CIVIL AERONAUTICS BOARD
ACCIDENT INVESTIGATION REPORT

Adopted: October 9, 1953 Released: October 14, 1953

TRANSOCEAN AIR LINES, ALVARADO, CALIFORNIA, MARCH 20, 1953

The Accident

A Douglas DC-4 aircraft, N 88942, owned and operated by Transocean Air Lines, crashed in a field near Alvarado, California, at approximately 1838 1/, March 20, 1953. All of the 35 occupants including the crew of five were killed. The aircraft was demolished.

History of the Flight

Transocean Air Lines' Flight 942 of March 20, 1953, departed Roswell, New Mexico, at 1211 for Oakland, California. On board were 30 military passengers and a crew consisting of Captain H. E. Hum, First Officer F. W. Patchett, Chief Pilot H. W. Rodgers and Stewardesses V. Sandridge and L. Chapman. The flight was for the purpose of transporting military personnel in accordance with the company's contract with the United States Department of Defense. Prior to departure a DVFR (Defense Visual Flight Rules) flight plan was filed with ARTC (Air Route Traffic Control), indicating a flight to be flown at an altitude of at least 500 feet on top of clouds via Red Airway 88 to Albuquerque, New Mexico; Green Airway 4 to Palmdale, California; Blue Airway 14 and Amber Airway 1 to Bakersfield, California; Amber Airway 1 to Fresno, California; and Blue Airway 10 to Oakland, California. There was sufficient fuel on board for 10 hours and the flying time to Oakland was estimated to be six hours and 35 minutes. According to the company's records the gross weight of the aircraft at the time of takeoff was 63,817 pounds, which was within the allowable gross weight of 73,000 pounds; the load was properly distributed.

After departing Roswell the flight progressed in a routine manner and at 1451, when in the vicinity of Winslow, Arizona, the DVFR flight plan was changed to IFR (Instrument Flight Rules), still at least 500 feet on top of clouds.

At 1732 the flight reported that it was over Fresno, California, at 1730, that it was cruising at 8,000 feet (at least 500 feet on top of clouds), estimating Los Banos, California, at 1740 and requested further clearance. At 1744 Flight 942 called the Fresno radio communications station and asked that the requested clearance be expedited, stating that it was now at 7,000 feet, at least 500 feet on top. At 1747, the following clearance was issued the flight: "ARTC clears Transocean 942 to the Newark radio beacon, maintain 8,000, contact Oakland Approach Control after passing Evergreen, no delay expected, report reaching 8,000." Approaching Evergreen at 1809, the flight was

1/ All times referred to herein are based on the 24-hour clock and are Mountain Standard until the aircraft reached Fresno, California, and from this point on the times are Pacific Standard.

advised to maintain 8,000 feet to Newark. One minute later, at 1810, Flight 942 reported over Evergreen at 8,000 and requested a lower altitude. This request was denied because of traffic at the 7,000-foot level. At 1819 the flight reported over the Newark, California, compass locator and fan marker (radio beacon) at 8,000 feet where it held for 11 minutes. At 1827, Oakland Approach Control cleared Flight 942 for a straight-in range approach, to descend in the holding pattern to cross the Newark compass locator at 3,500 feet and to report leaving each 1,000-foot level. Three minutes later, at 1830, the flight reported leaving 8,000 feet, and subsequently reported leaving each 1,000-foot level. At 1836, it reported being at 3,500 feet leaving the Newark compass locator inbound. This was the last known radio contact with the flight.

At approximately 1838 the aircraft crashed in a barley field. Impact and fire destroyed the aircraft. There were no survivors.

The Oakland weather reported at the time was: Measured ceiling 1300 feet broken, 1800 feet overcast, light rain, fog, visibility two and one-half miles, wind south-southwest 17 miles per hour, altimeter setting 30.09.

Investigation

Investigation revealed that the aircraft crashed in a large flat field located three miles on a magnetic bearing of 323 degrees from the Newark compass locator and one and one-half miles northeast of the town of Alvarado, California. The surrounding terrain consisted of flat farm land on which were a few scattered houses, fences, and trees. The elevation of the field is approximately 17 feet MSL.

The aircraft first struck the ground on its right wing tip and with the wing in a near vertical position, then cartwheeled and disintegrated. Wreckage was scattered over an area approximately 800 feet long and 300 feet wide. Due to impact forces and the resultant fire, the aircraft broke into numerous small pieces, many of which were destroyed by fire with only two large sections of the aircraft remaining after the crash. These were the fuselage center section with a portion of the left wing attached which was found lying inverted approximately 634 feet from the point of first impact and the rear section of the fuselage, including empennage, from approximately Station 660 rearward to the tail cone, which was also lying nearby.

The many pieces of wreckage were carefully examined and the major structural components including the flight control system were laid out in a manner to reproduce as closely as possible their original positions in the aircraft. This detailed examination revealed that no portions of the aircraft's structure failed prior to impact and that a structural failure or fire in flight had not occurred. No evidence of fatigue failure was found in any of the many fractures examined. All breaks appeared to have been caused by impact forces, with considerable ductility evident in all of the fractures.

There was no evidence to indicate failure or malfunctioning of the primary control system.

The right aileron was broken into five sections at impact. The breaks occurred through the hinge cutouts at Stations No. 421, No. 557, No. 613, and No. 675. All hinges moved freely and there was no indication of pounding or rubbing. The left aileron separated into two sections at approximately Station No. 613, and the inboard section from this station to Station 339 remained attached to the wing panel. All hinges on the latter section of the aileron were free to move.

The vertical stabilizer tip was broken off through its attachment to the stabilizer. The rudder was also broken off at the same location. Otherwise, the rudder and vertical stabilizer were in good condition with the rudder hinge brackets free to move.

The right horizontal stabilizer and elevator surfaces were broken just outboard of the center hinge. Both front and rear spars of the stabilizer were torn loose from the skin from the break to the tip joint. The top and bottom skin in this area was still attached to the tip. The outboard hinge was still attached to the elevator. The top and bottom bolts attaching the hinge bracket to the stabilizer spar on the inboard side of the hinge appeared to have failed in tension. However, the top and bottom bolts on the outside of the fitting of the hinge were still intact, and had pulled away from the surface, together with sections of the top and bottom spar cap, and the attachment fittings on the forward side of the spar. The outboard end of the right-hand elevator was bent to the rear at the outer hinge. The elevator trim mechanism in the right-hand elevator operated satisfactorily.

The left-hand stabilizer and elevator were broken just outboard of the center hinge. The front and rear spars of the stabilizer outboard of the break were torn out of the surface, and the section was generally demolished. The outboard hinge was attached to the rear spar of the stabilizer, and had become detached from the elevator, due to the elevator hinge fitting being pulled loose at its attachment to the elevator structure. The center elevator hinge was still attached to both the stabilizer and the elevator. The left-hand elevator was also broken through the outer hinge. The left-hand elevator trim mechanism operated satisfactorily.

The right aileron trim tab was in the "neutral" position. The needle of the pilot's aileron trim tab position indicator, however, was positioned at the extreme left wing "down" position. This pointer was bent and the wheel mechanism was also bent and immovable. The rudder trim tab setting was 10 degrees nose-left; this coincided with the setting of the rudder trim tab indicator in the cockpit. Both right and left elevator trim tabs were set one and one-half degrees nose-up. The aircraft carried both wing and propeller deicing equipment. Because of the extreme damage to the cockpit, it could not be determined whether these deicing systems were in operation at the time of the crash.

Both wing fillets and all lower fuselage compartment doors were accounted for, and it was evident that these had not opened or become detached while the aircraft was in flight.

The empennage was carefully examined and nothing was found to indicate that it had been struck by any object.

Although the cockpit section of the aircraft was destroyed, three seat belts were found which were identified as belonging to the seats of the three flight crew members; these belts were broken, indicating that the seats were occupied at the time of the crash. The two seats which were located in the extreme rear of the main cabin on the right side and normally assigned to the stewardesses, were found still in place but with their seat belts broken, indicating that these seats were also occupied at the time of the crash. Several buckled passenger seat belts which were partially burned were also recovered.

All the components of the landing gear system were examined and it was determined that both the main and nose landing gears were in the retracted position at impact. The flaps were extended 15 degrees.

All CO_2 bottles were found unused. A few of the cockpit instruments, although badly damaged, were readable. The indicators of the fuel flow gauges read 690 lbs. - No. 1 engine, 600 lbs. - No. 2 engine, 190 lbs. - No. 3 engine, and 120 lbs. - No. 4 engine. The barometric scales of the pilot's and copilot's altimeters indicated 30.10 inches hg. The horizon bar of a gyro-horizon indicated an extreme right wing "down" position. A turn and bank indicator with the turn pointer missing had the steel ball jammed in the extreme right position. The nose heater with its sides crushed had a half inch hole punctured in the center of the rear end of the combustion chamber. Both cabin heaters were damaged. Disassembly and inspection of these heaters revealed no evidence of external fire or that leakage from their combustion chambers had occurred during flight.

Each of the four propellers separated from the engines and was found on the ground in the following sequence from the beginning of the wreckage distribution path: No. 4 first, followed by Nos. 3, 2 and 1. The blades of all four propellers were badly bent or twisted. Propeller domes were removed and inspection showed that at the time of impact the pitch positions of the blades were in the cruising range and the settings were consistent. All four engines were recovered. Nos. 2 and 3 engines were complete; Nos. 1 and 4 engines were found with accessory sections separated from the power sections. A tear-down inspection of all engines showed no evidence of any malfunction or structural failure having occurred prior to impact. All engines were delivering power when the accident occurred. The fuel selector valves and the cross-feed valves were found positioned as follows: No. 1 fuel selector valve - No. 1 main to No. 1 engine, No. 2 fuel selector valve - No. 2 main to No. 2 engine, No. 3 fuel selector valve - No. 3 auxiliary to No. 3 engine, No. 4 fuel selector valve - No. 2 auxiliary to No. 4 engine. The right hand cross-feed valve was "on"; the left hand cross-feed valve was "off". Impact forces probably moved the Nos. 3 and 4 fuel selector valves because their valve yokes were turned in such a manner that the yoke pins were against the stops. The No. 4 fuel selector valve was frozen; No. 3 could be moved freely by hand; however, one yoke finger was broken off.

On the morning of March 20, 1953, a low pressure center was located in southeastern Montana and northeastern Wyoming. A cold front which was moving in an easterly direction extended from this low pressure center in a southwesterly direction across northwestern Arizona and the extreme southeastern portion of California. An occluded front which was lying off the coast of Oregon and Washington in the morning moved in a southeasterly direction and, at the time the accident occurred, was over the extreme northwest portion of California. Attendant to this synoptic condition, rain and snow showers were forecast in the frontal zone in Arizona with light to moderate rime ice between the 10,000 and 11,500-foot level east of the front and at the 4,500 to 6,000-foot levels west of the front. Light to moderate turbulence was expected over portions of the route involved and in the Oakland Bay area above an altitude of 5,000 feet. No severe weather of any type was forecast for the Oakland Bay area during the time the flight was expected to be there.

Eye witnesses of the accident stated that they estimated the cloud ceiling to be approximately 1,200 to 1,300 feet at the time of the accident, and that the aircraft was first observed beneath the overcast approximately one mile southwest of the scene. The aircraft was descending in a steep right wing low slipping attitude and it remained in this attitude until it contacted the ground. Wing lights were lighted, and all agreed that the engines appeared to be running normally and that they heard no unusual noises such as might be identified with a runaway propeller or backfiring. One witness, whose home is approximately 1,000 feet west-southwest of the point of impact, said that immediately following the explosion, which occurred when the aircraft struck the ground, numerous pieces of hard ice fell into his yard, the largest of which was rectangular in shape, approximately two inches thick, and bore evidence of having been attached to a surface on which there were rivets. According to witnesses, the flight path of the aircraft during its descent was slightly to the east of this witness' house.

Several pilots known to be flying in the area shortly before and after the accident reported that they encountered only mild turbulence and light icing above the 5,000-foot level. One pilot, who was holding over Newark at 8,000 feet approximately 35 minutes after the accident occurred, reported encountering severe icing conditions and mild turbulence with ice approximately three inches in diameter accumulating on antenna masts. He said that the ice began to melt when the 4,500-foot level was reached in the descent.

Chief Pilot Rodgers was on board to conduct a routine route check. He had considerable flying experience and ability and was known by his associates to insist that all flight crews adhere strictly to the company's regulations and the principles of safety. For passenger comfort, Rodgers insisted that all descents be made at a rate of descent not greater than 400 feet per minute. Another company rule he insisted upon was that all fuel selector valves be put in the main tank to engine positions during all approaches for landings. It is not known where Captain Rodgers was seated in the cockpit when this aircraft was making the approach to Oakland; however, judging from the way in which he had conducted such checks in the past he normally would be sitting in either the copilot's seat or on the jump seat between the pilots.

All CAA navigational ground facilities were operating in a normal manner at the time of the accident.

Analysis

All position reports made by the flight between Roswell and the Newark fan marker can be considered routine; however, two of these reports may need some clarification. At 1744, the flight asked Fresno communications station to expedite the clearance that had been requested at 1730, the time the aircraft was over Fresno, its altitude at least 500 feet on top. As 14 minutes had elapsed since the initial request for clearance, the use of the words "please expedite" is understandable. The distance from Fresno to the Los Banos fan marker (compulsory reporting point) is 60 statute miles. N 88942 was making good a ground speed of approximately 190 miles per hour. Thus it can be seen that in the 14 minutes subsequent to passing Fresno, the flight would have progressed about 44 miles, leaving only 16 miles or five minutes flying time before arrival over Los Banos. A clearance was necessary to cross Los Banos and Evergreen; the flight received and acknowledged the following clearance at 1747: "ATC clears Douglas 942 to the Newark radio beacon, cross Los Banos at 8,000, maintain 8,000; contact Oakland approach control after Evergreen. No delay expected." The flight reported over Los Banos at 1749 at 8,000 feet and estimated Evergreen at 1808. The time of arrival over Los Banos (1749) was only two minutes after the flight's receipt of the clearance to cross that check point. This time element, therefore, appears to be ample justification for the Captain's request that the clearance be expedited.

When over Evergreen (1810) the flight requested a change of altitude from 8,000 feet to 7,000 feet. No particular significance for this request was given by the crew, nor should any importance be attached thereto since it is customary for pilots to ask for changes in altitude for several reasons. However, since it was established that icing conditions probably existed at altitudes above 5,000 feet, Captain Hum may have requested a lower altitude for that reason. There still remained 21 statute miles or about nine minutes before arrival over Newark during which time the Captain may have thought that at 7,000 feet he might possibly encounter less ice than at 8,000 feet to which he had been cleared. The flight reported over the Newark facility at 1819 at 8,000 feet, ARTC having refused the request for 7,000 feet. It should be noted, however, that during the 11 minutes the flight was holding at 8,000 feet at the Newark compass locator, no radio contacts were made. This might indicate that the crew were not experiencing mechanical nor weather (icing) difficulties during that time; at least none was reported. From pilot reports and a study of the prevailing weather conditions, it is believed that any ice which may have accumulated on the aircraft's surfaces at the 8,000-foot level should have been melting at altitudes below 5,000 feet.

Approximately three minutes elapsed between the time the flight was cleared to descend and the message that it was leaving 8,000 feet. This is not an unusually long period of time for the crew to begin descent after receipt of descent clearance as it is not known at what point in the holding pattern the aircraft received permission to descend. This holding pattern

is a one-minute right elliptical track to be made southeast of the Newark compass locator on the east side of the southeast course of the Oakland range. If the aircraft was headed toward the southeast when the clearance was received, the captain may have, for reasons of his own, elected to complete his turn and head northwest toward the compass locator before he began his descent. Since the wind at 7,000 feet was reported as from 280 degrees at 55 miles per hour, this may have further reduced the ground speed on the approach to the locator and may possibly justify the three minutes involved. Once the descent was started, the flight reported leaving each 1,000-foot level until the final report stating that it was over the Newark compass locator at 3,500 feet inbound at 1836. None of these reports indicated that the flight was experiencing any difficulty nor did it declare an emergency at any time. The descent was made from 8,000 feet to 3,500 feet in six minutes at an approximate rate of 750 feet per minute. Although the descent to this level was made at a rate almost double that which Chief Pilot Rodgers instructed the company's pilots to use with passengers aboard, 750 feet per minute is well within safe limits. It is possible that because the crew was being checked, Pilot Rodgers purposely withheld criticism of their flying technique until the flight was completed.

All known facts indicate that the aircraft became uncontrollable almost immediately after the report leaving 3,500 feet was made. One, the accident occurred at a point about three miles inbound from the Newark compass locator and about two minutes after the last report was made; this necessitated an abnormal rate of descent of approximately 1,750 feet per minute. Two, witnesses agreed that the aircraft, when first seen beneath the clouds, was in a steep right wing low slipping attitude and that it remained in this attitude until striking the ground.

What caused the aircraft to become uncontrollable is not known. The possibility that aileron control may have become jammed was considered but is not supported by available evidence. The aileron trim tab control linkage is by means of cable between the cockpit control wheel and a point in the wing in front of the aileron trim tab. From that point back to the tab, the linkage is geared and rigid. Thus the finding of the right aileron trim tab in the neutral position after the accident indicates that it was so positioned immediately prior to the accident. The inconsistent position of the trim tab indicator could logically result from impact forces and progressive cable failure as the right wing sheared off.

The fact that ice fell to the ground adjacent to the scene of the accident, a large piece of which was identifiable by its contour as having previously been attached to an aircraft (most probably this one), indicates the probability that this aircraft had recently encountered a heavy icing condition. It is reasonable to assume that flying in weather where icing conditions were known to exist that the crew would have turned "on" both pitot heaters. If these heaters were not turned "on" or were malfunctioning, ice could accumulate at the orifices in the pitot heads and an erroneous indicated air speed would result. If the static vents were similarly closed and the crew did not detect it and change to the alternate source, erroneous readings of the rate of climb indicators and altimeters might also occur. If such were the case, loss of control of the aircraft could easily result in a stall and with the prevailing low overcast, it is

doubtful if there would have been sufficient time to regain control before striking the ground.

Another possible cause of the accident could have been the accumulation of ice on the surfaces of the aircraft in sufficient magnitude to have caused loss of control since the flight had flown for a considerable period of time above 5,000 feet in an area in which icing conditions prevailed. It is also apparent that the loss of control did not occur until after the pilot had made his routine report over the Newark fan marker at 3,500 feet. Had the aircraft been subjected to such a heavy icing condition, the ice could not have dissipated during the short period of time involved in making the descent despite the warmer temperature below 5,000 feet and the proper functioning of the aircraft's deicer equipment. It is true that the amount of an ice accretion varies greatly not only with altitude but also in relatively short distances and times, as does its rate of accretion.2/

Since the examination of the wreckage did not disclose any malfunctioning of the aircraft or its components prior to impact, the foregoing possibilities are worthy of consideration. Although the Board cannot state definitely that aircraft ice probably caused this accident, it is true that if the crew did not appreciate the seriousness of ice accretion and take preventive measures at once, the performance of the aircraft could have rapidly been reduced to a dangerous degree relative to control and stall speeds. It is recognized, however, that several other circumstances might have been involved, the evidence of which could have been destroyed by the impact and fire.

Findings

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

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

2. The flight was routine until arrival over the Newark compass locator and fan marker.

3. The aircraft was flying under instrument weather conditions with icing in the clouds above 5,000 feet; temperatures were above freezing below this altitude.

4. The descent from 8,000 feet to 3,500 feet was made at a rate of approximately 750 feet per minute.

5. After reporting at an altitude of 3,500 feet and leaving the Newark fan marker inbound, the aircraft became uncontrollable and its average rate of descent was approximately 1,750 feet per minute.

2/ The detrimental effect of ice formation on aircraft performance has been the subject of long research and numerous studies. The National Advisory Committee for Aeronautics has prepared several such reports; four highly informative ones are NACA Technical Notes Nos. 1598, 2962, 2212 and 1084.

6. Witnesses observed the aircraft when it was immediately below the 1,300-foot cloud ceiling in a right wing low slipping attitude and watched it continue in this attitude until it struck the ground.

7. No emergency was declared by the flight.

8. All ground navigational facilities were operating normally.

9. The location of the accident was approximately three miles beyond the Newark fan marker toward Oakland, and one and one-half miles to the right of course.

10. The available evidence does not indicate that any malfunctioning of the aircraft or controls, fire in flight, or structural failure occurred prior to impact.

Probable Cause

The Board determines that the probable cause of this accident was the loss of control of the aircraft for reasons unknown, during its descent from the Newark compass locator.

BY THE CIVIL AERONAUTICS BOARD:

/s/ OSWALD RYAN

/s/ HARMAR D. DENNY

/s/ JOSH LEE

/s/ JOSEPH P. ADAMS

/s/ CHAN GURNEY

SUPPLEMENTAL DATA

Investigation and Hearing

The Civil Aeronautics Board was notified of this accident at 1850, March 20, 1953, by CAA Communications at Oakland, California. 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 ordered by the Board was held in the Leamington Hotel, Oakland, California, April 16 and 17, 1953.

Air Carrier

Transocean Air Lines, a large irregular air carrier, is a California corporation, with its principal offices at the Oakland Municipal Airport, Oakland, California. The company possesses a letter of registration issued by the Civil Aeronautics Board and an operating certificate issued by the Civil Aeronautics Administration for operations over the route involved.

Flight Personnel

Captain Harvey W. Rodgers, age 41, held a currently effective airline transport pilot rating with an appropriate rating for the subject aircraft. He had a total of 8,312 flying hours, of which 5,570 were in the type equipment involved. He had successfully passed his last CAA physical examination on December 1, 1952, and had been employed by Transocean Air Lines since March 16, 1946. He successfully passed his last instrument check February 6, 1953.

Captain Herman E. Hum, age 41, was employed by Transocean Air Lines August 23, 1946. He held a currently effective airline transport pilot rating with an appropriate rating for the subject aircraft. He successfully passed his last CAA physical examination on March 16, 1953. He had accumulated a total of 10,656 flying hours, of which 7,379 had been in the type equipment involved. His last instrument check was successfully passed January 3, 1953.

Frederick W. Patchett, age 37, was employed by Transocean Air Lines September 17, 1947. He held a currently effective airman certificate with commercial pilot, single and multi-engine, and instrument ratings. He had successfully passed his last CAA physical examination on February 7, 1953, and his instrument check on October 31, 1952. He had accumulated a total of 2,886 flying hours, of which 1,782 were in the type equipment involved.

Stewardess Velma I. Sandridge was employed by Transocean Air Lines August 22, 1952.

Stewardess Lucille M. Chapman was employed by Transocean Air Lines March 20, 1953.

The Aircraft

N 88942, a Douglas Model DC-4, was operated under lease by Transocean Air Lines. It had a total of 5,976 flying hours since last overhaul and was currently certificated by the CAA. The aircraft was equipped with Pratt and Whitney R-2000-4 engines and Hamilton Standard Propellers.