tail Boom and Horizontal Stabilizer

The tail boom was located in the confines of the main burn area with the main wreckage. The aft section of the tail boom was mostly intact, but damaged from the aft end of the battery door to the aft junction frame. The aft section of the tail boom was displaced to the right, and the horizontal stabilizer as a whole was rotated counter-clockwise (as viewed looking down). The spar and spar strap on the left side of the horizontal stabilizer were deformed aft and up, and the trailing edge exhibited compression buckling. The left side of the horizontal stabilizer appeared to have been essentially intact before the postcrash fire. The inboard portion of the left side of the stabilizer was deformed up, but there was no obvious evidence of impact to any of the remaining portion on the left side. The outboard section on the right side of the horizontal stabilizer was separated. The remaining portion on the right side, including the main spar carry-through, the inboard leading edge, and a small amount of inboard trailing edge structure, was still attached to the tail boom assembly. The leading edge on the right side was deformed up and aft and crushed around the spar; the right outboard end of the spar was deformed aft and twisted leading edge down. The spar and upper spar strap on the right side were buckled just outboard of the attach point, and the inboard trailing edge was buckled.

Junction Frame

The forward flange of the aft junction frame was fractured circumferentially and remained attached to the tail boom. (For a detailed description of this fracture surface see the Metallurgical Examination section of this report and the Materials Laboratory report in the public docket.) The aft portion of the fractured junction frame including the vertical and aft flanges, with a small section of Fenestron structure attached to it, was recovered about 482 feet northwest of the main wreckage.

Fenestron

Sections of the Fenestron were found in multiple locations northwest of the main wreckage. The Fenestron gearbox was located about 80 feet north of the main wreckage. A large section of the upper Fenestron structure (approximately 10 o'clock to 4 o'clock when viewed from the left) was located about 398 feet northwest of the main wreckage. Two pieces of the lower Fenestron structure were recovered northwest of the main wreckage; one included the aft portion of the ventral fin and the other included the forward portion of the ventral fin. The piece that included the forward portion of the ventral fin had green plant debris and twigs lodged between the skin and the flange of the ventral fin in the area above the stinger attach point. The tail stinger was located in line with the debris path about

537 feet northwest of the main wreckage; the stinger attach bracket was located about 864 feet northwest of the main wreckage.

Tail Rotor Drive System

Pieces of the center tail rotor shaft with hanger bearings were found within the main wreckage burn area. The forward and aft tail rotor drive shafts were broken into several pieces, but were identified in the general area of the main wreckage.

Landing Gear

The landing gear came to rest inverted on top of the main wreckage. The aft cross tube was compressed near the aft attach point. The right aft skid extension was bent in a downward direction.

Hydraulic System

The hydraulic system was severely damaged by the postimpact fire. The belt-driven hydraulic pump assembly and transmission driven pump assembly were found separated near the main transmission. One main rotor servo was still attached at the upper and lower attachment points, and the other two servos were separated at one or more attach points.

Fuel System

The fuel system was consumed by the postimpact fire.

Engine

The engine was found resting in a forward-down orientation with the forward section of the axial compressor in the dirt. The axial compressor blade tips were curled. The power turbine was only partially visible, and no blade shedding had occurred on the visible portion. The power turbine could not be rotated by hand. The hydro mechanical unit (HMU) was broken away from the accessory gearbox, but remained attached by the fuel heating transfer tubes. The HMU short shaft was broken off flush with the associated mounting flange. The gas generator turbine casing was dented and deformed.

A majority of the engine accessories and the digital engine control unit (DECU) were consumed by the postimpact fire.

The reduction gearbox was removed and continuity through the gear train was confirmed. The input pinion slippage mark was misaligned approximately 2 millimeters in the tightening direction, consistent with a blade strike with power condition. The freewheel shaft was partially removed and showed twist in the clockwise direction, consistent with sudden tail rotor stoppage with power.

MEDICAL AND PATHOLOGICAL INFORMATION

An autopsy was performed on the pilot on November 14, 2011, by Pan Pacific Pathologists, Wailuku, Hawaii.

The FAA's Civil Aerospace Medical Institute performed forensic toxicology on specimens from the pilot with negative results for drugs of abuse and alcohol.

TESTS AND RESEARCH

Engine

The Turbomeca Arriel 2B1 turboshaft engine (serial no. 23067) was removed from the helicopter and shipped to Turbomeca's Grand Prairie, Texas, facility for disassembly and examination.

The disassembly and examination revealed no evidence of mechanical malfunctions or failures that would have precluded normal operation. Additional information can be found in the engine examination report located in the public docket for this accident case file.

Fenestron, Tail Boom, and Horizontal Stabilizer

Pieces of the Fenestron, tail boom, and horizontal stabilizer were shipped to NTSB facilities in Ashburn, Virginia, and Washington, DC, for additional examination.

The tail boom is a simple stiffened tubular (semi-monocoque) structure that is attached to the fuselage. A drawing of the aft end of the tail boom is shown in Figure A, which is located in the public docket for this accident case file. The fasteners and horizontal stabilizer have been omitted for clarity. The Fenestron is attached to the aft end of the tail boom by a junction frame (shown in green on the right side of Figure A) that is riveted to the aluminum tail boom structure and to the composite Fenestron structure. The junction frame has three flanges: the forward flange, aft flange and vertical flange. There is a ring frame installed forward of the horizontal stabilizer (shown in green on the left side of Figure A). There are four longerons (shown in purple in Figure A), two on each side, installed between the forward ring frame and the aft junction frame. The horizontal stabilizer is a single piece unit that is installed through the tail boom and attached to the tail boom by two vertical attachment bolts (shown in red in Figure A). The upper and lower horizontal stabilizer attach fittings (shown in orange in Figure A) are attached to the longerons on each side of the tail boom. A shim plate is installed on each stabilizer fitting with two countersunk screws (shown in blue in Figure A). The horizontal stabilizer attachment bolts pass through the shim plates and the horizontal stabilizer spar attaching the horizontal stabilizer to the tail boom. Forward of the ring frame, the tail boom is of typical skin/frame/stringer construction with six internal stringers spaced unevenly around the circumference between the ring frame and the battery door cutout.

The helicopter's tail boom transmits the Fenestron and horizontal stabilizer loads and moments to the fuselage. The loads and moments generated by the Fenestron are transmitted into the tail boom through the aft junction frame. The loads and moments generated by the horizontal stabilizer are transmitted to the tail boom through the attachment hardware (bolts, shim plates, shim screws, and attach fittings) to the four longerons installed between the forward ring frame and the aft junction frame. The four longerons together act to distribute the various stresses from the Fenestron and horizontal stabilizer to the tail boom structure, forward of the ring frame.

The examination of the Fenestron wreckage revealed that several areas exhibited angled cuts and/or deformation of the composite and aluminum structure, rotor blades, stators, and the tail rotor drive shaft. All of the fractures and damage were mapped on an exemplar helicopter using colored adhesive tape. This procedure revealed that there were three distinct cuts through the lower portion of the Fenestron. One cut was located just aft of the junction frame, one was located at the midpoint of the tail guard, and one was located near the aft edge of the duct. The location, spacing, and deformation of the cuts in the composite and aluminum structure, rotor blades, stators, and the tail rotor drive shaft were consistent with the main rotor blades striking the lower Fenestron three times on the left side (rotor blades rotate clockwise as viewed from above).

The aft portion of the tail boom with attached remnants of the horizontal stabilizer was cut from the wreckage for further examination. The upper portion of the tail boom exhibited buckling damage to the structure just forward of the ring frame. The location was immediately forward of where the four longerons attach to the ring frame and extended clockwise from about 10 o'clock to about 2 o'clock as viewed looking forward. There was also buckling damage from about 2 o'clock to about 6 o'clock as viewed looking forward that corresponded to the location where the right horizontal stabilizer was displaced forward.

The two horizontal stabilizer attach bolts were disassembled and removed, and the stabilizer was extracted from the tail boom; the upper steel spar straps remained fastened to the spar on both the left and right sides. On the left side, the spar and skin structure was deformed aft and exhibited moderate to heavy fire damage. On the right side, the spar was intact from the attach point out to the production end about 20 inches outboard of the attach point, and there was soil and wood debris embedded in the space between the spar and the spar strap on the aft side. The right side spar strap was buckled away from the spar; the outboard end of the right side spar was deformed aft and twisted leading edge down. The right side of the horizontal stabilizer leading edge structure remained attached to the spar from the attach point to about 15 inches outboard. It was deformed up and aft between about 6 inches and 11 inches outboard of the attach point and was crushed against the spar between about 11 inches and 15 inches outboard of the attach point. There were some small pieces of the upper and lower trailing edge skins attached to the inboard 14 inches of spar. The remaining trailing edge of the stabilizer on the right side exhibited buckling damage from the centerline outboard to the attach point.

On the left side, the horizontal stabilizer attach fittings, attach bolt, shim, and shim screws were generally intact. On the right side, the screws in the upper and lower parts of the attach fitting were

fractured in shear overstress. The direction of shear showed that the right side of the horizontal stabilizer had been moving aft when the screws fractured. The attach fitting had impressions consistent with multiple impacts from the right horizontal stabilizer attach bolt.

Metallurgical Examination

The circumferential fracture of the forward flange of the junction frame was examined in the NTSB Materials ~~l~~Laboratory. In general, the fracture surface showed relatively rough fracture features that were light gray in color. Multiple features including step patterns, branching patterns, and ridge patterns were used to determine fracture directions around the circumference of the fracture.

The examination revealed that the fracture in the flange initiated near the 5 o'clock position (lower, right side looking forward) and progressed counter-clockwise up the right side and clockwise around the left side of the flange towards the top (12 o'clock) of the flange. The fracture features on the junction frame all exhibited ductile overstress signatures in tension, compression or shear. There were no indications of any pre-existing cracks that would reduce the strength of the fractured junction frame flange.

ORGANIZATIONAL AND MANAGEMENT INFORMATION

Blue Hawaiian Helicopters is a 14 CFR Part 135 air carrier and holds on-demand operations specifications. The company headquarters is located at the Kahului Airport, Kahului, with additional bases located in Hilo, Waikoloa, Honolulu, and Lihue, Hawaii. The chief executive officer, president, director of operations, and director of maintenance all reside in Kahului. The chief pilot and director of safety reside in Honolulu.

On April 17, 1987 (later revised on August 30, 1995), the FAA's Honolulu Flight Standards District Office issued Helicopter Consultants of Maui, Inc., dba Blue Hawaiian Helicopters of Kahului, air carrier certificate number HCMA601E, which permitted the operator to conduct on-demand air carrier operations in the United States. Pursuant to the certificate, the operator was authorized to carry passengers in Eurocopter AS350 and EC130 B4 series helicopters under day/night visual flight rules (VFR). Operations under instrument flight rules (IFR) were prohibited.

ADDITIONAL INFORMATION

Based on the design of the EC130 B4 tail boom and Fenestron, and various accident or incident load cases, Eurocopter identified three critical areas of the tail boom that have experienced failures:

Location 1, at the forward ring frame where the tail boom attaches to the fuselage, becomes critical under hard landing conditions.

Location 2, at the battery door cutout, becomes critical for hard landings and tail skid impact conditions.

Location 3, at the junction frame, becomes critical for horizontal stabilizer impact conditions.

Eurocopter provided NTSB investigators with numerous examples of failures at the forward ring frame (location 1) and battery door cutout (location 2) that occurred due to hard/crash landings well in excess of the certification load levels.

According to Eurocopter, in addition to this accident, there have been four other accidents where the Fenestron separated from the tail boom at the junction frame during the accident sequence. Three of these cases involved a failure at the forward flange of the junction frame similar to the accident junction frame failure, and the fourth involved a failure at the aft flange of the junction frame. One case occurred during an in-flight collision with electrical power lines in the area of the horizontal stabilizer. The second case occurred during an uncontrolled crash landing in which the right horizontal stabilizer impacted a vehicle prior to ground impact. The third case occurred during controlled flight into terrain in which there was significant impact damage to the right horizontal stabilizer. The fourth case (failure of the aft flange) occurred during a hard landing with a significant tail skid impact.

As a result of these cases, Eurocopter performed finite element stress analyses of the tail boom when subjected to loading at the ends of the horizontal stabilizer. The results indicated that loads can be applied at the end of one of the horizontal stabilizers that are below the stabilizer failure loads that cause stresses in the junction frame high enough to result in fracture of the forward flange as observed in the accident.