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FILE NO. 1-0006

# **AIRCRAFT ACCIDENT REPORT**

**ALLEGHENY AIRLINES, INC.**

**ALLISON PROP JET CONVAIR 340/440, N5832**

**NEW HAVEN, CONNECTICUT**

**JUNE 7, 1971**

**ADOPTED: JUNE 1, 1972**

**NATIONAL TRANSPORTATION SAFETY BOARD**

**Washington, D. C. 20591**

**REPORT NUMBER: NTSB-AAR-72-20**

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16. Abstract Allegheny Airlines, Inc., Allison Prop Jet Convair 340/440, N5832, operating as Allegheny Flight 485, crashed during an approach to the Tweed-New Haven Airport, at 0949 a.m., on June 7, 1971. Twenty-eight passengers and two crewmembers were fatally injured. Two passengers and the first officer survived. The airplane was destroyed. The flight, operating between Washington, D.C., and Newport News, Virginia, with stops at Groton and New Haven, Connecticut, and Philadelphia, Pennsylvania, was making a nonprecision instrument approach and struck cottages at an altitude of 29 feet m.s.l., 4,890 feet from the threshold and 510 feet to the right of the extended centerline of Runway 2. The National Transportation Safety Board determines that the probable cause of this accident was the captain's intentional descent below the prescribed minimum descent altitude under adverse weather conditions, without adequate forward visibility or the crew's sighting of runway environment. The captain disregarded advisories from his First Officer that minimum descent altitude had been reached and that the airplane was continuing to descend at a normal descent rate and airspeed. The Board was unable to determine what motivated the captain to disregard prescribed operating procedures and altitude restrictions, and finds it difficult to reconcile the actions he exhibited during the conduct of this flight.					
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**JUNE 7, 1971**

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SA-427

File No. 1-0006

NATIONAL TRANSPORTATION SAFETY BOARD  
WASHINGTON, D.C. 20591  
AIRCRAFT ACCIDENT REPORT

Adopted: June 1, 1972

ALLEGHENY AIRLINES, INC.  
ALLISON PROP JET CONVAIR 340/440, N5832  
NEW HAVEN, CONNECTICUT  
JUNE 7, 1971

SYNOPSIS

On June 7, 1971, Allegheny Airlines, Inc., Flight 485, crashed at approximately 0949 a.d.t., while attempting an instrument approach to Runway 2 at the Tweed-New Haven Airport, New Haven, Connecticut. There were 26 adult passengers, two infants, two pilots, and a stewardess aboard the flight. Twenty-eight persons perished. Two passengers and the first officer survived.

The airplane struck three beach cottages located on the northern shore of Long Island Sound, at a height approximately 25 feet above mean sea level, (m.s.l.), 4,890 feet from the displaced threshold of Runway 2 and approximately 510 feet to the right of the extended centerline of the runway.

An intense fire ensued immediately upon initial impact and continued to burn to the point of near total destruction of the upper portion of the fuselage and cabin area of the airplane.

A special weather observation for the Tweed-New Haven Airport made at 0950 showed partial obscuration, visibility 1 3/4 miles, fog, wind 200° at 5 knots, altimeter setting 29.96 inches.

The National Transportation Safety Board determines that the probable cause of this accident was the captain's intentional descent below the prescribed minimum descent altitude under adverse weather conditions without adequate forward visibility or the crew's sighting of the runway

environment. The captain disregarded advisories from his first officer that minimum descent altitude had been reached and that the airplane was continuing to descend at a normal descent rate and airspeed. The Board was unable to determine what motivated the captain to disregard prescribed operating procedures and altitude restrictions, and finds it difficult to reconcile the actions he exhibited during the conduct of this flight.

The Board recommended to the Federal Aviation Administration that it incorporate in its Airworthiness Requirements provisions for fuel system fire safety devices which will be effective in the prevention and control of both in-flight and postcrash fuel system fires and explosions, and that the rulemaking action in this matter be applied to present and future transport category airplanes.

The Board also recommends to the Federal Aviation Administration nine specific items intended to improve flight attendants' functions, protection of flight attendants, airplane cabin furnishings and survivability characteristics.

The Board further recommended that labor organizations and air carriers review and delete from their wage agreements any clauses which would compensate flightcrews for operating flights ahead of scheduled flight times, and that government and industry efforts be applied toward application and use of technological advances in the field of all weather flight, navigation, and approach/landing systems.

## 1. INVESTIGATION

### 1.1 History of Flight

On June 7, 1971, Allegheny Airlines Flight 485, (AL 485) an Allison Prop Jet Convair 340/440, N5832, was operating in regularly scheduled passenger operations between Washington, D. C., and Newport News, Virginia, with scheduled en route stops at Groton Trumbull Airport, New London, New Haven, Connecticut, and Philadelphia, Pennsylvania.

Due to the below minima weather conditions existing in the Groton and New Haven areas, Flight 485's dispatch release had been amended to allow the flight to proceed Instrument Flight Rules (IFR) from Washington to Philadelphia via Groton and New Haven with Wilmington, Delaware, as an alternate airport. Minimum fuel required for this flight was 10,050 pounds. Prior to departure from Washington, additional fuel was added, bringing the actual fuel on board to 11,380 pounds. The additional fuel and the amended dispatch release eliminated the need for refueling which was normally accomplished at Groton.

The flight departed Washington at 0714 <sup>1/</sup> on an IFR flight plan. At 0719, AL 485 cancelled its IFR flight plan with Washington Departure Control and proceeded directly to New London, operating in accordance with Visual Flight Rules (VFR).

Upon arrival of the flight in the New London area at approximately 0813, reported weather conditions were below the minima prescribed for a VOR instrument approach to the Trumbull Airport. The flight proceeded to hold "VFR on top" <sup>2/</sup> at the Groton VOR <sup>3/</sup> while awaiting improvement in weather.

At 0835, the weather observer at Trumbull Airport, an Allegheny Airlines employee, made a special weather observation, reporting "Indefinite ceiling 200 feet sky obscured; visibility 1 mile, fog, surface wind 220° 5 knots." At 0841, AL 485 requested clearance from Quonset Point Approach Control for an IFR approach to Trumbull Airport. Approximately 4 minutes later the flight was given this clearance along with instructions to report back to Quonset when on the ground at Groton.

NOTE: All footnotes appear on Page 40.

At approximately 0852, AL 485 reported a "missed approach" 4/ to Quonset Approach Control and, at the request of the pilot, was cleared for a second approach. This second approach, as well as a third one, was attempted between 0852 and 0909:07, each terminating in a "missed approach."

Reported weather conditions during the second approach reflected an indefinite ceiling 200 feet, sky obscured, and visibility  $3/4$  mile in fog. During the third approach, the weather observation reflected an indefinite ceiling 100 feet, sky obscured, and visibility  $1/4$  mile in fog.

Available records and transcripts of recorded radio communications with AL 485, as well as extensive testimony by ground personnel at the public hearing on this accident, failed to establish that the changes in ceiling and visibility which had taken place between the first and third approach were either transmitted to, received or acknowledged by AL 485 before the second and third approaches were initiated.

Flight recorder data relative to the three "missed approaches" at Groton showed that on the first two approaches the airplane was descended to an approximate altitude of 175 feet m.s.l. 5/ while on the third approach the airplane was descended to an altitude of 125 feet m.s.l. before the climb associated with the missed approach procedure was initiated. Investigation disclosed that runway environment 6/ was not sighted when minimum descent altitude of 610 feet 7/ was reached during any of these approaches. After missing the third approach and so advising Quonset Approach Control at 0909, AL 485 further advised Quonset that the flight was climbing VFR and switching back to company radio frequency. After circling for approximately 5 minutes, AL 485 requested clearance for a "contact approach". 8/ This clearance was initially not granted by the Quonset controller because of reported weather conditions, but when the crew of AL 485 advised that the company (Allegheny Airlines) was reporting visibility of 1 mile at Groton, the controller approved a contact approach at 0919:46. The contact approach was completed with a landing on Runway 15. The flight arrived at the passenger gate at 0923, approximately 1 hour late.

Twenty passengers deplaned at Groton. Fourteen passengers were boarded and 713 pounds of cargo were loaded. No fuel was added. Allegheny Airlines ground personnel at Groton, who saw and conversed with the flightcrew while the flight was on the ground, noted nothing unusual about the crew's appearance or their activities.

The flight departed from the gate on an IFR clearance at 0933, and at 0936:30, the crew reported to Quonset Departure Control that the flight was airborne en route to New Haven.

Quonset Departure Control had cleared AL 485 to the Tweed-New Haven Airport via the Pond Point Intersection via the Groton 267° radial to Saybrook, thence via Victor Airway 16 to intercept the Bridgeport 099 radial to Pond Point, to maintain 4,000 feet. At 0944:57, Westchester Approach Control cleared AL 485 to descend to 2,000 feet, and then to 1,600 feet. New Haven weather was also transmitted at this time as follows: "Sky partially obscured, visibility 1 3/4 in fog, wind 180° at 5 knots, altimeter setting 29.97 inches." Both clearances and the weather information were acknowledged by the crew. Westchester Approach Control subsequently vectored the flight to intercept the final approach course at Pond Point and issued a clearance for a VOR approach to the New Haven Airport. After a routine position report, AL 485 established radio communications with the New Haven Tower. At 0948, the local tower controller advised the flight as follows:

"Runway your choice, sir, the winds one nine zero degrees at five, altimeter two nine nine six, Runway two or twenty."

AL 485 responded:

"O.K., the way it looks we will take two. It will be all right."

Whereupon AL 485 was cleared to land on Runway 2.

A company directive prohibits a downwind landing at the Tweed-New Haven Airport.

Subsequent to obtaining clearance to land on Runway 2 an altitude callout, "out of a thousand" was made by the captain. Landing flaps were extended subsequently to 24°;



first checklist items were completed; and flaps were extended to 40°, at the command of the captain. Subsequent altitude callouts, "500 Feet", "Top Minimums" and "Decision Height" were made by the first officer as the airplane proceeded inbound on its final approach course.

Airspeed of 105 knots and sink rate of 500 feet per minute were called out by the first officer after he noted that the flight had descended through the prescribed minimum descent altitude of 380 feet. This callout was acknowledged by the captain. The captain then instructed the first officer to "keep a sharp eye out here." This command was likewise acknowledged by the first officer. Approximately 18 seconds later, the first officer again remarked, "You can't see down through this stuff." The captain responded that he could see the water and could see straight down; whereupon the first officer exclaimed that he could see the water, also that they were "right over the water," and not twenty feet off the water. The descent continued unabated while this conversation was in progress. Approximately 3.5 seconds after the statement, "we're not twenty feet off the water," an abrupt tone said, "Hold it," and immediately thereafter, impact with the house occurred. Sounds of impact could be heard on the cockpit voice recorder tape approximately 1 second later. At 0950, the local controller noticed a fireball and a column of smoke south of the approach end of Runway 2. During deposition proceedings, when questioned regarding the final stage of this approach, the first officer stated that he saw "the building" appearing out of the fog in front of him at that time and that there was still no attempt by the captain to arrest the descent or to pull up.

The aircraft struck the upper portions of three beach cottages at a height of approximately 29 feet m.s.l., and came to rest at a point 270 feet from initial impact. Fire developed immediately upon initial impact.

1.2 Injuries to Persons

<u>Injuries</u>	<u>Crew</u>	<u>Passengers</u>	<u>Other</u>
Fatal	2	26	0
Non fatal	1	2	0
None	0	0	

1.3 Damage to Aircraft

The aircraft sustained near total destruction by fire.

1.4 Other Damage

Several beach cottages and a bathhouse with small attached structures were destroyed. Power lines and adjacent structures sustained major damage.

1.5 Crew Information

Both flightcrew members held appropriate certificates issued by the Federal Aviation Administration. All crewmembers were qualified for the flight involved. (For detailed crew information, see Appendix B.)

1.6 Aircraft Information

The airplane was a Convair 340/440 Serial No. 384. It had been modified to an Allison Prop Jet "Convair 580" by the Pacific Airmotive Corporation on September 19, 1967. This modification included the installation of two Allison 501D-13 powerplants with A6441FN606A Aeroproducts propeller assemblies. The current airworthiness certificate was issued on November 22, 1967.

The airplane had been maintained in compliance with existing regulations.

The maximum allowable takeoff weight of the airplane at Groton was 52,957 pounds. The computed gross takeoff weight at Groton was 46,459 pounds. The computed landing weight at New Haven was 45,502 pounds. The center of gravity was within the prescribed limits for both the takeoff from Groton and the planned landing at New Haven.

A total of 841 gallons of Jet-A-Fuel was delivered to the aircraft for Flight 485 on June 7, 1971, to bring the fuel load to 1,730 gallons prior to the flight's departure from Washington National Airport. Fuel weight was calculated at 6.7 pounds per gallon. (See Appendix C for additional aircraft information.)

### 1.7 Meteorological Information

Official weather observations at the Tweed New Haven Airport generally reflected poor visibility at the airport at the time of the accident. Testimony by an eyewitness, who was situated in the immediate vicinity of the accident site, described the forward visibility as ranging between 50 to 60 feet at the time of the accident. Cockpit conversation during the last 15 seconds of flight pertaining to the forward visibility in the airplane's environment during the final phase of the approach was as follows:

#### Time & Source

0949:14.3  
F/O Walker "You can't see down through this stuff"

0949:20.5  
Capt. Eastridge "I can see the water."

0949:22.1  
Capt. Eastridge "I got straight down."

0949:23.8  
F/O Walker "Ah, yeah, I can see the water.  
We're right over the water."

0949:26.2  
F/O Walker "Man we ain't 20 feet off the water."

#### Official Surface Weather Observations

##### Groton

0800, indefinite ceiling 100 feet obscuration, visibility 1/8 mile, fog, temperature 60° F., dew point 59° F., wind 210° 5 knots, altimeter setting 29.96 inches.

0818, Special, indefinite ceiling 200 feet obscuration, visibility 1/4 mile, fog, temperature and dew point missing, wind 210° 5 knots, altimeter setting 29.97 inches.

0835, Special, indefinite ceiling 200 feet obscuration, visibility 1 mile, fog, temperature and dew point missing, wind 220° 5 knots, altimeter setting 29.97 inches.

0856, Record Special, indefinite ceiling 200 feet obscuration, visibility 3/4 mile, fog, temperature and dew point missing, wind 220° 5 knots, altimeter setting 29.97 inches.

0901, Special, indefinite ceiling 100 feet obscuration, visibility 1/4 mile, fog, temperature and dew point missing, wind 210° 8 knots, altimeter setting 29.98 inches.

0920, Special, partial obscuration, 200 feet scattered, visibility 1 mile, ground fog, temperature and dew point missing, wind 210° 5 knots, altimeter setting 29.99 inches, 5/10 of the sky obscured by ground fog.

#### New Haven

0907, Special, partial obscuration, visibility 1 3/4 miles, fog, wind 200° 5 knots, altimeter setting 29.97 inches, 4/10 of the sky obscured by fog.

0950, Record Special, partial obscuration, visibility 1 3/5 miles, fog, temperature 70° F., dew point 58° F., wind 210° 5 knots, altimeter setting 29.97 inches, aircraft mishap, FIBI (observation recorded but not transmitted via teletype). Despite the remark of FIBI the observation was called to the Bradley Flight Service Station and transmitted via teletype.

There were no published pilot weather reports available pertinent to the time and place of the accident. The National Weather Service did not issue terminal forecasts for Groton or New Haven.

The aviation area forecast for eastern Pennsylvania, southeastern New York, Connecticut, New Jersey and coastal waters, as issued by the Forecast Office at New York City at 0240 and valid from 0300 to 1500, was in part as follows:

Synopsis: North-south warm front along line from upper Hudson Valley southward to New York City coastal waters moving eastward 15-20 knots to beyond area by 0900, followed by warm, moist, southwesterly flow.

Flight precautions are recommended for thunderstorms coastal southeastern New York, New Jersey, southern Connecticut, coastal waters and for developing poor visibilities inland sections and for local low ceilings, poor visibilities immediate coastal sections New Jersey, southern Connecticut, coastal southeastern New York.

Clouds and weather: Coastal southeastern New York, New Jersey, southern Connecticut, coastal waters 3,000-5,000 feet scattered variable to broken, tops 6,000 feet, 8,000-12,000 feet broken variable to overcast, tops 14,000 to 20,000 feet broken variable to overcast, scattered thunderstorms, with cumulonimbus tops to 40,000 feet, conditions local ceiling 1,500 feet overcast, visibility 2 miles, thunderstorms, moderate rain showers, visibility local 4-6 miles, haze, smoke inland sections, except local immediate coastal sections southeastern New York, southern Connecticut ceiling 100-500 feet obscuration, visibility 1/4-1 mile, fog. By 0500 conditions over inland sections becoming 8,000-12,000 feet scattered variable to broken 20,000 feet broken, visibility 3-6 miles, haze, smoke, local visibility 1/2-2 miles, ground fog, with little change immediate coastal sections. By 0900-15,000 feet scattered, 25,000 feet thin broken, visibility 4-6 miles, haze to 7 miles.

#### 1.8 Aids to Navigation

The Tweed-New Haven Airport is served by a VOR which is located near the center of the airport. The VOR facility was functioning at the time of the accident. The approach area to Runway 2 was equipped with visual approach slope indicator (VASI) lights as well as runway end identifier

lights (REIL). The airport was not equipped with an instrument landing system (ILS) at the time of the accident.

The Jeppesen Approach Chart, 19-1, dated April 2, 1971, for the Tweed-New Haven Airport Runway 2 VOR Approach, in effect on the date of the accident specifies that the final approach fix is the Pond Point Intersection. This intersection is defined as the 205° radial of the New Haven VOR and the 099° radial of the Bridgeport VOR and is located 5.7 nautical miles southwest of the New Haven VOR. The procedure provides for a descent from 1,600 feet to authorized minima after passing the Pond Point Intersection. For a straight-in landing on Runway 2, the minimum descent altitude is 380 feet with a minimum visibility of 1 mile. (See Appendix D for the applicable approach chart.)

#### 1.9 Communications

Communications between the flight and the various facilities were routine and were accomplished without any difficulties. The Allegheny Airlines' radio communication system located at the carrier's systems control facility in Pittsburgh, Pennsylvania, which is used by dispatchers for ground/air/ground communications with flights, has a maximum range of 150 miles. Consequently, communications with flights operating beyond the 150-mile radius from Pittsburgh must be accomplished through Aeronautical Radio, Inc. (AIRINC), or by telephone relays through ground stations which are located within range of the flight's position.

Part 121.601 of the Federal Air Regulations "Aircraft Dispatcher information to pilot in command: Domestic and Flag Air Carriers" states:

"(a) The aircraft dispatcher shall provide the pilot in command all available current reports or information on airport conditions and irregularities of navigation facilities that may affect the safety of the flight; and (b) During a flight the aircraft dispatcher shall provide the pilot in command any additional available information of meteorological conditions and irregularities of facilities and services that may affect the safety of the flight."

The dispatcher who was on duty at the time AL 485 was approaching New Haven testified that he "could have" informed the flight of any changes in weather conditions "but did not," because he did not "think any changes had taken place" and "was not aware of any changes that had taken place."

#### 1.10 Aerodrome and Ground Facilities

The Tweed-New Haven Airport is located 3.5 miles southeast of the city of New Haven, Latitude 41° 16' North, Longitude 72° 53' West. The airport elevation is 14 feet above sea level. There are two hard surface runways; Runway 2-20 is 5,600 feet long and 150 feet wide and is equipped with high-intensity runway lights. The usable length of Runway 2-20 is 4,771 feet. Runway 14-32 is 4,116 feet long and 150 feet wide. The approach to Runway 2 is over Long Island Sound and across the northern shore of the Sound. The final approach course extends northward for approximately 5,000 feet over the beach area and the adjacent community of East Haven. The south end of Runway 2 is approximately 4,000 feet north of the beach area.

#### 1.11 Flight Recorders

The airplane was equipped with a flight data recorder (FDR) and a cockpit voice recorder (CVR). Both units were in satisfactory condition for data retrieval.

##### Flight Data Recorder

The flight data recorder was a UCDD (Sundstrand) Model FA-542, Serial No. 1602.

Readout of the last 5 minutes of the flight record was accomplished. A readout was also made covering the flight 30 seconds prior to descent from cruise altitude and ending with landing at Groton. The total time read out was 75 minutes. An altimeter setting of 29.96 inches was used to convert pressure altitudes to mean sea level altitudes.

The recorder was overhauled by Allegheny Airlines on March 11, 1971, and was installed in N5832 at Washington, D. C., on March 24, 1971. At the time of the accident, the recorder had accumulated 495 hours

since installation. The foil recording medium removed from the recorder following the accident contained recorded data for all flight operations conducted during this period of time. A portion of foil medium containing the calibration record made at overhaul was submitted by the operator, and this record was measured on the same equipment as that used for the accident readout.

Measurements were made at various reference points on all parameter and binary traces in an area of the flight recorder foil where the aircraft was on the ground at Groton. These measurements disclosed that the indicated airspeed, magnetic heading and vertical acceleration parameters were being recorded consistent with the current calibration record; however, the pressure altitude parameter was recording outside the calibration on the high side. The following altitude measurement was based on the altimeter setting of 29.96 inches:

Trumbull Airport, Groton, Connecticut

Measured Elevation (based on current calibration)	207 feet m.s.l.
Published Airport Elevation	<u>10 feet m.s.l.</u>
	Difference +197 feet
Recorder Accuracy Tolerance in This Range	±100 feet

This difference of 197 feet, applied to the current calibration record, corresponded to a dimensional shift of +0.008 inch in the altitude recording stylus reference position.

The following altitude data were measured on the the first recorded flight following recorder installation. This was identified from the Trip/Date-Reference binary trace as Flight 691, March 25, 1971, originating at Washington National Airport, Washington, D. C., and terminating at Toronto International Airport, Toronto, Canada, with en route stops at Philadelphia and Erie, Pennsylvania. The measured elevation in each case was based on the current calibration, and the recorder accuracy tolerance is ±100 feet.



A difference of +19 feet between the published airport elevation and measured elevation was found for the Philadelphia segment, while a difference of +16 feet between published and measured elevations was found at the Erie, Pennsylvania, and Toronto, Canada, stops.

The +0.008-inch dimensional shift noted in altitude measurement on the ground at Trumbull Airport was reviewed with the recorder manufacturer. This shift had no effect on the normal operation of the recording stylus, but resulted in a shift of the entire range of the stylus by this dimension. New altitude calibration curves were prepared by adding 0.008 inch to each calibration point measured on the original calibration foil.

The data graph covering the final phase of the approach to New Haven showed a steady descent rate of approximately 500 feet per minute during the last minute of the flight, starting at 500 feet m.s.l. and terminating at 25 feet m.s.l. The graph airspeed indications for this same period averaged approximately 110 knots Indicated Air Speed (IAS) with a maximum of 118 knots and a minimum of 102 knots. The airspeed on the data graph remained at a steady 106 knots IAS for the last 5 seconds prior to recording termination. The final heading trace is approximately 010°. Vertical acceleration indicators were steady during the last minute of flight; however, the final "g" excursion appeared approximately 1 second prior to recording termination and showed an abrupt increase from +1g to +2.4g's.

#### Cockpit Voice Recorder

The cockpit voice recorder which was installed aboard N5832 at the time of the accident was a United Data Control Model V-557, Serial No. 2029.

The recording unit was essentially undamaged. A transcription of the pertinent portions of the recording was made at the National Transportation Safety Board laboratory in Washington, D. C. This transcription is contained in Appendix E to this report.

### 1.12 Wreckage

The airplane first struck three adjoining dwellings which were located 4,890 feet from the displaced threshold of Runway 2, 510 feet to the right of the extended centerline of that runway and 880 feet to the right of the 205° radial of the New Haven VOR.

The fuselage came to rest 270 feet north of the point of initial impact. (See Appendix F for detailed wreckage location as related to point of impact.) The landing gear was in the extended position and the wing flaps had been extended to 40°.

The forward section of the fuselage, comprising the cockpit area, was broken open and sustained massive damage due to the impact. The remainder of the fuselage, with the exception of a circumferential fracture and separation at fuselage station 790, remained in one section and sustained near total destruction by fire.

Extensive fire damage precluded determination as to which emergency exits were opened by surviving passengers. The remains of the rear service door disclosed that this door was unopened. The lower latch hooks which secured this door were engaged.

Examination of the remains of the aircraft's control system which were contained in the separated outboard sections of the left and right wings, as well as the empennage section, disclosed no evidence of a control system failure. The rudder and elevator control locks were in the disengaged position.

The engine nacelles, engines and both propellers and their reduction gear assemblies were separated from the aircraft structure at impact.

Laboratory examination of propellers and torque meter instrumentation disclosed approximate power settings of 1,600 horsepower on both engines at impact. There were no preimpact malfunctions or failures within the powerplants or associated systems.

Severe fire damage to the aircraft and to the majority of the aircraft's system components precluded accurate

determination of system parameters at the time of impact. However, there were no malfunctions of the recovered electrical, hydraulic, air-conditioning/pressurization, fire extinguishing, communications or flight system components. The fire extinguishing system had not been used. Particular emphasis was placed upon the recovery, possible reconstruction, and functional testing of parts and components comprising the aircraft's altimetry and associated static systems. Both altimeters were recovered. The captain's altimeter barometric setting was 29.84 inches of mercury. The adjusting knob had been separated at impact. The first officer's altimeter barometric setting was 29.96 inches of mercury; the adjusting knob had been bent.

Both the captain's and first officer's altimeter filter screens at the static connector were partially obstructed by a black substance which was identified as an antiseize compound used for the lubrication of threaded aluminum alloy parts.

#### 1.13 Fire

There was no in-flight fire. Ignition of spilled fuel occurred simultaneously with the airplane's initial contact with the buildings and powerlines and consequent fracture of wing structure which contained fuel.

The fuel spillage and the flame propagation continued at an accelerated rate after final impact. Secondary explosions occurred shortly after final impact. Fire damage and near total destruction of the cabin interior occurred within several minutes after final impact.

Two fire fighting units arrived at the crash site approximately five minutes after the accident occurred. However, upon arriving in the vicinity of the crash site, the firefighters did not see the burning airplane immediately and directed their efforts to the burning buildings. Subsequently, the firemen noticed the burning airplane, at which time they diverted their efforts to it.

#### 1.14 Survival Aspects

This accident was survivable. With the exception of the cockpit area, the fuselage structure remained sufficiently

intact to preclude the infliction of traumatic injuries to the occupants. One of the two surviving passengers experienced some difficulty in releasing his seat belt after the impact. He observed that the cabin was dark and that it was smoky at the rear. He had, however, thoroughly familiarized himself with the emergency exit configuration of the airplane while en route from New London to New Haven. After opening the right forward overwing exit, he was unable to leave the airplane by this exit because of flames entering the cabin through this opening. His face and hands were burned. He leaped back and went to the exit window directly across the cabin, found the exit was open, and left the cabin through it. The surviving female passenger saw the other passenger leave through this exit and quickly followed him. Both passengers proceeded through an area of fire outside of the airplane and into a water-filled ditch which was located near the airplane wreckage.

When the fire was extinguished, 15 of the 27 nonsurviving passengers were near the rear service door. The others were found near the center and forward cabin sections. Toxicological studies are available for 26 of the 27 passengers. Autopsy and toxicological studies showed that all had died of chemical asphyxiation and thermal injury or a combination of both. (See Appendix G for location and toxicological findings of fatalities.) The stewardess who was stationed near the rear door also died of chemical asphyxiation and, in addition, had suffered fractures of the upper posterior rib, fracture of the left clavicle and fracture of the third thoracic vertebra. The operation and opening of the rear service door by other than trained personnel requires an ability to see and adhere to the instructions which are affixed near the door handle. The lower portion of the rear exit door was found in the latched (closed) position. Because of extensive fire damage to the remaining emergency exits, a determination could not be made regarding which other emergency exits could have been opened by surviving passengers.

The capacity of the Allison Convair 340/440 configuration used by Allegheny Airlines is 50 passengers. Part 121.391(a) (2) of the Federal Aviation Regulations required two flight attendants "For airplanes having a seating capacity of more than 44 but less than 100 passengers . . . ." However, Part 121.391(b) of the Federal Aviation Regulations, effective 22 April 1969, stated:

"Upon application by the certificate holder, the Administrator may approve the use of an airplane in a particular operation with less than the number of flight attendants required by paragraph (a) of this section, if the certificate holder shows that, based on the following safety and emergency procedures and functions established under 121.397 for the particular type of airplane and operations can be adequately performed by fewer flight attendants:

- (1) Kind of operation
- (2) The number of passenger seats.
- (3) The number of compartments.
- (4) The number of emergency exits.
- (5) Emergency equipment.
- (6) The presence of other trained flight crewmembers, not on flight deck duty, whose services may be used in emergencies.

However, no certificate holder may take off an airplane with few flight attendants than the number used in conducting the emergency evacuation demonstration required by 111.291 of this chapter."

Under the provisions of these regulations and as the result of a petition by the Air Transport Association of America (ATA), Allegheny Airlines, as well as seven other air carriers, was first granted exemption No. 1108 on April 16, 1970, allowing operation "with one flight attendant when less than 51 passengers are carried." Exemption No. 1108 was to have expired on December 31, 1970; however, it was extended twice and was in effect as exemption No. 1108B, to expire on January 31, 1972, "unless sooner superseded or rescinded."

Current regulations in this area are predicated upon a complete evacuation of the airplane in 90 seconds.

Several witnesses stated that, when they first arrived at the accident site, they heard voices of people inside the aircraft and that several violent explosions occurred

shortly after impact. The female surviving passenger also recalled seeing seven or eight persons up and moving about the cabin and hearing the sound of a male voice calling, "Try to get to the back."

The first officer was rescued from a position on the ground approximately twenty feet in front of the nose section of the burning fuselage. He had sustained massive burn injuries and serious injuries to both legs. The injuries were so critical that amputation of both legs was required later.

The captain was observed in his seat in the nose section of the burning fuselage and could not be reached by rescuers. The captain's pulmonary tree, unlike that of the passengers, the first officer's, and the stewardess', showed no carbon deposit. The captain, however, did have severe burn injuries, a skull fracture, and rib and collarbone fractures.

The medical records of both pilots reflected no conditions which might have affected their ability to operate the airplane in a normal manner. Post mortem examination of the captain disclosed no disease or other conditions which could be related to accident causation. The toxicological studies on the captain were negative.

#### 1.15 Tests and Research

##### Altimeter Filter Obstruction Tests

Several tests were conducted to determine the effect of partially obstructed filters upon the operation of the altimeters. The altimeter cases from N5832 were used in these tests. New altimeter mechanisms were installed in the cases, and the effect of the obstruction of the filters was observed by simulating climbs and descents of 500, 1,000 and 2,000 feet per minute, through altitudes of 1,000 and 4,000 feet. Ten-foot lengths of static lines to each altimeter were used to simulate the aircraft static line system. Both altimeters closely followed the standard altimeter when the tests were conducted. A maximum lag of 20 feet was observed in one of the altimeters. The lag was always in a clockwise direction on the instrument and was defined as scale error.

### Lubricant Heat Tests

Tests were conducted to determine the temperatures at which the thread lubricant which was used on the static line fittings would flow and spread to adjacent areas.

An altimeter case was fitted with a connector on which an excessive amount of the antiseize thread lubricant was placed. The assembled unit was placed in an oven and heated at 150° F. for 1 hour. The lubricant did not flow or spread. A second test was conducted in which the unit was heated for 1 hour at 200° F. and, no flow or spreading of lubricant was noted.

When the temperature was increased to 250° F. for one hour, the lubricant flowed and covered the filter screen in the static port of the altimeter case.

### 1.16 Other Pertinent Information

#### (a) Pilot Flight Pay Provisions

The contractual agreement between Allegheny Airlines and the Air Line Pilots Association (ALPA), which represents the Allegheny Airlines pilots, primarily deals with salary structure and working conditions. One of the contractual items related to the pilots' earning capacity provides for a bonus pay plan if actual point-to-point flight time is reduced from the time published in the flight schedules; i.e., if the published, scheduled flight time from Point A to Point B is one hour and the flight is flown from Point A to Point B in 50 minutes, the following effect upon the pilot's pay computation takes place:

1. Pilot is paid for the full one hour scheduled flight time.
2. His official flight time log will reflect 50 minutes flight time.
3. Pilot's maximum allowable flight time of 86 hours per month is computed only upon the official flight time log.
4. The ten minutes saved and other cumulative savings accrued may be applied to flight time shortages at the end of the month.

make up a full allowable flight time of 86 hours.

5. If the flight pay for one month, after addition of the bonus time, should exceed 86 hours, the savings are placed in a "Bank" for pay purposes at a later date. Illness, termination or retirement may cause full payment of accumulated savings. The maximum that can be so accumulated is approximately 50 percent of the pilot's previous month's pay.

Contractual arrangements of other carriers with the Air Line Pilots Association contain similar provisions providing for varying degrees of incentive pay for maintaining or flying ahead of published schedules.

(b) Human Factors Aspects Pertaining to Flightcrew

Captain Eastridge's piloting performance was continually rated "satisfactory" by his check pilots and other flight personnel who had flown with him. He had no history of physical or emotional illness.

Allegheny Airlines has no medical facilities which are capable of monitoring the physical condition of its flight crewmembers. Completion of the required FAA physical examination is acceptable proof to the carrier that the pilot is physically fit to operate the aircraft. Under present FAA policy, a physician hired by an airline cannot conduct medical certification tests, and there is no requirement that air carriers maintain continuing medical records of flight crewmembers.

Allegheny Airlines requires that prior to the origination of each flight the captain in command must certify that he is fit in terms of preparation for the flight and in terms of his physical fitness to conduct that flight.

The first officer of Flight 485 stated that Captain Eastridge's mannerisms appeared perfectly "normal" during and prior to the approach to New Haven.

He also stated that Captain Eastridge was an excellent pilot, that he was able to get along well with Captain Eastridge, and that he liked flying with him.



The first officer also stated in part that "Lot of the guys didn't like to fly with him on account of his strict, in other words, that when you get in there with him, well you're supposed to do your job or you're going to hear about it. . . . He just didn't have much tact, in other words, he was very strict and firm about things like that. He was that type of fellow. In other words, he was the commander of that airplane and you knew it, I'll put it that way. He'd let you know it."

Allegheny Airlines' procedures relating to the responsibilities of a first officer state: "The first officer is designated as second in command, is directly responsible to the captain, and would assume command if the captain should become incapacitated. . . ."

These procedures further state that:

"All crewmembers must realize that the captain is in complete command of the airplane and his orders are to be obeyed, even though they may be at variance with written instructions. Any potential or actual emergency situation should be immediately called to his attention. If the first officer is actually manipulating the controls at this time, the captain shall assume complete command. Only he shall initiate such emergency procedures as engine shutdown, engine extinguisher discharge, aborted takeoff, rejected landing, go around, etc. (If the captain must be absent from the cockpit, the first officer is in command and must make the necessary decisions.)"

First Officer Walker, in response to a direct question, that at any time during the approach after passing minimum descent altitude did he consider taking over control of the airplane, the first officer replied that ". . . There was a thought in my mind. . . , It's better one man flying the airplane in perfect control, than than two men fighting over it. . . . Had he been incapacitated in any manner, I mean, I would have, because that is the only time that I can take an airplane away from a captain."

## 2. ANALYSIS AND CONCLUSIONS

### 2.1 Analysis

The investigation disclosed that there were no malfunctions of the airplane's systems, powerplants or airframe. A nominal altimeter error, due to accumulation of system tolerances, may have been present; however, such an error was not of a magnitude to be considered a causal or contributory factor to the initiation of the accident sequence. The first officer, in response to questions regarding "cross-checking" of altimeters during or prior to the approach to New Haven stated that he recalled no differences between the captain's and his altimeters.

The airplane was equipped for the type of flight operation in which it was engaged at the time of the accident. The captain and first officer were qualified for the flight.

The cause of this accident lies in the area of flight operation; specifically, the judgement and decisionmaking capability of the captain and his interaction with the first officer.

In retrospect, the three missed approaches at the Trumbull Airport at Groton, each one of which was associated with a deliberate descent below the specified minimum descent altitude, must be considered in the overall analysis of causal factors. One of the first items so considered was the captain's contact with the Pittsburgh dispatcher prior to departing Washington, D.C. The purpose of this contact was to obtain an amended release for the flight to proceed from Washington, D. C., through Groton and New Haven to Philadelphia, Pennsylvania. This amended release eliminated the refueling of the aircraft which was usually accomplished at Groton. In view of the below-minima weather conditions existing at Groton, the captain's request to amend the flight's release was a reasonable and practical one, for he had considered the possibility of overflying the Groton or New Haven airports. The fuel tanks were topped-off at Washington to provide additional fuel which would allow him to hold for a short period of time should weather conditions at either of these intermediate stops fail to improve by arrival time.

In analyzing the decision made by the captain, it is reasonable to assume that fuel requirements were of primary

concern to him and occupied much of his attention throughout the flight. The evidence would seem to corroborate this assumption. When the flight left the gate at Washington, D. C., a clearance was received to taxi to Runway 15, the active runway. Time would have been saved if Runway 3 could have been utilized as it is closer to the company gate and more nearly aligned with the routing to be flown after takeoff. The crew requested the use of Runway 3. This request was approved. Several minutes after takeoff, the Departure Controller cleared the flight to execute a 360° turn. The captain promptly elected to cancel his IFR clearance rather than make that turn. He later refused ATC's offer to retain the IFR clearance, even though the turn was no longer required. The captain obviously was aware that if he proceeded VFR via the most direct course additional time could have been saved. Evidence indicates that this was his plan. Scheduled flight time for the flight from Washington to Groton was 1 hour and 15 minutes. On this particular trip, the flight was overhead Trumbull Airport 59 minutes after departing from Washington, D. C. Had the weather conditions at Groton been suitable for a landing, the flight would have arrived approximately 10 minutes ahead of schedule.

Analyzing the specific circumstances surrounding the initial phase of AL 485's flight to Groton (overhead of the VOR), two facts were evident that seem to set the stage for the events that followed.

The captain's decision to amend the flight's release was motivated apparently by his advance planning and consideration of operational requirements for this particular flight. As a result, he established a firm plan as to how the flight should be conducted. He would fly the aircraft, and en route flight operations would be conducted in the least time possible in order to have more fuel available upon arrival at his destination in case holding became necessary.

Of significance is the fact that Captain Eastridge carried out the first portion of the flight exactly as planned. Upon arrival at Groton, the flight was ahead of schedule as far as time and fuel were concerned. Consequently, the crew was able to hold over Groton for a period of time without the need for operational considerations or decisions.

The first approach to Groton was started about 30 minutes after arrival over the Groton VOR. At that point the flight was 20 minutes behind schedule, and approximately one third of the available holding fuel had been consumed. The approach to the airport was commenced with a reported indefinite ceiling of 200 feet, sky obscured and 1 mile visibility. The crew had observed the fog's location over the airport and had seen the ground at their position northeast of the airport. After holding for 30 minutes and observing the fog lying right over the airport, the captain was aware that upon arrival at the 510-foot MDA the runway would not be visible to him. If he was, in fact, going to land, it would be necessary to get the aircraft down to 200 feet m.s.l. within a mile of the runway in order to effect the landing. The captain was acquainted thoroughly with the area and its local obstructions. Thinking ahead about fuel requirements and down-line scheduled operations, the captain attempted to get his airplane onto the ground. He decided to descend to about 200 feet, calculating that sufficient visibility would be available to permit a safe landing. Although such a procedure was not authorized, the captain believed that he could conduct the approach safely.

The first attempt to land was aborted and a missed approach procedure was executed. The captain did not acquire sufficient forward visibility to effect a landing. A second attempt to land, following the same type of approach, was unsuccessful for the same reason. The facts developed by the investigation showed that during the second approach the visibility had dropped to three-fourths of a mile, but the crew was not advised of this change in visibility. Furthermore, when the flight executed its third unsuccessful approach to the airport, the ceiling had dropped to an indefinite 100-foot ceiling and visibility to one-fourth of a mile, but again the crew of AL 485 had not been advised of this change and still believed the visibility to have been 1 mile.

It appears that on the third attempt to land, the captain became increasingly concerned over operational considerations such as his inability to effect a landing under the existing conditions, both as observed and reported. His aggressiveness and determination were more pronounced on the third approach, as evidenced by the fact that he flew the airplane down to an altitude of about 125 feet, but was still unable to align the airplane with the

runway for a landing. Another missed-approach was executed. The flight then circled the airport for another 10 minutes before the fog cleared sufficiently to permit a contact approach. This landing was then accomplished 1 hour and 8 minutes after the flight's initial arrival over the airport.

Based upon the crew conversation, as recorded on the CVR tape, it was evident that the captain made some calculations about fuel required to continue on to Philadelphia after being asked by the station agent via radio if they wanted to refuel. The captain said to the first officer "Twenty one hundred, fifty one hundred, nine hundred, we got enough if we don't run into any delays."

It is believed that those figures which were quoted referred to 2,100 pounds reserve fuel required; 5,100 represented the 2,100 pounds plus 3,000 pounds that would reflect 1 hour's fuel en route to Philadelphia (through New Haven), and the 900 figure represented the fuel required to proceed to an alternate. These figures totaled 6,000 pounds and represented rough calculations of minimum fuel required. The captain then advised the station operations agent ". . . we'll have enough fuel" and subsequently told one of the agents that fuel on board was 6,000 pounds. Although the captain stated he had 6,000 pounds of fuel, it was calculated that actual fuel on board the aircraft was 5,769 pounds maximum. The captain was aware also that if he reported anything less than 6,000 pounds, Allegheny Systems Control might request that the aircraft be refueled, and the flight would be delayed further.

Although the shortage of fuel was small, and in fact of no specific or critical operational significance insofar as fuel adequacy to New Haven was concerned, there is a distinct possibility that the captain's operational decision to continue with a known shortage influenced his flight planning and the conduct of subsequent flight operations.

When the flight left Groton, the captain was aware of the fact that the aircraft was several hundred pounds of fuel short of what he considered "legal" requirements. The reported weather at New Haven was of no great concern to him, but in all probability "fuel" and "time" were occupying much of his attention. If the flight encountered no ATC delays at New Haven; could make a right turn at Pond Point; and land straight-in on Runway 2; several minutes of "time"

could be saved and, in addition, several hundred pounds of fuel could be saved. If 200 pounds of fuel could be saved, actual fuel on board the aircraft at New Haven would be very close to legal requirements for the next leg to Philadelphia. Insofar as the conduct of the approach was concerned, it is believed the captain used the same basic rationale that was applicable to the Groton approaches. Furthermore, in view of the terrain, the New Haven approach would be considered less difficult by the captain than the Groton approach.

The facts developed by the investigation showed that the captain elected to land on Runway 2 with a 5 knot tailwind component. Such action was contrary to company regulations which prohibited any downwind landings at New Haven. The captain was aware of the tailwind component, as evidenced by the CVR transcript and it must be assumed that he was aware of the company directive. Therefore, it was reasonable to believe he had some compelling reason for selecting Runway 2 rather than circle to land on Runway 20. In the final analysis, that reason could have been the desire to save fuel so that refueling at New Haven would not be necessary.

As determined from available operational data and the first officer's testimony, the captain's actions were deliberate and planned. The first officer performed his duties in accordance with company procedures and apparently to the best of his ability.

In reviewing the text of the first officer's conversation with the captain after the flight descended below MDA, it was obvious that he attempted in several ways to alert the captain to the growing danger created by the continued descent.

Consideration was given to the possibility that an error in the airplane's altimeter system or a difference between the captain's and the first officer's altimeters caused the captain to disregard the first officer's advisories and descend to an altitude near zero.

The FDR readout showed that the altitude trace indicated 3,900, 1,900 and 1,550 feet m.s.l. while the flight was assigned to and should have been flying at altitudes of 4,000, 2,000 and 1,600 feet m.s.l., respectively. Since the FDR records the same indications as the first officer's altimeter, one could conceivably suspect that a slight

difference did in fact exist between the altitude indications as seen by the captain and the first officer, and that the captain was leveling off at altitudes as he saw them on his altimeter. If such were the case, the final 3 to 4 seconds of the flight could have been at approximately 100 feet M.S.L indication on the captain's altimeter.

Had tangible evidence been found to support such a suspicion, it could still in no way justify the descent to an altitude more than 400 feet below authorized MDA, it would merely lessen the degree of irresponsibility associated with an otherwise dangerous act. However, even this possibility could not be strongly supported by the evidence to the effect that there was no significant difference between the captain's and the first officer's altimeter indications or that there was a gross error within the indicating system. The airplane's maintenance history, the results of tests and examinations of the remains of the airplane's altimetry system and, most prominently, the testimony of the first officer supports the latter conclusions.

Another factor considered by the Board in its attempts to determine the answer to the obvious but most difficult question, "Why the continued descent despite the first officer's repeated warnings," is the conclusive evidence that both pilots had acquired visual contact with the water directly below them. This contact could have distracted the captain to the point that he failed to note the continued sink rate of the airplane.

Considerable testimony was developed during the public hearing and during the interviews with the first officer. Much of this testimony was oriented toward the fundamental question: "Why did the first officer not take more positive action or possibly take over control of the airplane when an extremely low and dangerous altitude was reached?"

As previously stated, the action of the first officer did not comply fully with prescribed procedures insofar as the terminology he used for "callout" of decision height in lieu of MDA was concerned. The captain and the first officer had apparently developed a high degree of mutual trust and respect for each other. The captain had achieved the success he had through his ability to meet schedules even under adverse conditions. The captain could also be

classified as an authoritarian who enjoyed absolute command. By contrast, the first officer appeared to be the quiet, submissive type, not one who would question a superior or his authority.

These personality profiles, combined with the apparent friendly relationship that existed between the captain and the first officer, would be conducive to a situation wherein the first officer would not challenge the judgment of the captain under virtually any operational circumstances.

A company check pilot testified that, keeping in mind that he was in fact a check pilot, if riding as a copilot, and the captain descended to an altitude 200 feet below the minimum descent altitude, he would tell him that he "was taking command of the aircraft."

In contrast to this testimony, a junior first officer testified that he would not necessarily take over control of an airplane under a similar situation unless the pilot was incapacitated; however, "Everyone has a strong sense of survival," that he was never in a situation like this and would have to be placed into a similar situation to make this judgment.

Similarly the first officer of Allegheny Flight 485 indicated that he had thoughts of taking over control but felt it was better to have one person in full control of the airplane than to have two persons fighting over it. The Safety Board fully appreciates the most difficult dilemma of the first officer in this case and recognizes the possibility of grave consequences in questioning the captain's command authority under a situation as developed in the case of AL 485.

The Safety Board is concerned with the apparent delegation of authority for operational control to the Pilot-in-Command without a concomitant system to assess the effectiveness of how that authority is exercised in view of the air carrier operator's duty to perform the operation with the highest of safety.

Inherent with delegation is a responsibility to assure that the delegation is effectively fulfilled. In this instance the Captain's deviation from the regulations governing the operation and the air carrier's operating



certificate was one that the operator could not control at that moment.

The concept of command authority and its inviolate nature, except in the case of incapacitation, has become a tenet without exception. This has resulted in second-in-command pilots reacting differently in circumstances where they should perhaps be more affirmative. Rather than submitting passively to this concept, second-in-command pilots should be encouraged under certain circumstances to assume a duty and responsibility to affirmatively advise the pilot-in-command that the flight is being conducted in a careless or dangerous manner. Such affirmative advice could very well result in the pilot-in command's reassessing his procedures.

The regulations prescribe that the pilot-in-command, during flight time, is in command of the aircraft and is responsible for the safety of the passengers, crewmembers, cargo and airplane. In this regard, he has full control and authority in the operation of the aircraft.

The second-in-command is an integral part of the operational control system in-flight, a fail-safe factor, and as such has a share of the duty and responsibility to assure that the flight is operated safely. Therefore, the second-in-command should not passively condone an operation of the aircraft which in his opinion is dangerous, or which might compromise safety. He should affirmatively advise the captain whenever in his judgment safety of the flight is a jeopardy.

The operation of an aircraft consistently and substantially below authorized minimums is an unsafe and dangerous procedure. In such a case, the second-in-command should have a duty and responsibility to advise the pilot-in-command that safety is being jeopardized and a missed approach should be immediately executed. The Board recognized that there is a dearth of guidelines regarding the circumstances and manner in which a flight crewmember should take affirmative action, which in turn leads to uncertainty in his mind when an actual dangerous situation. For this very reason, and in light of the circumstances of this accident, the Board believes that management and pilots' organizations should reexamine the relationship between the captain and flight crewmembers with a view

toward enunciating the responsibilities in circumstances where the aircraft is being operated unsafely.

The Board believes that it is incumbent upon the air carrier's management to devise and carry out a system that would enable it to continually assess the pilot-in-command's performance in executing the carrier's operational control responsibility which it must rely, to a great extent, upon the pilot-in-command to fulfill.

The Safety Board, in attempting to analyze fully all possible factors which could have influenced the captain's decisionmaking reviewed the pay provision of the contract between Allegheny Airlines and the Air Line Pilots Association. This agreement essentially rewards a pilot for operating a flight ahead (faster) of the published scheduled times. It is the opinion of the Board that such provisions may not be the best interest of safety. It also recognized the fact that the prudent and professional pilot would not and should not be influenced by monetary rewards at the cost of compromising safety. However, it is most difficult to relate the monetary aspects to the approach into New Haven.

A dense fog layer prevailed over the area at the time of the accident. The fog layer was based at the surface with the top of the layer at approximately 400 feet m.s.l. Both the ceiling and visibility were considerably lower over the water. An indefinite ceiling of less than 100 feet existed over the water and over the accident site. The horizontal visibility in the fog layer was restricted to less than 50 feet over the water and 150 to 200 feet over the beach area. Neither icing conditions nor turbulence was a factor.

The aircraft descended into the top of the dense fog layer at approximately 400 feet m.s.l. The flightcrew had not acquired visual contact with the water prior to descending below 100 feet m.s.l.

The conversation of the flightcrew made no mention of forward or horizontal visibility. Approximately 1 second prior to impact, the first officer's callout, "Hold it," indicated that he observed the houses on the beach. This corroborates the statements of ground witnesses who reported 150 to 200 feet forward visibility at the time.

The flightcrew did not obtain a weather briefing from the Weather Service Office at Washington National Airport or from the Washington Flight Service Station. However, existing weather conditions were discussed during the captain's conversation with the dispatcher prior to his departure from Washington. It must be concluded, therefore, that the captain was well aware of the meteorological conditions which prevailed in the area of his operation.

Company personnel at Groton did not give the crew the pertinent area forecasts which were issued at 0840. This deficiency was not considered a contributing factor because the forecast pertinent to the accident site was not fully accurate. Westchester Approach Control advised the flightcrew of the current New Haven weather before they started the approach to New Haven.

The weather observer at New Haven reported the sky condition and prevailing visibility accurately at 0907 but should have reported the obstruction to vision as ground fog instead of fog. He apparently did not call the 0907 weather observation to the Windsor Locks Flight Service Station for transmission on Service A teletype, but he did transmit this information to Westchester Approach Control, who, in turn, relayed it to AL 485.

The Safety Board has classified this accident as survivable. With the exception of the captain, who sustained fatal injuries upon impact, everyone aboard this flight could have survived if rapid egress from the fire area had been possible or if flame propagation had been retarded.

Primarily, the problem of rapid egress is most prominent. The stewardess is called upon and relied upon for assistance to the passengers in an emergency. In this case, as in so many other cases, such assistance may not have been possible due to a partially incapacitating injury which was inflicted upon the cabin attendant at impact. It appears likely that the stewardess was physically unable to operate the rear service door. Historically, difficulty has been experienced in the operation of this door, even under nonemergency conditions. It is considered unlikely that a passenger in the smoke-filled darkness of the rear cabin could have read or followed the instructions for opening this door or could have successfully opened this door. This

theory can be supported by a survivor's statement that someone shouted to go to the rear of the airplane and by the fact that 15 of the 28 fatalities were found close to the rear service door. It would be reasonable to suspect that one or more of them had tried to open this door but were not successful.

Allegheny Airlines, as well as other local service carriers, has been authorized to operate the Convair "580" airplane with one cabin attendant; pursuant to exemption No. 1108B exempting carriers from compliance with FAR 121.391, which requires two cabin attendants for this type of airplane.

Although cabin attendants' seating arrangements and restraining devices presently used might not have prevented injury to a second stewardess, the Board believes that the possibility for a greater number of survivors would have existed had a second cabin attendant been aboard this flight.

Both surviving passengers and eye witnesses described a series of explosions shortly after impact. Explosions and attendant flame propagation, as described by witnesses, would have made survival impossible subsequent to these explosions.

## 2.2 Conclusions

### (a) Findings

1. The airplane was certificated and airworthy.
2. The crewmembers were certificated.
3. AL 485 attempted three VOR instrument approaches to the Trumbull Airport. Each of these approaches was terminated with a missed approach after the captain deliberately descended well below the minimum descent altitude of 510 feet m.s.l.
4. The flight departed from Groton with 200 to 500 pounds less fuel than the 6,000 pounds reported by the flightcrew.

5. The slight shortage of fuel prompted the captain to accept Runway 2 at New Haven even though he was aware of the downwind component and the company's prohibition against making downwind landings at the Tweed-New Haven Airport.
6. Navigational aids which were used for the instrument (VOR) approach to the Tweed-New Haven Airport were functioning normally.
7. The Tweed-New Haven Airport was not equipped with an instrument landing system.
8. The first officer, in compliance with required procedures, called out altitudes, airspeed, and sink rate to the captain during the final phase of the approach.
9. The captain heard and acknowledged the first officer's altitude callout of passage through minimum descent altitudes but deliberately continued the descent.
10. There was no acquisition of forward visibility by the first officer or the captain during the final phase of the approach until the airplane descended to an altitude of approximately 25 feet above the water, and the buildings were sighted by the first officer.
11. No conclusive finding can be made relative to the captain's motivation to descend deliberately to a dangerously low altitude during a nonprecision approach without acquisition of forward visibility.
12. The captain of Flight 485 was not incapacitated physically prior to impact.
13. General weather conditions were reported and known to the crew of AL 485. Although some details of meteorological conditions were not reported to them; this was not a causal factor in the accident.
14. The probability of survival might have been increased substantially if there had been an additional cabin attendant aboard this airplane to

effect expedited egress of passengers from the cabin or if improved fuel system crash fire protection systems had been in use to preclude the rapid propagation of fire upon impact.

(b) Probable Cause

The National Transportation Safety Board determines that the probable cause of this accident was the captain's intentional descent below the prescribed minimum descent altitude under adverse weather conditions without adequate forward visibility or the crew's sighting of the runway environment. The captain disregarded advisories from his first officer that minimum descent altitude had been reached and that the airplane was continuing to descend at a normal descent rate and airspeed. The Board was unable to determine what motivated the captain to disregard prescribed operating procedures and altitude restrictions and finds it difficult to reconcile the actions he exhibited during the conduct of this flight.

3. RECOMMENDATIONS

As a result of this investigation the Safety Board recommended that the Federal Aviation Administration take the following actions:

- (a) Initiate action to incorporate in its airworthiness requirements, a provision for fuel system fire safety devices which will be effective in the prevention and control of both in-flight and postcrash fuel system fires and explosions.
- (b) It was further recommended that rulemaking action in this matter specifically apply to future passenger-carrying aircraft in the transport category, and that consideration be given to an adaptation to all other passenger-carrying aircraft now in service. (See Appendix H.)

On November 12, 1971, the acting Administrator of the Federal Aviation Administration responded to the recommendation stating in part ". . . that protection against the occurrence of fire and explosion, whatever the ignition source, would be an important safety improvement" and that ". . . we will develop a course of action regarding rule

promulgation, both with respect to new transport category aircraft and passenger carrying aircraft in service." (See Appendix I.)

The Safety Board further recommends to the Federal Aviation Administration that:

- (a) Federal Aviation Regulation 121.571 be revised to state that the appropriate crewmember must physically point out the location of all emergency exits on each aircraft PRIOR TO EACH TAKEOFF. As a general rule passengers do not listen to the oral announcements. This was testified to during the public hearing relative to this accident. However, passengers will tend to watch a flight attendant who physically points out the area of exits and will retain therefore a general idea of the location of such exits particularly those nearest to them.
- (b) Chime systems or other audible devices be installed and used on Convair Models 240, 340, 440 and 580 airplanes to allow the flight attendant sufficient time to be seated before takeoff and prior to landing. Additionally, the chime system should be sufficiently loud to alert the flight attendant in the forward part of the aircraft as well as in any rest room or work areas in the aft part of the aircraft. Presently, no formal signal is used to alert flight attendants.
- (c) Some means (either lights or lighted signs) be installed and used on the CV-580 forward galley to allow the flight attendant visual reference to the "No Smoking" sign. This would indicate to the flight attendant the necessity to secure her galley and return to her assigned seat.
- (d) Previously effective Federal Aviation Regulation 121.391, "Flight Attendants," requiring two flight attendants for more than 44 passengers be reinstated without any waivers, exemptions or deviations (as allowed under Exemption 1178B). As we have previously pointed out in our comments regarding Notice of Proposed Rule Making 70-35 (See Appendix J), the Board did not recommend a

permanent rule change but rather that the partial exemption should be extended for a period of time during which a program for collection of appropriate data can be accomplished. The exemption allowed certain carriers to operate a 50-passenger aircraft with one flight attendant for a 44-passenger seating capacity and two flight attendants for a 44- to 99-passenger seating capacity. Flight attendants should be so distributed within the cabin of the CV-580 so as to assure safe evacuation of passengers should the injury or fatality of one flight attendant during the impact sequence render her partially or fully incapacitated. As demonstrated in this accident, two flight attendants, offering leadership and assistance from all available window exits and the main cabin door, would expedite any evacuation.

- (e) The instructions for opening the Convair 580 rear service door which are presently affixed to this door should be subjected to a thorough study and reevaluation. The present instructions are misleading. Simple and clear language should be substituted, such as "Remove plastic cover, open door, pull red inflate cord." Additionally, the locking mechanism (which is easily mistaken for a door handle) should be covered with an opaque light-weight material or some other device which would blend with the cabin interior material and could not be mistaken as part of the egress system in an emergency situation. A complete modification of the door handle to simplify its operation should be considered as an alternate solution.
- (f) Present provisions for emergency exit lights for utilization during darkness or smoke conditions be evaluated. During darkness or smoke conditions, it is vitally important to have some form of light available to direct and conduct emergency evacuations as well as to read operating instructions. Surviving passengers indicated that the cabin was dark, and exits were difficult to see.
- (g) Standardized instructions to flight attendants be used during training. The practice of using the



main cabin door for both the planned and unplanned emergency tends to confuse the flight attendants. It is recommended that the sequence and procedure for a planned practice emergency be identical to that which is to be used in actual emergency. It is further recommended that the Allegheny Airlines Hostess Manual be revised accordingly.

- (h) Adequate shoulder harnesses be provided on all airplanes for the flight attendants at their assigned seats. This would give added protection, assure survival and prevent additional injuries to flight attendants and assure leadership for passenger evacuation.
- (i) The emergency instructions for the individual airplane be displayed on the back of the seats in eye level sight of the passenger, to provide added assurance that the passenger is fully aware of vital safety and survival information. Efforts should also be exerted by the industry in cooperation with regulatory and consumer protection agencies to ascertain that all vital safety information be disseminated to the traveling public in a straightforward, clear, and explicit manner.
- (j) Establish a procedure to require air carrier management to establish and implement a system that would provide a method for continual assessment of the pilot-in-command's performance in executing management's operational control responsibility.

Furthermore, review and revise where necessary the operations manuals of air carriers to clearly state management's operational control procedures with regard to the pilot-in-command and other crewmembers and the manner in which each crewmember is expected to execute his duty.

- (k) The Board also recommends to the Air Transport Association of America and to the pilot labor organizations that: they review existing wage agreements any clauses which provide any form of monetary reward to the pilot for a faster than scheduled flight operation to assure that they do not derogate safety.

- (l) Combined efforts and resources of government and industry be applied toward the expeditious application and use of technological advances in the field of all weather flight navigation and approach/landing systems. Although it cannot be stated unequivocally that this accident would not have occurred if an instrument landing system or more advanced landing system had been in use, it is the Board's belief that the probability of the occurrence of such an accident would have been greatly reduced.
  
- (m) That the Air Line Pilots Association and the Allied Pilots Association implement a program within existing professional standards committees to provide an expeditious means for peer group monitoring and disciplining the very small group of air carrier pilots who may display any unprofessional (including hazardous) traits as exemplified by this accident.

FOOTNOTES

1/ All times herein, unless specified otherwise, are eastern daylight based on the 24-hour clock.

2/ VFR on top - Operation under visual flight rules conducted at least 1,000 feet vertically above a cloud layer, fog, haze, etc. or other well defined meteorological formation.

3/ Very High Frequency omnidirectional radio range.

4/ Missed Approach as described in FAA's Airman's Information Manual Part 1, "Basic Flight Manual and ATC Procedures, May 1971."

"1. When a landing cannot be accomplished upon reaching the missed approach point defined on the approach procedure chart, the pilot must comply with the missed approach instructions for the procedure being used or with an alternate missed approach procedure specified by Air Traffic Control.

"2. If visual reference is lost while circling to land from instrument approach, the missed approach specified for that particular procedure must be followed (unless an alternate missed approach procedure is specified by Air Traffic Control). To become established on the prescribed missed approach course, the pilot should make an initial climbing turn toward the landing runway and continue the turn until he is established on missed approach course. Inasmuch as the circling maneuver may be accomplished in more than one direction, different patterns will be required to become established on the prescribed missed approach course depending on the aircraft position at the time visual reference is lost.

Adherence to the procedure, illustrated by the following examples, will assure that an aircraft will remain within the circling and missed approach obstruction clearance areas."

5/ Mean sea level.

6/ Runway environment as defined in the second edition of the "United States Standard for Terminal Instrument

Approach Procedures (TERPS) Manual 8260.3A, Appendix 1, paragraph 2, "The runway threshold or approved lighting aids or other markings identifiable with the runway."

- 7/ Although the published minimum descent altitude for a nonprecision approach to Trumbull Airport is 510 feet, Allegheny Airlines Flight Information Letter 69-150 in effect at the time of the accident requires that all nonprecision approaches operated with 580 aircraft requires that ground contact must be established at 100 feet above regular day minimums before descending to normal MDA . . . ."
- 8/ Contact approach as defined in FAA Air Traffic Service, Terminal Air Traffic Control Handbook 7110.8A, April 1, 1971. "An Approach wherein an aircraft on an IFR flight plan, operating clear of clouds with at least 1 mile flight visibility and having received an air traffic control authorization, may deviate from the prescribed instrument approach procedure and proceed to the airport of destination by visual reference to the surface."
- 9/ Minimum descent altitude as defined in Federal Aviation Regulations Part 1.1: "means the lowest altitude, expressed in feet above mean sea level, to which descent is authorized on final approach or during circle-to-land maneuvering in execution of a standard instrument approach procedure, where no electronic glide slope is provided."

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

/s/ JOHN H. REED  
Chairman

/s/ OSCAR M. LAUREL  
Member

/s/ FRANCIS H. MCADAMS  
Member

/s/ LOUIS M. THAYER  
Member

/s/ ISABEL A. BURGESS  
Member

June 1, 1972

APPENDIX A

INVESTIGATION AND HEARING

1. Investigation

The National Transportation Safety Board received notification of the accident at approximately 1030 on June 7, 1971, from the Federal Aviation Administration Communications Center in Washington, D. C.

An investigative team was dispatched to New Haven, Connecticut, and investigating groups were established for Operations, Air Traffic Control, Weather, Human Factors, Structure, Systems, Powerplants and Aircraft Records.

The Federal Aviation Administration, Allegheny Airlines, Inc., Airline Pilots Association, Convair Division of General Dynamics, Detroit Diesel Division of General Motors, International Association of Machinists, State of Connecticut, and the City of New Haven participated in the investigation as interested parties.

The onscene investigation was completed on June 12, 1971.

2. Hearing and Depositions

A public hearing was held at New Haven, Connecticut, on September 21 to September 24, 1971. Parties to the investigation included the Federal Aviation Administration, Allegheny Airlines, Inc., Airline Pilots Association and the National Weather Service. The State of Connecticut and the City of New Haven were represented by official observers.

A deposition from First Officer James A. Walker was taken at Memphis, Tennessee, on December 6, 1971. All parties to the investigation, with the exception of the National Weather Service, were present at these proceedings. Mr. Walker was represented by personal counsel.

3. Preliminary Reports

A preliminary report of the investigation was released on August 3, 1971, and a summary of testimony taken at the public hearing was released on October 7, 1971.

APPENDIX B

CREW INFORMATION

Captain David Gordon Eastridge, aged 39, had been employed by Allegheny Airlines, Inc., since March 7, 1960. He held Airline Transport Pilot Certificate No. 1294849 with type ratings in Convair 240, 340, 440, Fairchild F-27-227, and Allison Convair 340/440 (Convair 580) aircraft. He was upgraded from first officer to captain on September 25, 1965, and completed his captain's checkout in the Convair 580 on July 14, 1966. His last proficiency check was completed successfully in the Convair 580 on February 3, 1971. On February 25, 1971, he completed satisfactorily a line check in the same equipment.

Captain Eastridge had accumulated approximately 12,107:29 hours of flying time. Of that total an estimated 3,600 hours had been flown in Convair 580 type aircraft. In the 30-, 60-, and 90-day periods prior to the accident, Captain Eastridge had flown a total of 75:23, 80:24 and 79:45 hours, respectively, in Convair 580 aircraft. His FAA First Class Medical Certificate, without limitations, was issued on February 2, 1971.

Captain Eastridge had last completed 15 hours of recurrent ground training on December 16, 1970. Prior to that, on November 10, 1970, he had completed 9 hours of home-study training. On January 5, 1971, he received 2 hours of training in a procedures trainer.

During the period of April 11, 1969, to January 24, 1971, FAA Air Carrier Inspectors submitted 10 En Route Inspection Reports concerning Captain Eastridge's flight performance. All reports showed his performance to be satisfactory. One report contained a comment that Captain Eastridge was advised that he had crossed the outer marker too fast. Another report stated that the noise abatement departure (flown) was outstanding and that a full flap, short-field landing was perfect.

Prior to this flight Captain Eastridge had not performed any flight duties for Allegheny since May 28, 1971.

First Officer James Alford Walker, aged 34, was employed by Allegheny Airlines, Inc., on April 9, 1967. He holds



Commercial Pilot Certificate No. 1528379 with airplane single and multiengine land and instrument ratings. He qualified as first officer on the Convair 580 on April 29, 1967. His last proficiency check was completed satisfactorily on August 13, 1970; and on March 5, 1971, he completed a line check, but did not fly the aircraft during the check. Mr. Walker had accumulated an estimated total of 4,150 hours of flying time to the date of the accident. Of that total an estimated 2,400 hours had been flown in Convair 580 type aircraft. In the 30-, 60-, and 90-day periods prior to the date of the accident, he had flown a total of 75:13, 70:51 and 55:29 hours, respectively, all in Convair 580 aircraft. His FAA First Class Medical Certificate, without limitations, was issued on January 5, 1971.

Mr. Walker had completed 15 hours of recurrent ground training on March 10, 1971. On November 9, 1970, he had completed 9 hours of home-study ground training.

During the period of February 10, 1971, to March 1, 1971, FAA Air Carrier Inspectors submitted four En Route Inspections Reports evaluating flights on which First Officer Walker was a crewmember. All of these reports stated that his performance was satisfactory.

Prior to this flight, First Officer Walker had not performed any flight duties since May 28, 1971.

Flight Attendant Judith L. Manning, aged 27, was employed by Allegheny Airlines, Inc., on June 4, 1964. She last completed recurrent training in both the DC-9 and Convair 580 on January 28, 1971.

APPENDIX C

AIRCRAFT INFORMATION

N3434, Convair 440, S/N 384, was manufactured on November 29, 1956, and delivered to Braniff Airways, Inc. On March 28, 1962, the aircraft was purchased by Allegheny Airlines, Inc., and placed in air carrier service on June 4, 1962, with total airframe time of 13,298:03 hours. Registration No. N5832 was assigned to the aircraft on October 26, 1967.

The airplane was later modified to an Allison Prop Jet Convair CV-580 by Pacific Airmotive Corporation on September 19, 1967, and reentered air carrier service with Allegheny on September 29, 1967, with an accumulated time of 24,652:43 hours. The current airworthiness certificate was reissued for N5832 and dated November 22, 1967.

Total Airframe Time	33,058:55	hrs.
Time Since Conversion	8,406:12	hrs.
Time Since Maintenance Check	358:55	hrs.
Time Since Mid-Period Check	127:55	hrs.
Time Since Service Check	39:55	hrs.

Allison Model 501-D13 engines were installed as follows:

<u>Position</u>	<u>Engine S/N</u>	<u>Date Installed</u>	<u>Time Since Overhaul</u>	<u>Time Since Heavy Maint.</u>
1	501650	1/14/71	7,631:00 hrs.	2913:00 hrs.
2	500911	2/4/71	4,467:00 hrs.	1399:00 hrs.

Aero products propellers Model A 6441FN 606A propellers were installed as follows:

<u>Position</u>	<u>Propeller (Model A6441FN606A)</u>	<u>Time Since Overhaul</u>
1	P1078	6,963:00 hrs.
2	P1069	6,872:00 hrs.

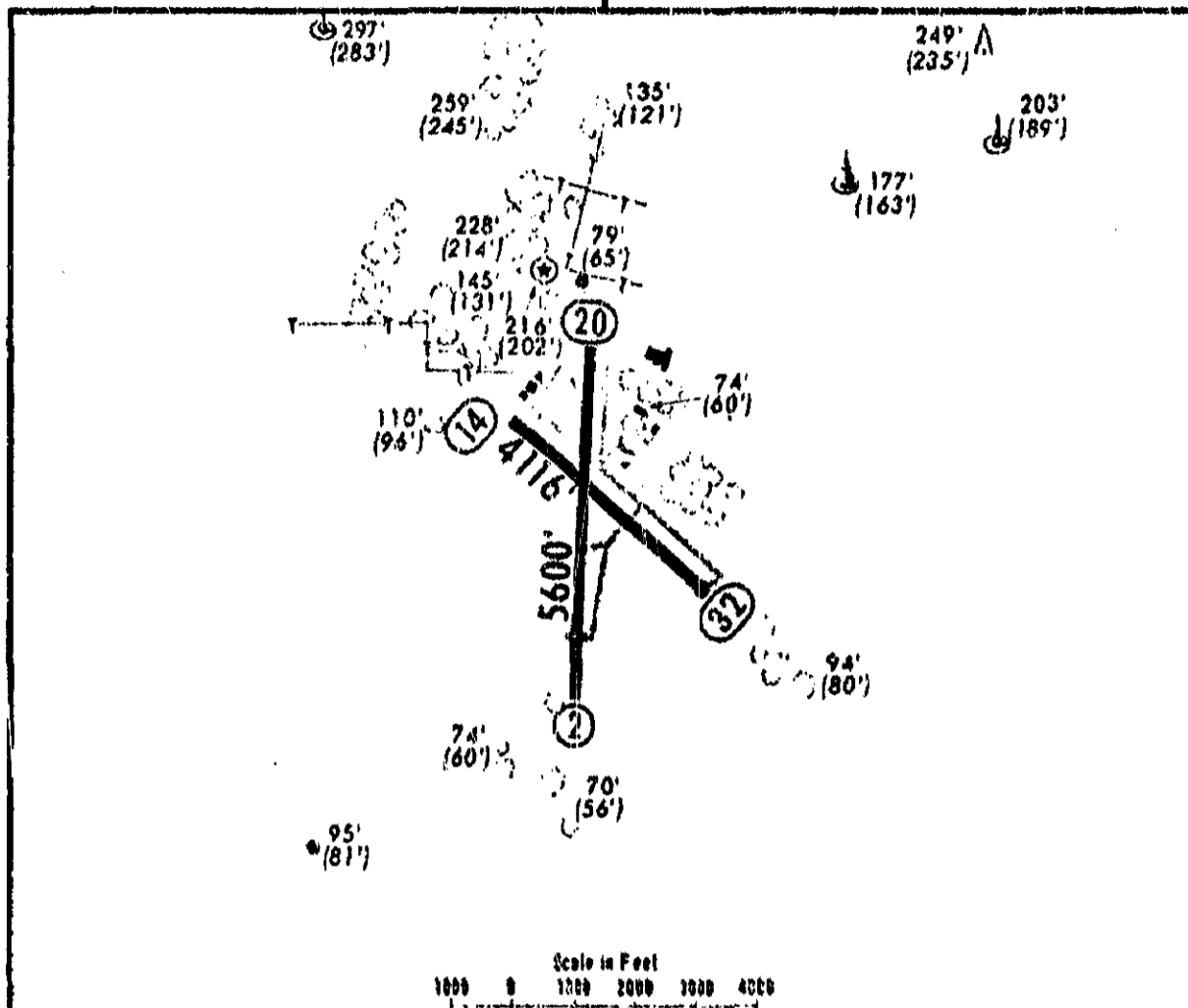
The airplane weighed 46,459 pounds at takeoff from Groton. The takeoff weight and center of gravity were within the allowable limits.

**NEW HAVEN, CONN.**  
**TWEED-NEW HAVEN APT.**  
 Elev 14° 41' 16" N 72° 53' W

13.1 APR 271

Jeppesen Approach Chart

NOTE: Customs on prior request.



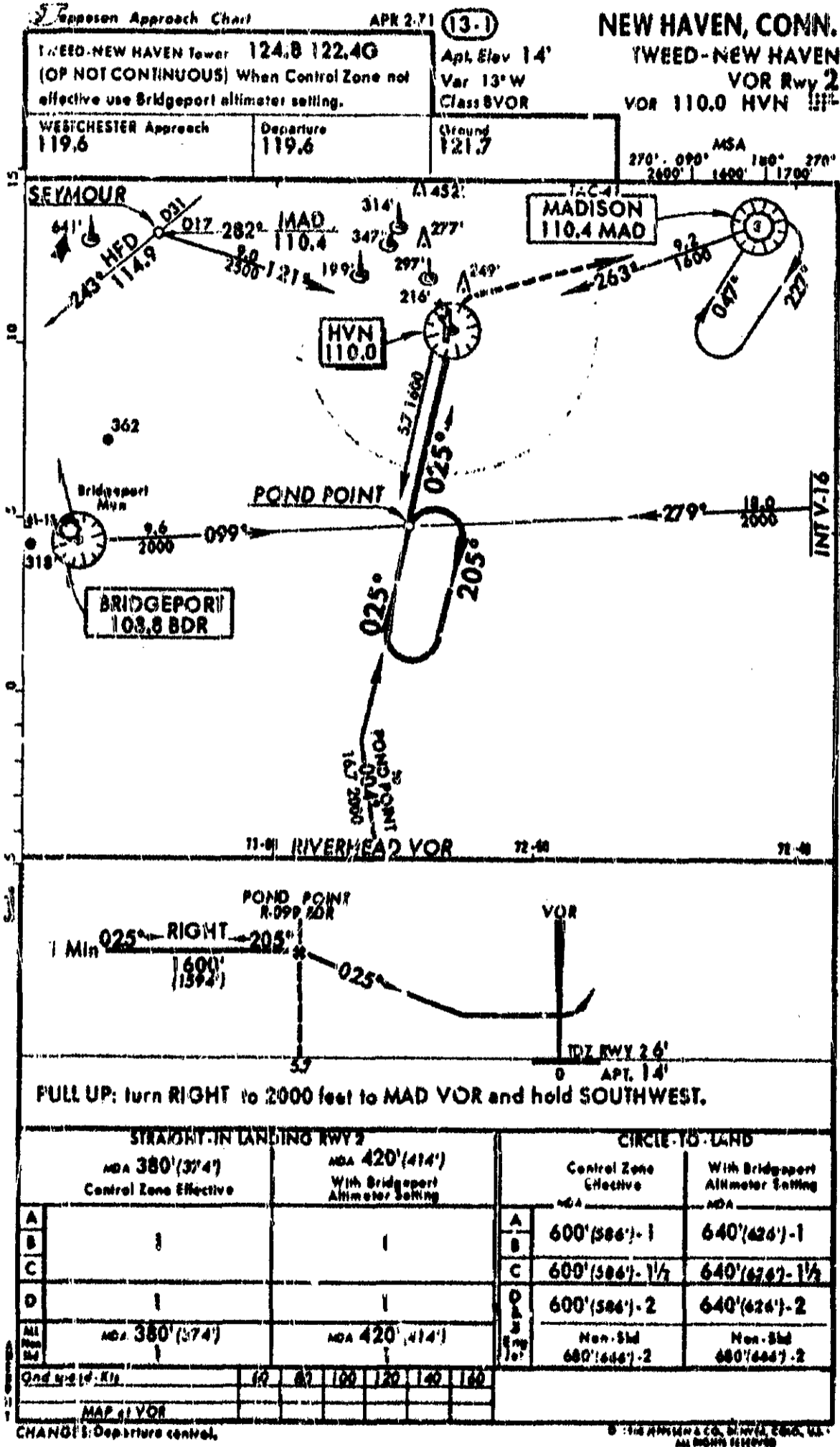
RWY	LIGHTING	LANDING		USEABLE LENGTHS		WIDTH
		Threshold	DAY (NIGHT)	Glide Slope	TAKE-OFF	
2	RL REIL VASI L	4771'	4771'			150'
20	RL					150'
14	RL		NA			150'
32	RL					150'

AIR CARRIER TAKE-OFF				ALTERNATE CEILING-VISIBILITY Authorized Only When Control Zone Effective
TAKE-OFF ALTITUDE FILED WITHIN 15 Min Piston 30 Min Turbine	TAKE-OFF ALTITUDE FILED WITHIN 1 Hr 2 Eng 2 Hr 3 & 4 Eng	TAKE-OFF ALTITUDE NOTIFIED	NOTIFIED	
SCHEDULED	Altitude	Altitude	All Carriers	800-2
2 Eng Turbine	1/2	1	Landing Weather Minimum	
2 Eng Piston	1/4	1		

RE 300 ceiling-1 required twys 2 & 32.

CHANGES: Runway 2 landing length.

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TRANSCRIPTION OF COCKPIT VOICE RECORDING  
ALLEGHENY AIRLINES CONVAIR 580, N5832, FLIGHT 485, JUNE 7, 1971  
NEW HAVEN, CONNECTICUT

LEGEND

NCO = Quonset Point Radar Air Traffic Control Center  
HPN = Westchester Approach Control  
HVN TWR = New Haven Tower  
HVN CO = Allegheny Airlines New Haven  
GON = Allegheny Airlines - New London  
AGENT = Ramp Agent - New London  
AL481 = Allegheny Airlines Flight 481  
CAM = Cockpit Area Microphone voice or sound source  
RDO = Radio transmission from N5832  
-1 = Voice identified as Captain  
-2 = Voice identified as First Officer  
-3 = Voice identified as Stewardess  
-? = Voice unidentified  
\* = Unintelligible word  
# = Non-pertinent word  
% = Break in continuity  
( ) = Speech enclosed in parentheses is subject to further interpretation  
(( )) = Editorial insertion

TIME & SOURCE

CONTENT

1319:39  
NCO Company says there's a mile visibility down there now?  
  
RDO-2 Yes sir, they're givin' a mile  
  
1319:28  
NCO Allegheny four eighty-five roger, cleared for a contact approach, report on the ground at Groton  
  
RDO-2 Okay, cleared for a contact, check with you on the ground  
  
((Final landing checklist))  
  
% % %  
  
((After landing checklist))

<u>TIME &amp; SOURCE</u>	<u>CONTENT</u>
1321:53 GON	Four eighty-five, do you read New London?
RDO-2	Ah, we got you, go ahead
GON	Four eighty-five, you gonna need fuel?
CAM-2	They wanna know if you wanna refuel here
CAM-1	Tell them to stand by one
RDO-2	Yeah, stand by just a minute
CAM-1	An hour and three thousand * * *
RDO-1	You got the late Philly weather handy?
GON	Four eighty-five, stand by
CAM-1	Twenty-one hundred, fifty-one hundred, nine hundred, we got enough if we don't run into any delays (1322:30)
	% % %
1322:57 CAM-1	It looks pretty good down in Philly. I think we're -- that's right
RDO-2	Yeah, we'll have enough fuel
CAM-3	Now how about New Haven?
CAM-1	It's all right now, they got limits
CAM-3	How late are we?
CAM-1	An hour
CAM-3	That's not too bad (1323:34)
	% % %
1323:54 CAM-1	You gonna get us out of here on schedule?
AGENT	Tomorrow
CAM-1	((laughter)) Okay

TIME & SOURCE

CONTENT

CAM-1            You gonna whip us right out?

CAM-1            If you talk to dispatch any time tell 'im we might make up a  
                  little of it going to Philly

CAM-1            We'll make up some of it going to New Haven 'n Philly

CAM-2            Eleven ten to twelve ten to one ten, two, looks like  
                  about two thirteen

CAM-?            (Seventeen)

CAM-1            One thing about it, it was honest ((laughter))

CAM-2            Man, you can't try no harder than that (1324:29)

                  % % %

1325:13  
CAM-1            We ought to be out of here about thirty

                  % % %

1326:05  
CON                Four eighty-five, do you read?

CON                'bout six thousand, you gonna take on any fuel or gonna  
                  go without?

RDO-2            Ah, we, ah, did you get us that late Philly weather there?

RDO-2            I think we got enough to get on down to Philly (1326:22)

                  % % %

1328:04  
CON                Four eight-five, New London

1328:11  
CON                Four eighty-five, New London

                  % % %

                  ((before start check list))

<u>TIME &amp; SOURCE</u>	<u>CONTENT</u>
1332:09 CAM-1	I told him if I could have ((pause)) he wants to go to fifteen late out of Newport News ((pause)) comin' back up
CAM-1	Okay, if I can get us down there in time to get out of there fifteen late then you can get us home on time
CAM-2	You know! (1332:24)  % % %  ((After start checklist))
1333:12 CAM-2	Come on, New London
CAM-1	I reckon they'll have a delay if they're not careful
1334:04 RDO-2	Quonset Approach, Allegheny's, ah, four eighty five's taxiing out of New London
NCO	Allegheny four eighty-five, have your clearance, ready to copy?
RDO-2	Yeah, go ahead
1334:13 NCO	Allegheny four eighty-five is cleared to the Pond Point Intersection via Groton two six seven degree radial to Saybrook, Victor sixteen to intercept the Bridgeport zero nine nine radial to Pond Point, maintain four thousand
1334:27 RDO-2	Understand we're cleared to Pond Point Intersection, that's by the Groton two sixty-seven radial to Saybrook, intercept Victor sixteen and Victor sixteen to intercepting the zero nine nine degree of Bridgeport to Pond Point, maintain four thousand
1334:50 RDO-2	Did you get the readback?
1334:53 NCO	Allegheny four eighty-five roger your readback is correct, you are released



<u>TIME &amp; SOURCE</u>	<u>CONTENT</u>
RDO-2	Rog
1334:58 NCO	And report airborne  % % %  ((before takeoff check list))
1335:33 CAM-2	Four, eight, nine and one twenty-nine  % % %  ((after takeoff checklist))
1337:09 RDO-2	New London, times are twenty-one, twenty-three, thirty-three, thirty-five, put us over at, ah, New Haven, make 'em about, ah, fifty-two
GON	Twenty-one, twenty-three, thirty-three, thirty-five, New Haven at fifty-two, see you later
RDO-2	Okay, we'll see ya (1337:32)  % % %  ((preliminary landing checklist))
1345:17 HPN	And Allegheny four eighty-one, at your nine o'clock position and five miles now is company inbound to New Haven
AL481	Yes sir, we have him
1345:26 HPN	Okay, what's your altitude now, sir?
AL481	Out of three point five
HPN	Okay, fine, thank you
1345:30 AL481	Okay, ah, Gordon, the visibility is good to the north of New Haven
HPN	Fine sir, thank you

<u>TIME &amp; SOURCE</u>	<u>CONTENT</u>
CAM-1	Yeah, that Dave, he keeps, keeps on runnin' ahead of us (1345:41)
	% % %
1345:54 RDO-2	New Haven, four eighty-five in range
HVN CO	Roger, four eighty-five
	% % %
1346:30 CAM-1	When he talks to you again tell him --
HPN	Allegheny four eighty-five descend to one six hundred
1346:35 RDO-2	Okay, we're going down to sixteen hundred, Allegheny four eighty-five
1346:38 CAM-1	-- we'll take a turn-on at Pond Point
1346:38 HPN	Four eighty-five, roger, Bridgeport, make it New Haven weather sky partially obscured, one and three-quarters in fog, wind one eight zero degrees at five, altimeter two nine nine seven
1346:47 RDO-2	Okay sir, and we'll take a turn-on right at the Point if that'll be all right
HPN	Okay, you want to turn right into the airport?
1346:52 RDO-2	Yeah, that'll be okay at, ah, Pond Point be fine
1346:55 HPN	Okay, I didn't get the latter part of that, turn right heading three six zero
1346:59 RDO-2	Three six zero, Allegheny four eighty-five turning

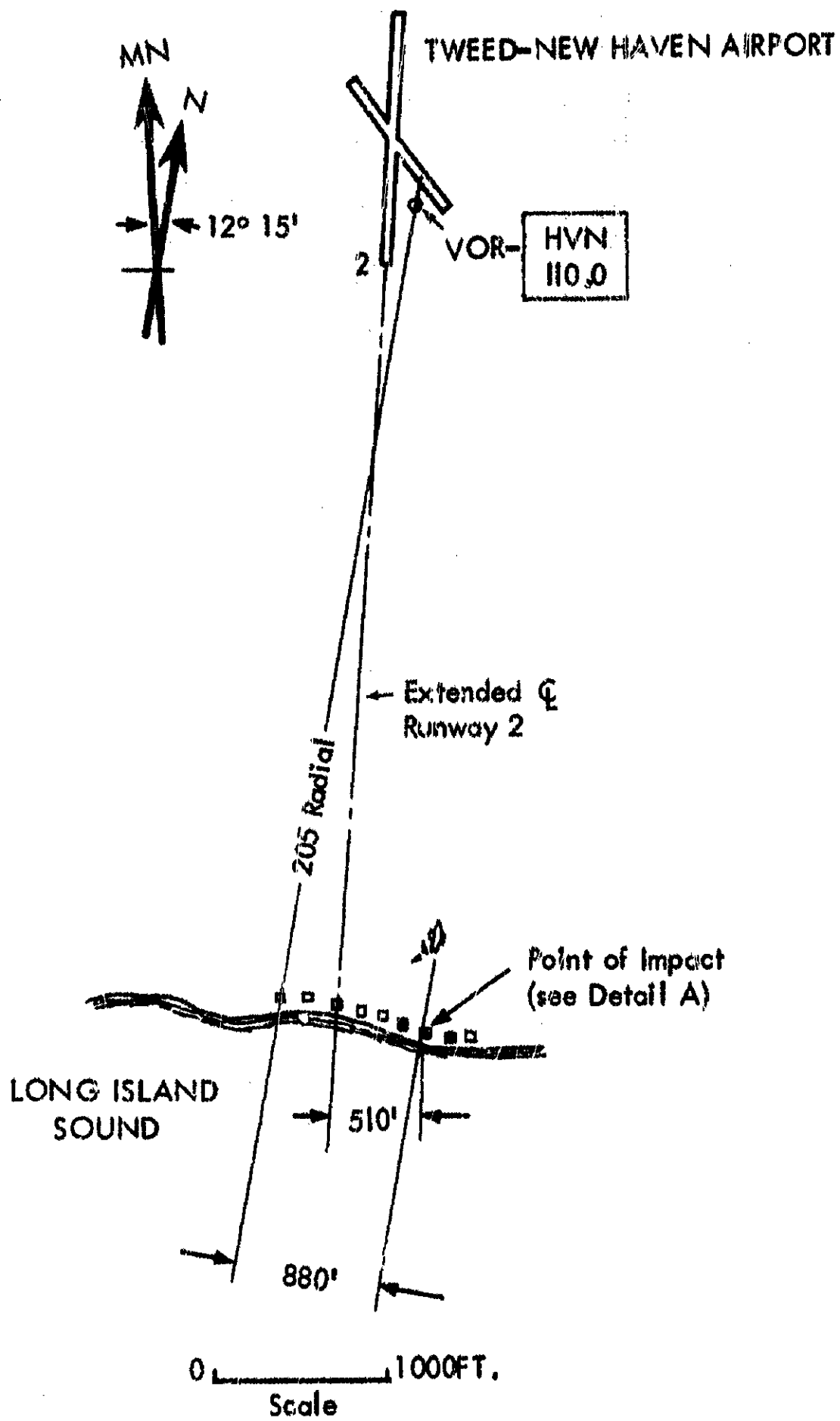
<u>TIME &amp; SOURCE</u>	<u>CONTENT</u>
1347:01 HPN	Okay and you can intercept the final approach course on that heading. You'll be right at Pond Point, you're cleared for a VOR approach
1347:06 RDO-2	Okay thank you sir, cleared for the approach, Allegheny four eighty-five
HPN	Roger, you're welcome
CAM-1	What was that wind, do you remember offhand?
CAM-2	A hundred and eighty at five
1347:25 HPN	Okay and Allegheny four eighty-five contact New Haven Tower one two four point eight now, you're Pond Point inbound
1347:30.1 RDO-2	"kay, twenty-four eight, thank you a lot
HPN	You're welcome, sir
1347:34.7 CAM-1	Before you talk to him, will you give me fifteen and gear down, please?
1347:39.7 CAM	Sound of landing gear in transit
1347:40.4 CAM-2	There ya go
1347:47-9 RDO-2	New Haven Tower, Allegheny four eighty-five is, ah, passin' the point comin' inbound
1347:53.9 HPN TWR	Roger, four eighty-five, runway your choice, sir, the wind on nine zero degrees at five, altimeter two niner niner six, runway two or twenty
1348:01.1 CAM-1	Well, tell him, ah, well that's all right, we'll take two (for the approach runway)

<u>TIME &amp; SOURCE</u>	<u>CONTENT</u>
1348:04.7 RDO-2	Okay, the way it looks we'll take two be all right
1348:07.5 HVN TWR	Roger, cleared to land runway two
1348:09.7 RDO	Sound of two microphone clicks
1348:11.2 CAM-1	Out of a thousand
1348:11.4 CAM-2	Twenty-four?
1348:17.9 CAM-1&2	* * * * * gear down ((final checklist items, challenge and response, both voices simultaneously))
1348:22.6 CAM-1	Give me forty
1348:29.4 CAM-1	I'm tellin' you
1348:32.2 CAM-2	Out of five hundred
1348:34.2 CAM-2	Looks about a hundred feet atop
1348:35.3 CAM-1	They sure do
1348:37.0 CAM-?	Not very good, is it?
1348:42.4 CAM-2	Top minimums ((pause)) I don't have it
1348:44.8 CAM-2	Decision height
1348:52.9 CAM-2	You got a hundred and five, sinkin' five
CAM-1	All right

TIME & SOURCE

CONTENT

1348:56.6 CAM-1	Keep a real sharp eye out here
CAM-2	Okay
1349:10.7 CAM-2	Oh, this * is low
1349:14.3 CAM-2	You can't see down through this stuff
1349:20.5 CAM-1	I can see the water
1349:22.1 CAM-1	* I got straight down
1349:23.8 CAM-2	Ah, yeah, I can see the water. We're right over the water
1349:26.2 CAM-2	Man, we ain't twenty feet off the water
1349:29.9 CAM-2	Hold it
1349:30.9 CAM	Sound of impact
1349.31.1	End of recording



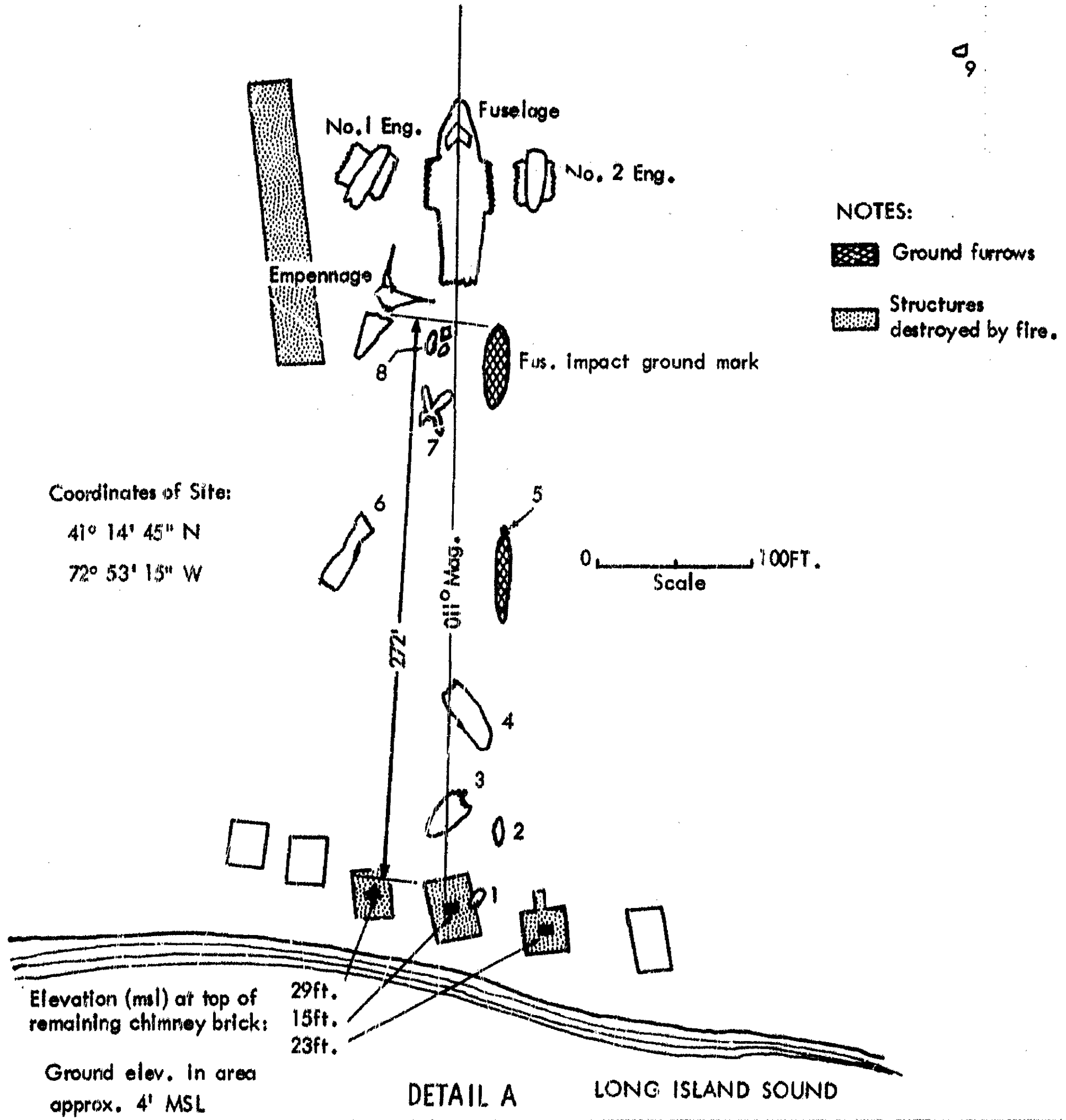
Coordinates of Site  
 41° 14' 45" N  
 72° 53' 15" W

Elevation (msl) at top of remaining chimney  
 59.1  
 Ground elev. in approx. 4' MSL

59.1

REPORT

09



Coordinates of Site:  
 41° 14' 45" N  
 72° 53' 15" W

NOTES:  
 [Symbol] Ground furrows  
 [Symbol] Structures destroyed by fire.

0 100FT.  
 Scale

Elevation (msl) at top of remaining chimney brick:  
 29ft.  
 15ft.  
 23ft.

Ground elev. in area approx. 4' MSL

DETAIL A LONG ISLAND SOUND

10

# APPENDIX F

D  
9

## NOTES:

 Ground furrows

 Structures destroyed by fire.

ground mark

## LEGEND

1. Propeller blade R4.
2. Propeller blade R3.
3. Section of right-hand outboard wing and aileron.
4. Section of left-hand outboard wing and aileron.
5. Landing gear microswitch.
6. Section of right-hand outboard wing and outboard wing Flap
7. No. 1 engine propeller gear case and blades L1, L3 and L4.
8. Piece of right-hand inboard flap; removable section of dorsal fin, piece of aft fuselage skin with tail skid attached.
9. No. 2 engine propeller spinner.
10. No. 2 engine propeller gear case and blade R2.

100FT.  
Scale

**NATIONAL TRANSPORTATION SAFETY BOARD**  
Washington, D.C.

**WRECKAGE DISTRIBUTION CHART**  
**ALLEGHENY AIRLINES**  
**CONVAIR 580, N 5832**  
**NEW HAVEN, CONNECTICUT**  
June 7, 1971

ISLAND SOUND

57.3



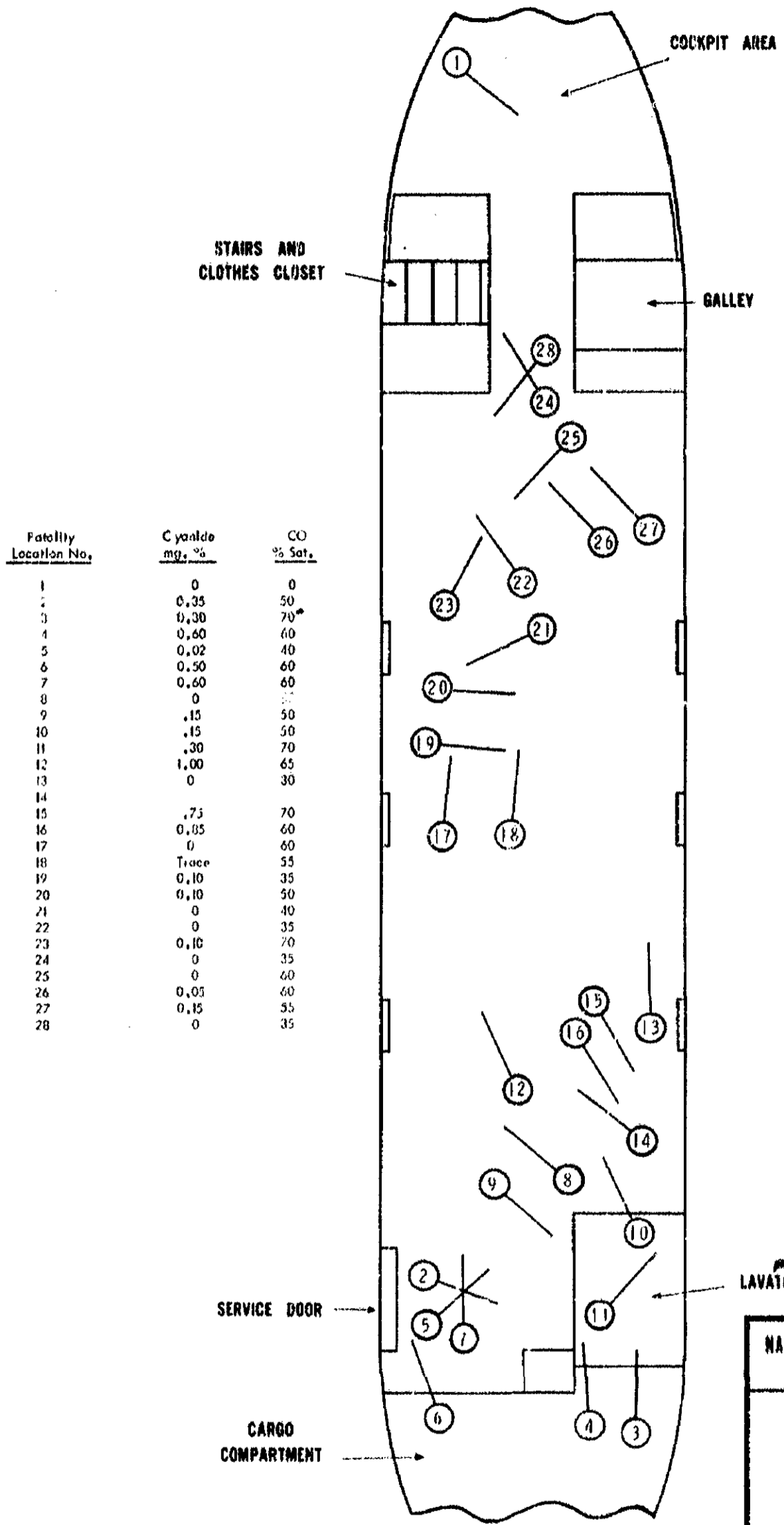
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APPENDIX I



Fatality Location No.	Cyanide mg. %	CO % Sat.
1	0	0
2	0.35	50
3	0.30	70
4	0.60	60
5	0.02	40
6	0.50	60
7	0.60	60
8	0	55
9	.15	50
10	.15	50
11	.30	70
12	1.00	65
13	0	30
14		
15	.75	70
16	0.05	60
17	0	60
18	Trace	55
19	0.10	35
20	0.10	50
21	0	40
22	0	35
23	0.10	70
24	0	35
25	0	60
26	0.03	60
27	0.15	55
28	0	35

APPENDIX G

NATIONAL TRANSPORTATION SAFETY BOARD  
WASHINGTON D.C. 20591

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FATALITY LOCATIONS / CYANIDE  
AND CARBON MONOXIDE LEVELS

ALLEGHENY AIRLINES CONVAIR 580  
N5832, FLIGHT 485, JUNE 7, 1971  
NEW HAVEN, CONNECTICUT

UNITED STATES OF AMERICA  
NATIONAL TRANSPORTATION SAFETY BOARD  
WASHINGTON, D.C.

ISSUED: November 12, 1971

Adopted by the NATIONAL TRANSPORTATION SAFETY BOARD  
at its office in Washington, D. C.  
on the 3rd day of November 1971

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FORWARDED TO:

Honorable John H. Shaffer  
Administrator  
Federal Aviation Administration  
Washington, D. C. 20591  
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SAFETY RECOMMENDATION A-71-59

During public hearings which were convened in the matter of the Allegheny Airlines and Capitol International Airways accidents, the National Transportation Safety Board obtained extensive expert testimony from the Federal Aviation Administration and from the U.S. Army Mobility Research Laboratory Staff pertaining to the technological advances in the field of in-flight and postcrash fuel system fire safety. The Board is most encouraged by these advances and the capability of industry to apply this technology to present and future aircraft.

Technology available today provides a wide scope of improvements in the fuel system fire safety field. Some systems, oriented primarily toward prevention of postcrash fires, are in successful use by the U.S. Army and have saved untold numbers of lives. Other systems such as the Parker liquid nitrogen fuel tank inerting system is most effective in preventing fuel system vapor explosions with the fuel tank system relatively intact.

The Safety Board is aware of the concerted efforts and programs that the Federal Aviation Administration has been engaged in over the past 8 years to promote the development of various explosion and fire prevention systems. The Board has on a regular basis observed, and highly commends the activities of the Advisory Committee on Fuel System Fire Safety which is operating under the chairmanship of Mr. Robert Auburn of your Flight Standards Service. We feel that significant advances in the field of both in-flight and postcrash fuel system fire

safety have been made as a result of this committee's work as well as the research and experience gained by the U.S. Army. Particularly encouraging is the operation of your DC-9 aircraft with an operationally functional explosion/fire suppression system.

Our current investigation of an accident involving an Allegheny Airlines Convair 580, N5832, which occurred at New Haven, Connecticut, on June 7, 1971, produced evidence that possibly as many as 27 of the 28 persons fatally injured survived the initial crash impact. We have witness reports and corroborative medical data to show that time for a successful evacuation of survivors was drastically limited by fire and smoke as well as by explosions which rapidly expanded the fire.

A similar obstacle to survival was found to be present in the case of a takeoff accident involving Capitol International Airways, Douglas DC-8-63, N4909C, at Anchorage, Alaska, on November 27, 1970. Forty-seven of the 229 persons aboard this aircraft perished. Again in this case, initial crash injuries were of a survivable nature, but the inability to escape the rapidly propagating fire proved fatal.

The Board, therefore, recommends that:

The Federal Aviation Administration initiate action to incorporate in its airworthiness requirements, a provision for fuel system fire safety devices which will be effective in the prevention and control of both in-flight and postcrash fuel system fires and explosions. It is further recommended that rulemaking action in this matter specifically apply to future passenger-carrying aircraft in the transport category, and that consideration be given to an adaptation to all other passenger-carrying aircraft now in service.

This recommendation will be released to the public on the issue date shown above. No public dissemination of the contents of this document should be made prior to that date.

Reed, Chairman; Laurel, Thayer, and Burgess, Members, concurred in the above recommendation; McAlams, Member, dissented.

  
By: John H. Reed  
Chairman

DEPARTMENT OF TRANSPORTATION  
FEDERAL AVIATION ADMINISTRATION

APPENDIX I

WASHINGTON, D.C. 20590



OFFICE OF  
THE ADMINISTRATOR

12 November 1971

Honorable John H. Reed  
Chairman, National Transportation Safety Board  
Department of Transportation  
Washington, D.C. 20591

Dear Mr. Chairman:

This will respond to your Safety Recommendation A-71-59 adopted 3 November 1971 concerning safety devices for enhancing survivability during in-flight and postcrash fires.

Your recommendation deals with the specific goal of preventing and controlling fuel system fires and explosions. We have been working toward this safety objective, recognizing that protection against the occurrence of fire and explosion, whatever the ignition source, would be an important safety improvement.

A key element in our program is the operational evaluation of a protective system in our DC-9 aircraft being utilized for pilot training. Shortly after 1 January 1972, it is anticipated that the accumulated data and information on system reliability, maintainability, and operating costs will be reviewed and discussed with interested industry segments under the auspices of the Advisory Committee on Fuel System Fire Safety. We welcome participation by members of your staff.

Following these coordinating actions, we will develop a course of action regarding rule promulgation, both with respect to new transport category aircraft and passenger-carrying aircraft in service.

Sincerely,

A handwritten signature in cursive script that reads "K M Smith".

K. M. Smith  
Acting Administrator



**NATIONAL TRANSPORTATION SAFETY BOARD**  
**DEPARTMENT OF TRANSPORTATION**  
WASHINGTON, D.C. 20591

**OFFICE OF  
THE CHAIRMAN**

C O

November 10, 1970

P  
Y

Honorable John K. Shaffer  
Administrator  
Federal Aviation Administration  
Washington, D. C. 20590

Dear Mr. Shaffer:

This is in reference to the Notice of Proposed Rule Making 70-35--  
Flight Attendants, which would amend Section 121.391(a) of the Federal  
Aviation Regulations to allow a higher ratio of seating capacity to  
number of attendants.

The National Transportation Safety Board believes that the proposed  
change decreases the potential safety level inherent in the present  
regulation. Appropriate data is lacking in the proposal to permit the  
determination of whether this safety degradation is acceptable.

The justification for the NPRM is based on the premise that enough  
improvements have been made in crashworthiness and evacuation provisions  
to allow the change. The Board agrees that these improvements have  
been considerable. However, these improvements were designed to correct  
proven and anticipated deficiencies rather than to justify a reduction  
in the attendant requirements.

The question is, then, have the improvements been of sufficient  
magnitude that enough additional safety "fallout" has occurred to allow  
the reduction in attendant requirements? We have made no appropriate  
study, nor are we aware of any such study that forms a basis for answer-  
ing this question. Further, since the application of current crash-  
worthiness regulations, there have been no accidents involving improved  
aircraft to provide data upon which to base such a proposed change.

In view of the foregoing, the Board recommends that:

The proposed rule change not be effected at this time;  
instead, the present partial exemption should be extended  
for a period of time during which a program for collection  
of appropriate data can be accomplished.

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Honorable John H. Shaffer

The Board suggests a program to include further analysis of existing accident data as well as controlled studies concerning passenger loads and their effect on attendants' service workload, on attendants' routine safety procedures, and on attendants' ability to handle various emergency procedures. Such a program should also include a study, under your auspices, of attendant redundancy (more than one attendant) as a factor in ensuring availability of leadership in response to emergency situations.

Sincerely yours,

/s/ John H. Reed  
Chairman