Docket SA-130 File No. 4331-46

CIVIL AERONAUTICS BOARD
SAFETY BUREAU

ACCIDENT INVESTIGATION REPORT

Adopted: November 10, 1947 Released: November 12, 1947

UNITED AIR LINES, INC.—CLEVELAND, OHIO—NOVEMBER 11, 1946

The Accident

United Air Lines' Flight 404, NC-19947, a Douglas DC-3A, crashed at 0330*, November 11, 1946, during a landing approach to the Cleveland Municipal Airport, Cleveland, Ohio. As a result of impact the aircraft was demolished, the pilot and co-pilot were killed, and five of the 17 passengers were seriously injured.

History of the Flight

Flight 404 departed Chicago, Illinois, at 0142 on an instrument flight plan to cruise to Cleveland at 9,000 feet with Akron, Ohio, designated as alternate airport. No position reports were received from the flight until it reported over the Toledo radio range station at 0251, at 9,000 feet, approximately 2 minutes earlier than its estimated time of arrival.

At 0254, Flight 404 was cleared to the Elyria fan marker to descend to and maintain 5,000 feet and to contact Cleveland Approach Control when over Elyria. The flight was advised that approach clearance to Cleveland Airport would be expected at 0326. At 0307, when approximately 35 miles west of Cleveland, the flight was further cleared to 4,000 feet and at 0317 was re-cleared to 3,000 feet. Cleveland Approach Control cleared Flight 404 to the Cleveland Tower at 0318.

The instrument approach was started at 0321 at which time the flight was given the 0320 special weather report for Cleveland ceiling indefinite 400 feet, overcast, low, thin, broken; visibility 2 miles, light rain, light fog.

The aircraft was heard southwest of the airport at 0327 and at this time Cleveland Tower cleared the flight to land on Runway 36-Left. At 0328 the aircraft was observed over the airport at an altitude of between 200 and 400 feet flying in a northeasterly direction. When approximately over the north boundary, the aircraft disappeared from view in what appeared to be a low cloud formation. At this time Cleveland Tower advised the flight that it was cleared to use Runway 36-Left, Runway 36-Right, or Runway 31, at the captain's discretion. The aircraft was next seen re-approaching the airport from the northeast in a right turn, during which turn the landing lights were switched on. In the latter part of the turn, a descent was established and this descent was continued in a northwesterly direction toward the dark, undeveloped area north of the airport.

With the exception of the fact that the aircraft was heading toward an area not within the boundary of the airport, its appearance was that of an aircraft in a normal landing approach. When at an altitude of approximately 30 feet, the aircraft banked slightly to the left and, immediately thereafter, it struck trees and high tension lines paralleling the north boundary of the airport. The aircraft veered sharply to the right and dived into the ground, coming to rest approximately 550 feet beyond the point of initial contact.

Investigation

The wrecked aircraft was located at a point approximately 600 feet north of the north boundary of the airport. The entire nose of the aircraft up to the pilot compartment bulkhead at the leading edge of the wings was demolished. Both engines were torn from their nacelles. The fuselage was broken immediately aft of the trailing edge of the wings, however, the cabin section between the forward passenger compartment bulkhead and the trailing edge of the wings was relatively intact. The landing gear was extended at the time of the accident and the flaps were extended approximately one-fourth of the full travel.

*All times referred to herein are Eastern Standard and based on the 24-hour clock

The examination of the wreckage failed to disclose any evidence of structural failure prior to impact. Inspection of the company maintenance records indicated that the aircraft was in an airworthy condition at time of departure from Chicago and that all pilot reports had been given proper attention by United Air Lines' maintenance service. Subsequent to departure from Chicago, the only comment from the flight concerning the condition of the aircraft was that the company high frequency receiver was inoperative.

An aftercast of the weather disclosed that during the afternoon of November 10 a low pressure area was centered in Canada off the northeastern edge of Lake Huron. The cold front associated with this low pressure system extended south-southwest from the center of the "low" passing through western Ohio and central Kentucky. This cold front passed Cleveland at approximately 1930. However, by this time the front had become diffused and a weak trough was developing to the rear of the cold front in northwestern Ohio and eastern Indiana. This trough had become sufficiently pronounced by 2300 to take on the form of a cold front and the original cold front in eastern Ohio appeared to have dissipated. By 0130 of the following day the rain which had been falling in the Ohio River Valley area spread northward throughout most of Ohio and the new cold front continued to intensify throughout the early morning. Moving eastward at approximately 15 miles per hour, this cold front passed Cleveland at approximately 0200.

The latest forecast available to the pilot concerning weather conditions at Cleveland was issued for the period 2330 to 0730. This forecast indicated that at the estimated time of arrival of Flight 404 a 3000 foot ceiling, scattered to broken clouds with 8 miles visibility could be expected. Weather Bureau forecasts under which this flight was operating did not anticipate the formation of a new cold front in western Ohio during the course of this flight and therefore predicted ceilings and visibility considerably higher than those which were reported at the actual time of arrival of the flight in the Cleveland area.

According to United Air Lines' airport specifications for Cleveland, the minimum ceiling and visibility for instrument approach at Cleveland are 400 feet and one mile. The Cleveland Weather Bureau station filed a weather observation at 0303 which reported indefinite ceiling, 1000 feet, overcast, thin, scattered clouds at 500 feet, visibility 2 miles, light rain, light fog. At 0320, Cleveland was reporting an indefinite ceiling, 400 feet, overcast, lower, thin, broken, visibility 2 miles, light rain, light fog. The lower clouds had become a solid overcast by 0328 and at that time the ceiling was reported as indefinite 300 feet, the visibility remaining the same. This last observation was made while Flight 404 was making its instrument approach to Cleveland and was filed at the time the aircraft was circling for a landing. In the intervening two minutes before the time of the accident, this report was being sent to the Cleveland control tower but, before the report could be transmitted to the flight, the accident had occurred.

The altitude of the aircraft as it passed over the airport was variously reported by tower personnel and other ground observers as between 200 and 400 feet, the more reliable of this testimony, particularly that of the airport traffic controller, indicating that its altitude was closer to 200 feet. It is significant to note that the tower operator testified that the aircraft appeared to disappear into low clouds at approximately the north boundary of the airport.

The Cleveland radio range station is located .7 of a mile west of the airport, and final instrument approach to the Cleveland Municipal Airport is made on the east leg. The minimum altitude for passing over the range station at Cleveland is 1,300 ~~feet above~~ sea level or 515 feet above the elevation of the airport. Since the normal approach speed of a DC-3 is 120 miles per hour, the distance between the range station and the airport is traversed in 21 seconds. The rate of descent required for a straight-in landing at Cleveland from the minimum altitude over the range station at this airspeed would be 1,470 feet per minute.

The only approach lights installed at the airport extend from the west end of Runway 9, a distance of approximately 2,000 feet toward the range station. In the center of the airport there exists a

concrete mat, the irregular dimensions of which are approximately 2,000 feet by 2,000 feet. Portions of the mat serve as a parking ramp and other portions comprise extensions of various runways. Those portions of the runway which extend into the mat are unlighted. At night, therefore, the center of the Cleveland Airport has the appearance of a large darkened area from which six sparsely lighted runway segments are projected. Green runway end markers (range lights) are installed at the end of each of these runways. The investigation disclosed that during the final portion of its descent immediately prior to the crash, the aircraft passed directly over the end markers located on the northeast end of Runway 23.

Discussion

As a result of the inspection of the wrecked aircraft, testimony of witnesses, and the review of the company maintenance records and all communications records concerning the flight, it can be concluded that the operation of Flight 404 was not complicated by mechanical malfunctioning or structural failure.

It is evident that the weather information available to the flight crew prior to departure from Chicago and the weather reports transmitted to the flight while en route from Chicago to Cleveland consistently indicated that the weather at Cleveland at the estimated time of arrival would be satisfactory for landing. It therefore appears that prior to the moment that the aircraft passed over the airport, the flight crew had no knowledge that the ceiling at Cleveland would be below authorized minimums. However, the trend of the weather, as revealed in reports received by the flight during the 30 minutes prior to the accident, indicated clearly that the forecasts previously provided the flight were invalid and that actual weather at Cleveland at the time of the final approach would be at or below instrument minimums.

The testimony of ground witnesses strongly indicates that the altitude of the aircraft as it passed over the airport was below 400 feet. This indication is substantiated by the fact that the weather observer at the airport had at that moment completed a weather observation, as a result of which a 300-foot ceiling was reported. It will be remembered that the aircraft was beneath this ceiling when it passed over the airport. It is further apparent that the aircraft entered still lower clouds in the vicinity of Cleveland Airport prior to establishing a landing approach. Upon completing the approach to a point over the airport, the pilot was certainly in a position from which he was able to determine the height of the ceiling and the extent of the visibility, regardless of the reports submitted to him previously. It can therefore be concluded that the pilot exercised poor judgment in continuing an attempt to align the aircraft with one of the runways at the airport in view of the fact that the weather was below the company minimums prescribed by the Civil Aeronautics Administration for Cleveland Airport.

The relative location of the radio range station and the airport renders a straight-in landing approach impracticable. With a ceiling of 400 feet at Cleveland, a DC-3 could not be expected to descend from the minimum altitude over the range station in sufficient time to effect a straight-in landing on Runway 9. It is necessary, therefore, for a pilot attempting a landing under a 400-foot ceiling to circle the airport underneath the overcast in order to align the aircraft with a suitable runway. The Board is informed that remedy of this situation is not feasible through relocation of the present radio range facilities. The current program of the Civil Aeronautics Administration looks toward the use of very high frequency instrument low approach facilities at such airports to provide the means for straight-in approach in the near future. In view of the rapid obsolescence of the low frequency radio range and the immediacy of regular ILS employment, the Civil Aeronautics Administration believes that relocation of the radio range is not warranted.

Throughout the entire length of Runway 31 there exist only 6 contact lights on each side, three of which are closely spaced within the first 700 feet and the other three of which are spaced within the last 1,000 feet. Between these two groups of contact lights there lies approximately 3,400 feet of unlighted runway and mat. Since most of the buildings in the hangar line on the east side

of the airport are lighted, the location of three closely spaced contact lights would be difficult to distinguish from the rest of the numerous lights in that vicinity.

In view of the fact that the landing approach of the aircraft was directly over the end markers on the approach end of Runway 23, it appears that the pilot of Flight 404 had mistaken these end markers for the approach end of Runway 31. The dark area north of the airport was evidently mistaken for the unlighted airport mat. Before the pilot was able to correct his error, the aircraft had struck trees and other obstructions beyond the north boundary of the airport and the crash ensued.

The responsibility for establishing standards governing air carrier operations lies with the Civil Aeronautics Board. However, because the Board does not possess the personnel or the facilities necessary for the preparation of such standards as airport lighting requirements, this function has been delegated to the Administrator of Civil Aeronautics. Sections 40.211 and 40 221 of the Civil Air Regulations, therefore, were so promulgated to require that all airports to be used in night operation by scheduled air carriers be equipped with lighting facilities which are satisfactory to the Administrator of Civil Aeronautics. No detailed standards were in existence at the time of the accident by which the adequacy of airport lighting could be determined, this evaluation being accomplished through the discretion of the individual Civil Aeronautics Administration's inspector concerned.

The Civil Aeronautics Administration has formulated complete specifications for runway lighting which are proposed by that agency as technical standards for civil aviation.** These standards govern the installation of runway lighting facilities at all airports for which federal funds are provided for such installation. No requirement exists, however, that runway lighting conform to these standards for the purpose of approval for use by scheduled air carriers for instrument approach at night. Instead, since the date of the accident the Civil Aeronautics Administration has published separate instructions for its inspection personnel which specify the minimum lighting facilities necessary for scheduled air carrier operation These instructions require, in addition to other lighting facilities, "adequate boundary lights defining the boundaries of the usable area and/or adequate contact (runway marker) lights identifying the outer limits of the runways." It is apparent from the foregoing that no specific requirement exists for runway lights on airports utilized in scheduled air carrier service whether or not that airport is used for instrument operation. Furthermore, no uniform definition is employed by which the adequacy of existing runway lights may be determined by the inspection personnel. It is the opinion of the Board that more complete standards should be prepared for the purpose of airport approval for air carrier night operations, that such standards should require runway lighting facilities at all airports at which instrument approaches at night under conditions of low visibility and ceiling are contemplated, and that where the runway lighting deviates materially from the provisions of the pertinent standard, compensation should be made by increase in ceiling and visibility minimums to the extent dictated by such deviation.

Findings

As the result of the investigation of this accident, the Board finds that

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

2. At the time of departure from Chicago, the total weight of the aircraft was within its maximum gross limits, and the load was distributed with respect to center of gravity within approved limits.

3. That portion of the flight from Chicago to a point over the Cleveland radio range station was entirely routine.

4. The weather reports and forecasts available to the flight crew indicated that weather conditions would be above contact minimums for Cleveland at the estimated time of arrival.

5. During the six hours preceding this flight, a low pressure trough was developing through western Ohio and eastern Indiana.

6. By 2,300 this trough began to take on the characteristics of a weak cold

**Technical Standard Order—N1, October 4, 1946 Civil Aeronautics Administration Uniform Requirements for Runway Lighting

front, and, unknown to the flight crew, thereafter began to cause lowering of ceilings throughout Ohio.

7. The weather reports received by the flight after 0.300 indicated a trend of lowering ceiling and visibility at Cleveland to levels below those contained in earlier forecasts.

8. The last Cleveland weather report given the flight was ceiling indefinite 400 feet, overcast, low, thin broken clouds, visibility two miles, light rain, light fog.

9. The ceiling and visibility minimums for Cleveland Airport are 400 feet and one mile.

10. After completing an instrument approach, the aircraft passed over the airport at an altitude less than 400 feet, and when over the boundary of the airport, the aircraft passed through low clouds.

11. At the time the aircraft passed over the airport the ceiling was observed to be indefinite 300 feet, overcast.

12. When north of the airport, the aircraft turned to the right for a landing approach to Runway 31.

13. Mistaking the end markers on the approach end of Runway 23 for the end markers on the approach end of Runway 31, the pilot established an approach toward a dark area north of the airport.

14. Before the pilot was able to correct his error, the right wing of the aircraft struck trees and other obstructions adjoining the northern boundary of the airport and the aircraft dived into the ground.

Probable Cause

On the basis of the foregoing, the Board determines that the probable cause of this accident was the error of the pilot in establishing an approach toward an area not cleared for landing as a result of having mistaken the end markers of Runway 23 for those of Runway 31. A contributing factor was the failure of the pilot to abandon his attempt to land at Cleveland Airport when confronted with weather conditions below the minimums prescribed for that airport.

BY THE CIVIL AERONAUTICS BOARD

/s/ J. M LANDIS
/s/ HARLLEE BRANCH
/s/ JOSH LEE

Ryan, Vice Chairman, did not take part in the decision.

Supplemental Data

Investigation and Hearing

The Civil Aeronautics Board was notified of the accident at 0610, November 11, 1946 and an investigation was immediately initiated in accordance with provisions of Section 702 (a) (2) of the Civil Aeronautics Act of 1938, as amended. An investigator from the Board's Chicago, Illinois, office arrived at the scene of the accident at 0915 and was subsequently assisted in the investigation by other personnel from the Board's Detroit, Michigan, and Washington, D. C., offices. A public hearing was ordered and was held in Chicago, November 22, 1946.

Air Carrier

United Air Lines, was incorporated under the laws of the State of Delaware and had established its headquarters in Chicago. At the time of the accident United Air Lines, Inc., was operating under a certificate of public convenience and necessity and an air carrier operating certificate both issued pursuant to the Civil Aeronautics Act of 1938, as amended. These certificates authorized the company to transport persons, property and mail in scheduled air transportation between various points in the United States including Chicago and Cleveland, Ohio.

Flight Personnel

Captain Fenton L. Brown, age 44, of Chicago, was pilot of the aircraft. Until the date of the accident he had accumulated 8,340 hours flying time, of which 967 hours had been obtained in DC-3 equipment. Captain Brown possessed an airline transport pilot rating and had been qualified over the route. First Officer Robert L. Arnold, age 25, of Lansing, Illinois, was co-pilot of the aircraft. He possessed a commercial pilot certificate and an instrument rating and until the date of the accident had accumulated a total of 2,268 hours of which 116 hours had been obtained in DC-3 equipment. Elizabeth A. Dobson of Madison, Wisconsin, was stewardess.

The Aircraft

NC-19947, a Douglas DC-3A had been operated a total of 11,684 hours since its manufacture in February 1942. It had accumulated a total of 1,390 hours since the last major overhaul, the last inspection having been completed on the date of departure from Chicago. It was equipped with Pratt & Whitney R18-1830-92 engines on which Hamilton Standard propellers were installed. The left and right engines had been operated a total of 3,741 hours and 14,210 hours respectively of which 561 hours had been accumulated by both engines since the last major overhaul. At the time of departure from Chicago the aircraft was loaded within the maximum permissible gross weight limits and the load was distributed with respect to center of gravity within approved limits.