



Captain Chesley Sullenberger



First Officer Jeffrey Skiles



Got Any Ideas?:

U.S. Airways Flight 1549

Leadership ViTS Meeting

April 2011

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Chief, Safety and Mission Assurance

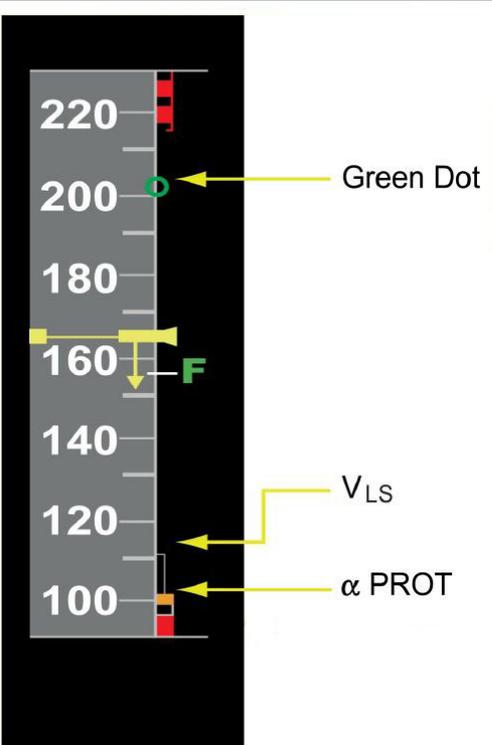
Wilson B. Harkins

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THE MISHAP

When the 155 passengers and crew members aboard U.S. Airways Flight 1549 left New York City on a cold day in January 2009, no one anticipated the drama that was about to unfold. Takeoff proceeded normally, but when the aircraft climbed to 3,200 feet, a flock of migratory geese crossed its flight path. Each of the Airbus A320's turbofan engines ingested a goose and subsequently suffered damage that disabled its thrust-producing capability. Unable to return to the airport and left without other landing options, the flight crew valiantly ditched the plane in the Hudson River. Seconds after the aircraft skidded onto the frigid water, passengers evacuated onto the wings and waited for rescue. Within minutes, commuter ferries and Coast Guard vessels arrived at the scene and rescued the airplane occupants.



Airbus A320 Airspeed Scale

Aircraft Controls

- Airbus A320 is not equipped with a conventional control yoke; pilots instead use a side stick to fly the aircraft.
- Side stick inputs are analyzed by a “fly-by-wire” electronic interface which prevents the aircraft from executing maneuvers outside its performance limits.
- Setting the fly-by-wire system to Normal Law keeps the aircraft within a safe flight envelope with respect to roll, pitch, yaw, and speed.

Airspeed Scale

- Green Dot: Represents the speed at which the aircraft must travel to obtain the best lift over drag ratio, allowing maximum range for glided flight.
- V_{LS}: Lowest selectable speed at which the aircraft can travel while still generating lift.
- α-protection: Prevents the aircraft from stalling, but only activates when the aircraft is flying under Normal Law.

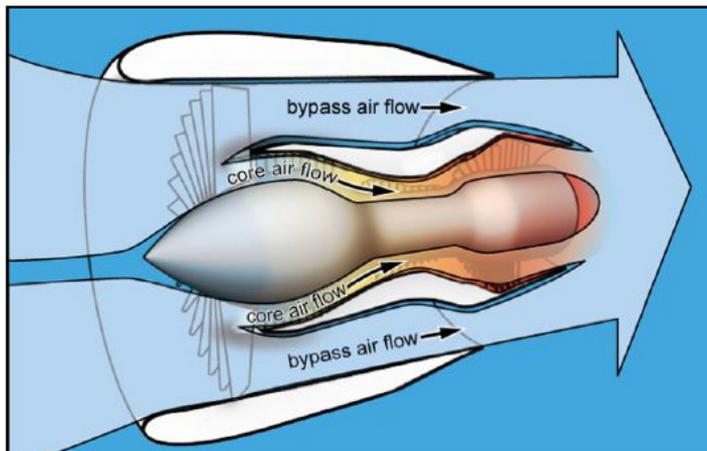
Extended Over Water Operations

- The aircraft used for U.S. Airways Flight 1549 was one of twenty fleet aircraft certificated for extended over water (EOW) operations.
- EOW aircraft contain safety features not found on conventional planes such as emergency slide/rafts at forward and aft exits, passenger life vests, and ditching certification.

WHAT HAPPENED?

Loss of Engine Thrust and Ditching

- On January 15, 2009, U.S. Airways Flight 1549 was cleared for takeoff from LaGuardia airport. As it climbed to cruising altitude, the aircraft encountered a flock of migratory geese.
- At 3,200 feet, both aircraft engines, operating at 80% fan speed, sucked several geese through their inlets.
- At least one goose impacted and destroyed each engine's core, abruptly terminating engine capability to generate useable thrust.
- The Captain immediately assumed control of the aircraft and activated the auxiliary power unit (APU).
- The First Officer started the Dual Engine Failure Checklist, beginning with an attempt to relight the engines.
- Air Traffic Control (ATC) began relaying instructions for landing at LaGuardia or Teterboro airports, but the captain saw the Hudson river as the only viable landing option.
- As the flight crew prepared the aircraft for ditching, no one noticed that the airspeed had fallen below the Green Dot.
- The aircraft entered alpha-protection mode at 150 feet and skidded onto the water 3 minutes after the birdstrike.
- External pressure from the impact tore the rear fuselage apart, and water gushed through the opening, rendering rear exits and slide/rafts useless.
- With only the forward emergency slide/rafts available, passengers were forced to evacuate onto the airplane wings.
- Rescue vehicles arrived within 5 minutes of the ditching, and the last passengers were rescued 20 minutes later.



Centrifugal force from engine fan blades slings small foreign objects through the bypass duct, but the engine core is susceptible to damage from large objects.



Flight Path of U.S. Airways Flight 1549



PROXIMATE CAUSE



Each engine of the accident aircraft ingested at least one 8-pound Canada Goose. Each bird's impact with the engine core caused critical damage that resulted in an almost complete loss of thrust. The professionalism and crew resource management of the flight crew enabled it to maintain control of the aircraft and increase the survivability of the impact. The captain's swift and thoughtful activation of the APU also contributed to the success of the ditching because the APU allowed the fly-by-wire system to remain in Normal Law. Without the APU, the aircraft would not have descended within the flight envelope and stall protections that Normal Law afforded. The official accident investigation report also noted that the aircraft operated that day had been certificated for EOW operations even though the FAA did not mandate the use of a water-rated plane for the flight from New York to Charlotte. Without the slide/rafts available on such an aircraft, many passengers would likely have drowned.



UNDERLYING ISSUES

In-Flight Engine Diagnostics

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- The NTSB investigation showed that the first officer spent the first 30-40 seconds after the bird strike attempting to relight the engines as per instructions on the emergency checklist.
 - The flight crew had no way of knowing the engines had been damaged to an extent that relighting would be impossible.
 - Since only three minutes elapsed from the time of the bird strike to the time of the ditching, the relight attempts only wasted precious time. Therefore, in-flight diagnostics providing more detailed information on engine problems could be instrumental in saving seconds that could mean the difference between life and death in an emergency.

Emergency Checklist Design

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- Airbus' 3-page Quick Reference Handbook Dual Engine Failure Checklist had been designed for use at altitudes over 20,000 feet, but at the time of the bird strike, Flight 1549 had only reached 3,200 feet. Time did not allow the flight crew to reach items critical to the ditching.
 - A checklist tailored for low altitudes would likely have allowed the crew to reach the ditching instructions at the end of the checklist in time, therefore NTSB recommended that the FAA require aircraft manufacturers to create checklists for engine failure at both high and low altitudes and review the ways in which steps on the checklists are prioritized.

FOR FUTURE NASA MISSIONS



- Effectively executing the contingency plans requires strong leadership and teamwork, so Crew Resource Management Training must teach crews how to create conditions that increase survivability in a worst-case scenario.
- NASA must continue to advance a culture of preparedness, teamwork, and communication, thereby leaving little to chance in saving its missions, spacecraft, or crew members when disaster strikes.

- Many factors outside the crew's control worked in conjunction with its efforts to bring the aircraft to a survivable landing and the passengers to a safe rescue.
- However, during emergencies such as this one, it is more often the case that external factors work against the crew in its attempts to save missions during a crisis.
- Therefore, NASA must constantly question the strength of its contingency plans.
- Ensuring the presence of efficient and effective emergency procedures can help operators perform situational analyses and make sound decisions while facing high workloads and stress levels.

