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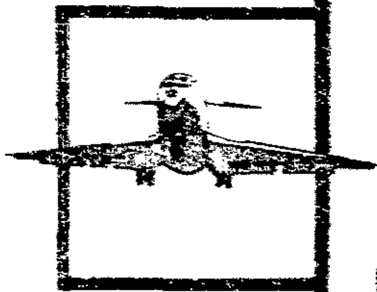

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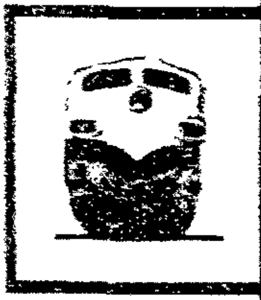

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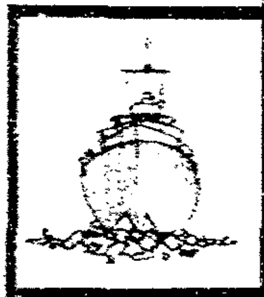
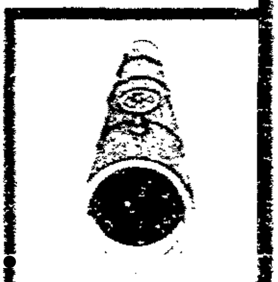
AIRCRAFT ACCIDENT REPORT



HENSON AIRLINES FLIGHT 1517
BEECH B99, N339HA
GROTTOES, VIRGINIA
SEPTEMBER 23, 1985



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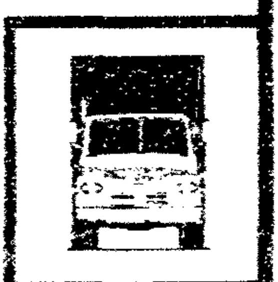

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15. Supplementary Notes

16. Abstract
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The wreckage of flight 1517 was located about 1842 approximately 6 miles east of the airport. Both crewmembers and all 12 passengers were fatally injured.

17. Key Words
Beech 99; procedure turn; localizer; glideslope; ILS; nonstandard VHF navigation radios; missed approach; interphone system; rapid turnover; FAA surveillance training; commuter air carrier; limited experience; high noise level; significant life events; uncertain of position; failure to maintain prescribed altitudes

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The National Transportation Safety Board determines that the probable cause of this accident was a navigational error by the flightcrew resulting from their use of the incorrect navigational facility and their failure to adequately monitor the flight instruments. Factors which contributed to the flightcrew's errors were: the nonstandardized navigational radio systems installed in the airline's Beech 99 fleet; intra-cockpit communications difficulties associated with high ambient noise levels in the airplane; inadequate training of the pilots by the airline; the first officer's limited multiengine and instrument flying experience; the pilots' limited experience in their positions in the Beech 99; and stress-inducing events in the lives of the pilots. Also contributing to the accident was the inadequate surveillance of the airline by the Federal Aviation Administration which failed to detect the deficiencies which led to the accident.

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CONTENTS
(continued)

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C. 20594

AIRCRAFT ACCIDENT REPORT

Adopted: September 30, 1986

HENSON AIRLINES FLIGHT 1517
BEECH B99, N.~9HA
GROTTOES, VIRGINIA
SEPTEMBER 23, 1985

SYNOPSIS

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1 FACTUAL INFORMATION

1.1 History of Flight

Henson Airlines (Piedmont Regional) Flight 1517, a Beech 599, N339HA, wes cleared €or takeoff from Baltimore-Washington International Airport (BWI) at 0922 e.d.t. 1/ on September 23, 1985. Two crewmembers and 12 passengers were aboard the scheduled domestic passenger flight (commuter) operating under 14 CFR 135.

1/ All times herein are eastein daylight based on the 24-hour clock.

The computer stored instrument flight rules (IFR) plan for flight 1517 was: BWI, Victor Airway 214, Martinsburg, West Virginia (MRB) VORTAC, 2/ direct to the Linden, Virginia (LDN) VORTAC, direct to Shenandoah Valley Airport (SHD), at a requested cruising altitude of 6,000 feet above mean sea level (m.s.l.). 3/ (See figure 1.)

The crew had reported for duty about 0515 and had flown from the Washington County Regional Airport, Hagerstown, Maryland (HGR) to BWI, from BWI to HGR, and from HGR to BWI. Weather information, which was provided by Eastern Airlines from National Weather Service (NWS) sources, was available to the crew at Henson's Hagerstown office. A more detailed weather briefing could have been obtained from Henson's flight control center in Salisbury, Maryland, but the crew did not call for additional weather information.

Air traffic control (ATC) handling of flight 1517 was routine. (See appendix D.) All transmissions from the airplane were made by the captain. The approach clearance to SHD was issued at 0959:14, and radar service was terminated at 1003:25. (See figure 2.) About 1005, the flightcrew made an in-range call 4/ to Henson's SHD station agent to report the number of passengers aboard and to request 100 gallons of fuel. Shortly thereafter, the flightcrew called the SHD UNICOM 5/ on 123.0 MHz, the Common Traffic Advisory Frequency (CTAF), to request weather and traffic information. The UNICOM operator transmitted the 0945 weather observation and advised that there was no reported traffic. About 1011, flight 1517 crossed the localizer for runway 4 eastbound on a magnetic track of about 075°. (See figure 3.) The last recorded radar return was at 1011:55 when the airplane was at 2,700 feet.

At 1014:18, after the airplane had descended below the area of radar coverage, the Gordonsville Low Altitude Sector Radar Controller (R31) asked flight 1517 to ". . .say your position," and at 1014:19 the captain replied, "ah we were gonna ask you we're showin a little west of course the inbound come here" and at 1014:25, ". . .we're turn inbound now. . . ." 6/ Later, the controller said that he ". . .could not see him [flight 1517] on the radar at that time." He stated that he would have expected a Beech 99 to land at SHD about 7 to 9 minutes after he terminated radar service at 1003:25. At 1014:26, the captain acknowledged an instruction to report passing STAUT, the locator at the outer marker (LOM). At 1015:55, the pilot inquired whether the center controller showed the aircraft east of course. The controller told flight 1517 that radar contact was lost and, at 1017:49, suggested a missed approach if the airplane was not established on the localizer course. There was no response from flight 1517. Repeated attempts to contact the flight were unsuccessful.

At 0945, the weather at the Shenandoah Valley Airport, as reported by Henson's station agent/weather observer was: sky--overcast at 1,000 feet above ground level (a.g.l.), visibility--2 miles in fog; temperature--63° F; dewpoint--missing; wind--calm; and altimeter-- 30.20 inHg.

2/ A VORTAC is a combined navigational facility consisting of a very high frequency omnidirectional range and tactical air navigation, which provides distance measuring equipment for civilian aircraft.

3/ All altitudes appearing herein are mean sea level unless otherwise noted.

4/ According to the Henson station agent, the in-range call is usually made about 10 minutes before arrival.

5/ UNICOM is a nongovernment communication facility which may provide airport information.

6/ The original transcript (see appendix D) stated, ". . .we're turnin inbound now." On January 23, 1985, the ATC group reconvened and agreed that the transmission was, ". . .we're turn inbound now.. . ."

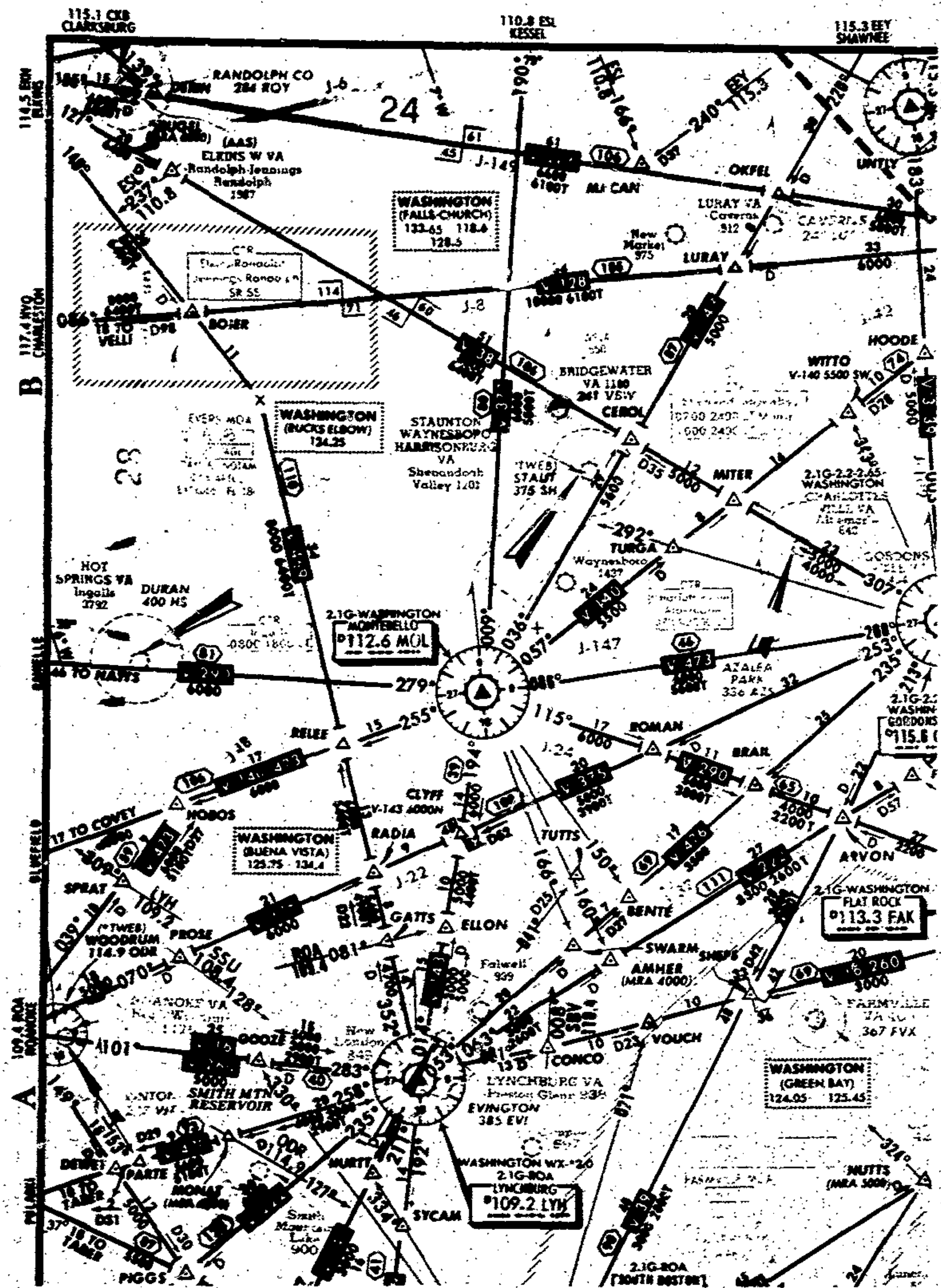

ILLUSTRATION ONLY - NOT TO BE USED FOR NAVIGATIONAL PURPOSES

Figure 1.—En route chart.

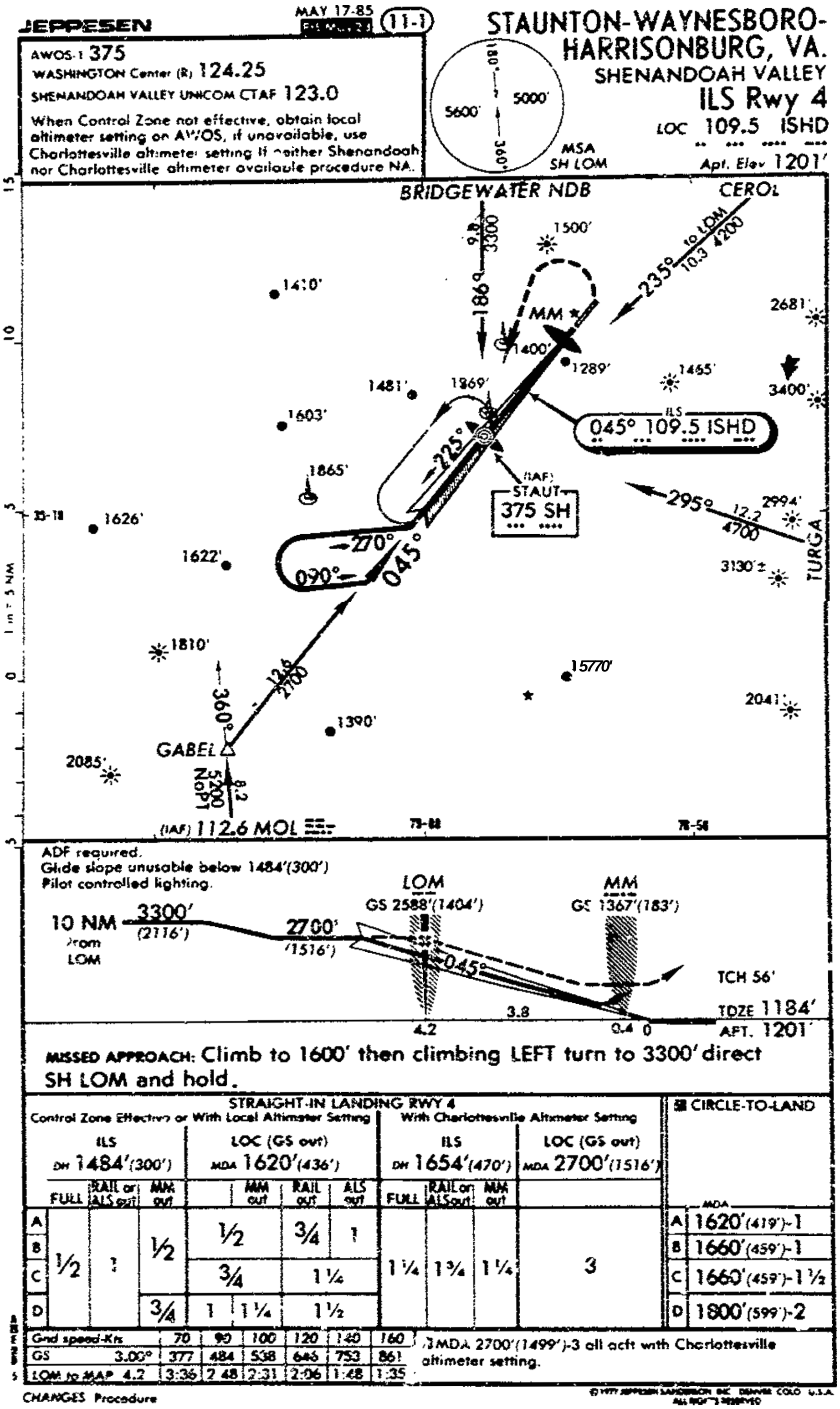

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Figure 2.—Approach chart.

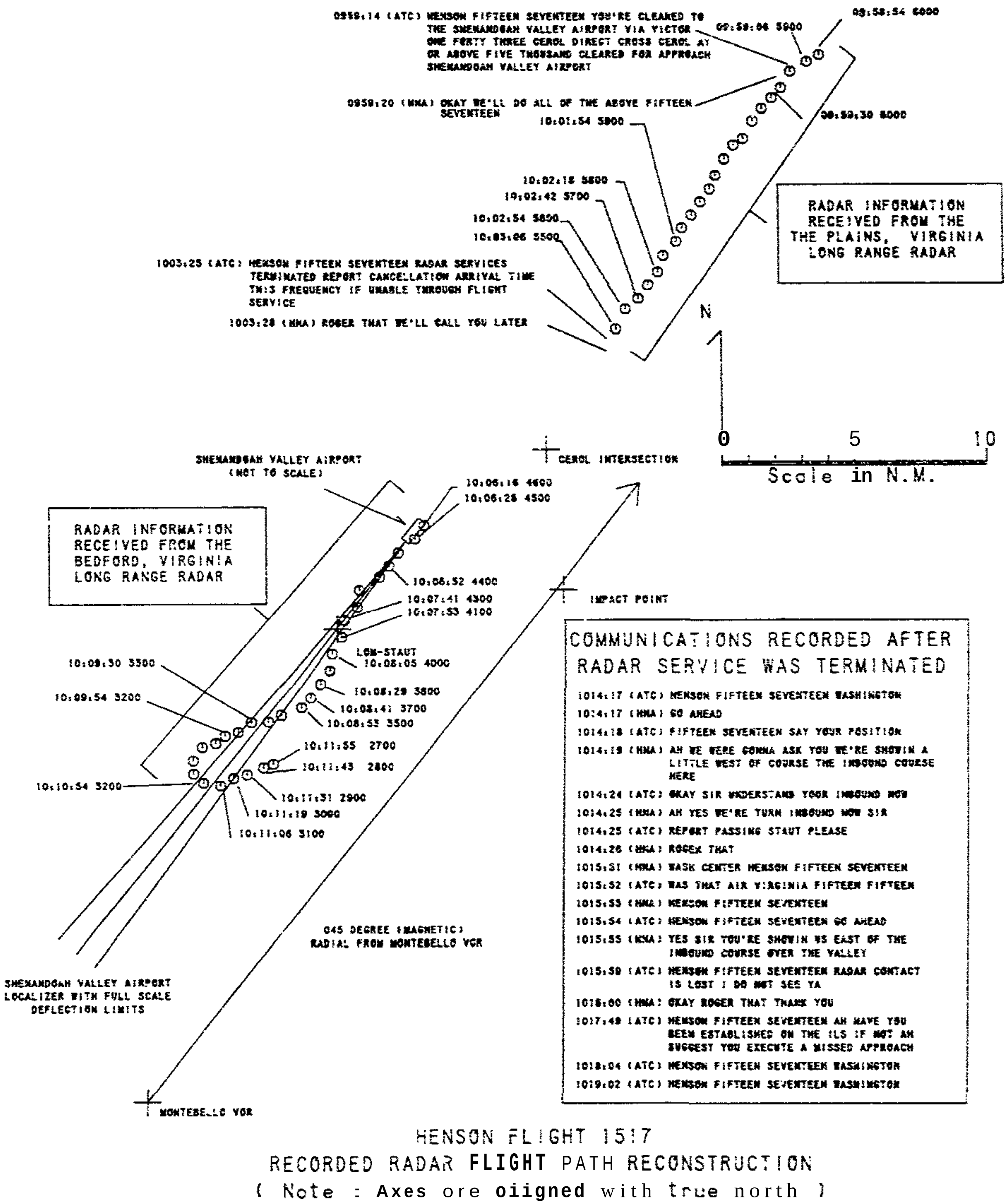

Figure 3.—Recorded radar flightpath reconstruction.

The airplane failed to reach its destination, and about **1025,** *a* communications search, the **Erst** step in search and rescue (SAR), was initiated by ATC. The **results** were negative, **and** the SAR Canter at Scott **Air** Force Base, **Illinois,** was notified of the missing airplane. Fuel exhaustion tine for flight 1517 was **calculated** to [illegible] at **1130. About 1137, SAR** authorities were notified that the airplane was p[illegible] down, **and** about **1430 ground end air** searches were initiated. The air search was [illegible] and hampered by **poor** weather in **the** mountainous terrain. The **airplane was** locateo about **1842** by a Civil Air Patrol observer about **6** miles **east** of the airport. The airplane **had** struck the southwest face of **Hal:** Mountain at an elevation of **2,400** feet at **3893'35.70"** north latitude **and 78°46'37.50"** west longitude. It was not possible to determine the exact time of the accident. The captain's watch **had stopped** at **1022** and **the** airplane's clock had stopped at **1026.**

Due to inaccessible terrain **and** heavy forest, crash/fire/rescue (CFR) equipment **could** not be brought into the area. Medical personnel **were lowered by** helicopter into the crash site, where they found no survivors.

1.2 Injuries to Persons

Injuries	Crew	Passengers	Total
Fatal	2	12	14
Serious	0	0	0
Minor/None	0	0	0
Total	2	12	14

B Damage to Aircraft

The airplane was demolished by impact forces and postcrash fire.

1.4 Other Damage

Ground damage **was** limited to ***trees*** and foliage. **Tops,** limbs, and branches of **trees** were felled **by** the airplane's passage and by propeller strikes. Cne large oak **tree** was uprooted just before the airplane came to rest.

1.5 Personnel Information

The flightcrew was properly certificated to conduct the flight, met the existing requirements of Federal Aviation regulations (FARs), and complied with company policy. (**See** appends B.)

The captain attended Embry-Riddle Aeronautical University between September **1977** and **July** 1980. He attended the Florida Institute of Technology between **August 1980 and** December **1982.** He held a position as corporate pilot for R.M. Singer and Associates between June **1981** and May **1383,** and was employed as a flight instructor at Frederick Aviation in Frederick, Maryland, between May **1983** and July **1984.**

The captain was hired by Henson on July **30, 1984,** with a **total flight** time **of 2,413** hours, **442** of **which** were **in** multiengine airplanes **and 75** of which were in **actual instrument** conditions. At the time of the accident, his total flying tine **was 3,447** hours, with 1,382 hours *in* multiengine airplanes and **301** hours **in the** Beech **99,** about 118 hours **of** which were as PIC and **158** hours were actual instrument time, **19** of which were in the Beech 99. **A** first class medical certificate with no limitations or waivers was issued **on**

April 17, 1985. He completed his first officer training in the SD3-30 (Shorts 330) on September 4, 1984. June 3-9, 1985, he attended Beech 99 transition school and took 3.5 hours of flight training to proficiency (June 6-81, which included 2.6 hours of instrument training; none in instrument meteorological conditions (IMC). He was assigned as a Beech 99 first officer on June 10, 1985. On June 17, 1985, he receiver! left seat authorization, a program in which a candidate for captain flies in the left seat but is not designated as pilot-in-command (PIC). He completed his Beech 99 captain upgrade training on August 16, 1985, in 4.9 hours, 3.5 of which were instrument training; all were in visual conditions. His instructor was unable to remember anything remarkable about the captain's flying skills. Between August 18 and 20, 1985, he received his initial operating experience (IOE), which consisted of 16.2 hours (with 4.6 hours in IMC), and 15 landings. During this time, he conducted four ILS approaches end one VOR approach; two ILS approaches were into SHD. All except one of the instrument approaches were conducted on the first day of his IOE. On August 20, 1985, he was upgraded to captain and e Henson check airman noted in his IOE log that his performance was satisfactory and that his IOE was complete. Additionally, he stated under the comments section, "Recommend a routcheck [sic] within 2 weeks."

The check airman testified under oath that be was unable to remember why he recommended a route check, but recalled that it was something which occurred on the first of the 3 days of IOE. He also testified that he customarily withheld comments until the operational experience was complete. The route check was never performed because e consultation was held with the Director of Airline "raining who testified that, ". . . it is either you a?e qualified or you ere not qualified. You don't send an individual out to fly passengers and then see if they are qualified." Except for that comment in his IOE log, all of the captain's training and proficiency records indicated satisfactory performerce and contained no negative comments. The captein conducted six instrument approaches as a captain with Hanson Airlines, all ILS; none were conducted at SHD.

Two days before ?he accident, the captain had announced his engagement to be married and had proposed a date for the wedding. He was scheduled for his final pilot employment interview with Eastern Airlines in Miami, Florida, on the day following the accident, although he had not requested leave and was scheduled to fly for Henson OR that day. "he captain had been off duty 2 days before the accident. He had retired a? 2130 the night before the accident end erose about 0330 on the day of the accident.

The first officer held several flying jobs in New York and Florida between April 1980 end July 1985, including charter pilot for land and see airplanes, tow pilot for gliders, banner tow pilot, jump pilot, and fight instructor.

The first officer was hired by Henson on July 15, 1985, with a total flight time of 3,200 hours, 154 of which were in multiengine airplanes and 75 of which were in actual instrument conditions. At the time of ?he accident, her total flying time was 3,329 hours, wit? 283 hours in multiengine airplanes, and 119 hours in the Beech 99; 87 hours were actual instrument time, 12 of which were in the Beech 99. She attended Basic Indoctrination July 15-17, 1985, and Beech 99 Initial Training, July 23-20, 1985, followed by 5.2 hours of training to proficiency on August 1-3, 1985, which included 2.6 hours of instrument training; none were in IMC. Her instructor characterized her flying skills as average. Between August 6 and 10, 1985, she received her IOE, which consisted of 13.8 hours. '?raining records show thet 1/2 hour was in IMC, even though the cheek airman noted on the IOE log that all flights were in VFR conditions. During her IOE, the first officer made five landings and no instrument approaches. Her check airman could not remember her flying skills specifically and thus concluded that they must have been average. On August 10, 1985, the first officer was assigned as a Beech 99 first officer. Her treining records indicated satisfactory performance with no negative comments. She conducted 23 instrument approaches as a first officer with Henson Airlines, 20 ILS; none were conducted at SHD.

Other Henson line pilots, who had flown with the first officer following completion of her IOE, characterized her abilities as a pilot from "average to good for her experience level" to "always behind the airplane in her instrument flying."

Before being hired, the first officer had submitted two different resumes to Henson. The first was submitted with her initial employment application; tiie second was submitted about 6 months before she was hired to update her application. ?%e resumes showed different flying times, and each differed from her Henson employment form. These comparative times follow.

	First Resume	Second Resume	Henson Employment Form	
Total	3,224	2,950	3,200	
PIC	3,012	2,030	2,000	
Instrument	264	160	135	(75 actual)
Multi	550	150	154	
Night	350	175	175	
Cross Country	1,900	1,050	-----	
Complex	1,850	550	-----	

The first officer shared an apartment in Hagerstown, Maryland, with another Henson employee, who stated that the first officer had some concerns about her health but did not want to go to a doctor in Maryland because she could not afford it. The roommate said that she suggested taking the first officer to an emergency clinic, which would have been paid by Henson's medical coverage, but that the first officer chose to wait until her vacation. Her roommate reported that the first officer had trouble sleeping away from home on overnight layovers.

The first offieer had just returned to duty after spending 8 days in Florida where she visited her husband. A Florida physician, who had examined the first officer 5 days before the accident, stated that she had expressed some concern over irregular menses, a lump in one breast, and soreness in her left shoulder and breast. The physician recommended an over-the-counter pregnancy test, which subsequently proved to be negative, and told her that lumps he found in both breasts were fibrocystic disease and probably not cancerous. No mammogram was performed. The first officer's mother died of cancer at the age of 47. The physician noted that the first officer reported to him that she took birth control pills in accordance with her prescription and that she also rook diethylpropion (a diet drug) to stay awake while flying. The first officer, however, did not report taking either birth control pills, diethylpropion, or any other medication on an August 27, 1985, aviation medical examination form.

The first officer's husband reported that she had taken e substantial pay cut from about $500 per week as a self-employed charter pilot to $850 per month which increased to $1,005 per month as a pilot for Henson. He said that she thought the $0.85 per hour per diem pay was inadequate.

The first officer had retired at 2130 the night before the accident and reported at the Hagerstown Airport et 0515 on the day of the accident.

18 Aircraft Information

N339HA, a Beech B99, was certified and maintained in accordance with applicable regulations. (See appendix C.) The airplane was equipped with two Pratt & Whitney Aircraft of Canada, Ltd., PT6A-27 turbopropeller engines and two Hartzell HC-B3TN-3B propellers.

A review of the maintenance and inspection records for N339HA far June 1985 through September 22, 3985, disclosed no repeated discrepancies or component failure trends. The review indicated that corrective actions were accomplished for each of the recorded discrepancies when a problem was found. A review of the phase inspection records for the 6-month period before 'the accident indicated that *all* inspections had been conducted before their specified time intervals. A review of the records concerning the altimeter, the transponder, the automatic direction finder (ADF), the distance measuring equipment (DME) and the heading indicators (directional gyros) indicated that between July 23 and September 23, 1985, there were two recorded discrepancies; the first involved the two transponders and the second involved the ADP. These discrepancies were corrected. All applicable Federal Aviation Administration (FAA) Airworthiness Directives (AD) were complied within their specified time limits. All time/cycle life limited engine and airplane components were replaced within their specified times or cycles.

The airplane was involved in e gear up landing on February 25, 1983, which resulted from the failure of the nose gear to extend due to the rupture of e pressure line to the nose gear actuator. It was repaired in accordance with standard procedures and was returned to service.

The logbooks for the airplane noted that 2 weeks before the accident the first officer's ILS localizer indicated a full left deflection when the airplane was on course with a normal glideslope indication. The unit was functionally tested and no irregularities were revealed. Following a 2-day interval with no problems noted, a scheduled avionics third phase inspection was completed and again, no irregularities were noted. The airplane flew for 11 days before the accident with no pilot reports of ILS problems.

1.7 Meteorological Information

SHD is served by a supplementary aviation weather reporting station (SAWRS) and an automatic weather *observing* system (AWOS). Surface weather observations are made by Henson employees who hold certificates issued by the National Weather Service (NWS). The weather reporting station is located *in* the main terminal building. The following surface weather observations were made on September 23, 1985:

> 0845—Record: estimated ceiling—2,000 feet overcast; visibility—2 miles, fog, haze; temperature—63° F; winds—calm; altimeter setting—30.19 inHg.
>
> 0945—Record: estimated ceiling—1,000 feet overcast; visibility—2 miles, fog; temperature—63° F, winds—calm, altimeter setting—30.20 inHg.

1045--Record: estimated ceiling--1,000 feet overcast; visibility--2 miles, fog; temperature--66° F, winds--calm, altimeter setting--30.20 inHg.

The NWS Area Forecast for the northeast issued on September 23, 1985, at 0840 Greenwich mean time (G.m.t.) and valid until September 23, 1985, at 2100 G.m.t. contained the following information pertinent to the geographical area in which the accident occurred:

A. Flight Precautions--IFR, mountains obscured, thunderstorms.

B. Ceilings--1,000 to 2,000 feet broken variable to overcast; visibility--3 to 5 miles in fog, occasional ceilings below 1,000 feet overcast and visibility below 3 miles. Mountains occasionally obscured.

Between 1005 and 1010, the station agent went outside the main terminal building to the ramp area to wait for flight 1517, based on his anticipation that it would arrive about 10 minutes after the in-range call. He said that the weather had not changed from his 0945 observation.

There were no NWS AIRMETS, SIGMETS, or convective SIGMETS 7/, and no Air Route Traffic Control Center (ARTCC) Weather Advisories or Meteorological Impact Statements, issued by the ARTCC weather service unit meteorologist at the Washington ARTCC, were in effect at the time in the geographical area of the accident. NWS weather radar data for 0930 and 1030, obtained from the weather radar site at Patuxent River, Maryland, indicated that there were no weather echoes in the area of SHD. Upper winds between 2,000 and 4,000 feet varied from 110° to 291° at 9 to 10 knots.

The pilot of a Beech 58 Baron held at STAUT, the locator at the outer marker, for approximately 40 minutes before lending about 1100. He made the following observations concerning the weather he had encountered: no turbulence, no icing, some drizzle during the approach, no wind shear, cloud tops about 5,000 feet, cloud bases ragged at approximately 500 feet a.g.l., and visibility below the clouds 3/4 mile. He stated that he obtained temperature and wind information from AWOS but that he did not remember what it was.

The pilot of a Gulfstream American AA5B Tiger landed at SHD about 1110 and made the following observations concerning the weather he had encountered: smooth flight to occasional light chop, no icing, light to no drizzle, wind light, cloud tops 3,000 to 4,000 feet, cloud bases ragged at 500 feet to 700 feet a.g.l., and visibility below the clouds 1 1/2 to 2 miles. (See appendix F.)

1.8 Aids to Navigation

SHD is served by two standard instrument approach procedures (SIAP): an ILS approach to runway 4 (ILS RWY 4) and a nondirectional beacon approach to runway 4 (NDB RWY 4.) At the time of the accident, the ILS RWY 4 approach, amendment No. 5, was in use. (See figure 2.) A localizer was installed in 1969, and a glideslope was added

7/ AIRMET--an advisory concerning weather of less severity than SIGMETS; SIGMET--significant meteorological information; and convective SIGMET--a weather advisory concerning convective weather.

to the system in 1974. The current ILS system was modified and recommissioned by an FAA flight inspeetion cn September 9, 1984. It is monitored by a fixed base operator (FBO) by means of an FAA installed and maintained monitor system as specified In FAA Order 6750.16B. FBO personnel stated that the ILS monitor did not alarm on the morning of the accident. Also, the Henson station manager confirmed that tine Henson monitor did not alarm on the day of the accident. A ground check of all components was conducted about 1855; all components were found to be operating within prescribed limits at that time.

The reports of flight inspections of the SHD ILS (I–SHD), including the compass locator at the cuter marker (NDB) conducted between September 9, 1984, and September 10, 1985, were reviewed by the Safety Board. The system was found to be operating within prescribed limits at the times of all flight checks. A flight inspection was conducted about 1925 on September 23, 1955, and the system, including the localizer, glideslope, and the compass locator, was found to be operating within specifications.

The pilot of the Beech 58 Baron noted that the quality of reception of the outer compass locator/marker was suitable for navigation, that the localizer was satisfactory, and that the glideslope was stable. He stated that he had made a coupled approach and considered it to be "very stable." The pilot of the Gulfstream American AA5B Tiger reported that the NDB and the ILS could be identified normally, and that the Localizer and glideslope needles in his aircraft were "very solid and free of any fluctuations."

Washington Automated Plight Service Station (AFSS) personnel stated that the Montebello (MOL) VOR/DME monitor indicated that the system was normal at the time of the accident and that no alarms were observed. Following the accident, the FAA conducted a flight inspection of MOL on September 23 and 24, 1985, and the facility was found to be operating within prescribed limits. A ground inspection of the VOR/DME and the Remote Communications Outlet (RCO) was completed on September 23, 1985, and all were found to be operating within prescribed limits. Additionally, a flight inspection was conducted on the Washington ARTCC radar, the transponder, end Very High Frequency (VHF) communications frequencies on September 23 and 24, 1985. All facilities were found to be operating within prescribed limits. There were no Notices Po Airmen (NOTAMS) in effect for SAD at the time of the accident.

1.9 Communications

There were no known communications difficulties.

1.10 Aerodrome Information

The Shenandoah Valley Airport is located in Weyers Cave, Virginia, ant! serves the communities of Staunton, Waynesboro, and Harrisonburg, Virginia. Its geographic coordinates are 38°15'48" north and 78°53'48" west. It is a noncontrolled airport and is served by UNICOM. Scheduled sir carrier service is accommodated under 14 CFR 135. The airport is certified under 14 CFR 139 with a limited crash/fire/rescue (CFR) index. 8/ (See appendix G.)

1.11 Flight Recorders

The airplane was not equipped with a cockpit voice recorder (CVR) or a flight data recorder (FDR), and neither was required by Federal regulations.

8/ A limited CFR index means that CFR Equipment may or may not be available.

1.12 Wreckage and Impact Information

The onsite examination of the wreckage revealed no evidence to suggest that the structural integrity of the airplane had been compromised before its initial in-flight collision with the trees. All damage and separations were the result of the airplane's passage through the heavily wooded area, the subsequent ground impact, and the postcrash fire.

The airplane struck the first tree at 31 feet a.g.l. This tree was located about 100 feet northeast of a very steep drop in the terrain. The airplane continued to travel in a northeasterly direction (045° magnetic). Damage to fallen tree tops, limbs, and branches indicated that the airplane was in a wings level, fuselage level attitude. Propeller slash marks on the fallen tree limbs were identified on both sides of the tree swath centerline. The tree swath was initially 40 feet wide and narrowed down to about 18 feet just before ground impact. There was no appreciable descent angle until just before ground impact. A 40-foot ground scar was noted with two deeper impressions located 12 feet apart. The ground scar terminated at the foot of an uprooted oak tree which was estimated to be about 50 feet high and about 2 feet in diameter, The cockpit/cabin area of the airplane came to rest northeast of the base of the uprooted tree. Both engines and propellers were located northeast of the tree base with the No. 1 (left) powerplant on the left side and the No. 2 (right) powerplant on the right side. "here was no fire damage to any of the structures which separated before the ground scar. (See appendix E.)

The fuselage of the airplane, from the nose aft to the lower empennage structure, was demolished. The emergency locator transmitter (ELT), which had failed to activate, was heavily damaged by fire, crushed, and deformed. The antenna lead had separated.

A section of the aft tail cone and the right horizontal stabilizer, with elevator attached, was found near the beginning of the ground scar. The left horizontal stabilizer, complete with a section of the elevator attached, was located to the left and northeast of the initial ground strike. The complete rudder, with trim tab attached, had separated from the vertical stabilizer and was located southwest and to ?he right of the uprooted tree.

The left wing section, outboard of the engine nacelle, had been fragmented as the airplane cut through the trees. Pieces of the leading edge skin, spar structure, wing tip, aileron, and trim tab were distributed along the wreckage path to the left of ?he tree swath centerline and before the beginning of the ground scar. The inboard and outboard flap sections were found near the uprooted tree. The No. 1 engine had separated from the nacelle and came to rest to the left and northeast of the uprooted tree, about 15 feet forward of the left propeller.

The right wing section outboard of the engine nacelle separated as a unit and was located about L00 feet southwest of the beginning of the ground scar and near the left edge of the tree swath. No fire damage was evident. About 5 feet of leading edge skin and spar were missing. Several pieces of leading edge skin were located along the wreckage path to the right of the tree swath, as were trailing edge flap pieces. A portion of the right inboard flap was found northeast of the uprooted tree. The No. 2 engine had separated from the nacelle and was located in two sections to the right of and adjacent to the base of the uprooted tree, abut 6 feet forward of the right propeller.

The wing center section and the left and right inboard **wing** sections were located about *25* feet northeast of the uprooted **oak** tree: it had been badly damaged by fire. The inboard sections were attached **by** the spar strap, with bolts in place. This area also contained the main *landing* gear wheel wells. Examination of the landing gear actuators, the positions of several trailing edge flap tracks, and **two** separated flap actuators indicated that the main landing gear **and** flaps were retracted at the time of impact.

Fuel system components associated with the wing sections outboard of the engine nacelles were scattered along the wreckage path, on the ground, and in the **trees.** Their locations coincided with the fragmentation of the left wing outboard section and the separation of the right wing outboard section. Pieces of fuel cell material, outboard fuel tank filler caps, and fuel lines were identified. There was no evidence of fire damage noted on any pieces of the airplane located southwest of the ground scar.

1.13 Medical and Pathological Information

Autopsies, which were performed on all 14 occupants **by** the Medical Examiner of the Commonwealth *of* Virginia, indicated *that* there were substantial impact injuries. Death resulted from the impact-type injuries or from the combined effects of impact injuries and fire.

Toxicological testing was done by the Bureau of Forensic Science, Commonwealth of Virginia. In all cases except one, in which the blood sample was unsuitable for carbon monoxide determination, carbon monoxide saturation of the blood **was** less than 7 percent. All drug screens of the captain's samples were negative. In the case of the first officer, **blood,** urine, and liver samples were positive for diethylpropion at the following levels: **blood,** 0.04 mg/L; urine, present: and liver, 0.04 mg/kg.

Toxicological analyses of the blood and urine of the flightcrew also were performed by the FAA Forensic Toxicology Research Unit in Oklahoma City, Oklahoma; the results were negative for acidic and neutral **drugs,** basic drugs, and ethyl alcohol. Blood samples taken from the flightcrew were sent to the Center for Human Toxicology in Salt Lake City, Utah, specifically to test for cannabinoids and to confirm the finding of diethylpropion. No cannabinoids **were** detected in the blood of either crewmember. Diethylpropion was present at 0.01 mg/L in a **blood** sample from the first officer submitted on December 17, 1985; however, the drug may have hydrolized (changed its chemical structure), which would explain the lower level of diethylpropion found by the Center for Human Toxicology.

An FAA physician with expertise in drug effects on pilot performance stated that this level of diethylpropion probably had no more effect upon her flying (alertness) than 5 to *6* cups of coffee.

1.14 Pi

There was **no** evidence of in-flight fire. A severe postcrash fire erupted and extinguished itself.

1.15 Survival Aspects

This accident was nonsurvivable due to excessive decelerative forces, disruption of the occupiable space in the airplane, and the postcrash fire during the breakup and **ground** impact sequences.

1.16 Tests and Research

1.16.1 Navigation Receivers

At the time of the accident, Henson operated eight Beech 99 &?planes. Each was equipped with two fully functional VHF navigation radios, consisting of a receiver located in the nose of the airplane, a control head with frequency selector located in the center of the instrument panel, and a navigational display located on the captain's instrument panel. 9/ Five airplanes were equipped with a third, completely independent, VHF navigation radio with a navigational display, receiver, control head, and frequency selector located on the first officer's instrument panel. Three airplanes were equipped with slaved, or partially slaved, third VHF navigational displays located on the first officer's instrument panel. The VHF radios were not Identical and the navigational displays were not uniformly positioned within the Beech 99s. Three airplanes, including the accident airplane, were equipped with two fully functional King radios with the navigational displays on the left side of the captain's panel, and one completely independent Narco navigation radio cn the lower right side of the first office;'.; instrument panel. (See figure 4.) Two other airplanes were similarly equipped, with the exception that the independent Narco navigation radio was on the lower left side of the first officer's panel. Two airplanes were equipped with two fully functional Narco navigation radios with navigational displays on the left side of the captain's instrument panel, and one slaved navigational display, which was a repeater of the No. 1 Narco navigation radio, positioned on the lower left side of the first office-'s instrument panel. One airplane was equipped with two King radios with the navigational displays on the left side of the captain's panel and one partially independent Narco navigation radio with its navigational display on the lower left side of the first officer's panel. The partially independent Narco navigation radio had an independent VCR and localizer with a slaved (repeater off the No. 1 King radio) glideslope.

The independent Narco navigation radios with navigational displays installed on the first officer's panel in six airplanes were incapable of any aura! station identification, in violation of Federal Aviation Regulations (FARs), because the audio-idem feature had never been connected. Additionally, the Safety Board was unable to locate & record of the installation of these independent navigation units on FAA Form 337, Major Repairs and Alterations, or of their inclusion in the airplanes' weigh: and balance data, also in violation of FARs.

Both the FAA's Principal Avionics Inspector (PAI) and the Principal Operations Inspector (POI) said that they were aware that the third radio was installed in the B99s, but they stated that they were not aware of the discrepancies noted above. Following the accident, the FAA required Henson to placard 3s "inoperative" the navigation radios on the right panels of the remaining five airplanes with independent Narco units until they had been rendered fully functional and were properly documented.

In an effort to determine their operating condition before the accident, the two Gables VHF navigation control heads (type VC-169C), two King navigation receivers (model KNR600A), and one Nsrco navigation receiver (model NAV 122) from the accident airplane were taken to Henson Aviation's Avionics Shop in Hagerstown for examination on

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9/ Navigational displays consist sf omnibearing selector (OBS), course deviation indicator (CDI), glideslope (GS), TO/FROM indicators, On/Off flags, and e scale to indicate the degrees of deflection from the centerline of the selected VOR radial or the localizer and the glideslope. (See figure 5.)

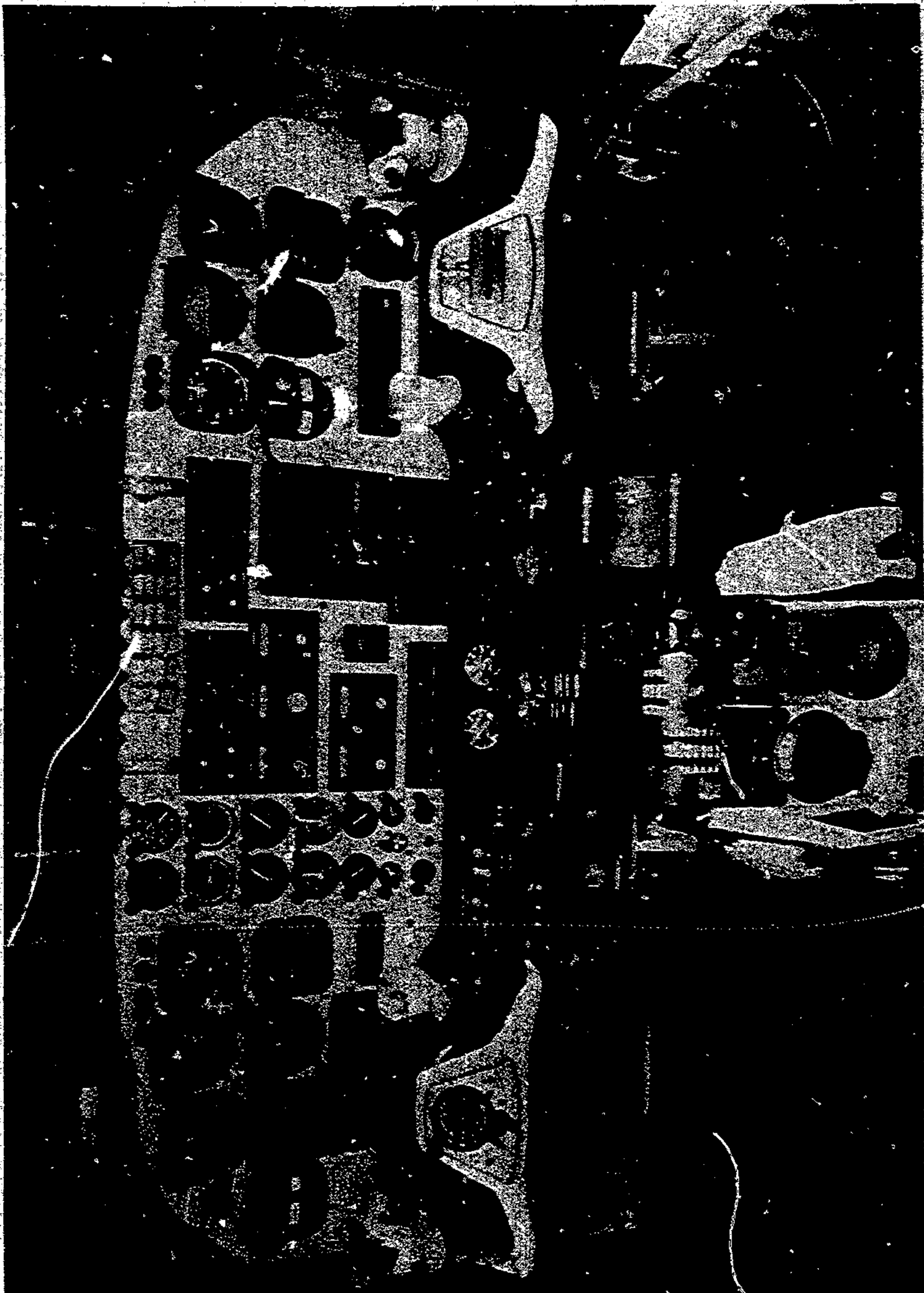

Figure 4.—Cockpit similar to N339HA.

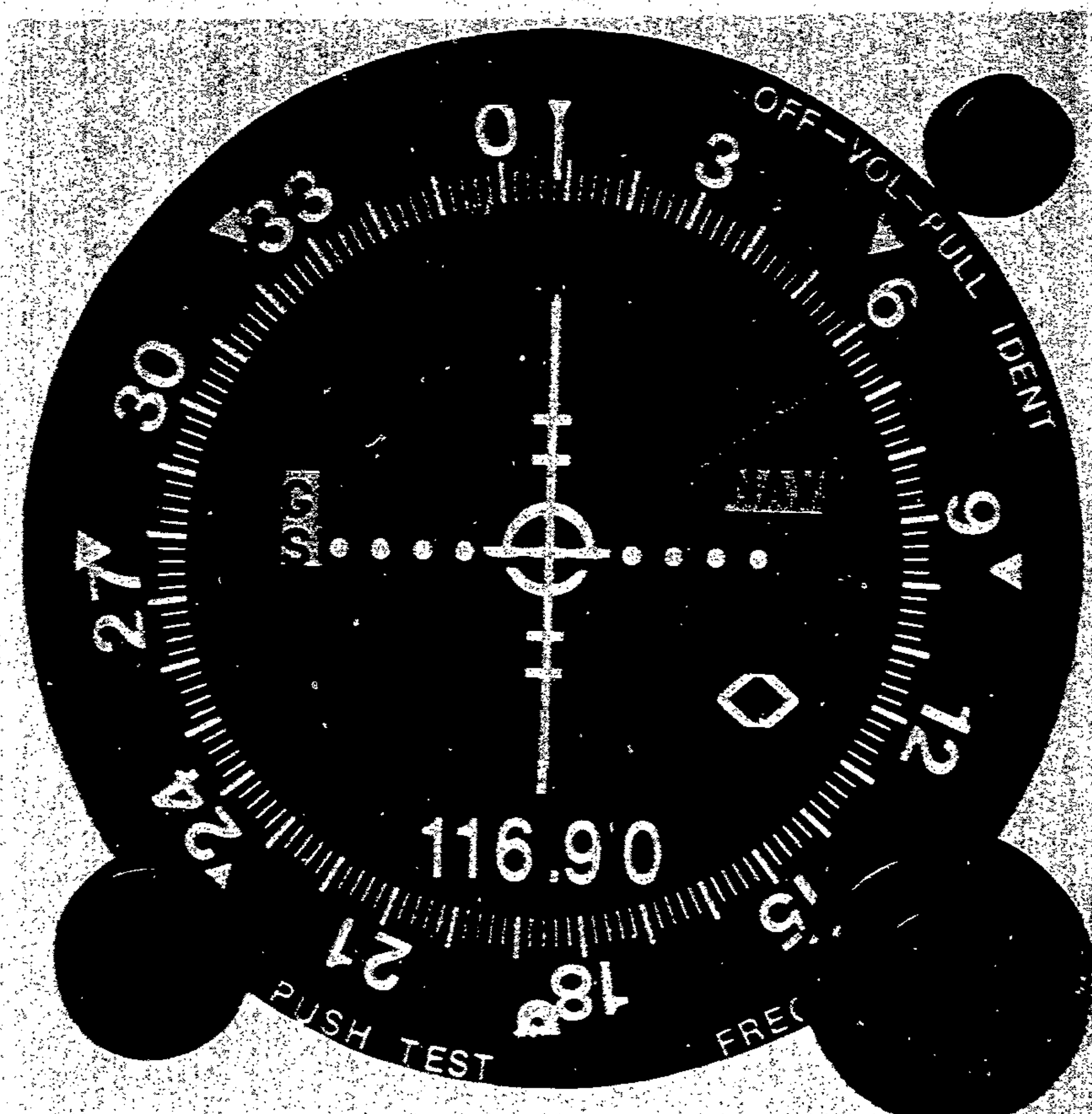

Figure 5.—Enlarged front view NAV 122 and NAV 122A.
(Courtesy of NARCO Avionics, Inc.)

September 26, 1985. The No. 1 navigation radio frequency selector was found tuned to 110.5 MHz and the No. 2 navigation radio frequency selector was found tuned to either 109.5 MHz or 110.5 MHz. The No. 3 navigation receiver, a self-contained NAV/LOC/GS receiver-indicator, could have been tuned to any of four possible frequencies: 110.5 MHz, 110.05 MHz, 115.5 MHz, or 115.05 MHz. Damage was too severe for any more precise determination of frequencies. The Nos. 1 and 2 omnibearing selectors (OBS) had been installed on the captain's (left) instrument panel, and the No. 3 OBS had been installed on the first officer's (right) instrument panel.

The No. 1 navigation receiver was powered and was determined to be capable of operating and tuning. The correlation tuning between the navigation receiver and the glideslope receiver was found to be accurate. The No. 2 navigation receiver had been compressed longitudinally to about half its normal length, and no attempt was made to power it upon the advice of the manufacturer's representative.

Due to severe fire damage, the No. 3 navigation receiver could not be subjected to any testing beyond the frequency determinations, which were accomplished by a comparative examination of a serviceable unit. The OBS potentiometer was removed from this unit and submitted for laboratory analysis of the internal wiper arm. Witness marks from the wiper arm corresponded with a selection of 105° in the OBS. The courses found selected in the Nos. 1 and 2 OBSs at the accident site were 015° and 045°, respectively.

Safety Board investigators determined that N339HA probably was equipped with a single three-port antenna coupler, equally coupling the three navigational receivers. When the operator tested a similarly equipped airplane, loss of signal strength resulting from the use of a three-port coupler was minimal.

1.16.2 Airplane Clock

The airplane's clock was returned to the Safety Board's Materials Laboratory. The clock had stopped at 1025 and the integral stopwatch indicated an elapsed time of 8 minutes 16 seconds. There were no indications of direct contact with any other objects. Damage to the internal mechanisms was limited to heavy oxidation. None of the gears would rotate. A large resolidified molten metal mess was found blocking the internal works, apparently from a structure originally encircling the clock which was determined to be made from an alloy which has a melting range of 715° F to 740° F.

1.16.3 Powerplants

The engines and propellers were transported to the Service Center of Pratt and Whitney Canada Inc., in St. Hubert, Province of Quebec, Canada, where disassemblies of the engines began on November 7, 1985. The propellers were removed and sent to Pratt and Whitney Canada Inc. propeller overhaul facility in Longueuil, Canada, where the disassemblies began on November 7, 1985.

Both the left and the right engine power turbine disks were shifted from their installed positions. The disk rim faces were rubbed rotationally from contacting the power turbine interstage baffles.

Seventeen power turbine blades in the left engine were broken off at various lengths; the remaining blades were complete and bent apposite to the direction of rotation. All of the right engine3 power turbine blades were pushed over the blade retaining rivet flares toward the downstream side. The left power turbine blade retention tangs (firtrees) were rotationally rubbed, and all the broken blades were pushed forward over the blade retaining rivet flares. Numerous right power turbine blades were forced out of their disk firtree fittings, and the remaining blades were broken off at various lengths. The left compressor turbine blades were complete; however, both the upstream and the downstream faces of the blade firtrees were rotationally rubbed. All of the right compressor turbine blades were complete and appeared to be in normal condition. There was no observable damage on the compressors of either engine. The centrifugal impeller vane profiles had rubbed the impeller housings of both engines.

Disassembly of the right engine fuel control unit and fuel pump showed that all internal components were in normal condition, except for the effects of the ground fire. The left engine's complete accessory gearbox housing and all attached accessories were destroyed, with the exception of some drive gears and the starter generator.

Indentation marks were found on the interior surfaces of both propeller pistons. The mark that was found on the piston of the left propeller was equivalent to a blade angle of about 20° and the mark found on the piston of the right propeller was equivalent to a blade angle of about 22°. The time in the impact sequence when these marks were made could not be determined.

1.17 Other Information

1.17.1 Henson Hiring and Training Data

Henson required a minimum total flight time of 2,500 hours for new hires until about the spring of 1985 when that total was lowered to 2,030 hours. The airline required 500 total hours of multiengine flight time and 75 to 100 hours of actual instrument flight time. According to Henson management, changing conditions in the industry dictated thet the requirements be flexible. In 1985, Henson hired 98 pilots; of these, 17 had fewer than 2,000 hours of total flight time and 4 had fewer than 1,600 hours of total flight time: 14 had fewer than 7[illegible] [illegible]urs of actual instrument flight time; and 1 was hired in the last 2 years with as few as 154 hours of multiengine time, that pilot being the Erst officer on flight 1517.

Henson had experienced a rapidly increasing turnover rate among flightcrew members in recent years with voluntary Pepertures increasing from 4 out of 80 pilots in 1981, to 12 out of 101 pilots in 1983, and to 54 out of 195 pilots in 1985. The percentage of voluntary departures from Henson's total pilot population increased from 5 percent in 1981, to 12 percent in 1983, and to 28 percent in 1985. According to the POI for Henson, regarding the commuter industry, "Now we are beginning to get to the bottom of the barrel so to speak, and that's part of the problem." He also stated thet the qualifications of the new pilots hired by Henson since 1983 were not as high as those whom they replaced.

At the time of the accident, Henson's policy was to request the records of new pilot hires from the FAA in Oklahoma City, Oklahoma, through the General Aviation District Office (GADO) in Baltimore, Maryland. Because this procedure took up to 90 days, the pilots were usually flying on thf line before their accident/incident and violation records were obtained, In the case of the first officer of flight 1517, neither Henson nor the Baltimore GADO was able to find a request for records from Oklahoma City. Officials of the airline stated that they attempted to contact all former employers to confirm flight time and to obtain recommendations, but that they had not always been successful in this endeavor. The airline management also stated that they checked logbooks to confirm flight time.

A check of FAA records revealed that the captain had no record of any accidents or incidents.

The answer to a question on Henson's application form which addressed accidents, incidents, and violations was omitted by the first officer. FAA records revealed that the first officer had three accident/incidents on file: (1) a no-injury incident on November 11, 1982, in which a float struck a fish net with stakes attached while on a takeoff run in glassy water; (2) an accident in which there was one serious injury and three minor injuries on February 22, 1984, resulting from an aborted takeoff, in which the Safety Board determined that the probable causes were a leak in a float assembly, water in the float assembly, and inadequate preflight by the PIC (the first officer on flight 1517); and (3) a no-injury incident on July 12, 1984, in which a seaplane was improperly anchored in a tern nesting area which had been mistaken for a nearby park. Her previous employment was terminated as a result of the February 22, 1984, accident. An official of that organization stated that, in his opinion, the accident was the result of compounded errors in the pilot's judgment.

Henson's 14 CFR 135 initial ground training course consisted of 24 hours of indoctrination and 24 hours of training on the airplane to which the pilot would be assigned. Both the captain and the first officer received their training in this program. Training aids for the Beech 99 consisted of slides and overhead transparencies.

Between 1977 and December 1985, the FAA permitted Henson to flight train its pilots to "proficiency" based on its record of a greater than 80 percent pass rate on check rides with the FAA. This training to proficiency generally took between 5.5 and 6 hours for a new Beech 99 captain. Following the accident, the authority for the reduced training program was rescinded by the FAA and, subsequently, Beech 99 captains were required to complete 10 hours of flight training and Beech 99 first officers were required to complete 5 hours of flight training. According to the testimony of Henson's POI, the rescission of Henson's authority to train to proficiency was the result of the 40 percent rate at which the Henson captain and first officer candidates were failing their check rides in the deHavilland DHC-8. The POI attributed this high failure rate to a decrease in the quality of training because of the rapid turnover of management, flight instructors, check airmen, and line captains. He also stated that it was increasingly difficult for Henson to retain qualified instructors and that they were required to perform line flying duties in addition to instructional duties.

Instrument training in the Beech 99 was conducted without the use of a view limiting device (hood). To accommodate the absence of a hood, the seat of the pilot receiving the training was lowered to restrict vision. According to Henson instructor pilots, this method was used in the interest of safety, since a large cumbersome hood also might obstruct the vision of the check pilot. The FAA POI said that he was aware of this practice and that it was an acceptable practice. The POI, who had flown 3,000 hours as PIC in a Beech 99, also stated that flying from the right seat by reference to instruments on the left panel should not be a problem to a first officer in a line flying situation.

The IOE was conducted in accordance with the requirements of 14 CFR 135, which consisted of 20 hours of flight time in the Beech 99. According to Federal regulations, the 20 hours could have been reduced to not fewer than 10 hours by additional landings per hour of flight time.

Henson had a left seat familiarization program for first officers who were about to be upgraded to captain; under the program, the first officer flew in the left seat, but *not* as PIC, and with restricted **gross** weight requirements and higher landing weather minimums. The captain of flight 1517 had completed this program before being upgraded to captain.

Henson captains were provided with one set of approach end *en* route charts to share with the first office? in the cockpit. According to Henson policy and practice, the flying pilot had custody of the approach chart.

1.17.2 Noise Level in the Beech 99

Henson supplied its pilots with Telex headsets. Some of the pilots said that, for protection from the high noise level in the Beech 39 cockpit, they had purchased earpieces, which were individually fitted to the external ear, while others had purchased noise attenuating headsets. None of Henson's Beech 99s were equipped with a mew interphone system. Other Henson pilots said thet both the captain and the first officer on flight 1517 had purchased their own noise attenuating headsets. Although one headset was found et the accident site, because of fire damage, the Safety Board was unable to establish that the pilots were wearing their headsets during the flight.

Noise levels in the Beech 99 were thoroughly reviewed in the Safety Board's investigation and analysis of the Cascade Airways' accident in 1981. 10/ Two cockpit noise-related recommendations to the FAA emanated from the Cascade accident: one requested the FAA to establish maximum cockpit noise levels which will permit adequate flightcrew communication, and one requested rulemaking to require the installation of crew interphone systems in aircraft which exceed the establisher! noise level maximum limits. The airplane in the Cascade Airways accident was e Beech Model A99; however, according to Beech Aircraft Corporation, there are no significant differences in cockpit nose levels between the A and B models. In the Cascade Airways investigation, cockpit noise levels in an A99 were measured at a point just to the right of the captain's heed at a 95 percent RPM power setting with 1,100-foot-pounds of torque. (This is equivalent to normal cruise power.) The sound pressure levels under these conditions measured 97 dB(A) or 87.7 PSIL. 11/ In July 1982, an FAA contract report 12/ agreed with the Cascade report that the noise levels in the Beech 99 were excessive. The report went on to state *that* it recommended "adoption of a noise level fence (limit) of PSIL=78," that reducing noise at the source was impractical, and that "interphone systems can lead to better signal to noise ratios (than currently present) if users are taught to use good microphone technique."

Interior sound level measurements provided by Beech showed that the noise level was a? its greatest during takeoff, at 88.3 PSIL. Additional measurements resulted in 84.8 PSIL at cruise and 77.9 PSIS at approach power. According *to* the testimony of audiologist Dr. Jerry Tobias, an intelligibility problem is created by noise, which requires shouting in the cockpit, and shouted speech becomes even less intelligible. The crew of

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10/ Aircraft Accident Report--"Cascade Airways, Inc., Beech 99, N390CA, Spokane, Washington, January 20, 1981" (NTSB/AAR-81/1).

11/ PSIL: Preferred-frequency speech interference level, which is the mean of the sound pressure levels of 3 octave bands (500, 1,000 end 2,000 Hz), is considered meaningful to speech communication. The dB(A) measurement includes all octave bands.

12/ "Cockpit Communications Interference," FAA Order No. DTFA-01-82-P-81561.

flight 1517 would have further reduced their ability to hear each other if they were using their sound attenuating headsets (for hearing protection). Also, according to Dr. Tobias, author of the FAA Contract Report, human beings automatically adjust their vocal levels to accommodate the environment; consequently, with the headsets on to cut out much of the noise, speech would tend to soften, making communications even more difficult. According to Henson pilots, some hand signals were used during takeoff, but these did not appear in the Henson Operations Manual.

An additional noise related problem, confirmed by several Henson pilots and the POI, was the absence of a door between crew and passengers in ?he Beech 99. Generally, conversations between a captain and a first officer had to be shouted during high noise periods, especially if heaping protection was worn. As a result, several rows of passengers could hear any verb83 exchanges. According to Dr. Tobias, an environment with a 77.9 PSIL would require most women to shout to be understood. On two of the first officer's flights in Beech 99 airplanes, the crew had entered in the Eight logs of the respective sirplanes comments about the need for an intercom system in the cockpit. On September 3, 1985, in N396HA, it was noted, "AC loud-needs intercom system for communication," and on September 14, 1983, in N496HA, it was noted, "Aircraft needs an intercom system-it is very difficult to talk and hear between both pilots."

The first officer had also complained both to her roommate and to her husband about the difficulty of communicating in the Beech 99 and of her desire for en interphone system. None of Henson's Beech 99s were equipped with a crew interphone.

1.17.3 Henson's Approach Procedures

According to Henson's Chief Pilot, procedures in the Beech 99 on an ILS approach include the following: cross the marker (LOM) outbound st 150 knots, proceed outbound on the procedure turn at i4C knots, extend 30 percent flaps at 140 knots, intercept the localizer at 120 knots, gear down at glideslope Intercept, and extend 100 percent flaps before landing. (Analysis of the radar data indicates that the groundspeed of flight 1517 was 180 knots or. the inbound leg of the procedure turn.)

According to a former Henson flight instructor and check airman, Henson's policy requires that, before beginning the approach, the flying pilot relinquishes control of the airplane to the nonflying pilot in order to study the approach chart and to set the correct frequencies into all navigational radios. In this sirplane, the first officer could easily reach the frequency selectors far all navigation radios. After the flying pilot resumes control, the nonflying pilot then briefs the flying pilot about field elevation; inbound course; initial approach altitude; decision height; approach speed, time an8 rate of descent; and missed approach procedures. In a review of the factual informstion contained in this report, Henson's chief pilot concurred with this summary.

According to the Henson Operations Manual, before landing the pilots should review the approach speed, Vref, and the missed approach power setting. The nonflying pilot should call out the following: leaving one step down altitude for mother, any deviations from the approach course, any significant airspeed deviations in relation to Vref, checklist items not completed, and 100 feet above each step down altitude. At the final approach fix, the nonflying pilot should cross check both altimeters and call out any discrepancy. At all times during the approach, the nonflying pilot should monitor the flight and navigation instruments and call out any irregularities or the appearance of warning flags. Finally, if at any time during the approach the runway or related lighting is sighted, the nonflying pilot is required to advise the flying pilot.

Henson Airlines' allowable deviation from the localizer and glideslope on an ILS approach in training situations was one dot. However, in line situations, the company allowed up to a full scale deviation. 13/ (See figure 5.)

Flight 1517 flew southwestbound on Victor airway 143 (V-143) en route to CEROL intersection. The flightcrew would have been navigating off the Montebello VOR 036° radial with 216° selected in the OBS. Upon reaching CEROL intersection, the flightcrew would have navigated directly to STAUT, a nondirectional beacon (NDB) located et the outer marker (LOM) and designated as the initial approach fix (IAF). After *leaving* CEROL, there would be no further need to have MOL in any of the VHF navigation receivers, and company policy dictated that the ILS frequency be placed into all three receivers for the approach.

1.17.4 Flight Check of 110.5 MHz at SED

Since 110.5 MHz was a possible choice of frequennies found in all three navigation radio control heads, Henson personnei performed a flight demonstration et SHD on September 27, 1985, at an altitude of between 2,700 and 3,700 feet with all three radios tuned to 110.5 MHz. According to the pilots, the No. I navigation receiver sensed nothing et any time during the flight. The No. 2 navigation radio was alive within a 4-mile radius of the airport and the localizer flag disappeared, the CDI gave positive indications, there was a "TO" indication, and the correct Morse code identification for I-SHD (109.5 MHz) was received. The No. 3 navigational display in the test airplane, which had e slaved glideslope *off* the No. 1 radio and an independent localizer with no audio-iden?, showed a localizer flag at all times. No bench check was conducted on any of the radios following the flight.

On October 1, 1935, the FAA made a specie! flight inspection to determine if any usable signal on frequency 110.5 MHz existed in t3e area. The frequency wes checked from 50 miles east of SHD, from 7,500 feet to the airport st ground elevation. At no time was any signa! or Morse Code identification received on 110.5 MHz. Paired TACAN/DME channel 42 also was checked and no signal was received.

1.17.5 Flight Demonstration of Montabello VOR 045° Radial

On September 25, 1985, the Safety Board conducted a flight demonstration aboard a Beech Baron supplied and flown by a Beech Aircraft Corporation pilot. Representatives of all parties except the FAA were present. The No. *1* navigation radio was tuned io frequency 112.6 MHz (MOL? and the No. 2 navigarion radio was tuned to 109.5 MHz, the SHD localizer. The pilot attempted to fly the approach as published, but navigating by the MOL VOR 045° radial instead of the localizer. Ke stated that he thought that he was doing a good job of flying the false "localizer." The course took the airplane directly to the accident site. The glideslope in the No. 2 navigation radio appeared to be usable until about 2 miles before the accident site. After crossing the true localizer course, the ADF indicated that the airplane was east of the desired course. The ADF display consists of a compass rose with a needle which points to the low or middle frequency NDB to which its frequency selector is tuned. Direction is indicated to the pilot as *a* magnetic bearing or as a relative bearing to the longitudinal axis of the aircraft

13/ The dot; on the face of a VHF navigation instrument represent the degree of deflection from the selected course. A full scale deflection on the localizer indicates that an aircraft is 2.5° or more *off* course. Full up to full down deflection on the glidescope represents a total of 1.4°, or 0.7° above or below the glideslope.

depending on what type of instrument is installed. N339HA was equipped with an indicator which presented the relative bearing to the station. The pilot of the demonstration flight said that he thought it took a long time to intercept the false "localizer." The distance between the true localizer course and the MOL 045° radial is about 8.2 nauticai miles, or about 4 minutes at 120 knots,

1.17.6 FAA Surveillance

Henson holds Air Carrier Operating Certificate No. 21-EA-1, dated May 29, 2969, issued by EA-GADO-21, Baltimore, Maryland. The certificate, with two separate sets of approved operations specifications, authorizes Henson to operate under both 14 CFR 121 and 135. Only the records pertaining to 14 CFR 135 were examined since the accident airplane was operating under that regulation. In 1985, the following inspections were conducted: three en route, six ramp, one cabin, and two training inspections. The overall performance of the airiine was found to be satisfactory.

During the first Nstional Air Transportation Inspection (NATI I), conducted by the FAA between March 4 and March 25, 1984, Henson received a satisfactory overall rating and was not required to undergo NATI II, e followup inspection of carriers found deficient during NATI I. The NATI inspections were special programs of increased surveillance of air carriers operating under 14 CFR 121 and 135.

One POI was assigned to Henson Airlines by the FAA's Baltimore GADO. He stated that he normally devoted about 60 percent of his time to Henson, half of which was spent in surveillance activities. However, since April 1985, almost 100 percent of his time with Henson had been involved in the issuanee of operetions specifications and approval of the operations manual, approval of the training program and cabin safety procedures, and pilot certification duties related to the addition of the deHavilland DHC-8 to Henson's fleet. The POI estimated that he had not flown on a Beech 99 training or proficiency ride for abut 3 months before the accident and that all Beech 99 training and proficiency flights were conducted by FAA designated company check airmen. He said that he last attended a ground training class in June 1985. He conducted 100 percent of tire check rides in both airplanes, the DHC-7 and -8, operated by Henson under 14 CFR 121.

1.17.7 Relationships Between Pilot Error and Stressful Life Events

Research conducted at the Naval Safety Center in Norfolk, Virginia, has evaluated the relationship between pilot error and stressful life events or behaviors indicative of stress in naval eviators. 14/ The study, which analyzed 737 questionnaires concerning stressful Life events which were completed by naval aviators who were involved in major aircraft mishaps over a 4-year period, determined that those pilots who were causally invoked could be distinguished from those who were not on 10 of the 22 stress and personality questionnaire items. 15/

Three of those distinguishing items were: recent engagement to be married (significant at 0.05); recent career decision (significant at 0.01); and financial difficulties (significant at 0.05). The authors concluded that these three factors, unlike the

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14/ Alkov, R.A., Gaynor, J.A., and Borowski, M.S., "Pilot Error as a Symptom of Inadequate Stress Coping," Aviation, Space, and Environmental Medicine, V56 (3), 1985, p. 244.

15/ The Fisher-Irwin Exact Test (One-Tailed) was used in the studv to determine these factors which distinguished the two groups and their significant levels.

remaining seven, "might be thought of as stressors that discriminated the group of aviators who contributed to the outcome of their mishaps," rather than behaviors resulting from stress. Symptoms of an aviator's inability to cope with these stressors mag manifest themselves as "acting out" behavior or as human error mishaps.

In a 1982 paper which discussed life change measurement in Canadian forces pilots, the authors concluded:

> . . . the effect of excessive life changes as a contributing factor to personal stress and illness merits further attention if a screening tool is to be developed to assess and predict accident-prone aviators. 16/

1.17.8 Emergency Guidelines

Flight 1517 never declared an emergency and never reported a missed approach or a climb to a minimum safe altitude. The following emergency guidelines address Federal regulations and advisory information for a pilot who is uncertain of the position of the aircraft being flown.

Title 14 CFR 31.3:

(a) "he pilot in command of an aircraft is directly responsible for, and is the final authority as to, the operstion of that aircraft.

(b) In an emergency requiring immediate action, the pilot in command may deviate from any rule of this Subpart or of Subpart B to the extent required to meet that emergency.

* * *

The Pilot/Controller Glossary in the Airmen's Information Manual defines an emergency as "a distress or urgency condition," and further defines an urgency condition as "a condition of being concerned about safety, and of requiring timely but not immediate assistance; a potential distress condition," and a distress condition as "a condition of being threatened by serious and/or imminent danger, and of requiring immediate assistance."

The Airman's Information Manual, Chapter 5 Emergency Procedures, C5-S1-1, contains the following discussion:

a. An emergency ean be either a distress or urgency condition as defined in the Pilot/Controller Glossary. Pilots do not hesitate to declare an emergency when they are faced with distress conditions such as fire, mechanical failure, or structural damage. Rowever, some are reluctant to report an urgency condition when they encounter situations which nay not be immediately perilous, but are potentially catastrophic. An aircraft is in at least an urgency condition the moment the pilot becomes doubtful about position, fuel endurance, weather, or any other condition that could adversely effect flight safety. This is the time to ask for help, not after the tituation has developed into a distress condition.

16/ Haakonson, P.M., and McCarron, N.H., "Recent Life Change Measurement in Canadian Forces Pilots," Aviation Space and Environmental Medicine, V53 (1) 1982, p. 6.

b. Pilots who become apprehensive for their safety for ANY reason should REQUEST ASSISTANCE IMMEDIATELY. Ready and willing heip is available in the form of radio, radar, direction fiiding stations and other aircraft. Delay has caused accidents and cost lives. SAFETY IS NOT A LUXURY. TAKE ACTION.

2 ANALYSIS

2.1 General

Henson flight 1517 failed to arrive at its destination, Shenandoah Valley Airport, following a routine flight. The Safety Board's investigation showed that the flightcrew was currently certificated to conduct the flight. The Safety Board concludes that the first officer was flying, since the captain made all of the radio communications throughout the flight from Baltimore-Washington International Airport, and since it was compsny policy for the nonflying pilot to operate the radios.

The first indication that there may have been a problem occurred after radar service had been terminated when the captain responded, at 1014:19, to a position request from the air traffic controller that, ". . . we were gonne ask you we're showin a little west of course the inbound course here." This response suggests e lack of certainty on the part of the captain as to the position of the airpiane. At that time, the airplane had been east of the lccalizer course for more than 3 minutes, on a projected track of about 075°. At 10:15:55, after radar contact was lost, the captain asked if the controller showed the airplane east of course, indicating further confusion on the part of the flightcrew. At 10:17:49, the controller suggested thst the crew of flight 1517 execute a missed approach if they were not established on the localizer. The crew did not replv. A? no time did the crew of flight 1517 suggest that they might have been experiencing a navigation radio or instrument malfunction.

A communications search was unsuccessful and search and rescue activities resulted in the location of the airplane about 8 hours later at an elevation of 2,400 feet and about 6 miles east of the airport. A smouldering fire was burning itself out and there were no survivors. It was determined that the airplane had impacted on a magnetic course of 045° in controlled flight with landing lights on end with gear and flaps retracted. (The 045° course of the airplane was on the 045° radial of the MOL VOR and the localizer course for the ILS runway 4 approach to SHD was also 045°.) The trees were broken in a relatively level straight line, indicating that the airplane was in a wings level, fuselage level flight at initial impact. There were propeller slash marks on both sides of the centerline, indicating that both engines were running and under power.

2.2 Airplane and Powerplants

No evidence was discovered to indicate that the structural integrity of the airplane had been compromised before contact with the trees. All observed damage was the result of passage through the trees, ground impact, and the postcrash fire. All structural separations were the result of overload. Consequently, the Safety Board concludes that there was no in-flight failure or malfunction of the airplane structure in this accident and that there was no in-flight fire.

The physical damage to, and the condition of, the airplane's engines and propellers indicate that both engines were operating at impact. Disassembly of the engines revealed the presence of rotstional damage t5 the power ana compressor turbines of both engines. Disassembly of the propellers revealed blade angles of about 20° for the left propeller and blade angles of about 22° for the right propeller, indicating that the propellers were in low pitch, as might be expected for an approach or missed approach. However, the time in the impact sequence when these blade angles were imprinted on the propeller pistons could not be determined. The condition of the engines indicated that the fuel systems of both engines were functioning and were supplying the engines with fuel until impact. The review of maintenance records for N339HA disclosed no repetitive or chronic discrepancies, or component failure trends which could have contributed to the cause of this accident. All ADs had been complied with and all time/cycle life limited components had been replaced. The Safety Board concludes that both engines, the propellers, and their various accessories were operating normally until the initial tree contact and that in-flight failure or malfunction of the airplane's powerplants did not contribute to this accident.

2.3 Systems and VHF Navigational Radios

No evidence was found to indicate any preimpact failure or malfunction of the airplane's electrical system, flight control system, flight instruments, or navigational instruments or radios. Two recent discrepancies related to fight or navigation instruments/radios had been corrected. The Safety Board notes that the discrepancy in N339HA's flight log regarding the first officer's navigation radio was in the opposite direction ot an error which might have led the accident airplane to the east of course.

The ADF was destroyed by impact and fire. No witness marks were left by the needle and the fact thet the flightcrew successfully navigated to STAUT is strong evidence that there was no malfunction of that instrument. However, a malfunction of the ADF radio or antennas cannot be completely ruled out.

The three YHF radios shared a common antenna, and N339HA probably was equipped with a three-port antenna coupler. When a similar antenna coupler on another Beech 99 was tested by the operator, the loss of signal strength was minimal, so that signal attenuation resulting from the use of a common antenna is not considered to be a factor in causing a navigational equipment malfunction.

The Safety Board considered the possibility of an antenna malfunction which would affect all three VHF navigations! radio receivers In an identical manner. There were no navigational problems before the airplane reached STAUT, so any malfunction would have had to occur after that point. The ADF antenna was separate, so the ADF needle should have been clearly indicating that the airplane was east of course, since it always points directly to the station. Finally, the airplane was outside the full scale deflection limits of the localizer for more than 4 minutes before tie captain's last transmission. Also, the airplane must hsve been receiving a signal, either VHF or LF, since the captain's transmissions indicate that he thought they were east of course at 10:15:55. The Safety Board believes that a malfunctioning antenna was not a factor In this accident; however, such a malfunction cannot be completely ruled out.

One system irregularity found in the accidect airplane was the installation of one of the three independent navigation receivers without audio capability for use in positive aural identification of navigational facilities. A Major Repair and Alteration form (FAA form 337) had not been prepared listing its installation, and it did not appear in the airplane weight and balance calculations. This radio's navigational display was installed on the lower right side of the first officer's instrument panel. The Safety Board does not believe that the paperwork irregularity relative to the installation of the No. 3 navigetion radio contributed tc the accident.

In postaccident testing, only the No. 1 navigation receiver could be operated and tuned- Both the Nos. 2 and 3 navigation receivers were too severely damaged for any testing beyond frequency determination. However, since the flightcrew navigated successfully to CEROL and since they did not suggest to the ATC controller that they were having my radio difficulties, the Safety Board believes that the VHF navigation radios probably were functioning properly; however, e malfunction of one or more of the VHF radios cannot be completely ruled out.

An examination of the three navigation radio control heads at Henson Aviation's Avionics Shop indiceted that, at the time of the examination, the No. I control head was tuned to 110.50 MHz; the No. 2 control head was tuned to either 109.50 MHz, the localizer frequency (I-SHD), or 110.50 MHz; and the No. 3 control heed (the first officer's) could have been tuned to any one of four possibilities: 110.85 MHz, 110.50 MHz, i15.05 MHz, or 115.50 MHz. None of these were the correct setting for I-SHD (109.5 MHz) or MOL (112.6MHz). It was not possible to determine conclusively which, if any, of the frequency readings found at the time of the examination were the frequencies which had been selected by the flightcrew before the approach. Impact forces were sufficiently great *to* move the tuning shafts. It is possible that the pilots mis-set, or failed to reset, all three radios. Also, it is possible that frequencies were changed, or were in tine process of being changed, just before impact, perhaps after a mistake was discovered. The fact that the choices of frequencies found in all three control heads were inconsistent with the expected settings, with the exception of the possible choice sf 1C3.5 MHz in the No. 2 control head (I-SHD), leads the Safety Board tc conclude that the possibile frequency settings which were found in the control heads were not necessarily those selected by the pilots during the approach, but that they resulted from impact forces. The Safety Board concludes thet all systems probably were operating normally at the time of the accident an6 the navigation frequencies selected before impact cannot be determined.

2.4 Airplane Clock and Captain's Watch

The airplane clock did not appear to have sustained a sufficiently severe direct impact to stop the works. It probably stopped sometime after the impact due *to* fire. Consequently, the accident probably occurred earlier than 1026 as indicated on the clock face. If the integral stopwatch had stopped at impact, the 8 minutes 16 seconds indicated could possibly represent the elapsed time after the airplane crossed STAUT; *the* pilot may have begun timing on the stopwatch at the outer marker to monitor the procedure turn and final approach. The time of 1022 found on the captain's watch probably indicates that it continued to run after impact, since flight X517 did not respond to the controller's cell st 1017:49 suggesting *a* missed approach.

2.5 Meteorology

At the time of the accident, instrument meteorological conditions (IMC) existed in the area from the cloud bases at abut 2,900 feet to the cloud tops at about 5,000 feet There was no significant windshear and no turbulence, other than light chop, in *the* area. The freezing level was above 10,000 feet, so airframe icing was *not* a factor in the accident. "hat portion of the NWS Area Forecast pertinent *to* the time and place of the accident was substantially correct.

Surface weather observations were made by Henson employees who hold certificates issued by the NWS. The NWS had conducted required inspections at the SAWRS and had rated it "excellent." Weather also was available to the flightcrew while in flight from AWOS over STAUT, the LOM. The AWOS had not received periodic inspections as specified. According to the NWS, it is not required to inspect AWOS facilities and, according to the FAA, it is not responsible. The Safety Board is currently corresponding with the FAA regarding who is responsible for the inspections.

Flight 1517 received the 0845 observation at SHD from the Gordonsville low altitude controller at 0957:43. About 1005, the flightcrew contacted the SHD station agent, who did not transmit the 0945 observation. According to the agent, this would be routine unless the weather was "bad" (low ceilings, low visibilities, or strong crosswinds). However, Flight 1517 received the 0945 observation when the flightcrew contacted UNICOM following their in-range call to Henson. The 0945 observation reflected that the ceiling was 1,000 feet lower than it had been at the 0845 observation. However, at 1,000 feet a.g.l., it was still well above the published decision height of 300 feet a.g.l, and the visibility remained at 2 miles with haze no longer noted. The temperature remained at 63° F, and the wind remained calm. The altimeter setting had changed from 30.19 inHg to 30.20 inHg.

According to pilots who had made the approach into SHD shortly after the accident, weather conditions on the approach were a little worse than the surface observations had suggested. The pilot who landed about 1100 had been holding for about 40 minutes at STAUT. His estimates of ceiling and visibility were 500 feet a.g.l. and 3/4 mile. He stated that he obtained temperature and wind information from AWOS, but did not remember what it was. (AWOS data are not recorded.) The pilot who landed about 1110 estimated ceiling and visibility to be 500 to 700 feet a.g.l. and 1 1/2 to 2 miles.

The fact that the actual weather was worse than reported led the Safety Board to consider what effect, if any, this may have had on the flightcrew's conduct of the approach. If the bases of the clouds were as reported (1,000 feet a.g.l.), the pilots would expect to break out and see the ground at about 2,200 feet m.s.l. However, because the cloud bases may have been about 500 to 700 feet a.g.l., the pilots would not have seen the ground until descending through 1,900 to 1,700 feet. With the expectation of breaking out at or near 1,000 feet a.g.l., the pilots might have been less concerned about precision on the approach than they would have been if the ceiling and visibility were lower and, when they became unsure of their exact location, they might have been less concerned about taking immediate action. Therefore, although imprudent, the pilot's failure to maintain the proper altitudes for the approach and the delay in initiating a missed approach may be explained, in part, by the relatively high ceiling and visibility reports. Whatever confusion which may have existed in the cockpit about the exact location of the airplane in relation to the localizer and glideslope, if the pilots believed they were relatively close to the localizer, they would believe that they had sufficient terrain clearance until breaking out of the clouds around 2,200 feet. The apparent controlled flight into the trees at 2,400 feet suggests that the pilots were in control of the airplane and may have been slowly descending intentionally without great concern. The absence of radio calls to the contrary supports this hypothesis.

Regardless of the fact that the actual weather may have been a little worse than reported, the Safety Board concludes that weather was a factor in the accident only to the extent that it necessitated an instrument approach.

2.6. Misinterpre cation or Malfunction of Altimeters

The altimeters installed on both sides of the instrument panel were of the design commonly referred to as three-pointers. Three separate pointers rotate to indicate increments of hundreds, thousands, and ten-thousands of feet of altitude. Mis-setting of altimeters by the pilot; is not suspected in this accident because both altimeters were found set very near the correct setting of 30.20.

A mechanical error in one or both altimeters aboard N339HA was not considered a reasonable possibility since the radar data and the ATC transcript showed that flight 1517 was cruising at 6,000 feet and, et 0959, flight 1517 was cleared for the approach and instructed to cross CEROL at 5,000 feet. Radar data showed a descent to 5,000 feet and, following a break in radar coverage, it showed a return at 4,600 feet followed by a steady descent until the last return at 2,700 feet. Therefore, the comparisons of radar data altitude readouts match the altitudes which should have been flown, until the descent below 3,300 fee?, and do not suggest that flight 1517 experienced any mechanical problems with the altimeter.

The Safety Board also considered the possibility that the first officer may have misread her eltimeter by 1,000 feet and that the captain may have, at the same time, failed to monitor closely the approach. If both pilots misread and/or failed to monitor the altimeters, it possibly could explain the airplane's continued descent io 2,700 feet while still in the procedure turn and before intercepting the localizer. The impact at 2,400 feet, nearly 1,000 feet lower than the procedure turn altitude of 3,300 feet, could heve occurred if the crew thought thep had noi yet completed their descent to 3,300 feet xnd if they were still waiting for the localizer needle to center.

A NASA quarterly report states, in an article regarding altimeter reading and setting errors, that most Aviation Safety Reporting System (ASRS) incident reports are either 1,000- or 10,000-foot altitude reading errors and that the accuracy end error response was poorest for the three-pointer altimeter. 17/ However, the greatest potential for error in reading the Three-pointer altimeter exists when they ere installed in modern high performanc .aircraft, which generally operate st much higher altitudes than previous generation aircraft and which are capable of rapid climbs and descents. The Beech B99 is not pressurized and does not operate at altitudes higher than 10,000 feet unless oxygen is available to the pilots.

it is possible, but highly unlikely that one or both pilots left the eltimeter out of his or her instrument scan for sufficient time that 1,000 fee: of altitude was lost without perception by the pilots in a descent from 6,000 to 2,408 feet. If a greater altitude change had occurred, such an error would be easier to understand. However, for this to happen, the first officer, who was probably flying, would have had to ignore the altimeter 1,000-foot needle for some time, while the captain would heve had to fail to monitor the altimeters during the same time period. Further, misreading the altimeter would not account for the fact that the eirplane was about 6 miles east of the approach course for SHD. Therefore, the Safety Board does not believe that the misinterpretation or malfunction of altimeters was e causal factor in this accident.

17/ Hemingway, John C., "Altimeter Readings and Setting Errors, NASA Quarterly Report No. 12, Dec. 1980, pp. 19-27.

2.7 Air Traffic Control and Airways Facilities

The investigation revealed that ATC procedures as applied by the Washington ARTCC Gordonsville low radar (R31) controller were proper and in accordance with FAA Handbook 7110.65.

Two questions arose regarding the exchanges between the R31 controller and flight 1517. The first question concerned the R31 controller's request at 1014:18 for a position report from flight 1517. The request was made for planning purposes since other flights were waiting to make the approach. The second question concerned the R31 controller's suggestion at 1017:49 that flight 1517 execute a missed approach if not established on the localizer. The suggestion was based on his past experience regarding the amount of time it took for a Beech 99 to complete the approach to SHD. The Safety Board noted that both the controller and the station agent apparently sensed that too much time had passed during the approach without the airplane landing or reporting a missed approach.

A flight inspection of the ILS at SHD was conducted by the FAA on September 23, 1985. All components were operating within specifications and the SHD ILS was certified for use upon completion of the flight inspection. FAA ground and flight inspections of the MOL VOX determined that the facility was operating within prescribed limits. An FAA flight inspection of the Washington ARTCC radar, transponder, and radio communications frequencies was also conducted and all were found to be operating within prescribed limits.

The pilot of the Beech 58 Baron which held at STAUT for 40 minutes, noted that the quality of reception of the compass locator/marker was suitable for navigation and that the coupled approach he subsequently made into SHD was very stable. That airplane tracked in from the southwest and entered holding at STAUT. According to the pilot, he was using both the NDB and the the localizer for navigation. At no time did he experience any difficulty with localizer reception or NDB reception. Since this pilot monitored the localizer continuously throughout the time period that flight 1517 was attempting to execute the ILS approach, it is obvious that flight 1517's failure to intercept the localizer was not caused by an interruption of the localizer signal. The Baron's flight was plotted on radar from 1002:54, at which time flight 1517 was a 6,000 feet northeast of CEROL, and he was tracking the localizer inbound from the southwest.

The fact that frequency 110.5 MHz was found in the No. 1 navigation receiver at the time of its examination and was among the choices of possible frequencies found in the Nos. 2 and 3 navigation receivers as well, suggested the possibility that one or more of the navigation receivers was tuned to 110.5 MHz instead of 109.5 MHz, and that the ground equipment was emitting a usable signal which could be received on that frequency.

To test the validity of this theory, Henson personnel flew the approach in another Henson Beech 99 airplane with all three navigation receivers tuned to 110.5 MHz. A signal was received on the No. 2 receiver only, but its reception was limited to a 4-mile radius of the airport, all to the northeast of STAUT. However, the accident airplane did not appear to have any navigational problems in that area; therefore, it is difficult to draw any conclusions from this test flight which apply to any possible navigation problems of flight 1527. Further, the receivers from the test airplane were not bench checked after the test flight, although the airplane continued to fly in revenue service. The FAA subsequently conducted a flight inspection of frequency 110.5 MHz in the vicinity of SHD; the flight did not receive, at any time, a signal or Morse Code identification. The Safety

Board concludes that there apparently was a performance deficiency in the navigation receive? which received a signal on 110.5 MHz on Henson's test flight. It *is* not possible to determine if the accident airplane was equipped with a navigation receiver which had a similar performance deficiency; however, if there had been, the pilots should heve had sufficient indications of receiver deficiencies or malfunctions during the approach to have notified ATC and *to* have safely abandoned the approach.

The Safety Board concludes that no elements of the Air Traffic control system or Airway Facilities contributed to the cause of this accident.

2.8 Montebello VOR 045° Radial Theory

Given that there were no known problems with the airplane, its night systems, the weather, or the airborne or ground based navigation equipment, and there was no evidence of flightcrew incapacitation, it is clear that operational and human performance issues played a significant role in this accident. If all of Henson's procedures had been followed, and if the correct navigational frequencies had bees selected, the approach should have been flown successfully by this flightcrew. Therefore, the Safety Board believes that the most plausible reasons for the navigational error that placer? the airplane almost 6 miles east of the ILS localizer course included the flightcrew's failure to follow recommended instrument flight procedures, such as properly tuning and identifying navigation facilities, maintaining prescribed altitudes, making prescribed altitude callouts, observing TO/FROM indications, observing "flags," cross-checking the navigational displays, and comparing VRF navigation indications with the ADF indications.

When Safety Board investigators conducted a flight check of the MOL VOR 045° radial to test the hypothesis that the flightcrew might not have changed the navigation frequency on one or more of the VHF navigation radio control heads from the MOL VOR to I-SHD, it was found that the 045° radial of the MOL VOR led almost directly to the accident site. This radial was selected because the inbound course of I-SHD is also 045° and because it is a common practice for pilots to select tine inbound ILS course on the OBS as *a* reminder to them of the correct course. (This action is not necessary for proper sensing of the localizer signal, but merely provides a convenient heading reference.)

According lo Henson's chief pilot, before reaching CEROL the Nos. 1 and 3 VHF navigation radios should have *been* tuned to the Montebello VOR and the No. 2 VHP navigation radio should have been tuned to the Shenandoah ILS. Henson's policy was to set all three VHF navigation control heads to the ILS frequency after leaving CEROL. An ADF is required for the ILS approach to SHD. Therefore, the NDB (STAUT) frequency would have been selected before reaching the CEROL intersection, since the NDB is the only facility which provided direct guidance from CEROL to STAUT. STAUT was the initial approach *fix* (IAF) as well as the *final* approach fix (FAF). Since the radar returns indicate that the airplane was flown from near CEBOL directly to STAUT, the correct NDB frequency must Rave been selected and the facility must have been functioning properly, as attested to by the pilot of the Beech *58* Baron.

Henson's procedures require that the flying pilot set all the navigation radios. However, in *the* accident airplane, the third navigation radio's frequency selection was located an the right side of the first officer's instrument panel, beyond the normal reach of anyone sitting in the left seat. The captain of flight 1517, because of his experience in two-pilot flight operations, may have assumed that the *first* officer had complied with company policy and had set I-SHD into the No. 2 navigation radio before reaching CEROL and into the Nos. 1 and 3 VHF navigation radios after leaving CEROL. However, if the pilots forgot, and if none of the VHF navigation *radio* frequencies were changed from those which should have been selected when the airplane was inbound to CEROL from the north, then the flightcrew would have received information from the MOL VOR on the Nos. 1 and 3 navigation displays. The No. 2 navigation receiver may have been inoperative or may have been mis-set to 110.5 MHz. However, when an attempt was made to determine frequency selections in the VHF navigation radios, the No. 2 control head was the only one with 109.5 as a possible selection and the No. 2 OBS was observed at the accident site to have 045° selected. However, a failure or mis-seting of the No. 2 navigation radio during the flight could not be completely ruled out.

Some of Henson's Beech 99s had navigational displays on the first officer's instrument panel which were slaved to the captain's No. 1 radio and others which were independent. The third radio in the accident airplane was a completely independent self-contained navigation unit. Consequently, because Henson's pilots frequently flew in several different airplanes on any given day, it would be possible for a pilot to forget which particular cockpit configuration was in the airplane on any given flight. The first officer on flight 1517 was new to the company, had low multiengine time, had low instrument time, and was making her first instrument approach into SHD in IMC. Therefore, the possibility exists that she forgot the cockpit configuration of N339HA and thought she had a slaved unit which would be set automatically at the same time she or the captain may have set the No. 1 receiver, rather than an independent unit which had to be set separately. Or, she may have been so preoccupied with flying the airplane in instrument flight conditions that she simply forgot to set any of the radios but remembered to place the final approach course heading of 045° into her OBS.

If the first officer was using the MOL VOR to navigate, this could also explain the imprecise execution of the procedure turn. If the first officer had thought she was flying outbound from STAUT on the localizer backcourse, but her VHF navigation radio was actually tuned to the MOL VOR, with the 045° radial in the OBS, the CDI would have been on the right side of her navigation display, indicating that she should fly to the left to correct her course, which the radar plot shows that she did. 18/

The outbound track of the procedure turn was about 254° instead of the published 270° and the inbound track was about 075° instead of the published 090°. Winds aloft were not of sufficient velocity to account for these offsets, but the inaccuracy might be explained by the first officer intentionally lessening the outbound heading of the procedure turn, since she thought she was already west of course and needed to modify the procedure turn so as not to travel too far westbound before turning back to intercept the localizer course. However, the inbound track of the procedure turn was also about 15° to the left of the desired course. Analysis of the radar indicates that the groundspeed on the inbound leg of the procedure turn was 180 knots, suggesting that approach flaps may not have been lowered. According to company policy, 30° of flaps are lowered at 140 knots, although the limit speed was 182 knots for 30° of flaps.

There is another possible explanation for the apparent deviation from the outbound ILS course and the imprecise headings flown during the procedure turn. Flight 1517 tracked directly to STAUT, but immediately after passing STAUT the track turned

18/ On a localizer backcourse, normal sensing gives the pilot a reverse indication of the correct direction in which to fly for course guidance, so that the pilot must fly in the opposite direction of that indicated on the CDI. Some aircraft are equipped with a backcourse switch which compensates for this apparent error, often called "reverse sensing." N339HA was not equipped with such a switch.

left (east) of the localizer. Once the airplane was outbound from STAUT, if the first officer was flying headings only, rather than receiving guidance from either I-SHD the MOL VCR, or STAUT, then gyroscopic precession of the heading indicator might explain the observed track of the airplane. If these deviations from the published courses are attributed to gyroscopic precession, it would be concluded that the first officer was not navigating on the ILS, but was flying indicated headings throughout the outbound and procedure turn portions of the approach. Furthermore, if the first officer was referring strictly tc the heading indicator, she might not heve noticed that she had passed through the localizer two times (if she were tuned to I-SHD.) If she was using the MOL VDR 045° rsdiei, there would have been no indicati ːs of localizer crossings. Gyroscopic precession would not be of significance while the airplane was tracking the MOL VOR on V143 or flying directly to STAUT using the ADF.

After completing the procedure turn, the first officer might then have referred once again to her VHF display which, if set to the MOL VOR frequency with 045° in tine OBS, would have resulted in flight 1517 being flown toward the 045° radial of the MOL VOR an? the accident site.

Whether the first officer flew the procedure turn using the VHF receiver (ILS), using the ADF, or using only heading indications from the heading indicator, flight 1517 apparently approached the MOL VCR 045° radial about 1014:19 because the communications from the captain indicate that he thought he was near or at the inbound localizer course at that time and was "turn inbound" at 1014:25. The flight's probable ground track combined with en average airplane ground speed of abut 140 knob3 would have placed tine airplane in the vicinity of the 045° radial about the tine the captain made these communicatiors. (See figure 6.)

After the flightcrew intercepted what they thought was tine localizer course and turned inbound, they must have descended below the glideslope intereept altitude of 2,700 feet since they struck tine mountain et 2,400 feet, about 371 feet below its peak altitude and about 200 feet below a ridge in the flightpath of flight 1517. There are two possible explanations for the airplane crashing: at 2,400 feet along the 045° radial of the MOL VOR.

One explanation for the final phase of the flight is that the flightcrew flew along the 045° radial of MOL end allowed the airplane to drift down to 2,400 feet as they waited for passage of STAUT. Eventually, they became uncertain as to their location after noting a slow swing of the ADP needle, no marker beacon indication, and no glideslope indication. The captain's contact with ATC at 10:15:55 about being east of course supports such an explanation. Further, there would be e time delay after turning inbound on the localizer before the crew would have expected to receive the marker beacon or an ADF needle swing indicating passage of STAUT. Thus, once the crew intercepted the 045° radial of MOL, thinking it was the localizer, the crew would not have expected to receive an immediate indication that they had passed STAUT. Once the crew realized that sufficient time had passed for outer marker passage, either the captain or the first officer may have noted the ADF needle pointing toward the left wing. This would indicate that the airplane was east of course and could account for the captain's inquiry to ATC. The flightcrew may have finally realized that they were not on the localizer course or, in response to the controller's suggestion that they execute a missed approach, they mag have initiated a climb to a minimum safe altitude. However, the airplane collided with the ground before it could begin a left turn to STAUT according to the missed approach instructions, since the airplane struck the trees in a wing's level fuselage attitude.

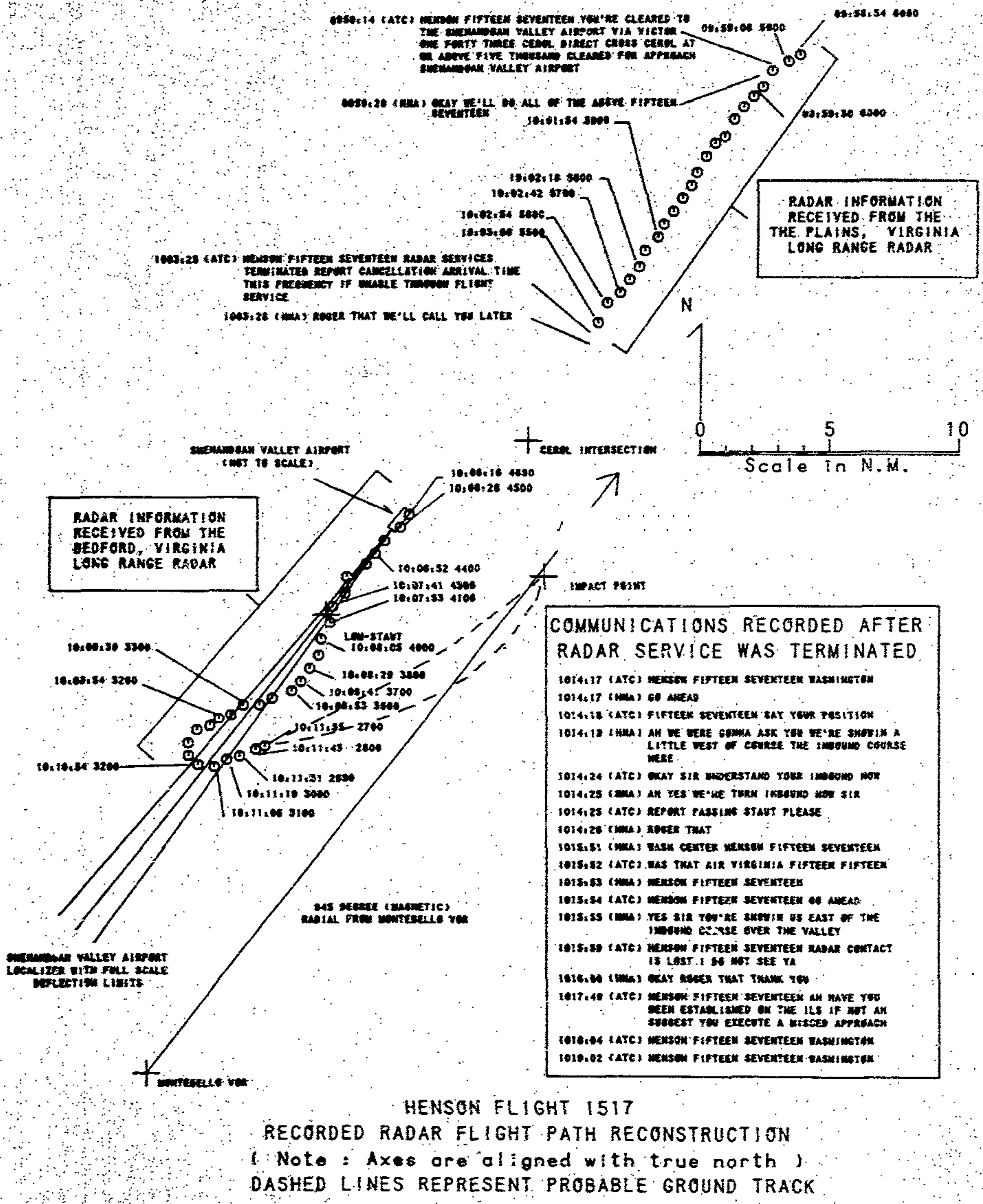

Figure 6.--Projected flightpath of flight 1517.

Another explanation is that the flightcrew believed that they had passed STAUT (the outer marker) and that, in the absence of a glideslope indication, they decided to execute a localizer-only approach although neither outer marker passage nor loss of glideslope was reported to XTC. Since the flight probably intercepted the 045° radial of MOL when the airplane was approximately abeam the STAUT NDB, it is possible that the flightcrew accepted the abeam indication on the ADF display as passage of the outer marker, even though the needle would have remained on the left and moved very slowly aft. At this time, they *would* have lowered their landing gear, turned OR the landing lights, and begun a descent to the localizer approach minimum descent altitude (MDA) of 1,620 feet. Although the absence of any glideslope indications should have alerted them to a problem, the reported weather conditions at SHD were well above the localizer-only landing criteria. Consequently, glideslope information would not have been important or needed to complete the approach and landing. However, since the weather in the mountains east of SHD probably was worse *than* the weather reported at SHD, they may have begun to execute a missed approach after arrival at MDA. In view of the fact that the airplane crashed with the gear and flaps up, which is the missed approach configuration, the accident could have occurred during the first moments of this missed approach attempt. The crew would have had about 1 minute 49 seconds from the time they acknowledged that they were not in radar contact until the controller suggested a missed approach to lower the gear, descend from 2,700 to 1,620 feet, then raise ?he flaps and sear, and climb back to 2,400 feet.

Regardless of what occurred after the flight intercepted the MOL 045° radial, the flightcrew did not detect their situation in sufficient time to take the appropriate action. This factor, as well as tine other information regarding the conduct of the approach, suggests inadequate instrument flying techniques and procedures on the parts of both pilots, including a faiiure of the captain to adequately monitor the approach.

If *the* first officer was navigating off the MOL VOR, it is difficult to understand why the captain did not detect such a gross error.. Furthermore, the conside-able time which had elapsed from the initiation of the procedure *turn* without localizer interception should heve been an additional indication to the pilots, especially the captain, that appropriate remedial action was needed. Under Federal Aviation Regulations, being unsure of one's position in IMC would certainly qualify as an "urgency" condition, constituting an emergency and requiring timely action. Although the airplane's configuration a? the accident site *suggests* that a missed approach or a climb to e minimum safe altitude (if the flightcrew knew that they were not on the localizer course) nay have been in progress at the time of impact, either on the flightcrew's initiative or at the controller's suggestion, this action was delayed until it was too late to avoid ground impact.

The Safety Board believes that *there are* several human performance, as well as operational factors. which could help to explain *how* such errors may have been compounded and not detected by the pilots in sufficient time to execute a missed approach. These factors include training to "proficiency" *in* minimum time, the assignment of a new captain to fly with a new first officer, the limited experience of the first officer in multiengine airplanes and in instrument flying, tine effects of a "noisy" cockpit (as reflected in the flight logs and as reported *to* her husband and roomate) documented dissatisfaction on the part of the first officer in communicating, the lack of en interphone system, the effect the proximity of the passengers to the cockpit had on crew communication, Henson's policy of providing en route and approach charts to the captain only, and several significant stress producing events in the lives of both pilots.

The facts illustrate that this flightcrew were not sufficiently prepared to conduct safe instrument flight operations and that the management and oversight of this commuter airline was inadequate. The Safety Board believes that the shortcomings on the parts of Henson management and the FAA are among the underlying reasons for this accident.

2.9 Operational and Human Performance Elements

2.9.1 Flightcrew Experience and Qualifications

The captain's entry level experience was 27 hours below the minimum total time desired by Henson (2,500 hours) at the time he was hired. His multiengine time was 58 hours below the desired time (500 hours), and his actual instrument time was at the minimum desired time of 75 hours. The first officer's entry level experience, as st..ed on the day she was hired, exceeded by 1,200 hours the total time desired by Henson (2,000 hours) at the time she was hired. Her multiengine time was 347 hours below the desired time (500 hours) and her actual instrument time was at the minimum desired time of 75 hours. The Safety Board acknowledges that the flightcrew's experience (flight time) far exceeded that required by Federal Aviation Regulations. To serve as pilot-in-command (PIC) of a multiengine airplane being operated as a commuter air carrier, a pilot must hold an airline transport pilot certificate, which requires a minimum of 1,500 hours of flight time, with appropriate category and class ratings. A second in command pilot (SIC), operating under 14 CFR 135, must hold a commercial pilot certificate, which requires a minimum of 250 hours of flight time, with appropriate category and class ratings and an instrument rating. (Appendix H contains excerpts from the relevant regulations.) However, the first officer had low time in operation of the Beech 99 and both pilots had limited time in their respective positions as captain and first officer. The Safety Board concludes that scheduling two pilots together, both of whom were relatively new to their positions, was a fact which permitted the errors to be made by the pilots, and which allowed the errors to go undetected. The captain was new to his duties as PIC and the first officer was not only new to her duties as SIC but came from a background consisting pimarily of single pilot operations.

Two earlier resumes submitted to Henson by the first officer, about 6 months and more before her employment by Henson, showed a total time of 3,224 hours with 550 hours of multiengine time and 264 hours of instrument time on the first and a total time of 2,950 hours with 150 hours of multiengine time and 160 hours of instrument time on the second. All three versions were in her personnel file at Henson Airlines. Her most recent logbook listed 5.7 hours of multi-engine flight time, which had culminated in the successful completion of a multiengine ATP checkride in February 1985. There were no cumulative totals of flight time in her most recent logbook (investigators were unable to locate and examine her previous logbooks), so it is impossible to precisely determine her flight experience, especially in multiengine airplanes, which ranged from 550 on her first resume to 154 when she was hired. Because the first officer appeared to be quite candid with instructors and line pilots about her low multiengine time, the Safety Board concludes that the 154 hours entered on the form completed on the day of her employment is probably most nearly correct, and that the values submitted on earlier resumes may have been "inflated" to enhance her chances of employment.

Henson Airlines has experienced a rapidly increasing turnover rate among flight crewmembers in recent years with voluntary departures increasing from 5 percent of total pilots in 1981 to 28 percent in 1985. According to Henson's former Director of Airline Operations, the first officer's credentials would have looked good at the time she was hired, notwithstanding multiengine flight time of only 154 hours (assuming that is the correct figure), since she had more than 3,000 hours of total flight time, held an ATP certificate, and had experience as a charter pilot. However, the Safety Board believes that a careful examination of the quality of her flight time, which was primarily in single engine, single pilot operations, should have alerted Henson Airlines that this candidate might need a greater than average amount of training to bring her to the skill level desired for commuter operations or that Henson Airlines might have asked her to accumulate more multiengine and/or instrument flight time before hiring her to as a professional pilot to conduct air commerce.

Henson Airlines was not aware that the first officer had a record of two incidents and one personal injury accident at the time she was hired. The answer to a question regarding accidents, incidents, and violations on Henson's application form were omitted by the first officer. Henson's procedure was to submit a written request for accident and incident records to FAA Airman Records in Oklahoma City through the GADO in Baltimore, which took about 90 days. There are no records to indicate that this was done in the case of the first officer. (The information could have been obtained by telephone from Oklahoma City in a few hours.) Furthermore, the airline did not contact the firm which employed her at the time of the injury accident. These facts would suggest that Henson was less than prudent in screening and selecting candidates for pilot training.

2.9.2 Flightcrew Training

Although Henson's classroom facilities were found to be adequate, the only training aids for the Beech 99 were slides and overhead transparencies. In ground school, the Beech 99 cockpit, instrument panel, and circuit breaker panels were presented in 35 milimeter slides and, before flight training, pilot candidates received briefings on the cockpit layout and instrumentation. No specific training was provided to address the differences in cockpit configurations of the various Beech 99 airplanes in the Henson fleet. The availability of a basic cockpit mockup or a ground procedures trainer, either of which could have easily been fabricated by Henson, would have greatly increased the student's familiarity with the airplane's controls and systems before beginning flight training, especially considering that the pilots currently being hired tend to have less experience than previous new hires.

Major air carriers, pilot groups, and large aircraft manufacturers have been aware of the problems brought about by nonstandard cockpit displays and equipment. Over the years, the emphasis in Part 121 air carrier operations has been on achieving standardization of cockpits throughout a major air carrier's fleet, although not always successfully so. However, many commuter air carriers are confronted with the need to purchase airplanes for their operations as they become available from other operators within the general aviation community or from different airplane manufacturers which have different concepts of, and therefore, different solutions to, the human engineering problems presented in the design of airplane cockpits. The Safety Board realizes that total standardization of an air carrier's fleet could present significant, if not prohibitive, economic penalties. Nevertheless, the Safety Board believes that the lack of cockpit standardization is a hazard to flight safety and must be addressed by the FAA and the commuter industry. The Safety Board believes that the FAA should alert its POIs of 14 CFR 135 operators to be aware of the potential hazards of nonstandard cockpit configurations and to encourage operators to include in their ground training the differences in their airplanes. Noting any critical differences in aircraft might also be made a part of the preflight checklist.

Instrument training at Henson Airlines was conducted without the use of a vision-restricting device. This practice was known to and approved by the FAA's POI. According to Henson training pilots, this was done in the interest of safety, since many large cumbersome hoods used for this purpose interfere with the vision of the check pilot; Henson also maintained that a complete scan was not possible with a hood. To achieve some restriction of vision, the pilot's seat was lowered. Additionally, most of Henson's instrument training was done at night. There are, however, many compact vision-restricting devices available which do not interfere with the vision of the check pilot. Without some kind of restriction, the trainee would perceive many visual cues and use them for orientation. Furthermore, using Henson's procedure, it is necessary to raise the seat to make the landing. That would occur at a critical time in the approach and would require the instructor pilot to take over, unless done so early in the approach that it would not really test the pilot's ability to fly an approach to minimums.

Instrument training should be conducted in a manner closely simulating actual instrument meteorological conditions. In the absence of an approved simulator or an advanced training device (ATD), training in the airplane should be conducted in a manner that will prevent pilots from obtaining visual cues. The practice at Henson Airlines allowed pilots who were receiving instruction or who were being tested to lower their seats rather than to use a vision restricting device. Since significant visual cues are provided to the pilot by peripheral vision, even if forward vision is somewhat restricted by this practice, this type of training environment is inappropriate and cannot provide an adequate opportunity either to develop instrument flying skills or to demonstrate instrument flying proficiency. Because the POI was aware of and accepted this practice, the Safety Board believes that the FAA should advise POIs to review air carrier training programs to verify that instrument flight training and checks are conducted in a properly simulated manner. Where approved simulators or ATDs are not available, appropriate vision restricting devices should be required.

In its special study 19/ on commuter airline safety, the Safety Board noted:

> ...pilot training would benefit greatly from increased use of flight simulation. While the number of suitable simulators is limited, they are generally available at aircraft manufacturers' training locations. The Board believes that training at manufacturers' training facilities will provide the most up-to-date simulator flight training. The Board urges the FAA and the commuter industry to encourage the development of sufficient numbers and types of aircraft flight simulators needed to upgrade the quality and scope of commuter airline training.

The Safety Board believes that, with the increasingly rapid turnover of flying personnel in the commuter industry, the need for the development of flight simulators is becoming increasingly more important so that the quality and scope of commuter airline pilot training may be upgraded.

In part, at the instigation of the RAA, the FAA has initiated efforts through its Proposed Advisory Circular (AC) No. 120-XX, in proposing standards for the procedures and criteria for use and evaluation of aircraft flight simulators (ATDs) under 14 CFR 135. The Safety Board strongly supported the FAA's efforts in its letter dated

19/ For more detailed information, read Special Study "Commuter Airline Safety 1970-1979" (NTSB-AAS-80-1).

May 23, 1986, and cautioned that "the use of Advanced Training Devices (ATD) only, may not result in improved regional airline pilot capabilities. Rather, the use of these devices must be augmented by a comprehensive training program for Part 135 operators."

The Safety Board urges the RAA to work with its membership in setting comprehensive industry training standards for initial and recurrent pilot training. Also, the Safety Board urges the FAA to expedite its program to introduce comprehensive standards on the use of aircraft flight simulators and to work with the industry in acquiring such training devices.

Henson provided only one set of approach and en route charts for its Beech 99 pilots. The approach chart was in the custody of the flying pilot, so the PIC on flight 1517 had no immediate reference to check the accuracy of the approach being conducted by the first officer.

The Safety Board believes that pilots at the controls should have their own set of pertinent navigational charts in their possession and accessible at all times. Also, if the nonflying pilots are to fulfill their duties in monitoring flight and navigation instruments, making radio calls, and calling out altitudes, it is necessary for those pilots also to have the continuous use of a set of charts. If a single chart has to be passed back and forth, or if one pilot has to move out of position to see a chart which is in the possession of the other pilot, confusion, poor flight monitoring, and inadequate cockpit coordination can occur. This would be especially true in the case of a pilot who was new to either position in the cockpit, as in the case of both pilots of flight 1517.

When both the captain and the first officer of flight 1517 received their flight training, Henson was permitted to train its pilots to "proficiency" in a minimum number of programmed hours of instruction. Since most instruction is given by company instructors and most check rides are given by company check airmen, "proficiency" is determined by the standard of the individual giving the instruction or the check ride. Although Henson's authority to train to "proficiency" was rescinded following this accident, it may be reinstated at any time by the POI. The POI stated that the rescission resulted from the rapid turnover of management, flight instructors, check airmen, and line captains, which caused a decrease in the quality of training. This was reflected by a 40 percent rate of failure in upgrade training in the DHC-8 in which he gave all of the checkrides. He also stated that it was increasingly difficult for Henson to retain qualified instructors and that they were required to perform line flying duties in addition to instructional duties.

The Safety Board believes that there should be a more objective standard for the minimum number of flight hours required to ensure an acceptable standard of professional competence for both captains and first officers of commuter air carriers operating under 14 CFR 135, and that a specific number of training hours should be required with more hours as an option if proficiency has not been reached when the prescribed number of hours had been completed. Under 14 CFR 121.424, pilots in command of turbopropeller powered airplaines, such as the Beech 99, are required to complete 15 hours of flight time and second in command pilots are required to complete 7 hours of flight time. (These hours may be reduced under 14 CFR 121.405.) Since those pilots flying for commuter air carriers operating under 14 CFR 135 are generally less qualified and have fewer hours of flying time than those flying for air carriers operating under 14 CFR 121, it would seem reasonable to require at least an equal amount of training to serve as PIC and SIC of similarly powered airplanes. Referring to commuter airline pilots in general, the POI said that, "Now we are beginning to get to the bottom of the barrel so to speak, and that's part of the problem." Specifically, in regard to Henson Airlines' pilots, he steted that the quality of the current pilots was of 2 "different calibre [less qualified] than it had Seen until late 1983." Before that time, he considered that Henson Airlines was very stable with succession from one airplane to another and upgrade to captain moving at a slow pace. For instance, a Beech 99 captain who was upgraded to the Shorts 330 would probably serve as a first officer on that airplane for 6 months before being upgraded to captain. In contrast, the captain of flight 1517 had spent about 1 month as a first officer on the Beech 99 before being upgraded to captair,.

2.9.3 Stressful Events in the Lives of the Crew

According to research conducted at the Naval Safety Center with naval aviators, recent marital engagements and recent cereer decisions are two major stressors which are frequently found in those who were causally involved in major aircraft mishaps. Because the captain had just become engaged to he married and was anticipating a job interview with Eastern Airlines, it is possible thet his attention was affected by these significant events in his life and, as a result of these distractions, he failed to monitor the approach vigilantly.

The first officer was unable to live with her husband due to job requirements and aspired to a flying job based i Florida, where he lived. Her husband reported that she took e large pay cut to work for Henson and considered her per diem pay inadequate. Her roommate in Hagerstown suggested that she had postponed a visit to a doctor in Maryland because of the cost. Financial difficulties, which was cited as a third major stressor in the study of naval eviators, nay have caused stress in the first officer.

The first officer had several unresolved medical concerns. Her physician, whom she had visited 5 days before the accident, said that she reported taking birth control pills for the past 9 months in compliance with her prescription. However, her menses were not regular, and she hac! missed the last 2 months. Physicians have studied the relationship between stress end amenorrhea (missed menses: in college students where the phenomenon is most evident. A paper on menstruai disorders in college students, reported that "Stress, physical or emotional, is probably the most common cause of amenorrhea in adolescents or young adults. The stressful life style at the college campus due to higher levels of competition and increasing demands on training and education may cause ". . . amenorrhea. . . ." 20/ A more recent article pointed out that "travel, change in climate or sleep habits, and mental distress all can affect menstrual regularity. If the stresses are great enough, the clinical condition of amenorrhea can be the result." 21/

The first officer's amenorrhea may well have resulted from the stressful environment associated with her recent employment and training as well as the necessary separation from her husband. At the 'rime of her visit to her physician, she had 'been working for Henson for 2 months, the same period of time during which she had been amenorrheic.

20/ Singh, K.B., "Menstrual Disorders in College Students," AM.J. Obstet. Gynecol., 144(1), 98-102, September 1, 1982.

21/ Ballentine, C., "No menstruation, no pregnancy = Amenorrhea," FDA Consumer, 18(4), 22-24, May 1984.

During the same visit to her physician, she reported a lump in her left breast and soreness in her left shoulder and chest. Although he did not perform a mammogram, the physician informed her that lumps, which he found in both breasts, were fibrocystic disease and probably not cancerous. However, without a mammogram and/or a biopsy of the tissue, a definitive diagnosis cannot be made. The first officer was instructed in breast self-examination and asked to return in 3 months for a followup visit. It is likely that she was concerned about the fibrocystic disease and its possible link to cancer since her mother had died of breast cancer at age 47, placing the first officer at a much higher risk for breast cancer than someone with no family history of the disease.

The first officer's physician said that she reported taking diethylpropion, a diet drug, in order to stay awake. Toxicological examination of postaccident samples revealed evidence of a therapeutic dosage. FAA and Safety Board experts agreed that this probably had no greater effect upon her flying than consuming 5 to 6 cups of coffee. However, the manager of the FAA's Aeromedical Standards Division of the Office of Aviation Medicine said that taking the drug to stay awake while flying raised a "red flag," suggesting other problems, such as some type of sleep disorder or disturbance of an emotional or physical nature. Her roommate reported that the first officer had difficulty sleeping when she was away on overnight layovers. However, she slept in her apartment the night before the accident. In any event, both birth control pills and the diet drug should have been noted on her application for a medical certificate and were not. Any one of these problems, or all of them in combination, may have affected the first officer's concentration on the day of the accident.

The FAA's Forensic Toxicological Research Unit in Oklahoma City did not detect diethylpropion in the first officer's blood, which was detected by the Bureau of Forensic Science of the Commonwealth of Virginia and the Center for Human Toxicology in Salt Lake City, Utah. Its failure to detect licit drugs at therapeutic levels remain a concern of the Safety Board.

In its report of the March 30, 1983, accident involving a Gates Learjet Model 25 at Newark International Airport, 22/ the Safety Board stated, in part:

> The use of both licit and illicit drugs by pilots is a major concern in aviation safety because of the critical skills required of pilots and the adverse effects of such drugs. Similarly, the physiological and/or psychological effects on pilot performance of such drugs are not clearly defined and are not well publicized to the flying community. Although some research has been conducted in this area, the need exists to collate available data and to institute additional research in drug involvement in aircraft accidents and the potential effects of such drugs on pilot performance. The Safety Board's difficulty during this investigation in obtaining definitive data, both quantitative and qualitative, regarding toxicological analyses and the resultant behavioral effects of such drugs indicates a need for research to develop scientific data on this subject. From such data, the potential drug problems in aviation could be assessed.

22/ Aircraft Accident Report--"Central Airlines Flight 27, Hughes Charter Air Gates Learjet Model 25 (N51CA) Newark International Airport, Newark, New Jersey, March 30, 1983" (NTSB/AAR-84/11).

The Safety Board believes that information on the effects of various drugs should be collected in the aviation mode because of the critical nature of pilot performance requirements and task complexity. The information that is collected should be used to develop guidelines end cautionary material for pilots on the use of both licit and illicit drugs before and daring flight operations.

+ * *

Many toxicology laboratories, including FAA's laboratory (CAMI), do not necessarily test for presence of therapeutic levels of licit drugs unless a specific request is made based on the finding of a prescription bottle or other indication of use of a particular drug by a pilot. Drug screens generally are designed only to detect abnormal (lethal or incapacitating) levels of licit drugs, and only the presence of illicit drugs. Additionally, the relationship of therapeutic levels of licit drugs and performance should he examined with a view toward providing guidelines to pilots and improving toxicological test procedures.

As a result of its investigation, the Safety Board recommended that Me FAA:

A-84-9'

Establish at the Civil Aeromedical Institute the capability to perform state-of-t'ne-art toxicological tests on the blood, urine, and tissue of pilots involved in fatal accidents to determine the levels of both licit and illicit drugs at both therapeutic and abnormal levels.

A-82-94

Review the research and literature on the potential effects on pilot performance of both licit and illicit drugs, in both therspeutic and abnormal levels, and use that to develop and actively disseminate to pilots usable guidelines on potential drug interactions with piloting ability.

Regarding Safety Recommendation A-84-93? the FAA replied on January 13, 1986, that the Civil Aeromedical Institute (CAMI) had increase< its screening capability with a "sensitive drug-class-selective immunochemical technique (specifically Emit or Enzyme Multiplied Immunoassay Technique) applied to wine." Confirmation of presumptive positive results would be performed by a contractor using a differential technique until CAMI could purchase the appropriate equipment.

As a result of the FAA's response, the Safety Board reclassified the status of Safety Recommendation A-84-93 from "Open—Unacceptable Action" to "Open--Acceptable Action" with the provision ?hat "additional information as to the detection of licit drugs and the level of detection now at CAMI" should include the detection of substances at the therapeutic level.

The Emit screening equipment was not in use at CAMI at the time of the Henson accident. However, a representative of the company which markets Emit stated that its equipment is not capable of detecting the level of diethylpropion hydrochloride (an amphetamine-like drug) which was found by the Bureau of Forensic Science of the Commonwealth of Virginia in the first officer's blood (.04 micrograms per milliliter). The company's Emit test for drugs of abuse is only capable of detecting amphetamines in urine, not in blood or serum. The level at which the Emit general amphetaime screen is capable of detecting diethylpropion is 850 micrograms per milliliter in urine, which is far in excess of the expected therapeutic level.

While this new screening equipment may be valuable in some applications, it clearly could not have successfully detected the drug of interest in this investigation. Further, samples of urine are not always available for testing, as was the case with the captain in this accident. Emit serum (blood) screening is limited to barbiturates, benzodiazepines, ethyl alcohol, phencyclidine, and tricyclic antidepressants.

In a January 3., 1986, letter, the FAA stated that the outside contractor will only be used for confirmation of presumptive positive results. Consequently, it is likely that, with its current screening capabilities, CAMI will continue to be unable to detect some drugs in urine and blood samples.

The Safety Board urges the FAA to revise its screening techniques to include the capability to detect both the therapeutic and abnormal levels of licit and illicit drugs in urine and serum or whole blood. Based upon this investigation, Safety Recommendation A-84-93 has been reclassified as "Open—Unacceptable Action."

Although the Henson Operating Manual clearly states the company guidelines on drug use while on duty, the first officer apparently did not comprehend the potentially serious side effects of the diet drug. The Safety Board believes a drug handbook, as recommended in Safety Recommendation A-84-94, may convey this message more forcefully than company guidelines and would reinforce and complement those guidelines. Safety recommendation A-84-94 currently is classified as "Closed—Unacceptable Action."

2.9.4 Cockpit Coordination

The captain had been flying in his position for about a month and the first officer had been flying in her position for about 6 weeks. The captain had conducted six instrument approaches as a Beech 99 captain, and the first officer had conducted 23 instrument approaches as Beech 99 first officer. Their training flights and IOE flights reflect minimum flight time in IMC. They had flown together on two occasions before the accident flight but had conducted no instrument approaches on those days and had not flown into SHD. On the day of the accident, they had successfully executed three instrument approaches. However, considering the brief amount of time devoted to cockpit coordination and the first officer's lack of experience in two pilot operations, Henson's procedures may not have been learned as thoroughly as may have been desired or expected by the company.

As a result of its investigation of the January 20, 1981, accident involving Cascade Airways, the Safety Board recommended that the FAA:

A-81-75

> Establish for aircraft used in commercial operation the maximum cockpit noise levels which will permit adequate direct voice communication between flight crewmembers under all operating conditions.

A-81-76

> Require the installation and use of crew interphone systems in the cockpits of those aircraft in which noise levels reach or exceed the maximum level established for adequate direct voice communication between flight crewmembers under all operating conditions.

Safety Recommendations A-81-75 and A-81-76 were classified as "Open—Acceptable Alternative Action," pending the development of an AC by the FAA regarding the measurement and analysis of cockpit noise and remedies to improve communications in cockpits with high noise levels. The AC was scheduled for May 1986, but has not yet become available, and there have been no steps taken to implement the retrofitting of airplanes which exceed allowable noise levels with interphones. Furthermore, as a result of this accident, the Safety Board no longer believes that an AC is acceptable as an alternative action. The Board believes that excessive Beech 99 cockpit noise levels precluded effective oral communication and contributed to a reduction in communications between the flightcrew in this accident. Consequently, the noise levels interfered with proper and timely crew coordination.

In a full-mission simulation study conducted at the National Aeronautics and Space Administration, researchers found that "when more information was transferred regarding aspects of flight status, few errors appeared which were related to systems operations (e.g., . . . misreading and missetting of instruments . . .Overall, there was a tendency for crews who did not perform as well to communicate less--a finding which underscores the importance of the information transfer process." 23/

The Safety Board agrees with this assessment. Consequently, the Safety Board finds that the FAA's proposal to issue an AC on cockpit noise levels is no longer an acceptable response to Safety Recommendations A-81-75 and -76, although it still believes the issuance of the AC to be an appropriate action. Therefore, the Board has classified Safety Recommendations A-81-75 and -76 as "Closed—Unacceptable Action/Superseded," and it has issued two new recommendations to the FAA based on the maximum cockpit noise level of 78 PSIL recommended in the FAA contract report. The Safety Board believes also that the FAA should not allow flights to be dispatched without a functioning interphone system. Therefore, the Board believes that the interphone system, when installed, should be removed from the Master Minimum Equipment List.

A crew interphone system would facilitate the exchange of unambiguous information under normal or abnormal flight conditions while at the same time it would preclude alarming the passengers who might misinterpret crew conversations even under normal flight conditions. An additional benefit of a crew interphone is to permit the continuation of on-the-job training for new first officers who may be unfamiliar with the airplane or with company procedures.

While it is not possible to assess the quality of flight 1517's crew coordination or communications in the absence of a CVR, it is not likely that the crew would have been able to discuss and agree that they were unsure of the airplane's location without having to shout and without the possibility that passengers could overhear their conversation. If an interphone had been available, such a discussion could have taken place without

23/ Foushee, H.C. and Manos, K.L. "Cockpit Communications Patterns and the Performance of Flight Crews," ISASI Forum, Spring 1981, pp. 19-20.

disrupting flying duties and in privacy, thereby making it more probable that it would have occurred. The Safety Board concludes that the lack of an interphone system was a contributing factor in this accident.

Considering that both the captain and the first officer were relatively inexperienced in their respective positions, the division of cockpit duties between the flying pilot and the nonflying pilot may not have gone as smoothly or as quickly as it might have if one or both had been more experienced. Training in crew coordination consisted of a video-taped program on cockpit resource management, and any further information or assertiveness training was covered by the flight instructor or the IOE check airman which, in the absence of any guidelines, would vary considerably with the instructor or check airman. In any event, considering the time frame within which training was accomplished, there would have been insufficient time to teach and to confirm that adequate coordination procedures were understood. This would place a heavy reliance on cockpit coordination being learned on the job.

The coordination problem would be magnified by a noisy cockpit and the difficulty in hearing and being heard. Further, the need for cautious communications between the pilots because the passengers can hear what is said, IMC, and a flying pilot who is reputed to be behind the airplane in instrument flying, would result in delays in making almost every decision.

The Safety Board is aware of the rapid turnover of the pilot population of commuter airlines and the fact that it has become necessary to hire pilots with fewer qualifications than was previously the case.

The Safety Board believes that inadequate cockpit coordination, resulting from having two pilots who are both inexperienced in their positions, could explain, in part, the otherwise inexplicable navigational error by these pilots, and this factor was causal in the accident. Consequently, the Safety Board believes that the FAA should caution commuter airlines against scheduling two inexperienced (in the position, in total time, instrument time, time in class, or time in type) pilots for the same flight.

However, the Safety Board notes that, at the time of the accident, the captain's total time and experience far exceeded both the FAA and Henson's minimum requirements and, although he had only accumulated a little more than 100 hours of PIC time in the Beech 99, he had spent about a year as a first officer with Henson Airlines and should have been acutely aware of his monitoring function in a two-pilot operation in which a new first officer was making an approach in instrument meteorological conditions.

2.10 <u>Summary of the Navigational Error</u>

In summary, the Safety Board was unable to determine conclusively the precise reason(s) for the navigational error leading to this accident in the absence of evidence which would have been provided by a CVR and/or FDR. However, the Safety Board believes that there is sufficient evidence to conclude that there was an error in navigation and a failure to monitor the flight instruments properly. The most credible explanation for the observed track flown by the airplane, the language of the recorded transmissions, and the location of the wreckage is that the flightcrew was navigating off the Montebello VOR 045° radial instead of the Shenandoah ILS. The available facts do not support any other reasonable scenario, since the Safety Board concludes that the flightcrew was navigating by information available to them in the cockpit and no facility, other than the Montebello VOR, was capable of presenting information which would lead the airplane to the accident site on a magnetic course of 45°.

Further, the communications by the captain to ATC at 1014:19 and 1014:25, the time at which the extended ground track of flight 1517 would have been approaching the MOL VOR 045° radial, that the flightcrew was turning inbound, is additional evidence to support the hypothesis that the crew was navigating off the MOL VOR. Of course, there are several factors which should have discouraged the flightcrew from the inadvertent use of the MOL VOR 045° radial: a "FROM" indication rather than a "TO" indication on the OBS, the incorrect aural identification on any incorrectly tuned VHF navigation radios, a glideslope "flag" on all incorrectly tuned VHF navigation radios, an ADF needle indicating that the airplane was east of course, and an excessive amount of elapsed time without intercepting the localizer. On the other hand, the flightcrews' qualifications, training, and experience which, in combination, left them poorly prepared for instrument flying, as well as several human performance factors, probably resulted in their failure to detect these errors and in their failure to monitor adequately the approach. The Safety Board concludes that the evidence is sufficient to determine that the accident probably was caused by the inadvertent use of the MOL VOR 045° for navigation.

2.11 FAA Surveillance

Surveillance of Henson's 14 CFR 135 operations by the FAA had been sharply curtailed since April 1985 when the airline introduced the deHavilland DHC-8 to its fleet.

The POI was fully aware of, and approved Henson's policy of conducting instrument training without the use of a view-limiting device. He stated that he was not concerned with the first officer flying approaches by reference to OBS and ADF displays on the left side of the captain's instrument panel, which is contrary to 14 CFR 23.1321(a). 24/ However, the fact that he had flown 3,000 hours as PIC in the Beech 99 may have affected his assessment of this arrangement. A pilot, such as the first officer, with minimum multiengine time and minimum instrument time could find the parallax, which this configuration presented, to be a significant problem, and could find it difficult to adjust his or her scan to include an instrument outside the normal scanning range.

The POI was fully aware that Henson's training standard for the ILS was a one-dot deflection and the line flying standard was a full scale deflection. He stated that he did not have the authority to impose a higher standard on the airline than is required by Federal regulation, although the airline could impose a higher standard upon itself. He based his opinion on the requirements of the Instrument Pilot Flight Test Guide (AC-61-56A). The POI indicated that he would be very uncomfortable with that standard and that failure to correct before a full scale deflection would be sufficient to fail a candidate on a checkride.

The Safety Board's investigation revealed that there is no Federal regulation which addresses the allowable amount of deviation of a glideslope or localizer needle on the pilot's OBS display. According to the FAA, flight test guides provide the only suggested guidelines for a POI's approval of an airline's operations. Since an Airline Transport Pilot Certificate is required to serve as PIC on multiengine airplanes operated by commuter air carriers, and since the flight test guide is the only standard available to the POI, it would seem to follow that this is the standard which should be adhered to in a

24/ Each flight navigation and powerplant instrument for use by any pilot must be plainly visible to him from his station with the minimum practicable deviation from his normal position and line of vision when he is looking forward along the flightpath.

commuter airline's training, check rides, and line flying. The standard found in the Airline Transport Pilot Flight Test Guide (AC 61-77) is a "one dot" deviation. The Safety Board believes that the FAA should bring this standard to the attention of all POIs of commuter air carriers and incorporate it into FAA Order No. 8430.1D, Air Carrier Inspector's Handbook, Part 135.

The Safety Board concludes that increased FAA surveillance might have disclosed the improper radio installations at an earlier date. It would certainly have allowed more recent and more frequent surveillance of Henson's Beech 99 initial and recurrent training, since most of the POI's time was consumed with preparations to place a new airplane on the line. The Safety Board believes that the FAA should give priority to the quality and quantity of surveillance activities. One procedure to assure this might be to provide additional staffing on a temporary basis when airlines are involved in changes which require the full time attention of the only inspector, such as the addition of new aircraft.

The Safety Board appreciates the latest efforts of the FAA to alleviate substandard surveillance problems of the commuter airline industry. In February 1984, the FAA embarked upon an in-depth review of the entire flight standards inspection system. According to the FAA, the review, entitled project SAFE (Safety Activity Functional Evaluation), encompassed a forecast of aviation activity under deregulation, the National Air Transportation Inspections (NATI-I and II), the General Aviation Safety Audit (GASA), and an evaluation of existing regulations, directives, programs, studies, and reports concerning flight standards inspection programs. The elements of the flight standards system, which received critical appraisal, included regulations, directives, work programs, program management information, industry safety findings, evaluation programs, budget, resources, position descriptions, classifications, hiring practices, career development, training, and supervisory evaluation. Deficiencies identified by project SAFE have been addressed in an implementation plan with a blueprint for short-term and long-range changes. The FAA has set targets in its implementation plan to update each part of the flight standards system by fiscal year (FY) 1988 and, by FY 1989, to standardize and integrate the parts into an automated, interactive system for updating and documenting FAA performance.

However, the SAFE program, which is in its infancy, will require a considerable period of time before measurable benefits can be derived and validated. The Safety Board believes that the continued dynamic growth of the commuter industry and these latest accident findings warrant the development of more timely interim procedures and guidelines which will allow for continued surveillance of commuter air carriers during periods when the POI is unable to fulfill those duties because of other work demands.

2.12 Survival Factors

Considering the inaccessible and heavily forested terrain in which the accident occurred, the emergency response was considered to be adequate, both in terms of the search efforts conducted and in the determination of the need for medical care. Because a livable cabin volume was not maintained and because the impact injuries were severe, the Safety Board concludes that this was *not* a survivable accident. The conclusion that the occupants died from impact forces is substantiated by the relatively low levels of carboxyhemoglobin levels found in the blood of those occupants for whom valid toxicological measurements could be obtained. Smoke inhalation during a ground fire would have resulted in higher levels of carboxyhemoglobin.

2.13 Cockpit Voice Recorder and Flight Data Recorder

The Safety Board believes that the facts and circumstances of this accident further illustrate the need for a requirement that FDRs and CVRs be installed in multiengine, turbine-powered, fixed-winged airplanes. Recorded flight parameters and CVR conversation would have provided significant factual information regarding the cause of this accident and thus provide the means for determining the proper remedial action needed to prevent recurrence.

As a result of its investigation of an airplane crash at Felt, Oklahoma on October 1, 1981, 25/ the Safety Board recommended that the FAA:

A-82-107

> Require that all multiengine, turbine-powered, fixed-wing aircraft certificated to carry six or more passengers manufactured on or after a specified date, in any type of operation not currently requires by 14 CFR 121.343, 122.359, end 135.151 to have a cockpit voice recorder and/or a flight data recorder, be prewired to accept a "general aviation" cockpit voice recorder (if also certificated for two-pilot operation) with at least one channel for voice communications transmitted from or received in the aircraft by radio, and one channel for audio signals from a cockpit area microphone, and a "general aviation" flight data reccrder to record sufficient data parameters to determine the informetion in Table I as a function of time.

A-82-109

> Require that "general aviation" cockpit voice recorders (on aircraft certificated for two-pilot operation) and flight data recorders be installed when they become commercially available as standard equipment in all multiengine, turbine-powered fixed-wing aircraf! and rotorcraft certificated to carry six or more passengers manufactured on or after a specified date, in any type of operation not currently required by 14 CFR 121.343, 121.359, 135.251, and 127.127 to have a cockpit voice recorder and/or a flight data recorder.

A-82-ill3

> Require that "general aviation" cockpit voice recorders be installed as soon as they are commercially available in all multiengine, turbine-powered aircraft (both airplanes and rotorcraft), which are currently in service, which are certificated to carry six or more passengers and which ere required by their certificate to have two pilots, in any type of operation not currently required by 14 CFR 121.359, 135.151, and 127.127 to have a cockpit vcice recorder. The cockpit voice recorders should have at feast one channel reserved for voice communications transmitted from or received in the aircraft by radio, and one channel reserved for audio signals from a cockpit area microphone.

25/ Aircraft Accident Report--"Sky Train Air, Inc., Gates Learjet 24, N44CJ, Felt, Oklahoma, October 1, 1381" (NTSB/AAR-82/4).

A-82-111

Require that "general aviation" flight data recorders be installed as soon as they are commercially available in all multiengine, turbojet airplanes which are currently in service, which are certificated to carry six or more passengers in any type of operation not currently required by 14 CFR 121.343 to have a flight data recorder. Require recording of sufficient parameters to determine the following information as a function of time for ranges, accuracies, etc.):

altitude
indicated airspeed
magnetic heading
radio transmitter keying
pitch attitude
roll attitude
vertical acceleration
longitudinal acceleration
stabilizer trim position
 or pitch control position.

Although the Safety Board is encouraged by the FAA's notice of proposed rule making (NPRM) concerning CVRs on newly manufactured multiengine, turbine-powered, fixed-wing aircraft operating under 14 CFR 135, it is concerned that a final rule has yet to be issued. Therefore, the Safety Board urges the FAA to expedite its implementation. Further, the Safety Board believes that the matter of prewiring newly manufactured aircraft, as defined in Safety Recommendation A-82-107, for eventual acceptance of a general aviation flight data and cockpit voice recorder retrofit, has been neglected. The Safety Board also reiterates Safety Recommendations A-82-109 through -111. Until further action is taken, those recommendations are being held in an "Open—Unacceptable Action" status.

The Safety Board believes that a CVR would not only have been a valuable tool in analyzing this accident to determine why it occurred, but that it would be a positive force in developing measures to prevent similar accidents in the future. Until the FAA requires the installation or airlines voluntarily install CVRs, similar accidents may occur and important preventive measures will go undetected.

2.14 Ground Proximity Warning System

As a result of this and two other approach phase accidents involving scheduled domestic passenger commuter flights operating under 14 CFR 135, which occurred between August 1985 and March 1986, and in which 25 persons were fatally injured, 26/ the Safety Board believes that the time has come for the FAA and the commuter airline industry to address the installation of ground proximity warning systems (GPWS) aboard those aircraft commonly used by the commuter airlines for the commercial transport of 30 or fewer passengers. While Henson flight 1517 was flying toward rapidly rising terrain,

26/ Aircraft Accident Reports—"Bar Harbor Airlines Flight 1808, Beech BE-99, N300WP, Auburn-Lewiston Municipal Airport, Auburn, Maine, August 25, 1985" (NTSB/AAR-86/06); and Simmons Airlines, Embraer EMB-110P1, N1356P, Alpena, Michigan, March 13, 1986 (currently under investigation).

it failed to clear a Hall Mountain ridge by only about 200 feet. A ground proximity warning device to monitor height above the ground may have been sufficient to direct the flightcrews' attention to the possibility of ground contact in time to avoid an accident.

As an example of the terrain protection afforded by GPWS systems, the Safety Board examined the alerting features of a GPWS manufacturer and applied these specifications to the three accident scenarios (i.e., flightpaths). In the case of the Henson accident, the manufacturer's standard GPWS would have activated approximately 29 seconds before impact with a "terrain" warning. (See figures 7 and 8.) The same GPWS would have activated at least 10 seconds—and possibly as much as 17 seconds—before impact in both the Bar Harbor and Simmons Airlines accidents.

A GPWS or similar device requires the installation of a radio altimeter, a transceiver, an indicator, an antenna, and a voice box. Presently, there is no requirement for a radio altimeter in turbine powered multiengine airplanes carrying 30 or fewer passengers. Because of the relatively high costs associated with this equipment, the protection of a ground proximity warning device is not provided in most airplanes in the commuter fleet. Although installation costs were previously prohibitive for both the radio altimeter and the GPWS on small airplanes, the state-of-the-art of both the commuter industry and ground proximity warning devices have progressed to the point that newly manufactured airplanes used in the commuter industry should be required to have such equipment, and consideration should be given to retrofitting older airplanes on a priority basis. The RAA documented about 1,745 such airplanes in the entire commuter fleet in 1985. That number has increased from 1,047 since deregulation in 1978 and is forecast to reach 2,300 aircraft in 1995. There are now about 179 commuter air carriers operating under 14 CFR 135. The cost of the equipment and installation of a ground proximity warning device is estimated at under $10,000.

3. CONCLUSIONS

3.1 Findings

1. There was no evidence of an in-flight structural failure or malfunction before contact with the trees, and all structural separations examined were the result of overload.

2. There was no evidence of a powerplant malfunction.

3. Propeller blade impact angle marks were consistent with operation in the low pitch (approach power) regime.

4. There was no evidence of any pre-impact failure or malfunction of the airplane's electrical, flight control, instrument, or navigation systems.

5. Maintenance records revealed no recent maintenance or open maintenance discrepancies which may have contributed to this accident.

6. The radio installations on the right sides of the instrument panels in Henson's Beech 99s were nonstandard and, in the accident airplane, the installation was not FAA approved.

7. Two VHF navigation radio displays and one ADF display installed on the left side of the captain's instrument panel were not in a suitable location for use by the first officer in the execution of an instrument approach.

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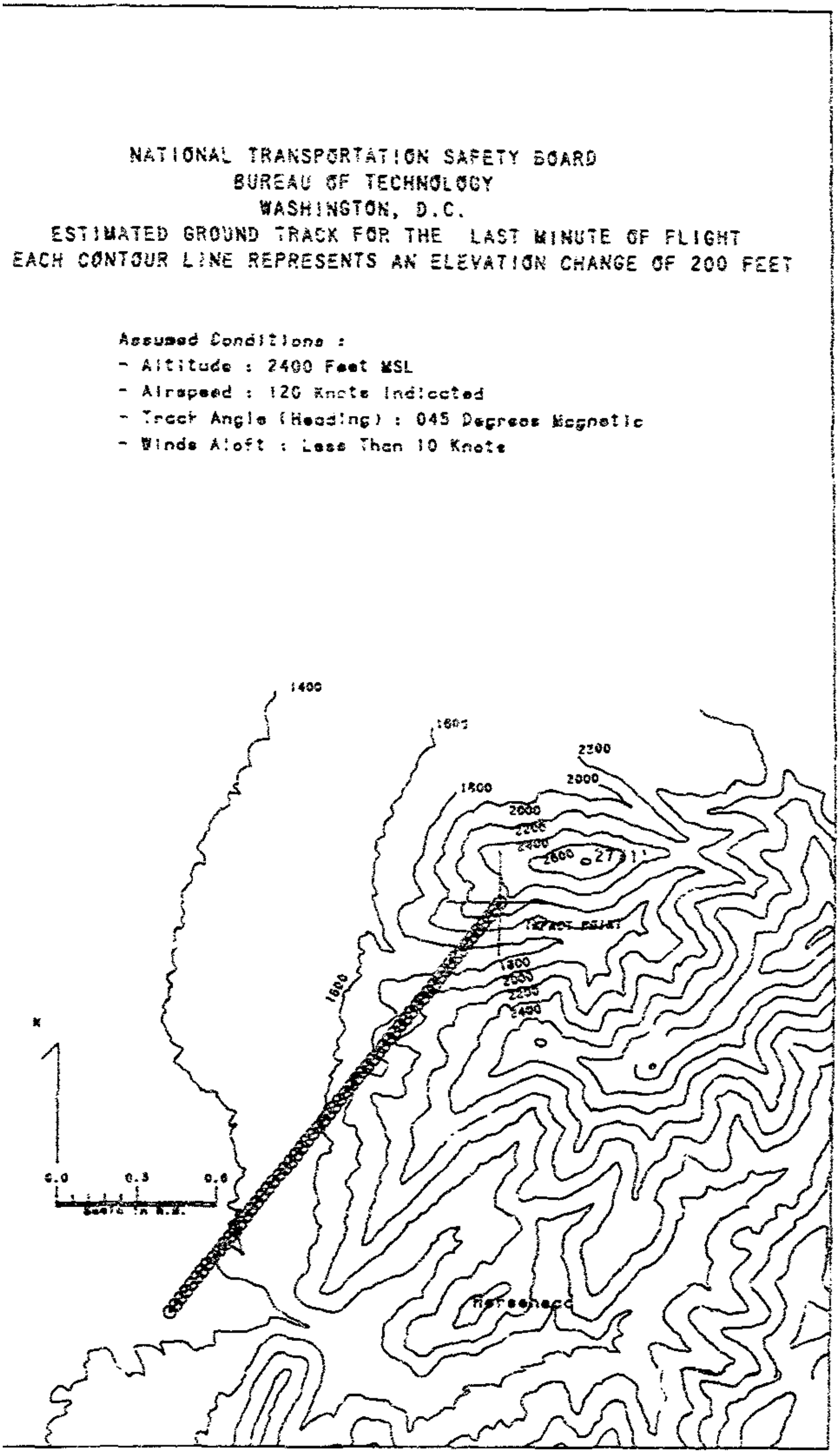


Figure 7.—Topography of flightpath.

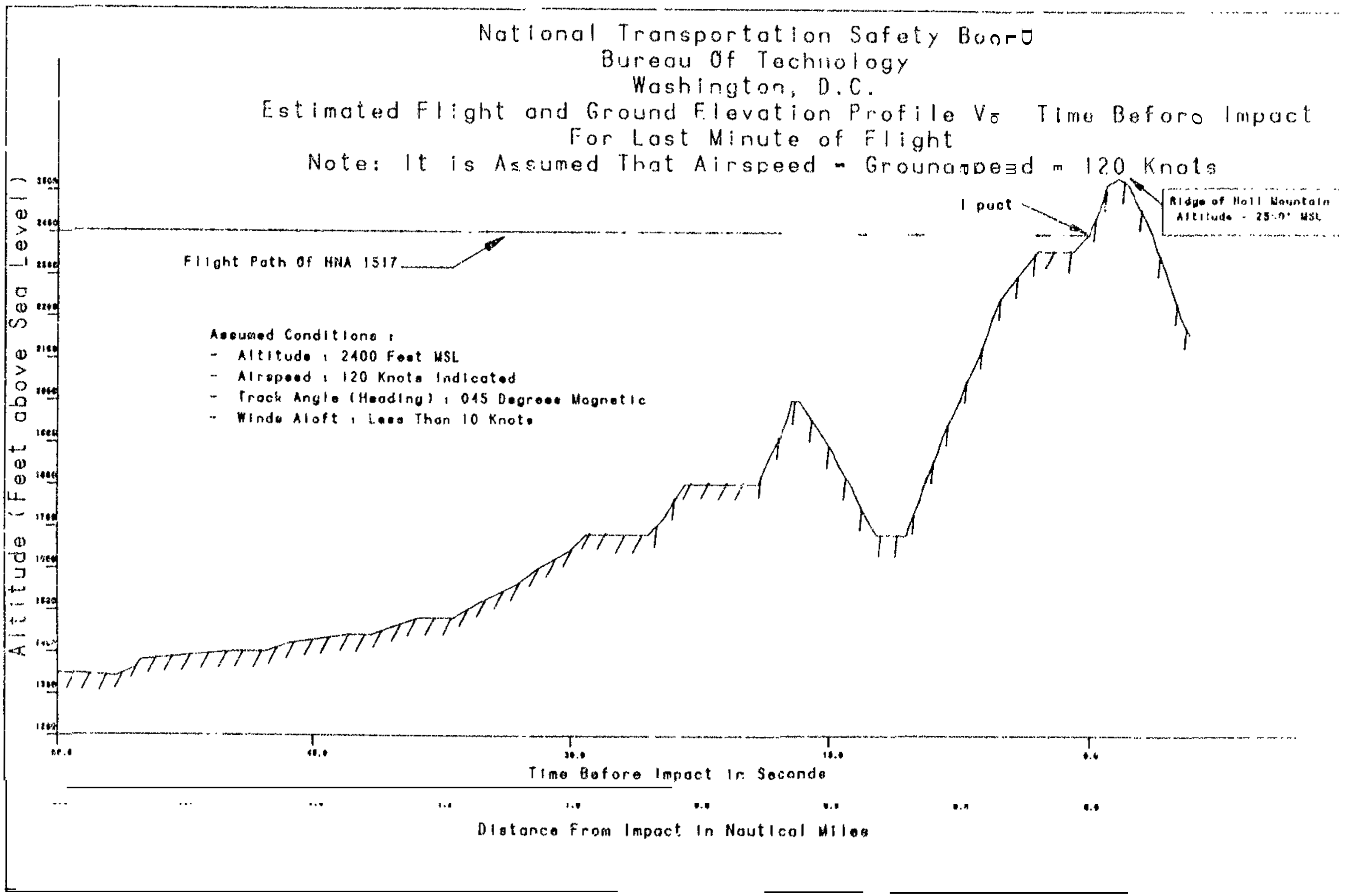


Figure 8.--Estimated flight/ground profile vs. time before impact.

8. A postaccident examination of the navigation radios was not conclusive regarding the frequencies selected before impact.

9. At the time of the accident, instrument meteorological conditions in the area of the accident existed from the cloud bases at about 2,000 feet m.s.l. to the cloud tops at about 5,000 feet m.s.l.

10. At the time of the accident, there was no significant windshear and no turbulence, other than light chop, in the accident area.

11. Weather conditions on the approach into SHD were probably slightly worse than the surface observations taken at the airport.

12. Airframe icing was not a factor in the accident.

13. There were no reported outages of the ILS at the time of the landing approach and the facility was found to be operating within tolerances prescribed by the FAA.

14. The air traffic controller was properly certificated and medically qualified to perform his duties and all ATC procedures were accomplished in accordance with FAA Handbook 7110.65.

15. The ground track of the airplane outbound from STAUT and continuing to the end of the radar recording was imprecise with respect to the published procedures.

16. At two points in the approach after the airplane was out of radar contact, the captain asked the air traffic controller for help in determining the airplane's position.

17. The airplane never intercepted the true localizer and descended below the procedure turn altitude before it intercepted the Montebello VOR 045° radial and below the glideslope intercept altitude and/or the final approach fix crossing altitude (in the event they were attempting a localizer-only approach).

18. The flightcrew did not report passing STAUT, the final approach fix.

19. There is sufficient evidence to suggest that the flightcrew was navigating off the Montebello VOR 045° radial rather than the Shenandoah ILS.

20. The flightcrew was currently certificated and met all existing requirements of the Federal Aviation Regulations and the company to conduct the flight.

21. Because of the rapid turnover and the reduction of minimum experience required of Henson's entry level pilots, the qualifications of flightcrews were lower than in the recent past.

22. The first officer had low time in the operation of the Beech 99, and both pilots had limited time in their respective positions as captain and first officer.

23. Henson was not thorough in its selection and screening of pilot candidates.

24. The quality of flight training at Henson was deficient and had been further degraded by the rapid turnover of instructors and check airmen, as well as management personnel.

25. Because of high cockpit noise levels and the absence of an interphone system, verbal communication was difficult in the cockpits of Henson's Beech 99s, and the pilots' conversation could be overheard by passengers.

26. The captain was experiencing some significant events in his life at the time of the accident which may have affected his performance.

27. The first officer had some financial concerns and some unresolved medical concerns which may have affected her performance.

28. A therapeutic dosage of diethylpropion was found in the blood of the first officer.

29. CAMI's forensic toxicology laboratory did not have adequate equipment to detect the diet drug in the first officer's blood.

30. During the 3 months before the accident, there was almost no FAA surveillance of Beech 99 operations at Henson due to the demands of a program to place a new airplane on the flight line.

31. The emergency response was adequate considering the inaccessible terrain in which the accident occurred and the lack of an ELT signal due to its destruction in the impact sequence.

3.2 Probable Cause

The National Transportation Safety Board determines that the probable cause of this accident was a navigational error by the flightcrew resulting from their use of the incorrect navigational facility and their failure to adequately monitor the flight instruments. Factors which contributed to the flightcrew's errors were: the nonstandardized navigational radio systems installed in the airline's Beech 99 fleet; intra-cockpit communications difficulties associated with high ambient noise levels in the airplane; inadequate training of the pilots by the airline; the first officer's limited multiengine and instrument flying experience; the pilots' limited experience in their positions in the Beech 99; and stress-inducing events in the lives of the pilots. Also contributing to the accident was the inadequate surveillance of the airline by the Federal Aviation Administration which failed to detect the deficiencies which led to the accident.

4. RECOMMENDATIONS

As a result of its investigation, the Safety Board reiterated the following recommendations to the Federal Aviation Administration:

A-82-10?

Require that all multiengine, turbine-powered, fixed-wing aircraft certificated to carry six or more passengers manufactured on or after a specified date, in any type of operation not currently required by 14 CFR 121.343, 122.353, and 135.151 to have a cockpit voice recorder and/or a flight data recorder, be prewired to accept a "general aviation" cockpit voice recorder (if also certificated for two-pilot operation) with at least one channel for voice communications transmitted from or received in the aircraft by radio, and one channel for audio signals from a cockpit area microphone, and a "general aviation" flight data recorder to record sufficient data parameters to determine the information in Table I as a function of time.

A-82-109

Require that "general aviation" cockpit voice recorders (on aircraft certificated for two-pilot operation) and flight data recorders be installed when they become commercially available as standard equipment in all multiengine, turbine-powered fixed-wing aircraft and rotorcraft certificated to carry six or more passengers manufactured on or after a specified date, in any type of operation not currently required by 14 CFR 121.343, 121.359, 135.151, and 127.127 to have a cockpit voice recorder and/or a flight data recorder.

A-82-110

Require that "general aviation" cockpit voice recorders be installed as soon as they are commercially available in all multiengine, turbine-powered aircraft (both airplanes and rotorcraft), which are currently in service, which are certificated to carry six or more passengers and which are required by their certificate to have two pilots, in any type of operation not currently required by 14 CFR 121.359, 135.151, and 127.127 to have a cockpit voice recorder. The cockpit voice recorders should have at least one channel reserved for voice communications transmitted from or received in the aircraft by radio, and one channel reserved for audio signals from a cockpit area microphone.

A-82-111

Require that "general aviation" flight data recorders be installed as soon as they are commercially available in all multiengine, turbojet airplanes which are currently in service, which are certificated to carry six or more passengers in any type of operation not currently required by 14 CFR 121.343 to have a flight data recorder. Require recording of sufficient parameters to determine the following information as a function of time:

altitude
indicated airspeed
magnetic heading
radio transmitter keying
pitch attitude
roll attitude
vertical acceleration
longitudinal acceleration
stabilizer trim position
or pitch control position.

A-84-93

Establish at the Civil Aeromedical Institute the capability to perform state-of-the-art toxicological tests on the blood, urine, and tissue of pilots involved in fatal accidents to determine the levels of both licit and illicit drugs at both therapeutic and abnormal levels.

A-84-94

Review the research and literature on the potential effects on pilot performance of both licit and illicit drugs, in both therapeutic and abnormal levels, and use that to develop and actively disseminate to pilots usable guidelines on potential drug interactions with piloting ability.

Also, the Safety Board made the following recommendations:

—to the Federal Aviation Administration:

Amend 14 CFR 135 to require periodic instrument proficiency checks for all Second in Command pilots required in commuter air carrier operations. (Class II, Priority Action) (A-86-98)

Issue an Air Carrier Operations Bulletin-Part 135 directing all Principal Operations Inspectors to require that Pilots in Command, as well as Second in Command pilots, be tested and be required to demonstrate proficiency in flying instrument approach procedures to the standards that are commensurate with the pilot certificate required for their respective pilot positions. (Class II, Priority Action) (A-86-99)

Issue an Air Carrier Operations Bulletin-Part 135 directing all Principal Operations Inspectors to require commuter air carrier operators to delineate in their Operations and Training Manuals missed approach procedures commensurate with Pilot in Command standards. (Class II, Priority Action) (A-86-100)

Revise Paragraph 72 of the Air Carrier Operations Inspector's Handbook Part 135 (8430.1D) to include guidance to Principal Operations Inspectors regarding the standards and level of precision to which Pilots in Command and Second in Command pilots should be tested during instrument proficiency checks. (Class II, Priority Action) (A-86-101)

Issue an Air Carrier Operations Bulletin-Part 135 to verify that commuter air carrier operators use appropriate vision-restricting devices for their pilots during initial and recurrent flight instrument training. (Class II, Priority Action) (A-86-102)

Expedite the program which proposes standards for the use and evaluation of aircraft flight simulator devices to be used in training programs of 14 CFR 135 operators and, in cooperation with the Regional Airline Association, encourage and assist operators to acquire flight simulator devices. (Class II, Priority Action) (A-86-103)

Issue an Air Carrier Maintenance Bulletin-Part 135 directing all Principal Maintenance Inspectors (PMI) to be alert to significant deviations in cockpit instrumentation and equipment installations of commuter air carriers. The maintenance bulletin should provide guidance with respect to the human engineering principles which are desirable in achieving cockpit standardization and which would tend to eliminate pilot errors in the interpretation of cockpit instruments and the operation of equipment. The bulletin should direct PMIs to encourage commuter operators to provide standardization of cockpit instrumentation and equipment in their airplane fleet to the greatest extent possible. (Class II, Priority Action) (A-86-104)

Issue an Air Carrier Operations Bulletin-Part 135 directing Principal Operations Inspectors to ensure that commuter air carrier training programs specifically emphasize the differences existing in cockpit instrumentation and equipment in the fleet of their commuter operators and that these training programs cover the human engineering aspects of these differences and the human performance problems associated with these differences. (Class II, Priority Action) (A-86-105)

Amend 14 CFR 135.83 to require that all required crewmembers have access to and use their own set of pertinent instrument approach charts. (Class II, Priority Action) (A-86-106)

Issue an Air Carrier Operations Bulletin-Part 135 directing all Principal Operations Inspectors to caution commuter air carrier operators that have instrument flight rules authorization not to schedule on the same flight crewmembers with limited experience in their respective positions. (Class II, Priority Action) (A-86-107)

Issue an Air Carrier Operations Bulletin-Part 135 requesting Principal Operations Inspectors to put special emphasis on their check airmen program to assure that company pilots are evaluated properly and that check airmen apply the training and check ride standards in a strict and standardized manner. (Class II, Priority Action) (A-86-108)

Amend 14 CFR 135.153 to require after a specified date the installation and use of ground proximity warning devices in all multiengine, turbine-powered fixed wing airplanes, certificated to carry 10 or more passengers. (Class II, Priority Action) (A-86-109)

Until the objectives and goals of the Safety Activity Functional Evaluation program are fully realized, establish and require, as an interim measure, a minimum level of direct surveillance, in terms of required tasks as well as personnel levels, to adequately oversee commuter air carrier operations. (Class II, Priority Action) (A-86-110)

Develop and issue guidelines to Air Carrier District Offices to provide for a minimum level of continued direct surveillance of commuter air carrier operators when the Principal Operations Inspector is occupied with other duties for extended periods of time. (Class II, Priority Action) (A-86-111)

Conduct noise measurement surveys of all makes and models of aircraft used in 14 CFR 135 passenger-carrying operations which are now not equipped with functioning crew interphone systems. (Class II, Priority Action) (A-86-112)

Require the installation and use of crew interphone systems in the cockpits of those aircraft which are used in 14 CFR 135 passenger-carrying operations and in which the noise levels exceed a preferred frequency speech interference level of 78 at any power setting and flight condition, and remove the crew interphone system as an item on the Master Minimum Equipment List. (Class II, Priority Action) (A-86-113)

Establish specific requirements for the placement of nighttime visibility markers at airports where preexisting markers are not available and transmissometers are not utilized with special consideration for accurately measuring the surface visibility in the vicinity of the approach end of instrument runways to assure that the published visibility minimums for an airport are met. (Class II, Priority Action) (A-86-114)

Amend the definition of radar arrival in Air Traffic Control Handbook 7110.65D to include all instrument flight rules arrivals under radar contract. (Class II, Priority Action) (A-86-115)

Amend the definition of nonradar arrival in Air Traffic Control Handbook 7110.65D to include only arrival aircraft that are not in radar contact. (Class II, Priority Action) (A-86-116)

Amend Section 9, Radar Arrivals, of Air Traffic Control Handbook 7110.65D to require that, when deviations from the localizer course by instrument flight rules arrivals are noted and the controller elects to vector the aircraft back to the localizer course, the intercept criteria of paragraph 5-121 be applied. (Class II, Priority Action) (A-86-117)

Amend Section 9, Radar Arrivals, of Air Traffic Control Handbook 7110.65D, to require that when a deviation occurs from the localizer course by an instrument flight rules arrivals and the aircraft cannot be vectored back on course within the parameters of paragraph 5-121, the pilot be informed that he appears to be too far off course for a safe approach and be asked his intentions. (Class II, Priority Action) (A-86-118)

—to the Regional Airline Association:

In cooperation with the Federal Aviation Administration, develop comprehensive industry standards for initial and recurrent pilot training programs. (Class II, Priority Action) (A-86-119)

Work with its membership to encourage the use of flight simulators or Advanced Training Devices in the pilot training programs of commuter airlines. (Class III, Longer-Term Action) (A-86-120)

Encourage its membership to provide, to the greatest extent possible, standardization of instrumentation and equipment in the cockpits of their airplane fleets. (Class II, Priority Action) (A-86-121)

Encourage its membership to institute a policy of pilot scheduling which would prevent the scheduling on the same flight of cockpit crewmembers with limited experience in their respective positions. (Class II, Priority Action) (A-86-122)

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

/s/ JIM BURNETT
Chairman

/s/ PATRICIA A. GOLDMAN
Vice Chairman

/s/ JOHN K. LAUBER
Member

/s/ JOSEPH T. NALL
Member

September 30, 1986

5. APPENDIXES

APPENDIX A
INVESTIGATION AND HEARING

1. Investigation

The National Transportation Safety Board was notified about 1130 on September 23, 1985, that Henson Airlines flight 1517 had failed to arrive at its destination. A full investigation team was sent from the Washington, D.C., headquarters. Safety Board specialists were assigned to chair groups in the following areas for investigation: operations, human performance, systems, structures, powerplants, survival factors, air traffic control, maintenance records, and weather.

The following parties were designated to participate in the field phase of the investigation: the Federal Aviation Administration, Henson Airlines, Beech Aircraft Corporation, the Air Line Pilots Association, Hartzell Propellers Product Division, Airwork Corporation, Pratt and Whitney, the Virginia State Police, and the Shenandoah Valley Airport Commission.

2. Public Hearing

A 2-day public hearing was conducted in Harrisonburg, Virginia, on February 5 and 6, 1986. Parties represented at the public hearing included: the Federal Aviation Administration, Henson Airlines, the Beech Aircraft Corporation, and the Air Line Pilots Association.

a

APPENDIX B

PERSONNEL INFORMATION

Captain Martin E. Burns, III

Captain Martin E. Burns, III, 27, held Airline Transport Pilot Certificate No. 216768831 with an airplane multiengine land rating and with commercial privileges in single engine land airplanes. He held a Flight Instructor's Certificate with airplane single and multiengine and instrument ratings and a Basic Ground Instructor's Certificate. He held a first class medical certificate with no limitations.

First Officer Zilda A. Spadaro-Wolan

First Officer Zilda A. Spadaro-Wolan, 26, held Airline Transport Pilot Certificate No. 125560960 with airplane single and multiengine land ratings and with Commercial privileges in single engine sea airplanes. A First Class Medical Certificate was issued on August 27, 1985, with the limitation that she must wear corrective lenses when exercising her airman privileges. Waiver No. 40D48425, issued on April 17, 1985, was in effect for defective distant vision (20/200 corrected to 20/20 bilaterally).

Station Agent Mark Rapert

Henson Airlines Station Agent, Mark Rapert, who was on duty at SHD before and at the time of the accident, was hired by Henson on September 1, 1981, and was certificated by the NWS to make weather observations on December 9, 1981.

Air Traffic Controller Stanley Sowers

The Gordonsville Low Altitude Sector Radar Controller (R31), Stanley Sowers, who last handled the flight, was a full performance level (FPL) Air Traffic Control Specialist (ATCS) employed by the FAA for about 4 years. He had qualified for his position about 2 1/2 years before the accident and was medically qualified to hold his position.

APPENDIX C

AIRCRAFT INFORMATION

Beechcraft B99 Airliner, manufacturer's serial No. U-156, was originally purchased from Beech Aircraft Corporation on May 30, 1974, by Pocono Airlines and was assigned registration no. N339PL. Henson Airlines acquired the airplane on December 2, 1981, and changed the registration number to N339HA. The airplane was manufactured under 14 CFR 23 and was issued a Standard Airworthiness Certificate in the Normal Category on May 3, 1974. As of September 22, 1985, the airplane had accumulated a total time of 23,455.1 hours and had been subjected to 41,215 landings.

Two Pratt and Whitney Aircraft of Canada Ltd. PT6A-27 turbopropeller engines, serial Nos. PCE-40184 (left) and PCE-40029 (right,) and two Hartzell HC-B3TN-3B propellers, serial Nos. BU2537 (left) and BU4641 (right) were installed. Three Hartzell T10173B-8 blades were installed in each of the propellers. This model engine develops 680 shaft horse power (SHP) on a standard day.

APPENDIX D

ATC TRANSCRIPT

U.S. Department of Transportation
Federal Aviation Administration

Memorandum

WASHINGTON ARTC CENTER
Leesburg, Virginia 22075

Subject TRANSCRIPTION concerning the accident involving HNA1517, Beechcraft Airliner on September 23, 1985

Date

From Charles R. Reavis
Air Traffic Manager, Washington Center, ZDC-1

Reply to Attn of ZDC-523

To

This transcription covers the time period from September 23, 1985, approximately 1345 GMT until approximately 1428 GMT. The times on the master voice recording tape are erratic and not always reliable. Times in parentheses are approximate, calculated by stop-watch sad computer data.

Agencies Making Transmissions	Abbreviation
Washington Air Route Traffic Control Center, Casanova Low Radar/Handoff Conrroller	R/LØ2
Washington Air Route Traffic Control Center, Gordonsville Lou Radar/Handoff Controller	R/L31
Washington Air Route Traffic Control Center. Gordonsville Low Radar Controller	R31
Henson One Five One Seven	HNA1517

I HEREBY CERTIFY that the following is a true transcription of the recorded conversation pertaining to the subject aircraft accident.

DONALD R. GREGORY
Quality Assurance Specialist
Title

(1345:00) Begin transcription

(1345:00)		Begin transcription
(1346)		
(1347)		
(1348)		
(1349)		
(1350:14)	HNA1517	Henson fifteen seventeen six thousand
(1350:15)	R/LC2	Henson fifteen seventeen at six thousand Washington ident altimeter at Shenandoah three zero one niner
(1350:23)	HNA1517	one niner thank you
(1351)		
(1352)		
(1353)		
(1354)		
(1355)		
(1356)		
1357:35	R/L32	Henson fifteen seventeen contact Washington Center one two fouz point two five good day
1355:36	HNA1517	twenty four and a quarter: good day
(1357:42)	HNA1517	Wash Henson fifteen seventeen with you six thousand

(1357:43)	R/L31	Henson fifteen seventeen Washington Center Shenandoah Valley weather is estimated two thousand overcast two miles fog and haze temperature six three dew point missing winds are calm altimeter three zero one niner
(1357:54)	HNA1517	one nine and we show established on victor one forty three is it possible for lower
(1357:55)	R/L31	I'll have it for you in five miles
(1357:56)	HNA1517	Okay
(1358)		
(1359:14)	R/L31	Henson fifteen seventeen you're cleared to the Shenandoah valley airport via victor one forty three CEROL direct cross CEROL at or above five thousand cleared for approach Shenandoah Valley airport
(1359:2?)	HNA1517	Okay we'll do all of the above fifteen seventeen
(1400)		
(1401)		
(1402)		
(1403:25)	R/L31	Hfnson fifteen seventeen radar services terminated report cancellation arrival time this frequency if unable through flight service
(1403:28)	HNA1517	Roger that we'll call you later
(1404)		
(1405)		

(1406)

(1407)

(1408)

(1409)

(1410)

(1411)

(1412)

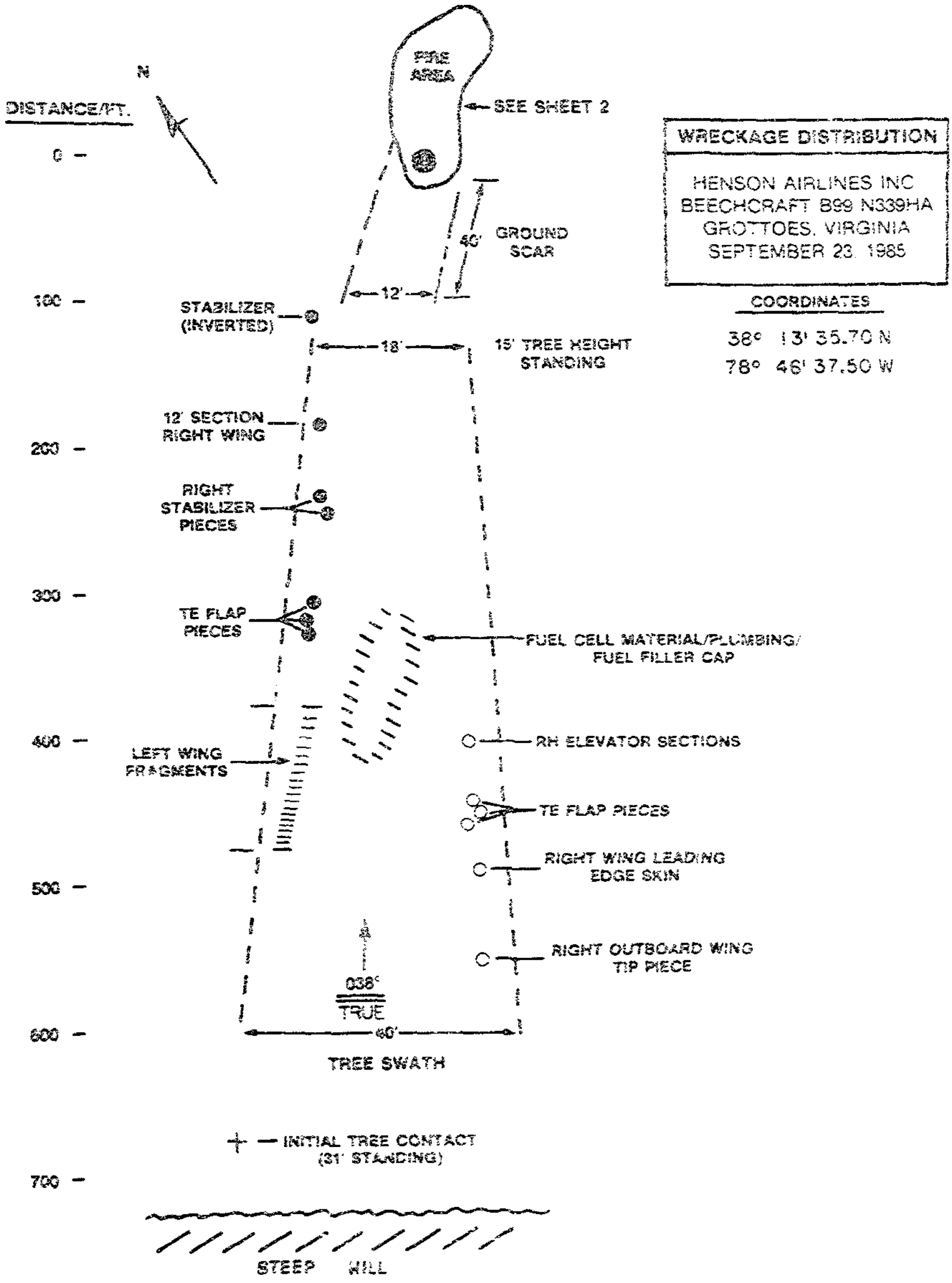
(1413)

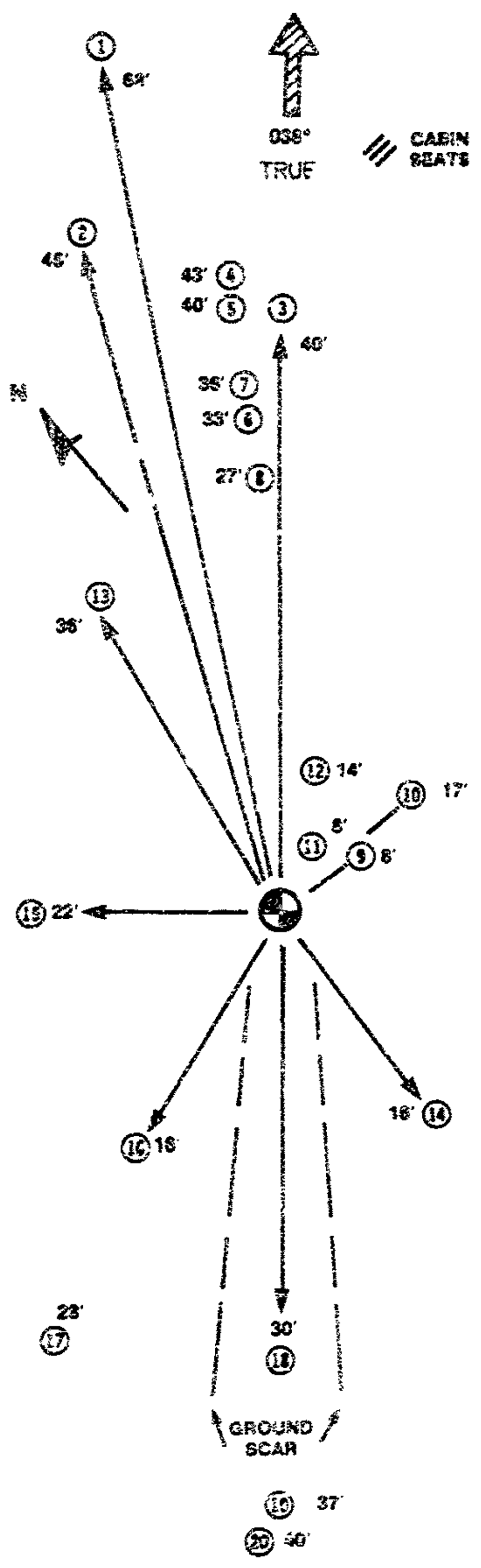
(1414:17)	R/L31	Henson fifteen seventeen Washington
(1414:17)	HNA1517	go ahead
(1414:18)	R/L31	fifteen seventeen say your position
(1414:19)	HNA1517	ah we were gonna ask you we're showin a little west of course the inbound course here
(1414:24)	R/L31	Okay sir understand your inbound now
(1414:25)	HNA1517	ah yes we're turnin inbound now sir
(1414:25)	R/L31	Report passing STAUT please
(1414:26)	HNA1517	Roger that
(1415:51)	HNA1517	Wash Center Henson fifteen seventeen
(1415:52)	R/L31	Was that Air Virginia fifteen fifteen

(1415:53)	HNA1517	Henson fifteen seventeen
(1415:54)	R31	Henson fifteen seventeen go ahead
(1415:55)	HNA1517	Yes si; you're showin us east of the inbound course over the Valley
(1415:59)	R3f	Henson fifteen seventeen radar contact is lost I do not see ya
(1416:00)	HNA1517	Okay roger that thank you
(1417:49)	R31	Henson fifteen seventeen ah have you been established now on the ILS if not ah suggest you execute a missed approach
(1418:04)	R31	Henson fifteen seventeen Washington
(1419:02)	R31	Henson fifteen seventeen Washington
(1420)		
(1421)		
(1422:26)	R31	Henson fifteen seventeen Washington
(1423)		
(1424)		
(1425)		
(1426)		
(1427)		
(1428)		End transcription

APPENDIX E

WRECKAGE DIAGRAMS





WRECKAGE DISTRIBUTION

HENSON AIRLINES INC.
BEECHCRAFT B99 N339HA
GROTTOES, VIRGINIA
SEPTEMBER 23, 1985

COORDINATES:

38° 13' 35.70 N
78° 46' 37.50 W

SHEET LEGEND

- —BASE OF UPROOTED TREE — 50' LENGTH
- 1.—NOSE LANDING GEAR/TIRE
- 2.—NO. 1 ENGINE (SN 40184)
- 3.—COCKPIT AREA
- 4.—LH WHEEL WELL/LANDING GEAR
- 5.—WING SPAR STRAP (INTACT)
- 6.—INBOARD FLAP SECTION (RH)
- 7.—RH WHEEL WELL/LANDING GEAR
- 8.—WING CENTER SECTION
- 9.—VERTICAL STABILIZER
- 10.—TOP AFT FUSELAGE SECTION
- 11.—NO. 2 ENGINE PROP
- 12.—NO. 2 ENGINE (SN 40029)
- 13.—NO. 1 ENGINE PROP/REDUCTION GB
- 14.—RUDDER & TRIM TAB
- 15.—LH OUTBOARD FLAP SECTION
- 16.—NOSE AVIONICS COVER
- 17.—OUTBOARD SECTION –LH STABILIZER
- 18.—OUTBOARD WING TIP SECTION (LH)
- 19.—TAIL CONE STRUCTURE/FWD OF STABILIZER ATTACH POINT
- 20.—RIGHT STABILIZER & ELEVATOR

APPENDIX F

WEATHER INFORMATION

The SAWRS at SHD consists of:

A. Two aircraft type altimeters calibrated in August 1984 and September 1984. Comparison readings were taken on September 23, 1985, and the notation on the Surface Weather Observations form (MF1-10C) indicated that both read 30.17 inHg.

B. Windspeed and wind direction readouts.

C. Instrument shelter with thermometers.

D. Ceiling light and a clinometer.

E. Weather balloons.

F. Visiiity reference charts.

G. Wind sensor located on top of the main terminal building.

The SHD SAWRS was inspected by the NWS on March 22, 1985, and by the FAA on September 21, 1984. The NWS rated the station as "excellent." The report noted that the equipment was in good working order and that the station was well maneged.

An automatic weather observing system (AWOS), manufactured by ARTAIS, Inc. of Columbus, Ohio, is located in the FBO building at SHD. The following perameters are generated by the system: time, temperature, wind direction, wind speed, and altimeter settii. Transmission of the information is accomplished by a computerized voice which can be accessed either by telephone or the locator (NDB) at the outer marker (LOM.) The system requires both annual and quarterly maintenance. The last quarterly maintenance was performed in November 1984.

APPENDIX G

AERODROME INFORMATION

SHD is located at 38°15'8" north latitude and 78°53'8" west longitude. Field elevation is 1,201 feet m.s.l. There is one runway designated as 4 and 22, with a magnetic orientation of 045° and 225°. It is 6,002 feet long by 150 feet wide, is constructed of asphalt, and is grooved. It is equipped with a high intensity runway lighting system (HIRL). Runway 4 has a medium intensity approach lighting system with runway alignment indicator lights (MALSR) and a four-box Visual Approach Slope Indicator (VASI) on the left side of the runway with a 3.0° approach angle and a threshold crossing height of 60 feet. There is a pole obstructing the approach. The control zone is effective from 1100 to 0400 Z daily (1 hour earlier during daylight saving time).

The airport currently maintains an Ansul 480 Dual-Agent Firefighting/Securing Vehicle, which is mounted on a 4-wheel driver chassis and contains 1,350 pounds of Purple K dry chemical and 200 gallons of FC 14 "lightwater." It is equipped with proximity suits, hand-held fire extinguishers, breathing packs, and rescue tools.

The airport is owned and operated by the Shenandoah Valley Airport Commission, which also operates the FBO.

(The above information is excerpted from the United States Government Flight Information Publication, Airport/Facility Directory, Northeast U.S., and it is subject to change.)

class rating, who seeks an airship class rating, must meet the requirements of paragraph (b) of this section as though seeking a lighter-than-air category rating.

(d) *Type rating.* An applicant for a type rating to be added on his pilot certificate must meet the following requirements:

(1) He must hold, or concurrently obtain, an instrument rating appropriate to the aircraft for which a type rating is sought.

(2) He must pass a flight test showing competence in pilot operations appropriate to the pilot certificate he holds and to the type rating sought.

(3) He must pass a flight test showing competence in pilot operations under instrument flight rules in an aircraft of the type for which the type rating is sought or, in the case of a single pilot station airplane, meet the requirements of paragraph (d)(3) (i) or (ii) of this section, whichever is applicable.

(i) The applicant must have met the requirements of this paragraph in a multiengine airplane for which the type rating is required.

(ii) If he does not meet the requirements of paragraph (d)(3)(i) of this section and he seeks a type rating for a single-engine airplane, he must meet the requirements of this subparagraph in either a single or multiengine airplane, and have the recent instrument experience set forth in § 61.57(e), when he applies for the flight test under paragraph (d)(2) of this section.

(4) An applicant who does not meet the requirements of paragraphs (d) (1) and (3) of this section may obtain a type rating limited to "VFR only." Upon meeting these instrument requirements or the requirements of § 61.73(e)(2), the "VFR only" limitation may be removed for the particular type of aircraft in which competence is shown.

(5) When an instrument rating is issued to the holder of one or more type ratings, the type ratings on the amended certificate bear the limitation described in paragraph (d)(4) of this section for each airplane type rating for which he has not shown his instrument competency under this paragraph.

§ 61.65 Instrument rating requirements.

(a) *General.* To be eligible for an instrument rating (airplane) or an instrument rating (helicopter), an applicant must—

(1) Hold at least a current private pilot certificate with an aircraft rating appropriate to the instrument rating sought;

(2) Be able to read, speak, and understand the English language; and

(3) Comply with the applicable requirements of this section.

(b) *Ground instruction.* An applicant for the written test for an instrument rating must have received ground instruction, or have logged home study in at least the following areas of aeronautical knowledge appropriate to the rating sought.

(1) The regulations of this chapter that apply to flight under IFR conditions, the Airman's Information Manual, and the IFR air traffic system and procedures;

(2) Dead reckoning appropriate to IFR navigation, IFR navigation by radio aids using the VOR, ADF, and ILS systems, and the use of IFR charts and instrument approach plates;

(3) The procurement and use of aviation weather reports and forecasts, and the elements of forecasting weather trends on the basis of that information and personal observation of weather conditions; and

(4) The safe and efficient operation of airplanes or helicopters, as appropriate, under instrument weather conditions.

(c) *Flight instruction and skill—airplanes.* An applicant for the flight test for an instrument rating (airplane) must present a logbook record certified by an authorized flight instructor showing that he has received instrument flight instruction in an airplane in the following pilot operations, and has been found competent in each of them:

(1) Control and accurate maneuvering of an airplane solely by reference to instruments.

(2) IFR navigation by the use of the VOR and ADF systems, including compliance with air traffic cont[illegible] instructions and procedures.

(3) Instrument approaches to published minimums using the VOR, ADF, and ILS systems (instruction in the use of the ADF and ILS may be received in an instrument ground tr[illegible]ner and instruction in the use of the ILS glide slope may be received in an airborne ILS simulator).

(4) Cross-country flying in simulated or actual IFR conditions, on Federal airways or as routed by ATC, including one such trip of at least 250 nautical miles, including VOR, ADF, and ILS approaches at different airports.

(5) Simulated emergencies, including the recovery from unusual attitudes, equipment or instrument malfunctions, loss of communications, and engine-out emergencies if a multiengine airplane is used, and missed approach procedure.

(d) *Instrument instruction and skill—(helicopter).* An applicant for the flight test for an instrument rating (helicopter) must present a logbook record certified to by an authorized flight instructor showing that he has received instrument flight instruction in a helicopter in the following pilot operations, and has been found competent in each of them:

(1) The control and accurate maneuvering of a helicopter solely by reference to instruments.

(2) IFR navigation by the use of the VOR and ADF systems, including compliance with air traffic instructions and procedures.

(3) Instrument approaches to published minimums using the VOR, ADF, and ILS systems (instruction in the use of the ADF and ILS may be received in an instrument ground trainer, and instruction in the use of the ILS glide slope may be received in an airborne ILS simulator).

(4) Cross-country flying under simulated or actual IFR conditions, on Federal airways or as routed by ATC, including one flight of at least 100 nautical miles, including VOR, ADF, and ILS approaches at different airports.

(5) Simulated IFR emergencies, including equipment malfunctions, missed approach procedures, and deviations to unplanned alternates.

(e) *Flight experience.* An applicant for an instrument rating must have at least the following flight time as a pilot:

(1) A total of 125 hours of pilot flight time, of which 50 hours are as pilot in command in cross-country flight in a powered aircraft with other than a student pilot certificate. Each cross-country flight must have a landing at a point more than 50 nautical miles from the original departure point.

(2) 40 hours of simulated or actual instrument time, of which not more than 20 hours may be instrument instruction by an authorized instructor in an instrument ground trainer acceptable to the Administrator.

(3) 15 hours of instrument flight instruction by an authorized flight instructor, including at least 5 hours in an airplane or a helicopter, as appropriate.

(f) *Written test.* An applicant for an instrument rating must pass a written test appropriate to the instrument rating sought on the subjects in which ground instruction is required by paragraph (b) of this section.

(g) *Practical test.* An applicant for an instrument rating must pass a flight test in an airplane or a helicopter, as appropriate. The test must include instrument flight procedures selected by the inspector or examiner conducting the test to determine the applicant's ability to perform competently the IFR operations on which instruction is required by paragraph (c) or (d) of this section.

[Doc. No. 11802, Amdt. 61-60, 38 FR 3161, Feb. 1, 1973, as amended by Amdt. 61-70, 47 FR 3486, Jan. 25, 1982; Amdt. 61-75, 50 FR 19294, May 7, 1985]

§ 61.67 Category II pilot authorization requirements.

(a) *General.* An applicant for a Category II pilot authorization must hold—

(1) A pilot certificate with an instrument rating or an airline transport pilot certificate; and

(2) A type rating for the airplane type if the authorization is requested for a large airplane or a small turbojet airplane.

(b) *Experience requirements.* Except for the holder of an airline transport that is carrying passengers or property for compensation or hire.

Subpart E—Commercial Pilots

§ 61.121 Applicability.

This subpart prescribes the requirements for the issuance of commercial pilot certificates and ratings, the conditions under which those certificates and ratings are necessary, and the limitations upon those certificates and ratings.

§ 61.123 Eligibility requirements: General.

To be eligible for a commercial pilot certificate, a person must—

(a) Be at least 18 years of age;

(b) Be able to read, speak, and understand the English language, or have such operating limitations placed on his pilot certificate as are necessary for safety, to be removed when he shows that he can read, speak, and understand the English language;

(c) Hold at least a valid second-class medical certificate issued under Part 67 of this chapter, or, in the case of a glider or free balloon rating, certify that he has no known medical deficiency that makes him unable to pilot a glider or a free balloon, as appropriate;

(d) Pass a written examination appropriate to the aircraft rating sought on the subjects in which ground instruction is required by § 61.125;

(e) Pass an oral and flight test appropriate to the rating he seeks, covering items selected by the inspector or examiner from those on which training is required by § 61.127; and

(f) Comply with the provisions of this subpart which apply to the rating he seeks.

(Doc. No. 11802, Amdt. 61-60, 38 FR 3161, Feb. 1, 1973, as amended by Amdt. 61-64, 41 FR 51392, Nov. 22, 1976)

§ 61.125 Aeronautical knowledge.

An applicant for a commercial pilot certificate must have logged ground instruction from an authorized instructor, or must present evidence showing that he has satisfactorily completed a course of instruction or home study, in at least the following areas of aeronautical knowledge appropriate to the category of aircraft for which a rating is sought.

(a) *Airplanes.* (1) The regulations of this chapter governing the operations, privileges, and limitations of a commercial pilot, and the accident reporting requirements of the National Transportation Safety Board;

(2) Basic aerodynamics and the principles of flight which apply to airplanes; and

(3) Airplane operations, including the use of flaps, retractable landing gears, controllable propellers, high altitude operation with and without pressurization, loading and balance computations, and the significance and use of airplane performance speeds.

(b) *Rotorcraft.* (1) The regulations of this chapter which apply to the operations, privileges, and limitations of a commercial rotorcraft pilot, and the accident reporting requirements of the National Transportation Safety Board;

(2) Meteorology, including the characteristics of air masses and fronts, elements of weather forecasting, and the procurement and use of aeronautical weather reports and forecasts;

(3) The use of aeronautical charts and the magnetic compass for pilotage and dead reckoning, and the use of radio aids for VFR navigation; and

(4) The safe and efficient operation of helicopters or gyroplanes, as appropriate to the rating sought.

(c) *Gliders.* (1) The regulations of this chapter pertinent to commercial glider pilot operations, privileges, and limitations, and the accident reporting requirements of the National Transportation Safety Board;

(2) Glider navigation, including the use of aeronautical charts and the magnetic compass, and radio orientation;

(3) The recognition of weather situations of concern to the glider pilot from the ground and in flight, and the procurement and use of aeronautical weather reports and forecasts; and

(4) The safe and efficient operation of gliders, including ground and aero tow procedures, signals, critical sailplane performance speeds, and safety precautions.

(d) *Airships.* (1) The regulations of this chapter pertinent to airship operations, VFR and IFR, including the privileges and limitations of a commercial airship pilot;

(2) Airship navigation, including pilotage, dead reckoning, and the use of radio aids for VFR and IFR navigation, and IFR approaches;

(3) The use and limitations of the required flight instruments;

(4) ATC procedures for VFR and IFR operations, and the use of IFR charts and approach plates;

(5) Meteorology, including the characteristics of air masses and fronts, and the procurement and use of aeronautical weather reports and forecasts;

(6) Airship ground and flight instruction procedures; and

(7) Airship operating procedures and emergency operations, including free ballooning procedures.

(e) *Free balloons.* (1) The regulations of this chapter pertinent to commercial free balloon piloting privileges, limitations, and flight operations;

(2) The use of aeronautical charts and the magnetic compass for free balloon navigation;

(3) The recognition of weather conditions significant to free balloon flight operations, and the procurement and use of aeronautical weather reports and forecasts appropriate to free ballooning;

(4) Free balloon flight and ground instruction procedures; and

(5) Operating principles and procedures for free balloons, including emergency procedures such as crowd control and protection, high wind and water landings, and operations in proximity to buildings and power lines.

§ 61.127 Flight proficiency.

The applicant for a commercial pilot certificate must have logged instruction from an authorized flight instructor in at least the following pilot operations. In addition, his logbook must contain an endorsement by an authorized flight instructor who has given him the instruction certifying that he has found the applicant prepared to perform each of those operations competently as a commercial pilot.

(a) *Airplanes.* (1) Preflight duties, including load and balance determination, line inspection, and aircraft servicing;

(2) Flight at critically slow airspeeds, recognition of imminent stalls, and recovery from stalls with and without power;

(3) Normal and crosswind takeoffs and landings, using precision approaches, flaps, power as appropriate, and specified approach speeds;

(4) Maximum performance takeoffs and landings, climbs, and descents;

(5) Operation of an airplane equipped with a retractable landing gear, flaps, and controllable propeller(s), including normal and emergency operations; and

(6) Emergency procedures, such as coping with power loss or equipment malfunctions, fire in flight, collision avoidance precautions, and engine-out procedures if a multiengine airplane is used.

(b) *Helicopters.* (1) Preflight duties, including line inspection and helicopter servicing;

(2) Straight and level flight, climbs, turns, and descents;

(3) Air taxiing, hovering, and maneuvering by ground references;

(4) Normal and crosswind takeoffs and landings;

(5) Rapid descent with power and recovery;

(6) Airport and traffic pattern operations, including collision avoidance precautions and radio communications;

(7) Cross-country flight operations; and

(8) Emergency operations, including landing on slopes, high altitude takeoffs and roll-on landings, operations on confined areas and pinnacles, autorotational descents, partial power failures, and rapid decelerations.

(c) *Gyroplanes.* (1) Preflight operations, including line inspection and gyroplane servicing;

(2) Straight and level flight, turns, climbs, and descents;

(3) Flight maneuvering by ground references;

(4) Maneuvering at critically slow airspeeds, and the recognition of and recovery from high rates of descent at slow airspeeds;

(5) Normal and crosswind takeoffs and landings;

APPENDIX H

-14-

(6) Airport and traffic pattern operations, including collision avoidance precautions and radio communications;

(7) Cross-country flight operations; and

(8) Emergency procedures, such as power failures, equipment malfunctions, maximum performance takeoffs and landings and simulated liftoffs at low airspeed and high angles of attack.

(d) *Gliders*. (1) Preflight duties, including glider assembly and preflight inspection;

(2) Glider launches by ground (auto or winch) or by aero tows (the applicant's certificate is limited to the kind of tow selected);

(3) Precision maneuvering, including straight glides, turns to headings, steep turns, and spirals in both directions;

(4) The correct use of sailplane performance speeds, flight at critically slow airspeeds, and the recognition of and recovery from stalls entered from straight flight and from turns; and

(5) Accuracy approaches and landings, with the nose of the glider coming to rest short of and within 100 feet of a line or mark.

(e) *Airships*. (1) Ground handling, mooring, and preflight operations;

(2) Straight and level flight, turns, climbs, and descents, under VFR and simulated IFR conditions;

(3) Takeoffs and landings with positive and with negative static lift;

(4) Turns and figure eights;

(5) Precision turns to headings under simulated IFR conditions;

(6) Preparing and filing IFR flight plans, and complying with IFR clearances;

(7) IFR radio navigation and instrument approach procedures;

(8) Cross-country flight operations, using pilotage, dead reckoning, and radio aids, and

(9) Emergency operations, including engine-out operations, free ballooning an airship, and ripcord procedures (may be simulated).

(f) *Free balloons*. (1) Inflating, rigging, and mooring a free balloon;

(2) Ground and flight crew briefing,

(3) Ascents;

(4) Descents;

(5) Landings;

(6) Operation of airborne heater, if balloon is so equipped, and

(7) Emergency operations, including the use of the ripcord (may be simulated), and recovery from a terminal velocity descent if a balloon with an airborne heater is used.

§ 61.129 Airplane rating: Aeronautical experience.

(a) *General*. An applicant for a commercial pilot certificate with an airplane rating must hold a private pilot certificate with an airplane rating. If he does not hold that certificate and rating he must meet the flight experience requirements for a private pilot certificate and airplane rating and pass the applicable written and practical test prescribed in Subpart D of this part. In addition, the applicant must hold an instrument rating (airplane), or the commercial pilot certificate that is issued is endorsed with a limitation prohibiting the carriage of passengers for hire in airplanes on cross-country flights of more than 50 nautical miles, or at night.

(b) *Flight time as pilot*. An applicant for a commercial pilot certificate with an airplane rating must have a total of at least 250 hours of flight time as pilot, which may include not more than 50 hours of instruction from an authorized instructor in a ground trainer acceptable to the Administrator. The total flight time as pilot must include—

(1) 100 hours in powered aircraft, including at least—

(i) 50 hours in airplanes, and

(ii) 10 hours of flight instruction and practice given by an authorized flight instructor in an airplane having a retractable landing gear, flaps, and a controllable pitch propeller; and

(2) 50 hours of flight instruction given by an authorized flight instructor, including—

(i) 10 hours of instrument instruction, of which at least 5 hours must be in flight in airplanes, and

(ii) 10 hours of instruction in preparation for the commercial pilot flight test; and

(3) 100 hours of pilot in command time, including at least:

(i) 50 hours in airplanes.

(ii) 50 hours of cross-country flights, each flight with a landing at a point more than 50 nautical miles from the original departure point. One flight must have landings at a minimum of three points, one of which is at least 150 nautical miles from the original departure point if the flight is conducted in Hawaii, or at least 250 nautical miles from the original departure point if it is conducted elsewhere.

(iii) 5 hours of night flying including at least 10 takeoffs and landings as sole manipulator of the controls.

(Secs. 313(a), 601, 602 and 607, Federal Aviation Act of 1958, as amended (49 U.S.C. 1354(a), 1421, 1422, and 1427), and sec. 6(c), Department of Transportation Act (49 U.S.C. 1655(c)))

[Doc. No. 11802, Amdt. 61-60, 38 FR 3161, Feb. 1, 1973, as amended by Amdt. 61-72, 47 FR 46068, Oct. 14, 1982]

§ 61.131 Rotorcraft ratings: Aeronautical experience.

(a) *Helicopter*. An applicant for a commercial pilot certificate with a helicopter rating must have a total of at least 150 hours of flight time as pilot, including—

(1) 100 hours in powered aircraft and at least 50 hours in helicopters;

(2) 100 hours of pilot in command time, including a cross-country flight with landings at three points, each of which is more than 50 nautical miles from each of the other points;

(3) 40 hours of flight instruction from an authorized flight instructor, including 15 hours in helicopters; and

(4) 10 hours as pilot in command in helicopters, including—

(i) Five takeoffs and landings at night; and

(ii) Takeoffs and landings at three different airports which serve both airplanes and helicopters; and

(iii) Takeoffs and landings at three points other than airports.

(b) *Gyroplanes*. An applicant for a commercial pilot certificate with a gyroplane rating must have a total of at least 200 hours of flight time as pilot, including—

(1) 100 hours in powered aircraft;

(2) 100 hours as pilot in command, including a cross-country flight with landings at three points, each of which is more than 50 nautical miles from each of the other two points;

(3) 75 hours as pilot in command in gyroplanes, including—

(i) Flights with takeoffs and landings at three different paved airports and three unpaved airports; and

(ii) Three flights with takeoffs and landings at an airport with an operating control tower, and

(4) Twenty hours of flight instruction in gyroplanes, including 5 hours in preparation for the commercial pilot flight test.

§ 61.133 Glider rating: Aeronautical experience.

An applicant for a commercial pilot certificate with a glider rating must meet either of the following aeronautical experience requirements:

(a) A total of at least 25 hours of pilot time in aircraft, including 20 hours in gliders, and a total of 100 glider flights as pilot in command, including 25 flights during which 360° turns were made; or

(b) A total of 200 hours of pilot time in heavier-than-air aircraft, including 20 glider flights as pilot in command during which 360° turns were made.

§ 61.135 Airship rating: Aeronautical experience.

An applicant for a commercial pilot certificate with an airship rating must have a total of at least 200 hours of flight time as pilot, including—

(a) Fifty hours of flight time as pilot in airships;

(b) 30 hours of flight time performing the duties of pilot in command in airships, including—

(1) 10 hours of cross-country flight; and

(2) 10 hours of night flight; and

(c) 40 hours of instrument time, of which at least 20 hours must be in flight with 10 hours of that flight time in airships.

§ 61.137 Free balloon rating: Aeronautical experience.

An applicant for a commercial pilot certificate with a free balloon rating must have the following flight time as pilot:

(a) If a gas balloon or a hot air balloon with an airborne heater is used, a total of at least 35 hours of flight time as pilot including—

(1) 20 hours in free balloons; and

(2) 10 flights in free balloons, including—

(i) Six flights under the supervision of a commercial free balloon pilot;

(ii) Two solo flights;

(iii) Two flights of at least 2 hours duration if a gas balloon is used, or at least 1 hour duration if a hot air balloon with an airborne heater is used; and

(iv) One ascent under control to more than 10,000 feet above the takeoff point if a gas balloon is used or 5,000 feet above the take off point if a hot air balloon with an airborne heater is used.

(b) If a hot air balloon without an airborne heater is used, 10 flights in free balloons including—

(1) Six flights under the supervision of a commercial free balloon pilot; and

(2) Two solo flights.

§ 61.139 Commercial pilot privileges and limitations: General.

The holder of a commercial pilot certificate may:

(a) Act as pilot in command of an aircraft carrying persons or property for compensation or hire;

(b) Act as pilot in command of an aircraft for compensation or hire; and

(c) Give flight instruction in an airship if he holds a lighter-than-air category and an airship class rating, or in a free balloon if he holds a free balloon class rating.

§ 61.141 Airship and free balloon ratings: Limitations.

(a) If the applicant for a free balloon class rating takes his flight test in a hot air balloon without an airborne heater, his pilot certificate contains an endorsement restricting the exercise of the privileges of that rating to hot air balloons without airborne heaters. The restriction may be deleted when the holder of the certificate obtains the pilot experience and passes the test required for a rating on a free balloon with an airborne heater or a gas balloon.

(b) If the applicant for a free balloon class rating takes his flight test in a hot air balloon with an airborne heater, his pilot certificate contains an endorsement restricting the exercise of the privileges of that rating to hot air balloons with airborne heaters. The restriction may be deleted when the holder of the certificate obtains the pilot experience required for a rating on a gas balloon.

Subpart F—Airline Transport Pilots

AUTHORITY: Secs. 313(a), 314, 601, and 607; 49 U.S.C. 1354(a), 1355, 1421, and 1427, unless otherwise noted.

§ 61.151 Eligibility requirements: General.

To be eligible for an airline transport pilot certificate, a person must—

(a) Be at least 23 years of age;

(b) Be of good moral character;

(c) Be able to read, write, and understand the English language and speak it without accent or impediment of speech that would interfere with two-way radio conversation;

(d) Be a high school graduate, or its equivalent in the Administrator's opinion, based on the applicant's general experience and aeronautical experience, knowledge, and skill;

(e) Have a first-class medical certificate issued under Part 67 of this chapter within the 6 months before the date he applies; and

(f) Comply with the sections of this part that apply to the rating he seeks.

[Doc. No. 1179, 27 FR 7966, Aug. 10, 1962. Redesignated by Doc. No. 11802, Amdt. 61-60, 38 FR 3161, Feb. 1, 1973]

§ 61.153 Airplane rating: Aeronautical knowledge.

An applicant for an airline transport pilot certificate with an airplane rating must, after meeting the requirements of §§ 61.151 (except paragraph (a) thereof) and 61.155, pass a written test on—

(a) The sections of this part relating to airline transport pilots and Part 121, Subpart C of Part 65, and §§ 91.1 through 91.9 and Subpart B of Part 91 of this chapter, and so much of Parts 21 and 25 of this chapter as relate to the operations of air carrier aircraft;

(b) The fundamentals of air navigation and use of formulas, instruments, and other navigational aids, both in aircraft and on the ground, that are necessary for navigating aircraft by instruments;

(c) The general system of weather collection and dissemination;

(d) Weather maps, weather forecasting, and weather sequence abbreviations, symbols, and nomenclature;

(e) Elementary meteorology, including knowledge of cyclones as associated with fronts;

(f) Cloud forms;

(g) National Weather Service Federal Meteorological Handbook No. 1, as amended;

(h) Weather conditions, including icing conditions and upper-air winds, that affect aeronautical activities;

(i) Air navigation facilities used on Federal airways, including rotating beacons, course lights, radio ranges, and radio marker beacons;

(j) Information from airplane weather observations and meteorological data reported from observations made by pilots on air carrier flights;

(k) The influence of terrain on meteorological conditions and developments, and their relation to air carrier flight operations;

(l) Radio communication procedure in aircraft operations; and

(m) Basic principles of loading and weight distribution and their effect on flight characteristics.

[Doc. No. 1179, 27 FR 7969, Aug. 10, 1962, as amended by Amdt. 61-11, 29 FR 14916, Nov. 4, 1964; Amdt. 61-30, 32 FR 5770, Apr. 11, 1967; Amdt. 61-44, 36 FR 13911, July 28, 1971. Redesignated by Doc. No. 11802, Amdt. 61-60, 38 FR 3161, Feb. 1, 1973, as amended by Amdt. 61-64, 41 FR 51392, Nov. 22, 1976]

§ 61.155 Airplane rating: Aeronautical experience.

(a) An applicant for an airline transport pilot certificate with an airplane rating must hold a commercial pilot certificate or a foreign airline transport pilot or commercial pilot license without limitations, issued by a member state of ICAO, or he must be a pilot in an Armed Force of the United States whose military experience qualifies him for a commercial pilot certificate under § 61.73.

(b) An applicant must have had—

(1) At least 250 hours of flight time as pilot in command of an airplane, or as copilot of an airplane performing the duties and functions of a pilot in command under the supervision of a pilot in command, or any combination thereof, at least 100 hours of which were cross-country time and 25 hours of which were night flight time; and

(2) At least 1,500 hours of flight time as a pilot, including at least—

(i) 500 hours of cross-country flight time;

(ii) 100 hours of night flight time; and

(iii) 75 hours of actual or simulated instrument time, at least 50 hours of which were in actual flight.

Flight time used to meet the requirements of paragraph (b)(1) of this section may also be used to meet the requirements of paragraph (b)(2) of this section. Also, an applicant who has made at least 20 night takeoffs and landings to a full stop may substitute one additional night takeoff and landing to a full stop for each hour of night flight time required by paragraph (b)(2)(ii) of this section. However, not more than 25 hours of night flight time may be credited in this manner.

(c) If an applicant with less than 150 hours of pilot-in-command time otherwise meets the requirements of paragraph (b)(1) of this section, his certificate will be endorsed "Holder does not meet the pilot-in-command flight experience requirement of ICAO", as prescribed by article 39 of the "Convention on International Civil Aviation." Whenever he presents satisfactory written evidence that he has accumulated the 150 hours of pilot-in-command time, he is entitled to a new certificate without the endorsement.

(d) A commercial pilot may credit the following flight time toward the 1,500 hours total flight time requirement of paragraph (b)(2) of this section:

(1) All second-in-command time acquired in airplanes required to have more than one pilot by their approved Aircraft Flight Manuals or airworthiness certificates; and

(3) Flight engineer time acquired in airplanes required to have a flight engineer by their approved Aircraft Flight Manuals, while participating at the same time in an approved pilot training program approved under Part 121 of this chapter.

However, the applicant may not credit under paragraph (d)(2) of this section more than 1 hour for each 3 hours of flight engineer flight time so acquired, nor more than a total of 500 hours.

(e) If an applicant who credits second in command or flight engineer time under paragraph (d) of this section toward the 1,500 hours total flight time requirement of paragraph (b)(2) of this section—

(1) Does not have at least 1,200 hours of flight time as a pilot including no more than 50 percent of his second in command time and none of his flight engineer time; but

(2) Otherwise meets the requirements of paragraph (b)(2) of this section,

his certificate will be endorsed "Holder does not meet the pilot flight experience requirements of ICAO," as prescribed by Article 39 of the "Convention on International Civil Aviation." Whenever he presents satisfactory evidence that he has accumulated 1,200 hours of flight time as a pilot including no more than 50 percent of his second in command time and none of his flight engineer time, he is entitled to a new certificate without the endorsement.

(Sec. 603, 72 Stat. 778, 49 U.S.C. 1423; secs. 313(a), 601 through 605, Federal Aviation Act of 1958 (49 U.S.C. 1354(a), 1421 through 1425), sec. 6(c), Department of Transportation Act (49 U.S.C. 1655(c)); and 14 CFR 11.49)

[Doc. No. 1179, 27 FR 7956, Aug. 10, 1962, as amended by Amdt. 61-44, 34 FR 17163, Oct. 23, 1969. Redesignated by Doc. No. 11802, Amdt. 61-60, 38 FR 3161, Feb. 1, 1973, as amended by Amdt. 61-64, 41 FR 51392, Nov. 22, 1976; Amdt. 61-71, 47 FR 13316, Mar. 29, 1982]

§ 61.157 Airplane rating: Aeronautical skill.

(a) An applicant for an airline transport pilot certificate with a single-engine or multiengine class rating or an additional type rating must pass a practical test that includes the items set forth in Appendix A of this part. The FAA inspector or designated examiner may modify any required maneuver where necessary for the reasonable and safe operation of the airplane being used and, unless specifically prohibited in Appendix A, may combine any required maneuvers and may permit their performance in any convenient sequence.

(b) Whenever an applicant for an airline transport pilot certificate does not already have an instrument rating he shall, as part of the oral part of the practical test, comply with § 61.65(g), and, as part of the flight part, perform each additional maneuver required by § 61.65(g) that is appropriate to the airplane type and not required in Appendix A of this part.

(c) Unless the Administrator requires certain or all maneuvers to be performed, the person giving a flight test for an airline transport pilot certificate or additional airplane class or type rating may, in his discretion, waive any of the maneuvers for which a specific waiver authority is contained in Appendix A of this part if a pilot being checked—

(1) Is employed as a pilot by a Part 121 certificate holder, and

(2) Within the preceding 6 calendar months, has successfully completed that certificate holder's approved training program for the airplane type involved.

(d) The items specified in paragraph (a) of this section may be performed in the airplane simulator or other training device specified in Appendix A to this part for the particular item if—

(1) The airplane simulator or other training device meets the requirements of § 121.407 of this chapter; and

(2) In the case of the items preceded by an asterisk (*) in Appendix A, the applicant has successfully completed the training set forth in § 121.424(d) of this chapter.

However, the FAA inspector or designated examiner may require Items II(d), V(f), or V(g) of Appendix A to this part to be performed in the airplane if he determines that action is necessary to determine the applicant's competence with respect to that maneuver.

(e) An approved simulator may be used instead of the airplane to satisfy the in-flight requirements of Appendix A of this part, if the simulator—

(1) Is approved under § 121.407 of this chapter and meets the appropriate simulator requirements of Appendix H of Part 121; and

(2) Is used as part of an approved program that meets the training requirements of § 121.424 (a) and (c) and Appendix H of Part 121 of this chapter.

(Secs. 603, 604, 72 Stat. 775, 776, 49 U.S.C. 1423, 1424)

[Amdt. 61-37, 33 FR 262, Jan. 11, 1967, as amended by Amdt. 61-31, 32 FR 6937, Apr. 14, 1967; Amdt. 61-43, 35 FR 88, Jan. 3, 1970. Redesignated by Doc. No. 11802, Amdt. 61-60, 38 FR 3161, Feb. 1, 1973, as amended by Amdt. 61-64, 41 FR 51393, Nov. 22, 1976; Amdt. 61-69, 45 FR 44183, June 30, 1980]

§ 61.159 Rotorcraft rating: Aeronautical knowledge.

(a) An applicant for an airline transport pilot certificate with a rotorcraft category and a gyroplane class rating, or a rotorcraft category and a helicopter class rating limited to VFR only must pass a written test on—

(1) So much of this chapter as relates to air carrier rotorcraft operations;

(2) Rotorcraft design, components, systems and performance limitations;

(3) Basic principles of loading and weight distribution and their effect on rotorcraft flight characteristics;

(4) Air traffic control systems and procedures relating to rotorcraft;

(5) Procedures for operating rotorcraft in potentially hazardous meteorological conditions; and

(6) Flight theory as applicable to rotorcraft.

(b) In addition to the requirements of paragraph (a) of this section, an applicant for an airline transport pilot certificate with a rotorcraft category and helicopter class rating not limited to VFR must pass a written test on the items listed under paragraphs (b) through (m) of § 61.153.

[Amdt. 61-24, 31 FR 12401, Sept. 17, 1966. Redesignated by Doc. No. 11802, Amdt. 61-60, 38 FR 3161, Feb. 1, 1973, as amended by Amdt. 61-64, 41 FR 51392, Nov. 22, 1976]

§ 61.161 Rotorcraft rating: Aeronautical experience.

(a) An applicant for an airline transport pilot certificate with a rotorcraft rating must hold a commercial pilot certificate, or its equivalent as determined by the Administrator.

(b) In addition, such an applicant must have had at least 1200 hours of flight time as a pilot within the 8 years before the date he applies including at least—

(1) 5 hours in rotorcraft within the 60 days before that date;

(2) 200 hours of cross-country flight time;

(3) 100 hours at night, including at least 15 hours in rotorcraft; and

(4) 200 hours in rotorcraft, including at least 75 hours as pilot in command or as second in command performing the duties and functions of a pilot in command under the supervision of a pilot in command, or any combination thereof.

(c) In addition to the requirements of paragraphs (a) and (b) of this section, an applicant for an airline transport pilot certificate with a rotorcraft category and a helicopter class rating not limited to VFR must have at least 75 hours of instrument time under actual or simulated instrument conditions of which at least 50 hours were completed in flight with at least 25 hours in helicopters as pilot in command, or as second in command performing the duties and functions of a pilot in command under the supervision of a pilot in command, or any combination thereof.

[Doc. No. 1179, 27 FR 7956, Aug. 10, 1962, as amended by Amdt. 61-24, 31 FR 12401, Sept. 17, 1966. Redesignated by Doc. No. 11802, Amdt. 61-60, 38 FR 3161, Feb. 1, 1973]

§ 61.163 Rotorcraft rating: Aeronautical skill.

(a) An applicant for an airline transport pilot certificate with a rotorcraft category and a gyroplane class rating or a rotorcraft category and helicopter class rating limited to VFR must show his ability to satisfactorily pilot rotor-

(3) On a final approach using a VOR, NDB, or comparable approach procedure; and the aircraft—

(i) Has passed the appropriate facility or final approach fix; or

(ii) Where a final approach fix is not specified, has completed the procedure turn and is established inbound toward the airport on the final approach course within the distance prescribed in the procedure; the approach may be continued and a landing made if the pilot finds, upon reaching the authorized MDA or DH, that actual weather conditions are at least equal to the minimums prescribed for the procedure.

(d) The MDA or DH and visibility landing minimums prescribed in Part 97 of this chapter or in the operator's operations specifications are increased by 100 feet and ½ mile respectively, but not to exceed the ceiling and visibility minimums for that airport when used as an alternate airport, for each pilot in command of a turbine-powered airplane who has not served at least 100 hours as pilot in command in that type of airplane.

(e) Each pilot making an IFR takeoff or approach and landing at a military or foreign airport shall comply with applicable instrument approach procedures and weather minimums prescribed by the authority having jurisdiction over that airport. In addition, no pilot may, at that airport—

(1) Take off under IFR when the visibility is less than 1 mile; or

(2) Make an instrument approach when the visibility is less than ½ mile.

(f) If takeoff minimums are specified in Part 97 of this chapter for the takeoff airport, no pilot may take off an aircraft under IFR when the weather conditions reported by the facility described in paragraph (a)(1) of this section are less than the takeoff minimums specified for the takeoff airport in Part 97 or in the certificate holder's operations specifications.

(g) Except as provided in paragraph (h) of this section, if takeoff minimums are not prescribed in Part 97 of this chapter for the takeoff airport, no pilot may take off an aircraft under IFR when the weather conditions reported by the facility described in paragraph (a)(1) of this section are less than that prescribed in Part 91 of this chapter or in the certificate holder's operations specifications.

(h) At airports where straight-in instrument approach procedures are authorized, a pilot may take off an aircraft under IFR when the weather conditions reported by the facility described in paragraph (a)(1) of this section are equal to or better than the lowest straight-in landing minimums, unless otherwise restricted, if—

(1) The wind direction and velocity at the time of takeoff are such that a straight-in instrument approach can be made to the runway served by the instrument approach;

(2) The associated ground facilities upon which the landing minimums are predicated and the related airborne equipment are in normal operation; and

(3) The certificate holder has been approved for such operations.

§ 135.227 Icing conditions: Operating limitations.

(a) No pilot may take off an aircraft that has—

(1) Frost, snow, or ice adhering to any rotor blade, propeller, windshield, or powerplant installation, or to an airspeed, altimeter, rate of climb, or flight attitude instrument system;

(2) Snow or ice adhering to the wings or stabilizing or control surfaces; or

(3) Any frost adhering to the wings or stabilizing or control surfaces, unless that frost has been polished to make it smooth.

(b) Except for an airplane that has ice protection provisions that meet section 34 of Appendix A, or those for transport category airplane type certification, no pilot may fly—

(1) Under IFR into known or forecast light or moderate icing conditions or

(2) Under VFR into known light or moderate icing conditions; unless the aircraft has functioning deicing or anti-icing equipment protecting each rotor blade, propeller, windshield, wing, stabilizing or control surface and each airspeed, altimeter, rate of climb, or flight attitude instrument system.

(c) Except for an airplane that has ice protection provisions that meet section 34 of Appendix A, or those for transport category airplane type certification, no pilot may fly an aircraft into known or forecast severe icing conditions.

(d) If current weather reports and briefing information relied upon by the pilot in command indicate that the forecast icing condition that would otherwise prohibit the flight will not be encountered during the flight because of changed weather conditions since the forecast, the restrictions in paragraphs (b) and (c) of this section based on forecast conditions do not apply.

§ 135.229 Airport requirements.

(a) No certificate holder may use any airport unless it is adequate for the proposed operation, considering such items as size, surface, obstructions, and lighting.

(b) No pilot of an aircraft carrying passengers at night may take off from, or land on, an airport unless—

(1) That pilot has determined the wind direction from an illuminated wind direction indicator or local ground communications or, in the case of takeoff, that pilot's personal observations; and

(2) The limits of the area to be used for landing or takeoff are clearly shown—

(i) For airplanes, by boundary or runway marker lights;

(ii) For helicopters, by boundary or runway marker lights or reflective material.

(c) For the purpose of paragraph (b) of this section, if the area to be used for takeoff or landing is marked by flare pots or lanterns, their use must be approved by the Administrator.

Subpart E—Flight Crewmember Requirements

§ 135.241 Applicability.

This subpart prescribes the flight crewmember requirements for operations under this part.

§ 135.243 Pilot in command qualifications.

(a) No certificate holder may use a person, nor may any person serve, as pilot in command in passenger-carrying operations of a turbojet airplane, of an airplane having a passenger seating configuration, excluding any pilot seat, of 10 seats or more, or a multiengine airplane being operated by the "Commuter Air Carrier" (as defined in Part 298 of this title), unless that person holds an airline transport pilot certificate with appropriate category and class ratings and, if required, an appropriate type rating for that airplane.

(b) Except as provided in paragraph (a) of this section, no certificate holder may use a person, nor may any person serve, as pilot in command of an aircraft under VFR unless that person—

(1) Holds at least a commercial pilot certificate with appropriate category and class ratings and, if required, an appropriate type rating for that aircraft; and

(2) Has had at least 500 hours time as a pilot, including at least 100 hours of cross-country flight time, at least 25 hours of which were at night; and

(3) For an airplane, holds an instrument rating or an airline transport pilot certificate with an airplane category rating; or

(4) For helicopter operations conducted VFR over-the-top, holds a helicopter instrument rating, or an airline transport pilot certificate with a category and class rating for that aircraft, not limited to VFR.

(c) Except as provided in paragraph (a) of this section, no certificate holder may use a person, nor may any person serve, as pilot in command of an aircraft under IFR unless that person—

(1) Holds at least a commercial pilot certificate with appropriate category and class ratings and, if required, an appropriate type rating for that aircraft; and

(2) Has had at least 1,200 hours of flight time as a pilot, including 500 hours of cross country flight time, 100 hours of night flight time, and 75 hours of actual or simulated instru-

ment time at least 50 hours of which were in actual flight; and

(3) For an airplane, holds an instrument rating or an airline transport pilot certificate with an airplane category rating; or

(4) For a helicopter, holds a helicopter instrument rating, or an airline transport pilot certificate with a category and class rating for that aircraft, not limited to VFR.

(d) Paragraph (b)(3) of this section does not apply when—

(1) The aircraft used is a single reciprocating-engine-powered airplane;

(2) The certificate holder does not conduct any operation pursuant to a published flight schedule which specifies five or more round trips a week between two or more points and places between which the round trips are performed, and does not transport mail by air under a contract or contracts with the United States Postal Service having total amount estimated at the beginning of any semiannual reporting period (January 1-June 30; July 1-December 31) to be in excess of $20,000 over the 12 months commencing with the beginning of the reporting period;

(3) The area, as specified in the certificate holder's operations specifications, is an isolated area, as determined by the Flight Standards district office, if it is shown that—

(i) The primary means of navigation in the area is by pilotage, since radio navigational aids are largely ineffective, and

(ii) The primary means of transportation in the area is by air;

(4) Each flight is conducted under day VFR with a ceiling of not less than 1,000 feet and visibility not less than 3 statute miles;

(5) Weather reports or forecasts, or any combination of them, indicate that for the period commencing with the planned departure and ending 30 minutes after the planned arrival at the destination the flight may be conducted under VFR with a ceiling of not less than 1,000 feet and visibility of not less than 3 statute miles, except that if weather reports and forecasts are not available, the pilot in command may use that pilot's observations or those of other persons competent to supply weather observations if those observations indicate the flight may be conducted under VFR with the ceiling and visibility required in this paragraph;

(6) The distance of each flight from the certificate holder's base of operation to destination does not exceed 250 nautical miles for a pilot who holds a commercial pilot certificate with an airplane rating without an instrument rating, provided the pilot's certificate does not contain any limitation to the contrary; and

(7) The areas to be flown are approved by the certificate-holding FAA Flight Standards district office and are listed in the certificate holder's operations specifications.

[Doc. No. 16097, 43 FR 46783, Oct. 10, 1978; 43 FR 49975, Oct. 26, 1978, as amended by Amdt. 135-15, 46 FR 30971, June 11, 1981]

§ 135.244 Operating experience.

(a) No certificate holder may use any person, nor may any person serve as a pilot in command of an aircraft operated by a Commuter Air Carrier (as defined in § 298.2 of this title) in passenger-carrying operations, unless that person has completed, prior to designation as pilot in command, on that make and basic model aircraft and in that crewmember position, the following operating experience in each make and basic model of aircraft to be flown:

(1) Aircraft, single engine—10 hours.

(2) Aircraft multiengine, reciprocating engine-powered—15 hours.

(3) Aircraft multiengine, turbine engine-powered—20 hours.

(4) Airplane, turbojet-powered—25 hours.

(b) In acquiring the operating experience, each person must comply with the following:

(1) The operating experience must be acquired after satisfactory completion of the appropriate ground and flight training for the aircraft and crewmember position. Approved provisions for the operating experience must be included in the certificate holder's training program.

(2) The experience must be acquired in flight during commuter passenger-carrying operations under this part. However, in the case of an aircraft not previously used by the certificate holder in operations under this part, operating experience acquired in the aircraft during proving flights or ferry flights may be used to meet this requirement.

(3) Each person must acquire the operating experience while performing the duties of a pilot in command under the supervision of a qualified check pilot.

(4) The hours of operating experience may be reduced to not less than 50 percent of the hours required by this section by the substitution of one additional takeoff and landing for each hour of flight.

[Doc. No. 20011, 45 FR 7541, Feb. 4, 1980, as amended by Amdt. 135-9, 45 FR 80461, Dec. 14, 1980]

§ 135.245 Second in command qualifications.

(a) Except as provided in paragraph (b), no certificate holder may use any person, nor may any person serve, as second in command of an aircraft unless that person holds at least a commercial pilot certificate with appropriate category and class ratings and an instrument rating. For flight under IFR, that person must meet the recent instrument experience requirements of Part 61 of this chapter.

(b) A second in command of a helicopter operated under VFR, other than over-the-top, must have at least a commercial pilot certificate with an appropriate aircraft category and class rating.

[44 FR 26738, May 7, 1979]

§ 135.247 Pilot qualifications: Recent experience.

(a) No certificate holder may use any person, nor may any person serve, as pilot in command of an aircraft carrying passengers unless, within the preceding 90 days, that person has—

(1) Made three takeoffs and three landings as the sole manipulator of the flight controls in an aircraft of the same category and class and, if a type rating is required, of the same type in which that person is to serve; or

(2) For operation during the period beginning 1 hour after sunset and ending 1 hour before sunrise (as published in the Air Almanac), made three takeoffs and three landings during that period as the sole manipulator of the flight controls in an aircraft of the same category and class and, if a type rating is required, of the same type in which that person is to serve.

A person who complies with paragraph (a)(2) of this section need not comply with paragraph (a)(1) of this section.

(b) For the purpose of paragraph (a) of this section, if the aircraft is a tailwheel airplane, each takeoff must be made in a tailwheel airplane and each landing must be made to a full stop in a tailwheel airplane.

Subpart F—Flight Crewmember Flight Time Limitations and Rest Requirements

SOURCE: Docket No. 23634, 50 FR 29320, July 18, 1985.

§ 135.261 Applicability.

Sections 135.263 through 135.271 prescribe flight time limitations and rest requirements for operations conducted under this part as follows:

(a) Section 135.263 applies to all operations under this subpart.

(b) Section 135.265 applies to:

(1) Scheduled passenger-carrying operations except those conducted solely within the state of Alaska. "Scheduled passenger-carrying operations" means passenger-carrying operations that are conducted in accordance with a published schedule which covers at least five round trips per week on at least one route between two or more points, includes dates or times (or both), and is openly advertised or otherwise made readily available to the general public, and

(2) Any other operation under this part, if the operator elects to comply with § 135.265 and obtains an appropriate operations specification amendment.

(c) Sections 135.267 and 135.269 apply to any operation that is not a scheduled passenger-carrying operation and to any operation conducted solely within the State of Alaska,

APPENDIX I

NTSB RECOMMENDATIONS RESULTING FROM COMMUTER ACCIDENTS

As a result of its analysis of accidents involving Air Taxi Operations between the years 1964 and 1968, the Safety Board recommended to the Federal Aviation Administration that:

A-70-31

(1) A comprehensive review be made of the Federal Aviation Regulations, Part 135, Subpart D, pertaining to pilot-in-command qualifications with a view toward specifying pilot-in-command time in type requirements; and (2) the Administrator's staff meet with representatives of our Bureau of Aviation Safety to discuss in depth this air accident study to determine what additional analyses would prove most fruitful in increasing safety in air taxi operations, particular areas recommended for further study are certain detailed cause/factors, such as inadequate preflight preparation and/or planning or inadequate maintenance and inspection.

In its response of April 15, 1971, the FAA stated it had amended Part 135 considerably, which included changes to upgrade training requirements, require pilot-in-command aircraft type ratings, and upgrade crew qualifications and operating practices. The Board found that the changes made to Part 135 complied with the intent of this recommendation and it was subsequently classified as "Closed—Acceptable Action."

Following the investigation of an accident involving an Alaska Aeronautical Industries Flight 30, on September 6, 1977, the Safety Board recommended that the FAA:

A-78-37

Revise the surveillance requirements of commuter airlines by FAA inspectors to provide stringent monitoring.

A-78-38

Identify FAA offices responsible for the surveillance of large numbers of air taxi/commuter operators and insure that an adequate number of inspectors are assigned to monitor properly each operator.

A-78-39

Review the flight operations and training manuals of all commuter airlines to insure that the requirements of 14 CFR 135 are met and practiced.

h-18-41

Review the maintenance procedures of air taxi and commuter airlines operators to evaluate the effectiveness of those procedures and to insure adequate company control.

A-82-73

> Review the training of and the surveillance procedures followed by Federal Aviation Administration inspectors and modify them if necessary to provide increased emphasis on the provisions of 14 CFR Part 135 with regard to occupant safety and safety equipment.

The FAA informed the Board on July 13, 1983, that it had extensively revised and reissued FAA Order 8430.1C, "Inspection and Surveillance Procedures - Air Taxi Operators/Commuter Air Carriers and Commercial Operator. The Safety Board reviewed this order and found that it complied with the Board's intent in Safety Recommendation A-82-73. Safety Recommendation A-82-73 was classified as "Closed—Acceptable Action."

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