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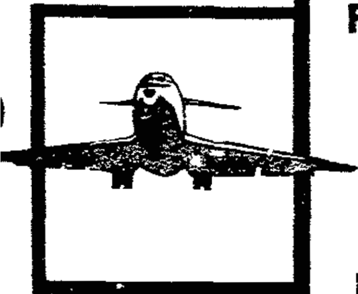

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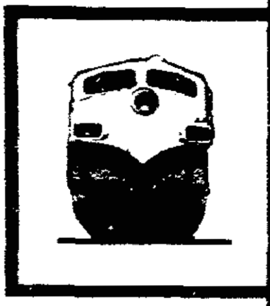
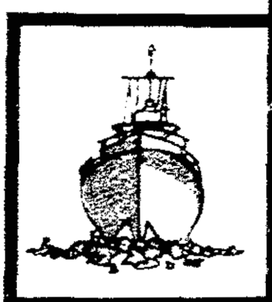
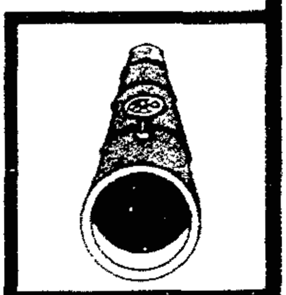


WASHINGTON, D.C. 20594



AIRCRAFT ACCIDENT REPORT

REEVE ALEUTIAN AIRWAYS
NIHON YS-11A, N169RV
KING SALMON, ALASKA
FEBRUARY 16,1982



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6. Abstract

About 0905, Alaska standard time, on February 16, 1982, Reeve Aleutian Airways, Inc., Flight 69, a Nihon YS-11.4, N169RV, with 36 passengers and 3 crewmembers onboard, made an emergency gear-up landing on the frozen Naknek River adjacent to the King Salmon Airport, King Salmon, Alaska, following the loss of power in both engines. The aircraft was damaged substantially, and one crewmember, two passengers, and two firefighters suffered minor injuries during the evacuation, firefighting, and rescue activities.

The National Transportation Safety Board determines that the probable cause of this accident was the loss of power in the right engine due to the freezing of water in the fuel filter after the fuel heaters were turned off in accordance with the before-landing checklist, and the loss of power due to the destruction of the left-engine turbine from overtemperature due to excessive fuel flow for undetermined reasons.

7. Key Words

fuel; water in fuel; fuel heat; engine failure: gear-up landing

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CONTENTS

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C. 20594

AIRCRAFT ACCIDENT REPORT

Adopted: November 30,1982

REEVE ALEUTIAN AIRWAYS, INC.
NIHON YS-11A, N169RV
KING SALMON, ALASKA
FEBRUARY 16,1982

SYNOPSIS

About 0905, Alaska standard time, on February 16, 1982. Reeve Aleutian Airways. Inc., Flight 69, a Nihon YS-11A, N169RV, with 36 passengers and 3 crewmembers onboard, made an emergency gear-up landing on the frozen Naknek River adjacent to the King Salmon Airport, King Salmon, Alaska, following the loss of power in both engines. The airplane was damaged substantially, and one crewmember, two passengers, and two firefighters suffered minor injuries during the evacuation, firefighting, and rescue activities.

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1. FACTUAL INFORMATION

1.1 History of the Flight

On February 16, 1982, Reeve Aleutian Airways, Inc., (Reeve) Flight 69 a Nihon YS-11A (N169RV), was operating as a scheduled passenger and cargo flight from Anchorage to Cold Bay, Alaska, with intermediate stops at King Salmon and Dutch Harbor, Alaska. The airplane had been in a hangar at Anchorage all day February 15. While in the hangar, the fuel sumps were drained and no water was found. At 0600 1/ on February 16, the aiplane was moved to gate 18 at Anchorage International Airport where it was fueled with 901 gallons of Jet A fuel. After refueling. the fuel sumps were drained again and no water was found. The total fuel onboard was 1,355 gallons.

Flight 69 received an instrument flight rules (IFR) clearance to King Salmon, taxied from the gate at 0751, and 4 minutes later departed runway 32. The weather at departure was 1,200 feet overcast, 5 miles visibility in light snow, temperature -5° F, (-20.6 C), wind less than 10 knots, and altimeter 28.96 inHg.

1/ All times are Alaska standard, based on the 24-hour clock.

During the climb to the assigned altitude of 12,000 feet, 2/ the flightcrew requested and was cleared to 14,000 feet. Shortly after passing 10,000 feet, the flightcrew noticed that the outside air temperature was lower than temperatures they were accustomed to seeing at thst altitude. At that time, the fuel heater switches were moved by the first officer from the normal to the manual position. The flightcrew confirmed a rise in fuel temperature on the fuel temperature indicator. After reeching 14,000 feet, they noted that the indicated outside air temperature was -37° C (-34.6° F).

Flight 69 remained at cruise altitude, 14,000 feet, for about 45 minutes. The weather during the flight was thin stratus clouds with no icing. although the outside air temperature was about -35° C to -40° C (-31° F to -40° F). When the airplane was about 50 miles from King Salmon, Ring Salmon approach control cleared the flight to descend to 7,000 feet. A constant power setting and airspeed of 240 knots were maintained during descent from 14,000 feet to 7,000 feet. The flight was leveled at 7,000 feet for about a minute and then was cleared to descend to 5,000 feet. The flightcrew initiated the descent and approach check, and the captain began to slow the aircraft. He stated that he set the power at 12.300 rpm and 850 pounds per hour fuel flow. As the flight neared 5,000 feet, approach control cleared it for a visual approach to the airport.

At 0900:30, as the airplane descended through 2,600 feet, the first officer contacted the King Salmon Tower and reported that the flight was on a right base leg for runway 29. The tower reported the winds, reported Flight 69 In sight, and cleared the flight to land. At that time, the first officer began to perform the before-landing check. He stated that his normal procedure was to move the high-pressure (HP) cock levers to the high stop withdrawal (HSWL) position, turn off the fuel heaters, and scan the engine instruments. He stated that immediately after turning off the fuel heaters, he looked at the engine instruments and saw that the torque pressure indication for the No. 2 fright) engine was 40 psi and that the fuel flow indication was well below 500 pounds per hour. Normal indications for the throttle position of 12,500 rpm would have been a torque pressure of 100 psi and a fuel flow of 850 pounds per hour. He said that at that tine he did not associate the loss of torque and fue! flow with his previous actions during the before-landing check. The first officer also stated that neither the fuel filter differential pressure warning lights nor the low fuel pressure warning lights were illuminated.

About the same time, ?he captain, who was flying the airplane. felt the airplane yaw to the right. At 0901:51, the firs' officer advised the captain, "we've lost one." The captain advanced the right-engine throttle, but the engine did not respond. He turned on both "relight" switches and again advanced the throttle, but the engine did not respond. He determined that the altitude, airspeed, and position were adequate for a single-engine approach and landing, and feathered the propeller and shut down the right engine, using manual feather procedures. He stated that he believed it was better at the time to eliminate the drag and adverse lateral control problems rather than attempt a restart because he believed he could easily make the airport. The first officer confirmed that the propeller had feathered and, at 0902:14, he advised the tower of the situation and requested that emergency equipment stand by. At 0902:18, the captain said, ". . . we're losing the other one." Four seconds later. he called for the gear down. The first officer selected gear down and confirmed the gear down indication as the captain began a turn onto final. The captain stated that he could not recall if he moved the left-engine (No. 1) throttle before or after the right propeller was feathered and he noticed a problem with the left engine. He stated, however, that he anticipated the need for a power increase when the gear wes extended. Both crewmembers stated that they could not recall if the indicating lights, which show that the propeller high stop is withdrawn, were illuminated when the engine problems occurred.

2/ All altitudes are above mean sea level.

Shortly after the gear was lowered, and as the captain was turning the airplane from base leg to final, he heard several sounds he described as popping noise, and smelled smoke. He noted large fluctuations in the left-engine fuel flow, roughly centered around 1,000 pounds per hour, and he felt the airplane yaw to the left. The Ieft engine began to lose power, and the captain ordered the first officer to try to restart the right engine. The first officer moved the high-pressure cock lever for the right engine forward and started to push the feather button to unfeather the propeller. He stopped the procedure, however, because the airplane was about to land on the ice.

According to the captain, as the rate of descent increased, he realized that the airplane would not reach the airport. He then decided to land on the frozen Naknek River, which is adjacent *to* the south edge of the airport, and he made a left turn to align the airplane with the river. While descending to land *on* the frozen river, the captain called for the gear to be retracted and elected to feather both propellers. He stated that when he reached to move the high-pressure cock levers to feather, they were **both** forward in the withdrawal position.

The airplane touched down on the ice before the gear was fully retracted, gradually settled onto the ice as the gear retracted, and then siid for about one-half mile. Both crewmembers stated that there was no fire warning until the airplane was on the ice. The captain ordered all fire extinguishers discharged after the airplane touched down. When the airplane stopped, the captain ordered an evacuation and secured the cockpit. The first officer and flight attendant directed the evacuation through the aft cabin door on the right side. When the captain left the cockpit? he encountered some passengers having difficulty attempting to open the right overwing exit. The captain opened the exit and assisted passengers through it.

Airport firefighters arrived shortly after the airplane stopped and extinguished the fire in the lef t-engine nacelle.

The emergency landing occurred during the hours of daylight at a location of 58°34'53" **N** and 156°39' W.

12 Injuries to Persons

	Crew	Passengers	Other	Total
Fatal	0	0	0	0
Serious	0	0	0	0
Minor	I	a	2	5
None	2	34	0	36
Total	3	36	2	41

1.3 Damage to Aircraft

Impact damage to the airplane was limited mainly to the lower fuselage surface between fuselage stations **F.S. 5,300** and **8,500.** 3/ The fuselage skin in this area was scraped and buckled, but had not been torn from the structure. The rotating beacon

3/ Fuselage station measurements are based on the metric system and are given in centimeters. Fuselage station (F.S.) 0 is located at the longitudinal midpoint of the fuselage. Negative numbers denote sta ons forward of F.S. 0, and positive numbers denote stations aft of F.S. 0.

and several antennas were broken and bent. The auxiliary power unit (APU) exhaust cowling and air conditioning scoop, located forward of this section, were crushed upward 3 to 6 inches. The right wing fairing above the APU was crushed upward 3 to 5 inches. The nosegear doors were crushed somewhat, and there was a 3-inch buckle in the lower fuselage skin forward of the cargo compartment access door at F.S. -9,900.

Several 3- to 5-inch chordwise scratch narks were found in the paint near the left wingtip trailing edge. There was no other damage to the wings.

The left stabilizer top surface was buckled beginning aft of the leading edge deicing boat and running inboard at 45° to the chord, ending at the stabilizer trailing edge. The buckle was deepest--about 3 inches--at the traiiing edge. Scratch marks 5 to 10 inches long were found on the lower surface at the tip, running in a chordwise direction. The flaps and flight control surfaces were not damaged.

On the left propeller, all four blade tips were curled back in a direction opposite the normal direction of rotation. The left-engine turbine section showed evidence of extreme overtemperature. In all three stages, the nozzle guide vanes and the turbine blades were burned and melted. All the discs were intact, and all blade roots remained mounted in the discs. The turbine exhaust duct was melted through on the inboard side. The left nacelle inboard cowling had been discolored by heat and, in an area adjacent to the turbine section, the fire had burned through the cowling.

The right propeller was in the feathered position. Two of the four blade tips were bent and curled aft and opposite the direction of normal rotation. The right engine and nacelle were not damaged.

1.4 *Other* Damage

None.

1.5 Personnel Information

The captain and first officer were properly certificated and qualified for the flight in accordance with Federal Aviation Administration (FAX) regulations. There was one flight attendant aboard the airplane. (See appendix B.)

1.6 Aircraft Information

The airplane, a Nihon YS-11A-600, was certificated: equipped, and maintained in accordance with FAA requirements. It was equipped with two Rolls Royce Dart 542-10K engines and two Dowty-Roto! R209/4-40-4 propellers. The gross weight at takeoff was 54,220 pounds, and the center of gravity was within limits. A: takeoff, there were 8,800 pounds of Jet A fuel onboard. (See appendix C.)

1.7 Meteorological Information

The surface weather observation for King Salmon Airport at 0910 was: 5,000 feet scattered clouds, visibility 15 miles, temperature -15° F (-26° C), dewpoint -31° F, wind 330° at 12 knots, altimeter setting 29.32 inHg.

1.8 Aids to Navigation

There were no reported difficulties with aids to navigation.

19 Communications

There were no reported communications difficulties.

1.10 Aerodrome Information

King Salmon Airport is a joint-use civilian and military airport, with air traffic control provided by the FAA, and firefighting and rescue services provided by the United States Air Force. It has two asphalt-paved runways--runway **11/29** and runway **18/36.** Runway **11/29** is 8,500 feet long and **150** feet wide. Runway **18/36** is **4,994** feet long and 100 feet wide. The airport elevation is **57** feet. It is bounded on the south and west **by** the Naknek River.

11 Flight Recorders

N169RV was equipped with a Sundstrand model **FA-542** flight data recorder (FDR), serial No. **4343.** The recorder and foil recording medium were not damaged, and all parameter and binary traces were active with no evidence of recorder malfunction. An error was discovered in the calibration data for the indicated airspeed above 200 knots, which caused certain recorded airspeed values to **be** above the maximum permitted operating speed of the airplane. When the calibration error was corrected, the airspeed values were found to be within the normal range.

A readout was made of the last **15.5** minutes of recorded data beginning at cruise altitude about 1 minute before the start of descent.

N169RV was also equipped with a Sundstrand model **V557** cockpit voice recorder (CVR). The tape recording quality was poor because of varying recorder drive motor speed and electronic distortion. Because of the speed variations, real times could not be measured, which caused a time discrepancy between the CVR recording and the air traffic control tower recording of communications. The electronic distortion prevented any engine sounds from being identified either audibly or eiectronically. (See appendix D.)

A correlation between the FDR and **CVR** readouts showed that the indicated airspeed during the first part of the descent was about 240 knots. After the airplane passed through 5,000 feet, its airspeed decreased and remained steady at about 210 knots until the airplane leveled at about 1,800 feet. The airspeed then began decreasing. When the flightcrew first noticed the low torque of the right engine, the airspeed was decreasing through **188** knots and the altitude was slightly less than 1,800 feet. When the captain first noted the problems with the left engine, the airspeed was about 165 knots at 1,800 feet. After the captain told the first officer "...we're losing the other one" at 0902:18, he called for gear down. The first officer confirmed "gear down and three green" 20 seconds later, and **then** radioed the control tower that Flight 69 was turning final at 0902:47. The order to attempt to restart the right engine was given at 0903:17, **59** seconds after the captain first noted the problem with the left engine. Twenty-three seconds later, the sound of the ground proximity warning began, and 13 seconds later, the recording ended.

1.12 Wreckage and Impact Information

The airplane was landed under control, with the landing gear retracting but not fully **up** and locked, OR the frozen Naknek River. It slid about one-half mile and came to rest on a magnetic heading of 270°. The ice was about **3** feet thick, and although the surface cracked, it remained solid and intact and supported the airplane.

The most prominent marks on the ice were made by the propeller blades, the auxiliary power unit enclosure, and the landing gear doors. Pieces of the rotating beacon, mounted under the fuselage, were found along the landing path on the ice.

1.13 Medical and Pathological Information

One passenger injured his knee while leaving the airplane through the right overwing exit; the injury was aggravated when he slipped *on* the ice outside the airplane. Another passenger suffered minor frostbite on one hand, and the first officer received minor frostbite on both ears. The passengers were treated at the scene and released. The first officer received treatment in Anchorage. Two U.S. Air Force firefighters suffered minor frostbite to their faces.

1-14 Fire

Fire began in and was confined to the left-engine turbine section, turbine exhaust duct, and nacelle cowling. The crew stated that there was no fire warning until after the airplane was on the ice. The captain stated that he did not see fire or smoke until the airplane came to rest and he was securing the cockpit. However, he smelled smoke shortly after he noted the large fuel flow fluctuations of the left engine while still airborne.

During the landing and slide on the ice, the captain ordered the first officer to discharge the nacelle fire extinguishers, both left and right. The first officer complied with this order.

A small fire continued in the left nacelle after the airplane came to rest. It was extinguished by U.S. Air Force firefighters, using two 18-pound, dry chemical extinguishers.

1.15 Survival Aspects

This was a survivable accident.

Passengers had been briefed orally before takeoff on the locations of the emergency exits. A printed card with small, unlabeled diagrams of an exit door and window was available to passengers. Instructions for operating the exits were in written form only. During the emergency evacuation, the passengers were not able to operate the right overwing exit. When the captain entered the passenger compartment, he opened the exit and assisted the passenger evacuation. The captain, who was familiar with the operation of the exit, reported that he experienced no difficulty in operating it.

Examination of the right overwing exit revealed that the operating instructions on the exit placard were simple and clearly stated. The instructions were as follows:

TAKE OFF THIS COVER
RELEASE CATCH
PULL HANDLE
THROW DOOR OUT

However, Safety Board investigators found that when they followed the placarded instructions, it was difficult to locate the catch referred to in the instructions, because both the handle and catch were painted the same color. In addition, neither the handle nor the catch was labeled. The exit operated without difficulty once the catch was located and released.

1.16 Tests and Research

1.16.1 Engine Examination and Tests

Both engines were removed from the airplane and taken to the Rolls Royce (Canada), Lachine, Quebec, Canada, manufacturing facility for examination and testing under the supervision of a Safety Board investigator.

Examination of the left engine confirmed that all three turbine stages and their associated nozzle guide vanes were melted and burned away. The fuel nozzles and flame tubes from the combustion chambers showed evidence of abnormally high temperatures The low-pressure and high-pressure compressors and gearboxes were not damaged and were in good condition. The fuel pump and fuel control unit from the left engine were run on a test bench, and they performed satisfactorily. Before the test, the residual fuel was removed from both units for laboratory analysis. A quantity of water was found in the fuel control unit and evidence of corrosion was found inside the magnesium housing.

The right engine was not damaged. It was installed in a test stand and a normal "as received" test run was accomplished. Engine operation and performance were satisfactory during this test. Following the test, the combustion section was disassembled and examined. Some normal wear and cracking were found in two flame tubes and some first-stage nozzle guide vanes. The fuel pump and fuel control unit also were run on a test bench, and they performed satisfactorily.

1.16.2 Propeller Examination and Test

Both propeller assemblies were taken to the manufacturer's facility in Sterling, Virginia, for examination under the supervision of a Safety Board investigator. The hub and pitchlock assemblies of both propellers were functionally tested in accordance with Dowty Rotol standard test procedures Both units functioned satisfactorily, and no malfunctions or defects were found in the pitchlock assemblies. The electrical brushes, backplates, and hub switches were checked electrically and found to be satisfactory. Both propeller control units were functionally tested and found to perform satisfactorily.

1.16.3 Airplane Electrical System

Electrical continuity checks were performed on the propeller cruise pitch stop withdrawal circuits for both engines following recovery of the airplane and its transfer to the ramp at King Salmon airport, but before the engines and propellers were removed. These included checks of the circuits for the warning and indicator lights in the cockpit. The only discrepancy noted was in the burned area of the left-engine wire bundle adjacent to the turbine section. The circuits on both sides of this burned area tested satisfactorily.

1.16.4 Fuel Samples and Analyses

Fuel samples were taken from fuel filters of both engines and from all the fuel tank sump drains while the airplane was outside in below-freezing temperature. These samples were taken on *the* second day following the accident while the airplane was still on the ice, in a left wing-down position. Ambient air temperature had not risen above 5° F (-15° C) since the accident occurred. Part of the sample from the right-engine fuel filter was lost before it was collected in the container. Samples also were taken on the day of the accident from the hydrant cart which was used to refuel Flight 69 in Anchorage. These samples were analyzed by an independent laboratory in Anchorage, Alaska, and identified by the Engler distillation method as Jet A turbine fuel. This is a standard test method accepted by the American Society for Testing Materials (ASTM). All samples contained water in varying amounts. The greatest amount of water, 150 parts per million, was found in the fuel taken from the left-engine fuel filter. The amount of water contained in the samples from the tank sumps and the right engine ranged from 29 to 51 parts per million. The sample from the hydrant cart contained 36 parts per million. All samples also contained relatively large amounts of suspended solids identified as fibers and crystals

Fuel samples also were taken from the ?eft-engine fuel pump and fuel control at the Rolls Royce facility before the components were examined and tested. These samples were examined in the Rolls Royce laboratory. The sample from the fuel control was determined to contain 31.4 percent by volume water. The sample from the fuel pum contained 3.3 percent by volume water. The water also was tested for salinity and wa found to contain 10- to 15-percent chloride. The Rolls Royce laboratory also made a comparison test of the sample against a standard fuel using infrared spectrophotometry, and concluded that the fuel type was JP-4. However, this method is not an ASTM-accepted method for positive identification of fuels, and the Rolls Royce laboratory later stated that it should not be considered as conclusive, and that the zccepted industry method of identification should be used.

1.16.5 Engine Fuel System Icing Tests

Sometime during 1961 and 1962, Rolls Royce conducted an extensive series of tests of the Dart engine fuel system to investigate the effects of icing due to water entrained in fuel. The tests included the portion of the system from the low-pressure filter downstream through the fuel control unit. The amount of water contamination in the fuel during this testing was 0.01 percent by volume (100 parts per million).

In these tests, fuel flow surged several times and was attributed to intermittent and partial blockage by ice particles of the strainers and orifices in the fuel control servo system. Other testing showed that fuel flow and pressure during an engine acceleration would not be affected unless the low-pressure fuel filter was blocked 90 percent before acceleration. Rolls Royce test data also showed that the temperature rise in fuel flowing across the fuel heater was 34° C (94° F) at 15,000 rpm and 44° C (110° F) at 14,200 rpm.

1.17 Additional Information

1.17.1 Engine Fuel System

Each engine is supplied with fuel from the integral fuel tank in its respective wing. The fuel flows through a fuel heater, a low-pressure fuel filter, and into the engine-driven pump. From the pump the high-pressure fuel is delivered to the fuel control unit where it is metered and directed to the fuel nozzles in the combustion chambers.

The fuel heater is a fuel-air heat exchanger which uses compressor bleed air as the heat source. It is controlled from the cockpit by a three-position switch, with manual, off, and auto positions. There is also a differential pressure warning light for each engine, actuated by a differential pressure switch. The light will illuminate when there is a 3.75-psi difference in fuel pressure between the inlet of the fuel heater and the outlet of the fuel filter. If the fuel heat switch is selected in auto, engine bleed air will be directed to the fuel heater when the differential pressure switch is actuated by the pressure difference. When the switch is in the manual position, bleed air is supplied continuously to the fuel heater. The warning light is located on the cockpit overhead panel next to the fuel heat switch. The fuel filter does not incorporate an automatic bypass valve.

The servo system in the fuel control senses engine inlet air pressure and throttle valve position to regulate fuel pump output. The servo pressure moves a piston which changes the stroke of the positive displacement fuel pump, thereby changing fuel flow.

1.17.2 Before-Landing Check

The YS-11 Before-Landing Check is a challenge and response check of the following items:

Landing Gear	Down and 3 Green
HP Cock	HSWL
Landing Lights	On 165 knots
Fuel Trim	Set
Prop Lights	3 ON - 3 OFF
Fuel Heaters	OFF
Flaps	OFF
Water/Methanol	ON
Spill Valves	MANUAL

The Reeves training manual requires that for instrument approaches, the check be performed before reaching the final approach fix. For visual approaches, it is to be performed upon entering the traffic pattern and completed before turning onto final approach, except for the final flapsetting.

The before-landing check requires that the fuel heaters be turned off before landing because the source of heat is engine compressor bleed air. Extracting air from the compressor causes a reduction in the shaft horsepower output of the engine. Power available at takeoff is reduced 4 percent when air is extracted for fuel heat. Therefore, to make maximum power available in the event of a go-around or missed approach. the fuel heaters are turned off during the approach for landing.

The YS-11 operations manual describes the use of fuel heat for all phases of flight. For climb and cruise. it states: "If the indicated fuel temperature is below 5° C or the outside air temperature is below -15° C in case of airplanes not equipped with the fuel temperature indicators, keep the fuel filter deicing switch in MANUAL."

For approach and landing, the manual states: "If the indicated fuel temperature is below 5° C, or the outside air temperature is below 20° C in case of airplanes not equipped with the fuel temperattire indicators, set the fuel filter deicing switch to MANUAL for 2 minutes within 5 minutes before landing and turn off the fuel filter deicing switch."

1.17.3 Propeller Pitch Stops

The Dowty Rorol propeller used on the Rolls Royce Dart engine incorporates a mechanical pitch stop which prevents the propeller blade angle from decreasing to a flat-pitch, high-drag condition during takeoff and cruise if the propeller windmills without engine power input for any reason. On the YS-11, the high pitch stop limits blade angle decrease to 27.5° pitch angle.

By means of electrical switches in the propellers connected in series and actuated by the propeller blades. the cruise pitch stop is set automatically in each propeller when the pitch angle of both propellers is above 29.5°. The *stops* are withdrawn automatically only when the pitch angle of both propellers is below 29.5,° or if one propeller is feathered and the angle of the other becomes less than 29.5°.

As a propeller is moving to the feather position, the stop cannot X removed automatically. At feather blade angle, the blade contacts another switch which again completes the circuit and allows stop withdrawal. The propeller will feather in about 10 seconds or less. The automatic system can be bypassed and the stops withdrawn manually by placing the high-pressure cock lever in the high stop withdrawal position. This action is required to be accomplished during the before-landing check.

The status of the high stop is displayed in the cockpit by yellow and Mue lights. The yellow "High Stop Unsafe" light indicates that the blade pitch of either propeller, or both, is below 29.5°. The blue "High Stop Removed" light indicates that the high stop has been withdrawn.

Calculations by Dowty Rotol indicate that for the YS-11 at 165 knots, 1,800 feet altitude, and 850 pounds per hour fuel flow. the propeller blade angle would be 29°.

1.17.4 Propeller Feathering

Propeller feathering can be accomplished in two ways--autofeather and manual feather. Autofeathering is accomplished automatically when the following conditions exist: the throttle lever is in the position corresponding to 12.800 engine rpm or greater, the high-pressure cock lever is in "fuel on" or high stop withdrawal position, torque pressure is below 50 psi, and the other engine is not feathered or being feathered. Manual feathering is accomplished by moving the high-pressure cock to the "feather" position and then pushing the "feather" button. These actions select the propeller control unit to feather, shut off fuel to the engine, and activate the feathering pump.

1.17.5 Cruise Altitude Temperatures

About 0615, Reeve Flight 17 departed Anchorage for King Salmon. The flight was cleared via the same ?outing and altitude as Reeve Flight 69, and followed Flight 69 by 20 minutes throughout the flight. Flight 17's fuel onboard and overall gross takeoff weight were nearly the same as Flight 69's. Upon leaving 10.000 feet for 14,000 feet, the crew also selected manual fuel heat after noting the low air temperatures en route. They noted the following indicated outside air temperatures at the following locations and altitudes:

Over Kenai at 10.000 feet, temperature -25° C (-12° F).
Over Mt. Iliamna at 14,000 fee:, temperature -40° C (-40° F).
Inbound to King Salmon at 14.000 feet, temperature -38° C (-36° F).

The descent of Flight 17 began approximately 40 nmi northeast of King Salmon and ended in a visual approach and landing OR runway 29 at King Salmon Airport. The crew noted no peculiar engine indications during the descent or landing phases except that after parking and shutdown, the power levers and high-pressure cocks were very stiff to move and the auxiliary power unit required three attempts to start.

1.17.6 Fuel, Fuel Storage, and Refueling Procedures

Water is highly soluble in kerosene-tvpe turbine fuels and may be present in tnree forms: dissolved, collodial suspension (entrained), and free water. Dissolved and entrained water cannot be filtered out. The entrained water remains suspended as submicroscopic particles that do not settle out. This entrained water usually results from dissolved water coming out of solution as the fuel is cooled. Some free water also may be converted to entrained water as the fuel passes through pumps. The quantity of water usually present in turbine fuel does not affect normal combustion. However, it is a potential source of ice in the fuel system when the fuel is a; low temperature because of exposure to cold temperatures at flight altitudes. For this reason, engines include fuel heat systems or fuel filter bypasses, or both.

At Anchorage Internationel Airport, fuel is stored in a central tank farm and pumped through underground pipes io the airplane parking locations. It is pumped by portable hydrant carts from these locations directly to the airplanes.

Reeve procedures for the first refueling of the day at Anchorage require that the fuel tank sumps be drained when the airplane is inside the hangar before it is moved to the parking spot at the boarding gate for refueling. At this time. at least 1 quart of fluid is drained from each sump and examined visually for water. If water is found. draining continues until no water is found. or, if water continues to appear in the samples. the cause is investigated. After the airplane is refueled at the gate, the sumps are again checked for water.

1.17.7 Right Engine History

In 1980, while installed on mother airplane, the right engine was subjected to sudden stoppage. It was removed and sent to Rolls Royce for overhaul. after which it was installed in the No. ? position on N169RV. During the investigation. when a force was applied to one propeller blade of the No. 2 propeller, the engine tailpipe was observed to move as if it were loose in its mount. However. an inspection of the mounts, including a check of the torque on the mount bolts reveaied no discrepancies. It was also alleged that after the engine examination and testing, the engine was installed on another YS-11 and subsequently removed for a vibration problem. A further review of Reeve maintenance records showed that, in fact, it replaced an engine which was removed for vibrations. and continued in service with no reported problems.

2. ANALYSIS

2.1 General

The flightcrew was properly certificated and qualified in accordance with existing regulations. Weather was not a factor in this accident, with the exception of extremely low temperatures at the airplane's cruise altitude. The airplane was properly equipped and maintained in accordance with the applicable regulations. There was no evidence found to indicate prior existing discrepancies which would have contributed to the accident.

2.2 Fuel Type

All the fuel samples taken from the airplane an; the hydrant cart were identified as Jet A fuel by an independent laboratory using industry-accepted methods. The fuel samples recovered from the engines at the engine manufacturer's test facility were concluded by the manufacturer's laboratory to be JP-4 by using a less accurate comparative-type test. When questioned, the manufacturer's laboratory conceded that this test should not be considered conclusive. and that standard test methods should he relied upon. In addition. the airplane was fueled at Anchorage. as well as at previous refueling stations in the Reeve system. with Jet A fuel. Therefore, it would have been impossible to have JP-4 fuel in the fuel controls. Therefore, the Safety Board concludes that the fuel was Jet A. The Safety Board further concludes that the water in the fuel was not the result of any improper handling:. but rather was the result of dissolved water coming out of solution in a suspended state due to the unusually low fuel temperatures.

2.3 Loss of No. 2 (Right) Engine Power

The loss of power on the No. 2 (right) engine, indicated by the low torque and fuel flow, can be associated directly with the removal of fuel heat as part of the before-landing check. The first officer first noticed the loss of torque after he turned off the fuel heaters. Because of the lengthy exposure of the airplane to very low temperatures before flight and to extremely low temperatures during cruise, the fuel temperature would have been well below the freezing point of water. The draining of the fuel sumps before and after refueling did not reveal any free water in the tanks. However, this visual check, while necessary to insure the absence of free water, cannot reveal water dissolved in the fuel and must not be relied upon as indicative that fuel icing will not occur. Analysis of the fuel samples, taken after the accident in less than ideal conditions, confirmed the presence of water in the fuel system. It is likely that the actual quantity of water, both free and dissolved, was greater than that implied by the fuel analysis. Because the samples were taken when the ambient temperatures were still well below 0° F, any collected free water in the system would have been frozen and would not have flowed through the drains when the samples were taken. During flight, the water would have been dispersed in the fuel either as supercooled droplets or small ice crystals in the fuel, but would not have restricted the fuel flow in the system in that form. And so long as heat was supplied by the fuel heater, the water would have easily passed through the engine fuel system as liquid. However, the fuel in the airplane's tanks was probably at very low temperatures because of the long exposure to low ambient temperatures. Therefore, the fuel heater would have raised the temperature of the fuel entering the engine only slightly above freezing. Once the fuel heaters were turned off, the water entrained in the cold fuel would have frozen quickly in the small orifices and screens in the fuel control and pump, and also could have impregnated the filter element and partially blocked fuel flow through the filter.

Although the first officer, when interviewed, seemed to associate the loss of torque with the removal of fuel heat, it seems apparent from the CVR transcript that he did not do so at the time, and, therefore, did not attempt to restore fuel heat. The captain stated that he sensed the loss of torque at the same time the first officer noticed the low torque indication. This also tends to associate the power loss with the removal of fuel heat. The captain stated that when the engine did not respond to throttle movement, he decided to feather the propeller because he believed that the airplane was in a good position to continue the approach on one engine. It is possible that, with the torque below 50 psi, the captain advanced the throttle to the 12,800-rpm position and the propeller autofeathered. However, because he decided to feather and carried out the manual feathering procedure, the crew may not have been aware that autofeather had occurred.

Because no discrepancies were found in the engine or in the crew's actions before the loss of power, the Safety Board concludes that the loss of power in the right engine occurred due to the freezing of fuel-entrained water in the low-pressure filter after the fuel heaters were turned off in accordance with the before-landing checklist.

2.4 Loss of No. 1 (Left) Engine Power

The CVR transcript indicated that only about 28 seconds elapsed between the time the crew noted the loss of torque on the right engine and the popping sounds and smell of smoke that indicated the failure of the No. 1 (left) engine. The failure of the left engine was caused by the severe overtemperature of the turbine, which can occur when excessive fuel flow is admitted to the combustors with insufficient airflow through the engine for proper cooling. The two most likely reasons for a turbine overtemperature are (1) an attempt at engine acceleration from a relatively low engine speed with the propeller cruise pitch stop not withdrawn, or (2) a large fluctuation in fuel flow from the fuel control caused by ice in the fuel control servo system.

If the cruise pitch stop is not withdrawn, the propeller blade angle cannot go below 27.5°. A blade angle of 27.5° will produce too great a load for the engine to accelerate rapidly from low power. Therefore, when fuel flow is increased for acceleration, engine rotor speed does not increase. Without an increase in engine rotor speed, the airflow is inadequate for cooling, and turbine overtemperature will occur.

During the descent and approach, the power setting had been maintained constant while the airplane was leveled at 1,800 feet and the airspeed was decreasing from 200 knots. The propeller manufacturer calculated that the blade angle would have been 29° at 1,800 feet at that power setting and 165 knots. Therefore, as airspeed decreased, the blade angle would have been above 29.5° and decreasing with the airspeed. From the FDR and CVR, the Safety Board determined that when the low torque was noticed on the right engine, the airspeed was 188 knots and feathering was completed by about 170 knots. The blade angles would have been greater than 29.5° at these airspeeds and the stop would not have been withdrawn.

Although the crew stated that they believed that the first officer had placed the high-pressure cocks in the high stop withdrawal position, the Safety Board could not confirm by other evidence the actual position of the high-pressure cocks or the cruise pitch stops. If the high-pressure cocks had not been placed in the high stop withdrawal position, then the stops would have withdrawn only when both propellers were below 29.5°, or when the left propeller was below 29.5° and the right propeller was feathered. Therefore, under these conditions the overtemperature of the left engine could have occurred only if the captain had advanced the left throttle at the same time the right propeller was moving to the feather position. The captain states that he could not remember if the throttle was moved immediately after he initiated the feather procedure, or after the propeller was feathered.

However, if the high-pressure cocks had been placed in the high stop withdrawal position before fuel heaters were turned off, the left propeller cruise pitch stop should have withdrawn as the blade angle decreased to 29.5°, regardless of the pitch angle of the right propeller. If this were the case, and in the absence of any malfunction or discrepancy in the propellers or propeller control units, the overtemperature of the left-engine turbine could have occurred only because of excessive fuel flow for some other reason. It has been shown by previous tests by the manufacturer that water in the fuel that freezes in the fuel control servo system can cause large fuel flow fluctuations. If the orifices or screens in the servo system were blocked, moving the throttle would cause fuel pump output flow to increase, but the servo signal would be prevented from balancing the fuel pump output with reference to throttle position. Thus, the fuel flow to the engine would become excessive and could produce an overtemperature condition. Because the actual positions of the high-pressure cock levers and the cruise pitch stops could not be verified by the available evidence, and because the presence of ice in the fuel control could not be verified but only inferred from the water found in the control, the Safety Board is unable to determine the precise cause of the overtemperature.

Although the Safety Board could not establish the exact cause of the left engine failure, it is apparent that this accident sequence originated with the removal of fuel heat in accordance with the operating manual and before-landing checklist. The Safety Board believes that while the crew complied with the manual instructions and checklist, they did so without a full understanding of the significance of fuel temperatures that were well below freezing. The instructions in the Nihon operations manual and the Reeve training manual are not sufficiently detailed to provide adequate guidance for the crew to make a proper decision on the need for continuing the use of fuel heat. As this accident revealed, the requirement in the manual for using fuel heat for 2 minutes within 5 minutes of landing is not adequate to prevent engine fuel system icing when operating in extreme conditions. The Safety Board believes that if the manuals and crew training had included more specific discussion and instructions for the use of fuel heat, the crew would have been aware of the need to make a decision on whether fuel heat was still required during the approach and also would have had the guidance necessary to make that decision.

2.5 Emergency Evacuation

Passengers were not able to open the right overwing exit to escape from the airplane until assisted by the captain who opened the exit. Subsequent investigation revealed that the catch was difficult to locate. The Safety Board believes that under conditions of panic, poor lighting, or fire with its accompanying smoke and toxic fumes, where time for escape is severely limited, a person unfamiliar with the exit operation would have difficulty locating the catch and subsequently opening the exit.

The type certificate for the YS-11 was applied for on June 15, 1962, and was approved on September 7, 1965. Certification for the YS-11 and all subsequent models is based on Civil Air Regulation (CAR) 10, "Certification and Approval of Import Aircraft and Related Products." This regulation states, in part, that a type certificate will be issued when the government of the manufacturing country certifies that the airplane "has been examined, tested, and found to comply with" the airworthiness requirements of the applicable CAR;s or the applicable airworthiness requirements of the government of the manufacturing country and any additional requirements "prescribed by the FAA to provide a level of safety equivalent to the requirements" of the applicable CAR's.

The applicable requirements for the YS-11 were those in CAR 4b in effect on December 31, 1953. Car 4b.362(f), "Emergency exit marking," states, in part, that "All emergency exits, their means of access, and their means of opening shall be marked conspicuously." The Federal Air Regulation (FAR) currently in effect, 14 CFR 25.811(a), which resulted from the recodification of CAR 4b.362(f), carried forward the requirement that the exits, their access, and means of opening be "conspicuously marked." The current regulation has been added to and clarified periodically since 1967 to provide more specific guidance on how to mark the exits and their means of opening. However, the Safety Board is concerned that the unchanged guidelines for exit markings on airplanes certificated and still being manufactured under CAR 4b are too subjective and do not take into account fully the reactions and understanding of passengers unfamiliar with air travel, or of different sociological/cultural backgrounds. Such guidelines, therefore, may not provide a level of safety equivalent to that required by current regulations.

Title 14 CFR 121.571, which addresses briefing of passengers before takeoff, includes only the requirement that passengers be briefed orally on the locations of the emergency exits, and does not require a briefing on their methods of operation. The regulation further states that the airplane shall have printed cards supplementing the oral briefing. The cards are to contain "diagrams of, and methods for operating, the emergency exits. . ." The Reeve card, which has small, unlabeled diagrams of an exit door and window, with the methods for operating the exits presented in written form only, apparently meets these criteria.

Advisory Circular (AC) 121-24 4/ provides guidance material for the preparation of passenger briefings and briefing cards. The circular states that most of the passenger briefings have been standardized, but that the briefing cards continue to exhibit a wide variety of both quality and methods used to communicate information. It further states that the primary method used to present the required information on the briefing card should be pictorial. Although the passenger briefing and the briefing card used by

4/ "Passenger Safety Information Briefing and Briefing Cards," Advisory Circular 121-24, Department of Transportation, Federal Aviation Administration, June 23, 1977.

Reeve mee: the requirements in the regulations. the Safety Board believes that **neither** the amount of information nor its manner of presentation is sufficient to allow passengers. especially Chose **whose** knowledge of the English language is limited, to operate ihe exits with minimum delay in an emergency situation.

Because o: the circumstances of this accident, the passengers' difficulty in opening the overwing exit was not a major factor in their survival. However, had *a* **rapid** evacuation been necessary in this case. the passengers' inability to operate the exit could have resulted in unnecessary **injuries** or deaths. especially if crewmembers had been unable to assist in opening the exits.

The Safety Board has issued several recommendations 5/ concerning the adequacy of passenger briefings and briefing cards in dealing with specific problem areas. The FAA has been responsive to these recommendations. and they have been classified by the Safety Board as "Closed--Acceptable Action" or 'Closed--Acceptable Alternate Action." However, it is apparent that there are additional significant problems in passenger education and awareness. The Safety Board believes that additional problems will continue to surface, and thereiore a systematic approach to periodic evaluation *of* oral briefings and briefing cards **is** needed.

The Safety Board understands that Reeve has taken steps to mark more clearly *the* catch on each emergency exit on It.. YS-11's. and is currently revising its passenger safety cards.

2.6 Cockpit **Voice Recorder**

The United Control Corporation (Sundstrand) V-557 CVR tape from this airplane exhibited variations in tape speeds and a poor signal-to-noise ratio. The unstable tape speed **made** a frequency analysis of the engine sounds and ai" traffic control/CVR time correlation impossible.

The FAA addressed similar problems **with** this model recorder in 1978 ir response to Safety Board recommendetions **A-78-21** and -22, issued on April **13.** 1978, which asked the **FAA** to "review the adequacy of current cockpit voice recorder preflight testing procedures to assure satisfactory system operatio!:" **and** to "review the reliability of cockpit voice recorder units to assure that the mean time between failure is not excessive." The FAA replied on June **19, 1978**, that it had "directed principal inspectors to reevaluate their assigned cperators' CVR testing procedures to assure that the CVR testing procedures are satisfactory." FAA ins tors "were also directed to stress the need for operators to follow the CVR manufacturers' procedures and maintenance schedules. . . ." As a result of corrective actions in CVR maintenance programs, the FAA stated that it expected a substantially improved mean time between failures.

The Safety Board is concerned that the degraded quality of the recordings that it has found **in** this investigation and two other recent investigations 6/ indicates that the maintenance practices for the model V-557 CVR have **again** degraded and that valuable accident information will continue to he lost in accidents involving aircraft eq lipped

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5/ Safety recommendations A-69-15, A-74-11?. A-76-75. A-76-26, A-77-28. A-77-59 and A-82-70.

6/ Pan American Flight 757. Roeing 727, Kenner. Louisiana, duly 9, 1982 (investigation in progress), and Aircraft Accident Report—"Air Florida Airlines. Inc.. McDonnell **Douglas,** Inc., DC-10-30CF, N101TV. Miami International **Airport.** Miami. Florida, September 22, 1981" (NTSB-AAR-82-3).

with this model CVR. Since the model V-557 is no longer being manufactured, the general population currently in the fleet is aging and in need of more frequent maintenance and repair. About 18 US. carriers are using these recorders, and there are an estimated 2,000 units either installed in various aircraft or available as spares.

Therefore, the Safety Board recommended, on July 13, 1982, that the FAA:

> Initiate a program involving all US. operators using United Control Corporation (Sundstrand) V-557 cockpit voice recorders to randomly check a representative sample of these recorders in operational use to assure that they are operating within. design specifications. If this inspection reveals significant problems with acceptability of recorded data, require the necessary changes in the carriers' maintenance programs to assure continued airworthiness of these recorders. (A-82-62).
>
> After a specified period of no: more than 2 years, require the removal of all United Control Corporation (Sunstrand) V-557 cockpit voice recorders and installation of suitable replacements. (A-82-63)

The FAA responded on September 28, 1982, that it was obtaining maintenance information regarding the Pan American Airways Boeing 727 which crashed in Kenner, Louisiana, to confirm whether the inadequate CVR performance cited by the Safety Board was maintenance-related. The FAA also stated that it was determining th: number of V-557 CVR's currently in use and the inspection intervals the air carriers are using, before deciding to initiate inspection of a random sample. After completing this evaluation, the FAA will study the feasibility of requiring the removal and replacement of all model V-557 CVR's.

3. CONCLUSIONS

3.1 Findings

1. The crew was properly certificated and qualified for the flight.

2. The airplane was properly equipped and mnintnined.

3. The temperatures at cruise altitude were -38° C (-36° F) to -40° C (-40° F).

4. The airplane was fueled properly with Jet A turbine fuel.

5. Dissolved water in the fuel came out of solution due to the low fuel temperature and was carried in the fuel as entrnined water.

6. The water entrained in the fuel froze in the right engine fuel filter when the fuel heat was turned off in accordance with the before-innding checklist.

7. The loss of power in the right engine occurred while the first officer was performing the before-landing check.

8. Shortly after the right engine was shut down, a loss of power due to turbine overtemperature occurred in the left engine.

9. The cause of the left-engine turbine overtemperature could not be determined.

10. The airplane operations manual is not sufficiently detailed to permit an adequate determination of when fuel heat may safely be discontinued during very low temperature operations.

11. Neither the amount of information on the Reeve Aleutian Airlines passenger safety card nor its manner of presentation is sufficient to allow passengers to operate the exits with minimum delay in an emergency situation.

12. The adequacy of passenger briefings and briefing cards needs to be evaluated periodically.

3.2 Probable Cause

The National Transportation Safety Board determines that the probable cause of this accident was the loss of power in the right engine due to the freezing of water in the fuel filter after the fuel heeters were turned off in accordance with the before-landing checklist, and the loss of power due to the destruction of the left-engine turbine from overtemperature due to excessive fuel flow for undetermined reasons.

4. RECOMMENDATIONS

As a result of its investigation of this accident, the National Transportation Safety Board recommended that the Federal Aviation Administration:

> Review and revise as necessary the Federal Aviation Administration-approved Nihon YS-I? operations manual, the Reeve Aleutian Airlines, Inc., training manual, and the YS-11 before-lsndinp checklist to incorporate more specific information and guidance io enable YS-11 crews to decide when fuel deicing map be safely terminated. (Class II, Priority Action)(A-82-150)

> Issue an Operations Bulletin requiring Principal Operations Inspectors to inform all air carrier and commercial operators of Tihon YS-11 airplanes under their cognizance of the need to mark the catches on all emergency exits so that they are easily located and distinguishable from the exit handles and other components. (Class II, Priority Action)(A-82-151)

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

/s/ JIM BURNETT
Chairman

/s/ PATRICIA A GOLDMAN
Vice Chairman

/s/ FRANCIS H. McADAMS
Member

/s/ G.H. PATRICK BURSLEY
Member

/s/ DONALD D. ENGEN
Member

November 30, 1982

APPENDIXES

APPENDIX A

INVESTIGATION AND HEARING

1. Investigation

The National Transportation Safety Board was notified of the accident about 1500 e.s.t. on February 16, 1982, and dispatched a partial investigative team to the scene. Investigative groups were formed for operations, structures, powerplants, human factors, maintenance records, cockpit voice recorders, and flight data recorders.

Parties to the investigation were Reeve Aleutian Airways, Inc.; Air Line Pilots Association; Federal Aviation Administration; and Rolls Royce.

2. Public Hearing

A public hearing was not held and depositions were not taken.

APPENDIX B

PERSONNEL INFORMATION

Captain Thomas Hart

Captain Hart, age 45. employee No. 2016, was employed by Reeve Aleutian Airways. Inc., on May 1, 1969, as a pilot. He was upgraded to captain on YS-11 aircraft on January 18, 1980.

Ye held airline transport pilot certificate No. 1359857 with ratings in L-188, DC-3, YS-11, and C-46 aircraft. with airplane multiengine land and commercial airplane single-engine land and sea privileges.

He had a total of 11,509 flight-hours, 4,177 of which were in YS-11 aircraft.

His last proficiency check was accomplished on January 15. 1982, and his last line check was accomplished on January 29, 1982.

Captain Hart was designated as a pilot check airman for initial operating experience, line checks, and proficiency checks as required on Reeve Wihon YS-11 aircraft on April 14, 1981, by the FAA.

He had flown 33 flight-hours in the last 30 days. 65 flight-hours in the last 60 days, and 76 flight-hours in the last 90 davs. Captain Hart held a first-class medical certificate dated December 12. 1981, with the limitation that he wear distant vision-correcting glasses while flying.

First Officer Roger 3. Showers

First Officer Showers. age 34, employee No. 2047. was employed by Reeve Aleutian Airways, Inc., on October 30, 1981. He held airline transport pilot certificate No. 2082479 with airplane multiengine land and commercial single-engine land and sea privileges. He was rated in BY-204 and SK-64 rotorcraft-helicopters. He also held mechanic certificate No. 2203273 with airframe and powerplant ratings: flight instructor certificate No. 2082479 CFI with airplane single-engine, instrument airplane, and helicopter and rotorcraft-helicopter ratings.

He had a total of 6,600 flight-hours of which 110 hours were in Ninon YS-11 aircraft. His last proficiency check was accomplished on December 29, 1981. He had flown 27 flight-hours in the last 30 days; 63 flight-hours in the last 60 days: and ?he same for the last 90 davs.

First Officer Showers held a first-class medical certificate dated July 27, 1981, with no limitations.

Flight Attendant Cecilia Allen

The flight attendant, Cecilia Allen, was hired by Reeve Aleutian Airways, Inc., on October 29, 1976. She received initial ground and flight training in the L-?88 in November 1976, and flew 50 hours as training-observer on this aircraft. During May and June 1977, Ms. Allen received initial ground and flight training in the YS-11, and flew 61 hours as training-observer. Her first solo YS-11 flight was on June 13, 1977. She had 3,118 hours in the L-188, and 1,493 hours in the YS-11.

Ms. Allen satisfactorily completed a company flight attendant competence check/evaluation flight on May 22, 1981. Between January 6, 1982, and January 20, 1982, Ms. Allen completed ground training in recurrent emergency, recurrent aircraft, and recurrent hazardous materials, for both the YS-11 and L-188. On January 10, 1982, she satisfactorily completed the required practical and oral competence check on the YS-11 and L-188.

Ms. Allen was last on duty February 10,1982. Her duty times were as follows:

Last 90 days	:	122 hours
Last 60 days	:	92 hours
Last 30 days	:	51 hours
Last 48 hours	:	2 hours
Last 24 hours	:	2 hours

APPWDIX C

AIRCRAFT INFORMATION

NIHON YS-11A-600, N169RV

The airplane was manufactured by Nihon Aeroplane Manufacturing Company of Japan and delivered to Air Gabon on February 12, 1973. It was acquired by Reeve Aleutian Airways, Inc., on February 29, 1980, and received an FAA Standard Airworthiness Certificate on May 19, 1980.

Aircraft:

Date of manufacture	9/10/71
Date of certificstion to Reeve Aleutian Airways, Inc.	2/29/80
Date of certification for transport category	5/19/80
Serial number	2169
Registration number	N169RV
Airframe flight-hours (total?	4,385:21
Airframe cycles (total)	3,239
Date of last inspection	1/6/82
Flight-hours since last inspection	87:34

Engines: Rolls Royce, Dart 542-1013

	No. 1	No. 2
Serial number	21420	21469
Date of manufacture	2/25/70	*
Total flight-hours	12,952	6,211
Total cycles	4,566	5,087
Date of last overhaul	12/24/80	7/16/80
Flight-hours since overhaul	852	1,531
Date installed on airplane	7/22/80	7/25/80
Cycles since installed on airplane	626	620
Date of last 1,500-hour inspection	12/24/80	5/28/81

* Log book destroyed in hangar fire.

APPENDIX D

TRANSCRIPT OF COCKPIT VOICE RECORDER

LEGEND

CAM	Cockpit area microphone voice or sound source
RDO	Radio transmission from accident aircraft
-1	Voice identified as Captain
-2	Voice identified as First Officer
-?	Voice unidentified
LCL	Local Control
IC3	Stewardess on interphone
IC2	Copilot on interphone
B1	Barrier one
•	Unintelligible word
#	Nonpertinent word
%	Break in continuity
( )	Questionable text
(( ))	Editorial insertion
---	Pause
Note:	All times are expressed in zulu time.

INTRA-COCKPIT

TIME & SOURCE	CONTENT
1900:48 CAM-1	Three zero at one zero?
1900:57 CAM-2	Three two zero at one zero, that was In the ATIS
1901:01 CAM-1	Thought he was giving us a squawk
1901:14 CAM-1	He's not very clear today. sounds like he's talking through a wet sock

AIR-GROUND COMMUNICATIONS

TIME & SOURCE	CONTENT
1900:30 RDO-2	King Salmon tower Reeve sixty nine. uh, five mile right base for two nine, been cleared fop. the visual
1900:37 LCL	Slaty nine King Salmon tower, roger wort tnig fml rummy tam niner ---
1900:45 RDO-2	Sixty nine
1900:46 LCL	Three zero at one zero
1900:50 RW-2	Say again, ah, the lost part of transmission
1900:52 LCL	Roger that the wind at this time is three two zero at one zero, you are In sight and cleared to land runway two nine

INTRA-COCKPIT

TIME & SOURCE	CONTENT
1901:31 CAM-1	It's not standard •
1901:34 CAM-2	It's not very clear
1901:51 CAM-2	We've lost one • •
1901:53 CAM-2	(Fuel flow) • •
1901:54 CAM-2	Torque's very down
1901:57 CAM-1	Okay feather the #
1902:06 CAM-1	Feathered?
1902:07 CAM-2	It's feathered

AIR-GROUND COMMUNICATIONS

TIME & SOURCE	CONTENT
1901:26 LCL	Barrier one ground
1901:34 B1	Barrier one
1901:39 LCL	What's your position now, ah. I've got you in sight. remain clear of runway one one and two nine, landing traffic a YS eleven on a right base
1901:52 LCL	Barrier one Reeve six niner. there will be men and equipment on the departure end of runway on the left side, they are clear and outside the lights

INTRA-COCKPIT

TIME & SOURCE	CONTENT
1902:13 CAM-1	Tell 'em we have one shut down and would like the fire trucks out
1902:18 CAM-1	(I)it we're losing the other one
1902:22 CAM-1	Gear down
1902:38 CAM-2	Gear down and three green
1902:53 CAM-1	Okay. tell the girl in back we've got a problem

AIR-GROUND COMMUNICATIONS

TIME & SOURCE	CONTENT
1902:14 RDO-2	And, ah. Anchorage King Salmon Reeve sixty nine, ah, get the fire trucks out, we lost one engine on --- we're turning final at this time
1902:32 LCL	Roger say your fuel aboard and persons
1902:47 RDO-2	Turning final at this time, sixty nine
1903:02 IC3	Hello
1903:03 IC2	Yeah, we've got a little problem here •
RDO	((Radio call overlays the intercom communications))
LCL	Reeve sixty nine. cleared to land runway two niner, the ah emergency equipment has been advised
1903:11 RDO-2	Six, sixty nine roger

INTRA-COCKPIT TIME & SOURCE	INTRA-COCKPIT CONTENT	AIR-GROUND COMMUNICATIONS TIME & SOURCE	AIR-GROUND COMMUNICATIONS CONTENT
1903:17 CAM-1	• • get the other one gofng		
1903:19 CAM-1	Get the other englne golng		
1903:21 CAM-1	Get ft gofng		
CAM	((Possible sound of englne surges))		
1903:29 CAM-1	We're not gofng to make ft		
1903:30 CAM-1	We're not going to make ft		
		1903:31 ROO-2	Sixty nine Is lost both engines, on final here to the river
1903:32 CAM-1	We're not gofng to make It		
		1903:35 LCL	Sixty nlne roger
1903:36 CAM-2	You want the gear up7		
1903:37 CAM-1	Yeah. put It up		
1903:40 CAM	((Sound of ground proximity narnfng system))		
1903:40 CAM-1	We got a fire		
1903:41 CAM-?	Pull 'em both?		

INTRA-COCKPIT

TIME & SOURCE	CONTENT
1903:43 CAM-1	Gang bar, fire bottler
1903:52 CAM-1	Fire bottles
1903:53 CAM	((Recorder shut down and started up))

AIR-GROUND COMMUNICATIONS

TIME & SOURCE	CONTENT
	X
RDO-1	((not broadcast)) Hey, this is Reeve sixty nine, we're down on the ice, nobody's hurt, we're still on fire over here though and ah we had t fire in the air and lost power on the engines tnd couldn't get to the end of the runway, we had to make a quick left turn here but we're still on fire
	X

U S ... PRINTING OFFICE