SA-311

File No. 1-0130

CIVIL AERONAUTICS BOARD

ACCIDENT INVESTIGATION REPORT

Adopted: March 19, 1957

Released: March 22, 1957

UNITED AIR LINES, INC., DOUGLAS C-54B-DC, N 30062
MEDICINE BOW PEAK, WYOMING, OCTOBER 6, 1955

The Accident

United Air Lines' Flight 409, a Douglas C-54B-DC, N 30062, struck Medicine Bow Peak, Wyoming, near its top at approximately 0726,[1] October 6, 1955. All of the occupants were killed and the aircraft was demolished.

History of the Flight

Flight 409 originated at New York, New York, on October 5, 1955, destination San Francisco, California, with intermediate stops including Chicago, Illinois; Denver, Colorado; and Salt Lake City, Utah. The trip to Denver was routine except for traffic delays, caused principally by weather, and the flight arrived there at 0551, October 6, one hour and 11 minutes late. Routine crew changes were made at Chicago and Denver, the last crew consisting of Captain Clinton C. Cooke, Jr., First Officer Ralph D. Salisbury, Jr., and Stewardess Patricia D. Shuttleworth. No discrepancies were reported by the former crew and none were found at Denver. While at Denver the aircraft was refueled to a total of 1,000 gallons of gasoline.

Prior to departure Captain Cooke was briefed by the company's dispatcher on the en route weather, based on both U. S. Weather Bureau sequence reports and forecasts and the company meteorologist's forecasts and analysis. Following this briefing the flight was dispatched to Salt Lake City via airways V-4, V-118, V-6, and V-32, to cruise at 10,000 feet, and to fly in accordance with Visual Flight Rules (VFR). The estimated time en route was two hours and 33 minutes. The only obligatory reporting point along the route was Rock Springs, Wyoming.

The flight departed Denver at 0633, with 63 passengers, including two infants. At takeoff, the gross weight of the aircraft was 64,147 pounds, 653 pounds under the allowable weight of 64,800 pounds; an error of 100 pounds in excess of the allowable rear baggage compartment weight[2] was made in loading. Flight 409 reported its time off to the company and this was the last known radio contact with the flight.

1/ All times herein are mountain standard and based on the 24-hour clock; all altitudes are mean sea level; and all miles are nautical.

2/ This minor error, affecting the center of gravity of the aircraft, had no bearing on the accident.

When the flight failed to report at Rock Springs at 0811, its estimated reporting time, repeated efforts were made to establish radio contact with it. These were unsuccessful and the company then declared an emergency. A widespread search was immediately coordinated by Air Search and Rescue, which included the Wyoming Air National Guard, the Civil Air Patrol, and United Air Lines. At approximately 1140 the same day the wreckage was sighted near Medicine Bow Peak, 33 miles west of Laramie, Wyoming. The Laramie weather at 0728 was: Scattered clouds, 5,500 feet; visibility 40 miles; wind west-northwest 13 knots; snow showers of unknown intensity over the mountains.

Investigation

The aircraft struck the almost vertical rock cliff of the east slope of Medicine Bow Peak (elevation 12,005 feet) located in the Medicine Bow Mountains. The crash occurred at an elevation of 11,570 feet, 60 feet below the top of that portion of the mountain directly above it. Two large smudge marks were apparent on the face of the mountain. In these marks were four scars, evenly spaced and in a horizontal line, the result of the engines and propellers of the aircraft striking the cliff.

At impact the aircraft disintegrated and the wreckage was strewn over a wide area. Some parts were thrown to the mountain top above the crash site, others rested on ledges at various levels, and the remainder fell to the slope below.

In order to be closer to the scene so that the recovery operation and investigation could be conducted expeditiously, a base camp was established on the mountainside at an elevation of 10,400 feet. Above the camp, travel was extremely difficult up a talus slope to the base of the cliff. From there it was necessary to scale the almost vertical cliff a distance of 600 feet to reach the point of impact. Because of the rugged terrain, groups of experienced mountain climbers were formed in an effort to reach locations otherwise inaccessible. Removal of the bodies of the victims took several days because of the rugged terrain and snow conditions. While this was being accomplished investigation was considerably hampered by falling rocks dislodged by the climbers.

As the investigation continued the Board decided that working conditions were too dangerous for other than the experienced mountain climbers and, therefore, investigators who had at this time reached an elevation of 11,275 feet were not allowed to proceed further. At this elevation several large sections of the aircraft were found, including the empennage which had been broken from the fuselage just in front of the vertical fin.

Sufficient portions of the aircraft were identified to indicate that it was intact at the time of impact. This was substantiated by the fact that no portion of wreckage was found during an extensive air and ground search of the determined flight path. The empennage and portions of the fuselage and wings were studied. The entire empennage section was severed aft of the passenger cabin near station 929. This section was generally intact and was wedged in an opening in the cliff. The left stabilizer and elevator were severely damaged but the right stabilizer and elevator received only minor damage. The fuselage

forward of the empennage, including the cockpit, disintegrated at the time of impact. Only twisted and distorted portions of each were located. Examination of the control cables indicated tension type failures. The left windshield, with windshield wiper attached, was found, its frame twisted, and the glass shattered.

No evidence was found in the examination of the recovered parts of the aircraft or its components to indicate that fire or structural failure had occurred prior to impact.

The four engines were located and examined. They were badly damaged but no evidence was found to indicate they were not functioning in a normal manner prior to impact.

All 12 propeller blades were accounted for; these were badly twisted and bent. Examination of the propeller blades and propeller hubs indicated that all four propellers were rotating at the time of impact.

Both large CO_2 bottles and one hand bottle were found. These were empty and their valves had been broken at impact.

Oxygen bottles were also recovered with valves attached. Laboratory tests showed that these bottles did not contain oxygen when examined and that there was no toxic contamination. A pilot's smoke mask was recovered but it was impossible to determine if it had been worn during the subject flight. The pilots' oxygen masks were not recovered.

Two cabin heaters were found. These were so damaged that an operational test could not be made. However, teardown inspection revealed nothing to indicate malfunctioning prior to impact.

Three watches and an aircraft clock were found and examination showed that the average time of their stoppage was 0726.

The radio and navigational equipment on board the aircraft was damaged in a manner which did not permit reliable readings to be made. All ground navigational facilities that could have been involved were checked as soon as possible after the accident and were found to be operating within tolerances.

A study of the maintenance records showed that this aircraft had been properly maintained in accordance with company procedures and Civil Air Regulations.

On October 6, 1955, at the time of the subject flight, a large high-pressure area was centered over Idaho. This high-pressure area was preceded by a cold front which, at the time of the accident, was located 500 to 600 miles to the southeast. This resulted in the weather being generally fair with some scattered clouds over the lower terrain of the planned route Denver to Salt Lake City. However, off the airway broken to overcast cloud conditions, accompanied by light snow showers, were present over the high mountain peaks and ridges. From the available information it is concluded that the free air wind

at the 12,000-foot level in the Laramie, Wyoming, - Medicine Bow Mountain range was from 330 degrees at 30 to 40 knots. The velocity of the wind in the immediate vicinity of Medicine Bow Peak can only be estimated; however, it is believed that because of added terrain effect it could have been increased to 50 to 60 knots. This would have resulted in downdrafts and turbulence being present near the lee slope and probably for a distance of 10 to 15 miles away from the mountain on that side.

Considerable thought and study were given to the possible existence of a mountain wave[3/] condition in that area. Some of the factors associated with the formation of a mountain wave were present; however, a number of the factors considered vitally important were not present and it is doubtful if such a wave did exist at the time of the accident.

A pilot flying a small aircraft on October 6 from Cheyenne, Wyoming, to Reno, Nevada, passed Medicine Bow Peak approximately 22 miles to the east and north within a few minutes of the time the accident occurred. He described the weather conditions as follows: ". . . the haze was thick especially to the north. However, the visibility toward the mountains was very good. The tops of the mountains were hidden by white cumulus clouds which I estimated the 'tops' to be about 13,000 feet. I was especially interested in the tops at the time as I had considered, before leaving Cheyenne, using the Victor 4[4/] airway but was warned by the lady in the Weather Bureau that I could expect heavy turbulence and strong downdrafts over the mountain."

During the investigation a number of persons believed to have seen the aircraft prior to its striking the cliff were interviewed. None of these witnesses could positively identify the aircraft they saw as a United Air Lines C-54; however, they said the airplane was large and had four engines. All of the witnesses who were in the general vicinity of Medicine Bow Peak agreed that this airplane was silver in color and was flying in a northwesterly direction toward the peak. Three witnesses, who were at a logging camp located about 10 air miles southeast from the crash site, said that the airplane did not appear to be turning but that its right wing was slightly down. They estimated its altitude to be about 10,000 feet by the known elevation of the camp (9,600 feet), the approximate height of the nearby trees (60-75 feet), and the fact

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3/ Under certain atmospheric conditions, a strong windflow perpendicular to a mountain ridge will produce a wave-type structure on the lee side similar to the waves produced downstream from fast-flowing water over a submerged rock. These waves develop on a tremendous scale, often two or more times the height of the mountain barrier which produced them. Violent downdrafts, updrafts, and turbulence occur in the wave when it is well developed. When moisture content of the air involved is favorable, characteristic cloud patterns develop in the wave.

4/ Victor 4 Airway lies just north of Medicine Bow Peak and extends between Laramie radio and Cherokee radio on a magnetic bearing of 273 degrees.

that the aircraft did not appear to be more than 500 to 600 feet above the ground. These witnesses saw the airplane (for only a short time) several hundred yards away and through a clearing in the trees. The aircraft was then flying immediately below the clouds and intermittently flew either into or behind clouds, momentarily obstructing their view of it. One of these witnesses said he believed one propeller was not rotating; others said they believed all of the engines were operating in a normal manner. One witness testified that a few minutes after the airplane passed from his view he heard a noise in the distance which sounded like a cannon firing or a mining blast. He did not at that time associate the noise heard with the airplane he had seen. In the vicinity of the camp at the time were low rolling clouds and the visibility was somewhat hazy owing to dusting snow; the sun could not be seen. Medicine Bow Peak could not be seen from the camp because of terrain obstructions. A check was made of all available sources, both civil and military, to determine if another airplane of that size could have been flying in that vicinity at that approximate time; none was found.

As a result of information obtained from the witnesses, a probable flight path was constructed. (See Attachment A.) This flight path, projected from the accident site on a magnetic heading of 120 degrees, covered a distance of approximately 23 miles. An extension of this flight path to the southeast crosses the planned route in the vicinity of Ft. Collins, Colorado, and to the northwest again crosses it near Rawlins, Wyoming.

Medicine Bow Peak is located about 124 miles north-northwest of Stapleton Field, Denver, and is 33 miles west of Laramie. A few miles south of the peak the mountains can be crossed at an altitude of 10,000 feet and once beyond them the North Platte River valley can be followed to the vicinity of Rawlins (Sinclair radio.)

As previously stated, the company Flight Plan and Dispatch Release for the subject flight specified a course to be flown VFR over airways V-4 Denver to Laramie, V-118 to Rock River radio, V-6 to Fort Bridger, Wyoming, and V-32 to Salt Lake City; weather analysis, weather forecasts, and sequence reports were attached. This document was signed by both the dispatcher on duty and Captain Cooke. The "Weather Analysis" portion of the release was signed by Captain Cooke as having been prepared by him. Under the subsection entitled "Mass Weather" was the following: "High-pressure area, Great Basin moving slowly eastward, scattered, occasionally broken and cumulus clouds along the east slope of the Rockies based above flight level. Air slightly rough."

A review of all documents pertaining to the dispatch and release of the aircraft at Denver, together with the testimony of company personnel, indicates that other than the error in loading the rear baggage compartment the dispatch was made in accordance with United Air Lines' established procedure. Company officials testified that under VFR conditions any deviation from the prescribed route, either in altitude or direction, is the captain's responsibility but must be coordinated between the captain and dispatcher. Captain Cooke did not advise the dispatcher of any intended deviation from the flight plan.

The Company Flight Operations Manual re - Maximum Flight Levels - Unpressurized Cabins - states: "Flight will normally be conducted at levels not to exceed 12,000 feet above sea level . . . ." Another company rule is: "In VFR conditions, flights will check and follow the radio navigational courses which define the airway . . . ." These and other company rules governing VFR-IFR flight represent a company policy which is patterned for the safety and comfort of its passengers.

Captain Cooke was qualified to fly the route involved in August 1951 and had flown it 45 times in the year preceding the accident. According to his superiors in the company he had never been known to deviate from a planned route without advising the dispatcher.

In accordance with the Board's policy of keeping accident investigations open for consideration of new evidence, and since incapacitation of the crew was a possibility that could neither be supported nor negated by existing evidence, it was decided to return to the accident scene to continue the investigation. This could not be done for an appreciable time because of deep snow on the mountain. However, prior to the decision to continue the investigation, the wreckage had been released to the carrier and, because it was believed to be a hazard to the public welfare, an attempt was made to destroy and bury it - this was done by U. S. military ground and air forces.

On August 27, 1956, a second investigation was begun. This working group, headed by Board personnel, included employees of United Air Lines and company pilots representing the Air Line Pilots Association. The investigation on the mountain took three days, and many aircraft parts which had previously been examined were reexamined. Numerous components of the cockpit, together with the fuselage nose section, were found at an elevation of 11,390 feet on a rocky ledge. This wreckage was badly damaged by impact, and the ensuing fire. Beneath a portion of the wreckage the cockpit combustion heater was found. It was mashed flat and was bent 90 degrees near its middle. The igniter plug, with its lead torn away, remained in place. All fuel and air controls were missing. The heater was brought back to Washington, D. C., subsequent to the investigation and was delivered to the National Bureau of Standards for further examination. It was their determination that all failures were apparently caused by mechanical damage. It is possible that the mechanical damage referred to could have occurred at the time of impact.

The No. 3 propeller hub found on the talus slope was further examined. Its dome shell was broken off and the piston was broken. The distributor valve was mashed in the end of the propeller shaft. All but three of the barrel bolts were broken and the barrel halves had separated approximately one inch. The barrel bolts were removed and the barrel halves separated in order to examine the dome position. The stop rings were in place and had been in position for a blade range of 24 degrees low pitch and 93 degrees full feathering. The dome piston position indicated a blade angle of approximately 31 degrees.

Because of the extensive impact damage to the propeller it was impossible to remove the rear barrel half from the propeller shaft. Parts of two spider

shim plates and two brass shims were recovered. By matching the pieces of the shim plates, an impact mark was determined which indicated an approximate blade angle of 38 degrees. Impact marks on the brass shims indicated approximate blade angles of 35 degrees.

A propeller governor was also located on the talus slope. It was determined from the model and serial numbers of this governor that it had been installed on the No. 4 engine. The drive shaft coupling was missing and the drive shaft housing was pushed inward at impact. The control pulley was broken from the head; the control shaft was intact. The control head was removed and installed on a serviceable governor. This assembly was then placed on a governor test stand in order to check the r. p. m. setting of the control head. This test revealed that the control head was positioned for 2,080 engine r. p. m. which is within the normal cruising range for the subject aircraft and engine. Disassembly of the control head revealed a slight binding of the shaft due to impact. The counterbalance spring was intact with normal tension. Examination of the pilot valve and flyweight assemblies revealed no indications of operational distress. All this additional evidence concerning the propellers and their related systems substantiates the fact that all propellers were rotating at the time of impact.

Analysis

Hazardous working conditions throughout the investigation of this accident made it difficult to examine adequately pertinent components of the aircraft; however, there are many known factors and the careful consideration of these is presented.

It is obvious from the established flight path that the aircraft deviated from the planned route a number of miles to the west of course. Although witnesses close to the scene of the accident were unable to positively identify the aircraft they saw, in the light of known facts it is reasonable to assume that the aircraft seen was the United C-54. Therefore, it can be concluded that considering the weather conditions and mountainous terrain the aircraft was flying at a dangerously low altitude at that time.

A UAL captain testified that it was normal procedure for UAL pilots, during a climbout from Denver under VFR conditions, to fly several miles east of the airway. He said this was done to avoid incoming low-flying aircraft which usually begin their letdown near Fort Collins, Colorado. This fact was considered in computing probable flight data for Flight 409, from which it was determined that the flight reached its cruising altitude of 10,000 feet approximately 25 miles north of Denver. From this point a heading of approximately 315 degrees magnetic would have been required to fly to Laramie. From this same location a magnetic heading of 300 degrees would have been necessary to fly directly toward Medicine Bow Peak.

An extension in both directions of the known flight path indicates that either a shortcut was being attempted when the accident occurred or that the crew was incapacitated and the aircraft was flying without assistance.

In considering the first premise, it is difficult to understand how a pilot of Captain Cook's experience would deliberately attempt a shortcut, and even if he did why he would have flown at such a low altitude over hazardous terrain. It is true that the flight was an hour and 11 minutes late; however, the time saved by taking a shortcut would have been inconsequential. Prior to departing Denver the crew had full knowledge, through weather reports, that scud and turbulence were present in the mountainous areas and that snow squalls were expected to occur. Knowing this, and the fact that the weather along the planned route was good, makes a shortcut even more incomprehensible; also, Captain Cooke was fully aware of the hazards accompanying mountain flying. There is also the fact that the visibility was 40 miles that morning and it is evident that the clouds covering the mountains could have been seen from a considerable distance. To cross the mountains over Medicine Bow Peak safely, an altitude of approximately 14,000 feet would be necessary. Such an altitude and its attendant passenger discomfort in a nonpressurized aircraft would normally be avoided. Finally, to deviate from course in this manner the captain would have been breaking rigid company rules and his record indicated that he had never been known to do so.

Considering the navigation equipment on board the aircraft, the fact that all pertinent ground facilities were functioning in a normal manner, the pilot's knowledge of the terrain, and the good visibility prevailing that day, it does not seem possible that a navigational error of any magnitude could have been made.

The matter of crew incapacitation cannot be completely ruled out. The cockpit heater, when examined, did not indicate any burnouts prior to impact which could cause poisonous gases to enter the cockpit; however, the exhaust manifold was badly damaged and some of it was not recovered. Should this portion of the heater have been defective, dangerous gases could have entered the nosewheel well and could have been transported from there to the cockpit by means of the ground blower. However, the ground blower is normally turned off before the aircraft becomes airborne and is never turned on in the air unless there is a blockage of the nose ram airscoop. Although the incapacitation of persons in the cockpit in this manner appears unlikely it nevertheless cannot be completely discounted. Also, it is possible that the crew may have become incapacitated by some other means. One possible fact points strongly toward this not being true - when the aircraft was only four minutes from Medicine Bow Peak it was flying at an altitude of approximately 10,000 feet. Since the aircraft struck the mountain at an altitude of 11,570 feet it must have climbed about 1,500 feet in approximately four minutes, and it appears likely that some positive action on the part of the crew was necessary to accomplish the climb.

In consideration of the above facts, the Board is of the opinion that there is insufficient evidence to establish that the deviation from the planned route was due to incapacitation of the crew, errors in navigation, or malfunctioning of the aircraft or any of its components, but rather that the pilot deviated from the planned course for reasons unknown.

Findings

On the basis of all available evidence the Board finds that:

1. The carrier, the aircraft, and the crew were properly certificated.

2. The gross takeoff weight was within the allowable limits at the time of takeoff; improper distribution of the load was of such minor extent it was not a factor.

3. The flight plan was properly prepared by the crew.

4. The weather along the prescribed route was good and the aircraft could have been flown safely at an altitude of 10,000 feet.

5. The pilot deviated from the planned route.

6. The aircraft was observed flying in and out of clouds at an approximate altitude of 10,000 feet, 10 miles southeast of the accident scene and 21 miles west of the prescribed course.

7. The aircraft struck the mountain peak at an altitude of 11,570 feet.

8. Examination of the recovered sections of the aircraft failed to indicate any fire, structural failure, or malfunctioning of the aircraft or its components prior to impact.

Probable Cause

The Board determines that the probable cause of this accident was the action of the pilot in deviating from the planned route for reasons unknown.

BY THE CIVIL AERONAUTICS BOARD:

/s/ JAMES R. DURFEE

/s/ CHAN GURNEY

/s/ HARMAR D. DENNY

/s/ G. JOSEPH MINETTI

SUPPLEMENTAL DATA

Investigation and Hearing

The Civil Aeronautics Board was notified of this accident at 1000, October 6, 1955. An investigation was immediately initiated in accordance with the provisions of Section 702 (a) (2) of the Civil Aeronautics Act of 1938, as amended. A public hearing was ordered by the Board and was held in Denver, Colorado, on November 14 and 15, 1955. This hearing was reconvened January 9, 1957, in Washington, D. C.

Air Carrier

United Air Lines, Inc., is a scheduled air carrier incorporated in the State of Delaware with its principal offices in Chicago, Illinois. It operates under currently effective certificates of public convenience and necessity issued by the Civil Aeronautics Board and scheduled operating certificates issued by the Civil Aeronautics Administration. These certificates authorize the company to transport by air persons, property, and mail between various points in the United States, including the route New York, New York, to San Francisco, California.

Flight Personnel

Captain Clinton C. Cooke, Jr., age 35, held a currently effective airman certificate with airline transport rating and an appropriate rating for the subject aircraft. Captain Cooke was employed by United Air Lines on January 13, 1944. He had a total of 9,807 pilot hours, of which 2,289 hours were in the type equipment involved. His last physical examination was on June 22, 1955, and his last route check was on June 20, 1955.

First Officer Ralph D. Salisbury, Jr., age 33, held a currently effective airman certificate with commercial rating. He was employed by United Air Lines on May 21, 1952. He had a total of 2,418 pilot hours, of which 343 hours were in the type of equipment involved. His last physical examination was on August 23,1955, and his last route check was on November 12, 1953.

Stewardess Patricia D. Shuttleworth, age 21, was employed by the company in February 1955. She graduated from the Stewardess School in Cheyenne on March 7, 1955, and was assigned to Salt Lake City April 13, 1955. Her performance and evaluation records as a stewardess reflect excellent grades.

The Aircraft

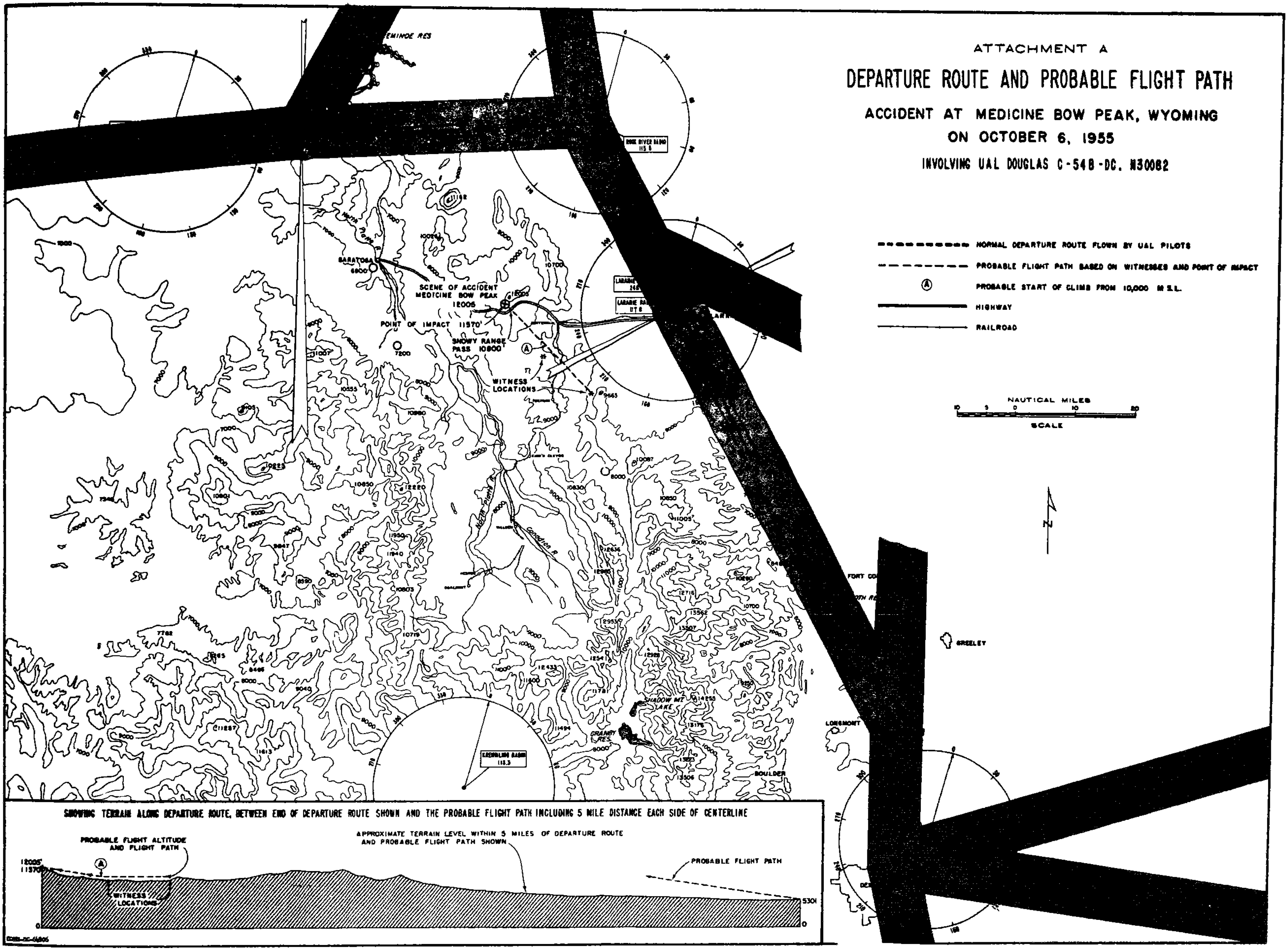
N 30062, a Douglas C-54B-DC, manufacturer's serial number 18389, was manufactured in 1943 and had a total time of 28,755 hours with 1,289 hours since the last overhaul. It was currently certificated by the Civil Aeronautics Administration. The aircraft was equipped with Pratt and Whitney model R2000-11 engines and Hamilton Standard model 23E50 propellers with model 6507 blades. Time since major overhaul on the four engines was within approved limits.

ATTACHMENT A

DEPARTURE ROUTE AND PROBABLE FLIGHT PATH

ACCIDENT AT MEDICINE BOW PEAK, WYOMING ON OCTOBER 6, 1955

INVOLVING UAL DOUGLAS C-54B-DC, N30062



NORMAL DEPARTURE ROUTE FLOWN BY UAL PILOTS
PROBABLE FLIGHT PATH BASED ON WITNESSES AND POINT OF IMPACT
(A) PROBABLE START OF CLIMB FROM 10,000 M.S.L.
HIGHWAY
RAILROAD
NAUTICAL MILES
SCALE
SARATOGA
SCENE OF ACCIDENT MEDICINE BOW PEAK 12005
POINT OF IMPACT 11570'
SNOWY RANGE PASS 10800'
WITNESS LOCATIONS
GRANBY RES.
SHADOW MT LAKE
GREELEY
LONGMONT
BOULDER
SHOWING TERRAIN ALONG DEPARTURE ROUTE, BETWEEN END OF DEPARTURE ROUTE SHOWN AND THE PROBABLE FLIGHT PATH INCLUDING 5 MILE DISTANCE EACH SIDE OF CENTERLINE
PROBABLE FLIGHT ALTITUDE AND FLIGHT PATH
APPROXIMATE TERRAIN LEVEL WITHIN 5 MILES OF DEPARTURE ROUTE AND PROBABLE FLIGHT PATH SHOWN
PROBABLE FLIGHT PATH
WITNESS LOCATIONS
5301