NATIONAL TRANSPORTATION SAFETY BOARD
OFFICE OF AVIATION SAFETY

September 15, 2009

Operations Factual Report

LAX08PA259

A. ACCIDENT

Operator:	United States Forest Service
Location:	Weaverville, California
Date:	August 05, 2008
Time:	1941 Pacific daylight time
Aircraft:	Sikorsky S-61N, N612AZ

B. OPERATIONS GROUP

Group Chairman

Zoë Keliher
National Transportation Safety Board
Western Pacific Region
Gardena, California

Group Members

Sean Moretz
Director of Operations
Carson Helicopter Services, Inc.
Grants Pass, Oregon

Jim Morrison
Safety Systems
USDA Forest Service
Ogden, Utah

C. SUMMARY

On August 5, 2008, about 1941 Pacific daylight time[1], a Sikorsky S-61N helicopter, N612AZ[2], impacted trees and terrain during the initial climb after takeoff from Helispot 44, located at an elevation of about 6,000 feet in mountainous terrain near Weaverville, California. The airline transport pilot, the safety crewmember and seven firefighters[3] were killed; the commercial copilot and three firefighters were seriously injured. Impact forces and a postcrash

[1] All times in this report are expressed in terms of a 24-hour clock and Pacific daylight time unless otherwise noted.
[2] Throughout this report the accident helicopter will be referenced as N612AZ, however throughout the attachments it should be noted that USFS personnel and the pilots reference the helicopter as Helitanker (HT) 766
[3] Throughout this report the term "firefighters" is used in place of qualified non-crewmembers. As per Advisory Circular (AC) 00-1.1, a firefighter is considered a qualified non-crewmember when their presence is required to perform, or is associated with the performance of a government function (firefighting).

fire destroyed the helicopter. The helicopter was being operated by the United States Forest Service (USFS) as a public flight to transport the firefighters from Helispot 44 to another location. The helicopter was registered to Carson Helicopters, Inc. (CHI) of Grants Pass, Oregon, and leased to Carson Helicopter Services, Inc. (CHSI) [4] of Grants Pass. The USFS had contracted with CHI for the services of the helicopter. Visual meteorological conditions prevailed at the time of the accident, and a company visual flight rules flight plan had been filed.

D. DETAILS OF THE INVESTIGATION

The on-site portion of the operations investigation began on August 06, 2008. This phase of the investigation was conducted at the following locations: the accident site in the Shasta-Trinity Forest; Redding, California, where many witnesses were stationed; Aurora, Oregon, where the engines were examined and further interviews were conducted; Grants Pass, Oregon, where the pilots' records and operational facets of Carson Helicopters, Inc.(CHSI) were initially examined; and Perkasie, Pennsylvania, where the helicopter's records were examined and maintenance-related interviews were conducted.

Additional interviews included the CHSI Federal Aviation Administration (FAA) Principal Operations Inspector (POI), Chief Pilot, Director of Operations (DO), Vice President, President, several company pilots, the copilot, other S-61 pilots employed at different operators, and additional individuals who had knowledge of the accident pilots or CHSI and CHI operations. Safety Board investigators requested data, records, manuals, and other pertinent documents from CHSI, CHI, and the FAA. A subpoena[5] was served to CHSI and CHI several months following the accident; although broad in nature, the subpoena encompassed electronic transmissions regarding the accident helicopter, an exemplar helicopter, and performance charts. The field phase of the accident investigation concluded on April 08, 2009.

1.0 History of Flight[6]

(a) Day of the Accident

The day began similarly to that of the days prior to the accident, with both pilots eating breakfast at Trinity Helibase[7] which was followed by a morning briefing. After the briefing, the

[4] Refer to section 1.9, Company Information, of this report.
[5] See Attachment #01: Subpoena
[6] Information utilized to write this section was primarily obtained from interviews with the Trinity Helitack crewmembers and witnesses, the copilot's interview with investigators, sound spectrum analysis of the engine noise from the Cockpit Voice Recorder (CVR), SkyConnect Global Positioning System (GPS), and the CVR transcript.

pilot-in-command (PIC) completed the required performance load calculation forms using an array of predicted altitudes and temperatures, including the least favorable conditions that were expected to be encountered that day[8]. Thereafter, the pilots were unoccupied for most of the morning, though they heard rumors of possible demand for water-dropping and handcrew-repositioning missions. The pilots were made aware that a USFS inspector pilot would be available later that day to give the PIC a flight evaluation in the S-61.

In the late morning the pilots were participating with the helitack[9] crew in performing rappel training with a mock-up system on the accident helicopter. During the training, they received an assignment to execute a water dropping mission. The flight departed around 1321 with the accident copilot acting in the capacity of PIC. He had been to the destination[10] before, performing the same mission of dropping water and sourcing the same dip sites[11]. The pilots performed the mission for the entire fuel cycle, not returning to the helibase until the fuel was low, which comprised a fairly routine mission. The fire conditions were classified as low to moderate, which meant that they were not required to continue water dropping. The pilots returned to the helibase around 1515, shut down the helicopter, and ate lunch. For the next several hours they were inactive and discussed the PIC's upcoming flight evaluation.

The day continued on similarly until the USFS inspector pilot arrived at the helibase around 1615. After discussing the possibility of a firefighter hauling mission later in the day, they all decided that even if a mission was not assigned, they would still make a flight in an

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[7] According to the USFS, each helicopter that is contracted is provided a permanent host helibase, which is the location from which the helicopter support missions are flown, and where it is parked, serviced, and refueled; there can be many helicopters that share the same helibase. Usually a temporary incident helibase is established in a field location that is close enough to the Incident Base Camp so that supplies and personnel can be ferried by ground to the helibase from the camp in a timely manner. Helibases are staffed with a Helibase Manager, Deck Coordinator, Landing and Takeoff Coordinator, Radio Operator, and numerous subsidiary positions operating in a Helibase Operations trailer or out on the landing pads.

[8] See Attachment #03: Load Calculations; a complete narrative regarding the load calculations performed by the PIC is in section 1.5, Load Calculations and Manifests, of this report.

[9] Helitack refers to "helicopter-delivered fire resources", and encompasses the system of managing and using helicopters and their crews to perform aerial firefighting and other firefighting duties. The number of crewmembers on a given Helitack varies, but they are all normally contracted for a 90 to 150 day duration. Some Helitack crews, depending upon type and number of helicopters hosted at a helibase may have as many as 30 people to as few as 1. Typically, a standard category helicopter used for initial attack, as was the case at Trinity Helibase, would have 8 to 22 people on the crew. Exclusive use helitack crews are hosted at a single base, although they may spend little time at that particular base. Depending upon the type of helicopter, its operational role, and the nature of the demands for helicopters, a crew or many of the personnel on a crew may be away from their host base for significant portions of a fire season, operating from other permanent helibases, airports, or remote temporary helibases.

[10] The water dropping mission was conducted in division Foxtrot in fire suppression efforts of the Buckhorn Fire.

[11] Refers to the location of a water source where pilots load their aircraft with water for the purpose of water dropping/fire suppression missions.

effort to have the PIC complete his mandatory flight evaluation. Following that decision, the inspector pilot gave the PIC an oral examination, querying him on many operational facets of the S-61, including specific focus on the performance load calculations, which enables the pilot to determine the performance of the helicopter at a specific pressure altitude and temperature. Around 1630 the helibase manager informed the pilots and helitack crew of a request for them to perform a handcrew repositioning mission.

(b) Mission

On the day of the accident, around 1000, a USFS Incident Meteorologist (IMET[12]) forecasted lightning that night occurring in the high mountainous areas. The USFS Operations opted to attempt relocating the ground crews in the area of Helispots H-44 and H-61 due to their locations being situated on the crests of hills and susceptible to such inclement weather. Based on the discussions of the possible lightning, management decided to transport two handcrews (Ferguson and Grayback[13]) from H-44 to the lower H-36, which are 10.9 nautical miles (nm) apart. The relocation mission from H-61 had begun in the late afternoon and a call was placed to the Trinity Helibase to have N612AZ perform the firefighter transport from H-44, which was 21.79 nm from the helibase. Neither the pilots nor the helitack crewmembers had been to H-44 prior to the day of the accident.

Prior to N612AZ commencing the mission, two helitack crewmembers were taken to H-44 by another helicopter prior to the accident helicopter arriving. They were to prepare the manifests, brief the firefighters, and assess the landing area for potential hazards. An initial evaluation of the landing area was unsatisfactory due to the presence of multiple rocks and a wide patch of dry dirt. After moving the dead branches and clearing rocks, one of the helitack crewmembers requested a water drop for dust abatement, which was performed by another helicopter shortly thereafter. At that time, there were a total of 46 people that needed to be transported from H-44 (2 Helitack crewmembers, 19 Ferguson crewmembers, 20 Grayback crewmembers, and 5 fire overhead personnel).

[12] An IMET is a specially trained meteorologist who provides site specific weather forecasts and information at an incident. The individual works under the direction of the fire behavior analyst and the planning section chief.
[13] Grayback Forestry Inc., is a civilian company that contracts out trained firefighters. A 20-employee crew was working in remote terrain on the Shasta Trinity National Forest on the Iron/Alps complex for the 4 days prior to the accident. Ferguson is also a contracted Fire Management Company.

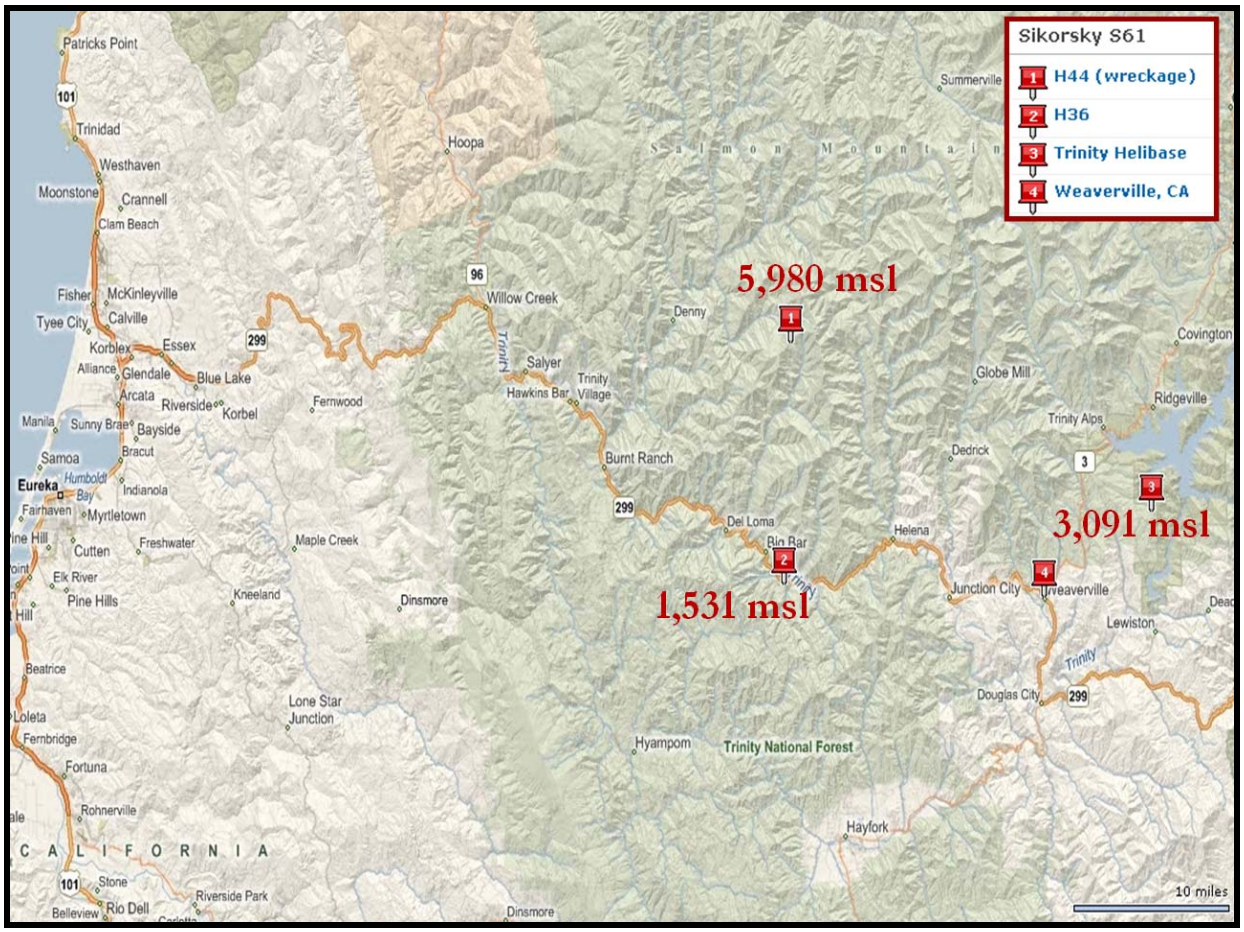

Figure 01: Location and Mean Sea Level (msl) of H-44, H-36 and Trinity Helibase with Relation to Weaverville

(c) Flight

The first segments of the flight were intended to position 5 Trinity helitack crewmembers at H-36 and the remaining 5 at H-44, staging them to assist transporting the handcrews from H-44. The helitack crewmembers, pilots, and inspector pilot all agreed on the mission plan and coordinated the helitack crewmembers to be located at each respective helispot. Prior to departure, the inspector pilot reviewed the PIC's load calculations, primarily referencing the 6,000 foot pressure altitude (PA) at 32°C condition, which was the most similar to those

expected to be encountered; according to that load calculation there was an allowable payload of 2,552 pounds (lbs)[14].

The helicopter departed at 1707 with 10 of the Trinity Helitack crewmembers onboard and the PIC acting in the capacity of the pilot flying. The inspector pilot was simultaneously conducting the flight evaluation while the mission was being executed. The flight was first destined for H-44, and upon arriving in the vicinity, the pilots opted to perform several orbits at 300 feet above ground level (agl) as their high reconnaissance of the landing zone (LZ) and surrounding area. Over the duration of about 7 orbits, they discussed the approach, termination and safety considerations for the helispot, including the altitude, temperature and wind. Together they agreed that all parameters fell within the bounds of the previously computed load calculations and therefore, the mission could be conducted safely. After determining that the mission could continue, they did not land, but continued to H-36, where 5 helitack members were to be staged. While en route, the pilots overflew the helispot by several miles, as there was some confusion about the coordinates. The location issue was resolved and the pilots performed high reconnaissance of the LZ.

The pilots conducted a low reconnaissance of H-36 and subsequently performed an uneventful landing; 5 helitack crewmembers disembarked to prepare for the firefighter transport mission. The helicopter departed at 1751 back to H-44. While en route, the pilots began to discuss the helicopter's fuel load with respect to the mission. Having completed numerous orbits for the purpose of reconnaissance, combined with the indirect route to H-36, the helicopter had burned more fuel than the pilots anticipated. The pilots estimated that the helicopter had about 50 minutes of fuel onboard and calculated that with the 5 loads of firefighters remaining, they may not be able to safety complete all the trips with their fuel load. The pilots additionally discussed the upcoming landing at H-44 and the copilot queried the PIC if the helicopter would be capable of hovering at H-44. The PIC responded that the helicopter had the performance capability to hover.

After arriving in vicinity of H-44, the pilots entered a high-area reconnaissance and again confirmed that they would land in the area the helitack crewmembers had staged for landing. Upon the pilots' first attempt to land, the helicopter encountered a brownout[15] near the LZ as a result of the rotor downwash. The helicopter approached closer to the ground and the dust became so severe that a helitack crewmember communicated to the pilots a request for them to abort the landing. With the helicopter's wheels lightly touching the ground, the pilots executed a

[14] The helicopter specifications and calculations used by the PIC to obtain this number are explained in section 1.5, Load Calculations and Manifests, of this report

[15] Brownout conditions connote in-flight visibility restrictions due to dust or sand in the air generated by the helicopter's own rotor downwash

go-around. Medium helicopters were called in to perform water drops on the LZ as a dust abatement procedure. On the second attempt, the pilots landed at a location about 100 feet to the south of the original spot on a comparatively dust-free rock outcrop.

The remaining 5 helitack crewmembers egressed the helicopter and aided in the loading of the first group of 10 firefighters; the manifests and briefings were completed prior to the helicopter landing. While on the ground at H-44, the copilot queried if the helicopter would have "enough power" to depart vertically out of the LZ. The PIC responded by confirming, "Absolutely, yes." Communications between the helitack crewmembers and the pilot transpired about the firefighter loads and upcoming pumpkin time[16] of 2053. It was decided that given the time and fuel load, the firefighter loads would be changed from 5 loads of 8 people to 4 loads of 10 people.[17]

The helicopter departed at 1814 with 50-foot trees directly ahead. The departure path started vertically, then veered to the right, and continued forward where a natural depression in the trees existed[18]. While performing the initial departure, the copilot announced, "75-percent" followed by, "everything's good," referring to the engine torque gauge indication. The helicopter continued the vertical ascent by an increase to "87-percent," and then was clear from trees with "102-percent" where the copilot added that "power's good." According to the sound-spectrum analysis of the CVR recordings, the engines reached topping[19] about 30 seconds after the collective increases, with a gas generator speed (N_G) increase of 102-percent and 101.4-percent on the individual engines over a duration of 14 seconds. During this time, the main rotor speed (N_R) began a slow droop from 108.7[20]-percent to 100-percent over 50 seconds.

[16] Pumpkin time is a common USFS term used to express the required shut down time for helicopter operations. This time is derived by adding 30 minutes to the predicted sunset time. On the day of the accident sunset was determined by referencing one of many sunset data sources and noted as 2023, equating to a pumpkin time of 2053. No flights may be conducted below 1,000 feet agl during the period of darkness, which is defined as the period falling between 30 minutes after official sunset and 30 minutes before official sunrise.

[17] At this time, there were 41 people on the ground that needed to be transported from H-44, it is unknown how the remaining person was going to be transported

[18] The copilot recalled in a post accident interview that during the first takeoff the "power was good," and the wind was "a help." He additionally stated that during the departure sequence after veering right they had to "just kind of get her flying"

[19] The term "topping" refers to the maximum N_G limit (physical speed, not corrected speed)

[20] These numbers have been rounded for ease of reading. See the Sound Spectrum Analysis report for actual numbers obtained.

Figure 02: H-44 Approximate Departure Flight Path

The pilots continued to H-36, performed a reconnaissance, and landed. The helitack crewmembers escorted the firefighters away from the helicopter and unloaded their equipment. The helicopter departed at 1829[21] to return back to H-44 and while en route the pilots discussed yet again the diminishing fuel supply. They calculated that dark would be approaching in about 2 hours and 20 minutes and agreed that they would have to get more fuel sometime amid all the trips back and forth. During the flight to H-44 the pilots additionally conversed about the wind being "real light out of the south" and that the helicopter was well below their previously determined load calculation performance numbers. While landing at H-44 they noted the winds were negligible and that they had 3 loads of firefighters remaining.

After landing at H-44, 10 people were boarded and the helicopter departed at 1843. During the departure, the copilot called out "103-percent" adding that the power was "good" and

[21] During all the departures from H-36 and Trinity Helibase, the copilot did not announce the engine torque, as was heard on the departures from H-44.

exclaimed that "she's flying."[22] The sound-spectrum analysis of the CVR recordings indicated that the engines reached topping about 16 seconds after the collective increases, with an N_G of 101.9-percent and 101.4 percent on the individual engines for a duration of 18 seconds. During this time, the N_R began a slow droop from 108.0-percent to 101-percent over 35 seconds.[23]

The pilots transported the firefighters to H-36 uneventfully. While on the ground at H-36 the pilots decided to return to Trinity Helibase to refuel before transporting the remaining 3 loads of firefighters. The helicopter departed at 1854 and continued to the helibase. While en route, a discussion transpired between the pilots about the quantity of fuel that should be added. They stated that the helicopter could perform with the addition of at least 1,000 lbs of fuel in each the forward and aft tanks and 200 lbs in the center tank. At the time of the conversation they noted that the current fuel supply totaled 800 lbs. The copilot remarked that if they did refuel the forward and aft tanks to the top, the helicopter would then have 2,500 lbs of fuel[24]. He further calculated that with that fuel load the helicopter's allowable payload would be 2,552 lbs[25], which was more than the 2,400 lbs that the helitack crewmembers had been loading that day. He estimated that after refueling, that the helicopter would burn about 400 lbs en route to H-44, which would give them an additional margin. It was also noted that if they added 1,200 lbs in the forward and aft tanks that equated to 1 hour and 45 minutes flight time.

Upon landing at the helibase at 1905, the pilots shutdown the helicopter while one mechanic performed quick routine checks and the other added fuel. The copilot instructed the mechanic to add fuel for a total of 1,200 lbs in both the forward and aft tank. The fueler queried if he should add fuel to the center fuel tank, to which the copilot replied that he had already pushed 100 lbs in the center. The mechanic noted that both engine intakes were covered in ash, however the first stage stator was clean. He checked the oil levels, which were all sufficient. During his inspection of the main rotor blades, he observed a thick layer of ash that made-up a film on the leading edge. He began to wipe the blades with a rag, which effortlessly removed the ash, cleaning the blades free from debris.

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[22] In the post-accident interview, the copilot defined the second takeoff as having "plenty of power," and noted nothing unusual when flying out of the area.

[23] This information and following N_R and N_G data was obtained from the Safety Board Sound Spectrum Analysis and Performance Study

[24] In actuality the total capacity for both tanks is 384.4 gallons, which equals 2,614 lbs during pressure fueling (using the weight of 6.8 lbs per gallons for Jet-A). According to CHSI personnel, the pilots' standard procedure for refueling is to fuel the forward and aft tanks to a combined total of 2,500 lbs (1,200 per side and 100 in the center), rather then all the way to the top in an effort to avoid tank rupture in the event of a float malfunction..

[25] This number is seen as the computed payload of the performance load calculation for 6,000 feet PA at 32°C.

The inspector pilot passed the PIC for the flight evaluation [26] and they retreated inside the helibase facilities temporarily. The PIC then conveyed to the mechanics that the helicopter had to depart immediately. The pilots discussed as to if they would be able to complete all 3 remaining handcrew shuttles and indicated that they would have to expedite. The inspector pilot spoke with the pilots about staying onboard the helicopter not as part of a flight evaluation (which had ended), but as a safety crewmember to aid in the timely completion of the mission before dark. It was agreed by everyone that the inspector pilot would remain on the helicopter acting in the capacity of a safety crewmember[27].

The helicopter departed back to H-44 at 1923 and the pilots agreed that the LZ and approach would be the same as before. While en route the copilot commented that a gauge [presumably, the oil pressure gauge] was at the edge of the normal operation (green) arc, indicating high temperatures. The PIC responded saying that was "pretty normal," with the S-61. He added that the gauge will always be at the bottom of the green arc, "which is kind of hot." The copilot opined that the oil was "pretty thin."

When the helicopter approached the vicinity of the helispot, the copilot announced that the fuel load was 2,300 lbs, to which the PIC responded "we're gonna be heavier." The copilot than stated, "so we're right at the edge," and the PIC pointed out that the temperature had cooled, with the copilot stating that the outside air temperature (OAT) gauge was reading 20°C[28]. The copilot stated that the helicopter would have "quite a bit of performance with the drop in temperature." The helicopter landed at 1936 and a helitack crewmember queried the pilots if he should get another helicopter to aid in the transportation, as dark was nearing. The copilot responded saying that they should be able to complete the mission. The helitack crewmember then informed the pilots that weight of the load being boarded was 2,355 lbs[29].

(d) Accident Sequence

After the pilots were notified of the manifested weight of the firefighters and cargo, the copilot stated that the performance load calculation numbers indicated a maximum payload at

[26] During the entire CVR recording there was no time where the inspector pilot instructed the PIC to perform any maneuvers, nor did he question the PIC as to anything helicopter related

[27] A safety crewmember is required on each passenger flight and is usually a helitack crewmember, although any USFS carded helicopter pilot is qualified to fill this position

[28] The exact altitude this reading was taken is unknown, and therefore that temperature is not used as the accurate temperature at the accident site for this report. Refer to the Meteorological Factual Report

[29] This number was computed by the helitack crew member and included 10 passengers, 10 tools, and 2 saws; this weight did not include the 210 lb inspector pilot (nor did the performance load calculation). The itemized list used by the helitack crewmembers to obtain this number is explained in section 1.5, Load Calculations and Manifests, of this report

2,552 lbs at 32°C. He added that because the temperature was 12 to 13 degrees cooler and their payload was 200 lbs less, the helicopter would be able to perform. Both pilots restated that they were indeed 200 lbs lighter than the previously calculated weight and the copilot affirmed that the helicopter was "good to go." At no time in the CVR recording do the pilots discuss the fact that the engine reached topping on the previous two departures from H-44.

The PIC began to increase the collective for takeoff at 1940:42 and the copilot was verbally informing the pilot that the helicopter was clear from the trees to the right. The copilot stated "okay, just nice and smooth here," and at 1941:02 he called out the engine torque was increasing through 75 percent torque to 80, and then to 85. About 4 seconds later he called out 90 percent [torque] and then 103 percent [N_R][30]. About 9 seconds later he informed the PIC that N_R had decreased to 100 percent and was drooping. The recording ended 20 seconds later, at 1941:38. The sound-spectrum analysis of the CVR recordings indicated that the engines reached topping 20 seconds after departure, with an N_G of 102.1-percent and 101.5 percent on the individual engines until the end of the recording. During this time, the N_R began a slow droop from 106.6-percent to 91-percent over 60 seconds.[31]

[30] According to CHSI personnel, announcing the torque reading of 90-percent and 103 percent N_R is typical parlance during takeoff. The additionally noted that once a "higher" torque is reached the copilot will usually switch to reading N_R.

[31] This information was obtained from the Safety Board Sound Spectrum Analysis and Performance Study displaying plots of N_G and N_R versus time for the 7 recorded departures. The transient flat pitch N_R varies from one takeoff to the next, with a range between 106.05 percent to 108.65 percent. These transient mathematical overshoots of N_R are not steady state flat pitch N_R values, which varied between 106 percent and 107 percent N_R when briefly pausing at flat pitch before collective is increased. According to a representative from the engine manufacture, the transient and steady state flat pitch N_R's may depend on pilot technique advancing the engine control levers and collective pull-up.

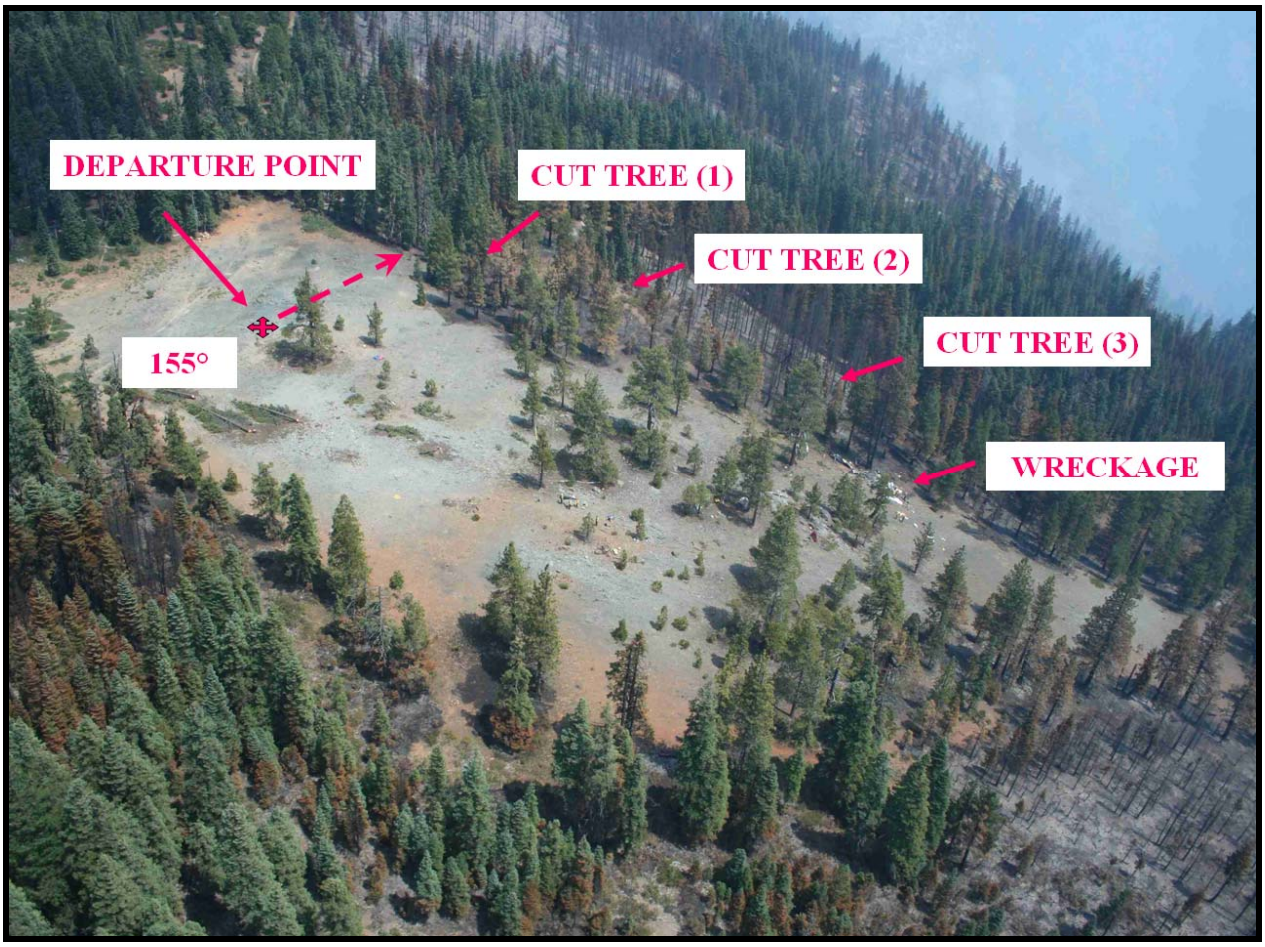

Figure 03: H-44 Wreckage in Relation to Approximate Departure Point

Witnesses[32] stated that as the helicopter began to lift off, the vertical ascent appeared very slow and the helicopter moved as though it was labored. The helicopter began to move forward in a nose-low configuration, and was drifting right with the nose still pointing in the same direction. The flight path of the helicopter continued forward and then began losing altitude as it continued down slope. The helicopter collided with the trees and subsequently impacted the down sloping terrain, coming to rest on its left side.

[32] There were 21 people on the ground at H-44 during the accident

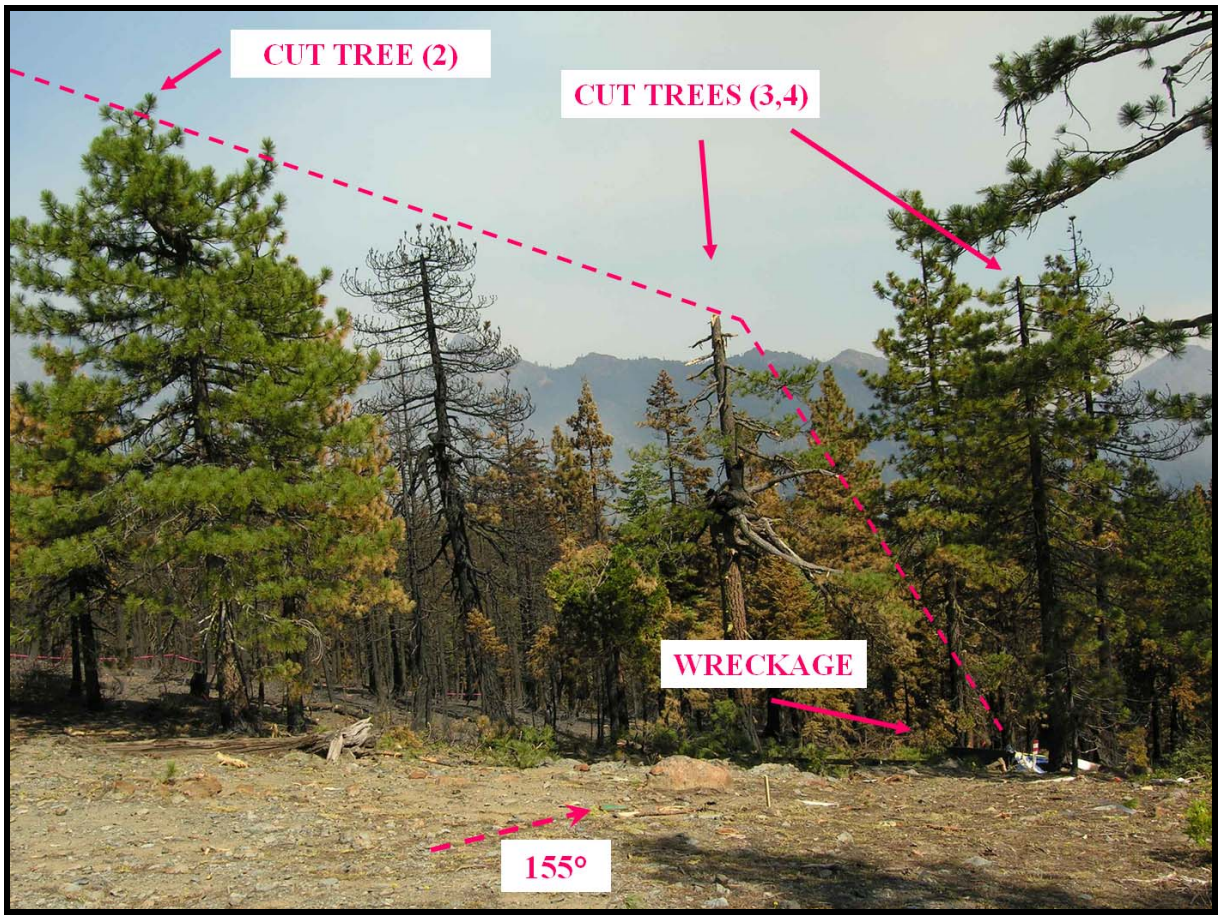

Figure 04: Main Wreckage

1.1 Injuries to Persons

Injuries	Crew	Firefighters	Total
Fatal	1	8	9
Serious	1	3	4
Minor/none	0	0	0
Total	2	11	13

Figure 05: Injuries Sustained as a Result of the Accident

1.2 Personnel Information

(a) Pilot-in-Command (PIC)[33]

Roark D. Schwanenberg

The PIC, age 54, was certified to fly the Sikorsky S-61N helicopter in accordance with existing Federal Aviation Regulations (FAR). A review of the FAA Airman and Medical Records database disclosed that the PIC held an airline transport pilot certificate (ATP), with a commercial rating for helicopter rotorcraft; the certificate listed the type rating of SK-61[34]. His second-class medical certificate was issued on March 03, 2008, with the limitation that he shall possess correcting glasses for near vision while exercising the privileges of his airmen certificate.

The PIC held the following licenses and ratings:

Commercial Pilot, Rotorcraft Helicopter, Instrument Helicopter
- -Issued: March 03, 1979[35]

Airline Transport Pilot Rating
- -Issued: June 03, 1981

Type Ratings
- -SK-76: June, 03, 1981
- -BV-234: March 25, 1983
- -BV-107: July 17, 1986
- -SK-61: June 21, 1993

The PIC received his initial flight training in the US Army from 1974 to 1978. He began employment with Columbia Helicopters, Aurora, Oregon, where he worked for 14 years performing logging, fire fighting, passenger transport, and precision long-line work. From 1993 to 1994 he performed logging operations at Rocky Mountain Helicopters, Provo, Utah, where he received his initial type certificate in the SK-61. He flew passenger transport in the S-76 in the Gulf of Mexico and BV-234 in the Bering Sea, during which he accumulated about 3,000 hours. He did not fly outside of work.

The DO at CHSI reviewed the PIC's paperwork which disclosed that at the time of the incident, he had a total flight time of 20,286 hours, with 8,166 hours accumulated in S-61 helicopters all of which were in the capacity of PIC.

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[33] See Attachment #04: PIC Records
[34] "SK-61" is the FAA's type-designation for Sikorsky's "S-61"helicopters
[35] Received based on US Army flight time in UH-1

The PIC was hired by CHI on December 01, 1994. The pilot held his United Stated Department of Agriculture (USDA)/USDI Interagency Helicopter Pilot Qualification card[36], which had an expiration date of May 31, 2009. The card indicated that he was approved for mountain flying, external load (sling), retardant/water dropping, longline vertical reference, and snorkel, all of which were permitted in S-61 helicopters. The PIC was the lead pilot for N612AZ.

During the flight legs prior to the accident, the PIC underwent a flight evaluation for fire suppression (helitack) operations which would qualify him to transport firefighting personnel to and from the fire line. Most of the CHSI pilots performed their flight evaluations during the first weekend of July 2008; however, the PIC could not attend.

Duty Hours[37]

The PIC's last duty rotation ended July 6, 2008, equating to a 25 day break until the beginning of his duty period on August 02. According to the CHSI records, during the preceding 90 days and 30 days, the PIC had amassed approximately 25 and 15 hours, respectively. The four days prior to the accident the PIC had recorded as being available and on duty for 14, 14, 12, and 12 hours, respectively. During that time, he flew 4 hours on August 02 and then did not fly again until the morning of the accident.

Personal

During an interview with the Operations Group Chairman, the PIC's spouse stated that she noted that nothing unusual occurred in his life in the last 48-hour period prior to the accident. She opined, that although he was away from home for several days leading to the accident, he obtained a sufficient and normal amount of rest in the preceding week.

The PIC's spouse additionally stated that she spoke with him frequently while he was away. During their last several conversations he conveyed that he wasn't flying the helicopter a great deal, only a couple of hours every other day. He wanted to fly more and felt as though he was waiting around idle much of the day. He did express his delight in flying with the copilot, who he really liked and respected, both as a person and a pilot. She recalled speaking to him in the afternoon of the accident. He seemed in good spirits and was excited to finally get to fly.

[36] Pilots are required by the USFS to have a current interagency card showing qualifications for the mission to be performed; each qualification card has an annual expiration date. The card qualifications are the primary criteria used to select a pilot for a given mission.

[37] See Attachment #05: Pilots' Duty Hours

The spouse further reported that the pilot did not take medications or have any physical conditions or ailments. She did note that he went to a rehabilitation facility for alcohol abuse around November 2007, on his own account. He was at the facility for about 1.5 months and had reportedly consumed no alcohol 9 months prior to the accident. He had notified CHSI with regards to his rehabilitation, and they were supportive in granting him the time he needed to be away. There were no FAA records reflecting that the PIC had enrolled himself in an alcohol rehabilitation program. CHSI personnel stated that they notified their POI in November 2007, as soon as they were aware of the PIC's situation.

(b) Copilot[38]

William H. Coultas[39]

The copilot, age 44, was certified to fly the Sikorsky S-61N helicopter in accordance with existing FARs. A review of the FAA Airman and Medical Records database disclosed that the copilot held a commercial pilot certificate for helicopter rotorcraft; the certificate listed the type rating of SK-61. His second-class medical certificate was issued on May 12, 2008, with no limitations.

The copilot held the following licenses and ratings:

Commercial Pilot, Rotorcraft Helicopter, Instrument Helicopter
-Issued: July 08, 1992[40]
Type Ratings
-SK-61: May 10, 2005 (VFR only)

The copilot received his initial flight training in the US Army from 1991 to 1995. He subsequently served as a US Army National Guard helicopter pilot from 1999 to 2000 and then from 2003 to 2007; during this time he served as a medical evacuation (Medivac) pilot conducting military and civilian missions. The copilot was hired by CHI in May 2002; he had no experience in the S-61 prior to starting at CHI. He worked for four years performing logging, fire fighting, and passenger transport. From August 2006 to October 2006, he was employed at Arctic Air Service, Astoria, Oregon where he conducted offshore Part 135 passenger transport operations. He returned to CHI in October 2006.

[38] See Attachment #06: Copilot Records
[39] Nickname: Bill
[40] Received based on US Army flight time in OH-58 and UH-1.

The copilot estimated that he had a total flight time of about 3,000 hours, with 1,100 hours accumulated in S-61 helicopters. He held his USDA/USDI Interagency Helicopter Pilot Qualification card, which had an expiration date of July 31, 2009. The card indicated that he was approved for mountain flying, external load (sling), retardant/water dropping, longline vertical reference, fire suppression (helitack), reconnaissance and surveillance, and snorkel, all of which were permitted in SK-61 helicopters. The copilot was assigned to the accident helicopter for the duration of the contract.

Duty Hours

The copilot's last duty rotation ended July 23, 2008, equating to a 6 day break until the beginning of his duty period on July 30. According to the CHSI records, during the preceding 90 days and 30 days, the copilot had amassed approximately 65 and 25 flight hours, respectively. The five days prior to the accident the copilot had recorded as being available and on duty for 14, 14, 14, 12, and 12 hours, respectively. During that time, he flew 2 hours July 31, 4 hours on August 02, and then did not fly again until the morning of the accident.

Personal

During an interview with the Operations Group Chairman, the copilot stated that nothing unusual occurred in his life in the last 48-hour period prior to the accident. He stated that he was averaging at least 8 hours of sleep a night. He classified his health as good and reported that he was not taking any medications or using alcohol. He reported that he has never abused alcohol or drugs, nor has he been arrested.

(c) Inspector Pilot

James N. Ramage[41]

A review of the FAA Airman and Medical Records database disclosed that the inspector pilot held a certificated flight instructor (CFI) certificate for helicopter rotorcraft; and a commercial certificate for airplane single and multiengine land, as well as rotorcraft. The inspector pilot held no type ratings. His second-class medical certificate was issued on November 20, 2007, with the limitation that he must wear corrective lenses and possess glasses for near and intermediate vision while exercising the privileges of his airmen certificate.

[41] Nickname: Jim

The inspector pilot was initially approved as an Interagency Inspector Pilot on October 12, 2005. His last evaluation was on April 23, 2008; the evaluation included emergency procedures, night operations, and GPS familiarization. On the inspector pilot's last application for a medical certificate he indicated that his total aeronautical experience consisted of about 12,100 hours, of which 11,537 hours were in turbine helicopters. The inspector pilot had given evaluations and provided 3 CHSI pilots their USFS cards in the 2 months prior to the accident; these evaluations were given in the S-61. He gave the copilot his initial carding on September 30, 2005. The inspector pilot had never flown as PIC in an S-61.

Prior to being employed at the USFS, the inspector pilot was employed with the California Department of Forestry (CDF) from 1982 to 2003 (he was their first helicopter pilot). In January 2004 he was hired by the USFS. His USFS supervisor reported that his primary position was an Interagency Regional Helicopter Inspector Pilot, but he also worked in the capacity of a pilot of the BH209 and assisted with accident investigations. He performed the evaluation because of his inspector pilot position at the USFS and his extensive flying experience; additionally, the helicopter was assigned to a fire in his region, which was about an hour drive from his residence.

In the days preceding the accident, the inspector pilot was assigned to the Iron Complex fires. During such assignments, duty time for USFS employees or contracted pilots is limited to a maximum of 14 hours per day, and no more than 12 days worked in a 14 day period. The inspector pilot communicated whenever he was nearing a duty limitation to schedule the requisite time off to comply with policies; he had not made any such communication. Therefore the maximum hours he would have worked the 72 hours before the accident most likely did not exceed 42 hours. USFS personnel estimated that on the day of the accident the inspector pilot had probably worked 9 to 10 hours.

1.3 Company Training Program[42]

According to CHSI and their POI, pilots receive annual training over a 7 to 10 day period. The Vice President organizes most of the training, which consists of regulation review, company policy, and actual flight training. The DO reviews the pilot's logbooks annually to record hours flown and ensures currency.

[42] See Attachment #07: CHSI training program

PIC Training

On June 23, 2008, the PIC successfully passed his initial Airman Competency check ride 14 CFR Part 135.293 and Part 135.299, which was administered by the Chief Pilot. The 0.5 hour check ride encompassed the PIC's demonstration of current knowledge and competency as well as satisfactorily demonstrating operational procedures.

Copilot Training

Company records indicated that the copilot completed his initial training on October 13, 2006. He completed his Airman Competency check rides 14 CFR Part 135.293 and Part 135.299 with all areas passed satisfactorily 3 days later. He received his recurrent checkride November 29, 2007 with the CHSI POI, passing satisfactorily in all areas tested during the 1 hour flight. His last training was completed the first week of June 2008, which was part of the CHSI annual training. The check rides encompassed the PIC's demonstration of current knowledge and competency as well as satisfactorily demonstrating operational procedures.

1.4 Aircraft Information

Manufactured in 1965 by Sikorsky Aircraft Corp., the helicopter (serial number 61297), was registered as N612AZ; at the time of the accident, it had accumulated 35,400 hours[43] of time in service. The helicopter was a metal semi-monocoque construction and equipped with a 5-blade CHI composite main rotor system installed under the provisions of a Supplemental Type Certificate (STC); the helicopter had been modified by the installation of the fixed, non-amphibious S-61L type landing gear. The helicopter was also equipped with two 1500-horsepower General Electric CT58-140 turboshaft engines. The overall length of the helicopter was 72 ft 10 inches and the height was 18 ft 10in. The main rotor disc diameter was 62 feet, equating to an out of ground effect (OGE) height[44] most likely less than that distance. At the time

[43] As of August 04, 2008, N612AZ had accumulated 35,396.4 flight hours. Based on data from Skyconnect system and CVR, the helicopter had accumulated about an additional 3.5 hours of operating time prior to the accident, equating to a total operating time of 35,399.9 hours.

[44] According to the FAA Rotorcraft Flying Handbook, ground effect usually occurs less than one rotor diameter above the surface. As the induced airflow through the rotor disc is reduced by the surface friction, the lift vector increases. This allows a lower rotor blade angle for the same amount of lift, which reduces induced drag. Ground effect also restricts the generation of blade tip vortices due to the downward and outward airflow making a larger portion of the blade produce lift. This does not account the ground surface (e.g., sloping terrain) or nearby obstacles (e.g., tress), which will likely result in a HOGE much less than the rotor diameter.
Sikorsky representatives reported that ground effect in the S-61 is not 'digital' and that it tapers off non-linearly with height.

of the accident, the helicopter was configured with a pilot seat (left side), a copilot seat (right side) and 18 passenger seats. The helicopter is certificated for a two-pilot operation.

The helicopter was configured with the original three fuel tanks: a forward tank (210 gallons gravity feed, 197.6 gallons with pressure refuel), a center tank (244 gallons gravity feed; 228 gallons with pressure refuel) and an aft tank (200 gallons gravity feed; 186.8 with pressure refuel); the forward and aft tanks are considered the "main" tanks. According to both the USFS and CHSI, fuel burn can be estimated at 20 lbs per minute in flight and 10 lbs per minute while on the ground (equating to about 170 gallons per hour).

At the time of the accident, the helicopter was owned by CHI and leased to CHSI. CHI purchased the accident helicopter from CHC Helicopter Corporation (CHC), based in Canada, on June 20, 2007. The helicopter was flown to the CHI Perkasie facilities on July 10, 2007 where maintenance was performed and the helicopter was reconfigured[45]. Several months thereafter, the helicopter was utilized to perform flight testing for a Goodrich Hoist installation and was granted an Experimental Special Airworthiness Certificate from December 20 to 27, 2007, for this purpose.

Following the testing and various other missions, the helicopter arrived at the CHI Perkasie facilities on June 18, 2008, where maintenance was performed and the helicopter was reconfigured as required by Modification No. 2 to USFS Contract AG-024B-C-08-9340[46]. The helicopter was assigned to Trinity Helibase and approved to reposition to that location by USFS personnel on June 26, 2008. After the approval, it arrived at Trinity Helibase on July 1, 2008.

Trinity Helibase maintained daily logs of the accident helicopter's activities titled "Aircraft Contract Daily Diary" entries[47]. The following activities were recorded for the four days prior to the accident:

August 01, 2008:
Flight Time: 0 hours
Availability: 14 hours

[45] The helicopter was flown with the Sikorsky metal main rotor blades, which were later shipped back to CHC, as the helicopter was modified with the CHI composite main rotor blades. Following the second review of the draft of this report, CHSI submitted comments stating that at this time there were additional changes made "to the landing gear, seats, cargo hook, interior, and removal of overwater equipment." No documentation of these changes was provided and none could be found in the available maintenance records.
[46] See Attachment #83: Modification to contract AG-024B-C-08-9340.
[47] See Attachment #08: Aircraft Contract Daily Diary (OAS-137)

August 02, 2008:
Flight Time: 4 hours; all of which were water dropping missions (17,500 gallons dropped)
Availability: 14 hours

August 03, 2008:
Flight Time: 0 hours
Availability: 14 hours

August 04, 2008:
Flight Time: 0 hours
Availability: 14 hours
Checks: Power Check[48] performed at 233.4 Hobbs during system run-up

The PIC was assigned as the lead pilot for the accident helicopter, with three additional pilots assigned.

Power Assurance and Topping Checks

Under USFS contract,[49] Power Assurance Checks (PACs) are required to be completed every 10 hours. According to Sikorsky, a PAC is a test used to verify engine performance without operating the engine at its actual maximum performance level. They are typically conducted at about 50 percent torque and can be conducted on the ground, as full engine power is not required. Performance charts required to conduct a PAC are not available for higher altitudes where the S-61 typically operates for the USFS.[50] Therefore, to comply with the USFS required PAC, CHI/CHSI performs a topping check as specified in Chapter 73 of the Sikorsky Aircraft S-61N Maintenance Manual.

According to Sikorsky, a topping check is used to verify an engine's performance at its actual maximum fuel flow (referred to as topping), when an engine is taken to the maximum allowable N_G speed. At that speed, the resultant parameters of engine torque (Q) and T_5 are

[48] The term "Power Check," is a generic term for a "Topping Check" or "PAC." A "Topping Check" typically implies the engines operating at a maximum power setting, where a PAC implies a lower power setting is used.
[49] According to the USFS contract "A power assurance check shall be accomplished on the first day of operation, and thereafter within each 10-hour interval of contracted flight operation unless prohibited by environmental conditions (i.e., weather, smoke). The power assurance check shall be accomplished by the contractor in accordance with the Rotorcraft Flight Manual or approved company performance monitoring program. A current record of the power assurance checks will be maintained with the aircraft under this Contract and any renewal periods."

[50] Chapter 71 of the Sikorsky Aircraft S-61N Maintenance Manual provides tables necessary for conducting PACs for pressure altitudes of -500 to +2,000 feet.

recorded by the flightcrew. The numbers obtained are then corrected to sea-level standard conditions and engine performance is verified. Topping verifies that under the specified conditions, the engine produces at least the minimum required torque (specification torque). If the minimum specification torque is NOT achieved, then engine maintenance is required.

The engines' Maintenance Manual states that when performing a topping check, a load is applied to the power turbine by increasing the collective. When the engines are 'topped' (at maximum N_G), and even more collective is applied, the power turbine speeds and, as a result, N_R will bleed off (droop).

According to CHSI's Chief Pilot, CHSI pilots are trained to perform their topping checks both on the ground and during a single-engine climb. To perform an on ground topping check, the pilots engage, and subsequently run up the engines. The engine not being topped is set at flight idle and the engine being topped is set at full throttle. The collective is increased until the N_G tops out and further increased to droop the rotor speed (N_G) to 100 percent. After briefly maintaining this setting, the pilots would record the OAT, PA, N_G, T_5, and torque readings. After one engine is checked, the other engine is checked in the same manner. After obtaining the recorded numbers, CHI Supplement 7, Figure 7-4-8 (2 ½ Minute Power, 100 percent N_R), is used to obtain engine shaft horsepower (SHP)[51]. Thereafter, SHP can be converted to torque using Figure 7-4-13 (Indicated Torque vs. SHP) which provides minimum specification (min spec) torque. This "min spec" torque is then compared to the actual torque reading on the helicopter at topping. The difference between the two torque values is the engine's torque margin. According to Sikorsky, no additional lift or performance "credit" is given for engines that are found above specifications; rather, this is a "go" or "no go" check. Engines found to produce higher than minimum specification engines simply increase the operational margin of safety and cannot be accounted for in the performance charts.

The in flight topping check procedure is similar to the aforementioned on-ground check. Initially the N_R is set at 106 percent, while the engine being topped is set at full throttle and the other engine is retarded to about 98 percent free turbine speed (N_F). Upon reaching their target altitude and appropriate droop to 100 percent N_R pilots will record torque, N_G, and T_5 on the engine under test. They perform this procedure first on one engine, and then repeat it for the other engine. The same performance charts used for the on ground check are then used to calculate the torque margins.

[51] Any S-61 2 ½ Minute Power, 100 percent N_R chart can be used to obtain this number with an accuracy of +/- 1.5-precent toque.

For every power check completed, the pilots fill out a USFS 'ticket' called a Helicopter Power Check, and submit it to the assigned helicopter manager. The engines are then trended by plotting torque margins. A (+) sign indicates the engine is producing power above the minimal limit and (–) indicates the engine is producing less power than the minimal limit; engines that produce less than minimum specification power are removed from service.

The last power check was recorded as being performed by the accident flight crew the day prior to the accident at an hour meter (Hobbs) time of 233.4 hours; this topping check was performed on the ground. It indicated that at an OAT of 30°C and a 3,160 feet PA, the engines were indicating a +3 and +6 margin difference (derived from a chart reading of 94 percent, and actual cockpit gauge indication of 97 and 100 percent).

Utilizing the methods suggested by the CHSI Chief Pilot, Safety Board investigators entered in the same OAT of 30°C and PA of 3,160 feet on the aforementioned Supplement 7 charts. The charts indicated the engines were giving a +1.5 and +4.5 margin difference (derived from a chart reading of 95.5[52] percent, and actual cockpit gauge indication of 97 and 100 percent). At the time of the accident, the Hobbs most likely should have been 236.9 hours, or 3.5 hours since the last power check.

	PA (ft)	°C	N_G	EGT	Torque #1	Torque #2	Chart	Δ #1	Δ #2
July 3	3200	21	102.1/102.1	721/717	105	107	105	0	2
July 5	4200	22	102/102	716/700	100	100	98	2	2
July 7	700	34	101.8/101.5	721/718	102	103	99	3	4
July 18	5000	22	102/102.1	710/700	99	98	94	5	4
July 25	2000	28	102/102	712/702	104	105	102	2	3
July 29	2500	24	102/102.1	712/706	105	106	101	4	5
August 4	3160	30	101.8/101.5	720/714	97	100	94	3	6
							Average	**2.71**	**3.71**
								Total Average	**3.21**

Figure 06: Power Checks Performed prior to the Accident

[52] This is an interpolated value, as the performance charts are not depicted to this precision.

1.5 Load Calculations and Manifests

(a) CHSI 14 CFR Part 135 Operations Specifications

CHSI's Operations Specifications indicated that before each revenue flight, the pilot must calculate the gross takeoff weight and actual center of gravity for the loaded weight. Following the calculations, the pilot must determine if the computed values fall within the manufacturer's allowable weight and balance limits for the helicopter. The calculations must be based on the records from the Rotorcraft Flight Manual (RFM) Chart C, Form 80-285.

The Operations Specifications dictate that the methods to determine passenger weight are twofold: weighing each passenger prior them boarding the helicopter or by asking each individual their weight and adding either 5 or 10 lbs to that weight (depending on the season). Passenger and crew baggage are to be determined by actual scale weighings. The specifications further state that for revenue flights, the pilot should record the weight and balance calculations on a CHSI Load Calculation Form[53]. In addition to the empty weight of the helicopter, the form requires the following: number of passengers, maximum allowable takeoff weight for the specific flight, identification of crewmembers and their crew position assignments.

(b) USFS Operations

According to the Interagency Helicopter Operations Guide (IHOG)[54], a government representative (e.g., a helicopter manager, project flight manager, loadmaster, etc.) is responsible for providing an accurate passenger/cargo manifest weight that does not exceed the allowable payload based on real-time, on-site conditions. As part of the manifest makeup, a listing of all passengers and cargo being transported is required and may be accomplished on the Interagency Helicopter Passenger/Cargo Manifest or the load calculation form. Handcrews may provide a pre-completed crew manifest utilizing their own format as long as the information on the form is accurate and verified. The listing of passengers must include the full name of each passenger, clothed weight of each passenger and their personal gear, weight of additional cargo, and the destination.

While it is the responsibility of the helicopter manager or another authorized individual (e.g., helicopter crewmember, loadmaster, etc.) to complete the manifest prior to each flight leg being flown, it is the responsibility of the pilot to ensure the actual payload on a manifest does not exceed the allowable payload on the load calculation.

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[53] See Attachment #09: Load Calculation Form
[54] See Attachment #10: IHOG Chapter 7, Helicopter Load Calculations and Manifests

In Chapter 7 of the IHOG, the introduction states that the, "helicopter load calculations shall be completed for all flights to ensure that the helicopter will perform within the limitations established by the helicopter manufacturer, without exceeding the gross weight for the environmental conditions where the helicopter is to be operated." The pilot is responsible for completing the load calculation correctly using proper performance charts and is also responsible for computing the allowable payload. In addition, the pilot shall check or be informed of any subsequent passenger/cargo manifested weights completed under the initial load calculation to ensure allowable payloads are not exceeded. After completion of the load calculation form, the pilot and government representative are required to sign the form, agreeing that the parameters are correct. A note is highlighted in the manual stating that a "government representative MAY participate in the completion of load calculations. However, the pilot is ultimately responsible for content accuracy". Form HCM-8 is provided in the IHOG and appears to be the same as the form the pilots used on the morning of the accident.

The IHOG states that one calculation is valid for points of similar elevation, temperature, and fuel load, provided the load for each flight leg is manifested. A new load calculation is only required when there is a change of 5 °C in temperature (hotter or cooler), a 1,000 feet change of altitude (higher or lower), or when the helicopter operating weight changes (e.g., changes to the helicopter equipped weight, changes in flight crew weight, or a change in fuel load).

According to the IHOG, a weight reduction is required for all "nonjettisonable" loads[55] and is optional (mutual agreement between the pilot and helicopter manager) when carrying jettisonable loads. The appropriate weight reduction value, for make and model, is predetermined and listed in the current helicopter procurement document.

In an effort to maintain standardization, the IHOG factors that the actual weight of a quantity of jet fuel may vary slightly, and requires that pilots use a standard conversion of one gallon of fuel equating to 7 lbs.

The USFS contractual requirements state:

> "The pilot is responsible for computing the weight and balance for all flights and for assuring that the gross weight and center of gravity do not exceed the aircraft's limitations. The pilots shall be responsible for the proper loading and securing of all cargo. Load calculations (Exhibit 13, Form 5700-17/OAS-67) shall be computed and completed by the pilot using appropriate flight manual hover performance charts."

[55] The predetermined weight reduction was 550 lbs, although in the load calculation performed by the pilots the weight of 560 lbs was used. This 10 lbs discrepancy is apparently from an error in a USFS publication, where they printed 560 lbs as the reduction weight for the S-61.

(c) Load Calculations

Investigators obtained the original copies of the performance load calculations signed by the PIC as being completed the day of the accident. The conditions used were as follows: 500 feet PA at 38 °C; 3,500 feet PA at 32°C; 6,000 feet PA at 32°C; and 7,000 feet PA at 25°C.

Minutes prior to the accident, the copilot referenced load calculations completed using 32°C, which is consistent with referencing the 6,000 feet PA form. The following weights were used to obtain the performance calculations and recorded on the form:

Helicopter Equipped Weight: 12,408 lbs
Flight Crew Weight: 440 lbs
Fuel Weight: 2,400 lbs

The helicopter equipped weight (empty weight) was taken from the accident helicopter's most recent weighing records located at the helibase[56]. The flight crew weight was derived by the PIC adding his weight to copilot's weight. The fuel weight was calculated by using 343 gallons and multiplying it by the USFS standard set weight of 7 lbs per gallon for Jet-A. The weights were added to equal a total operating weight of 15,248 lbs. Through using the helicopter's performance charts[57], and subtracting the 560 lb non-jettisonable weight reduction, the pilot derived an allowable payload of 2,552 lbs.

(d) Firefighter Manifests

A senior firefighter with the Trinity Helitack was assigned to create the firefighter and helitack crewmember manifests for N612AZ; another crewmember was assigned as the load master. They both arrived at H-44 about 1 hour prior to the helicopter arriving. Upon arrival, they created the manifests and briefed the handcrews awaiting transport. A total of 5 different manifests were created, organizing the firefighters according to their handcrew affiliation and if they would be drivers after arriving at the destination.

The manifests were derived by using the firefighter's reported weights with the inclusion of 30 lbs each for firefighting line gear. Additionally, tools, saws and dolmars[58] were included on the manifest using standard weights of 10, 25, and 15 lbs each, respectively. Safety Board

[56] See Attachment #12: Chart C, dated June 27, 2008; a complete discussion of this weight is contained in section 1.6, Weight and Balance Information, of this report.
[57] A detailed description of the performance charts used to calculate the payload is in section 1.8, Charts, of this report
[58] A gas-powered chainsaw used for clearing terrain.

investigators noted discrepancy in Load 2, where the calculations were low by 45 lbs. All of the manifests referenced an allowable payload of 2,497 lbs[59]; no fuel loads were calculated. The accident flight was Load 3 and the CVR transcripts verify that the pilots were using 2,355 lbs as their anticipated payload.

	Load 1	Load 2	Load 3	Load 4	Load 5
Firefighter 1	250	280	185	215	245
Firefighter 2	260	190	190	235	205
Firefighter 3	275	290	240	250	215
Firefighter 4	200	195	250	220	290
Firefighter 5	250	210	250	175	215
Firefighter 6	270	200	210	240	230
Firefighter 7	185	190	200	175	175
Firefighter 8	200	210	200	195	200
Firefighter 9	225	250	230	190	230
Firefighter 10	175	205	250	200	0
Tools (10lbs)	100	150	100	100	100
Saws (25lbs)	25	50	50	50	0
Dolmars (15lbs)	15	30	0	0	30
Total	2430	2450	2355	2245	2135

Figure 07: Manifests as Created by Helitack Crewmembers and Reported to the Pilots[60]

The helitack crewmembers creating the manifest did not record that the 210-pound inspector pilot was onboard, and only included him on the first manifest on the initial departure from Trinity Helibase. His name was later added, after the accident had transpired and the helitack crewmembers communicated amongst themselves as to the possible fatalities.

	Load 1	Load 2	Load 3
Sub-Total	2430	2450	2355
Inspector pilot	210	210	210
Pilots	440	440	440
TOTAL	**3080**	**3100**	**3005**

Figure 08: Manifest Weights including Inspector pilot and Pilots

[59] This payload weight comes from the PIC's HOGE performance load calculation for 7,000 feet PA at 25°C.
[60] See Attachment #13: Original Manifests

1.6 Weight and Balance Information

During the course of the investigation, documentation of six different weighings of the helicopter was found: two were provided by CHSI, two were discovered independently by Safety Board investigators, and two were discovered in subpoenaed documentation. Additionally, a review of the maintenance work orders revealed that two other weighings were completed for which records could not be located.[61] The complete documentation of a weighing comprises a Chart A, Chart B, and Chart C, which are all CHSI forums.

The Chart A is a tabulation of all operating equipment that is or may be installed, and for which provision for fixed stowage has been made in a definite location in the helicopter. It customarily provides a weight, arm, and moment of individual items. This is the primary document utilized to identify how a helicopter was precisely configured at the time of weighing. The items installed are indicated with a check mark or "x," where the items not installed are identified with a "0."

The Chart B is a single-page form used for recording the scaled weighing data and computing the empty weight and balance of the helicopter. This document will usually provide the individual weights for each scale and show which type of scale was used to obtain the weight.

The Chart C is a malleable list that updates the weight obtained from the Chart B as equipment is added or removed. It additionally shows a continuous history of the basic weight, arm, and moment resulting from structural and equipment changes in service.

At the time of the accident, CHSI/CHI owned two sets of scales, one of which was comprised of roll-on type platform cells and the other was jack-point cells. The roll-on scale system was purchased in an effort to initiate a procedure to accurately weigh the helicopter with the water tank installed[62]. CHSI purchased the scales on July 03, 2006 and they were sent back on March 03, 2008 for an annual calibration test. During post-accident examinations, a scale calibration facility determined that both main wheel scales were damaged, with deformation to the platforms[63].

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[61] These weighings were recorded as being performed on August 13, 2007 and December 18, 2007.
[62] The Fire King 900 gallon liquid (water) tank is attached to the bottom area (belly) of the fuselage.
[63] Jackson Aircraft Weighing Service reported that the deformation observed on the pads is consistent with damage seen if aircraft are weighed on a surface of inadequate hardness, such as grass or dirt. He stated that the scales were not deformed when inspected on March 03, 2008; and are therefore considered to be accurate prior to then.

(a) April 22, 2003 – June 21, 2007 (13,279 lbs)

Prior to CHI procuring N612AZ, identified as serial number 61297, the records indicate that the last weighing was performed by CHC on April 22, 2003. An examination of the CHC documents[64] for this weighing revealed that the Chart B lists an empty weight of 13,506 lbs and the Chart A includes over 200 line items of equipment installed. The Chart C entry dates range from the Chart A date in 2003 to June 21, 2007. The last weight recorded on the Chart C was 13,279 lbs.

(b) August 06, 2007 (12,491 lbs)

The helicopter underwent an Airworthiness Conformity Inspection performed from August 09 through August 10, 2007. The FAA Designated Airworthiness Representative (DART) performing the inspection retained a copy of the Chart B that he was provided at the time. The signed weighing was dated August 06, 2007. The document indicated the weighing was performed in Perkasie on the jack-point type scales and displayed an empty weight of 12,491 lbs. There was no Chart A provided to the Safety Board to accompany this weighing, and therefore it is unknown how the helicopter was configured at the time the weighing was performed. The DART could not recall the exact configuration of the helicopter at the time of the inspection, but did state that the main rotor blades were not installed. Additionally, the maintenance work orders revealed that the composite main rotor blades were installed on August 10, 2007; each of the individual blade component card contained an installation date of August 14, 2007. The metal main rotor blades were removed around July 13, 2007 and shipped back to CHC shortly thereafter.[65]

(c) August 11, 2007 (11,476 lbs)

CHSI provided investigators with copies of the Charts A and B that were completed for a weighing performed August 11, 2007. The Chart B indicates that the weighing was performed at the Perkasie facilities utilizing the jack-point type scales. An empty weight is recorded as being 11,476 lbs, which was 1,803 lbs lighter than the last CHC Chart C, recorded about 50 days prior. In pertinent part, the Chart A indicated that the composite main rotor blades (1135 lbs), sponsons[66] (971 lbs), and passenger seats (354 lbs) were installed at the time of weighing; the

[64] See Attachment #14: CHC Weight Documentation (Chart A, B, and C)
[65] The CHI DOM stated that due to the Perkasie facility space constraints, helicopters were often weighed without their main rotor blades. He further commented that the helicopters could be signed off as being in airworthy condition without the main rotor blades installed, as the confined space sometimes necessitated such actions.
[66] The sponson's primary purpose is to provide stability and buoyancy in amphibious/water operations. They additionally provide a small amount of lift in forward flight. Sponsons contain the retractable main landing gear; at

fixed gear (357 lbs), hoist (135 lbs), liquid tank and snorkel (1090 lbs), and Ag-Air hydraulic system (108 lbs) were noted as not being installed.

Maintenance records did not indicate any major weight changes that occurred during the time CHI received the helicopter to the time of the first weighing. A comparison was performed of the items shown as installed on the helicopter on the CHC Chart A and C to those installed on the CHSI provided August 11 Chart A. The Chart A templates were different and therefore the comparison could only be estimated. The evaluation of the forms revealed that the CHC weighing was roughly 823 lbs heavier.[67]

(d) August 15, 2007 (13,073 lbs)

During the approval process for an STC, N612AZ was used for several of the flight tests. An FAA Designated Engineering Representative (DER) oversaw flight testing and retained a copy of the Chart B that he was provided at the time. The signed weighing form was handwritten and dated August 15, 2007. The document indicated the weighing was performed in Perkasie on the jack-point type scales and displayed an empty weight of 13,073 lbs. There was no Chart A provided to the Safety Board to accompany this weighing, and therefore it is unknown how the helicopter was configured at the time the weighing was performed. The Chart A for this weighing is referenced in a March 25, 2008 Chart C, where the weight of 13,073 lbs is entered and in the description field there is a typed notation stating "See Equipment List."[68]

(e) December 26, 2007 (12,369 lbs)

The FAA New York Aircraft Certification Office (ACO) that approved the aforementioned STC for CHI had a Chart B on file for N612AZ. The signed form was typed and dated December 26, 2007. The document indicated the weighing was performed in Perkasie on the jack-point type scales and displayed an empty weight of 12,369 lbs. There was no Chart A to accompany this weighing, and therefore it is unknown how the helicopter was configured at the time the weighing was performed. There was maintenance documentation indicating that on December 20, 2007, at an aircraft total time of 35161.9 hours, the following was installed: fixed gear (357 lbs), Ag-Air hydraulic system (108 lbs), cargo hook (75 lbs), Pulse Light (2 lbs), AFF Tracker (2 lbs), and Siren (20 lbs). An additional sign off was made in the logbooks stating that the hoist (135 lbs) was installed at that time to facilitate STC testing.

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the time of the accident, the helicopter was reconfigured with the fixed landing gear (without sponsons), which is 614 lbs lighter.

[67] See Attachment #15: Chart A and C Comparisons

[68] See Figure 13

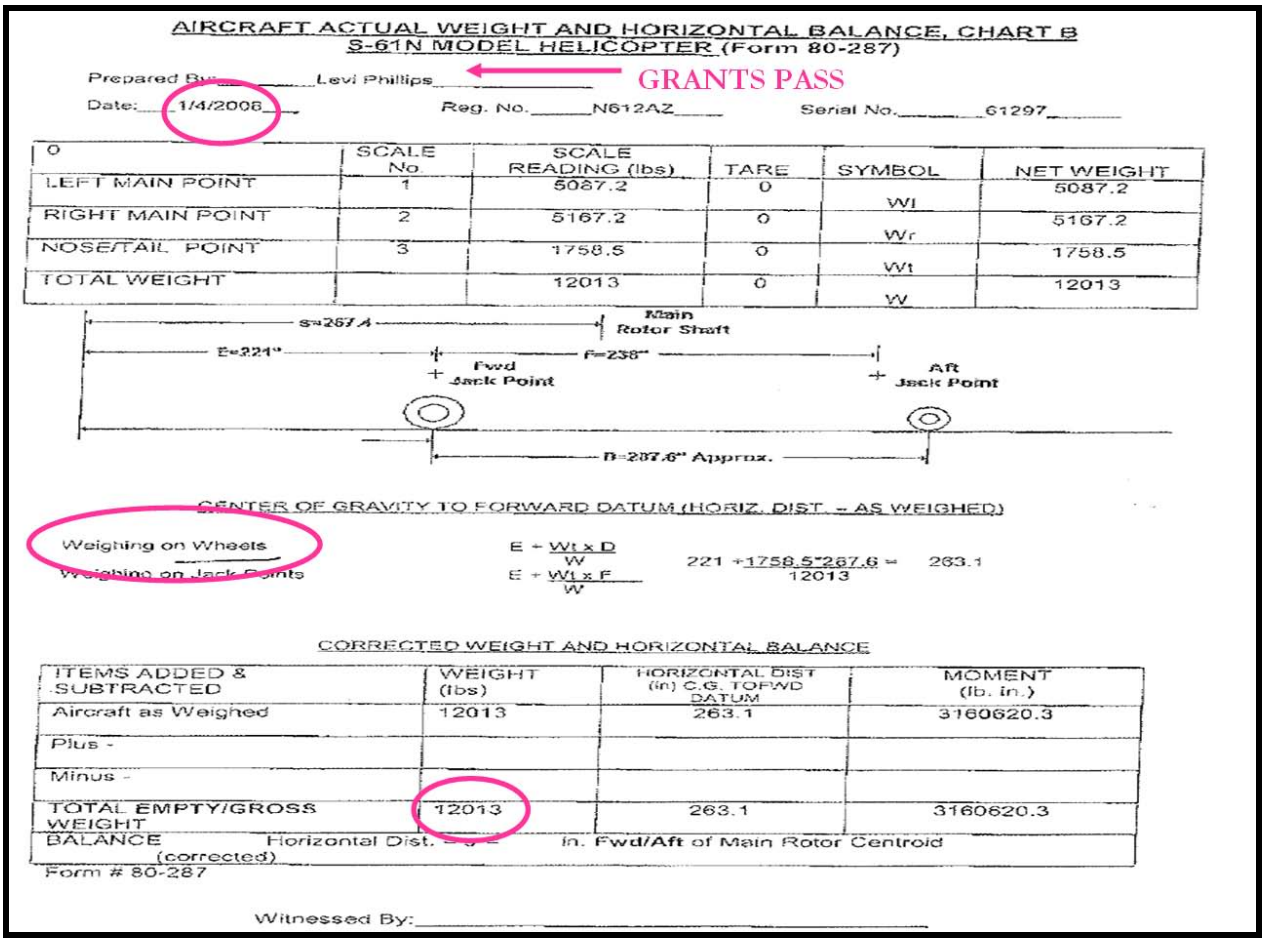
The pilot performing the testing in both August and December stated that there were only several seats installed during the time of testing; he estimated possibly 3 to 4 seats were installed. The DER confirmed that there were only several seats installed. The spreadsheets for the December testing imply that there were only seats C6 and C7 installed (2 one-man seats and 1 two-man seat, equating to 80.4 lbs) and lists the empty weight of 12,369 and 12,397 (with 28 lb run-in kit).

(f) January 04, 2008 (a) (12,013 lbs)[69]

CHSI provided investigators with copies of the Charts A and B that were completed for a weighing performed January 04, 2008[70]. The Chart B indicates that it was prepared by personnel at the Grants Pass facilities[71] and that the roll-on type scales were used to in the weighing to provide an empty weight of 12,013 lbs. The investigation disclosed that the scales would have been accurate and in calibration at the weighing date, as they were damaged sometime after March 03, 2008[72]. The left main, right main, and tail scale readings were recorded in tenths. The scale system that provides a readout is digital and does not provide readings in tenths, as the scales are not capable of such precision.

The CHSI DOM stated that when N612AZ was put on their 135 certificate, he used the Chart B that the Perkasie facility provided him and copied the weights onto the 135 approved Chart B; he added that this transferring of weights is routinely done. The Vice President of CHSI added to the comment by stating that weighing data was transferred to a standardized Part 135 form in an effort to be part of "a standardized proposal for the USFS bid proposals." He noted that N612AZ was never at the Grants Pass facilities.

[69] This was the base weight of the Chart C empty weight the pilots were using to calculate their performance load calculations. This weighing document was additionally submitted to the USFS for the contract.
[70] The helicopter was physically located at Perkasie on this date.
[71] A review of the subpoenaed documentations revealed that these Chart A and Chart B documents were sent from personnel at Grants Pass to personnel at Perkasie on May 05, 2008.
[72] See Attachment #16: Calibration Records



AIRCRAFT ACTUAL WEIGHT AND HORIZONTAL BALANCE, CHART B
S-61N MODEL HELICOPTER (Form 80-287)

Prepared By: Levi Phillips GRANTS PASS

Date: 1/4/2008 Reg. No. N612AZ Serial No. 61297

0	SCALE No.	SCALE READING (lbs)	TARE	SYMBOL	NET WEIGHT
LEFT MAIN POINT	1	5087.2	0	Wl	5087.2
RIGHT MAIN POINT	2	5167.2	0	Wr	5167.2
NOSE/TAIL POINT	3	1758.5	0	Wt	1758.5
TOTAL WEIGHT		12013	0	W	12013

s=267.4 Main Rotor Shaft
E=221" Fwd Jack Point F=238" Aft Jack Point
D=287.6" Approx.

CENTER OF GRAVITY TO FORWARD DATUM (HORIZ. DIST. – AS WEIGHED)

Weighing on Wheels
Weighing on Jack Points

$E = \frac{Wt \times D}{W}$
$E = \frac{Wl \times F}{W}$

$221 + \frac{1758.5 * 267.6}{12013} = 263.1$

CORRECTED WEIGHT AND HORIZONTAL BALANCE

ITEMS ADDED & SUBTRACTED	WEIGHT (lbs)	HORIZONTAL DIST (in) C.G. TO FWD DATUM	MOMENT (lb. in.)
Aircraft as Weighed	12013	263.1	3160620.3
Plus -			
Minus -			
TOTAL EMPTY/GROSS WEIGHT	12013	263.1	3160620.3
BALANCE (corrected)	Horizontal Dist.	in. Fwd/Aft of Main Rotor Centroid	

Form # 80-287

Witnessed By:

Figure 09: Chart B for January 04, 2008 (a) Weighing

In pertinent part, the Chart A indicated that the composite main rotor blades (1135 lbs), Ag-Air hydraulic system (108 lbs), fixed gear (357 lbs), and liquid tank and snorkel (1090 lbs) were installed at the time of weighing; the hoist (135 lbs), Sponsons (971 lbs), and passenger seats (354 lbs) were noted as not being installed. The Chart A box for the liquid tank for this weighing had what appeared to be a check mark *and* a "0" indication.

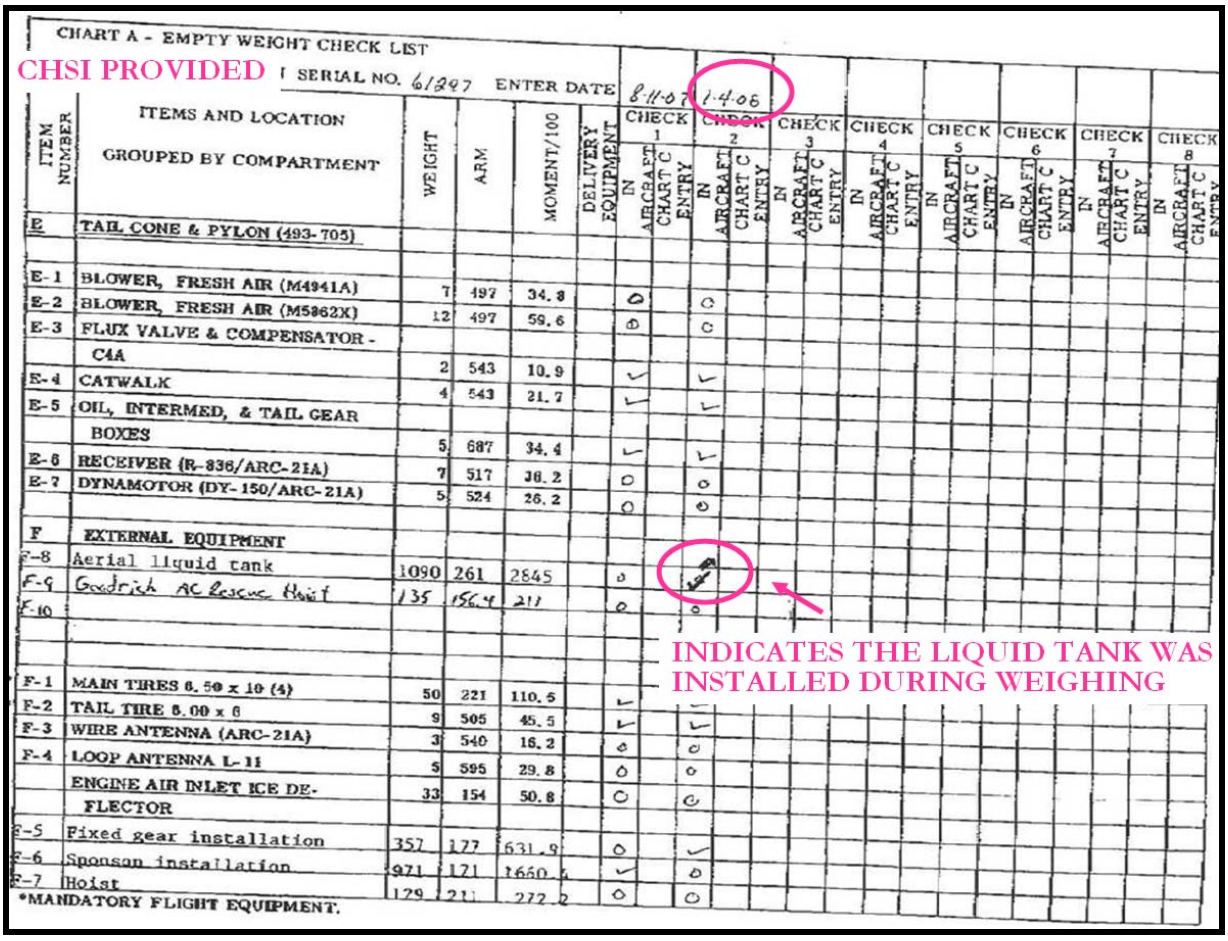


CHART A - EMPTY WEIGHT CHECK LIST

CHSI PROVIDED | SERIAL NO. 61297 ENTER DATE 8-11-07 1-4-08

ITEM NUMBER	ITEMS AND LOCATION GROUPED BY COMPARTMENT	WEIGHT	ARM	MOMENT/100	DELIVERY EQUIPMENT	CHECK 1 IN AIRCRAFT CHART C ENTRY	CHECK 2 IN AIRCRAFT CHART C ENTRY	CHECK 3 IN AIRCRAFT CHART C ENTRY	CHECK 4 IN AIRCRAFT CHART C ENTRY	CHECK 5 IN AIRCRAFT CHART C ENTRY	CHECK 6 IN AIRCRAFT CHART C ENTRY	CHECK 7 IN AIRCRAFT CHART C ENTRY	CHECK 8 IN AIRCRAFT CHART C ENTRY
E	TAIL CONE & PYLON (493-705)												
E-1	BLOWER, FRESH AIR (M4941A)	7	497	34.8		O	O						
E-2	BLOWER, FRESH AIR (M5862X)	12	497	59.6		O	O						
E-3	FLUX VALVE & COMPENSATOR - C4A	2	543	10.9		✓	✓						
E-4	CATWALK	4	543	21.7		✓	✓						
E-5	OIL, INTERMED, & TAIL GEAR BOXES	5	687	34.4		✓	✓						
E-6	RECEIVER (R-836/ARC-21A)	7	517	36.2		O	O						
E-7	DYNAMOTOR (DY-150/ARC-21A)	5	524	26.2		O	O						
F	EXTERNAL EQUIPMENT												
F-8	Aerial liquid tank	1090	261	2845		O	✓						
F-9	Goodrich AC Rescue Hoist	135	156.4	211		O	O						
F-10													
F-1	MAIN TIRES 6.50 x 10 (4)	50	221	110.5		✓	✓						
F-2	TAIL TIRE 5.00 x 6	9	505	45.5		✓	✓						
F-3	WIRE ANTENNA (ARC-21A)	3	540	16.2		O	O						
F-4	LOOP ANTENNA L-11	5	595	29.8		O	O						
	ENGINE AIR INLET ICE DEFLECTOR	33	154	50.8		O	O						
F-5	Fixed gear installation	357	177	631.9		O	✓						
F-6	Sponson installation	971	171	1660.4		✓	O						
F-7	Hoist	129	211	272.2		O	O						

*MANDATORY FLIGHT EQUIPMENT.

INDICATES THE LIQUID TANK WAS INSTALLED DURING WEIGHING

Figure 10: Excerpt of Chart A for January 04, 2008 (a) Weighing- Indicates Liquid Tank was Installed

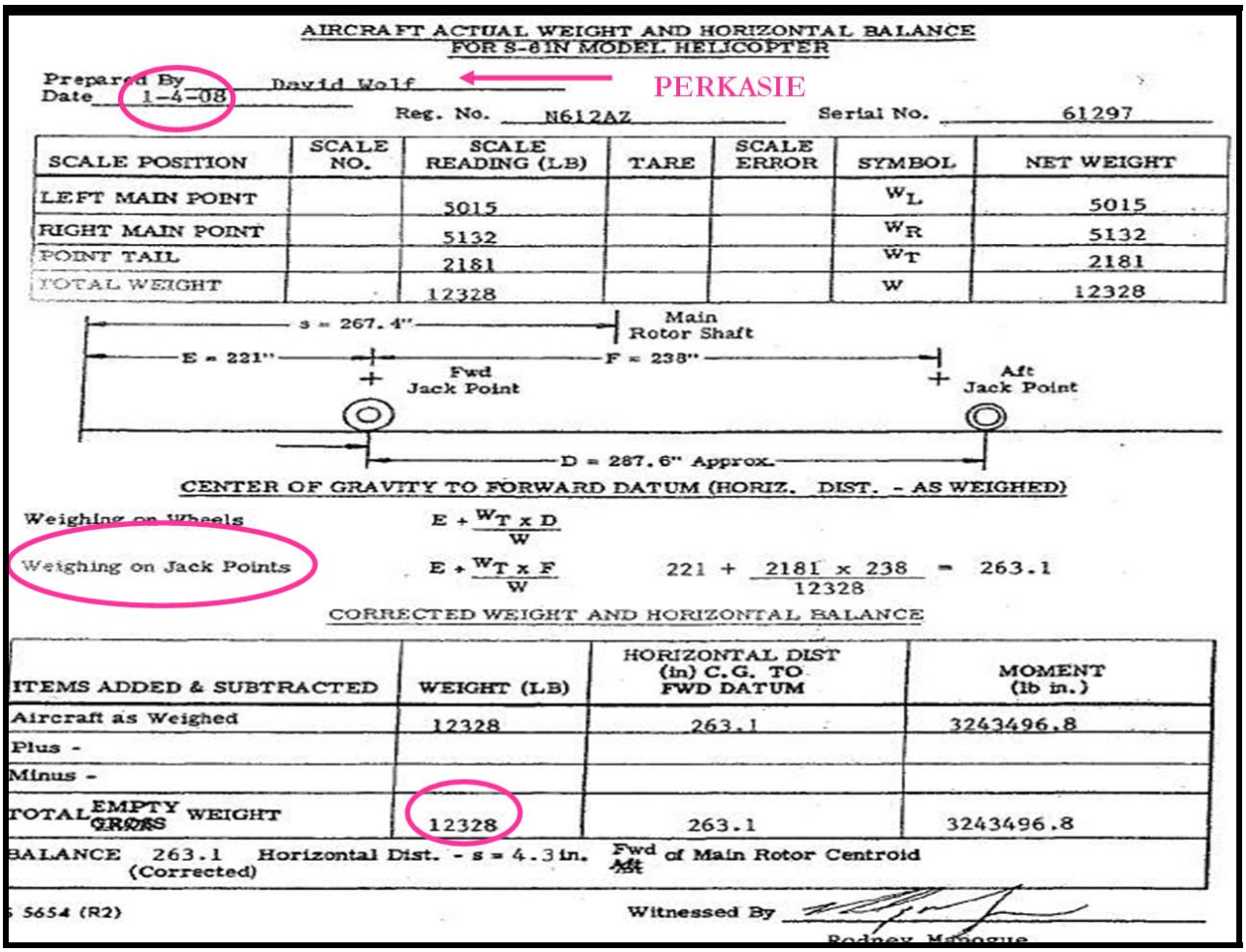
(g) January 04, 2008 (b) (12,328 lbs)[73]

Investigators discovered additional weighing documentation in attachments found in a large group of subpoenaed emails. A Chart A and B was included as an attachment for an email that was sent by personnel from Perkasie to personnel in Grants Pass[74]. The documents showed that a weighing was completed on January 04, 2008 at the Perkasie facilities on jack-point type

[73] Following a review of the draft of this report, CHSI/CHI personnel stated that the Chart A is erroneous due to the mechanic who prepared the equipment list not being the same technician who actually weighed the helicopter. Specifically, they report that the seats, hoist and bubble windows were installed at the time of weighing.

[74] A review of the subpoenaed documentations revealed that these Chart A and Chart B documents were sent from personnel at Perkasie to personnel at Grants Pass on March 28, 2008.

scales and produced an empty weight of 12,328 lbs or 315 lbs heavier than the other January 04, 2008 (a) weighing.



AIRCRAFT ACTUAL WEIGHT AND HORIZONTAL BALANCE
FOR S-61N MODEL HELICOPTER

Prepared By David Wolf ← PERKASIE
Date 1-4-08

Reg. No. N612AZ Serial No. 61297

SCALE POSITION	SCALE NO.	SCALE READING (LB)	TARE	SCALE ERROR	SYMBOL	NET WEIGHT
LEFT MAIN POINT		5015			W_L	5015
RIGHT MAIN POINT		5132			W_R	5132
POINT TAIL		2181			W_T	2181
TOTAL WEIGHT		12328			W	12328

s = 267.4" — Main Rotor Shaft
E = 221" — Fwd Jack Point
F = 238" — Aft Jack Point
D = 287.6" Approx.

CENTER OF GRAVITY TO FORWARD DATUM (HORIZ. DIST. - AS WEIGHED)

Weighing on Wheels $E + \frac{W_T \times D}{W}$

Weighing on Jack Points $E + \frac{W_T \times F}{W}$ $221 + \frac{2181 \times 238}{12328} = 263.1$

CORRECTED WEIGHT AND HORIZONTAL BALANCE

ITEMS ADDED & SUBTRACTED	WEIGHT (LB)	HORIZONTAL DIST (in) C.G. TO FWD DATUM	MOMENT (lb in.)
Aircraft as Weighed	12328	263.1	3243496.8
Plus -			
Minus -			
TOTAL EMPTY GROSS WEIGHT	12328	263.1	3243496.8

BALANCE 263.1 (Corrected) Horizontal Dist. - s = 4.3 in. Fwd Aft of Main Rotor Centroid

5654 (R2) Witnessed By Rodney McDogue

Figure 11: Chart B for January 04, 2008 (b) Weighing

The Chart A was identical to that of the other January 04 (a) weighing, with the exception of it showing the liquid tank and snorkel (1090 lbs) were not installed with a "0" mark. The Chart A had an additional column that recorded the liquid tank and snorkel being installed on March 25, 2008.

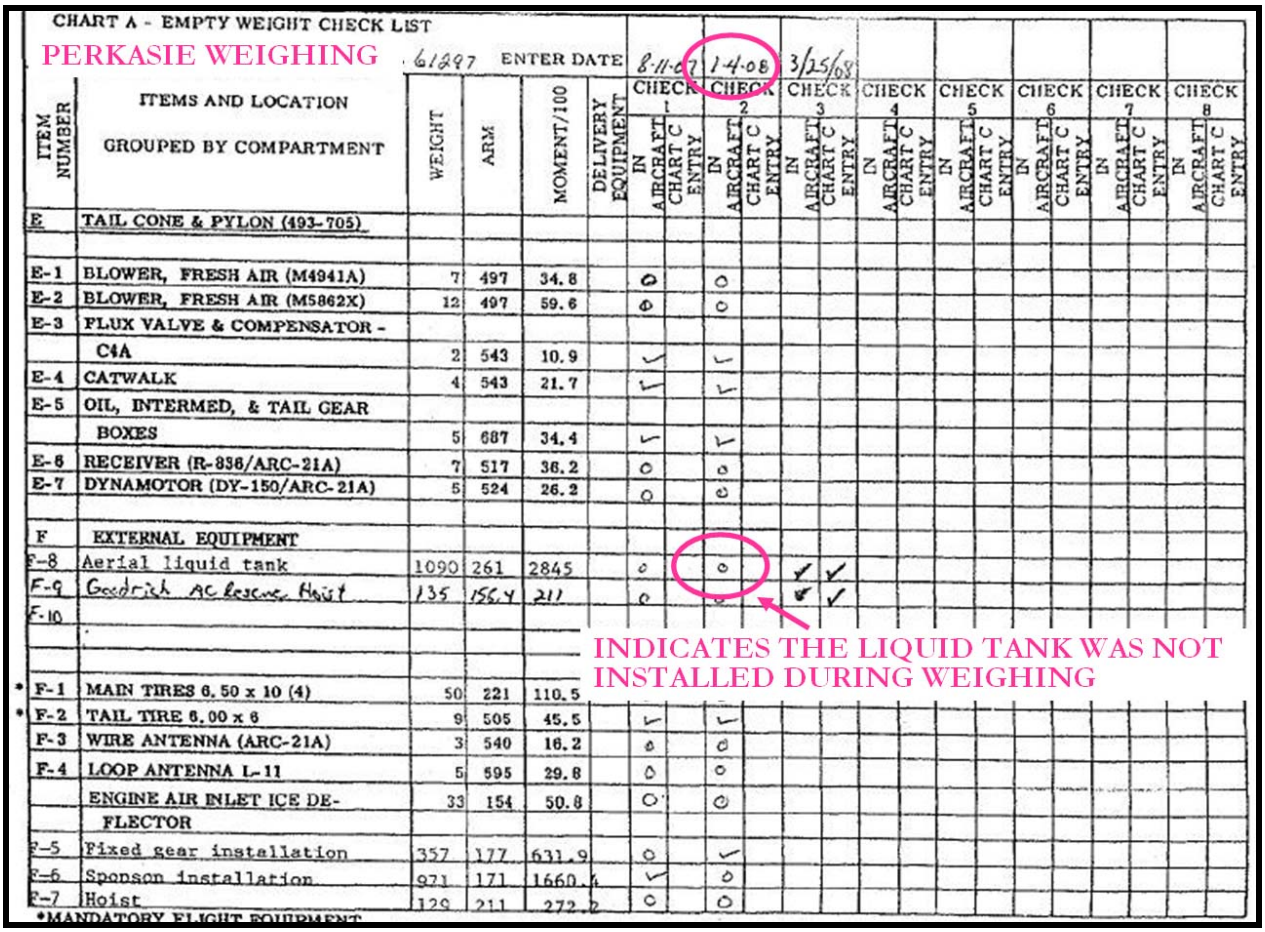


CHART A - EMPTY WEIGHT CHECK LIST

PERKASIE WEIGHING 61297 ENTER DATE 8-11-07 1-4-08 3/25/08

ITEM NUMBER	ITEMS AND LOCATION GROUPED BY COMPARTMENT	WEIGHT	ARM	MOMENT/100	DELIVERY EQUIPMENT	CHECK 1 IN AIRCRAFT	CHECK 1 CHART C ENTRY	CHECK 2 IN AIRCRAFT	CHECK 2 CHART C ENTRY	CHECK 3 IN AIRCRAFT	CHECK 3 CHART C ENTRY	CHECK 4 IN AIRCRAFT	CHECK 4 CHART C ENTRY	CHECK 5 IN AIRCRAFT	CHECK 5 CHART C ENTRY	CHECK 6 IN AIRCRAFT	CHECK 6 CHART C ENTRY	CHECK 7 IN AIRCRAFT	CHECK 7 CHART C ENTRY	CHECK 8 IN AIRCRAFT	CHECK 8 CHART C ENTRY
E	TAIL CONE & PYLON (493-705)																				
E-1	BLOWER, FRESH AIR (M4941A)	7	497	34.8		0		0													
E-2	BLOWER, FRESH AIR (M5862X)	12	497	59.6		0		0													
E-3	FLUX VALVE & COMPENSATOR - C4A	2	543	10.9		✓		✓													
E-4	CATWALK	4	543	21.7		✓		✓													
E-5	OIL, INTERMED, & TAIL GEAR BOXES	5	687	34.4		✓		✓													
E-6	RECEIVER (R-836/ARC-21A)	7	517	36.2		0		0													
E-7	DYNAMOTOR (DY-150/ARC-21A)	5	524	26.2		0		0													
F	EXTERNAL EQUIPMENT																				
F-8	Aerial liquid tank	1090	261	2845		0		0		✓	✓										
F-9	Goodrich AC Rescue Hoist	135	156.4	211		0				✓	✓										
F-10																					
* F-1	MAIN TIRES 6.50 x 10 (4)	50	221	110.5																	
* F-2	TAIL TIRE 6.00 x 6	9	505	45.5		✓		✓													
F-3	WIRE ANTENNA (ARC-21A)	3	540	16.2		0		0													
F-4	LOOP ANTENNA L-11	5	595	29.8		0		0													
	ENGINE AIR INLET ICE DEFLECTOR	33	154	50.8		0		0													
F-5	Fixed gear installation	357	177	631.9		0		✓													
F-6	Sponson installation	971	171	1660.4		✓		0													
F-7	Hoist	129	211	272.2		0		0													

*MANDATORY FLIGHT EQUIPMENT

INDICATES THE LIQUID TANK WAS NOT INSTALLED DURING WEIGHING

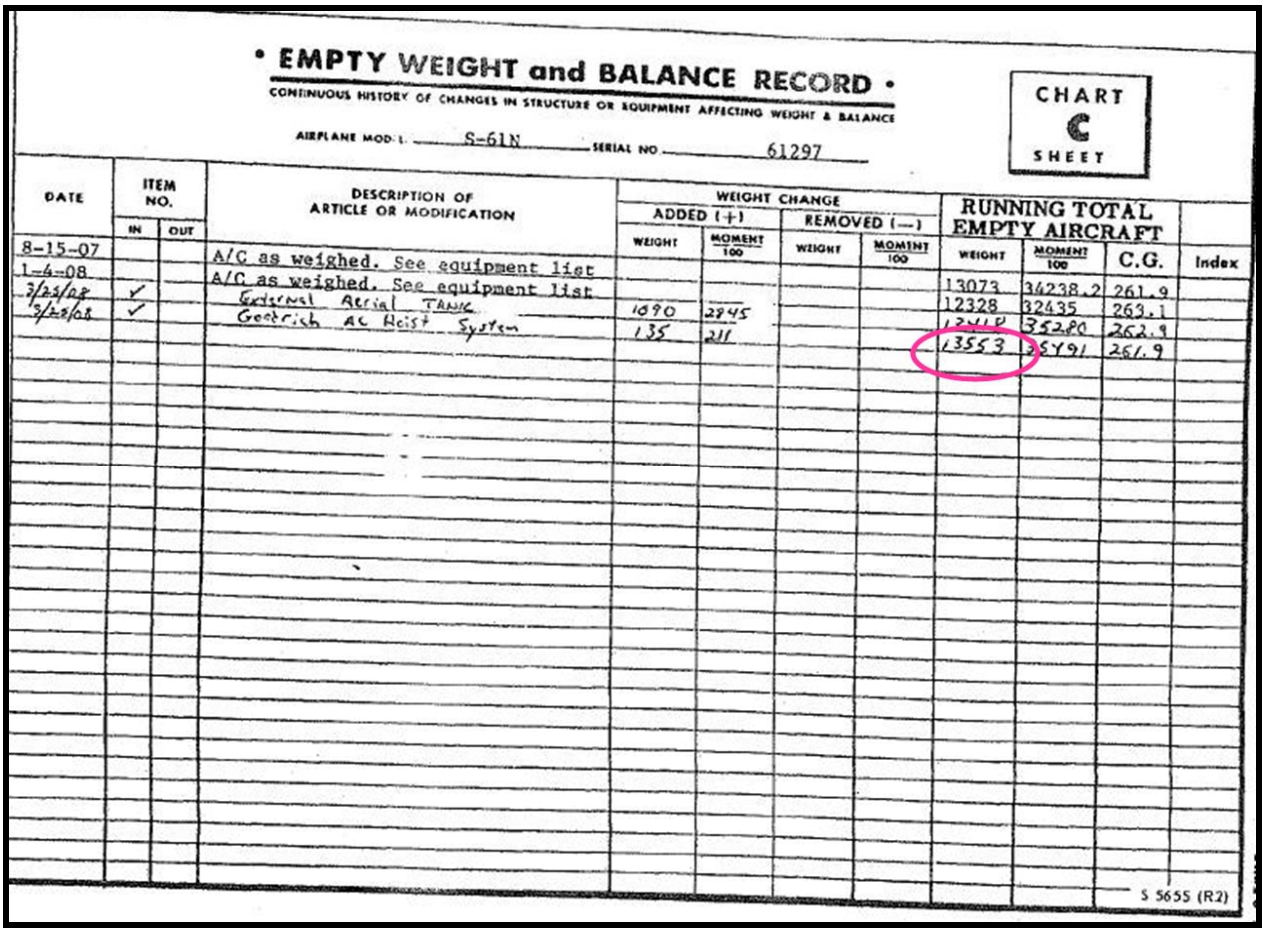
Figure 12: Excerpt of Chart A for January 04, 2008 (b) Weighing- Indicates Liquid Tank was Not Installed on that Weighing and Added on March 25, 2008

(h) March 25, 2008 (13,553 lbs)

A Chart C was discovered within the subpoenaed documentation that referenced empty weights of 13,073 lbs and 12,328 lbs, which were recorded in the August 15, 2007 and January 04, 2008 (b) weighings, respectively. The Chart C lists the addition of two items on March 25, 2008: the liquid tank and snorkel (1090 lbs)[75] and the hoist (135 lbs). The addition of the items is calculated to a total empty weight of 13,553 lbs. A review of the helicopter's records of Major Repair and Alteration FAA form 337s, revealed that on March 25, 2008 the STC was completed

[75] A Daily Inspection Compliance Form for the liquid tank additionally indicated that it was installed on March 25, 2008.

for the installation of the liquid tank and snorkel; additionally an FAA Form 337 was completed in reference to the STC for installing the hoist.



• EMPTY WEIGHT and BALANCE RECORD •

CONTINUOUS HISTORY OF CHANGES IN STRUCTURE OR EQUIPMENT AFFECTING WEIGHT & BALANCE

CHART C SHEET

AIRPLANE MOD. L S-61N SERIAL NO 61297

DATE	ITEM NO. IN	ITEM NO. OUT	DESCRIPTION OF ARTICLE OR MODIFICATION	WEIGHT CHANGE ADDED (+) WEIGHT	WEIGHT CHANGE ADDED (+) MOMENT/100	WEIGHT CHANGE REMOVED (—) WEIGHT	WEIGHT CHANGE REMOVED (—) MOMENT/100	RUNNING TOTAL EMPTY AIRCRAFT WEIGHT	RUNNING TOTAL EMPTY AIRCRAFT MOMENT/100	C.G.	Index
8-15-07			A/C as weighed. See equipment list					13073	34238.2	261.9	
1-4-08			A/C as weighed. See equipment list					12328	32435	263.1	
3/25/08	✓		External Aerial Tank	1090	2845			13418	35280	262.9	
3/25/08	✓		Goodrich AC Hoist System	135	211			13553	35491	261.9	

S 5655 (R2)

Figure 13: Chart C for March 25, 2008

(i) June 27, 2008 (12,408 lbs)

The Chart C that was provided to the pilots and was on-file at the Trinity Helibase contained a referenced empty weight of the January 04, 2008 (a) weighing of 12,013 lbs. The document listed the addition of 10 items, all of which were seats[76]. The weight derived from this Chart C was the weights the pilots used in their load calculations.

CHART C – BASE WEIGHT AND BALANCE RECORD — Form # 80-285

Make & Model: Sikorsky S-61N | Reg. No. N612AZ | Serial No. 61297 | Page No. 1

DATE (MMDDYY)	ITEM NUMBER IN	ITEM NUMBER OUT	DESCRIPTION OF ARTICLE OR MODIFICATION	WEIGHT CHANGE ADDED (+) WEIGHT	ADDED (+) ARM	ADDED (+) MOMENT	REMOVED (-) WEIGHT	REMOVED (-) ARM	REMOVED (-) MOMENT	CURRENT TOTAL BASIC AIRCRAFT WEIGHT	MOMENT	C.G.
01/04/08	X		Aircraft as Weighed							12013.0	3160620.3	263.1
06/27/08	X		2 MAN PASS SEAT W/HARNESS C1	15	128.5	1927.5				12028.0	3162547.8	262.9
06/27/08	X		1 1/2 MAN PASS SEAT W/HARNESS C6	55	167.0	9185.0				12083.0	3171732.8	262.4
06/27/08	X		1 1/2 MAN PASS SEAT W/HARNESS C7	55	201.0	11055.0				12138.0	3182787.8	262.[illegible]
06/27/08	X		1 1/2 MAN PASS SEAT W/HARNESS C8	55	235.0	12925.0				12193.0	3195712.8	262.0
06/27/08	X		1 1/2 MAN PASS SEAT W/HARNESS C9	55	269.0	14795.0				12248.0	3210507.8	262.1
06/27/08	X		1 1/2 MAN PASS SEAT W/HARNESS C10	55	303.0	16665.0				12303.0	3227172.8	262.3
06/27/08	X		1 MAN PASS SEAT W/HARNESS C11	20	337.0	6740.0				12323.0	3233912.8	262.4
06/27/08	X		1 MAN PASS SEAT W/HARNESS C13	20	371.0	7420.0				12343.0	3241332.8	262.6
06/27/08	X		2 MAN PASS SEAT W/HARNESS C14	35	394.9	13821.5				[illegible]	3254154.3	262.9
06/27/08	X		2 MAN PASS SEAT W/HARNESS C16	30	439.6	13170.0				12408.0	3267624.3	263.3

Figure 14: Chart C for June 27, 2008

[76] The seat weights are listed as 20 lbs for each single seat and 35 lbs for each double seat, with the exception of the aft-facing forward seat noted as 15 lbs and the last double seat listed as 30 lbs.

(j) Empty Weight at Accident (13,845 lbs)

As the helicopter was destroyed in a post crash fire, it was not possible to take actual weights from installed equipment. The empty weight was derived by using the Chart C weight of 13,553 lbs calculated on March 25, 2008, as it was the most recent reference of weight. During a meeting in October 25, 2008, the Operations Group members came to the agreement that the following equipment was either removed or installed after the January 04, 2008 weighing[77]:

[77] At that time CHSI personnel additionally provided a spreadsheet indicating what they believed was installed and not installed at the time of the August 11, 2007 and January 04, 2008 weighing; this document revealed that neither the hoist nor the seats were installed during the January 04 weigh. Following the initial review of the draft of this report, CHSI submitted comments stating that they believed the hoist was installed at the time of weighing; no maintenance documents provided substantiated that claim. A picture was submitted by CHSI that they stated was taken on March 25, 2008. According to CHSI, "a careful zoom examination" through the helicopter windows displays there are dark areas in the windows, which they believe prove that seats were installed at the time of the January 04, 2008 weighing. Additionally, CHSI stated that "Mr. Carson personally strongly recalls seeing that the seats, hoist, and bubble windows were on the aircraft for this testing."

+/-	Item #	Item	Weight (lbs)	Arm	Moment	DOI
		Empty (03-25-08)	13553	261.87	3549100	3/25/2008
+	C1	2 man seat	35	124	4340	8/4/2008
+	C6	1 man seat	21.6	171	3693.6	8/4/2008
+	C7	1&2 man seat	58.8	205	12054	8/4/2008
+	C8	1&2 man seat	58.8	239	14053.2	8/4/2008
+	C9	1&2 man seat	58.8	273	16052.4	8/4/2008
+	C10	1&2 man seat	58.8	307	18051.6	8/4/2008
+	C11	1 man seat	25	341	8525	8/4/2008
+	C14	2 man seat	37.2	371	13801.2	8/4/2008
+		Cargo Box (and installation)	95	405	38475	7/4/2008
+		Siren	20	221	4420	6/1/2008
+		Rappel Bracket	17	156.4	2658.8	UNKN
-		Foam Tank	-29	328	-9512	7/4/2008
+		Bird Screens	33	154	5082	UNKN
+		Survival Kit	35	371	12985	7/1/2008
-		Hoist	-135	211	-28485	03/25/08
-		Cargo Hook (+ load beam)[78]	-75	267	-20025	UNKN
-		Transmission Panels	-5	280	-1400	7/5/2008
-		Bubble Window (copilot)[79]	-18	99	-1782	8/5/2008
		Total Empty	**13845**	**263.19**	**3643869.8**	**8/5/2008**

Figure 15: Weight and Balance at the Time of the Accident[80]

Based on the added equipment, the helicopter's empty weight at the accident is calculated to be 13,845 lbs[81]. By calculation, no center of gravity limits were exceeded[82].

[78] Although the liquid tank cannot be installed at the same time as the cargo hook, CHSI personnel have declared that it was installed during the January 04, 2008 weighing; there was no documentation of it being removed from the December STC hoist, as it was not annotated on the Chart C.

[79] The PIC's bubble window was installed during the accident, however no window was installed on the copilot's side.

[80] The 18 passenger seat weights were derived from using the data gathered by the Survival Factors group. Of the 18 seats, there were 5 Burns 650D-2-39 double seat which weigh 37.2 lbs (with restraints attached), 1 Aerosmith and Burns aft-facing double seat that weighed 35 lbs, 1 Aerosmith single high-back seat that weighed 25 lbs, and 5 Burns or Aerosmith 1-man seats that weighed about 22 lbs each. These weights are for new seats. According to CHSI, the seats installed in the accident helicopter were not new, and would therefore weigh slightly more (accumulation of dirt and moisture).

[81] This is the empty weight used throughout this report to calculate performance.

[82] The center of gravity calculation at empty weight was 263.19 inches, where the helicopter's flight manual indicates that the center of gravity envelope is between 254 and 280 inches. Given the calculation, the actual CG was 9.19 inches aft of the forward limit of the center of gravity datum.

Although the exact configuration of the helicopter is not known during the August 15 and December 26, 2007 weighing, suppositions can be made of equipment installed for the purpose of the hoist STC testing. Attempting to recreate the configuration during the hoist STC weighings, Safety Board investigators constructed build-up weights[83] of the helicopter by adding and subtracting equipment to mimic the accident configuration. For the August 15 weighing, the accident configuration weight equated to 13,906.6 lbs; the December 26 weight calculated to 13,704 lbs.

(k) Fuel Weight

During the last refueling, 22.1 minutes prior to the accident (12.7 minutes of which was actually in-flight with 3.8 minutes on the ground at Trinity and 5.6 minutes at H-44), the pilots instructed ground personnel to fill the forward and aft fuel tanks to 1,200 lbs in each tank; there was discussion about 100 lbs of fuel remaining in the center tank (2,500 lbs total). Based on the party-agreed upon fuel burn of 20 lbs per minute (in flight) and 10 lbs per minute (on ground), the fuel consumption after refueling was about 349.1 lbs, equating to 2,158 lbs onboard at the time of the accident.

	Weight (lbs)	Arm	Moment
Fuel Tank Fwd	1029	203.90	209813
Fuel Tank Aft	1029	305.90	314771
Fuel Tank Mid	100	264.80	26480
Total Fuel	**2158**	**255.36**	**551064**

Figure 16: Fuel Load at the Time of the Accident

(l) Gross Weight at the Accident (19,008 lbs)

Using the empty weight calculation of 13,845 lbs along with the flightcrew weights of 650 (pilots and inspector pilot) and firefighter's weights of 2,355, the total helicopter weight without fuel equates to 16,850 lbs. With the addition of an approximate fuel load at the time of the accident of 2,158, the total weight of the helicopter at the time of the accident calculates to 19,008 lbs. The center of gravity calculation was 258.71 inches, where the helicopter's flight manual indicates that the center of gravity envelope is between 258 and 267 inches. Given the calculation, the actual CG was 0.71 inches aft of the most forward limit of the center of gravity datum.

[83] See Attachment #90: Weight Build-Up to Accident Configuration

Item	Weight (lbs)	Arm	Moment
Total Empty	13845	263.19	3643869.8
Total Payload (including pilots and inspector pilot)	3005	240.49	722672.5
Total Fuel	2158	255.35	551045.3
TOTAL Gross Weight	19008	258.71	4917593
	Forward Limits	258	Within
	Aft Limits	267	0.71

Figure 17: Helicopter Weight at the Time of the Accident

(m) Bid Weights

The empty weight for N612AZ that was submitted to the USFS for the purpose of contract bidding was the January 04, 2008 (a) weighing of 12,013 lbs. A review was conducted of the weighing documentation submitted by CHSI to the USFS for bids of 2008 contracts. There were 11 helicopter's Chart Bs submitted, of which 9 were recorded as being prepared by personnel in Grants Pass and 8 of those indicated that they were prepared by the CHSI DOM.

On the 8 Chart Bs prepared by the CHSI DOM, the weighings were recorded as being conducted on the roll-on type scales. The left main, right main, and tail scale weights were all recorded in tenths, a precision which the scale is not capable of measuring. The weight difference between the left and right main scale readings for all the 8 helicopters was exactly 80.0 lbs. The accident helicopter and another helicopter, N4503E, were recorded as having the same empty weight of 12,013 lbs. The weights submitted for 4 of the helicopters were all within 14 lbs of another, with the lowest weight of 12,009 and the highest of 12,013 lbs.

Registration #	**612AZ**	**4503E**	**7011M**	**612RM**	**116AZ**	**905AL**	**410GH**	**61NH**
Left Main	5087.2	4794.9	4852.9	4351.6	4784.9	5179.4	5276.3	5043.2
Right Main	5167.2	4874.9	4932.9	4431.6	4864.9	5259.4	5356.3	5123.2
Tail	1758.5	2343.3	2366.2	2242.8	2359.2	1830.1	1879.4	1843.7
Empty Weight	**12013**	**12013**	**12152**	**11026**	**12009**	**12269**	**12512**	**12010**
Moment	3160620	3328830	3366104	3081767	3332498	3237763	3305670	3184478
Arm (EW/M)	263.1	277.1	277	279.5	277.5	263.9	264.2	265.15
Delta Δ (L & R)	**80**	**80**	**80**	**80**	**80**	**80**	**80**	**80**
Date	1/4/2008	1/14/2008	4/3/2008	1/20/2008	12/5/2007	4/8/2008	4/6/2008	3/28/2008
Location/Person[84]	GP DOM	GP DOM	GP DOM	GP DOM	GP DOM	GP DOM	GP DOM	GP DOM

Figure 18: Weights Submitted to USFS for 2008 Bidding Contracts

Additional weight documentation submitted by CHSI to the USFS for the 2007 bidding contracts showed similar weight anomalies. The weights of the right main and left main were 251 lbs apart for 2 different helicopters; those weights were also prepared by the Grants Pass DOM.

Registration #	**61NH**	**103WF**	**612RM**	**4503E**	**7011M**	**116AZ**	**3173U**	**9696W**
Left Main	4532	4507	4545	4362	4307	4343	4185	4555
Right Main	4783	4758	4605	4407	4515	4181	4233	4520
Tail	2235	2205	2165	2774	2809	2772	2407	1825
Empty Weight	**11550**	**11470**	**11315**	**11543**	**11631**	**11296**	**10825**	**10900**
Moment	3083850	3057099	3178157	3211263	3239234	3156102	2964968	3160620
Arm (EW/M)	267	266.53	280.88	278.2	278.5	279.4	273.9	274.1
Delta Δ (L & R)	**251**	**251**	60	45	208	-162	48	-35
Date	4/27/2007	5/2/2007	3/15/2007	2/20/2007	2/7/2006	5/24/2006	7/18/2006	10/23/2006
Location/Person	GP DOM	GP DOM	GP DOM	Perkasie	Perkasie	Perkasie	Perkasie	Perkasie

Figure 19: Weights Submitted to USFS for 2007 Bidding Contracts

[84] Indicates the location of person preparing the weighing documentation; in this case all shown are, Grants Pass (GP) DOM

(n) Post Accident Weighings

Between September 25 and October 02, 2008, the USFS performed weighings on 10 CHI/CHSI helicopters to compare those weights with their current Chart C weights; the weights were recorded on a spreadsheet dated October 06[85]. The weighings were not performed in accordance with the applicable Sikorsky Maintenance Manual, as the helicopters were not leveled prior to readings being obtained. Although the helicopter was configured in a seemingly level attitude, it was not leveled according to the maintenance manual, which was thought to possibly induce a side load; additionally, cup fittings were not used during the weighings.

In an effort to verify the accuracy of these weights, Safety Board investigators conducted testing to determine the amount of side load that could be induced during non-leveled weighings both with and without cup fittings.[86] The testing revealed that in a seemingly level attitude the standard deviation of the weighings was about 16.3 lbs.

The weighings conducted by the USFS in September and October 2008 were performed on 9 standard category S-61N helicopters and 1 restricted category S-61A helicopter, 5 of these helicopters were on contract AG-024B-C-08-9354 and 5 were on contract AG-024B-C-08-9340.[87] The weighings revealed that all of the helicopters were over the weights listed on their respective Chart Cs by an average of 490 lbs. The most recent Chart As were not obtained, therefore it was not possible to know the exact configuration of the helicopters. In an effort to compare the helicopters configured for passenger transport to that of N612AZ at the time of the accident, the weights of additional equipment known to be installed was added or subtracted[88] to their actual weights. The average weight of the helicopters was 13,248 lbs, with the heaviest being 13,797 lbs.

A review of the helicopters' Chart C forms revealed that different weights were entered for the same items. For example, the snorkel system was listed as being the following weights throughout the 9 Chart C forms (in lbs): 100, 104, 105, 118, 120, 140, and 147. The discrepancies appear to be a result of the helicopter maintenance chiefs all utilizing different methods of obtaining the weights. In response to Safety Board investigator querying about the differing weights, CHSI stated that several of their equipment items (including liquid and foam tanks, interiors and snorkels) have gone through various developments and vary in generations,

[85] See Attachment #92: USFS Post Accident Weighing
[86] See Attachment #80: Weight Testing
[87] Refer to section 2.1, USFS, of this report.
[88] This included weights for the following equipment: interior (120 lbs); liquid tank and snorkel (1090 lbs); engine screens (33 lbs); cargo sling (55 lbs); cargo box (90 lbs); radio (5 lbs); and seats.

which changes their overall weight (e.g., the snorkels vary in length, material makeup, and the heads which are used for different type of operating conditions).

(n) Additional Information (Weights)

Following the initial review of the draft of this report, CHSI personnel reported that due to the great variation of missions, N612AZ was reconfigured on numerous occasions, which necessitated multiple weighings in the 13 month duration that CHI owned the helicopter. They further stated that the helicopter was "weighed at least 4 times in less than 12 months, which is very unusual for large helicopters" and that "this generated multiple Chart B weighing sheets, and chart A and chart C entries." Prior to this response, Safety Board investigators were only made aware of 2 weighings that occurred after purchase: August 11, 2007 and January 04, 2008. After the roll-on scales were found to be damaged, CHSI personnel insisted that the only other weighing performed was on August 11, 2007.

Additionally, after reviewing this report, CHSI personnel provided Safety Board investigators the Chart B from the December 26, 2007, weighing and several spreadsheets referencing empty weights of 12,369 lbs and 12,397 lbs that were apparently used for hoist flight testing in December 2007.

1.7 Meteorological Information[89]

There were no weather reporting facilities at the accident site. There were no pressure observations for H-36 or H-44[90] and therefore the Safety Board Meteorologist was unable to obtain precise pressure or density altitudes. Estimates were made based on weather reporting stations at Redding Municipal Airport, Redding, California (located 60 miles southeast of H-44) and Trinity Helibase (located 25 miles southeast of H-44). Calm winds at the time of the accident were reported by witnesses and appeared in pictures taken between 3 to 5 minutes after the accident transpired.

[89] Information in this section was obtained from the Meteorological Factual Report
[90] Station pressures were assumed at 23.88 inches of Hg.

	Location	Takeoff Time	Time Before Accident	Temp °C	Wind kts	Pressure Altitude	Density Altitude
1	Trinity 1st Refuel	17:07	154 mins	30	ESE 8	3,168	5,657
2	H36 1st	17:51	110 mins	34	WNW 5-10	1,500	4,000
3	H44 1st	18:14	87 mins	29	calm[91]	6,105	9,072
4	H36 2nd	18:29	72 mins	33	WNW 5-10	1,500	3,950
5	H44 2nd	18:43	58 mins	27	calm	6,106	8,840
6	H36 3rd	18:54	47 mins	31	W 3-10	1,500	3,800
7	Trinity 2nd Refuel	19:23	18 mins	27	SE 2-8	3,168	5,354
8	H44 3rd	19:41	0 mins	23[92]	calm	6,106	8,476

Figure 20: Weather Conditions at Various Locations and Times on the Day of the Accident

The helicopter was equipped with an OAT gauge, however no calibration records could be found to verify its accuracy.

1.8 Charts[93]

CHI's fleet of helicopters has been substantially modified by STC and field-installed changes. As such, they have developed their own FAA-approved charts which may differ from

[91] Calm is defined as no motion of air being detected.
[92] The temperature at H-44 during the accident used in this report is 23°C. The copilot referenced 20°C twice on the CVR, once while on approach. During the post-accident interview with the copilot, he stated the OAT just prior to the accident was 22°C. A Sikorsky representative stated that the OAT gauge consists of a bi-metallic strip in which the two metals expand and contract unequally. The difference in their expansion and/or contraction gives an indication of the ambient temperature. This device is typically accurate plus or minus 1°C to 3°C.
[93] All charts are calculated using minimum specification engine performance.

the original Sikorsky RFM charts. They separate their fleet into the short-body (STC-modified S-61N) and long-body S-61N aircraft. The short-body helicopters use RFMS 5 and 9, where the long-body helicopters use RFMS 7 and 8.

The charts the pilots used to perform their load calculations were contained in the Trinity Helibase binder[94] for N612AZ. The following charts were contained within the binder, and were used by pilots to obtain the load calculation numbers:

(a) Rotorcraft Flight Manual Supplement (RFMS) 7

RFMS 7, STC SR02487NY, was issued December 2007 and encompasses S-61N helicopters equipped with the CHI composite rotor blades in addition with various other configurations. RFMS 7, Figure 7-1-2, Maximum Takeoff and Landing Gross Weight (103-percent N_R), is the chart used to define the helicopter's limitations[95] at a hover of 10 feet for Category B operations[96]. This chart requires the user to input the ambient temperature conditions and pressure altitude, in an effort to derive a maximum gross weight limitation.

In the load calculations the pilots performed and then referred to just prior to the accident (6,000 feet PA at 32°C condition, giving an allowable payload of 2,552 lbs), the HOGE was 17,800 lbs. Using the performance chart for conditions at the accident of 6,106 feet PA and 23°C, equates to a HOGE of about 19,000 lbs.

RFMS 7 additionally contains Figure 7-4-21, "Category 'B' Takeoff Distance from 5 ft Hover to 50 ft," which parameters include the helicopter configured at maximum allowable weight and calm wind conditions. Using the accident site conditions derives a distance required of 740 ft.

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[94] Referred to as the "football," this binder contained documents of duty hours of pilots and mechanics, helicopter charts, phone lists, copies of contracts, etc.

[95] Limitation is defined as the helicopter's structural capability.

[96] Category A and Category B are defined as follows:

-Category A, with respect to transport category rotorcraft, means multiengine rotorcraft designed with engine and system isolation features specified in Part 29 and utilizing scheduled takeoff and landing operations under a critical engine failure concept which assures adequate designated surface area and adequate performance capability for continued safe flight in the event of engine failure

-Category B, with respect to transport category rotorcraft, means single-engine or multiengine rotorcraft which do not fully meet all Category A standards. Category B rotorcraft have no guaranteed stay-up ability in the event of engine failure and unscheduled landing is assumed

(b) Rotorcraft Flight Manual Supplement 8

RFMS 8, STC SR02507NY, was issued February 07, 2008 and encompasses S-61N helicopters equipped with a 600 lb Capacity Goodrich Hoist. There are 3 main charts within this supplement that are used to derive performance numbers for the load calculations: Figures 4 (page 15), 5 (page 16), and 7 (page 18).

Figure 1

RFMS 8, Figure 1, Power Available 2.5 Minute Power (100-percent N_R), is the chart used to show the maximum specification torque available when one engine is inoperative; only single engine operation (OEI) limits are shown[97]. This chart requires the user to input the ambient temperature conditions and pressure altitude, in an effort to derive an engine torque (in percent). This chart specifically pertains to helicopters equipped with GE CT-58-140-1 engines.

In using the accident conditions, the chart gives an engine torque of 89.5 percent. The pilots were not required to use this chart, nor is there a box in the load calculation to enter the number.

Historically, S-61 operators had bid on USFS contracts using performance numbers derived from the 2.5 Minute Power charts. In a letter to all S-61 operators dated March 20, 2006, the USFS stated that, "After review of the S-61 flight manual and consultations with GE technical representatives, Sikorsky Aircraft Corporation and the FAA, we have determined that the 2.5 minute power available charts are intended for OEI (One Engine Inoperative) operations only," and that the, "USFS does not permit the use of performance charts for other than their approved and intended application. Allowing operators of S-61 helicopters to use enhanced performance data (2.5 Minute OEI Power Available Charts) to better the aircraft's performance for bidding or dispatch purposes not only compromises safety, but gives S-61 operators an unfair advantage over other comparable Type I helicopters that are contracting to the USFS." It continued by stating, "Upon receipt of this letter, the 2.5 Minute OEI Power Available Charts shall not be used for contract bidding, or for load calculations in the field."

On April 28, 2006 CHI formally protested the decision made by the USFS regarding the termination of use of 2.5 Minute Power chart stating that because it does not specifically state OEI they were "challenging the USFS decision." In a different letter addressed to the National

[97] According to 14 CFR Part 1, rated 2.5 minute OEI power, means the approved brake horsepower developed under static conditions at specified altitudes and temperatures within the operating limitations established for the engine for periods of use no longer than 2.5 minutes each after the failure or shutdown of one engine of a multiengine rotorcraft.

Aviation Operations Officer and also dated April, 28, 2006, revised load calculations were submitted using the 5 Minute Power chart instead of the 2.5 Minute Power chart. The allowable payload on the load calculations was reduced from as much as 7,300 lbs using the 2.5 Minute Power chart to 4,900 lbs using the 5 Minute Power chart. As a result of the conversations the USFS had with GE, Sikorsky Aircraft Corporation and the FAA, who all indicated that the 2.5 Minute Power chart was in fact intended for OEI, the USFS considered the matter closed and did not pursue any further review nor did CHI pursue the matter.

In the 2006 discussions, Sikorsky Airport Corporation reiterated to the FAA that indeed the 2.5 Minute Power Available charts are for OEI conditions only and "*not* intended for dual engine operation to permit the aircraft to operate at higher powers."[98]

According to CHI/CHSI, the chart shows 2.5 minute limitations for power for single and dual operation, but it is not specifically an OEI chart, nor is it labeled as such. They further state that as long as maximum torque from the two engines together does not exceed 206-percent, the chart can be used for two engine operation at elevations above sea level, as the helicopter is transmission limited.

Figure 4

RFMS 8, Figure 4, Power Available Takeoff Power; 5 minute twin and 30 minute OEI (103-percent N_R), shows the maximum specification torque available per engine for 30 minute operation at various conditions of pressure altitude and temperature; both twin engine and OEI are shown[99]. This chart requires the user to input the ambient temperature conditions and pressure altitude, in an effort to derive an engine torque (in percent).

(b) CHSI Provided Figure 4

The Figure 4 chart provided by CHSI to the pilots was contained in both the Trinity Helibase documents and provided to them in an email dated July 07, 2008. The email was sent by the CHSI Chief Pilot to 45 of their pilots, including the accident pilots. The subject line read "New Load Calc Info," and instructed them to replace Figure 4 (page 15) from their current RFMS 8 with a "new" Figure 4 that was attached to the email; the attachment was the same Figure 4 the pilots were using to perform their load calculations. The email additionally stated

[98] See Attachment #34: Sikorsky's Conversions with FAA regarding 2.5 Minute Power Available Chart

[99] According to 14 CFR Part 1, rated 30 minute OEI power, means the approved brake horsepower developed under static conditions at specified altitudes and temperatures within the operating limitations established for the engine and limited in use to one period of use no longer than 30 minutes after the failure or shutdown of one engine of a multiengine rotorcraft.

that both Figure 4s were dated February 07, 2008. The pilots were also notified that if they were in training the week prior, they could ignore the email because they and their helicopter would already have the new Figure 4. This email was not provided in the subpoenaed documentation, nor did CHSI personnel on the investigation team make Safety Board investigators aware of its existence during the investigation and in response to numerous questions regarding the chart origins. Following the initial review of the draft of this report, the law firm representing CHI/CHSI supplied the email.

In using the accident conditions, the chart gives an engine torque of 89.5 percent, which is the same value from using the Figure 1 charts. The pictorial section of the charts did not reference both a twin engine and OEI limit, as it should. Additionally the charts are slightly askew on the page and have less crisp, distinct lines then the other charts in RFMS 8. The pictorial section of the chart was compared to the pictorial section of Figure 1, and they appeared to be identical.[100]

[100] A review of the CHSI provided RFMS 5, Figure 1, Power Available Takeoff Power; 5 minute twin and 30 minute OEI (103-percent NR), shows the maximum specification torque available for the short body S-61N. Again, a comparison between the CHSI provided performance chart and the FAA's provided RFMS 5 revealed that they were different. The CHSI provided chart, dated February 07, 2008 was identical to the CHSI provided RFMS 8, Figure 4 performance chart. The RFMS 5, Figure 1 chart provided by the FAA was dated October 06, 2003.

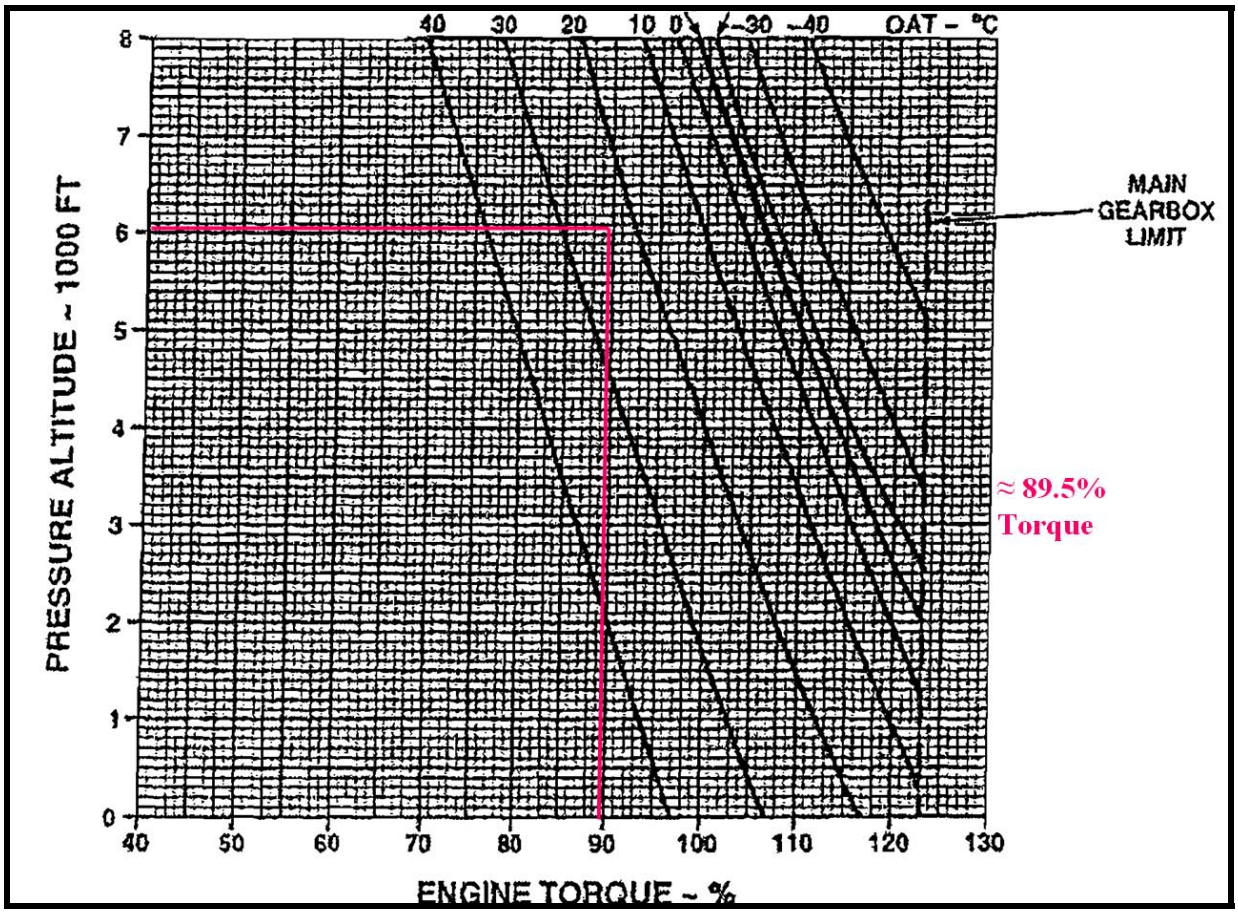

Figure 21: CHSI Provided RFMS 8, Figure 4; Power Available Takeoff Power; 5 minute twin and 30 minute OEI (103-percent N_R) for actual accident conditions

(a) FAA Provided Figure 4

The Figure 4 chart was requested directly from the FAA after the aforementioned anomalies were found with the CHSI provided charts. The FAA provided Figure 4 looked identical in format to the CHSI provided chart with the page header and footer the exact same; both charts were dated as FAA approved on February 07, 2008. The notable difference was the pictorial charts were not the same. The pictorial section of the FAA provided chart did have twin engine and OEI limits as it should. In using the accident conditions, the chart gives an engine torque of 81.5 percent, which is a difference of 8 percent from the CHSI provided chart. When

asked to explain the discrepancy between the two charts, CHSI personnel stated that origin of the "mislabeled" charts is unknown.[101]

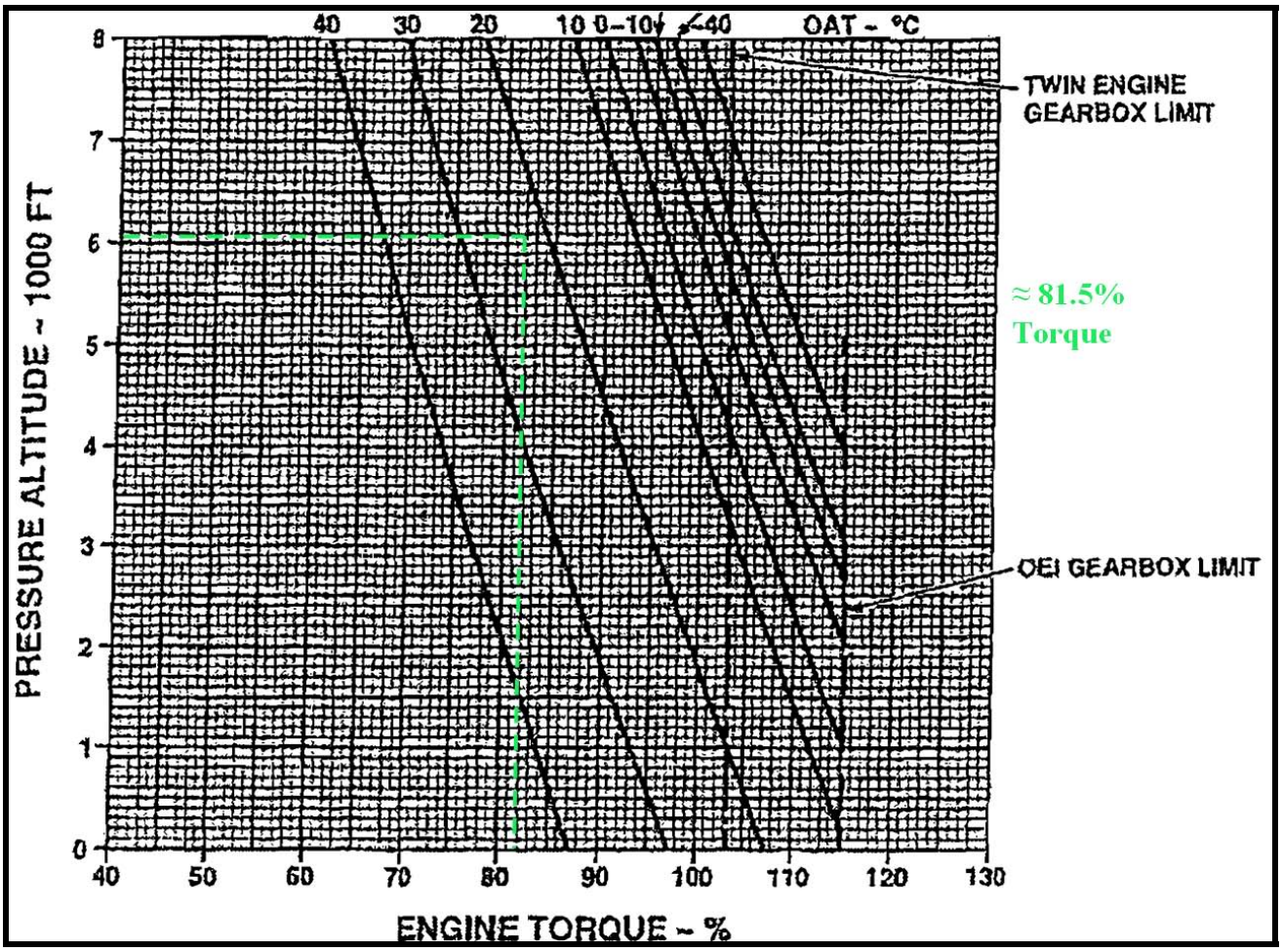

Figure 22: FAA Provided RFMS 8, Figure 4; Power Available Takeoff Power; 5 minute twin and 30 minute OEI (103-percent N_R) for actual accident conditions

[101] During the investigation, the Vice President originally stated that the mislabeled chart originated from CHI, as all the flight supplements regarding composite blades or performance originate from there and are sent to CHSI after FAA approval. Later in the investigation he opined that a terminated disgruntled employee had switched the charts in an act of sabotage, however this theory was discarded after further investigation. A law firm representing CHI/CHSI outsourced a computer forensics expert in an effort to determine more information about the chart; as of this writing, Safety Board investigators have not been made privy as to what was discovered during that investigation.

Figure 5

RFMS 8, Figure 5, Indicated Torque vs. Engine Shaft Horsepower, is the chart that converts the indicated torque derived in Figure 4 to horsepower using either 100 or 103 percent. In using Figure 4 from the CHSI and FAA provided charts, the engine horsepower at 103 percent equates to 1,120 shp and 1,015 shp, respectively.

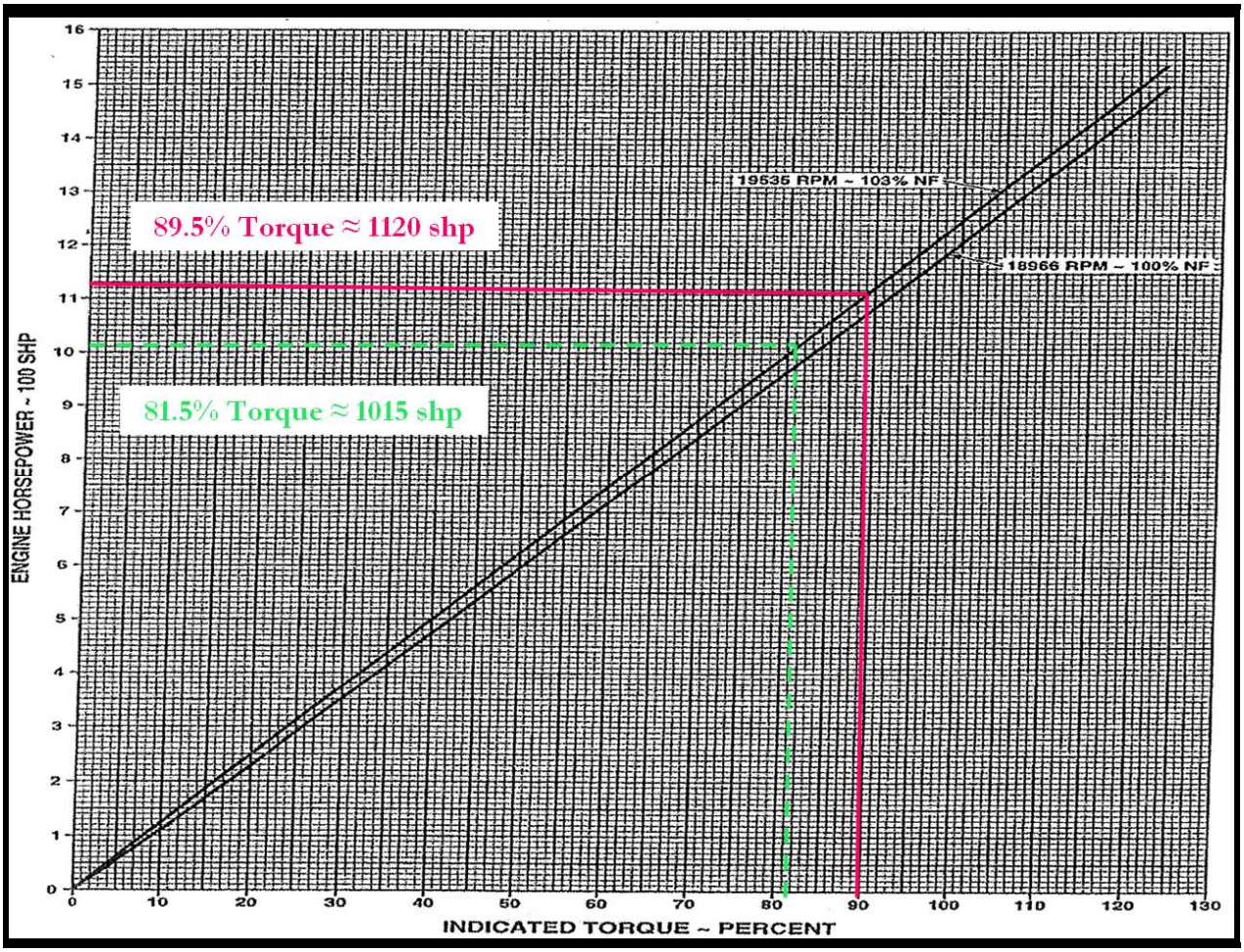

Figure 23: RFMS 8, Figure 5; Indicated Torque vs. Engine Shaft Horsepower, Using Percent Torque Obtained by CHSI (pink) and FAA (green) Provided Figure 4 Charts for actual accident conditions

Figure 7

RFMS 8, Figure 7, Power Required to Hover Out of Ground Effect (103 percent N_R), is used to determine the weight at which the helicopter can hover OGE. The shaft horse power obtained from Figure 5 is multiplied by 2 to account for both engines and input in the chart. Accounting for winds, temperature, and pressure altitude, the chart derives the HOGE weight. In using Figure 5 from the CHSI and FAA provided chart numbers, the HOGE weight is 18,800 lbs and 17,550 lbs, respectively (a difference of 1,250 lbs).

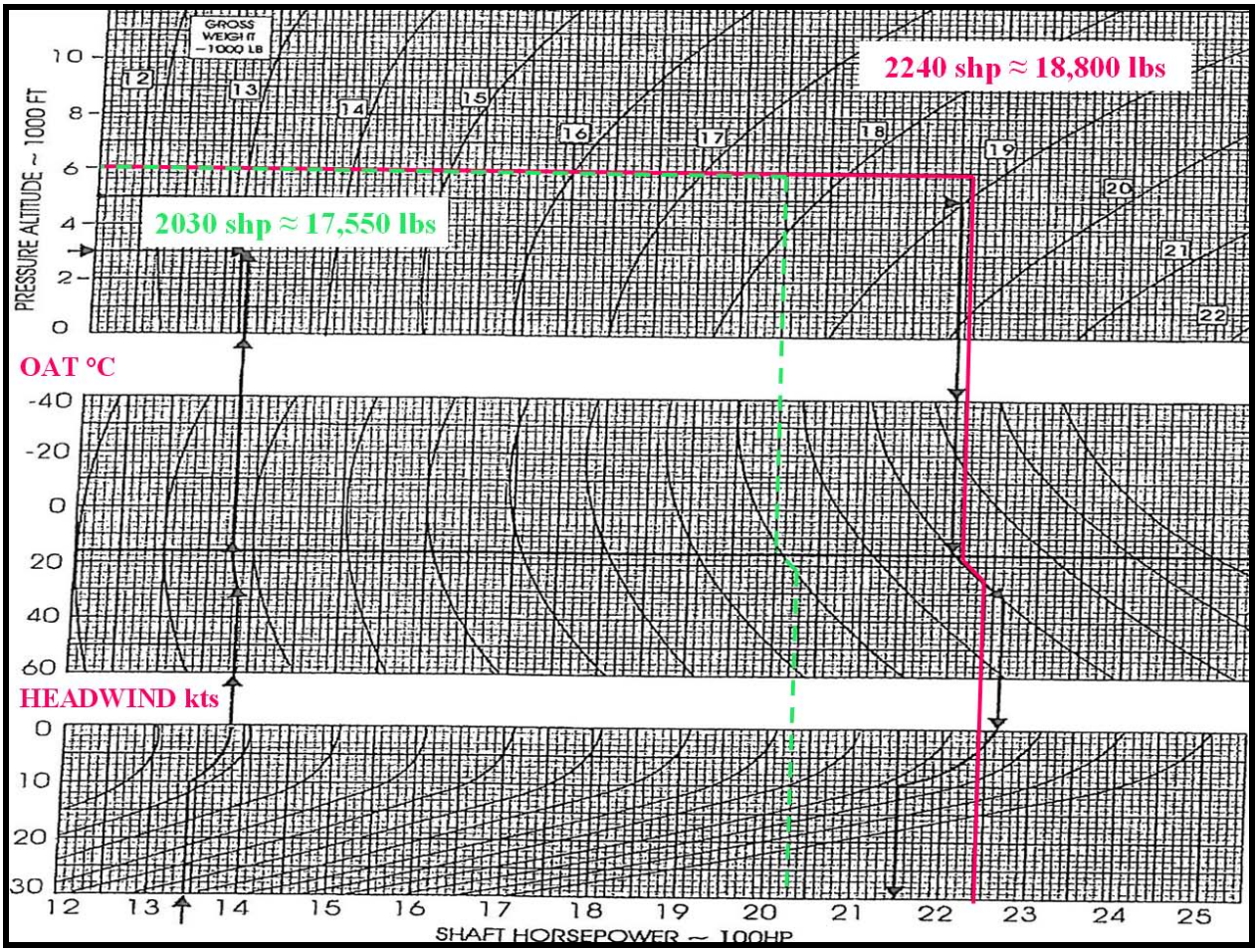

Figure 24: RFMS 8, Figure 7; Power Required to Hover Out of Ground Effect (103 percent N_R), Using Shaft Horsepower by CHSI (pink) and FAA (green) Provided Figure 4 Charts for actual accident conditions

1.9 Company Information

At the time of the accident, Carson Helicopter Services, Inc. (CHSI), headquartered in Grants Pass was a separate entity from Carson Helicopters, Inc., (CHI) headquartered in Perkasie. Both companies had the same president, Frank Carson and vice president, Steve Metheny. CHI has facilities in Grants Pass, and shares the CHSI facilities in that location. CHSI and CHI had their own operating certificates, which were issued by the FAA Hillsboro[102], Oregon and Allentown, Pennsylvania Flight Standards District Offices (FSDO), respectively. CHI held operating certificates for 14 CFR Part 133 operations Rotorcraft External-Load Operations (NBEL647G) and 14 CFR Part 137 Commercial Agriculture Aircraft Operations (NBEG647G); CHI did not have a certificate to conduct operations under 14 CFR Part 135. On March, 30, 2006 CHSI of Grants Pass, Oregon, was issued air carrier certificate for 14 CFR Part 135 operations (C4NA128K), which permitted the operator to conduct on-demand air carrier operations in the contiguous United States and the District of Columbia[103]. Additionally, the operator held certificates for 14 CFR Part 137 operations (C4NG128K) and 14 CFR Part 133 operations (C4NL128K) dated June 06, 2005 and June 06, 2008, respectively.

Pursuant to the certificate, the operator was authorized to carry passengers and cargo in SK-61-N series helicopters under VFR. Operations under instrument flight rules (IFR) were prohibited.

N612AZ was listed under both CHI and CHSI Operating Certificates/Specification and added on the following dates:

-CHI Part 133 Operations Specifications:	February 28, 2008
-CHI Part 137 Certificate:	April 20, 2007[104]
-CHSI Part 133 Operations Specifications:	June 30, 2008
-CHSI Part 137 Certificate:	June 04, 2008
-CHSI Part 135 Operations Specifications:	June 04, 2008

At the time of the accident, CHSI was leasing 10 Sikorsky S-61N helicopters (including N612AZ) from CHI. The lease agreement, dated June 08, 2008, stated that with regards to the operation of the helicopters, "It is understood by CHSI and Carson [CHI] that CHSI will be operating as a Part 133 Rotorcraft External Lift Carrier AND/OR Part 135 On-Demand Air Carrier" and that "CHSI will exercise full operational control of the Helicopters." It further stated that, "All operations shall be conducted in accordance with CHSI's operation specifications."

[102] Referred to as the Portland FSDO
[103] See Attachment #02: Operating Certificates

[104] Part 137 certificates do not require that each aircraft be listed under the certificate

The term of the lease commenced on July 8, 2008, and was to continue for a period of three years.

At the time of the accident, CHSI employed just over 200 people, of which there were 50 pilots (32 qualified to operate under FAR part 135) and 51 maintenance personnel. CHSI started in 2003 as a western operation that almost exclusively performed logging operations. The facilities, located at the Grants Pass Airport (3S8), consist of a welcome counter, several offices, and a maintenance hangar.

In the three years prior to 2008, CHSI's primary operations during the summer consisted of performing contracts for the USFS consisting mainly of water dropping missions. In 2008 CHSI was awarded contracts for Type 1 passenger transport missions (troop shuttles); this was the first firefighter hauling operation they had performed in the US. In the winter, their operations range from relocating helicopters to Firefighting Services Australia and performing a variety of logging and construction missions. Normal summer operations for CHSI start in the March time frame where they will start bids with the USFS for upcoming contracts. The helicopters each accumulate about 1,400 hours annually.

CHSI operations are organized where pilots will relocate to the helicopter for a 12 day duty period and then have 12 days off (personal time). CHSI pilots are paid a predetermined salary for the year; however if they fly in excess of 130 days, they will receive a daily rate for each day thereafter. According to several CHSI pilots that were interviewed after the accident, the duty schedule and pay were above average as compared to industry.

CHSI has a Chief Pilot and DO who are both based in Grants Pass and work in their assigned positions on a full time basis. If a pilot had a complaint they would generally report the problem to the Vice President, Chief Pilot, or DO. All three described their relationship with all the pilots as excellent. CHSI/CHI pilots have an average experience level of over 12,000 flight hours.

The Chief Pilot and DO were both hired in the six months prior to the accident. Prior to their employment, the Vice President additionally worked in the capacity of the Chief Pilot. The previous DO left the company in October 2007 after about 3 years of full-time employment. The Chief Pilot was a pilot with CHI for about 1 year and 11 months prior to being hired into that position. In his extensive flying career, the Chief Pilot had amassed about 10,500 total hours flying experience, of which about 605 hours was acquired in the S-61 and most of which was performing logging and firefighting operations; prior to being employed with CHSI, he worked as a pilot for Columbia Helicopters, Inc. The DO had previously been the Vice President of Commercial Operations and the Chief Pilot for Silver State Helicopters, Inc (SSH); he had about

4000 hours of total flying experience of which about 30 hours was acquired in the S-61. While at SSH, he accumulated about 6 years of experience as PIC under 14 CFR Part 135 operations.[105]

2.0 Flight Operations

The USFS requires that, "contractors shall be currently certificated to meet 14 CFR 133 (External Load Operations), 135 (Air Taxi Operators and Commercial Operations), and 137 (Agriculture Aircraft Operations), as applicable" to the operation being bid. Any helicopter listed in the bid "shall be listed by make, model, series and registration number" on the operator's certificates. If an operator has a Part135 certificate, the aircraft is required to be maintained in accordance with their FAA approved maintenance program.

At the beginning of the Mandatory Availability Period (MAP) for a USFS contract, the helicopter will be operated under Advisory Circular (AC) 00-1.1, Government Aircraft Operations. According to AC 00-1.1, "Agencies which conduct public aircraft operations are encouraged to comply with the Federal Aviation Regulations (FAR), even when they are not required to do so." The USFS states that, "Regardless of any status as a public aircraft operation, the Contractor shall operate in accordance with their approved FAA Operations Specifications and all portions of 14 CFR 91(including those portions applicable to civil aircraft) and each certification required under this Contract unless otherwise authorized by the CO [Contracting Officer]."

To the extent the operator's aircraft is maintained in accordance with the air carriers FAA approved Part 135 maintenance program and the pilots are trained and maintain currency in accordance with the air carrier's FAA approved pilot training program, the aircraft can remain on the air carrier's operations specifications while conducting public aircraft operations. The USFS has always required that operators who offer passenger transport aircraft maintain those aircraft to FAR Part 135 standards. Pilots who fly these aircraft are also required to be FAR Part 135 qualified.

While an aircraft is operating under the MAP of the Exclusive Use (EU) Contract[106], and because of the remote nature of firefighting, the USFS maintains operational control. Even

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[105] According to FAR 119.71, "Management personnel: Qualifications for operations conducted under part 135," section 2 stated that "In the case of a person becoming Director of Operations- (i) For the first time ever, have at least 3 years experience, within the past 6 years, as pilot in command of an aircraft operated under part 121 or part 135."

though the USFS maintains operational control when conducting public aircraft operations the pilot-in-command remains the final authority for the safe operation of the aircraft. The following operational control functions are conducted by the USFS and with the concurrence of the PIC:

> Dispatch: The initial request for dispatch of an aircraft is from the Operations Section of the Incident Command Team. The Operations Section develops a tactical operations plan which is the identified in the incident action plan. The request is then forwarded through the Air Operations Branch Director, then to the Helicopter Base Manager and finally to the person in charge of the helicopter which is the Helicopter Manager. The manager then briefs the pilot on the mission to be flown. The mission could be firefighter transport to the incident, water delivery to the incident, cargo delivery, initial attack of new fire starts, or any combination of these missions. The PIC is the final authority as to whether the mission will be flown.
>
> Flight following: Pilots shall file and operate on a FAA, ICAO or agency flight plan. Contractor flight plans are not acceptable. Flight Plans shall be filed prior to take off when possible. Pilots are responsible for flight following with the FAA, ICAO or in accordance with FS or DOI-Bureau approved flight following procedures, which includes Automated Flight Following (AFF) and radio check-ins.
>
> Manifests (crew and cargo): Prior to point-to-point ferry flights, the PIC shall provide to the appropriate FS or DOI dispatch office or coordination center or helibase with current passenger and cargo information. This is normally delegated by the PIC to the helicopter manager.
>
> Safety briefings: Before each takeoff, the PIC shall ensure that all passengers have been briefed in accordance with the briefing items contained in 14 CFR 135. A briefing shall include the following: Personal Protective Equipment (PPE), Shut-Off Procedures for Battery and Fuel, and Aircraft Hazards. This can be delegated to the Helitack module.

In pertinent part, the AC defines a "public aircraft" to mean any of the following aircraft:

> (1) An aircraft used only for the United States Government; an aircraft owned by the Government and operated by any person for purposes related to crew training, equipment development, or demonstration; an aircraft owned and operated by the government of a State, the District of Columbia, or a territory or possession of the

[106] "Exclusive use" (EU) means that the helicopters are contracted to be paid on a daily basis and a certain funding allocation is associated for their 120 to 180 day contract. "Call when needed" (CWN) means that the helicopters are not committed to the USFS and used on an intermittent basis pending demand. The vendors are only paid if the assets are utilized.

United States or a political subdivision of one of these governments; or an aircraft exclusively leased for at least 90 continuous days by the government of a State, the District of Columbia, or a territory or possession of the United States or a political subdivision of one of these governments.

It further states that the term, "Firefighting," includes the dispensing of water or fire retardants on a fire. It also includes the transport of firefighters and equipment to a fire or to a base camp from which they would be dispersed to conduct the firefighting activities.

According to USFS personnel, CHSI configured the pilots' duty schedule for 12-day periods. The contract for the accident helicopter required the pilots to stay at a Helibase until called out for either a water dropping or passenger hauling mission. This was the first time that the accident pilots had been called out for a firefighter hauling mission to remote helispots since the start of the contract on July 01, 2008. The accident pilots had flown N612AZ with the purpose of USFS flight crewmember repositioning, to another helibase or for a flight evaluation on three prior occasions: July 05, 13, and 15. On July 30, 6 days prior to the accident, two other CHSI pilots had flown to a remote helispot to transport firefighters. If the flight schedule were full, the helicopter would be started at the beginning of the day, and might run continuously up to 4 hours, at which point the contract states the helicopter must be shut down from continuous operation to accommodate a break for the pilots.

Firefighters were provided with a safety briefing at the place of departure by the utilization of a Helitack crewmember giving a short scripted briefing/demonstration. The briefing included information about the use of the seatbelts. Another Helitack crewmember was to escort the firefighters to the helicopter and assist with loading, making sure their seatbelts were latched. The IHOG states that "The safety briefing may be given by the Pilot or as delegated by the Pilot to authorized and qualified personnel (that is, the Helicopter Manager, the Flight Manager, Helicopter Crew member (sic) or Loadmaster)."

2.1 USFS

Contracting Process

The Acquisition Management (AQM) at the National Interagency Fire Center (NIFC) organization in Boise, Idaho provides procurement support for Fire and Aviation. The AQM organization has two primary Contracting Officers supporting Aviation for helicopter resources; one is responsible for EU helicopter contracts and one for Call When Needed (CWN) helicopter contracts.

The Operations organization at the NIFC develops the technical requirements and the number of aircraft needed to incorporate into all aviation solicitations and those resources are procured through the two Contracting Officers. The Contracting Officer's duty is to determine how the procurement will be made with respect to the solicitation (i.e., low price and best value) and to identify the potential markets for resources (via market research, past procurements and attending industry meetings).

After the technical requirements have been identified and the solicitation has been created, it is reviewed and finalized with the Operations and AQM organizations. The solicitation is subsequently finalized and then dispersed for public bidding, typically staying active for 30 to 60 days.[107] The solicitation will state a date and location of where proposals are to be delivered. After the date for receipt of proposals has closed, the Contracting Officer convenes the Technical Evaluation Team (TET) and begins the evaluation process as per the solicitation.

A TET Chair is appointed and is responsible for the TET evaluations and ultimately developing a recommendation to the Contracting Officers, who will forward it to the Director of AQM. Upon concurrence, the Contracting Officer then proceeds to make the awards for each line item. Pre-work meetings (post-award) are scheduled and a notice to proceed for work to begin is issued. Contract administration includes assuring all requirements in the solicitation are adhered to during the contract period. According to the USFS, communications between the Contracting Officers, NIFC-Operations, Host base (field) and the contractor are constant during MAP.

The TET conducts a formal technical evaluation of each independent vendor’s technical and cost proposal as per the solicitation. The items evaluated are as follows:

-Mandatory Documentation (based on an acceptable/unacceptable rating)

-Aircraft Technical Assessment (based on either an acceptable, marginal, or unacceptable rating)

-Safety/Risk Management (based on either an exceptional, acceptable, marginal or unacceptable rating)

-Past Performance (based on either an exceptional, acceptable, neutral, marginal or unacceptable rating)

-Organizational Experience (based on either an exceptional, acceptable, marginal or unacceptable rating)

[107] Dispersed via a website: https://www.fbo.gov (Federal Business Opportunities; FedBizOpps)

-Price (evaluation includes total overall price reasonableness and the best value formula noted in the solicitation to determine cost per pound delivered for each helicopter offered to determine best value)

The cost of CWN type 1 and type 2 helicopters is nearly double that of EU type 1 and type 2 helicopters.[108] The average daily availability rate for the different helicopters between 2005 and 2007 were as follows:

Average Daily Availability Rate of type 1 CWN Helicopter	$23,045
Average Daily Availability Rate of type 1 EU Helicopter	$14,818
Average Daily Availability Rate of type 2 CWN Helicopter	$5,713
Average Daily Availability Rate of type 2 EU Helicopter	$3,422

The technical proposals are separately evaluated and documented by members of the TET. Upon completion of the independent evaluations, the TET members discuss each proposal and determine an overall rating for each vendor. The TET ranks each proposed helicopter per each bid item by price per pound delivered and total cost to the government for the entire term of the solicitation.

The bid items (price analysis) are evaluated by a combination of annual availability and total cost to the government (availability and flight time) for the entire term of the solicitation. As helicopters are selected as the best qualified bid for a specific item, they become unavailable for other bid items. A consensus evaluation for the vendor is then determined and recommendations are made for each line item.

Contract History

In an effort to aid in the prediction of fire support, a study, named K-2, was completed in 2007. It revealed that between 1999 and 2006, helicopters were being activated for a fire season beginning around May 01 with a gradual build up to the peak of the season, occurring between July 01 and September 01; thereafter, the demand would decrease. At the peak of the fire seasons there were as many as 55 type 1 helicopters in the field (CWN and EU). Between 2004 and 2006, there were as many as 60 CWN and EU type 2 helicopters.

As a result of the findings, it was agreed between USFS operations and management that the addition of EU contracts would increase preparedness costs, but would result in a substantial

[108] A type 1 is considered a "heavy" and is defined as over 12,500 lbs maximum gross takeoff/landing weight. A type 2 is considered a "medium" and is 6,000-12,500 lbs gross weight

reduction in suppression costs due to decreased use of CWN contracts. It was determined that 35 EU water hauling helicopters were considered adequate for Large Fire Support (LFS) and 33 EU helicopters were considered adequate for Initial Attack (IA). IA was to include not only water delivery, but also passenger transport and support of the helitack.

The USFS classified the type 1 helicopter community as relatively stable, as there are several vendors whose main market is firefighting. During economic cycles when logging, oil exploration, off-shore work, and construction are at a peak, the USFS has traditionally seen a small reduction in the total number of helicopters available.

The USFS relies heavily on type 2 helicopters for EU contracts, however there are numerous other government agencies soliciting for the same helicopters. There is also competition from the civilian industry, which is specifically seen when the economy is robust, the number of type 2 helicopters that bid on USFS contracts decreases.

Contracts

A total of 24 type 1 and 31 type 2 helicopters were awarded contracts for the USFS in 2007. That year a LFS solicitation was advertised for 35 type 1 and 2 helicopters, with the following performance specifications:

- HOGE at 5,000 feet PA and 30° C
- Lift a jettisonable load of 2,300 lbs

In response to the 35 item solicitation, 32 potential contractors (vendors) submitted 70 bids. The awards were dispersed to include 24 type 1 helicopters, of which CHI received 7; there were 11 type 2 helicopters awarded. The awards were protested and ultimately, the USFS was told to re-advertise for 2008.

There were several solicitations for type 2 helicopters, which were considered regional support and had a lower payload requirement of 1,600 lbs. The difference between the payload specifications was due to the regional helicopters being used for passenger and firefighter transport, which requires additional equipment (weight).

In 2008, the LFS 34 item solicitation (AG-024B-S-08-9003) was advertised for type 1 and type 2 helicopters. With the amount of large amount items, the USFS opted to divide them into the following 3 different tiers:

Tier 1	HOGE at 8,000 feet PA and 30 °C	5,000 lbs jettisonable weight
Tier 2	HOGE at 7,000 feet PA and 20 °C	3,000 lbs jettisonable weight
Tier 3	HOGE at 5,000 feet PA and 30 °C	2,300 lbs jettisonable weight

The tiers were expected to attract certain helicopters that fit the criteria, with tier 2 expected for S-61 proposals. In response, a range of vendors bid 79 helicopters and all items were awarded. Of the 34 awarded helicopters, 26 were type 1 helicopters with the remaining 8 being type 2 helicopters. CHI, based in Grants Pass, received 5 awards for Type 1 helicopters in tier 2 (Contract AG-024B-C-08-9340, Items Numbers 11, 12, 13, 16, and 23). N612AZ, was assigned to Item Number 16 with a host base of San Bernardino, California.

In April 2008, a 25 item solicitation for type 2 IA passenger transport helicopters was advertised. In response 7 vendors bid 10 helicopters, of which 9 were awarded contracts. The performance specifications were:

- HOGE at 7,000 feet PA and 20° C
- Lift a non-jettisonable load of 2,300 lbs

The remaining 16 IA passenger transport helicopters were advertised in a June 2008 solicitation (AG-024B-S-08-9008), which opened the criteria to large businesses[109] and type 1 helicopters. In response, 10 vendors bid 19 type 1 and type 2 helicopters. A total of 14 items were awarded, of which CHSI[110] received 5 for Type 1 helicopters (Contract AG-024B-C-08-9354, Item Numbers 1, 3, 4, 5, and 9). The performance specifications were:

Type 1	7,000 feet PA and 20° C	3,000 pound non-jettisonable weight
Type 2	7,000 feet PA and 20° C	1,650 pound non-jettisonable weight

A total of 40 type 1 and 17 type 2 EU helicopters were awarded in 2008. Adding the total of the 9 regional helicopters that were awarded in 2007 on a two year contract, the total breakdown is a follows:

[109] The original solicitation required a small business designation which is defined by the USFS as 1,500 people or less.
[110] The contract was dated June 20, 2008 and listed the contractor as CHSI.

Number of Exclusive Use Type 1 Passenger Transport Helicopters (IA)	6
Number of Exclusive Use Type 2 Passenger Transport Helicopters (IA)2008	17
Number of Exclusive Use Type 2 Passenger Transport Helicopters (IA)2007	9
Number of Exclusive Use Type 1 Water Delivery Helicopters (LFS)	26
Number of Exclusive Use Type 2 Water Delivery Helicopters (LFS)	8

Since 2004, CHI has actively been soliciting the USFS in Washington, D.C. and Boise, keeping them abreast of the increased performance capabilities of their helicopters. This included the CHI STC composite main rotor blades, the improved water tank and the addition of their Part 135 Certification. Initially the USFS did not have much interest in utilizing type 1 helicopters for passenger transport.[111] With the lack of bids for such operations in response to the April 2008 solicitation, the USFS began to consider the use of type 1 helicopters for EU Initial Attack. The USFS stated that the decision to use the S-61 was in no way based on the active pursuit of CHSI to provide information, but rather the fact that there were a limited number of helicopters available to the USFS.

Contract Details

The accident helicopter was awarded a bid contract, Item No. 16 on contract No. AG-024B-C-08-9340, from solicitation No. AG-024B-S-08-9003. The solicitation stated that when calculating helicopter performance "only FAA approved charts based on minimum specification engine performance shall be used."[112] It further states that helicopter equipped weights are required to be based on the actual weighing of the helicopter. Helicopters awarded bids under the contract are required to remain at or below the helicopter equipped weight as bid. The helicopter is allowed to be one percent above the awarded contracted helicopter equipped weight during the contract option periods.

CHI submitted a bid in response to the solicitation on April 10, 2008. In the bid verbiage, CHI stated that they were offering 10 helicopters (including N612AZ) that met all the requirements of the solicitation. The bid stated that "the offered aircraft are maintained on Carson Helicopters, Inc. Federal Aviation Administration (FAA) 14 CFR Part 133, 135, & 137 operating certificates." Submitted with the bid documentation were Part 133 and Part 137 certificates under the name of CHI and a Part 135 certificate which was issued to CHSI.

[111] On at least 2 previous occasions, the USFS solicited bids for passenger hauling from type 1 helicopters.

[112] As a result of a protest in 2005 involving performance charts, the USFS changed the performance specifications in 2006 to say that, "Aircraft performance shall be based on minimum engine specification…Performance enhancing data (Power Assurance Checks, wind charts, etc.) shall not be used and will not be considered for the evaluation of proposals. Only FAA approved charts based on minimum specifications engine performance shall be used."

The bid advertised the operator's additional capabilities as follows:

-Offering "best value" by being "able to fly internal loads, external loads, carry up to 15 passengers, fight fires and provide hoist and rappel capabilities."
-Improved Category A and B performance for the S-61 by STC#SR02487NY [Supplement 7], "which gives a tremendous enhancement in performance in internal payload/passengers at hot temperatures and high altitudes."
-"Improved takeoff power performance" for the S-61 by STC#SR02507NY [Supplement 8].

The contract award date for N612AZ was June 6, 2008. Modification No. 02 to the contract contained an effective date of June 29, 2008, and changed the helicopter's host base from San Bernardino to Weaverville (Trinity Helibase). This modification required additional equipment to be furnished by CHI, including rappel capability and seating for 16 passengers.

Oversight

Oversight of aviation contractors begins with the evaluation of the contractor's bid to determine if the contractor meets the contract solicitation requirements. After the awarding process of a contract and before the start of the MAP of the contract, a contract "pre-work" or post-award meeting is conducted by the Contracting Officer. At this meeting, a company representative meets with the Contracting Offices to ensure that the requirements of the contract and expectations of the USFS are understood.

Either before or after the pre-work meeting, interagency contracting officer technical representatives (COTR) who are airworthiness and pilot inspectors arrange a date for inspection. Typically the inspection occurs at the contractor's main facility however, many times, because of on-going fire activity, inspections occur away from the contractor's main base of operation. Inspections consist of reviewing aircraft maintenance records; a physical inspection of the aircraft; ensuring that aircraft maintenance technicians meet USFS contractual requirements; inspection of fuel trucks and fuel truck drivers; reviewing pilot records and that flight time requirements are accurate and meet USFS flight time requirements; and when necessary, conduct pilot flight evaluations. When all contractual requirements have been met, the aircraft, maintenance personnel, and pilots are each issued a USFS card delineating exactly the qualifications.

Regional Helicopter Inspector Pilots, maintenance personnel and Contracting Officers had visited and inspected the CHSI facilities. The sole inspection in 2008 was performed on July 03 and 04, 2008. During this inspection there was no report made and the contract was used as a

checklist of items to evaluate. On an annual basis, inspector pilots would visit the CHSI facilities and conduct the USFS Operations brief as a refresher for the upcoming fire season.

When the carded contract employees and equipment arrive at their predetermined assigned helibase, a briefing will take place with the contractor and the local USFS personnel. Individuals cards again will be reviewed to ensure contract compliance and compatibility with the mission requested. Oversight on the overall mission may come from ground personnel such as a Fire Incident Commander (IC) or an aviation project manager or the helicopter manager. Additional oversight may come from individuals assigned to an Aviation Safety Technical Assistance Team (ASTAT) which generally consists of Helicopter Operations Specialists, Pilot Inspectors, Airworthiness Inspectors, and Aviation Safety Managers. The ASTAT may visit a Fire Incident (or multiple incidents depending upon complexity/severity/size) to perform spot checks of contractors assigned to an incident.

Oversight of contractors may also come in the form of spot checks from Forest/Unit Aviation Managers, Regional Aviation Managers, and Fire Incident Aviation managers as they visit the helibases to follow up on mission requests. Depending on the mission requests, the spot check will vary in scope and detail. Additionally, there are Regional Aviation Inspections of Helicopter Base facilities and overall program reviews that are initiated each season if possible per Interagency Helicopter Operations Guide checklist standards.

The USFS verifies each aircraft's weight and balance records and that the aircraft had been weighed within the preceding 24 months. This was verified during the helicopter's yearly "carding" inspection. Witnessing the weighing of aircraft was only done when an aircraft was suspected of being overweight.

The carding inspection for the N612AZ was performed at the CHI facilities in Perkasie on June 26, 2008. During this time a, "Helicopter Data Record" was completed, form FS-5700-21(a). The entry on the form indicates that the last weighing was completed on January 04, 2008. The spaces for entries below titled, "equipped weight" and "bid weight" were empty. The USFS representative that performed the inspection stated that he did not include an empty weight or bid weight on the form, as the USFS was in the midst of modifying their contract with CHI, which would change those both.

Inspector pilots

The USFS policy and contract language require that all contractor pilots performing flight services on interagency contracts shall be approved by an Interagency Pilot Inspector. The USFS inspector pilot process for performing a pilot evaluation flight initially starts with a logbook

review. Following the confirmation of adequate flight time and a current medical certificate, an Operations and Safety Procedures brief is conducted by the inspector pilot. Once the brief and paperwork are complete, the pilot receiving the evaluation flight is required to perform a load calculation based on either the contract specifications or, if on an active fire, the conditions of the day. Once the load calculation is verified the practical portion of the flight evaluation is completed. The standards used are the Interagency Practical Test Standards which covers different maneuvers that demonstrate the pilots' abilities in performing "Special Use." These areas include long-line vertical reference, water/retardant delivery, aerial ignition, flight in mountainous terrain, high- density altitude operations, fire suppression and helitack, fire reconnaissance, rappel operations, unimproved helispot operations, confined area, pinnacle and slope operations, and other fire related flight maneuvers.

After the flight is completed, the pilot, if successful, will receive a USFS card from the inspector pilot approving the pilot to fly for the USFS. The content of the evaluations is significantly different from that of the FAA in that the inspector pilots do not reevaluate the tasks typically evaluated by the FAA and the evaluations are not for the purpose of determining competency to act as a pilot.

The USFS evaluations are conducted utilizing the Interagency Practical Test Standards which state, "The Inspector Pilot is not expected to accept that a pilot is proficient simply based on a paperwork presentation. It has been our experience that pilots have been presented who did not meet the basic safe skill levels. The Inspector Pilot may ask the pilot to demonstrate those tasks that the Inspector Pilot feels are necessary to assure himself that the pilot will likely be able to perform the more difficult tasks demanded later in the practical test."

The USFS inspector pilots were performing evaluations on all CHSI pilots that were assigned to helicopters on Exclusive Use IA Contracts. The USFS had assumed that most of the pilots had never performed passenger transport missions in a fire environment, which has different procedures than their normal water dropping assignments. CHSI pilots were additionally given a mountain flying evaluation in conjunction with the personnel transport evaluation ride. When an USFS inspector pilot conducts an evaluation for the purposes of approving a contract pilot to transport agency personnel there is focus on crew resource management (CRM), performance planning and power checks, load calculations, judgment and decision making, responsibilities and authorities, crew coordination, etc. During the flight portion of the evaluation the inspector pilot will focus on safety-related skills, such as adherence to Fire Traffic Area requirements, landing zone selection, high density altitude operations, wind recognition skills, mountainous terrain operations, confined area and slope operations, etc.

The USFS inspector pilots do not have to be carded or type rated in the helicopter in which they are performing an evaluation. According to the USFS, the inspector pilot was onboard N612AZ for the purpose of conducting the evaluations detailed above, as well as for the purpose of evaluating the PIC CRM abilities and CRM between the agency crewmembers. Additionally, type ratings are not required of a USFS inspector pilots because the never act in the capacity of PIC of aircraft during evaluations. Typically, in the case of aircraft requiring two pilots, the inspector pilot will conduct the flight evaluation from the jump seat or other approved location in the aircraft. This facilitates the inspector pilot's ability to evaluate such areas as flightcrew CRM, use of checklists, and systems familiarity.

Helispots

Helispot H-44 clearing measured approximately 240 feet by 140 feet, with surrounding trees around 50 feet in height. According to the USFS IHOG, Type 1 requirements for a helispot safety circle must be at least 110 feet in diameter with a touchdown pad at least 30 feet by 30 feet. It adds that a path should be cleared of all obstacles higher than touchdown pad for distance of 300 feet along approach and departure path. A note states that pilots should "Avoid helispots that require vertical take-offs," and that "Almost-vertical approaches and departures are not inherently unsafe, but should be avoided if possible, especially on an extended-use basis."

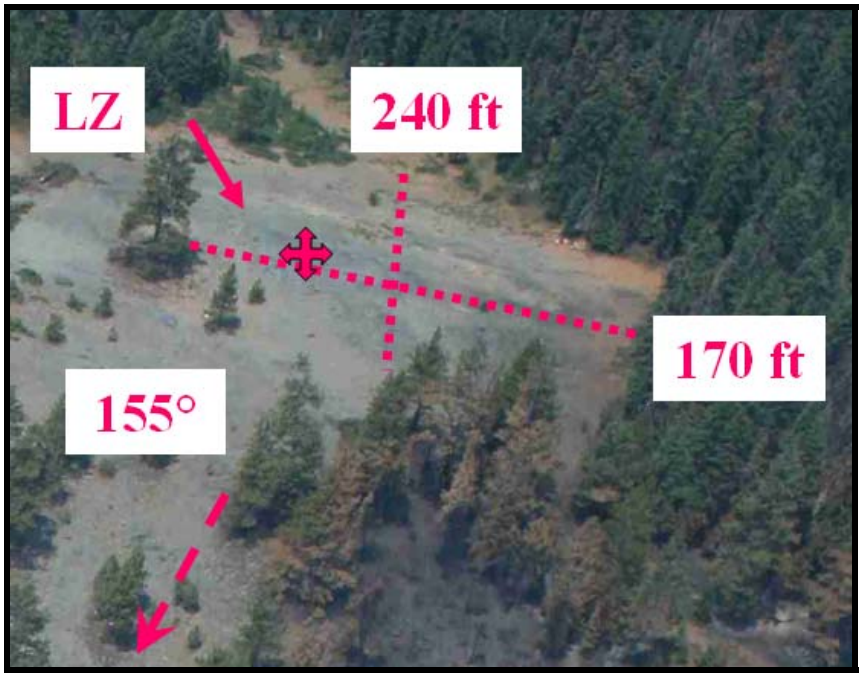

Figure 25: Approximate Helispot H-44 Orientation and Dimensions

Post-Accident Actions

From August 13 to August 18, 2008, the USFS detailed a Contract Compliance Inspection Team to examine 6 helicopters operating on CHI contracts, of which 3 were on LFS contract AG-024B-C-08-9340, and 3 were on IA contract AG-024B-C-08-9354. On August 21, 2008, the USFS Contracting Officer sent a letter notifying CHI of items found during the examinations that were not in compliance with the contracts. A list of "items of concern" was provided for each of the 6 helicopters inspected. A majority of the "concerns" were consistent from helicopter to helicopter (e.g., 5 of the 6 helicopters had the following concern listed: "Chart "C" and the equipment list did not reflect the current equipment installed and the configuration of the aircraft").

From September 26 to October 02, 2008, the USFS issued a total of 4 cure notices suspending all work on both CHI contracts. These notices resulted from the reweighing of helicopters on the contracts[113], which revealed significant discrepancies from the weights submitted by CHI in its bid proposals. The cure notices were issued by the USFS to provide CHI with "an opportunity to provide an explanation of why the helicopters are not meeting the contract equipped weights."

On November 7, 2008, the USFS issued a cure notice for additional concerns and responded to information submitted by CHI in their reply to the initial cure notices. In regards to the information submitted by CHI, the USFS stated, in part: "The information we received and reviewed is still unclear….We continue to have the same questions on the weights of the helicopters as in the initial cure notice." In regards to additional concerns, the USFS stated, in part: "Because of information you submitted in response to the [initial] cure notice operational concerns have been identified. The performance charts that were submitted with your response to the cure notice are different than what was provided with your initial proposal."[114] The USFS requested "accurate information in respect to the weights of the helicopters and for the company to address the additional concerns."

On November 18, 2008, the USFS terminated for cause both CHI/CHSI contracts. The decision to terminate for cause was based on "Carson's responses to [the] cure notices" and "Carson's failure to comply with contract terms and conditions." Three specific contract violations were identified by the USFS. The first of which was that 7 of the 10 helicopters under the contracts weighed "more than their equipped weight as bid," putting them in default of clause B-3 of the contracts, which states that helicopters "initially awarded contract(s) under this

[113] See section 1.6 Weight and Balance Information; subsection (n)

[114] The performance chart discrepancy indentified in the cure notice involved RFMS 5, Figure 1, Power Available Takeoff Power; 5 minute twin and 30 minute OEI (103-percent N_R), as mentioned earlier in this report.

solicitation shall remain at or below contracted helicopter equipped weight as bid." The second violation indentified was that 5 of the 10 helicopters under the contracts were not in compliance with the minimum performance specifications in clause B-3, which required a minimum payload requirement of 3,000 pounds for helicopters performing at 7,000 feet PA and 20 °C. The last violation stated that CHI violated clause C-10 of the contracts with respect to all the helicopters, by using in its operations an improperly modified performance chart in its flight manuals. The clause referenced requires compliance with "all portions of 14 CFR 91 (including those applicable to civil aircraft)." The USFS identified the relevant regulation as 14 CFR 91.9(b), which states, in part, "[n]o person may operate a U.S.-registered civil aircraft…unless there is available in the aircraft a current, approved Airplane or Rotorcraft Flight Manual, approved manual material…or any combination thereof."

2.2 Federal Aviation Administration

FAA Oversight

The Portland FSDO was CHSI's assigned certificate holding district office (CHDO) and was responsible for the geographic area in which the principal base of operations was located. FAA Order 8900.1, Flight Standards Information Management System states that the CHDO "management shall have overall responsibility for all FAA reporting requirements, technical administration requirements, and regulatory oversight of the operator." At the time of the accident the Portland FSDO employed approximately 20 field inspectors (17 principal inspectors and 3 journeyman), who were responsible for an estimated 242 certificated operators.

The CHSI principal operations inspector (POI) began employment with the FAA in June 1988. In 2006 he was assigned as the POI for CHSI. He classified his relationship with the CHSI as "open", stating that he talks to the Vice President frequently. The POI stated that he was the principal operations inspector for 29 operators. He stated that his assistant principal operations inspector (APOI) aided him with the oversight for all his assigned operators. The FAA records revealed that he oversaw 24 designees and was the POI on 58 certificates which were broken down into the following categories:

-14 CFR Part 141= 2 operators
-14 CFR Part 135= 12 operators
-14 CFR Part 133= 21 operators
-14 CFR Part 137= 23 operators

The POI oversaw many operators that contracted with the USFS. The largest of these was Erickson Air-Crane Inc., followed by Columbia Helicopters, Inc. and then CHSI. The POI reported that he and the APOI visited CHSI regularly (about once every 1 to 1.5 months) for both

scheduled appointments and unannounced visits. While at CHSI, he would typically give type-rides, review records, and audit their flight locating system. He stated that many of the visits comprised the entire day. He estimated that he gave one-third of the S-61 type rides for CHSI.

The POI's flying career has encompassed flying both civilian and military airplanes and helicopters over the last 50 years; with his start in 1958. During 1964 he piloted heavy-category helicopters in Vietnam. He currently has amassed about 6,000 hours total flight experience in fixed-wing and about 8,000 hours in rotorcraft, of which 3,000 hours is in the S-61 and 4,000 in the Sikorsky S-64 Skycrane. He was employed by the FAA in 1988 at the St. Louis, Missouri FSDO. Nine years thereafter, he moved to Portland, as the FSDO was actively looking for an inspector with heavy-category helicopter experience. The POI described his current position at the FSDO as overworked, with 50% of his time being tasked with superfluous activities (e.g., paperwork, training). He stated that the FSDO is understaffed and he is always out in the field trying to complete all of his vast oversight duties.

FAA records indicated that both the current and former POI (and other assigned operations inspectors) conducted 117 work activities at CHSI since 2003 (when operations began in Grants Pass). In the year prior to the accident the FAA recorded 42 work activities at CHSI, of which 8 were by the POI and 12 were by the PMI.

The FAA required work program for CHSI in fiscal year 2008 required the POI and PMI to visit the facilities a minimum of 1 time in that year. During the visits the areas of inspection were as follows:

-Crew records inspection
-Ramp inspections
-Training program inspection
-Inspection program inspection
-AD compliance inspection
-Manual procedures inspection.

Inspections[115]

FAA records reveal that in December 2007, while an Allentown FSDO inspector was performing an inspection at CHI, he discovered that the number of pilots and helicopters operated by CHI did not match his records. He found that CHI had only 4 pilots that were operating under their Part 133 and 137 certificates. He classified this discovery as a "potential problem" after becoming

[115] See Attachment #81: Pertinent List of FAA Inspections/Actions

aware that there were 23 other pilots that were on Part 133, 135, and 137 certificates issued by the Portland FSDO.

The inspector further noted that it would not be possible to identify if a helicopter and pilot were under CHI or CHSI's Part 133/137 certificate. Additionally, it would be problematic to abide by the FAR required Skills and Knowledge tests required for their Exclusive Use status, which is required to be performed by the certificate holder's chief pilot.

This issue was considered resolved on July 02, 2008, after helicopters were removed from certificates and identified under what certificate they were operating. N612AZ was reported to be operating under CHSI's 135 certificate

From September 27, 2007 (the first FAA record of inspection for the CHSI Part 135 certificate) to the accident date there were 40 recorded entries of FAA action. Of those actions, 12 were with regards to operations actives, 16 were maintenance, and 12 were avionics related.

Post Accident Actions

A review of the records further detailed that prior to the accident the Portland FSDO received two letters with regards to CHSI helicopter weights. Both letters alleged that the weights on the Chart C forms were consistently under reported and did not accurately reflect the items installed on the helicopter. These letters were referenced as being investigated on November 19, 2008. As a result of this investigation the APOI reported that his findings were unable to support a violation.

2.5 Accident/Incident History[116]

A review of FAA and Safety Board records found documentation concerning accident/incidents that occurred at CHSI and CHI, in the ten years prior to the accident:

-January 12, 2003: An S-61A was substantially damaged when the pilot experienced a loss of control due to the improper installation of the left tailrotor control cable by company maintenance personnel.

-March 23, 2003: An S-61A was substantially damaged when the helicopter experienced an interruption of rotor system drive power due to the input free wheeling unit malfunctioning

[116] See Attachment #17: Prior Accident/Incidents

2.6 Additional Information

Other Procedures

Several former CHSI pilots were interviewed following the accident. Most were in consensus that it is a rarity to reach engine topping during normal flight operations. They stated it is a more common occurrence during logging operations. Typically, during water dropping missions a pilot will verify the helicopter's power available prior to arriving at a dip site. In general, the pilot will perform this check when operating above approximately 3,500 feet (depending on temperature, PA, and the health of the engines), because the helicopter is limited by the transmission dual-engine maximum torque rating below that altitude, preventing the helicopter from reaching the topping limit.

This is performed by the pilot temporarily pulling power by increasing collective until the N_R begins to droop. The pilot will note the engine torque attained and use that as a reference. When at the dip site and pumping water into the tank, the pilot will monitor the gauges and when the torque reaches about 10 percent below the reference engine torque, the pilot will shutoff the pump and depart. This practice is common among the industry and considered a safety check to ensure there is enough power to safely accomplish a mission.

2.7 Interviews

A copy of interview summaries and transcripts obtained during the investigation is contained in the public docket of this report.

Zoë Keliher
Air Safety Investigator
September 15, 2009