

CIVIL AERONAUTICS BOARD

ACCIDENT INVESTIGATION REPORT

Adopted: December 29, 1951

Released: January 4, 1952

EASTERN AIR LINES, INC.—NEAR RICHMOND, VIRGINIA, JULY 19, 1951

THE ACCIDENT

At approximately 1559¹ on July 19, 1951, Eastern Air Lines' Flight 601, a Lockheed Constellation, N-119A, made an emergency landing with landing gear retracted on Curles Neck Farm, located eight and three-fourths miles and on a bearing of 162 degrees from Richard Byrd Airport, Richmond, Virginia. The landing resulted in major damage to the aircraft. No injuries were sustained by any of the passengers or members of the crew.

HISTORY OF THE FLIGHT

Flight 601 departed Newark, New Jersey, for Miami, Florida, at 1415, July 19, 1951. The flight was cleared by Air Route Traffic Control, (ARTC) La Guardia Airport, New York, to proceed in accordance with Instrument Flight Rules from Newark to Miami at 18,000 feet via Amber Airway 7 to Philadelphia, Pennsylvania, direct to Norfolk, Virginia, Wilmington, North Carolina, West Palm Beach, Florida, and thence via Amber Airway 7 to Miami.

The aircraft carried 48 passengers, 2,800 gallons of fuel, 140 gallons of oil, 2,663 pounds of mail and cargo, and the crew. Total aircraft weight at the time of take-off was 92,533 pounds, and the disposable load was properly distributed with relation to the center of gravity of the aircraft. The maximum allowable gross take-off weight for this aircraft was 100,355 pounds. The crew consisted of Captain John B. Armstrong, Copilot William C. Davis, Flight Engineer David B. Lane, and Flight Attendants John MacDonald and Frank L. DeVane.

As part of the usual preparation for flight, the captain and copilot were briefed on the weather situation by company and United States Weather Bureau representatives.

Two frontal systems were in existence on July 19, a cold front extended southwest through Buffalo and a weak warm front extended east-southeast from near Buffalo. The forecast indicated scattered thunderstorms along the route to North Carolina, with turbulence at all levels. A thunderstorm with squall line characteristics had already moved southeastward across the route between Wilmington, North Carolina and New York. Since it was not expected that a second squall line would form, no stress was laid on that possibility in the briefing. Radar weather reports from the weather Bureau office in New York City did not indicate the presence of a squall line until after the flight had encountered those conditions.

The flight had estimated Philadelphia at 1446, but modified it to 1443. It was in the storm area, continuing the climb from 15,000 feet to the assigned cruising altitude of 18,000 feet, as it passed Philadelphia.² Cruising altitude was reached at approximately 1452 where for the next 25 to 30 minutes violent turbulence accompanied by intermittent periods of hail was encountered. It was during this period that the captain first noted severe buffeting of the aircraft. The flight continued past Philadelphia for a few minutes toward Dover, Delaware, and then made a turn to the west in an attempt to avoid as much of the storm area as possible. By taking such action, the pilots felt they would traverse the storm line at 90 degrees. Updrafts in the storm were so severe that the aircraft was carried to 23,500 feet and for a short time it was impossible to maintain the assigned altitude. Speed was reduced in the turbulence.

The flight broke out in a clear area at about 1517. All vibration and buffeting

¹All times referred to herein are Eastern Standard and based on the 24-hour clock.

²See attachment.

disappeared as it resumed cruising speed. The copilot, who had been flying since take off, was relieved by the captain after breaking out of the disturbance. The flight had been conducted entirely under instrument conditions since 12 minutes after departure from Newark.

The flight then advised ARTC that it was about 30 to 40 miles northwest of Washington, D. C. At 1521 ARTC was further advised that the flight was proceeding southwest by Visual Flight Rules (VFR) and estimated Lynchburg, Virginia, in a few minutes. A request was made for a new altitude and route assignment which was followed by a query from ARTC, asking which route would be preferred. ARTC was asked to stand by, the captain later stated that he was quite busy at the time and did not know as yet what route and altitude he wished. The flight descended VFR to 8,000 feet.

At 1540 Eastern Air Lines' Flight 510, which was in the vicinity of Richmond, was contacted by Flight 601 for information regarding weather further on the route on Airways Green 6 and Amber 7. Flight 510 advised that the weather was clear to the east and therefore a turn was made to an easterly heading.

A second squall was encountered in the vicinity of Lynchburg at 1550. The aircraft was slowed to 185 miles per hour indicated air speed, light turbulence and buffeting were experienced. After breaking out of the storm at 1554, the buffeting became so severe that the crew believed the aircraft would disintegrate. Air speed was further reduced, but the buffeting continued. At 1556, the captain made a radio transmission, stating that an emergency landing was being made.

In the descent, indicated air speeds ranging from 205 to 140 miles per hour were tried in an effort to reduce the buffeting, but it could not be eliminated. Shortly after breaking out of the second disturbance, the captain recognized Curles Neck Farm, selected the largest field, and landed straight ahead with the flaps up and the landing gear retracted. The propellers were kept in high pitch. He felt it inadvisable to make any turn, lower the flaps, or otherwise to change the flight configuration, since the cause of the severe buffeting was unknown. During the last few moments of flight, as the nose of the aircraft touched

high corn in a field, the copilot and flight engineer cut all switches. A power line pole at the edge of the corn field was struck by the right wing as the aircraft passed under the wires. After passing over Curles Neck Road, a section of fence was torn down and the aircraft skidded 1,100 feet through a field, another fence, and finally came to rest in a pasture 265 feet from the second fence. A localized fire developed outside of the No. 4 engine, but was extinguished by rain and a local fire truck which arrived at the scene within a short time. Evacuation of the aircraft was accomplished in an orderly fashion.

THE INVESTIGATION

A later study of the weather which existed on July 19 showed that a line of scattered storms noted on radar at 1410 in New York was in fact the forerunner of a squall line. The storms joined very rapidly, forming a solid or nearly solid squall line between 1410 and 1443. This development, of course, differed substantially from the scattered thunderstorms on which the captain had been briefed. He had no means of knowing of this development, other than flying through the storm before the time weather analysts could collate weather station reports.

The post study of weather further revealed that at the time Flight 601 departed Newark, a line of convergence and instability extended southwest from near New York City to north of Philadelphia and Baltimore, then swung westward to near Warrenton and Harrisonburg, Virginia. It was moving southeast at 25 to 30 miles per hour. A continuous squall line did not extend throughout the length of this line, but rather a broken line of storms containing squall line characteristics. This would explain why Flight 601 encountered severe storm conditions while other airline flights experienced no difficulty.

By the time the flight arrived near Philadelphia, such a portion of squall line was well-developed between Philadelphia and Baltimore. It was in the forward edge of the storm, in the area south and southwest of Philadelphia that the worst conditions were encountered—hail, severe turbulence, aircraft icing, and strong updrafts.

By turning to the west, Flight 601 took a course which nearly paralleled the storm

line Traversing this line, it broke out to the rear but re-entered the storm line a little later Analysis of weather showed that had the initial turn to the west not been made, the flight would have broken out of the first storm near Dover, Delaware, and would have had good weather for the remainder of the trip However, once the flight was in the clear area to the west and rear of the first squall line, it had to again cross the line of convergence as it continued to Norfolk and Miami A scattered thunderstorm condition had become a solid, or nearly solid, squall line from Quantico to Gordonsville and near Lynchburg at about 1500

After passing the Potomac River the flight described an approximate semicircle, curving from northwest of Washington, southwest to about Waynesboro, Virginia, and thence eastward to Richmond

After the second storm encounter, the flight broke out ahead of the storm as it neared Richmond Squall conditions in the second storm were less severe than those encountered in the first The squall arrived at Richmond about 15 minutes after the emergency landing

The landing was made on a course of approximately 120 degrees magnetic The leading edge of the right wing just outboard of number 4 engine struck a power line pole The fuel tank in that area was ruptured and fire occurred behind the No 4 nacelle The wing was burned approximately one-third through at that point, and collapsed just outboard of the nacelle The No 2 engine and nacelle were detached from the wing, and No 3 engine nacelle was partially detached as the aircraft skidded through the fields The fuselage remained practically intact

The engine nacelles, leading edge areas of the wing center section, leading edges of rear stabilizing surfaces, and the nose section all showed that heavy hail had been encountered Exposed cylinder barrel fins were flattened by the impact of hailstones

Some peeling and lifting of skin on the central vertical fin and fin-stabilizer fillet was noted It was not possible to establish whether this was caused by the storm, buffeting of the empennage, or the crash landing

The hydraulic reservoir access door, located on the top side of the left wing-to-

fuselage fillet forward of the front spar, was found fully open This door is approximately 9 inches wide and 15 inches long Its four Hartwell-make fasteners were of the type commonly referred to as Messerschmidt fasteners They furnish a flush closure with the aircraft surface and are actuated simply by a moderate pressure of finger and thumb The fastener is spring loaded, and the model on N-119A had two small coil springs per fastener The spring keeps the fastener latched, and also serves to force the latch open once pressure has been applied to unlock it One spring on each of two fasteners was detached A slight upward bend was noted on the outer edge of the door frame, corresponding with the position occupied by one of the fasteners with the door closed This indicated the possibility that the door was sprung open while this one fastener was in the locked position A considerable amount of mud and debris was found in the drain scupper of the hydraulic filler neck, corresponding closely with the soil and vegetation of the field across which the aircraft skidded

Investigation disclosed that previous in-flight openings of this door on Constellations had been reported, namely a Military Air Transport Service aircraft of January 3, 1951, an Eastern Air Lines training flight of June 1, 1951, and an Eastern Air Lines scheduled flight of June 8, 1951 In each instance, the manner in which the door latches released could not be ascertained

Eastern Air Lines' Chief Pilot for the Eastern Region ran a series of tests on June 1 immediately following the incident of that date, using the same aircraft It was found that the buffeting which was caused by the hydraulic reservoir access door being open during flight could be eliminated by extension of flaps Details of these tests were transmitted to the Chief Engineering Pilot on June 6, and it was suggested that further investigation be made of the matter In his reply the Chief Engineering Pilot stated, in effect, that many such malfunctions are encountered in flight test work, and considered the matter of relatively minor importance, therefore, it was not necessary to notify pilots Eastern Air Lines, it might be noted, had operated Lockheed Constellations with this make fastener for over 250,000 hours with no fastener malfunctions prior to June 1

In a letter dated June 15, 1951, the director of flight operations for Eastern Air Lines notified the chief pilots, the superintendent of maintenance, and the chief engineer of the possibility that hydraulic reservoir access doors on Constellations might open in flight. It was suggested that all Constellation personnel be advised of this. By manual supplement published on July 11, 1951, by the superintendent of maintenance, all mechanical personnel, including flight engineers, were so advised. The notification did not indicate corrective action which could be taken in flight to eliminate buffeting, other than acceleration of the aircraft. The pilot group was not officially notified prior to the accident.

As a result of this accident and the three previous incidents, a test flight was conducted as part of the investigation in an identical Constellation, flown by the crew of Flight 601. Suitable means were provided for selective release of the fasteners in flight. The crew concurred in the opinion that buffeting experienced on the test flight was of the same order which had occurred on Flight 601. With all four latches released, the trailing edge of the door rose and oscillated in the air stream. The induced buffeting was so severe that it was not allowed to continue for more than 30 seconds at any one time. Buffeting, it was found, could be eliminated entirely by the use of 60 per cent flaps or by increasing power on No. 2 engine. The open door created turbulence in the wing-to-fuselage fillet area. Turbulence, in turn, caused the entire empennage to buffet. Extension of the flaps changed the air flow over the wing, causing the critical air speed for buffeting to be reduced.

The mechanic who serviced the aircraft at Newark and the flight engineer both knew of the importance which should be placed on locking all four fasteners, since they were acquainted with the June 1 incident and the notice to flight engineers. They both opened the door at Newark, but stated that they were positive all fasteners were secured.

Examination of the latches and coil springs on the fasteners from N-119A revealed that very little pressure was required to open these latches due to weakened coil springs. This type of coil spring will be-

come extended with constant use, thus resulting in a lessening of tension on the latch.

The Hartwell representative advised that his company had known of in-flight openings of that model fastener on other aircraft types. The Messerschmidt-type fastener is in common use as a flush-type closure. As a consequence of these failures due to faulty fasteners, it was redesigned with a torsion spring replacing the coil springs. This new design requires considerably more pressure to actuate and is interchangeable with the former design.

As a result of the experience of June 1, Eastern Air Lines had started to check all Lockheed Constellations in its fleet on July 3 for security and fit of the hydraulic reservoir access door. N-119A was one of those on which the check had been completed. Following the accident, corrective action was taken on all Eastern Constellations by adding a Dzus fastener at the rear of the door. This fastener was installed as a positive lock should external forces cause the Hartwell fasteners to release. Although the earlier Hartwell fastener was considered reliable, it is now being replaced with the improved fastener.

Following the accident, the Lockheed Aircraft Corporation made certain design changes in the access door, incorporating improvements in the method of closure. All Constellation operators were advised of the conditions which could be encountered with the door open, and changes which might be made in flight configuration to overcome the buffeting.

Maintenance records for N-119A reflected that the aircraft was properly certificated and was airworthy upon departure from Newark. Company records reflected that the pilots and flight engineer were competent and properly certificated. No evidence of malfunctioning of the aircraft control system was found during the investigation.

ANALYSIS

From the foregoing it is apparent that the captain was confronted with two situations during the course of the flight. In the first place, he was in an area of severe weather conditions, and secondly, an unusual malfunction occurred. The only course of action available to him under the

circumstances, it would appear, was to rely upon his experience and good judgment

With regard to the weather, conditions which were actually encountered differed from forecasts principally in the extent of storm generation along the route. If only scattered thunderstorms had been encountered, the captain would have been able to avoid the more severe storm conditions. Meteorologists are not able to anticipate the time or extent of squall line development with any great degree of accuracy. Further, in most cases they cannot be sure whether the condition will result in a squall line or a series of disconnected storms. In the case of the storms encountered by Flight 601, where they very rapidly merged into a squall line, earlier recognition by meteorologists would probably have been possible only had ground storm detection radar been available for constant surveillance, or had timely in-flight weather reports been received prior to departure of the flight.

Had the airborne radar been available on Flight 601, it is quite probable that the storms could have been avoided. Airborne radar suitable to the needs and capabilities of commercial aircraft is today yet in the developmental stages. The Board is maintaining a strong interest in the research and development of feasible airborne radar equipment. The trend toward greater utilization of radar in weather forecasting should be beneficial. Ground radar in its present stage of development would be of assistance should the utilization be increased. Airborne radar has shown promise as a device for early storm detection, for circumnavigation of severe storm areas, and as an aid to navigation.

With aircraft speeds increasing, and with flights now being conducted at higher altitudes, it is highly desirable that means be sought which will furnish pilots with more timely weather information, not only at briefing but while en route. More information on upper air data is also indicated. Pilots should be encouraged to make more in-flight reports, particularly when adverse weather is encountered.

Although weather was a contributing factor in this accident, the principal reason for making a precautionary landing was the captain's belief that it was unsafe to continue the flight.

The access door is located in a portion of the structure which is quite rigid, therefore, the possibility that there might have been sufficient flexing in that area to allow the fastener lips to become unlocked is considered highly improbable.

There was evidence of hail damage on and in the vicinity of the door. It was considered possible that hail struck the trigger plates on three of the latches, causing them to release, and the remaining latch was then forced because of the air load over the door, which was evidenced on the latch itself.

The mechanic who serviced N-119A and the aircraft's flight engineer both stated that the access door was secured prior to take-off. It could then only have opened during flight through faulty fasteners due to the weak coil springs in the latches, hail strikes, or both.

Prior to the accident, the carrier had taken limited action to acquaint personnel with the consequences of an open hydraulic reservoir access door. Those primarily concerned with such a possibility—the pilots—were not informed of the circumstances under which the buffeting would occur, or of changes which could be made in the in-flight configuration to eliminate it.

The Board is cognizant of the fact that previous cases were considered as isolated incidents, and of the time required to disseminate information to interested parties. However, it is the Board's opinion that this accident might well have been avoided had all interested personnel, particularly pilots, been promptly notified of corrective action to take during flight in the event buffeting of this nature was encountered. It is probable that a precautionary, but normal, landing could have been made without endangering lives and suffering extensive aircraft damage had Captain Armstrong been so advised.

It is, of course, almost impossible to foresee the effect of isolated failures. In this case, however, three similar incidents had been reported within six months, all known to the carrier. The cause had been ascertained prior to this accident but no effective corrective action was taken until after the accident. It would therefore appear incumbent upon the carrier to have initiated corrective action and to have notified all pilots.

FINDING

Upon consideration of all available evidence, the Board finds that

- 1 The carrier, the aircraft, and the crew were properly certificated
- 2 Weather conditions which the flight encountered were more severe than forecast and these conditions were not completely known to meteorologists until post-flight time
- 3 The flight made a turn to cross the storm area, but actually almost paralleled it
- 4 Severe vibration of the aircraft structure was experienced both in the storms and in clear weather
- 5 Buffeting of the tail group was caused by the opened hydraulic reservoir access door

—38843

- 6 The manner in which the door became opened could not be positively determined

PROBABLE CAUSE

The Board determines that the probable cause of this accident was the in-flight opening of the hydraulic access door, which caused extreme buffeting of the aircraft and resulted in the captain's decision to make an emergency landing

BY THE CIVIL AERONAUTICS BOARD

/s/ DONALD W NYROP

/s/ OSWALD RYAN

/s/ JOSEPH P ADAMS

Josh Lee and Chan Gurney, Members of the Board, did not participate in the adoption of this report

Supplemental Data

INVESTIGATION AND HEARING

The Civil Aeronautics Board was promptly notified of this accident by a telephone call from an Eastern Air Lines representative at 1630 on July 19, 1951. 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 the Hotel Lexington, 48th Street and Lexington Avenue, New York, New York, on August 23 and 24, 1951.

AIR CARRIER

Eastern Air Lines, Inc., is a Delaware corporation, with its principal offices at New York, New York. The company is engaged in the transportation by air of persons, property, and mail under certificates of public convenience and necessity issued by the Civil Aeronautics Board. It also possesses air carrier operating certificates issued by the Civil Aeronautics Administration for operations between Newark, New Jersey, and Miami, Florida.

FLIGHT PERSONNEL

Captain John B. Armstrong, age 41, was employed by Eastern Air Lines, Inc., on September 9, 1929, and was transferred to duties involving flying on August 18, 1930. He is a holder of a valid airman certificate with air transport rating No. 7639 for multi-engine landplanes. Captain Armstrong had a total of 20,307.45 flying hours, of which 3,026.00 were in Lockheed Constellation equip-

ment, and 1,947.30 hours were instrument flying time. His last instrument check was accomplished on March 30, 1951, and he qualified on the Miami-New York route in 1930. Captain Armstrong received a CAA physical examination on June 21, 1951.

Copilot William C. Davis, age 30, was employed by Eastern Air Lines on April 16, 1945. He is the holder of a valid airman certificate with airline transport rating No. 391012. Mr. Davis had a total of 6,804.35 flying hours, of which 1,345.35 were in Lockheed Constellation aircraft, and 418.45 hours were instrument flying time. His last CAA physical examination was accomplished on December 22, 1950.

Flight Engineer David B. Lane was employed by Eastern Air Lines on February 1, 1947, and was checked out as a flight engineer on May 19, 1947.

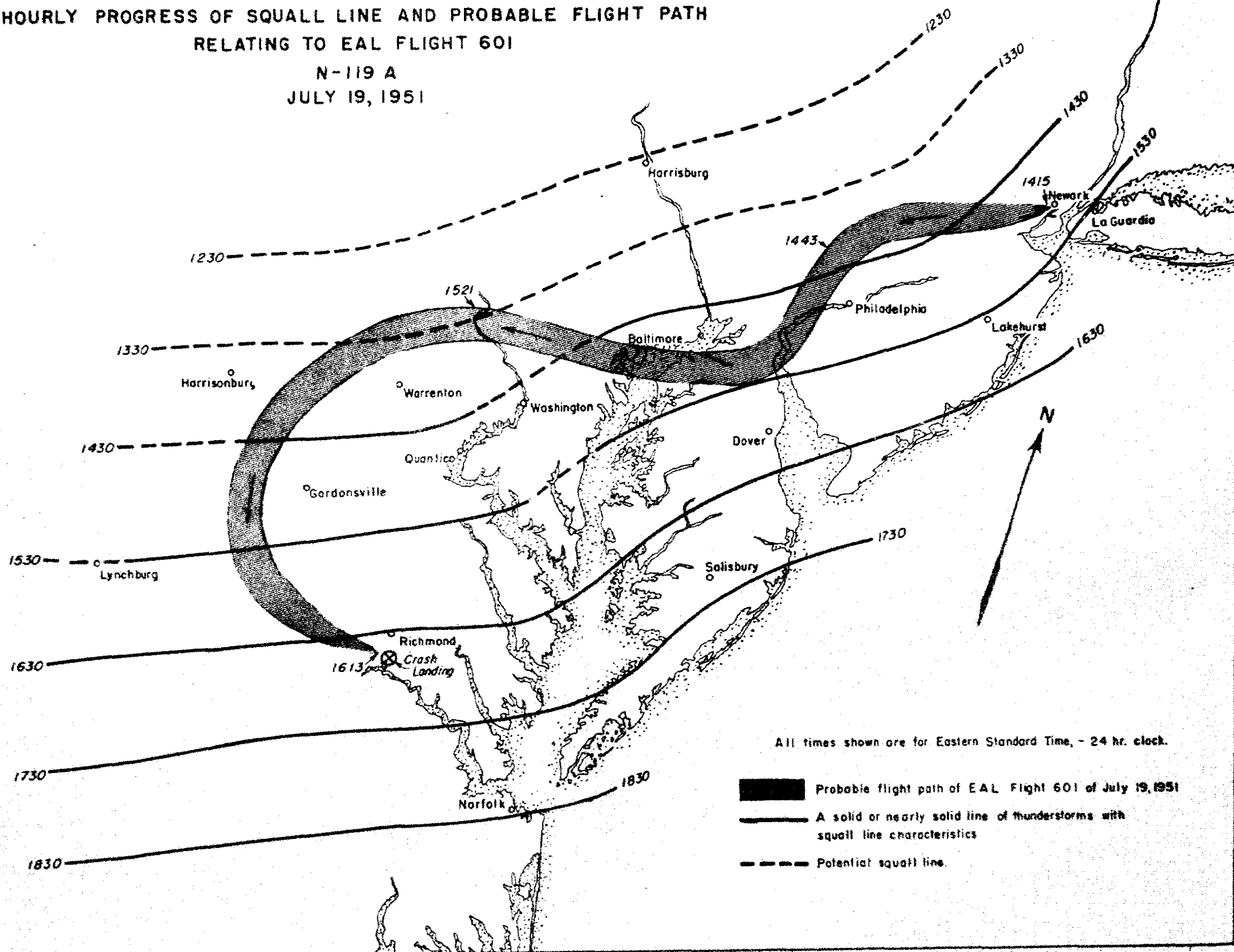
Flight Attendant John MacDonald had been employed by Eastern Air Lines since October 19, 1941. Flight Attendant Frank L. DeVane had been employed by Eastern Air Lines since November 23, 1948.

THE AIRCRAFT

N-119A, a Lockheed Constellation, Model L749, serial number 2616, was owned and operated by Eastern Air Lines, Inc. It had a total of 5,776.05 flying hours and was currently certificated by the Civil Aeronautics Administration. It was equipped with four Wright C18BD-1 engines and Hamilton Standard 33-E-60 propellers. All maintenance records for the aircraft were reviewed and no discrepancies were noted.

HOURLY PROGRESS OF SQUALL LINE AND PROBABLE FLIGHT PATH RELATING TO EAL FLIGHT 601

N-119 A
JULY 19, 1951



All times shown are for Eastern Standard Time, - 24 hr. clock.

- Probable flight path of EAL Flight 601 of July 19, 1951
- A solid or nearly solid line of thunderstorms with squall line characteristics
- Potential squall line.