National Transportation Safety Board

Washington, D.C. 20594

Response to Petition for Reconsideration

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In accordance with 49 *Code of Federal Regulations* (CFR) 845.41, the National Transportation Safety Board (NTSB) has reviewed the November 15, 2010, petition for reconsideration and modification of the findings and probable cause for the aircraft accident involving a Eurocopter AS350 B2 helicopter, N213EH, on April 15, 2008, near Chickaloon, Alaska (ANC08FA053). On the basis of this review, the NTSB hereby denies the petition in its entirety.

On April 15, 2008, about 0923 Alaska daylight time, a Eurocopter AS350 B2 helicopter, N213EH, experienced a loss of engine power during flight and sustained substantial damage during an emergency descent and impact with terrain about 34 miles east of Chickaloon, Alaska. The commercial pilot and three passengers were fatally injured, and one passenger was seriously injured. The on-demand air taxi flight was operating under the provisions of 14 CFR Part 135 in visual meteorological conditions.

The findings and probable cause of the accident, which were adopted on March 3, 2010, were as follows:

Occurrences
Initial climb – Loss of engine power (total)
Autorotation – Collision with terrain/object (non-CFIT [controlled flight into terrain])

Findings
1. Aircraft–Aircraft power plant–Engine fuel and control–Fuel controlling system–Unintentional use/operation (Cause)
2. Aircraft–Aircraft power plant–Engine controls–Power lever–Design (Cause)
3. Environmental issues–Task environment–Physical workspace–Access to equipment/controls–Contributed to outcome (Cause)

4. Environmental issues–Physical environment–Terrain–mountainous/hilly terrain–Contributed to outcome
5. Personnel issues–Miscellaneous–(general)–(general)–Passenger
6. Personnel issues–Action/decision–Action–Forgotten action/omission–Pilot (Factor)
7. Organizational issues–Support/oversight/monitoring–Safety programs–Adherence to safety program–Operator (Factor)

The NTSB determined that the probable cause of the accident was "the loss of engine power due to an overspeed of the helicopter's turbine engine, precipitated by the inadvertent movement of the fuel flow control lever [FFCL] by the [front seat] passenger. Also causal was the manufacturer's design and placement of the fuel control lever which made it susceptible to accidental contact and movement by passengers. Contributing to the accident was the pilot's failure to properly secure/stow the passenger's backpack. Likely contributing to the severity of the occupants' injuries was the helicopter operator's failure to properly monitor their satellite flight following system and to immediately institute a search once the system reported the helicopter was overdue."

The petitioner, the former Eurocopter vice president of fleet safety, claimed that "key findings listed in the NTSB Final Report are erroneous, and important technical aspects of the investigation were overlooked or have not been adequately addressed by the NTSB." Specifically, the petitioner claimed that the NTSB erred when it concluded that the accident was precipitated by the inadvertent movement of the FFCL by the front seat passenger. Further, the petitioner claimed that there is no evidence to support that (1) the manufacturer's design and placement of the FFCL made it susceptible to accidental contact and movement by passengers or (2) the pilot failed to properly secure or stow the passenger's backpack. Each of the petitioner's claims is discussed below.

Movement of Fuel Flow Control Lever

The control quadrant of the Eurocopter AS350 B, AS350 BA, AS350 B1, and AS350 B2 helicopter models is located on the floor between the pilot's seat and the front left seat. The floor-mounted control quadrant includes the FFCL and its detent track, which has three positions. The first and second positions are the stop and the flight detents, respectively. The third position is the emergency position, which is forward of the flight detent and is used only for emergency operations. When the FFCL is moved into this position, the emergency fuel flow control valve opens to introduce additional fuel to the engine. The FFCL can be moved along the detent track with minimal pressure. To access the emergency position from the flight detent, the FFCL has to be moved about 3/16 of an inch to the right and between 1/2 and 3/4 inch forward.

The petitioner stated that, according to "physical evidence and information provided by Eurocopter during the investigation, an inadvertent movement of the FFCL to the emergency range during flight is not a possible cause for the accident." For example, the petitioner stated, "during normal cruise flight, the movement of the FFCL to the full forward (emergency) position would initially cause an increase in fuel flow to the engine; however, with...the rotor system loaded (as it would be during flight), the FCU [fuel control unit] will react immediately, and the maximum fuel flow delivered by the emergency valve to the injection wheel will be 180 liters

per hour due to closure of the metering valve." The petitioner further stated that the maximum emergency valve fuel flow rate would result in a maximum torque value (with a loaded rotor system) that was "significantly less" than the torque evidenced by the main wreckage.

The NTSB determined that, within seconds after departure, the pilot was presented with indications of an engine overspeed as a result of the FFCL being moved to the emergency position. During the course of the investigation of the Chickaloon accident, and as part of its petition for reconsideration, Eurocopter provided no evidence indicating that the fuel control unit, by limiting the fuel flow to 180 liters per hour, would prevent an engine overspeed. Because additional fuel was introduced into the engine when the FFCL was moved to the emergency position, the engine oversped and, in response, shed its free turbine blades. (As a safety measure, the helicopter's engine was designed to shed its free turbine blades during an overspeed to keep the turbine wheel from coming apart. The NTSB determined no other reason for the shedding of the turbine blades.)

Also, the petitioner's statements indicated that the pilot had loaded the rotor system, (that is, increased collective pitch to control the rotor rpm), which is the correct response to an engine system overspeed. However, in this case, the NTSB determined that the pilot was unable to load the rotor because he would have encountered instrument meteorological conditions, and lost ground reference, as the helicopter climbed. (The weather conditions at the time of the accident included 2-mile visibility in light snow and a ceiling of 400 feet overcast.) Also, the pilot was unable to load the rotor because the helicopter engine had shed its free turbine blades. As a result, after engine power was lost because of the overspeed, the pilot had to instead lower the collective to conserve rotor rpm and attempt an emergency autorotation landing on the hillside. A motorist who observed the helicopter's departure noticed its steep vertical descent (consistent with an attempted autorotation landing) into a ravine about 1 minute later. (The helicopter's satellite tracking system also indicated that the duration of the flight lasted about 1 minute.)

The petitioner also stated that "there is no evidence to prove that the observed position of the FFCL [in the wreckage] was the position at the time of final impact." The petitioner indicated that the length of a mark/scratch (caused by impact damage) below the normal detent contact area "shows that the FFCL was not in the full emergency position when the damage occurred." Further, the petitioner stated that the location of the FFCL "could have been a result of a post crash action by the pilot or the survivor, or a result of the wreckage recovery process."

The petitioner's statements are incorrect. The three levers comprising the floor-mounted control quadrant (the FFCL, the emergency fuel shutoff lever, and the rotor brake lever) were found trapped in the wreckage, and the positions of the levers were photographed by the NTSB investigator-in-charge before any attempt was made to recover parts from the helicopter. Afterward, the investigator-in-charge tried to move the FFCL from its forward emergency position but was unable to. (Similarly, the emergency fuel shutoff lever and the rotor brake lever could not be moved from their positions as recovered in the wreckage.) The indicator at the fuel control unit also showed that the FFCL was in the emergency position at the time of impact. The cable connecting the FFCL and the fuel control unit indicator was found slacked (as a result of bending of the airframe during the impact), so the indicator's position would not have changed from its position at the time of impact. Thus, if the FFCL had been in the flight position at the

time of impact, the lever would have most likely stayed in that detent. In addition, the emergency valve is considered to be open regardless of where the FFCL is located within the emergency position. There was no evidence to indicate that the emergency valve opening was graduated.

The petitioner further stated that "a main rotor blade strike is the only cause for this accident that explains all of the physical damage throughout the aircraft's dynamic components." Specifically, the petitioner claimed that the following physical evidence suggested that a main rotor blade strike occurred during flight:

- The engine-to-main transmission driveshaft and the engine module 5 drive retaining nut exhibited corresponding high torque damage.
- The engine-to-forward tail rotor driveshaft flex coupling discs were splayed, which was consistent with power/rotation during an in-flight impact.
- The splined flex coupling assembly that connects the forward steel tail rotor driveshaft to the aft aluminum tail rotor was disengaged, and rotational scoring was observed on the interior of the driveshaft cowling in the area of the coupling.
- The tail rotor shaft key sheared inside the tail rotor hub, which was consistent with a high torque event involving a sudden tail rotor driveshaft acceleration with a disengaged main gearbox drive.
- The main rotor hub and the red main rotor blade leading edge exhibited damage that was consistent with a powered impact, suggesting an in-flight main rotor impact, and the damage to the red main rotor blade (static punctures and chordwise bending) was consistent with a low rpm impact.
- The lack of evidence of overall rotation/power at final impact suggested that a high torque event occurred during flight.

Regarding the petitioner's first point, the NTSB determined that the overtorque at the module 5 drive retaining nut (as evidenced by an index mark that was misaligned by about 7 millimeters) was caused by a main rotor strike at impact. Evidence showed that the rotor strike occurred at impact because there was nothing at the departure site or between the departure site and accident site (a ravine embankment with an incline of 35° to 50°) that the rotor could strike. In addition, all of the helicopter's major components, including the rotor components, were found at the main wreckage site. The damage to the driveshaft, which was found twisted and shortened (liberating the splined [aft] end of the shaft from the engine output spline), was caused by the overtorque to the module 5 nut. (The torque on the nut greatly exceeded the torque that would be required for the driveshaft to collapse.)

Regarding the petitioner's second point, evidence showed that the splayed engine-to-forward tail rotor driveshaft flex coupling discs resulted from impact damage. Specifically, given the steep terrain and the angle of descent at which the helicopter impacted the hillside, the tail rotor likely struck the ground first, shearing the tail rotor shaft key. After shearing the key, the tail rotor stopped rotating, but the driveshaft, which was still connected to the drive train, continued to turn. (The engine was not producing power because of the overspeed but was still turning at a rate of about 60,000 rpm when it shed its turbine blades.) The main fuselage impacted the ground next. The fuselage (including the tailcone) collapsed, binding the

driveshaft and splaying the coupling. Thus, the splayed coupling discs were consistent with rotation at impact but were not consistent with power at impact.

Regarding the petitioner's third and fourth points, the NTSB notes that, because the engine shed its turbine blades and the pilot moved the emergency fuel shutoff lever to the off position (because of the overspeed), the only thing that could be driving the tail rotor with any force was the main rotor. Thus, the main transmission driveshaft had to be intact until impact. After impact, the main fuselage and the engine collapsed, binding the main transmission driveshaft, which was found twisted, shortened, and liberated from the engine output spline. At that point, the main rotor system operated free from the engine and continued to rotate for a short time (even though the rotor blade tips had already struck the ground) before coming to a stop. The break at the main transmission shaft, along with the two other breaks in the drive train (the tail rotor hub and the tail rotor shaft), had likely happened simultaneously as a result of the main and tail rotors' impact with the ground. The tail rotor strike with the ground caused the shearing of the tail rotor shaft key. The tail rotor driveshaft, which was being driven by the main rotor, continued to turn until the collapse of the tailcone. The splined flex coupling then failed, but it continued to rotate for a short time afterward, causing the rotational scoring on the interior of the driveshaft cowling.

Regarding the petitioner's fifth point, the NTSB determined that a "powered impact" did not likely occur because the pilot had shut off the emergency fuel lever (to shut down the runaway engine). The damage to the main rotor hub was consistent with the rotor system operating at a low rpm as it impacted the ground. The red blade likely contacted the side of the ravine first because of the major damage to the blade's leading edge. The damage to the red main rotor blade that was consistent with a low rotor rpm (static punctures and chordwise bending) occurred because the pilot likely attempted to arrest the helicopter's steep vertical descent and used all of the energy available in the rotor system to cushion the attempted autorotation landing.

Regarding the petitioner's sixth point, the main rotor showed evidence of rotation at impact, resulting in a high torque event, which occurred even as the rpm was decreasing. A high torque event would not be possible during flight without a main rotor blade strike. The NTSB did not find any evidence of an in-flight main rotor blade strike at the time of the initial investigation of the accident site and during a trip to the site about 2 months afterward. The petitioner stated that it would be "unlikely that evidence of a main rotor blade strike would remain [about 2 months after the accident], as the general accident area was covered in snow at the time of the accident." The NTSB found no evidence of a blade strike because, as previously stated, there were no intervening objects near the site for the blades to strike during the helicopter's departure and steep vertical descent.

The petitioner further cited an NTSB investigation of a May 4, 2000, AS350 B accident near Blanding, Utah, that involved the intentional movement of the FFCL to the emergency range during flight (DEN00FA084). The NTSB determined that a contributing factor to the accident was "the total loss of engine power due to the pilot manually introducing excessive fuel into the engine and over temping the turbine section." The petitioner claimed that "the lack of any engine overspeed damage [in the Blanding accident] with the intentional in-flight movement

of the FFCL to the emergency range is substantial evidence that movement of the FFCL was not involved with the engine damage in [the Chickaloon] accident."

To support his claim, the petitioner indicated that, in the Blanding accident, the first and second stage turbine wheels were found with their blades 50 to 70 percent melted, demonstrating that the additional fuel flow resulting from movement of the FFCL to the emergency range would result in overtemping. However, in the Chickaloon accident, there is no evidence to indicate that the additional fuel flow resulted in overtemping.

In addition, the petitioner indicated that, in the Blanding accident, (1) no blade shedding occurred on the free turbine blades, (2) no evidence of an overtorque was found on the module 5 splined sleeve, and (3) the engine-to-main gearbox coupling shaft showed no sign of torsion. However, the NTSB notes that blade shedding is determined by an engine rpm of 150 percent and not by temperature, and the Blanding accident involved an overtemp. Also, although no evidence of overtorque was found on the module 5 splined sleeve and no sign of torsion was found on the engine-to-main gearbox coupling shaft for the Blanding helicopter, there was evidence of overtorque and torsion on the Chickaloon helicopter (on the module 5 nut and the engine-to-short tail rotor driveshaft, respectively), which occurred at the time of impact and not during flight. Finally, in the Blanding accident, the pilot was able to repeatedly load and unload the rotor system as he attempted to control the helicopter, whereas the pilot in the Chickaloon accident was unable to load the rotor system.

The petitioner's assertions imply that the circumstances surrounding the Blanding and Chickaloon accidents are similar. However, the NTSB believes that the accident circumstances are only similar in that they demonstrated the problems that could quickly result from the FFCL being moved to the emergency position. Both accidents involved a loss of engine power, even though the engine on the Blanding helicopter had overtemped and the engine on the Chickaloon helicopter had oversped.

The petitioner believed that the probable cause of the accident should be "an in-flight main rotor impact with snow-covered terrain, resulting in decoupling between the engine and main rotor system and subsequent loss of main rotor RPM." The NTSB continues to believe that the evidence, as discussed in this petition, does not support an in-flight main rotor impact but rather an engine overspeed that led to a loss of engine power. During the investigation of the accident, the NTSB learned (from the helicopter manufacturer) that the inadvertent movement of the FFCL into the emergency range could cause an engine overspeed within seconds if the rotor system was not loaded. The petitioner (on behalf of the helicopter manufacturer) claimed that, "if the FFCL is moved to the emergency range during flight with a functioning FCU [fuel control unit], NR (rotor rpm) will increase slightly, but no engine overspeed would occur because the main rotor is loaded by the flight loads." However, as previously stated, the evidence gathered during this accident investigation indicated that the pilot was not able to load the rotor system. In addition, the NTSB notes that Eurocopter has not provided any engineering data to refute its former position or support its current one.

The petitioner further believed that a contributing factor to the accident may have been "reduced visibility and snow at the time of the accident." The NTSB believes that the low

visibility and ceiling at the time of the accident likely contributed to the pilot's inability to load the main rotor system but that they were not contributing factors to the accident.

Design and Placement of Fuel Flow Control Lever and Stowage of Passenger's Backpack

The petitioner claimed that "there is no evidence to support…that the manufacturer's design and placement of the fuel [flow] control lever made it susceptible to accidental contact and movement by passengers" and that "the pilot failed to properly secure/stow the passenger's backpack." However, the petitioner did not offer any evidence to refute the NTSB's findings except to note that a search of Eurocopter's records found no accidents or incidents caused by the inadvertent displacement of the FFCL into the emergency position during flight.

During its investigation of the Chickaloon accident, the NTSB learned of an April 1994 AS350 B accident near High Prairie, Alberta, Canada, in which a passenger inadvertently moved the FFCL from the flight detent to the stop detent while trying to adjust a knapsack placed under his right knee. The engine suddenly lost all power (due to fuel starvation), the pilot conducted an autorotation, and the helicopter made a hard landing. Among its conclusions, the Transportation Safety Board of Canada found that the FFCL was not guarded or protected against inadvertent movement. The NTSB notes that, even though the FFCL movement in the Canadian accident did not involve movement of the FFCL into the emergency range, the accident demonstrated how easily the FFCL could be moved from one detent to another.

The NTSB investigated a November 2006 accident in Fort Myers, Florida, that was caused by a pilot's failure to maintain aircraft control during engine start (MIA07TA017). The pilot had intended to move the FFCL from the stop detent to the flight detent, but he unintentionally moved the FFCL all of the way forward to the emergency position, causing an increase in engine torque and engine rpm. The NTSB recognizes that, in this case, the pilot was responsible for moving the FFCL forward but notes that the pilot missed the intended detent because of the ease in which the FFCL could be moved.

During the investigation of the Chickaloon accident, the NTSB asked two U.S. commercial AS350 B2 operators about whether they had experienced events in which passengers had interfered with floor-mounted engine controls, such as the FFCL. Both operators stated that they were aware of events in which passengers' items were either placed on the FFCL or became entwined with the FFCL. The FFCL moved out of the detent during some of these events, but the events were not reported because they occurred on the ground and did not cause damage or injury.

During the initial examination of the wreckage, the front seat passenger's backpack was found about 2 feet in front of the helicopter along with the left chin bubble (a clear acrylic window in the lower portion of the helicopter's nose), which had popped loose from its mounting in front of the left front seat. The backpack was found between the chin bubble and the opening in the nose of the helicopter where the chin bubble had been mounted. All other baggage and cargo had been found stowed and secured in the aft baggage compartment.

The FFCL's position on the helicopter's cabin floor was near where the front seat passenger's right foot was located. Although the front seat passenger could not recall (during a postaccident interview) where he had placed his backpack, wreckage evidence showed that the backpack had been stowed on the left side of the cockpit. Further, the Canadian accident, the Fort Myers accident, and the experiences of two U.S. commercial AS350 B2 operators all demonstrate that pilots, passengers, and items, such as unstowed baggage, can inadvertently move the FFCL, or cause the FFCL to inadvertently be moved, to the incorrect position. Thus, the NTSB continues to believe that the passenger's right foot or his unstowed backpack had inadvertently moved the FFCL into the emergency position, causing the engine overspeed and loss of power, and that FFCL's floor-mounted location permits non-crewmembers to readily access and move the lever.

Therefore, after review of the evidence, the petition for reconsideration of the NTSB's findings and probable cause in connection with the aircraft accident involving a Eurocopter AS350 B2 helicopter, N213EH, on April 15, 2008, near Chickaloon, Alaska, is denied in its entirety.

Chairman HERSMAN, Vice Chairman HART, and Members SUMWALT, ROSEKIND, and WEENER concurred in the disposition of this petition for reconsideration.