CIVIL AERONAUTICS BOARD

ACCIDENT INVESTIGATION REPORT

Adopted: June 5, 1956 Released: June 8, 1956

EASTERN AIR LINES, INC., MARTIN 404, N 487A, TRI-STATE AIRPORT, HUNTINGTON, WEST VIRGINIA, JANUARY 15, 1956

The Accident

An Eastern Air Lines Martin 404, N 487A, Flight 175, was damaged extensively when it overran the Tri-State Airport, Huntington, West Virginia, at approximately 1850[1] on January 15, 1956. No injuries resulted to either crew or passengers, and no fire occurred.

History of the Flight

Flight 175 originated at Chicago, Illinois, for Charlotte, North Carolina, via intermediate stops including Louisville, Kentucky, and Huntington, West Virginia. Captain Robert C. Moore, Pilot James L. Lane, and Flight Attendant Dolores D. Pauls comprised the crew. The flight was routine to Louisville where a landing was made at 1731.

At Louisville the aircraft was serviced and at the time of departure carried 680 gallons of fuel and 32 passengers for a gross takeoff weight of 42,913 pounds. (Maximum allowable was 44,900 pounds.) The center of gravity was within prescribed limits. The crew was given the latest Huntington, Charleston, and Greensboro weather and the flight departed Louisville ramp on schedule at 1750 on a VFR flight plan, estimating 51 minutes to Huntington.

Captain Moore made the takeoff and flew the entire Louisville-Huntington segment. En route the flight requested and received an IFR clearance, via V-4 Airway to cruise at 5,000 feet, and was given the latest Huntington weather. This indicated the ceiling to be 1,000 feet, visibility 1 mile, wind calm, light snow, and that braking action was "poor" on the snow-covered runway.

Charleston approach control[2] cleared the flight for an approach to Tri-State Airport at Huntington. The aircraft crossed the end of runway 30 at an estimated speed of 90-95 knots at an altitude of 50-100 feet and passed over almost one-half the length of the 4,600-foot runway before touching down. The crew was not able to stop within the confines of the airport and the aircraft nosed slowly over the brink of a slope approximately 100 feet beyond the end of the runway.

1/ All times herein are eastern standard and based on the 24-hour clock; all airspeeds are in knots; and all distances are in nautical miles (except visibilities which are in statute miles).

2/ Charleston approach control normally handles IFR air carrier traffic for Huntington.

Investigation

The dispatch release for this flight out of Louisville listed Charleston as alternate for Huntington, and Huntington as alternate for Charleston. This was changed at 1735 listing Roanoke as alternate for Charleston, but retaining Charleston as alternate for Huntington. The Huntington, Charleston, and Greensboro weather given the crew was as follows: Huntington - Precipitation ceiling 1,500, obscuration; visibility 3/4 miles; light snow showers; smoke; temperature 29; dewpoint 26; wind calm. Charleston - 6,000 scattered, estimated 9,000 overcast; visibility 1 mile; smoke; temperature 33; dewpoint 30; wind west-southwest 5. Greensboro - 16,000 scattered, estimated 30,000 overcast; visibility 12 miles; temperature 54; dewpoint 2; wind southwest 6; breaks in the overcast.

The flight reported as being over the Lexington VOR station at 1813 at 5,000 feet to the company radio at Louisville, and requested and received an IFR clearance to Huntington. The flight reported to Charleston approach control over Bruin Intersection at 1833 at 5,000 feet and was cleared via Wayne Intersection direct to the Huntington marker to maintain 5,000 feet, and to report passing Wayne.

Charleston approach control then transmitted the flight the latest Tri-State Airport weather conditions as furnished by the company: "Precipitation ceiling 1,000, sky obscured; visibility 1; light snow; temperature 28; dewpoint 24." At 1835 Huntington company radio advised the flight directly, "We have about an inch or inch and a half of snow; we have no outgoing passengers, and braking conditions on the runway are poor."

At 1836 Flight 175 was also advised by company radio of the altimeter settings, calm wind conditions favoring runway 30, no traffic, and Huntington 1830 weather: "Precipitation ceiling 1,000 feet, obscuration; visibility 1 mile; light snow; temperature 28; dewpoint 24; wind calm, braking action poor; we have no outbound load."

Charleston approach control then cleared the flight for an approach to the Huntington Airport, to descend to and cruise at 4,000 feet, and to report leaving 5,000 feet. The flight reported leaving 5,000 feet at 1837-1/2 and passing the Wayne Intersection at 1838.

Flight 175 arrived over the Huntington H-facility[3/] at 1842, and then, in accordance with prescribed procedure, flew outbound 17 degrees magnetic and made a procedure turn, descending to 700 feet above the ground before returning at 197 degrees magnetic over the H-facility. The aircraft then proceeded to and passed directly over the airport and its single runway at about a 90-degree angle. Both pilots stated that all airport runway lights were sharp and clear through snow precipitation. A check of the windshield wiper and leading edge of the wing showed no ice. After crossing the airport the captain made a left turn of about 270 degrees, concluding the turn at an estimated three-fourths of a mile from the approach end of runway 30. Both pilots stated that again they could see all runway lights at that time.

3/ An "H-facility" is a nondirectional radio transmitter used for homing and navigational fixes.

Final approach was continued with landing gear down and flaps fully extended. The end of the runway was crossed at an estimated airspeed of 90-95 knots at an altitude of 50-100 feet. Just before touchdown Captain Moore advised Pilot Lane that he intended to use propeller reversing "because of snow on the runway and possible poor braking."

Upon touchdown Pilot Lane raised the reverse thrust lockout flag, permitting propeller reversal before the aircraft's weight was on its landing gear, and the captain used reverse thrust beyond the normal reverse range into the emergency reverse range. Pilot Lane observed the No. 1 propeller reversing light come on slightly before No. 2 came on. According to the captain, No. 2 propeller lagged momentarily. Forward visibility was completely cut off by surface snow blown forward and up by the reverse thrust. The captain noted a slight change in heading on the Flux Gate Compass and reduced r. p. m. in order to see where he was headed because of sharp drop-offs in the terrain near the runway edges, particularly to the left. When visibility was regained he realized that he was then going off the left edge of the runway. This was at a point about 1,400 feet beyond touchdown and about 1,100 feet short of the far end of the 4,600-foot runway. See Attachment A.

The captain then applied right rudder and right brake and increased the reverse thrust, taking more from No. 2 than from No. 1, bringing the aircraft to a course approximately paralleling the runway. Again blown snow blocked visibility and again the captain reduced power to regain it. He realized he was again turning to his left, away from the runway, and quickly applied right rudder and right brake to change direction. This accomplished its purpose until the aircraft was parallel to and approaching the end of the runway. Again the captain applied maximum reverse and lost all forward visibility.

During this relatively short period the aircraft maintained a course generally parallel to and at the left of the runway until, when nearing the end, it was turning to its left. It then went slowly over the brink some 100 feet beyond the runway. Both propellers remained in reverse thrust with varying amounts of power being used throughout the landing roll. Nose-wheel steering was not used to correct the swerves.

Just after the aircraft rolled over the brink of the slope the captain shut off all electrical power to lessen the possibility of fire. Total darkness resulted as the cabin emergency impact light did not come on. The stewardess was unable to reach it to turn it on because of the aircraft's extreme angle. She advised passengers to remain seated and calm.

The aircraft came to rest on a ledge about 186 feet beyond, and about 60 feet below the level of the runway. The rough terrain sloped downward about 28 degrees; the aircraft was nose-down even more to 40 degrees and tilted 15 degrees to the right. Evacuation through the rear passenger loading ramp or via windows was not feasible because of their heights above the ground and the steep nose-down angle. Consequently, and upon instruction from the crew using flashlights, all passengers deplaned via the left front loading door without disorder despite the difficulty induced and augmented by darkness and slippery, rocky, sloping terrain.

The first point of touchdown was made by the left landing gear at a point 2,015 feet down the runway. All three landing gears were on the runway a measured distance of 2,130 feet from the approach end and slightly left of center laterally.4/ This runway has no gradient and is 4,600 feet long and 150 feet wide, with level sodded areas extending about 100 feet at both ends. The left or south side is bordered with a level sodded area about 125 feet wide; the other side has a similar area about 225 feet wide. The terrain falls away in varying degrees of steepness from both ends and from most of both sides.

There was no physical evidence of fire either before or after impact although several passengers reported a momentary flash fire near the left engine after the aircraft came to rest. Both propellers and the nose sections of both engines were torn free before the aircraft stopped. The lower drag strut of the nose landing gear failed and the gear folded backwards damaging the adjacent lower portion of the fuselage. Damage to the fuselage, although of a major nature, was confined to the forward region generally below the aircraft's floor line. All passenger seats were intact and no seat belt failed. Emergency exits were not used but all were operational. Wing flaps were found fully extended.

Examination of the landing gear latching mechanisms revealed that all three landing gears were extended and locked, and that the nose gear steering cylinder was intact and in normal operating condition. Examination of the brake system failed to reveal any indications of operating distress and all hydraulic lines were intact. Both sets of main tires had about equal amounts of tread and inflation.

Both engines, both propellers, both propeller governors, and the two main landing gear wheels with their brakes were studied at the Miami base of Eastern Air Lines. This examination showed that:

a. Neither engine had had any evidence of failure or any precrash condition that would cause malfunctioning.

b. Both propellers had been operating within specified pitch limits and all examination of their components indicated that they were in good condition prior to impact with the ground.

c. Bench tests of both propeller governors revealed no evidence of failures or any condition that might have caused malfunctioning.

d. Both brake assemblies were in good condition and should have been operating normally. All brake pucks were free in their housings and show no excessive wear, nor did the brake housings show any evidence of excessive heat.

A careful examination showed that the rigging between the reverse throttle levers and the reversing throttle switches was such that final actuation of the reverse switches occurred when both throttles were moved

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4/ This, and other information, including the actual ground track of the aircraft down the runway, is depicted in Attachment A.

aft 1½ inches. This specified rigging limit is 1½ inches, plus or minus 1/8 inch.

Examination of the rigging between the throttle levers in the cockpit and the throttle openings at both carburetors showed proper adjustment. With both throttles in the reverse idle position, both throttle arms were 1/4 inch from their stops; with both throttles in the full reverse position, both throttle arms were 1½ inches from their stops. Impact had stretched the throttle cables to a degree where testing of their tensions could not be significant.

All logbook entries for a significant period preceding the accident were carefully reviewed. Nothing was found to show evidence of operational difficulty or failure of the propeller reversing, hydraulic or braking systems, or of the nose-wheel steering system. There were no squawks or mechanical irregularities reported by either of the two crews who flew N 487A on its two flights immediately prior to the one culminating in this accident.

The high-intensity runway boundary lights were of variable output and were set at position No. 3, which is midway in brilliance between positions No. 1 (minimum) and No. 5 (maximum). They had been at that setting before the accident and the incoming pilot did not request any change. His testimony indicated that he was completely satisfied with the runway lighting and that runway lights were within his range of vision throughout the entire final approach.

The "poor" braking reported to the crew was the result of actually testing the braking conditions on the runway in an airport limousine equipped with snow tires only a few minutes before Flight 175 arrived. Speed was increased up to 45-50 miles per hour with difficulty because of poor traction on the runway and the car then braked violently. The resulting skid and spin were of such nature that its driver, an airport employee, decided to use "poor" as a means of describing the condition, although there was some evidence that it was much worse than "poor." However, "poor" was entered in the official log, and was duly reported to and acknowledged by Flight 175.

The last previous flight to land at the Tri-State Airport before Flight 175 was also an EAL Martin 404. It landed without incident about one hour and 20 minutes earlier and its crew reported that braking was "fair." At that time snow was falling and the snow cover on the runway was about two inches deep.

Eastern Air Lines' landing minimums for Martin 404's at Tri-State Airport are 700 feet ceiling and 1 mile visibility. Conditions prevailing at 1830, the last official observation, were reported to the incoming flight as 1,000 feet and 1 mile.

Captain Moore and Pilot Lane testified that their approach was substantially normal, that final was started at about three-fourths mile from the approach end of the runway at an estimated altitude of 500 feet, and that they came over the end of the runway at an estimated 50-100-foot altitude.

They also testified that their final turn into approach was terminated at the proper point so that little or no deviation from a straight path was necessary. However, this is contrary to the testimony of a number of ground witnesses who described an appreciable bank to the right immediately prior to touchdown. These witnesses in consensus, but with considerable generality, were of the opinion that the approach was higher and/or faster than is customary with similar aircraft. Captain Moore testified that he purposely came over the approach end of the subject runway a bit higher than at other airports because of the sharp drop in terrain at that end of the runway and the consequent possibility of turbulence at that point. There was some testimony that a burst or several bursts of power were used just before touchdown, but the captain insisted that he did not apply any power at that time or elsewhere during final approach.

Reversal of the aircraft's propellers is accomplished by pulling back the main throttles to the idle position and then continuing rearward with the reversing throttle into the reversing range. For normal reversing the force required to pull the latter back is adjusted to eight pounds per throttle. An additional 15 pounds per throttle is required to bring them further back into the "emergency" reverse range. Thus the total force needed is 46 pounds.

The Martin 404 aircraft carries a placard in the cockpit relative to reversing propellers. It reads: "Exercise caution in using reverse thrust on runways covered with dust, snow, or other matter which would reduce visibility." This same warning appears in Eastern Air Lines' Flight Manual for the Martin 404 which states further: "Caution should also be exercised when approaching the low speed range of the landing run so that the operator will be prepared for sudden control buffeting which might be injurious to the operator or structure unless the controls are monitored by the pilot or copilot during reverse thrust application. While the control forces are not excessive when operating in a normal power range for reverse thrust, the controls are subject to sudden and sharp reversals when approaching the slow speed range of the landing run."

All radio navigational and communication facilities, as well as the airport and runway lights, were found to have been operating normally.

Wind conditions at the Tri-State Airport were very light to calm at the surface when Flight 175 was making its approach and landing. The pressure gradient was weak in that area; light wind was indicated for the first two or three thousand feet above the surface. No turbulence was indicated at low levels. The temperature on the morning of the accident had been down to 13 degrees and never rose above 32 degrees during the day. As thin obscuration of the sky existed, followed by an overcast, there was not much opportunity for the runway surface to have become warm enough to melt the snow even in the beginning of the fall. It therefore appears doubtful that ice existed below the snow cover unless it remained from a previous condition. However, in some cases very poor braking exists on a dry snow cover.

The weather reporting service at the Tri-State Airport at Huntington, West Virginia, is classed as a Supplemental Aviation Weather Reporting

Station. This means that the observers have been obtained by the Weather Bureau from airline and/or airport personnel and that following a period of training in weather observations, they have been certificated as competent to make surface weather observations.

Analysis

Captain Moore attributed the first swerve to the left to a momentary lag in the No. 2 (right) engine. This would cause more, or quicker, reverse thrust on the left engine than on the right and consequently result in a tendency to yaw to the left. But it seems unlikely that any momentary lag in the No. 2 engine caused the initial swerve because the aircraft traveled a good 1,000 feet before swerving. (This distance would have taken 7.4 seconds at an assumed average speed of 80 knots.)

Subsequent swerves to the left, as the aircraft continued generally parallel to the runway, occurred as Captain Moore attempted to use maximum reverse thrust to stop the aircraft on the airport. He was using different amounts of reversing to effect steering and stop the aircraft without any forward visibility except for two brief periods, as described.

The given braking condition of "poor" did not carry with it a warning against landing; it was merely information for the captain to use as he saw fit. Adjectives in common usage to describe braking effectiveness are "good," "fair," "poor," and "nil." None, not even "nil," is tantamount to a prohibition against landing because even with little or no braking it is possible to land and stop on certain runway lengths, depending on wind, gradient, altitude, temperature, and other factors.

Captain Moore could not explain why he landed so far down the runway after a final approach such as he described. As stated, there was little or no wind, and if the aircraft had crossed the boundary at 50 feet altitude and at the conventional speed of 90-95 knots, then the touchdown should have been well within the first quarter of the runway.

If the approach was conducted as Captain Moore testified, then there would have been no need for any final maneuver or maneuvers just prior to touchdown as described by witnesses, although denied by Captain Moore. It seems probable that there was some misalignment of the final approach to the right of the runway as a result of overturning during the close-in circling approach.

The fact that Captain Moore advised Pilot Lane to raise the reverse flag before touchdown indicates that he realized he was then critically far down the runway and wanted to be sure of instantaneous reversal on demand.

The Board concludes that Captain Moore made his last turn into final somewhat higher, closer, or faster than he would have during better visibility. Visibility of one mile was exactly at authorized minimum.

It was found during the course of the investigation that additional training of the weather observers would be desirable. This does not appear

to have been a factor in the accident; however, the Weather Bureau has started a program for improving the training of personnel and inspection of this class of stations.

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 last weather report for 1830 given the flight included 1,000 feet ceiling, 1 mile visibility, and light snow; the captain confirmed that these conditions prevailed during the approach.

3. Captain Moore had been advised of snow on the runway and that braking conditions were poor.

4. The approach caused the touchdown to be nearly half-way down the 4,600-foot runway.

5. Captain Moore was familiar with the aircraft's placard warning of the use of propeller reversing on ground snow and the elaborated material on the subject contained in the aircraft's flight manual.

6. Propeller reversal blew up snow, completely obscuring forward visibility.

7. The on and off application of reverse thrust, in order to regain visibility, impaired deceleration so that the aircraft overran the airport.

Probable Cause

The Board determines that the probable cause of this accident was improper approach and subsequent landing too far down a snow-covered, slippery runway.

BY THE CIVIL AERONAUTICS BOARD:

/s/ JAMES R. DURFEE

/s/ CHAN GURNEY

/s/ HARMAR D. DENNY

Adams, Vice Chairman, did not participate in the adoption of this report.

SUPPLEMENTAL DATA

Investigation

The Civil Aeronautics Board was notified of this accident shortly after occurrence. An investigation was immediately initiated in accordance with the provisions of Section 702 (a) (2) of the Civil Aeronautics Act of 1938, as amended. Depositions in connection with the investigation were taken at Huntington, West Virginia, on February 13 and 14; at Chicago, Illinois, on February 15; at McGuire Air Force Base, Trenton, New Jersey, on March 8; and at Washington, D. C., on May 15, 1956.

Air Carrier

Eastern Air Lines is a Delaware Corporation engaged in the transportation by air of persons, property, and mail under certificates of public convenience and necessity issued by the Civil Aeronautics Board and an air carrier operating certificate issued by the Civil Aeronautics Administration. These certificates authorized flight between Chicago, Illinois, and Huntington, West Virginia, and numerous other places.

Flight Personnel

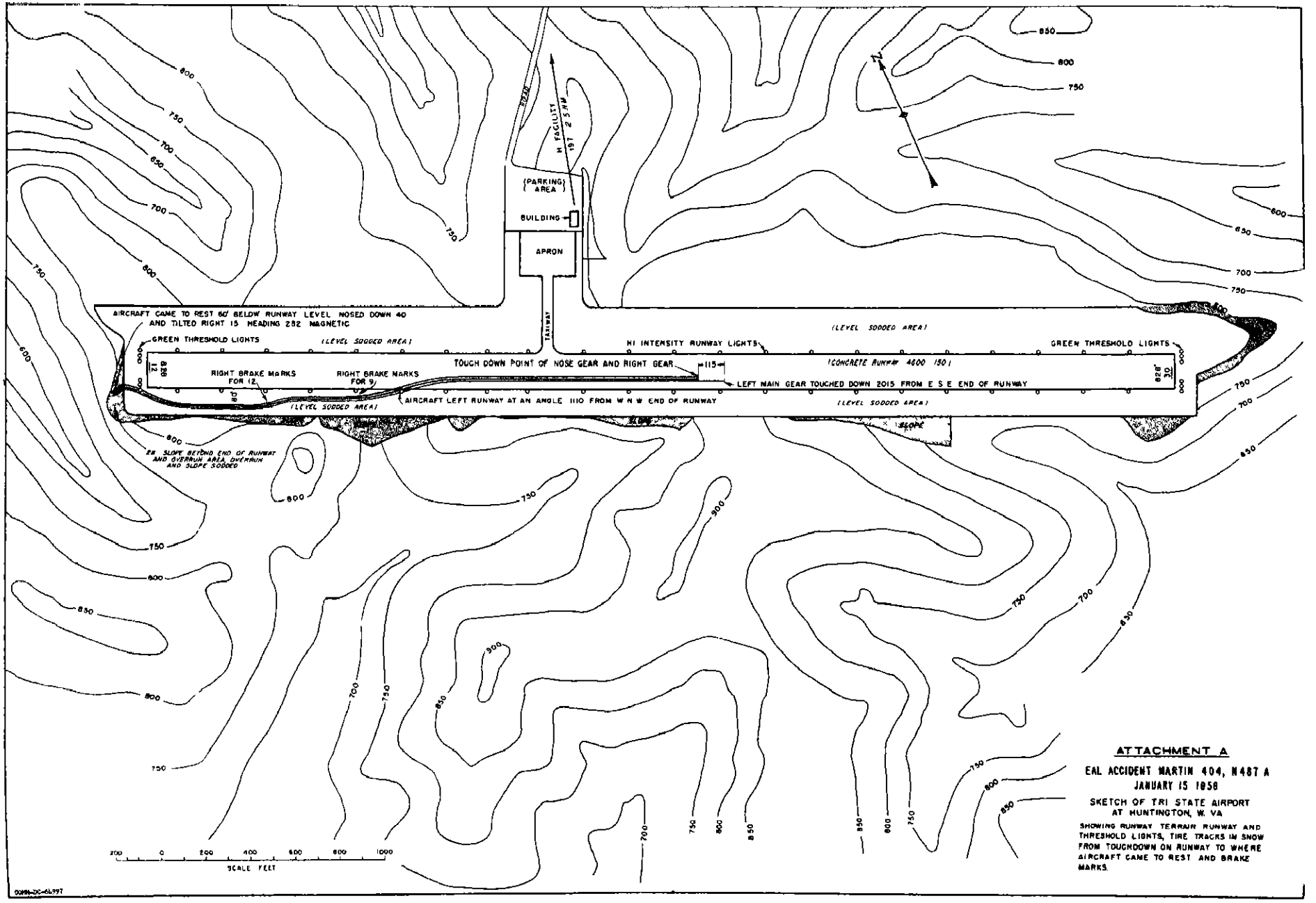
Captain Robert C. Moore, age 34, was employed by Eastern Air Lines as a pilot on June 6, 1946, and made his first flight as captain on July 1, 1953. He held a valid airline transport pilot certificate with a rating for the subject aircraft. Captain Moore had a total of 9,680 flying hours, of which 2,351 hours were in Martin 404's, and 535 hours of instrument flying. He passed a CAA physical on October 27, 1955. Captain Moore had made 11 previous landings at Tri-State Airport, all at night and all in Martin 404's.

Pilot James L. Lane, age 29, was first employed by Eastern Air Lines, December 28, 1953. He later was furloughed, was re-employed on August 8, 1954, again furloughed, and again re-employed on December 8, 1955. He held a valid commercial pilot certificate with airplane single- and multi-engine land and instrument ratings. Pilot Lane had a total of 2,426 flying hours, of which 856:17 hours were in Martin 404's, and 90:29 hours of instrument flying. He passed a CAA physical on December 15, 1955.

Flight Attendant Dolores D. Pauls, age 23, was employed by Eastern Air Lines as a student flight attendant on June 6, 1955. She completed Eastern Air Lines Flight Attendant Training on July 9, 1955, and was then promoted to flight attendant.

The Aircraft

N 487A, a Martin 404, serial number 14235, was owned and operated by Eastern Air Lines and was currently certificated by the Civil Aeronautics Administration. The aircraft had accumulated approximately 9,854:00 hours. It was equipped with two Pratt and Whitney R-2800-CB3 engines and two Hamilton Standard model 43E60 propellers. The airframe, engines, and propellers had been maintained in full compliance with prescribed methods and within all time limitations.



ATTACHMENT A

EAL ACCIDENT MARTIN 404, N487A
JANUARY 15 1958

SKETCH OF TRI STATE AIRPORT AT HUNTINGTON, W. VA

SHOWING RUNWAY TERRAIN RUNWAY AND THRESHOLD LIGHTS, TIRE TRACKS IN SNOW FROM TOUCHDOWN ON RUNWAY TO WHERE AIRCRAFT CAME TO REST AND BRAKE MARKS.