Aviation Investigation Final Report

Location:	Smethport, Pennsylvania	**Accident Number:**	ERA18FA122
Date & Time:	April 8, 2018, 17:11 Local	**Registration:**	N602BP
Aircraft:	MD Helicopter 600	**Aircraft Damage:**	Destroyed
Defining Event:	External load event (Rotorcraft)	**Injuries:**	2 Fatal, 1 Serious
Flight Conducted Under:	Part 133: Rotorcraft ext. load		

Analysis

The pilot of the helicopter was conducting a power line construction flight. The power lines were supported by a series of structures made of either wood (dual-pole, H-frame) or steel (single pole). A static line was affixed to the top of the structures above the power lines. The purpose of the flight was to remove the static line from the wheeled, pulley device (dolly) that temporarily secured the static line and permanently secure the static line to the structures. One lineman completed the task from the skid of the hovering helicopter, and another lineman inside the helicopter passed tools and equipment back and forth to the lineman on the skid. The accident occurred when the crew (the pilot and the two linemen) were working on the second structure, which was constructed of wood. During work on that structure, the helicopter hovered facing westbound adjacent to the wooden structure with the pilot, both linemen, and the structure on the helicopter's left side. The static line sloped upward aft of the helicopter toward the uphill structure and downward and to the right toward the downhill structure.

The initial steps taken for the task included wrapping the line with a spiraled wire coating (armor rod) and attaching a safety strap (safety). The lineman on the helicopter skid attached the first half of the armor rod ahead of the dolly and manipulated the line and the dolly to complete the wrap. According to the pilot, the lineman opened the spring-loaded locking gate on the dolly above the static line to wrap the second half of the armor rod, which was "normal" before the attachment of the safety. About that time, the pilot felt the helicopter being "pulled" toward the structure. The pilot stated that he made cyclic and pedal inputs to avoid the structure but reported that "all I remember is rolling over the structure." The pilot stated that he neither felt nor heard anything unusual before the helicopter was pulled toward the structure.

Visual examination of the static line, helicopter rotor blades, and visual and metallurgical examination of the dolly revealed that, as the lineman on the skid wrapped the armor rod, and before he attached the safety, the aft portion of the main rotor struck the static line, which broke the locking gate that secured the line inside the dolly. Once free of the dolly, the static line fell between the uphill and downhill structures and over the left front skid of the helicopter, which created the pivot point over which the helicopter rolled inverted.

The pilot and the linemen began work without installing a safety. According to the operator's director of safety, the safety strap aboard the helicopter was "not long enough" to install it before work began. The holding company of the subsidiary that hired the operator as an independent contractor had a safety manual for linemen who performed work from helicopters. The manual indicated that "secondary securement systems shall be utilized" when clipping wire (permanently securing a static line to the structures).

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: The helicopter pilot's failure to maintain adequate clearance during power line construction work, which resulted in the helicopter's main rotor striking and becoming entangled with a wire and a subsequent dynamic rollover and collision with terrain. Contributing to the accident was the pilot's and linemen's decision to continue work without a secondary safety device installed, which was contrary to standard operating procedures.

Findings

Aircraft	(general) - Not attained/maintained
Personnel issues	Aircraft control - Pilot
Environmental issues	Wire - Response/compensation
Personnel issues	Decision making/judgment - Flight crew
Personnel issues	Incorrect action performance - Flight crew
Personnel issues	Use of policy/procedure - Flight crew

Factual Information

History of Flight

Maneuvering-hover	Miscellaneous/other
Maneuvering-hover	Collision with terr/obj (non-CFIT)
Maneuvering-hover	External load event (Rotorcraft) (Defining event)
Maneuvering-hover	Loss of control in flight
Uncontrolled descent	Collision with terr/obj (non-CFIT)

On April 8, 2018, about 1711 eastern daylight time, an MD Helicopters 600N helicopter, N602BP, was destroyed when it collided with a wooden power line support structure and terrain in Smethport, Pennsylvania. The commercial pilot was seriously injured, and two linemen were fatally injured. The helicopter was being operated by High Line Helicopters, Inc., as Title 14 *Code of Federal Regulations (CFR)* Part 133 external load flight. Visual meteorological conditions prevailed, and no flight plan was filed. The flight departed from an unimproved landing zone adjacent to the accident site.

Three power lines, which were newly constructed in mountainous terrain and oriented approximately east/west, were supported by structures that were constructed of either wood (dual pole, H-frame) or steel (single pole). A static line was affixed to the top of the structures above the power lines. The purpose of the flight was to remove the static line from the wheeled pulley device (dolly) that temporarily secured the static line and permanently secure the static line to the structures ("clipping wire"). One lineman completed the task from the skid of the hovering helicopter, and another lineman inside the helicopter passed tools and equipment back and forth to the lineman on the skid.

The steps to complete the task on each support structure included wrapping the line with a spiraled wire coating (armor rod), attaching a safety strap (safety), ratcheting a chain lifting device (hoist) to the top of the structure pole, and placing the static line attachment device (shoe) to the line. Afterward, the line was hoisted into position and bolted to the structure, and the safety, hoist, and dolly were then removed from the structure and static line. The pilot then repositioned the helicopter so that the linemen could repeat the steps on the next structure.

During a postaccident interview, the pilot reported that he and the linemen (the crew) met earlier in the day and flew to one of the structures to assess the work and tools required to complete the task. The helicopter then returned to the landing zone and was refueled before departing on the accident flight. The crew completed one structure, and the pilot hovered the helicopter into position so that work could begin on the next structure. In a written statement, the pilot stated that the pole where the accident occurred was at "a slight inside angle" but was considered to be a "safe" area in which to work. According to the pilot and the operator, the helicopter was hovering "inside the bite," which was the triangular area comprising the wire from the uphill pole, the turn at the accident pole, and the wire to the downhill pole. The "base" of the triangle was the horizontal line from the uphill pole to the downhill pole. The operator indicated that the "bite" had a vertical dimension as well.

Once the helicopter was in position, the lineman on the helicopter skid attached the first half of the armor rod ahead of the dolly and manipulated the line and the dolly to complete the wrap. According to the pilot, the lineman opened the spring-loaded locking gate on the dolly above the static line to wrap the second half of the armor rod, which was "normal" before the attachment of the safety. About that time, the pilot felt the helicopter being "pulled" toward the structure. The pilot stated that he made full right cyclic and full left pedal inputs to avoid colliding with the structure but that "all I remember is rolling over the structure." The pilot said that he neither felt nor heard anything unusual before the helicopter was "pulled" toward the structure.

A witness to the accident stated that, while the helicopter was hovering, its nose turned away from the pole, and the helicopter "was violently forced back to the pole." The witness also stated that the tail section struck the pole and that the helicopter "broke in two," after which the helicopter appeared "to fall straight down." The witness did not see the helicopter's impact but stated that the engine "continued to surge."

The helicopter descended vertically between and adjacent to the dual-pole structure. The tailboom and the six rotor blades from the main rotor separated from the helicopter during the descent.

Pilot Information

Certificate:	Commercial	**Age:**	30,Male
Airplane Rating(s):	None	**Seat Occupied:**	Left
Other Aircraft Rating(s):	Helicopter	**Restraint Used:**	4-point
Instrument Rating(s):	Helicopter	**Second Pilot Present:**	No
Instructor Rating(s):	None	**Toxicology Performed:**	No
Medical Certification:	Class 2 Without waivers/limitations	**Last FAA Medical Exam:**	April 5, 2017
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	
Flight Time:	6200 hours (Total, all aircraft), 250 hours (Total, this make and model), 150 hours (Last 90 days, all aircraft), 50 hours (Last 30 days, all aircraft), 4 hours (Last 24 hours, all aircraft)		

According to Federal Aviation Administration (FAA) records, the pilot held a commercial pilot certificate with ratings for rotorcraft-helicopter and instrument helicopter. The pilot's most recent FAA second-class medical certificate was issued April 5, 2017. According to the operator, he had accrued about 6,200 hours of total flight experience, 250 hours of which were in the 600N helicopter. The operator estimated that that pilot had accrued 3,000 hours performing power line operations.

Aircraft and Owner/Operator Information

Aircraft Make:	MD Helicopter	**Registration:**	N602BP
Model/Series:	600 N	**Aircraft Category:**	Helicopter
Year of Manufacture:	1998	**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	RN025
Landing Gear Type:	N/A; Ski	**Seats:**	
Date/Type of Last Inspection:	February 4, 2018 100 hour	**Certified Max Gross Wt.:**	4500 lbs
Time Since Last Inspection:	73 Hrs	**Engines:**	1 Turbo shaft
Airframe Total Time:	5203.6 Hrs at time of accident	**Engine Manufacturer:**	ALLISON
ELT:	Installed, activated, did not aid in locating accident	**Engine Model/Series:**	250-C47
Registered Owner:	FTAV LLC	**Rated Power:**	650 Horsepower
Operator:	High Line Helicopters, LLC	**Operating Certificate(s) Held:**	Rotorcraft external load (133)

The helicopter was manufactured in 1998 and was equipped with a Rolls-Royce/Allison 250-C47 600-horsepower turboshaft engine. At the time of the accident, the helicopter's Hobbs meter indicated a total of 5,203.6 hours.

Maintenance record excerpts showed that the helicopter's most recent 100-hour inspection was completed on February 4, 2018. The helicopter had accumulated 5,120.8 hours at that time.

An FAA airworthiness inspector reviewed the helicopter's maintenance records. The inspector found numerous record-keeping errors but overall compliance with hourly and calendar inspections as well as compliance with airworthiness directives.

The helicopter was installed with aluminum diamond-plate flooring, which required the removal of the left-side cabin door, and a 6061-T6 aluminum pipe. A search of the FAA's aircraft registry records and the helicopter's maintenance logbooks found no information regarding these installations. Also, no records were found showing FAA approval for these modifications or company documentation of weight and balance computations that reflected the changes.

According to section 2-1 of the MD 600N flight manual, operations with the left-side cabin door removed were authorized, but operations with the pilot (right) seat removed (resulting in a left-seat command configuration) were not. Neither of these modifications was reflected in the helicopter's weight and balance or aircraft records.

Title 14 *CFR* 91.107(a)(3) required that all passengers be seated in an approved seat and properly secured with a seatbelt during aircraft movement. The helicopter's cabin had no passenger seats installed.

Weight and balance computations based on pilot and lineman weights, cargo, and three different fuel

states (full, one-half, and one-third tank) showed that the helicopter, as configured, was likely within weight, lateral, and longitudinal center-of-gravity limits for the accident flight.

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	BFD,2150 ft msl	**Distance from Accident Site:**	10 Nautical Miles
Observation Time:	20:53 Local	**Direction from Accident Site:**	260°
Lowest Cloud Condition:		**Visibility**	10 miles
Lowest Ceiling:	Overcast / 4100 ft AGL	**Visibility (RVR):**	
Wind Speed/Gusts:	10 knots /	**Turbulence Type Forecast/Actual:**	/ None
Wind Direction:	290°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	29.95 inches Hg	**Temperature/Dew Point:**	-3°C / -12°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Smethport, PA	**Type of Flight Plan Filed:**	None
Destination:	Smethport, PA	**Type of Clearance:**	None
Departure Time:	17:00 Local	**Type of Airspace:**	Class G

At 1653, the weather reported at Bradford Regional Airport (BFD), Lewis Run, Pennsylvania, which was located 10 miles west of the accident site, included an overcast layer at 4,100 ft, 10 statute miles visibility, and wind from 290° at 10 knots. The temperature was -3°C, the dew point was -12°C, and the altimeter setting was 29.95 inches of mercury.

Wreckage and Impact Information

Crew Injuries:	2 Fatal, 1 Serious	**Aircraft Damage:**	Destroyed
Passenger Injuries:		**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	2 Fatal, 1 Serious	**Latitude, Longitude:**	41.828334,-78.419441

The accident site was at an elevation of about 1,600 ft. All major components were accounted for at the scene. The wreckage was contained largely at the bottom of the wooden H-frame structure that was struck, with the six rotor blades separated at the hub and scattered at various distances on the south side of the power lines. One rotor blade traveled about 300 ft down the hill (west) of the structure. The tailboom separated and was found about 70 ft west of the structure. Striating marks consistent with wire contact were visible on top of the left skid forward of the front cross-tube.

The six main rotor blades remained inside their respective pitch housings, and the laminated steel strap sets ("strap packs") were fractured at the hub. The blades showed varying degrees of chordwise and spanwise twisting and bending. One of the rotor blades displayed a concave dent 2.25 inches from the tip. The dent was about 1 inch wide and 0.75 inch deep. The overall dimensions of the dent and the dimensions of the individual striating marks inside it were consistent with the total dimensions of the static line and its individual strands.

The safety strap was suspended from a cross-brace of the H-frame structure, and the hoist was found next to the fuselage. Both appeared undamaged. Examination of the structure poles and the static line revealed signatures consistent with blade strikes. Blemishes on the static line, about 11 feet uphill (east) of the structure where the dolly was mounted, displayed smearing signatures consistent with a high-speed, metal-to-metal strike.

Continuity of the flight control and drive systems was established through several breaks. The fractures and breaks all displayed features consistent with overstress. Examination of the wreckage revealed no preimpact mechanical anomalies.

The dolly was in its swiveling mount and was facing 180° from its operational position. Damage signatures to the pole above the dolly's mount matched the dimensions of the dolly. The dolly was recovered from the top of the structure and was found to be intact except for the locking gate, which was fractured. The fracture surfaces displayed features consistent with overstress. The dolly was retained for further examination at the National Transportation Safety Board (NTSB) Materials Laboratory where it was compared it with an exemplar dolly. The dolly assembly consisted of a circular pulley wheel with a U-shape groove for holding a cable that was surrounded by a block with a locking gate. The locking gate latch was spring loaded to stay in the closed position (when not being actuated) against a tab on the block. The latch, when resting against the tab, would be under a bending force with the tension side facing outward face and the compression side facing inward.

In the closed position, the locking gate latch would prevent the cable from leaving the groove on the pulley wheel. When the locking gate latch was actuated, it rotated inward to allow a cable to be moved either inward or outward.

Examination of the fracture surfaces on the locking gate latch with a scanning electron microscope revealed fractures consistent with overstress. The direction of the fractures on the latch remnants, and the smear marks on the pulley wheel guide outer corners, were from the pulley wheel moving outward.

Tests and Research

The NTSB deployed two unmanned aircraft systems (UAS) to conduct aerial imaging of the power lines that the helicopter impacted and to map the terrain in the area in and around the power lines and supporting structures. The UAS flights were conducted 1 year after the accident; during that time, the construction work on the powerlines had been completed.

A mapping flight of an exemplar MD Helicopters 600N helicopter was conducted to create a three-dimensional point cloud/surface model of the helicopter. Photogrammetry software was used to process the data and imagery from the accident scene map along with the three-dimensional model of the helicopter. The three-dimensional model was used to demonstrate the relative position of the helicopter to the tower, wires, and the dolly as well as the clearances available between the main rotor blades and the static line.

Additional Information

Organizational Information

High Line Helicopters was hired as an independent contractor by J.W. Didado Electric, LLC, a subsidiary of Quanta Services, Inc., to transport J.W. Didado employees to job sites for new power line construction. First Energy Corporation hired J.W. Didado to perform the construction.

During a postaccident telephone interview, the NTSB asked the director of safety for High Line Helicopters about the task sequence and specifically why the safety strap was not installed first. He replied that the safety strap aboard the helicopter was "not long enough" to stay attached while the armor rod was being installed and that a "choker safety" should have been used. When asked if the company's standard operating procedures directed that the crew retrieve the choker safety, the director of safety replied, "that is more or less a contractor thing" and that High Line Helicopters did not have procedures for contractor equipment. When asked to describe operations "inside the bite," the safety director stated that it was the area where, once the helicopter was inside it, the wire would move toward the helicopter if the wire became loose from the dolly.

Quanta Services published a safety manual with detailed guidelines and a skills proficiency sheet, also referred to as a grade slip, for linemen who performed their work from helicopters. Section 14, Helicopter Safety, Rigging, page 14-10, states the following: "secondary securement systems shall be utilized in situations that can [a]ffect safe helicopter operations, such as clipping wire." Quanta Services further indicated that the safety manual was for "guidance only" and the training of linemen for helicopter operations was the responsibility of the helicopter contractor.

Previous Related Accidents

A review of the NTSB's accident database revealed that the operator was involved in three accidents within a 3-month period in 2018, including this accident. The first accident (ERA18LA091) occurred in San Juan, Puerto Rico on January 11, 2018, and the second accident (CEN18LA121) occurred in Blair, Wisconsin, on March 7, 2018, and involved the accident pilot. The accident in Smethport, Pennsylvania, occurred about 1 month later.

The first two accidents occurred during "human cargo external load operations." For the first accident (ERA18LA091), the NTSB found that probable cause was the helicopter pilot's improper decision to use

an open-end grapple, instead of an A-frame attachment, to lift and move a ladder with a lineman on it and the lineman's improper decision to be lifted on a ladder via an open-end grapple, which were contrary to company policy and the Federal Aviation Regulations.

For the second accident (CEN18LA121) the NTSB determined that the probable cause was the pilot's failure to recognize and compensate for hazards during the human cargo external load operation, which led to a collision between a lineman, who was the external load, and a live power line. FAA inspectors determined the company's Rotorcraft External Load Flight Manual had inadequate procedures and training for human external cargo.

FAA Oversight

During the investigation, FAA aviation safety inspectors identified areas within the flight and maintenance departments for improvement. Inspectors visited the operator's facilities, presented a "maintenance demonstration," and provided templates for documents and standard operating procedures for recordkeeping and pilot training.

During a subsequent aircraft conformity inspection, an FAA aviation safety inspector (airworthiness) noted that the operator had incorporated the documents provided and that no deficiencies were noted.

As a result of this accident investigation, the president of High Line Helicopters mandated the installation of safety straps to wires before work begins. The safety straps are to remain in place until work is completed at each structure.

Administrative Information

Investigator In Charge (IIC):	Rayner, Brian
Additional Participating Persons:	Richard Boucek; FAA/FSDO; Pittsburgh, PA Nicholas Shepler; Rolls-Royce; Indianapolis, IN Joan Gregoire; MD Helicopters; Mesa, AZ
Original Publish Date:	December 16, 2019
Last Revision Date:	
Investigation Class:	Class
Note:	The NTSB traveled to the scene of this accident.
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=96999