The NTSB cites misstatement of empty weight as a cause of a fatal S-61N crash; the operator disagrees.

Weighty Issues

BY LINDA WERFELMAN

The owner's "intentional understatement" of a helicopter's empty weight was partly to blame for the Aug. 5, 2008, crash of a Sikorsky S-61N that killed seven firefighters and two crewmembers during a forest fire near Weaverville, California, U.S., the U.S. National Transportation Safety Board (NTSB) says.

Three firefighters and a third crewmember were seriously injured and the helicopter was destroyed in the crash of the S-61N, which was operated by the U.S. Forest Service (USFS) as a public flight,[1] under contract with Carson Helicopters[2] of Grants Pass, Oregon.

In its final report on the accident, the NTSB said the probable causes were "the following actions by Carson Helicopters: the intentional understatement of the helicopter's empty weight, the alteration of the power-available chart to exaggerate the helicopter's lift ability and the practice of using unapproved above-minimum

Accident aircraft snorkeling water for fire fighting.

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specification torque in performance calculations that, collectively, resulted in the pilots relying on performance calculations that significantly overestimated the helicopter's load-carrying capacity and did not provide an adequate performance margin for a successful takeoff."

The NTSB also cited "insufficient oversight by the USFS and the Federal Aviation Administration (FAA)."

Factors contributing to the accident were the "immediate, intense fire that resulted from the spillage of fuel upon impact from the fuel tanks that were not crash resistant, the separation from the floor of the cabin seats that were not crash resistant and the use of an inappropriate release mechanism on the cabin seat restraints."

Carson Helicopters disputed the NTSB's findings, saying that it "strongly believes that the accident was caused by the loss of power to the no. 2 engine due to contamination in the fuel control" (see "Dissenting Opinion," p. 32).

Performance Charts

The morning of the accident, around 0830 local time, crewmembers attended a briefing at the Trinity Helibase,[3] 7 nm (13 km) northeast of Weaverville. Afterward, the pilot-in-command (PIC) completed performance load calculation forms required by the USFS. The copilot told investigators that all calculations were performed using Carson Helicopters' performance charts and the helicopter empty weight specified by the company.

Later in the day, the pilots participated in rappel training with the Trinity helitack crew — trained in working with helicopters in an initial attack on a large fire and in suppressing fires with bucket drops and the movement of equipment and personnel. About 1320, the pilots flew a two-hour water-dropping mission over a fire in the Shasta–Trinity National Forest. They then ate lunch and had the helicopter refueled before the PIC met with an inspector pilot for an oral examination.

About 1630, the pilots were told about a planned repositioning mission.

"Based on a forecast of lightning for the high mountainous areas that night, USFS management had decided to transport two hand crews[4] from H-44 [Helispot-44], which has an elevation of 5,980 ft, to Helispot-36 (H-36), which has an elevation of 1,531 ft," the report said. The pilots had never flown to H-44; neither had members of the Trinity helitack crew, who were being transported to both locations to aid in the repositioning.

About 1707, the helicopter left the Trinity Helibase for a series of flights to H-36 and H-44, first to prepare and then to begin transporting the firefighters. The two-pilot crew was accompanied by the inspector pilot, who conducted a flight evaluation of the PIC early in the operation and also served as the required safety crewmember.

About 1814, during departure from H-44, the helicopter "felt heavy, slow and sluggish," one of the firefighters in the aircraft said. Flight recordings indicated that the engines reached "topping" — maximum gas generator speed limit, which corresponds to maximum engine power output — and then decreased. The report noted that in an S-61N, "when the collective is raised, power is automatically increased up to the point at which the engines reach topping. At that point, any further increase in collective results in an increase in drag that cannot be compensated for, and the main rotor speed begins to decay, or droop. When the speed of the main rotor droops significantly, the main rotor loses lift and the helicopter descends."

The cockpit voice recorder (CVR) contained no discussion of reaching topping speed, the report said.

About 1843, during the next departure from H-44, the engines again reached topping speed for about 18 seconds and then decreased. Again, the pilots did not discuss the matter.

At 1905, after the helicopter landed at the helibase for refueling, two mechanics conducted a routine visual inspection. They found ash on the main rotor blades and at the engine inlets, but the compressors' first-stage stators were clean. One mechanic "began wiping the blades with a rag, which easily removed the ash, leaving the wiped area of the blades free of debris," the report said.

The mechanics told investigators that both pilots had said that the helicopter had been operating well, and one added that the PIC asked them to finish their work because the required shut-down time was approaching and he wanted to depart. In response, the mechanics stopped wiping the blades and engine inlets and prepared the helicopter for takeoff.

The helicopter landed at H-44 about 1936, picked up the departing firefighters and, at 1941, lifted off. Before takeoff, the pilots were told that the manifested weight of the firefighters and cargo was 2,355 lb (1,068 kg), below the maximum payload of 2,552 lb (1,158 kg). The copilot also noted that the temperature was 12 or 13 degrees F cooler than they had calculated.

Analysis of the CVR indicated that, 22 seconds after the crew applied power, the engines reached topping speed, and remained there until the end of the recording.

Witnesses on the ground said that as the helicopter lifted off, it appeared to be moving slowly and that its movement was "labored," the report said. The slow movement was "inconsistent with the last two departures," one witness said.

The helicopter climbed about 20 ft, then moved forward and to the right, struck trees, fell to the ground and burned. One witness said that both engines continued operating for about 30 seconds after the impact.

Dissenting Opinion

Carson Helicopters has challenged the U.S. National Transportation Safety Board's (NTSB's) finding that company actions were to blame for the Aug. 5, 2008, crash of a Sikorsky S-61N, complaining that the agency tried to "make Carson a scapegoat" while ignoring "an ongoing safety-of-flight issue."

Franklin Carson, president of Carson Helicopters, denounced as "arbitrary and one-sided" the Dec. 7, 2010, public hearing during which the NTSB approved its final report on the accident, including the probable cause.

Carson said that the company believes that the accident was caused by a loss of power to the no. 2 engine and that the power loss resulted from contamination in the fuel control. He said the NTSB ignored "indisputable evidence" that supports the company's claim.

He noted that, six years before the accident, his company told engine manufacturer General Electric (GE), Sikorsky and Columbia Helicopters, which overhauls fuel controls, about Carson Helicopters' belief that fuel control contamination caused engines to lose power.

"Two years before the accident, GE recommended that Sikorsky change the airframe filter for the fuel control from 40 microns to 10 microns to address this problem," Carson said. "One day after the accident, GE e-mailed Sikorsky asking what was being done about changing the airframe fuel filter. It wasn't until almost two years after the accident that Sikorsky issued a service bulletin changing the approved filter from 40 microns to 10 microns."

Carson said that the NTSB "ignored the experienced copilot's direct testimony that he saw signs of power loss in the no. 2 engine immediately prior to the crash, and … ignored his direct reading of the actual air temperature at the scene in favor of manufactured data that fit their preconceived narrative."

In addition, he said that the NTSB "lost care and custody of fuel control unit (FCU) parts early in this investigation and from that point forward did not pursue evidence chains leading to the fuel control units." He said that "significant contaminants ranging in size up to 28 microns" were found inside the no. 2 FCU and added, "There is a history of power loss problems due to contaminants in the FCU because of inadequate fuel filtering that was known by the manufacturer and not properly explored by the NTSB."

Carson said that the NTSB did not participate in independent flight tests that were conducted in density altitude conditions that matched those at the accident site. The tests verified U.S. Federal Aviation Administration performance charts that showed that the helicopter had more than enough power to fly out of Helispot-44, he said.

He also said that the NTSB's primary investigation team "had no relevant helicopter experience to properly investigate this accident and misplaced their emphasis on poorly contrived data instead of concentrating on the hard evidence leading to the ultimate cause of this accident and an ongoing safety-of-flight issue."

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Qualification Cards

The PIC held an airline transport pilot certificate, a helicopter rating and type ratings for S-76s and Boeing Vertol 234s; he also had type ratings at the commercial level for BV-107s and S-61s. He had 20,286 flight hours, including 8,166 hours in S-61s, and an Interagency Helicopter Pilot Qualification card issued by the U.S. Agriculture

Department and U.S. Interior Department. The card — required by the USFS for pilots flying its missions — cited the pilot's qualifications and indicated that he was approved for mountain flying, external load operations, retardant/water-dropping, long-line vertical reference and snorkel. All of these operations were permitted in S-61s.

The evaluation on the afternoon and the evening of the accident flight had been conducted to add a "mission fire suppression (helitack)" endorsement to allow the PIC to transport firefighters to and from a fire line. He had been on duty for four days before the accident for as long as 14 hours each day but had flown only on the first of the four days, when he recorded four hours of flight time.

The copilot had 3,000 flight hours, including 1,100 hours in S-61s. He had a commercial pilot certificate with helicopter and instrument-helicopter ratings, an S-61 type rating and a second-class medical certificate. He also held an Interagency Helicopter Pilot Qualification Card, which specified his qualifications for the five types of missions for which the PIC qualified, in addition to fire suppression (helitack) and reconnaissance and surveillance.

His duty period began July 30, and he had flown for two hours on July 31 and four hours on Aug. 2.

The helicopter was manufactured in 1965 and was purchased in 2007 by Carson Helicopters and reconfigured, with modifications of the landing gear, seats, cargo hook and interior, and removal of overwater equipment. In June 2008, further modifications were made, including the installation of additional passenger seats required by the USFS. The helicopter arrived at the Trinity Helibase, under contract to the USFS, on July 1, 2008.

It had 35,396 flight hours when the accident occurred. It had two General Electric CT58-140 turboshaft engines. The no. 1 engine had 22,323 hours and the no. 2 engine, 32,439 hours total time; the no. 1 engine had accumulated 1,016 hours since overhaul, and the no. 2 engine, 238 hours. The helicopter was equipped with a 900-gal (3,407-L) aerial liquid-dispersing tank.

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The helicopter was owned by Carson Helicopters Inc. (CHI) and was one of 10 S-61Ns that the company leased to Carson Helicopter Services Inc. (CHSI). CHSI began operations in 2003, with headquarters in Grants Pass, and focused on logging operations. By 2005, the bulk of CHSI summer operations consisted of contracts with USFS, especially for water-dropping flights.

Witnesses said the helicopter's movement was "labored" as it lifted off and climbed about 20 ft before crashing into the ground.

At the time of the accident, CHSI employed 200 people, including 50 pilots — whose experience averaged 12,000 flight hours — and 51 maintenance personnel.

Weight and Balance

The NTSB's review of aircraft weight and balance records indicated that the empty weight of the helicopter at the time of the accident was

13,845 lb (6,280 kg) — 1,437 lb (652 kg) more than the empty weight used by the PIC in his load calculations. During the investigation, Carson Helicopters estimated the empty weight at 13,432 lb (6,093 kg) — 1,024 lb (464 kg) heavier than the empty weight used by the PIC, the NTSB said.

The NTSB calculated the total weight of the helicopter — including the weights of the flight crew, the inspector pilot, the load manifest and the estimated fuel load — to be 19,008 lb (8,622 kg). Using the operator's estimate of empty weight, the total was 18,595 lb (8,435 kg).

In a May 2010 submission to the NTSB, Carson Helicopters said that it was unaware until after the accident "that there were anomalies and irregularities in the weight documents maintained for [the accident helicopter] and in the performance charts in Carson's, and presumably the accident aircraft's, flight manuals."

In the submission, Carson Helicopters said it could not determine the reason for the incorrect information, although "many of the anomalies and irregularities" apparently originated in documents put together by a company official who later was fired.

"In response to these anomalies and irregularities, Carson has modified its operations and procedures, including but not limited to improving internal controls over the weighing process, to minimize chances of such anomalies and irregularities occurring in the future," the submission said.

After the accident, the USFS examined six of Carson Helicopters' aircraft working on agency contracts and concluded that records did not accurately reflect the equipment installed in the helicopters. Several weeks later, the USFS suspended work being performed in accordance with its two contracts with Carson Helicopters, citing its concerns about discrepancies in recorded statements of helicopter weights and the "Takeoff Power Available" chart.

In February 2009, the USFS terminated the contracts, citing issues involving helicopter weight and related performance specifications. The USFS said that seven of the 10 Carson Helicopters aircraft under contract to the agency weighed "more than their equipped weight as bid," that five of the helicopters did not meet a specification requiring a minimum payload of 3,000 lb (1,361 kg) for operations at 7,000 ft pressure altitude and 20 degrees C (68 degrees F), and that operations of all 10 helicopters were conducted using "an improperly modified performance chart that was propagated into Carson's internal flight manuals."

Contract Changes

The report said that both the USFS and the FAA failed to detect the use of incorrect weight and performance charts for the accident helicopter and that, if either agency had identified the problem, and the problem had been rectified, the accident might have been prevented.

After the accident, the USFS made a number of changes in its contract for heavy and medium helicopters used in fire fighting, including:

- The addition to evaluation flights of tasks designed to "determine whether the pilot exhibits the knowledge and skills to properly perform a HOGE [hover out of ground effect] power check before landing at or departing from helispots located in confined areas, pinnacles or ridgelines";
- The use of spot checks, to be observed by a USFS maintenance inspector, that include "inspections/weighing/tests as deemed necessary to determine the contractor's equipment and/or personnel currently meet specifications"; and,
- A new requirement that "after proposal evaluations and before or post award, all aircraft will be physically weighed with the weighing witnessed by agency aircraft inspectors."

The report included about one dozen recommendations each to the FAA and the USFS, including a call for the FAA to clarify its authority over public aircraft (*ASW,* 12/10-1/11, p. 10).

This article is based on NTSB Accident Report NTSB/AAR-10/06, Crash During Takeoff of Carson Helicopters Inc. Firefighting Helicopter Under Contract to the U.S. Forest Service; Sikorsky S-61N, N612AZ; Near Weaverville, California; August 5, 2008.

Notes

1. As public flights — conducted on behalf of the government — these operations are not subject to many of the Federal Aviation Regulations that govern civil flights.
2. The NTSB used the term "Carson Helicopters" to refer to two companies — Carson Helicopters Inc. and Carson Helicopter Services Inc. — which are separate legal entities although they are owned by the same people and have the same president.
3. The USFS defines a *helibase* as a "designated, permanent facility for helicopter operations." A related facility is a *helispot*, defined by USFS as "a natural or improved takeoff and landing area intended for temporary or occasional helicopter use."
4. A *hand crew* consists of about 20 people who have been organized and trained for fire fighting work, usually using hand tools.