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NATIONAL TRANSPORTATION SAFETY BOARD

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AIRCRAFT ACCIDENT REPORT

ALOHA AIRLINES, INC.
Vickers Viscount Model 745D, N7415
Honolulu International Airport
Honolulu, Hawaii
August 8, 1971



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NATIONAL TRANSPORTATION SAFETY BOARD
Washington, D. C. 20591
REPORT NUMBER: NTSB-AAR-72-2

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Adopted: DECEMBER 29, 1971

NATIONAL TRANSPORTATION SAFETY BOARD

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16. Abstract <p>Aloha Airlines, Inc., Vickers Viscount 745D, N7415 was operating as Flight 845 between Hilo and Honolulu, Hawaii. After landing at Honolulu and during taxi to the terminal, smoke was detected coming from below the passenger cabin floor. The aircraft was stopped on the taxiway, the engines were shut down and all passengers and crewmembers evacuated without incident. The fire was extinguished by airport emergency equipment.</p> <p>The Board determines that the probable cause of this accident was an undetected electrical short within the left nickel-cadmium aircraft battery, which resulted in the absorption of an increasing amount of heat energy over an unknown period of time, and progressed to a state of thermal runaway.</p> <p>The Board recommends that the Federal Aviation Administration issue an Airworthiness Directive requiring owners/operators of U.S. registered Viscount aircraft to comply with modifications proposed by the British Aircraft Corporation relative to fire precautions in Underfloor and Electric Bay Regions of the 700, 800, and 810 series Viscount aircraft.</p>					
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ALOHA AIRLINES, INC.
VICKERS VISCOUNT MODEL 745D, N7415
HONOLULU INTERNATIONAL AIRPORT
HONOLULU, HAWAII
AUGUST 8, 1971

TABLE OF CONTENTS

	<u>Page</u>
synopsis	1
Investigation	3
Analysis and Conclusions	5
Probable Cause	7
Corrective Action	7

Appendices

Appendix A - Notification and Investigation

Appendix B - Crew Information

Appendix C - Aircraft Information

SPECIAL NOTICE

This report contains the essential items of information relevant to the probable causes and safety messages to be derived from this accident. However, for those having a need for more detailed information, the original factual report on the accident is on file in the Washington office of the National Transportation Safety Board. Upon request the report will be reproduced commercially at an average cost of 15¢ per page for printed matter and 75¢ per page for photographs, plus postage. (Minimum charge \$1.00.)

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NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D. C. 20531
AIRCRAFT ACCIDENT REPORT

Adopted: December 29, 1971

ALOHA AIRLINES, INC.
VICKERS VISCOUNT MODEL 745D, N7415
HONOLULU INTERNATIONAL AIRPORT
HONOLULU, HAWAII
AUGUST 8, 1971

SYNOPSIS

Aloha Airlines Flight 845, a Vickers Viscount 745D, N7415, was a regularly scheduled passenger flight from Hilo, Hawaii, to Honolulu, Hawaii. Flight 845 departed Hilo at 1630 Hawaii standard time, on August 8, 1971, and following a routine and uneventful flight landed at Honolulu at 1724. There were 17 revenue passengers, two nonrevenue passengers, and a crew of three aboard the flight.

After the flight landed at Honolulu, and following her arrival announcement, the stewardess observed smoke midway in the cabin and immediately informed the captain. The presence of smoke was confirmed and the captain immediately stopped the aircraft and notified the control tower that he had a fire aboard. The forward passenger door was opened and the passengers were ordered to deplane. Passengers and crewmembers descended to the taxiway by means of the air stairs. There were no injuries to passengers or crewmembers. Airport firefighting equipment arrived on the scene within 2 minutes of notification and the fire was brought under control within 3 minutes 30 seconds of their arrival. Investigation showed that the cockpit and cabin interior, including seats, rugs, wall and overhead coverings, were severely damaged by fire and excessive heat due to a thermal runaway of the left Sonatone nickel-cadmium aircraft battery.

The National Transportation Safety Board determines that the probable cause of this accident was an undetected electrical short within the left nickel-cadmium aircraft battery, which resulted in the absorption of an increasing amount of heat energy over an unknown period of time and progressed to a state of thermal runaway.

Coordinated efforts by the Board and the Federal Aviation Administration (FAA) resulted in the issuance of Airworthiness Directive 71-21-5, applicable to the operators of turbine-powered aircraft having a primary electrical system that includes nickel-cadmium batteries containing any polystyrene cell cases.

The Board recommends that the FAA issue an Airworthiness Directive requiring owners/operators of U. S. registered Viscount aircraft to comply with modifications proposed by the British Aircraft Corporation relative to fire precautions in Underfloor and Electric Bay Regions of the 700, 800, and 810 series Viscount aircraft.

INVESTIGATION

Aloha Airlines Flight 845 departed Hilo, Hawaii, at 1630 ^{1/} on August 8, 1971, on an instrument flight rules (IFR) flight plan to Honolulu, Hawaii. Shortly after departure, the captain cancelled the flight plan and proceeded in accordance with a visual flight rules (VFR) flight plan via the same route. The flight was conducted at an altitude of 10,500 feet and was routine and uneventful until after the landing at Honolulu International Airport.

Flight 845 contacted the Honolulu Airport tower at 1721:20 and was cleared to land on Runway 4R. The landing was accomplished at approximately 1724:00. During the landing roll the captain noticed an unusual odor and discussed it with the first officer. It was decided that the odor was caused by engine fumes coming from the fresh air inlet due to a quartering tailwind. The circulation fan was then turned off. Following the landing rollout, the crew taxied left onto Taxiway "E", crossed Runway 4L and held as directed at Runway 8 for a landing American Airlines Boeing 707. Flight 845 was then cleared by ground control to cross Runway 8 and to follow the American Airlines 707. The crew then taxied left onto Taxiway "A" and, shortly thereafter, the stewardess came forward and informed the captain that there was smoke in the vicinity of seat row 4 on the left side. Acting on the captain's orders, the first officer checked the cabin and verified the presence of smoke. At 1727:30, the crew requested ground control to check the right side of the aircraft for smoke. Prior to a ground control acknowledgement of this request, Flight 845 transmitted, "Shutting down, bring out the fire stuff." The captain stopped the aircraft immediately and ordered that the air stair door be opened. After the engines were shut down and all electrical switches were turned off, the first officer was ordered to proceed to the bottom of the stairs to direct passengers away from the aircraft and the rotating propellers ^{2/}. As the captain started to leave his seat, he noted that he could move the control wheel to the full aft position although the control lock had been engaged following the landing rollout, about 2 minutes earlier. After all passengers had deplaned, the captain entered the partially smoke-filled cabin and made a positive check that everyone had evacuated. At no time did the captain observe any fire. The captain then deplaned and directed the passengers to an area farther away from the aircraft. The airport emergency equipment arrived at this time and began to direct foam into the cabin. A total of 11 pieces of firefighting equipment responded and dispensed 165 gallons of foam liquid, 1,500 pounds of CO₂ and approximately 3,600 gallons of water to control the fire.

^{1/} All times used herein are Hawaii standard based on the 24-hour clock.

^{2/} Continued propeller rotation is due to the spool-down time of the engines

The aircraft interior was severely damaged by fire, heat, and smoke. The most severe fire and heat damage existed in the passenger compartment in the vicinity of seat row 4. The intensity of damage throughout the cabin was more extensive at the ceiling level than on the lower side wall structure.

The area below seat 4B had a hole about 21 by 31 inches burned through the wood floor. The left aircraft battery tray located in the electrical compartment directly below the hole was visible. The left nickel-cadmium battery, while in a smoldering state, was removed from the tray by a company mechanic during the final phase of the firefighting, approximately 10 minutes after smoke was first detected onboard the aircraft. Damage to the area below the cabin floor was limited to the left side of the electrical compartment located immediately below seat row 4. That portion of the aileron, elevator and rudder control push rods (approximately 16 inches) located about 11½ inches above the left battery had melted away, as did three floor support stringers. Fuel and hydraulic systems showed no evidence of system leakage which could have fueled the fire.

The Sonatone nickel-cadmium battery, type CA-20H, which had been removed from the left side of the aircraft, was examined. The battery was severely charred and discolored by heat and fire. The polystyrene cell case material had melted and solidified in the bottom of the battery case. A solidified flow pattern of this material through the battery case viewing ports was also evident. All external battery case damage was above these viewing ports.

The battery on the right side, a Marathon nickel-cadmium, type CA-20H, which contained nylon cell cases was subjected to detailed shop inspection and tests. The battery was found to be in a state of complete discharge. However, this battery recovered full charge after a deep cycle process as recommended by the manufacturer.

Electrical tests conducted on the aircraft wiring and the electrical generating system disclosed no malfunction or failures except those failures attributable to the fire and heat.

The near complete destruction of the nickel-cadmium battery installed on the left side precludes a determination of the mechanics of the internal failure which resulted in a thermal runaway.

A thermal runaway is a condition in which a battery on constant-potential charge at elevated temperature destroys itself due to internal heat generation which is caused by the high overcharge currents in constant-potential charging. These high currents increase the battery temperature, causing higher currents, in turn resulting in higher temperatures and even higher currents, ending in destruction of the battery.

Aloha Airlines, Inc., does not require the use of batteries for engine or auxiliary power unit starting. The batteries are normally used for only short periods of time between the stopping of engines and the plug-in of the external power unit. The batteries on all Aloha Airlines, Inc., Viscounts are disconnected after each daily termination flight to preclude the possibility of power remaining on the aircraft overnight.

Aloha Airlines, Inc., Maintenance Department requires the removal of the nickel-cadmium batteries monthly for a service check. Both batteries on the aircraft at the time of the accident were placed aboard on July 17, 1971, and remained on the aircraft without reported discrepancy until the accident.

The Company Operations Manual requires a battery voltage check by the pilot on the originating flight each day. Although this check will not indicate the physical condition of a battery, it nonetheless will reveal if a battery is in a low state of charge. This check was performed prior to the originating flight of Viscount N7415 on August 8, 1971, and also before the aircraft's departure from Hilo, Hawaii, prior to its final flight. In both instances the voltmeter indicated normal voltage (above 21 volts).

The crewmembers were regularly employed by Aloha Airlines, Inc. They were properly certificated for the type equipment and operation involved. Refer to Appendix B for further information.

The aircraft was a Vickers Viscount, S/N 113, identification N7415, owned and operated by Aloha Airlines, Inc., Post Office Box 9038, Honolulu, Hawaii. It had operated a total of 31,354:59 hours, including 2257:35 hours since the last major inspection and 155:55 hours since the last line maintenance. The aircraft was properly maintained and all applicable Airworthiness Directives were complied with. Refer to Appendix C for additional pertinent details.

ANALYSIS AND CONCLUSIONS

Maintenance and operational techniques used for charging batteries while installed on Viscount aircraft were reviewed. Aloha Airlines, Inc., follows the manufacturer's preventative maintenance instructions for nickel-cadmium batteries. The batteries are reconditioned as recommended by the manufacturer. Pilot techniques for charging batteries while aircraft are on external power are similar to those used by maintenance personnel for the daily inspection of aircraft. Aloha Airlines, Inc., records showed that on June 3, 1971, a change had been made in the shop rotation of nickel-cadmium batteries from a 2-month cycle to a 1-month cycle. Additionally, an interoffice memorandum dated July 7, 1971, to all pilots and all

maintenance personnel stated the procedures to be followed in the event of cadmium-battery overheat. This memorandum resulted from FAA GENOT (General Notice) 8340.116, subject: "Nickel-Cadmium Battery Overheating and fires."

Considering the operational requirements and practices of Aloha Airlines, Inc., in conjunction with an in-depth review of their maintenance program, it appears quite evident that the batteries on all company Viscount aircraft are not heavily used and are maintained in accordance with the manufacturer's recommended requirements. In view of the foregoing, it is concluded that company operational demands and maintenance procedures can be eliminated as contributing factors in this accident.

The air circulation pattern when the aircraft's pressurization system is in operation makes it difficult to determine the time that the battery malfunction began. The pressurization system in this aircraft forces air from the cabin into the baggage compartment, aft through the electrical and hydraulic compartments, then overboard through the outflow valves located in the aft underside of the aircraft. Smoke or fumes originating in the batteries during flight would dump overboard through normal air circulation and the odor would not enter the cockpit until after the aircraft had landed and the cabin pressurization system spill valves were opened. In this case, the crew smelled a burning odor while the recirculation fan was on after landing; however, when the fan was turned off the odor dissipated.

During the landing rollout and the subsequent taxi to the terminal there was minimum movement of air within the aircraft because the pressurization system spill valves were closed and the recirculating fan had been switched off. In this configuration with the battery in a state of thermal runaway one or both of the following sequence of events developed: (1) The polystyrene cell case material heated by the thermal runaway ignited and emitted fire and smoke through the battery case viewing ports, or (2) the cell case material was heated to its decomposition temperature giving off a highly volatile styrene gas which was ignited by the hot battery and in turn ignited the polystyrene cell cases. The smoke/fumes from the shorted battery then began to seep into the cabin through vent holes below the windows at seat A rows 4 and 5 and 6 was observed by the seat occupants.

The exact time of the initial battery malfunction cannot be ascertained; however, the flight control push rods located a short distance above the left battery had not been burned through at the time the flight control lock was engaged following the landing rollout. Control lock engagement in this aircraft is made at the flight control surfaces, and control yoke movement from the forward position (normal position

following runway touchdown) to the neutral (engage) position was necessary before engagement could be made. Therefore, the flight control push rods were burned and melted by fire originating from the left-hand battery between the time the aircraft was turned from the landing runway end the time the captain assisted himself out of his seat by pulling on the locked control yoke. The elapsed time between these two occurrences was approximately 2 minutes, which attests to the extreme intensity of the battery fire.

PROBABLE CAUSE

The National Transportation Safety Board determines that the probable cause of this accident was an undetected electrical short within the left nickel-cadmium aircraft battery, which resulted in the absorption of an increasing amount of heat energy over an unknown period of time and progressed to a state of thermal runaway.

CORRECTIVE ACTION

This accident is the most recent in a series of nickel-cadmium battery fires which the National Transportation Safety Board has investigated. As a result of this and the previous similar accidents, the Board continues an in-depth involvement in a National Bureau of Standards program aimed at an analysis of these battery failures with a view toward a discovery of the failure mechanism.

Coordinated efforts by the Board and the Federal Aviation Administration resulted in the issuance of Airworthiness Directive 71-21-5, applicable to the operators of turbine-powered aircraft having a primary electrical system that includes a nickel-cadmium battery containing any polystyrene cell cases. This Airworthiness Directive requires the continued periodic inspection of all in service batteries for evidence of heat damage until such time as the listed battery changes are effected. The required battery changes must be complied with prior to April 15, 1972, or prior to a specified in service time, depending upon the rated ampere hour capacity of the battery. The Federal Aviation Administration also issued Advisory Circular AC 00-33, dated August 26, 1971, subject: "Nickel-Cadmium Battery Operational, Maintenance, and Overhaul Practices." This circular provides guidelines for more reliable nickel-cadmium battery operation through sound operational and maintenance practices.

As a result of this and other fires which have occurred aboard Viscount aircraft, the British Aircraft Corporation of England is contemplating issuing engineering changes on the subject of Fire Precaution Modifications to the Underfloor in the Electric Bay Region for all Viscount series aircraft. Pending the finalization of such engineering changes,

the Board recommends that the Federal Aviation Administration issue an Airworthiness Directive to require accomplishment of the following items by operators of U. S. registered Viscount aircraft.

1. Install steel flight control push rods in the electrical compartment area.
2. Shield the electrical components in the aft section of the electrical compartment.
3. Attach aluminum reflector material to the underside of the cabin floor in the electrical compartment area.

BY THE NATIONAL TRANSPORTATION SAFETY BOARD:

4
/s/ JOHN H. REED
Chairman

/s/ OSCAR M. LAUREL
Member

/s/ FRANCIS H. McADAMS
Member

/s/ LOUIS M. THAYER
Member

/s/ ISABELL A. BURGESS
Member

December 29, 1971

APPENDIX A

NOTIFICATION AND INVESTIGATION

1. Investigation

The National Transportation Safety Board received notification of the accident at 0130 Pacific daylight time, on August 9, 1971. The Investigator in Charge was dispatched immediately to the scene from the Oakland, California, Field Office. One Air Safety Investigator was dispatched from the Board's Aircraft Factors Branch in Washington, D. C., to assist in the investigation. Two working groups were established: (1) Operations and Witnesses, and (2) Systems and Structures. Parties to the investigation were: Aloha Airlines, Inc., the Federal Aviation Administration, and the Air Line Pilots Association. The on-scene investigation was completed on August 14, 1971. Additional investigative activities were conducted at the National Bureau of Standards between September 16, 1971, and September 30, 1971.

2. Hearing

A public hearing was not held.

3. Preliminary Reports

An interim report was not issued.

APPENDIX B

CREW INFORMATION

Captain James J. Feeney, aged 43, held Airline Transport Pilot Certificate No. 1321004. His first-class medical certificate dated June 29, 1971, listed no limitations. Captain Feeney held type ratings for the Douglas LE-3, Fairchild F-27/227; Vickers Viscount; British Aircraft Corp. BAC 1-11 and the Boeing 737. He was employed by Aloha Airlines, Inc., on June 6, 1957, and was upgraded to Viscount 745D Captain on April 9, 1965. As of August 8, 1971, he had accumulated a total of 11,800 hours, of which 3,081 hours were flown in the Viscount 745D aircraft. His last proficiency flight check was completed on May 6, 1971. His date of birth was August 4, 1928.

First Officer James S. Haruguchi, aged 32, held a Commercial Pilot Certificate No. 1673204, with airplane single engine land and instrument ratings. His second-class medical certificate dated May 1, 1971, listed no limitations. He was employed by Aloha Airlines, Inc., on May 7, 1966, and was upgraded to Viscount 745D First Officer on June 3, 1966. As of August 8, 1971, his total flying time was 3,689 hours of which 1,263 hours had been accumulated in the Viscount 745D aircraft. His last proficiency flight check was completed on July 4, 1971. His date of birth was July 25, 1939.

Stewardess Keiko Basalio was employed by Aloha Airlines, Inc., on June 5, 1971. Prior to her employment, Miss Basalio completed a 40-hour Aloha Airlines, Inc., Flight Attendant Indoctrination Course and a 10-hour ground school training course in the Viscount systems pertinent to her duties. This training was completed on May 21, 1971. Her initial check flight was completed satisfactorily on June 14, 1971.

AIRCRAFT INFORMATION

Viscount 745D series.

Registration No. N7415.

Serial No. 113.

Date of Manufacture: March 13, 1956.

Total Airframe Hours: 31,354.59.

Pertinent company records show that Aloha Airlines, Inc., purchased the aircraft from Austrian Airlines on April 19, 1963. The aircraft interior was renovated by Marshalls Flying School, Cambridge, England, in accordance with company work order MCE #134. This interior refurbishing was directed by an Aloha Airlines, Inc., representative. Viscount N7415 was received by Aloha Airlines, Inc., on June 18, 1963, and Federal Aviation Administration Airworthiness Certificate No. 146-5 was issued on the same day. Following receipt of the aircraft the company installed 48 Burn Aero B-1600 passenger seats. These seats were approved in accordance with FAA TSO (Technical Standard Order) C-39. NO further interior changes were made to the date of the accident.

This aircraft is maintained under an FAA approved continuous maintenance program and is progressively overhauled under the block overhaul system.

The inspection check periods are:

1. Daily Inspection. This check is performed once in each 24-hour period.
(Battery Voltage Check included in Daily Inspection.)
2. Cycle Inspection. These are known as the Nos. 1, 2, 3 and 4 cycles and are conducted in sequence at 200 flying hour intervals.
3. Airframe Overhaul. Established on a recurrent fixed time basis of 12,600 hours.

Component Maintenance. Nickel-cadmium batteries are rotated through the shop for deep cycle each month. Effective date of this procedure was June 3, 1971.

The Aloha Viscount battery cables are disconnected at the battery after the daily termination flight.

Aloha Airlines, Inc., had issued an inter-office memo, 7 July 1971, to all pilots and maintenance personnel informing them of the contents of FAA General Notice 8340.116, date 11 May 1971, subject: Nickel-Cadmium Battery Overheating and Fires.

Airworthiness Directives. All Airworthiness Directives applicable to the Viscount 700 series commencing with No. 55-22-4 through 70-11 were complied with.