



AVIATION



HIGHWAY



MARINE



RAILROAD



PIPELINE

Aviation Investigation Final Report

Location:	Chico, California	Accident Number:	SEA05MA085
Date & Time:	April 20, 2005, 18:50 Local	Registration:	N926AU
Aircraft:	Lockheed P-3B	Aircraft Damage:	Destroyed
Defining Event:		Injuries:	3 Fatal
Flight Conducted Under:	Part 137: Agricultural		

Analysis

Prior to the accident flight, the air tanker airplane had flown 9 times on the day of the accident, for a total flight time of 5 hours and 46 minutes. The purpose of the flights was to provide recurrent training for pilots scheduled to conduct fire-fighting operations for the United States Department of Agriculture Forest Service (USFS) during the upcoming fire season. Pilots aboard the airplane during the earlier flights reported no mechanical problems with the airplane. As was the mission for other flights that day, the accident flight, the tenth flight, was a training flight to conduct practice drops of water over an area of rugged mountainous terrain located north of the airport. Aboard the flight were the captain, the copilot, and the company's Chief Pilot, who was providing flight instruction. The Chief Pilot had been on board all the flights that day. Radar data indicated that the flight departed the airport and proceeded about 10.5 nautical miles to the north where it began maneuvering in a manner consistent with the conduct of practice water drops. The data showed the airplane entering and then following a right-hand racetrack pattern oriented northeast-southwest, during which it appeared that practice drops were being made on the southwest leg. During the last minute of the flight, the airplane was on the northeast leg of the racetrack pattern, flying up a valley that was oriented northeast-southwest with uphill being to the northeast. The airplane's flight path was initially near the middle of the valley. During the last 36 seconds of the flight, the airplane's flight path began to deviate towards the rising terrain on the eastern side of the valley. The last two radar hits show the airplane at an altitude of less than 100 feet above ground level. The airplane had completed approximately 1.75 circuits of the racetrack when the data ended with the airplane at 2,900 feet msl, heading northeast. The initial impact point was located about 2,150 feet northwest of the last radar data point at an elevation of about 2,450 feet msl, indicating the airplane entered a left descending turn and completed about 90 degrees of turn between the last radar hit and the impact. No distress calls were received from the airplane. According to local authorities, witnesses observed a "fire ball" at the time of the accident. Examination of the wreckage site revealed that the airplane impacted on about a 304 degree magnetic heading in a 40 degree left bank with the left wingtip striking the ground first. The airplane was

severely fragmented and a severe post crash fire burned most of the structure and surrounding vegetation. Remnants of the entire airplane were accounted for at the wreckage site. There was no evidence of pre-existing structural failures or impact with foreign objects in any of the wreckage. All four of the engines and propellers were found at the wreckage site. The engines did not have any indications of an uncontainment, case rupture, or pre-impact in-flight fire. All four engines had damage to the compressor and/or turbine rotors that was consistent with engine operation. The cockpit engine instrumentation gages indicate that all four engines were running at about 2,200 shaft horsepower at impact. Review of the airplane's maintenance records did not reveal any chronic issues with the airplane nor any system/component anomalies that would have contributed to the accident. The airplane was equipped with neither a cockpit voice recorder (CVR) nor a flight data recorder (FDR) and Federal Aviation Regulations did not require the airplane to be so equipped. The reason for the in-flight collision with terrain could not be determined.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: Terrain clearance was not maintained while maneuvering for undetermined reasons. Mountainous terrain was a factor.

Findings

Occurrence #1: IN FLIGHT COLLISION WITH TERRAIN/WATER
Phase of Operation: MANEUVERING

Findings

1. (F) TERRAIN CONDITION - MOUNTAINOUS/HILLY
2. (C) CLEARANCE - NOT MAINTAINED - FLIGHTCREW

Factual Information

HISTORY OF FLIGHT

On April 20, 2005, about 1850 Pacific daylight time, a Lockheed P-3B air tanker airplane, N926AU, registered to and operated by Aero Union Corporation, Chico, California, impacted terrain while maneuvering about 12 nautical miles north of the Chico Municipal Airport (KCIC). The three crewmembers on board, the airline transport rated captain, the commercial rated copilot and the operator's chief pilot, who was providing flight instruction, were fatally injured, and the airplane was destroyed by impact forces and fire. The training flight was being conducted under 14 CFR Part 137. Day visual meteorological conditions prevailed, and a company flight plan was filed. The flight departed KCIC at 1838.

According to Aero Union Corporation records, prior to the accident flight, the airplane had flown 9 times on April 20, for a total flight time of 5 hours and 46 minutes. The purpose of the flights was to provide recurrent training for pilots scheduled to conduct fire-fighting operations for the United States Department of Agriculture Forest Service (USFS) during the upcoming fire season.

The accident captain flew the first two training flights of the day. In an interview conducted by Safety Board investigators, the copilot on those flights stated that although the accident captain had a lot of time in P-3s, he did not have much time in the low level environment. On flights 1 and 2, they dropped 2 loads of water. The accident captain briefed the copilot well regarding the drop area and escape routes. Normal drop speed was between 130 and 140 knots, and the mission was flown at an altitude about 200 feet above ground level (AGL). There were no open minimum equipment list (MEL) items and no "abnormals" were encountered during the flight.

On flight 1, they climbed out of Chico to an altitude of 3,500 feet. The Chief Pilot assumed the role of Attack Captain and selected a simulated spot fire area that needed the first portion of the drop across the head of the fire. The Chief Pilot noted that the accident captain never called for the Before Drop checklist. When conducting a drop, basically, they are trying to simulate a landing pattern with the landing gear retracted. They were at 120 knots approaching a "saddle" (between two peaks) before the push over to make the drop across the simulated head of the fire. The second part of the drop was to be made down the left or right flank; therefore, the accident captain attempted to do the drop out of a right hand turn. They had to go around because they were not lined up on the target. The copilot stated that the go-around decision was made late. The accident captain then decided to do the drop from a left hand pattern. The third drop was also made from a left hand pattern. When they departed the drop area and headed back to Chico, the accident captain faked a heart attack as a cue for the copilot to take over and land the airplane.

On flight 2, the Chief Pilot selected a drop area that was along a road that curved. The accident captain selected a right hand pattern for the drop but had to make a go-around. He then selected a left hand pattern and made the drop while in a turn. The Chief Pilot did not like that the accident captain made the drop while in a turn and briefed him accordingly, stating the dangers of possibly hitting a snag or other hazards. The copilot stated that he did not remember the accident captain making a go-around call but he did remember him saying "check flaps approach" as the go-around was initiated. The copilot waited for a minimum of 140 knots before retracting flaps beyond Takeoff/Approach setting.

The copilot stated that they try not to exceed 30 degrees of bank angle. The accident captain got close to that at times but did not exceed it. Final approach entails a constant descent to a level altitude. On these runs, the lowest altitude was perhaps 200 feet above terrain, but certainly not less than 150 feet. In case of a go-around, there is no lag in power; power is available right away.

The copilot stated that the accident captain was not as comfortable in the low level environment as he was in the normal flight regime, but the accident captain was confident. The copilot stated that he believed that the accident captain was task saturated in the low level environment, but that was not uncommon for other captains, as well. There was not much talk on final approach and the copilot stated that he did not think there should be. There were no simulated emergencies during the drop. They had already done a lot of simulated emergencies at other times during training.

In an interview conducted by Safety Board investigators, the captain of flights 3 and 4 on the day of the accident stated that they took on a load of water and did three drops in a triangular area with a simulated boxed-in area of fire. They normally train in the area where the accident occurred, using a variety of different targets in that general area. The captain does all the flying during the actual fire-fighting activity. There were no mechanical problems with the airplane; it was a good flying airplane. He wrote up a couple of light bulbs after the flight but there were no other problems noted.

Flight 7 was a type rating check ride. The accident captain occupied the copilot seat on the flight and the Chief Pilot was conducting the check from the center seat. According to company records, the flight lasted for 1 hour and 56 minutes.

In an interview conducted by Safety Board investigators, the captain of flights 5, 6, 8 and 9 on the day of the accident stated that he flew the accident airplane for a total of 2 hours and 2 minutes on these four flights. The captain did not report any anomalies with the airplane.

The accident airplane had been fueled to 22,500 pounds just prior to flight 9. After flying for 28 minutes, flight 9 returned to KCIC at 1815. After returning to KCIC, no additional fuel was added but the airplane's retardant tank was loaded with 2,550 gallons of water.

The accident flight, the tenth flight of the day, taxied out for takeoff at 1834 and departed at 1838. As was the mission for other flights that day, the accident flight was a training flight to conduct practice drops of water over an area of rugged mountainous terrain located north of the airport. Aboard the flight were the captain, the copilot, and the Chief Pilot. The Chief Pilot had been on board all 10 flights that day.

According to radar plots of data provided by the U. S. Navy, the flight departed the airport and proceeded north while climbing to and maintaining between 3,000 and 3,500 feet msl. The airplane turned northeast and approximately 10.5 nautical miles from the airport, descended to between 2,700 and 2,900 feet msl and executed a left-hand 270-degree turn. The airplane then executed a second level left-hand turn of about 270 degrees coming out of the turn on a southwest heading. While on the southwest heading, the airplane descended to 2,300 feet msl and then began climbing. The airplane continued to climb to an altitude of 3,200 feet msl as it executed a right-hand race track pattern oriented northeast-southwest. In the race track pattern, as the airplane returned to a southwest heading, it again descended to an altitude of 2,300 feet msl and then began climbing. As the airplane continued to follow the race track pattern and turned from the southwest to the northeast it climbed to 2,700 feet msl. The last minute of radar data showed the airplane continuing to head northeast with its altitude varying as follows:

Time	Mode C Altitude
18:49:55	2,700 feet
18:50:07	2,500 feet
18:50:19	2,500 feet
18:50:31	2,700 feet
18:50:43	2,600 feet
18:50:55	2,900 feet

The airplane had completed approximately 1.75 circuits of the racetrack when the data ended at 1850:55 with the airplane at 2,900 feet msl, heading northeast. The initial impact point was located about 2,150 feet northwest of the last radar data point at an elevation of about 2,450 feet msl.

No distress calls were received from the airplane. According to local authorities, witnesses observed a "fire ball" at the time of the accident. When the airplane did not return to the airport, a search was initiated. The wreckage was spotted from the air on the evening of April 20, and ground search and rescue personnel reached the site early on the morning of April 21. The main wreckage was located at 39 degrees 59.241 minutes North latitude and 121 degrees 47.208 minutes West longitude at an elevation of 2,359 feet.

PERSONNEL INFORMATION

The Captain

The captain held an airline transport pilot certificate with the ratings and limitations of airplane multiengine land; commercial privileges for airplane single-engine land; and type ratings for the B-737 and the L-188. He obtained his L-188 type rating on August 30, 1993, on the basis of military competence. Additionally, he held flight engineer and mechanic certificates. His most recent FAA first-class medical certificate was issued on April 18, 2005, with the limitation that he must have available glasses for near vision.

According to Aero Union Corporation records, the captain had accumulated 4,937 total flying hours, of which 2,915 were in the L-188/P-3. He had flown 12, 12, and 135 hours in the past 30 days, 90 days, and 1 year, respectively. His most recent L-188/P-3 competency/proficiency check was completed May 2, 2004.

The captain's date of hire with Aero Union Corporation was March 31, 1995. He was employed as a P-3 pilot for the U. S. Navy Reserves from June 1993 until the time of the accident. Before that, he was employed as a P-3 flight engineer and P-3 pilot for the U. S. Navy from December 1975 until June 1993.

The Copilot

The copilot held a commercial pilot certificate with the ratings and limitations of airplane single- and multiengine land, instrument airplane, and an L-P2V type rating. Additionally, he held flight instructor and mechanic certificates. His most recent FAA second-class medical certificate was issued on April 15, 2005, with no limitations or restrictions.

According to Aero Union Corporation records, the copilot had accumulated 4,317 total flying hours, of which 192 hours were in the L-188/P-3. He had flown 15, 27, and 251 hours in the past 30 days, 90 days, and 1 year, respectively. His most recent FAR 61.55 second-in-command qualification check was completed January 28, 2005.

The copilot's date of hire with Aero Union Corporation was April 1, 1997. He was employed as an air tanker copilot for TBM, Inc., from April 1996 until December 1996. Prior to that he was the owner of an air conditioning and heating business from April 1992 until April 1996.

The Chief Pilot

The chief pilot held an airline transport pilot certificate with the ratings and limitations of airplane multiengine land; commercial privileges for airplane single-engine land; and type ratings for the DC-4, L-188, L-382, and L-P2V. The chief pilot obtained his L-188 type rating on April 18, 1996. Additionally, he held flight instructor and mechanic certificates and was a designated pilot examiner. His most recent FAA second-class medical certificate was issued on January 3, 2005, with no limitations or restrictions.

According to Aero Union Corporation records, the chief pilot had accumulated 6,527 total flying hours, of which 902 were in the L-188/P-3. He had flown 34, 88, and 232 hours in the past 30

days, 90 days, and 1 year, respectively. The chief pilot's most recent FAR 61.58 pilot-in-command proficiency check was completed November 14, 2002.

The chief pilot's date of hire with Aero Union Corporation was May 1990. He was employed as an instructor/charter pilot for Flight Operations, from July 1989 until May 1990. Prior to that he was employed as a DHC-4 copilot for Union Flights from March 1989 until July 1989. Before that he was a flight instructor for various companies from 1987 to June 1989.

AIRCRAFT INFORMATION

The Lockheed P-3B Orion is a low-wing, 4-engine anti-submarine warfare airplane originally developed from the Lockheed L-188A Electra passenger airplane. The airplane is 106 feet long, has a wingspan of 99 feet, 8 inches and a height at the tip of the vertical stabilizer of 33 feet, 8.5 inches. It is constructed primarily of aluminum alloy with a semi-monocoque fuselage design. The empennage is of the conventional design utilizing a single elevator on each horizontal stabilizer each with a trim tab and a force link tab. There is a single rudder on the vertical stabilizer with an attached trim tab. Each wing is equipped with an aileron and attached trim tab and a one-piece fowler flap. The flaps are each actuated by two jackscrews and the motion is defined by five flap tracks. The nose and two main landing gear are installed in a tricycle configuration.

The airplane was manufactured by Lockheed around February 1966 in Los Angeles, California for the United States Navy. The United States Navy took delivery of the airplane on March 10, 1966. According to military records, the airplane had accumulated 13,751 total hours since new and 10,293 total landings. Aero Union purchased the airplane from the General Services Administration on January 14, 1997. A special ferry flight permit was issued by the FAA on January 23, 1997 to ferry the airplane from MacDill Air Force Base, Florida to Chico, California. On May 3, 1999, the airplane was converted to a tanker configuration using Aero Union Supplemental Type Certificate (STC) STC00792LA and Master Drawing List Number 11700 Rev F dated September 3, 1998. The FAA issued a restricted category airworthiness certificate for the airplane on May 5, 1999. The airplane had accumulated 15,614.1 total hours at the time of the accident. Aero Union had flown the airplane 1,863.1 hours since purchasing the airplane from the military.

The airplane was equipped with four Rolls-Royce T56-A10W turbo propeller engines. The T56-A10W engine features a power reduction gearbox, 14-stage axial flow compressor, a can-annular combustor with 6 combustion chambers, and a 4-stage turbine. The T56-A10W engine has a takeoff power rating of 4,591 shaft horsepower (shp). The airplane was also equipped with four Hamilton Sundstrand 54H60-77 propellers. The 54H60-77 propeller is a four-bladed, hydraulically actuated, variable pitch, constant speed propeller.

Aero Union Corporation maintained its P3 fleet in accordance with an FAA Approved Inspection Program, signed and dated May 6, 2004. The most recent inspection was accomplished on April 11, 2005 in Chico, California. This inspection was a "Special"

inspection, which is the equivalent of an annual inspection. At the time of the inspection, the airplane had accumulated 15,583.0 hours. The inspection consisted of a detailed airframe inspection, lubrication of the entire airplane, inspection of the retardant tank and its systems, a check of FAA and USFS requirements, and a discrepancy review and corrective action. Review of the airplane's maintenance records by Safety Board investigators revealed no significant issues, trends, or findings.

The airplane's weight and balance were estimated for the time of the accident. The estimated gross weight of 73,292 pounds and center of gravity of 586.5 inches were within the manufacturer's Airplane Flight Manual (AFM) limits (105,000 pounds and 577.95 to 598.20 inches). The estimated weight was based on the assumption that all retardant (water) was jettisoned. The actual amount of retardant that was jettisoned could not be determined.

According to the AFM Supplement, Lockheed P3A/P3B STC ST00792LA, the maximum drop speed is 150 KIAS and the minimum flap setting for retardant drop is TAKEOFF/APPROACH.

The airplane was equipped with neither a cockpit voice recorder (CVR) nor a flight data recorder (FDR) and 14 CFR Part 137 did not require the airplane to be so equipped.

METEOROLOGICAL INFORMATION

The closest operating weather reporting station was located at Red Bluff Municipal Airport (KRBL), Red Bluff, California, about 25 miles northwest of the accident site at an elevation of 349 feet msl. The Automated Surface Observing System (ASOS) at KRBL reported the following weather at 1854: Wind from 170 degrees at 4 knots, visibility 10 statute miles, broken clouds at 11,000 feet, temperature 19 degrees Celsius, dew point 7 degrees Celsius and an altimeter of 30.03 inches of mercury.

According to the U.S. Naval Observatory, the sun set in Chico at 1951 on April 20, 2005. The captain of flights 5, 6, 8 and 9 on the day of the accident stated that sun glare was not an issue during flight 9.

WRECKAGE AND IMPACT INFORMATION

The accident site was located in a ravine oriented approximately East-West (98°-278° magnetic). The airplane was severely fragmented and a severe post crash fire burned most of the structure and surrounding vegetation. The airplane left a ground scar down the south slope of the ravine and most of the wreckage was scattered along and up the north slope of the ravine. The ground scar and debris field were oriented about 304° magnetic and measured approximately 525 feet long and 100 feet wide.

The initial impact point (N39° 59.210, W121° 47.142) was identified by a ground scar approximately 9.5 feet long by 3 feet wide. There was some orange paint transferred to some of the dirt and rocks in the scar and a piece of wing tip structure with an "E.C.M. Antenna"

placard attached was found adjacent to the scar. There were small fragments of clear and red glass in the scar along with small remnants of foam with brown paint. The bushes to the right of the ground scar were broken and cut at about a 40 degree angle to horizontal.

There was a gap of about 21 feet with no scarring between the end of the initial ground scar and the beginning of the second ground scar. The second ground scar was continuous to the bottom of the ravine and the major airplane wreckage. Some of the bushes to the right of the ground scar exhibited clean, angled cuts. Numerous small pieces of fragmented wing skin, several propeller blade fragments, some propeller blade cuff material and fragments of the flaps were found in the second ground scar area. Two of the larger propeller tip fragments exhibited significant chord wise scratching and leading edge damage. One propeller blade missing the tip section, an engine cowl door, a fire bottle, and several unburned wing fragments were found to the left of the ground scar area. About 46 feet along the wreckage path from the beginning of the second ground scar, the dirt had a wet appearance with a kerosene smell. About 20 feet further along the wreckage path, the first evidence of fire began with scorched earth and charred plants. A section of the removable left wing tip was found near the bottom of the ravine, on the right side of the ground scar with chord wise scratching in the paint on the lower surface.

At the bottom of the ravine there was an area between two small streams that was unburned. Four sections of flap were found here totaling 18 feet in length. Also, landing gear door fragments, portions of the retardant tank, some forward wing spar remnants and a propeller dome were found here. The two retardant tank doors were found intact and bent at the bottom of the ravine. On the right side of this area there were several small sections of the orange painted aft fuselage skin. On the left side of this area a large section of the outboard left wing about 14 feet long was found relatively intact and unburned. The wingtip, aileron and flaps were not attached.

The north side of the ravine, where most of the wreckage was found, was heavily burned. About 20 feet up the north side of the ravine on the right side of the wreckage field, the remnants of the outboard right wing were found. Portions of the right outboard nacelle, sections of the rear spar, sections of the flap, and the aileron were identified in this area. The structure was extremely fragmented and exhibited severe fire damage. Immediately to the left of the outboard right wing remnants were the two retardant tank door torque tubes, intact and bent, and a large section of the retardant tank skin. Above the right wing remnants was a somewhat flat area on the north ravine face. The empennage was found here laying on the rudder and elevator trailing edges. The lower section of the empennage was completely consumed by fire and the remainder exhibited moderate-to-severe fire damage. The rudder, both elevators, and their associated bell cranks remained attached to the empennage along with the rudder trim tab and the elevator trim and force link tabs. The outboard 4 feet of the right horizontal stabilizer and the outboard 2 feet of left horizontal stabilizer were crushed aft and the tips were missing. The area above and to the right of the right outboard wing remnants and north of the empennage remnants was littered with numerous small pieces of internal wing structure and wing skin.

Below the flat area on the north ravine face on the left side of the debris field was a rock ledge where a large section of the aft fuselage was found. The section was about 42 feet long and included the skin-frame-stringer structure from the over wing hatch area to the aft pressure bulkhead. The area from above the wing was splayed open and exhibited moderate fire damage. The middle area between the wing trailing edge and the start of the dorsal fin was severely fire damaged and collapsed upon itself. The area beneath the dorsal fin exhibited moderate fire damage and included most of the aft pressure bulkhead. The aft fuselage and empennage separated at the production break.

A majority of the airplane structure was found below the rock ledge at the bottom of the ravine. The center wing structure was essentially intact from the right wing attach points to about 18 inches inboard of the left wing attach points. It was lying upside down on top of a propeller. Adjacent to the wing structure were a section of the lower fuselage with the bomb bay hinge and the cockpit overhead hatch, all with moderate fire damage. The remains of the forward fuselage structure including the cockpit were found in the main wreckage area with severe fire damage. The pilot seat area was selected as the reference point of the wreckage and was located at N39° 59.241, W121° 47.208. The inboard and center sections of the left wing were found in the main wreckage area with moderate fire damage. All four engines and propeller hubs were also found in the main wreckage area. All three landing gear were found separated from their respective trunnions in the main wreckage area. The left main landing gear actuator was found in the extended position, which corresponds to a retracted gear position. Several small pieces of structure were found down the ravine from the main wreckage area with little-to-no fire damage.

One of the propeller tips was found on an adjacent ridge about 1,150 feet southwest of the main wreckage (N39° 59.079, W121° 47.335) and was the furthest piece of wreckage located.

All of the aircraft structure was accounted for at the wreckage site. Remains of all the control surfaces were found. Control continuity could not be established due to the severe fragmentation of the airplane.

Most of the cockpit structure and instruments were consumed by fire. The captain's and first officer's panels were located in the main wreckage area. On the captain's panel, the airspeed indicator and altimeter were the only instruments still intact. On the airspeed indicator, the Vne barber pole indicated 275 knots while the airspeed pointer was free to move. There were no slap marks evident on the indicator face. The captain's altimeter indicated 13,500 feet on the dial, the needle was at 5, and the pressure was set to 30.05" Hg. On the first officer's panel the airspeed indicator, altimeter, and flap indicator were still intact. The airspeed indicator pointers were both free to move but there was a slap mark at 275 knots. The altimeter indicated 19,400 feet on the dial, the needle was at 5, and the pressure setting was unreadable. The flap indicator needle was at the upper edge of the landing flap band.

Three of the four flap jackscrews were found in the wreckage. Since they were all separated

from the wing and flap structure, no determination could be made of their original installed position. The first jackscrew (#1) was found at the forward end of the aft fuselage structure in the vicinity of a flap track and was bent approximately 20 degrees at about the mid span. The #2 jackscrew was found adjacent to the left outboard wing section and was missing the wing fitting and the flap attach fork. The #3 jackscrew was found near the right outboard wing remnants and was missing the wing fitting. Each jackscrew consists of an inner and outer screw with the forward end of the inner screw attached to the wing fitting and the aft end of the outer screw attached to the flap attach fork. On all three, the length of the screw between the wing fitting and the flap attach fork was measured. The results were: #1 - 32 1/4 inches, #2 - 32 1/8 inches, #3 - 32 inches.

The same flap jackscrew measurements were made on an intact airplane (N921AU) with the flap handle in the full down and in the takeoff/approach positions. The indicator in the cockpit was at the lower edge of the "LAND" band for the landing configuration and at the hash mark between the "60" hash mark and the "T.O. & APPROACH" band for the takeoff/approach configuration. For the landing configuration, all four jackscrews measured 40 3/4 inches. For the takeoff/approach configuration, the four jackscrews all measured 30 3/8 inches.

The No. 1 engine was intact from the air inlet duct to the exhaust case. The reduction gearbox and propeller were missing from the engine. The engine was upright and partially enclosed in the cowling. The engine was identified by the data plate on the front of the engine. On the portions of the engine that were visible, the engine did not have any indications of an uncontainment, case rupture, or in flight fire. The 1st stage compressor blades were all in place in the disk, were full length, and were straight. The turbine case was pushed radially inward at 12 o'clock. The 4th stage turbine blades were all in place in the disk and were full length. The tips of the 4th stage turbine blades were bent slightly opposite the direction of rotation. The exhaust case was pushed forward and radially inward at 12 o'clock.

The No. 2 engine was intact from the air inlet duct to the exhaust case. The reduction gearbox and propeller were missing from the engine. The engine was upright. The engine was identified by the data plate on the front of the engine. The engine did not have any indications of an uncontainment, case rupture, or in flight fire, although the engine had been partially burned by a ground fire. The 1st stage compressor blades were all in place in the disk, were full length, and were straight. The 4th stage turbine blades were all in place in the disk and were full length. The tips of the 4th stage turbine blades were bent slightly opposite the direction of rotation.

The No. 3 engine was intact from the air inlet duct to the exhaust case. The reduction gearbox and propeller were separated from the front of the engine. The engine was rolled over to the left about 65 degrees. The engine was identified by the data plate on the front of the engine. The engine's cases did not have any indications of an uncontainment, case rupture, or in flight fire, although the engine was partially burned from a ground fire. The exterior of the compressor case was sooted. The 1st stage compressor blades were all in place in the disk, but the tips were bent opposite the direction of rotation. Some of 1st stage compressor

blades had impact damage to the leading edges. The top of the combustor case had a circumferential split about 12-inches long, about 9-inches aft of the forward flange where the case was pushed inward. The exterior of the combustor case did not have any indication of thermal distress and the edges of the split were not petaled outward. The 4th stage turbine blades were all in place in the disk, but all of the blades were fractured transversely across the airfoil in the midspan area. The fractured ends of the blades were bent slightly opposite the direction of rotation. The accessory drive gearbox was broken open exposing the internal gears. The gear teeth of the exposed gears did not have any rotational damage.

The No. 4 engine was broken up into several pieces, but the complete engine from the air inlet housing to the exhaust duct was accounted for. The compressor and diffuser were separated from the combustor and turbine at the diffuser-to-combustion chamber case flange. The engine was identified from the maintenance records by the process of elimination after the other three engines were identified. The compressor case halves were separated along the flange split lines. The separation of the case halves was wider at the forward end than at the rear. The compressor case halves did not have any indications of an uncontainment. The compressor rotor and stators were missing from the compressor case. The compressor rotor was intact. Except for two rows of blades that were bent opposite the direction of rotation down flush to the surface of the rotor, all of the other blades in the rotor were either missing from the blade slots or were fractured transversely across the airfoil adjacent to the blade root platform. The diffuser case with the fuel nozzles remained attached to the compressor case halves. The diffuser case did not have any indications of thermal distress or a case rupture. The six fuel nozzles were in place in the diffuser case. There was no indication of burning or thermal distress on the faces of the fuel nozzles. The combustor case had an 8-inch long circumferential split at about 12 o'clock where the case was pushed inward. The combustor case did not have any thermal distress and the edges of the split were not petaled outward. The six combustion chambers were in place in the combustion chamber, but the chambers at the top of the case were distorted where the case was pushed inward. Two of the combustion chambers on the left side of the case had some metal spray material on the dome. The parts of the combustion chambers that were visible did not have any thermal distress, although they were sooted. The turbine and exhaust cases were intact. The 4th stage turbine blades were all in place in the disk and were full length. The tips of the 4th stage turbine blades were bent opposite the direction of rotation.

All four of the propeller hubs had separated from their respective engines, but were located at the crash site. Two of the hubs still had parts of the blades in place. There were numerous broken propeller blade pieces that ranged in size from small pieces of the tip to almost full length blades scattered about the first half of the debris field. The fracture surfaces on the broken pieces all had a grainy, rough texture, and were at an angle to the finished surface.

All of the reduction gearbox main drive gears were found at the crash site. One was located in the center of the debris field short of the remains of the right wing, two were located in the right side of the debris field in the area where three of the engines were recovered, and one was on the right side at the very end of the debris field. All of the reduction gearbox main drive

gears were intact and did not have any damage to the gear teeth. One of the main drive gears had the rim bent. Some of the roller bearing rollers at the inner diameter of each main drive gear were missing and the cages' pocket retainers were broken. Those rollers that remained in each bearing did not have any rotational damage.

Three of the four propeller pitch control mechanisms were located in the wreckage. The dome assembly of the fourth propeller pitch control mechanism was located, but it had separated from the propeller hub and the rotating and stationary cams were not located. The rotating and stationary cams were visible on two of the three pitch control mechanisms and both were in the flight range.

The tailpipes were separated from their respective engines. The tailpipes did not have any indications of thermal distress. The tailpipes did not have any impact marks or dents on the gaspath surfaces of the pipe.

The cockpit engine instruments were found in the debris and the shaft horsepower, turbine inlet temperature, and fuel flow indications were read out. (The shaft horsepower, turbine inlet temperature, and fuel flow indicators all receive alternating current electrical signal for the indication.) The shaft horsepower indications were: #1 - 2,200 shp, #2 - broken, #3 - 2,200 shp, #4 - 2,200 shp. The turbine inlet temperature indications were: #1 - 650 degrees C, #2 - 750 degrees C, #3 - 750 degrees C, #4 - 870 degrees C. The fuel flow indications were: #1 - 750 pounds per hour (pph), #2 - 1,200 pph, #3 - 1,050 pph, #4 - 850 pph. The RPM indication was zero on all four engines. (The RPM indicator receives a direct current electrical signal for the indication.)

MEDICAL AND PATHOLOGICAL INFORMATION

Autopsies of the three pilots were conducted by the Forensic Medical Group, Inc., of Fairfield, California. Toxicology tests were performed by the FAA Civil Aeronautical Institute (CAMI) on specimens obtained during the autopsies. According to CAMI, the specimens showed no indication of drugs of abuse or alcohol. For the copilot, blood and urine specimens tested positive for ibuprofen. The levels of ibuprofen were not quantified. According to a representative of CAMI, the levels would have been quantified if a substantial amount were present. For the Chief Pilot, blood and urine specimens tested positive for quinine and atenolol (neither of which was quantified). Quinine is found in tonic water and is not quantified in CAMI results unless a substantial quantity is present. Atenolol is a medication used to treat hypertension. The Chief Pilot had reported using this medication to the FAA on his most recent application for a medical certificate in January 2005, and also on his medical certificate applications in 2004 and 2001-1985. According to FAA medical records, he had a history of hypertension that was "under good control."

TESTS AND RESEARCH

At the request of the NTSB, the U.S. Navy performed a radar data analysis. The analysis

indicated that during the final two minutes of the flight, the airplane's estimated calibrated airspeed assuming standard-day conditions averaged about 150 knots. Additionally, the U.S. Navy conducted a performance assessment. The assessment was based on the following assumptions: flaps at TAKEOFF/APPROACH, engine power 2,200 shp, gross weight 94,379 pounds, reference airspeed 120 knots, pressure altitude 2,300 feet and temperature 19 degrees C. The assessment predicted the stall speed to be 97 knots for straight and level flight and 120 knots at a load factor of 1.55g. (For level flight, a 1.55g load factor equates to a 50 degree bank.) The assessment also determined that the airplane's rate of climb potential was in excess of 1,100 feet/minute with four engines operating at 2,200 shp and in excess of 2,100 feet/minute with four engines operating at 3,900 shp (military power).

The NTSB investigator-in-charge (IIC) plotted the final minute of radar data on a topographical map. The plot showed that during the last minute of the flight, the airplane was flying up a valley that was oriented northeast-southwest with uphill being to the northeast. The airplane's flight path was initially near the middle of the valley. About 18:50:19, the flight path began to deviate towards the rising terrain on the eastern side of the valley. The IIC estimated the airplane's height above ground level (AGL) at each data point as follows:

Time	Mode C Altitude	Estimated Elevation	Estimated Height AGL
18:49:55	2,700 feet	1,525 feet	1,175 feet
18:50:07	2,500 feet	1,850 feet	650 feet
18:50:19	2,500 feet	1,650 feet	850 feet
18:50:31	2,700 feet	2,100 feet	600 feet
18:50:43	2,600 feet	2,600 feet	0 feet
18:50:55	2,900 feet	2,850 feet	50 feet

COMPANY INFORMATION

Aero Union Corporation is a commercial agricultural aircraft operator. The company was incorporated in 1961 and its corporate offices are located in Chico, California. Aero Union Corporation received its FAR Part 137 Operating Certificate (AUCD270C) in 1966. The company is contracted by the USFS for air tanker services. Aero Union airplanes operate out of USFS tanker bases, which cover most states in the western United States, from Arizona to Montana, with frequent dispatches to fires in the Midwest and the east coast. About the time of the accident, the company had 183 employees, including 19 pilots. The company operated eight Lockheed P-3s, three DC-4s, and three P-2V-SP2Hs.

Aero Union Corporation's Air Operations Division is overseen by the President, who oversees the Director of Maintenance and the Director of Flight Operations. The Director of Flight Operations is directly responsible for the supervision of the Chief Pilot and the Office Assistant. The Chief Pilot is directly responsible for supervision of the flight crews.

The Maintenance Department is responsible for keeping the fleet of air tankers fully operational. Aero Union has approximately 70 maintenance personnel in its Air Tanker

Operations. All the maintenance on the airplanes is accomplished by Aero Union maintenance personnel. Aero Union has its own component shops (i.e. landing gear, hydraulics, flight control accessories, engine, propeller, avionics, and structures/sheet metal) that support the maintenance of its fleet.

ADDITIONAL INFORMATION

Aero Union Corporation Recurrent Training

In an interview conducted by Safety Board investigators, Aero Union's Director of Flight Operations stated that Aero Union Corporation provided training for its pilots each year prior to the fire season. According to company records, the training consisted of ground school and flight training. The 2005 season in-house training began on Wednesday, April 13, 2005, and was scheduled to conclude Friday, April 22, 2005. Each flight crew was assigned to a specific airplane for the season. Since they would be flying together for the season, each flight crew accomplished training and took check rides as a pair, if possible. There were 6 full time pilots and 2 relief copilots in the group. Two other groups had already been trained earlier in the year.

The training started with three to four days of ground school. The ground school portion of the training included a review of Federal Aviation Regulations, Crew Resource Management (CRM), human factors, airplane systems, and normal and emergency procedures.

The Chief Pilot provided all of the flight training for this group of pilots. Flight training started with a familiarization flight which included Visual Flight Rules (VFR) air-work, steep turns, and a series of stalls. Next they made an Instrument Flight Rules (IFR) cross-country flight, followed by training on emergency procedures. During training, the Chief Pilot would pull a power lever or two power levers back to simulate feather (zero thrust). He would often do this right after they made a drop or right before. The proper response was to get rid of the load, apply maximum power, and start climbing away.

In an interview conducted by Safety Board investigators, the captain of flights 5, 6, 8 and 9 on the day of the accident described a typical training flight. They depart Chico Municipal Airport and proceed to the usual practice area around Promontory Point, about three miles west of the accident site. They use this practice area because there are a lot of different types of terrain in the area. It is important that they practice how to exit drop areas and in the practice area they can work lots of different kinds of problems.

Once a drop site is selected, they orbit over the site. The first priority is to learn how to safely depart the site after a drop is made. After they have figured out an escape path, then they figure out how to get in to make the drop. They use an airspeed of 170 knots while orbiting.

After orbiting, they descend and do a high and low reconnaissance of the drop site, looking for wires, people, and verifying the entry and exit selected. Then they set up for the drop.

Depending on terrain and conditions, they pull up to 1,000 feet AGL and set up a pattern like a landing traffic pattern, with a downwind leg, base leg, and a final approach segment. Sometimes terrain dictates modification of the standard pattern. Fighting fires is accomplished strictly by visual reference.

According to the captain, the downwind leg is flown at 150 knots, 140 knots on base and 135 to 140 knots on final approach. The maximum speed on final approach is 150 knots, which is the door-opening limit speed. If this speed is exceeded, a go-around is required. All runs are set up to escape downhill. On final approach a descent is made to 150 feet AGL. Flaps are extended to landing position (full down) for the drop. Just prior to or immediately after passing the target, he calls for climb power and flaps to TAKEOFF/APPROACH setting. He is looking for a positive rate of climb and any maneuvering completed before the flaps are raised further. Once the flaps are retracted and the airplane is climbing, he calls for the AFTER DROP checklist.

During drops, they fly at an altitude of 150 to 200 feet AGL. He knows when he is at 150 feet AGL because they practice making passes over the runway during the early part of training at that altitude to get the sight picture. This helps to "calibrate the eye." He is comfortable that he knows when he is at 150 feet; he gets uncomfortable fast if the airspeed gets below 150 knots. He stated that the key thing is terrain clearance but airspeed management is critical; nothing less than 135 knots.

Administrative Information

The wreckage was released to a representative of the owner on August 24, 2005.

Pilot Information

Certificate:	Airline transport; Flight engineer	Age:	47,Male
Airplane Rating(s):	Single-engine land; Multi-engine land	Seat Occupied:	Left
Other Aircraft Rating(s):	None	Restraint Used:	
Instrument Rating(s):	Airplane	Second Pilot Present:	Yes
Instructor Rating(s):	None	Toxicology Performed:	Yes
Medical Certification:	Class 1 With waivers/limitations	Last FAA Medical Exam:	April 1, 2005
Occupational Pilot:	Yes	Last Flight Review or Equivalent:	May 1, 2004
Flight Time:	4937 hours (Total, all aircraft), 2915 hours (Total, this make and model), 12 hours (Last 90 days, all aircraft), 12 hours (Last 30 days, all aircraft), 3 hours (Last 24 hours, all aircraft)		

Co-pilot Information

Certificate:	Commercial; Flight instructor	Age:	52, Male
Airplane Rating(s):	Single-engine land; Multi-engine land	Seat Occupied:	Left
Other Aircraft Rating(s):	None	Restraint Used:	
Instrument Rating(s):	Airplane	Second Pilot Present:	Yes
Instructor Rating(s):	Airplane multi-engine; Airplane single-engine	Toxicology Performed:	Yes
Medical Certification:	Class 2 Without waivers/limitations	Last FAA Medical Exam:	April 1, 2005
Occupational Pilot:	Yes	Last Flight Review or Equivalent:	January 1, 2005
Flight Time:	4317 hours (Total, all aircraft), 192 hours (Total, this make and model), 3237 hours (Pilot In Command, all aircraft), 27 hours (Last 90 days, all aircraft), 7 hours (Last 30 days, all aircraft)		

Flight instructor Information

Certificate:	Airline transport; Flight instructor	Age:	41, Male
Airplane Rating(s):	Single-engine land; Multi-engine land	Seat Occupied:	Center
Other Aircraft Rating(s):	None	Restraint Used:	
Instrument Rating(s):	Airplane	Second Pilot Present:	Yes
Instructor Rating(s):	Airplane multi-engine; Airplane single-engine; Instrument airplane	Toxicology Performed:	Yes
Medical Certification:	Class 2 Without waivers/limitations	Last FAA Medical Exam:	January 1, 2005
Occupational Pilot:	Yes	Last Flight Review or Equivalent:	November 1, 2002
Flight Time:	6527 hours (Total, all aircraft), 902 hours (Total, this make and model), 5328 hours (Pilot In Command, all aircraft), 88 hours (Last 90 days, all aircraft), 34 hours (Last 30 days, all aircraft), 6 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	Lockheed	Registration:	N926AU
Model/Series:	P-3B	Aircraft Category:	Airplane
Year of Manufacture:		Amateur Built:	
Airworthiness Certificate:	Restricted (Special)	Serial Number:	152731
Landing Gear Type:	Retractable - Tricycle	Seats:	5
Date/Type of Last Inspection:	April 1, 2005 AAIP	Certified Max Gross Wt.:	105000 lbs
Time Since Last Inspection:	31 Hrs	Engines:	4 Turbo prop
Airframe Total Time:	15614 Hrs at time of accident	Engine Manufacturer:	Rolls-Royce
ELT:	Installed, not activated	Engine Model/Series:	T56-A10W
Registered Owner:	Aero Union Corporation	Rated Power:	4591 Horsepower
Operator:		Operating Certificate(s) Held:	
Operator Does Business As:		Operator Designator Code:	AUCG

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	Condition of Light:	Day
Observation Facility, Elevation:	RBL,349 ft msl	Distance from Accident Site:	25 Nautical Miles
Observation Time:	18:54 Local	Direction from Accident Site:	315°
Lowest Cloud Condition:		Visibility	10 miles
Lowest Ceiling:	Broken / 11000 ft AGL	Visibility (RVR):	
Wind Speed/Gusts:	4 knots / None	Turbulence Type Forecast/Actual:	/
Wind Direction:	170°	Turbulence Severity Forecast/Actual:	/
Altimeter Setting:	30.03 inches Hg	Temperature/Dew Point:	19°C / 7°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Chico, CA (CIC)	Type of Flight Plan Filed:	Company VFR
Destination:	(CIC)	Type of Clearance:	None
Departure Time:	18:38 Local	Type of Airspace:	

Airport Information

Airport:	Chico Municipal CIC	Runway Surface Type:	
Airport Elevation:	238 ft msl	Runway Surface Condition:	
Runway Used:		IFR Approach:	None
Runway Length/Width:		VFR Approach/Landing:	None

Wreckage and Impact Information

Crew Injuries:	3 Fatal	Aircraft Damage:	Destroyed
Passenger Injuries:		Aircraft Fire:	On-ground
Ground Injuries:	N/A	Aircraft Explosion:	None
Total Injuries:	3 Fatal	Latitude, Longitude:	39.98722,-121.786666

Administrative Information

Investigator In Charge (IIC):	Struhsaker, Georgia
Additional Participating Persons:	Tony James; FAA Office AAI-100; Washington, DC Mike Thomas; Aero Union Corporation; Chico, CA Robert E Ketchum; Rolls-Royce Corporation; Indianapolis, IN Ted W Hobart; Lockheed Martin; Marietta, GA Gil Elmey; USFS; Ogden, UT
Original Publish Date:	August 29, 2006
Last Revision Date:	
Investigation Class:	Class
Note:	The NTSB traveled to the scene of this accident.
Investigation Docket:	https://data.nts.gov/Docket?ProjectID=61344

The National Transportation Safety Board (NTSB) is an independent federal agency charged by Congress with investigating every civil aviation accident in the United States and significant events in other modes of transportation—railroad, transit, highway, marine, pipeline, and commercial space. We determine the probable causes of the accidents and events we investigate, and issue safety recommendations aimed at preventing future occurrences. In addition, we conduct transportation safety research studies and offer information and other assistance to family members and survivors for each accident or event we investigate. We also serve as the appellate authority for enforcement actions involving aviation and mariner certificates issued by the Federal Aviation Administration (FAA) and US Coast Guard, and we adjudicate appeals of civil penalty actions taken by the FAA.

The NTSB does not assign fault or blame for an accident or incident; rather, as specified by NTSB regulation, “accident/incident investigations are fact-finding proceedings with no formal issues and no adverse parties ... and are not conducted for the purpose of determining the rights or liabilities of any person” (Title 49 *Code of Federal Regulations* section 831.4). Assignment of fault or legal liability is not relevant to the NTSB’s statutory mission to improve transportation safety by investigating accidents and incidents and issuing safety recommendations. In addition, statutory language prohibits the admission into evidence or use of any part of an NTSB report related to an accident in a civil action for damages resulting from a matter mentioned in the report (Title 49 *United States Code* section 1154(b)). A factual report that may be admissible under 49 *United States Code* section 1154(b) is available [here](#).