

DIRECCIÓN GENERAL DE TRANSPORTE AÉREO

AIRCRAFT ACCIDENT REPORT

AVIATECA FLIGHT 901

BOEING 737-200

15 MILES NE EL SALVADOR INTL ARPT

SAN SALVADOR, EL SALVADOR

AUGUST 9, 1995

1.1 HISTORY OF FLIGHT.

On August 9, 1995, at approximately 2014 local time (0214 UTC August 10, 1995)¹, a Boeing 737-200, United States registration N125GU, was destroyed on impact with terrain 15 miles northeast of San Salvador International Airport, San Salvador. The flight was on an instrument flight plan operating in instrument conditions when it collided with the side of the San Vicente (Chichontepec) volcano. The aircraft was being operated by Aviateca, S.A., the national airline of Guatemala, which operates as a domestic and international airline. All of the 7 crewmembers and 58 passengers were fatally injured. The flight, operating as Aviateca Flight 901 (GU901), was on an IFR flight plan from La Aurora International Airport, Guatemala City, Guatemala to San Salvador International Airport, San Salvador, El Salvador. Thunderstorms existed at the time of the 14 CFR 129 flight and the aircraft had deviated from airway G436 to the north to avoid these storms.

The aircraft was owned by CIT Leasing Corporation, 1211 Avenue of the Americas, New York, New York, 10036 and leased to Aviateca, S.A.

Flight 901 departed Miami, Florida, at 1456 and made a scheduled stop at La Aurora International Airport, Guatemala City, Guatemala. The flight had a scheduled departure time of 1815 from La Aurora, however, the flight was delayed by aircraft maintenance (the #4 main brake assembly had to be changed). The flight departed Guatemala City (MGGT) at 1948.

The initial weather briefing was completed with the Captain of flight 901 by the MGGT dispatcher at 1730. Since the flight did not depart on schedule the Captain was provided a

El suscrito Notario CERTIFICA la fidelidad y conformidad de la presente fotocopia con el Original que tuvo a la vista y para los efectos del Art. 30 de la Ley del Ejercicio Notarial de la Jurisdicción Voluntaria y de otras Diligencias, extendiendo, firmo y sello la presente, en la ciudad de San Salvador, a los

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weather update at 1912. After the aircraft departed the crew called in and were given updated weather information indicating thunderstorms and rain at their destination, San Salvador (MSLP). ATC clearance delivery and "company" communications are not recorded.

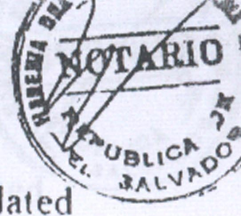
The destination of Flight 901 was San Salvador International Airport (MSLP), with Managua (MNGA) as the alternate. The route of flight as listed on the flight plan was NO385 F170 DCT AUR G436 OTAMI DCT ALERA DCT. This route utilizes flying the Guatemala VOR (TGE) radial 126 to the El Salvador border (OTAMI), direct to ALERA, then direct to either the LAN radio beacon or the CAT VOR, depending upon the ATC clearance on arrival. The total distance is approximately 110 nautical miles or about 27 minutes of flying time.

The Air Traffic Control (ATC) transcript indicates that the crew of flight 901 contacted Salvador Approach control at Otami intersection at 1959 hours stating that they were at Flight Level 170. They were cleared to LAN, the non-directional beacon and Initial Approach Fix (IAF) for the Instrument Landing System (ILS) approach to Runway 07 at MSLP. Flight 901 was told to "Expect ILS one five arc zero seven..." and were told they could descend and maintain 11,000. They then asked for weather and were given the 2000 weather observation which was obtained by the controller as they were talking. The weather observation as transmitted to the flight included wind from 070, at 5 knots gusting 16, visibility more than 10 kilometers, rain, clouds broken at 3,700, scattered at 3,700, cumulonimbus "around", showers to the south, (clouds) broken at 17,000, altimeter 29.84, temperature 27, and light rain over the station.

About 3 minutes after obtaining the weather the flight crew of flight 901 requested "deviations because of bad weather cells please on discretion." The controller then asked the flight to confirm whether the deviations would be to the north or south of the airway. The crew of flight 901 responded that the deviations would be to the north of the airway. After confirming the transmission, the controller asked the flight to notify him when they were abeam of the ALERA intersection, which is located 31 miles northwest of LAN on the 306 radial. The flight crew of flight 901 then confirmed the transmission.

About 2005 the approach controller, after receiving a transmission from flight 901 that they were at the ALERA intersection and "arriving 11,500 for 11,000", asked the flight to confirm that they were deviating to the left. The flight crew of flight 901 confirmed that they were going to the left. He then asked "which radial are you crossing or are you established inbound" to which flight 901 responded "we are on the 300... on the radial 300." The flight was then given clearance to descend and maintain 8,000 feet and report at 15 DME. They responded by repeating the clearance and adding that they were on the 310 radial.

About 2 minutes later the El Salvador approach controller asked flight 901 to confirm the inbound radial they were on. The flight crew responded stating that they were on the 315 radial. The controller then stated "Confirm if it's possible to establish a 15 DME arc for runway 07?" to which the flight crew gave a positive response. Shortly thereafter they transmitted that they were level at 8,000 to which the controller asked them to "notify commencing the 15 mile arc."



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About 2 minutes later the El Salvador approach controller asked flight 901 to confirm the inbound radial they were on. The flight crew responded stating that they were on the 315 radial. The controller then stated "Confirm if it's possible to establish a 15 DME arc for runway 07?" to which the flight crew gave a positive response. Shortly thereafter they transmitted that they were level at 8,000 to which the controller asked them to "notify commencing the 15 mile arc."



Approximately 2008 the flight crew of flight 901 requested to fly directly to the CAT VOR (co-located at MSLP) due to bad weather. The controller responded to notify him 15 DME out and maintain 8,000. Shortly thereafter the controller asked which radial the flight was crossing to which the flight crew transmitted "320." About 2009 the controller informed the flight that there was a storm over the station and about another minute after that the flight indicated that they were 13 DME and that they were deviating to the left due to bad weather.

After a briefing in the cockpit concerning entrance to an inbound radial of 065 and departure on the 245 (which, coincidentally, are the inbound and outbound headings for the holding pattern located west southwest of the airport), shortly prior to 2011 the flight crew of flight 901 requested "the 12 mile arc over 135, to the right for the 07." The controller then cleared the flight to descend and maintain 5,000 feet and "clear at the time 11 for procedure ILS 12 mile arc 07. Notify over the station." The flight crew of flight 901 then reported leaving 8,000 and 12 miles. The controller then asked what radial they were crossing to which they responded 360. About a minute later the flight crew of flight 901 transmitted that they would maintain the arc of 12 miles because of bad weather. The controller responded "understand on the arc of the south" to which the flight stated "correct." The controller then asked their position and the flight crew responded "at the moment we are in the 020" and later added that they were 12 miles away. About 2013 the approach controller asked flight 901 to "notify passing abeam the station..." to which the flight crew of flight 901 responded "we are abeam the station at the present right now at the 030..."

At 2013:38 the flight crew of flight 901 transmitted that they had reached 5,000 feet. This was the last transmission received from flight 901. At 2013:44 the CVR records the sounds of the Ground Proximity Warning System (GPWS) which continue until the sound of impact at 2013:56. Five seconds after the GPWS starts the captain says "let's go up." At 2013:55 the captain says "let's go up... we are climbing, tell him."

The wreckage was located on a 120 degree heading at 13°, 35', 57" north latitude, 88°, 50', 58" west longitude, approximately 5600 feet elevation. The time of the accident was about 2014 local time, during evening hours.

Included in the 58 passengers were 2 retired FAA inspectors, 2 Aviateca mechanics, the director of security for the company, and 2 foreign Ambassadors.

1.2 INJURIES TO PERSONS

All occupants were fatally injured during the impact sequence. There were no injuries to ground personnel.

1.3 DAMAGE TO AIRCRAFT

The aircraft was destroyed by impact damage and a post-crash fire.

1.4 OTHER DAMAGE



Not Applicable.

1.5 PERSONNEL INFORMATION

The Captain, age 39, was hired by Aviateca in September of 1989. The Captain was in the Guatemala Air Force for 10 years when he retired and joined Aviateca. The First Officer was also in the Air Force for 11 years until he left in 1991 and subsequently joined Aviateca in 1992. There was no evidence in the company files for either the Captain or First Officer of any drug or alcohol related difficulties, absenteeism, or any other adverse actions taken by the company. Both pilots possessed the required U.S. Airmen Certificates (FAR Part 61.77 & ICAO Annex 1) to operate U.S.-Registered aircraft in international air commerce and Guatemala airmen certificates. Both pilots possessed unrestricted First Class medical certificates: the Captain's was dated 04/24/95 & the First Officer's 05/26/95.

Training records for both pilots indicated the following:

Both pilots received ground school recurrent training on 03/22/95.

The Captain received the two ICAO Annex 6 paragraph 9.4.4 mandated proficiency evaluations on 07/30/95 and 01/26/95.

The First Officer completed initial B-737 flight training and was recommended for a proficiency check on 06/08/92. On 02/20/94 and 02/16/95 he completed his proficiency checks.

Both pilots received an annual line evaluation, the Captain on 10/19/94, and First Officer on 11/15/94.

The following information pertains to the flight crew:

	<u>Captain</u>	<u>First Officer</u>
Date of Birth:	11/06/55	05/26/59
Position:	Captain	First Officer
Date of Hire:	09/08/89	05/10/92
Initial training Capt:	01/09/90	SIC 05/22/92
Total Flying Hours:	9,828.41	4,696.47
Hours 1994:	460:37	473.53
Hours 1995:	243:19	354.39
Last 12 mo.:	415:58	545:48
Last 6 mo.:	340:59	354:39
Last 30 days:	57:48	45:42
24 hr. prior to Flight:	None	None
Rest period before the accident:	47 hours	23 hours 30 minutes

Aviateca has three flights per day to San Salvador which allows for each pilot to be scheduled for approximately four flights into SAL each month. The last flight into San Salvador for the Captain was Flt 901 of 08/05/95.



1.6 AIRCRAFT INFORMATION

The transport category airplane, serial number 23849, fuselage line number 1453, was manufactured by Boeing Aircraft Company on October 11, 1987. The airplane was originally owned by International Finance Leasing Corporation and operated by Malaysian Airlines. It was bought by CIT Group in March 1995 and operated by Aviateca Airlines. The airplane was currently registered in the United States as N125GU. Total time on the airplane was 16,645 hours and 20,323 cycles.

The airplane was equipped with two Pratt & Whitney engines, one JT8D-15A and the other JT8D-15, serial numbers P-717172B and P-688682B, respectively. The number one engine, installed on August 30, 1993, had accumulated a total of 12,939 hours and 16,527 cycles. The last hot section inspection (HSI) was completed on March 31, 1992, by Ishikawa Production and Overhaul Group in Japan. Time since last HSI was 4182 hours and 4699 cycles. The number two engine, installed on May 13, 1995, had accrued a total of 28,894 operating hours and 35,167 cycles. The last overhaul was completed on March 2, 1995, by Aerothrust Corporation in Miami, Florida. Time since the last overhaul was 442 hours and 437 cycles.

The airplane was configured for 123 passengers, with a maximum occupancy of 129 persons. The departure gross weight was calculated to be 93,050 pounds. That weight included 9,860 pounds for the passengers, 5390 pounds for the cargo, and 17,000 pounds for the fuel. The estimated landing weight was calculated as 90,352 pounds. The maximum allowable takeoff weight for this flight was 109,200 pounds, with a maximum allowable landing weight of 107,000 pounds. The documented load was within CG limits, both for takeoff, and at the time of the accident.

The airplane was equipped with a Sundstrand Mark II ground proximity warning system. This system provides a warning of imminent inadvertent contact with the ground in the following modes of aircraft operation:

1. Excessive rates of descent.
2. Excessive closure rate to terrain.
3. Negative climb rate or altitude loss after takeoff.
4. Flight into terrain when not in the landing configuration.
5. Excessive downward deviation from an ILS glideslope.

The aural warning for modes 1 through 4 is the sound "whoop-whoop," followed by "pull-up." The aural warning for mode 5 is the annunciation "glide slope." These warnings will continue until the hazardous condition ceases to exist. The warning indications on this system are automatically deactivated when the airplane is configured for landing, and no ILS glide slope is available.

A review of the maintenance records disclosed that the most recent inspection conducted was an "A" check (due at 125 hour interval), performed on July 28, 1995. The last "B" check

(500 hour interval) was completed on May 23, 1995. The last "C" check (3,000 hour interval) was completed on May 23, 1995. All scheduled inspections/maintenance is performed at the airline's maintenance hangar at La Aurora International Airport (GUA).

Copies of the aircraft logbook pages dating back to March 1, 1995, were reviewed by the investigation team. There were no maintenance discrepancies remaining uncorrected that would have adversely affected the performance of the aircraft or the ability of the flight crew to perform their required duties.

1.7 METEOROLOGICAL INFORMATION

1. Surface Weather Observations

Surface weather observations for San Salvador International Airport are taken by certified weather observers. The weather observing station is located on the third floor of the Terminal Building. Following are pertinent Aviation Routine Weather Reports (METAR) taken from the weather observations form (times in UTC and altimeter settings in hectoPascals [hPa]) for August 10, 1995:

San Salvador International Airport (MSLP)

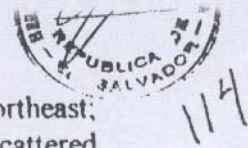
Time--0100; Wind--230 degrees at 7 knots; Visibility--greater than 10 kilometers; Clouds--3,000 feet broken 3,700 feet scattered cumulonimbus 17,000 feet scattered; Temperature/Dew Point--28°/26° C; Altimeter Setting (QNH)--1006.9 hPa; Remarks--lightning from east/north/northwest

Time--0200; Wind--070 degrees at 8 knots; Visibility--greater than 10 kilometers; Weather--light rain showers; Clouds--3,700 feet broken, 3,700 feet scattered cumulonimbus, 17,000 feet broken; Temperature/Dew Point--27°/21° C; Altimeter Setting--1008.7 hPa; Remarks--cumulonimbus lightning around, thunderstorm south

Time--0300; Wind--340 degrees at 12 knots; Visibility--5,000 meters; Weather--thunderstorm, light rain; Clouds--3,700 feet broken, 3,700 feet scattered cumulonimbus, 17,000 feet broken; Temperature/Dew Point--23°/21° C; Altimeter Setting--1009.8 hPa; Remarks--thunderstorm at the station and around

Weather observations were also taken at Ilopango, San Salvador. Ilopango is located about 15 nautical miles north northwest of the San Salvador International Airport. Following are transmitted observations from Ilopango:

Ilopango (MSSS)



Time--0055; Wind--180 degrees at 12 knots; Visibility--8,000 meters north/northeast; Weather--thunderstorm moderate rain vicinity; Clouds--2,700 feet scattered 4,000 feet scattered cumulonimbus 17,000 feet broken; Temperature/Dew Point--24°/23° C; Altimeter Setting--1013 hPa.

Time--0150; Wind--040 degrees at 12 knots; Visibility--4,000 meters; Weather--thunderstorm moderate rain; Clouds--2,300 feet scattered 3,000 feet broken 4,000 feet scattered cumulonimbus; Temperature/Dew Point--22°/21° C; Altimeter Setting--1015 hPa.

Time--0250; Wind--160 degrees at 6 knots; Visibility--5,000 meters; Weather--thunderstorm moderate rain; Clouds--2,700 feet broken 4,000 feet scattered cumulonimbus 20,000 feet broken; Temperature/Dew Point--22°/21° C; Altimeter Setting--1015 hPa.

The investigation revealed that the ceilometer at the weather observatory at San Salvador International Airport was inoperable at the time of the accident and had been broken for some time. An interview with one of the weather observers at the MSLP weather observatory by the investigation team on August 15, 1995, revealed that the techniques for estimating cloud heights were to request pilot reports through the tower and to estimate cloud bases by comparing cloud bases to known terrain elevations. The teletype machine, which receives weather information from the National Weather Service (NWS), Washington, D.C., had been out of service for several days before the accident. The weather observer stated that the temperature and dew point sensors were somewhat unreliable and that those values were determined manually. Weather observations were disseminated long-line through a teletype circuit. Locally, the weather observations were telephoned to the tower controllers. The weather observer stated that the only weather information available to an observer at the San Salvador International Airport after 6:00 P.M. was from Ilopano.

The investigation team toured the San Salvador International Airport Tower. Tower personnel have wind information readouts available from both ends of runway 07-25. The tower also has an altimeter setting indicator. The tower controller on duty during the accident of Flight 901 did not remember the maximum wind gust around the accident time.

2. Weather Radar/Pilot Interview

No ground weather radar was available from the San Salvador area.

The Captain of TACA flight 211 that landed at San Salvador International Airport about 2000, on August 9, 1995, reported observing his weather radar during his flight from Guatemala City, Guatemala. He stated that he mostly observed red, a little magenta, some yellow, and very little green on his airplane color weather radar. He indicated that the most intense radar return was shown by magenta, followed by red and yellow. The least intense returns on his weather radar was denoted by green. His company policy was to avoid flying into magenta or red areas.

The pilot described the weather as a "wall of weather northeast-east of San Salvador moving to the southwest." He indicated that, while on approach to runway 07, he encountered windshear at 600 feet AGL and lost 25 knots of airspeed. He further said that, in his opinion, weather similar to that only occurred once or twice a year.



3. Winds and Temperatures Aloft

No upper air sounding data were available for the El Salvador area.

4. Terminal Aerodrome Forecast (TAF) Issuance's

Following is the TAF prepared by the Departamento De Sinóptica y Aeronáutica at Ilopango, San Salvador, valid during the period beginning 0000 UTC August 10, 1995:

0000 UTC Wind 240 degrees at 8 knots; visibility exceeds 10 kilometers; 3,000 feet scattered 3,700 feet scattered cumulonimbus 30,000 feet scattered

Temporary 0300-1000 Wind 360 degrees at 7 knots; 3,300 feet scattered 4,000 feet scattered cumulonimbus 12,000 feet scattered; probability 30 percent drizzle

Becoming 1600-1800 Wind 090 degrees at 8 knots; 4,300 feet scattered 30,000 feet broken

Becoming 2000-2200 Wind 180 degrees at 9 knots; 3,000 feet scattered 3,700 feet scattered cumulonimbus 30,000 feet broken

1.8 AIDS TO NAVIGATION

Air Traffic Control operates in a non-radar environment in El Salvador. All navigational aids pertinent to this flight were reported as operating normally. The airplane was expected to execute an ILS approach to runway 07 at MSLP.

1.9 COMMUNICATIONS

There were no known air-to-ground communications difficulties.

The cockpit voice recorder (CVR), to include air traffic control transmissions between El Salvador Approach Control and the flight crew of AVIATECA 901 is included in appendix C of this report.

1.10 AERODROME INFORMATION

San Salvador International Airport is located about 12 miles southeast of the capital of El Salvador, San Salvador. The only instrument runway is 7-25, which is 10,500 feet long and 148 feet wide. The surface of the runway is concrete and both runways are equipped with High Intensity Runway Lights (HIRL) and 3-bar Visual Approach Slope Indicator (VASI).

Although not applicable to the investigation, examination of the airport revealed the lack of a back-up power supply for the outer marker.



The aircraft impacted the ground on the 046 degree radial of the El Salvador VOR, approximately 15 nautical miles northeast of the VOR. The sector altitude as noted on the ILS approach plate for runway 07 at MSLP for the site where the airplane came to rest was 8200 feet.

1.11 FLIGHT RECORDERS

1.11.1 COCKPIT VOICE RECORDER

The aircraft was equipped with a Fairchild (model unknown) cockpit voice recorder (CVR). The tape drive unit and its enclosure were recovered and transported to the NTSB laboratories in Washington, D.C. The interior of the container and the tape sustained no heat or impact damage. Examination and testing of the CVR revealed that the recorder was operative at the time of the accident and a transcript was generated from 25:50 minutes of the 31:00 minute recording and is provided in appendix B.

The recording consists of three channels of audio information. One channel contains the cockpit area microphone information. The other two channels contain the Captain and First Officer information. Timing of the recorded events was established using the known time of an air traffic control transmission.

The transcript starts at 1947:52 El Salvador standard time (EST) and continues uninterrupted until 2013:57 EST when electrical power is removed from the unit. When the transcript starts, the crew is preparing for take-off from MGGT. The transcript continues through the initial descent to MSLP and ends upon impact with the terrain. Most of the language on the recording was spoken in Spanish.

1.11.2 FLIGHT DATA RECORDER

The mounting tray holding the FDR was recovered, however the FDR has not been found. A reward was offered for the FDR and flyers distributed in the local towns and around the accident site, however, the recorder has not been recovered.

1.12 WRECKAGE AND IMPACT INFORMATION

The airplane impacted the side of the Chinchontepec Volcano located west southwest of the town of San Vicente. The approximate heading of the ground path of the wreckage was 120 degrees. Examination of damaged trees and terrain at the accident site indicated that the pitch attitude of the airplane through the trees was approximately 10 to 15 degrees nose up during the impact sequence.

The first evidence of impact was found on the center section of a 15 meter high, 12 inch diameter tree. The initial point of impact with the ground was found about 20 meters east of that tree in the area where the number 2 engine came to rest. The coordinates of the initial impact point of the accident site were:



13• 35' 57.3" North Latitude
88• 50' 57.95" West Longitude

The elevation of the initial impact point was approximately 5642 feet.

The major portion of the aircraft structure was located along the ground path in three major areas; the initial impact area, the ravine, and the final impact area, which included the burn area. The length of the accident site was estimated to be two thirds of a mile. The average slope of the ravine was estimated to be about 30 degrees with increases up to 45 degrees in some areas. The steep slope of the site allowed separated structure pieces to slide downhill. The impact forces broadcast parts forward, away from the ground path and into the trees.

All measurements indicated flaps up position. Only two leading edge slat actuators were found indicating both slats were retracted. Two inboard ground spoiler actuators were found below the cliff in the ravine. Both actuators were fully extended. The elevator PCU's were found intact but elevator positions could not be determined because of loss of hydraulic pressure during the impact sequence. The horizontal stabilizer jackscrew measured 17 inches to the lower stop, equivalent to 3 degrees stabilizer leading edge down (6 units of trim). The rudder was found at about 5 degrees to the right. Because of cable separation after impact, this measurement may not be meaningful. The aileron PCU's were found at the forward edge of the burn area about one half mile from the initial impact however loss of hydraulic pressure during the impact sequence made all measurements unreliable for aileron positions. The throttle handles were full forward and bent. The left main gear was found in the gear retracted position. The right main gear was found in the extended position indicating gear retracted. The nose gear actuator was found extended indicating gear retracted.

1.13 MEDICAL AND PATHOLOGICAL INFORMATION

Autopsies and toxicological tests were ordered and performed on the flight crew. The death of the flight crew members was the result of traumatic injuries sustained during the impact sequence. According to the aviation medical examiner, none of the occupant's death was the result of fire, or smoke inhalation.

1.14 FIRE

Examination of the wreckage revealed no evidence of in-flight fire or explosion at the accident site. There was evidence of a post impact fire at the site.

1.15 SURVIVAL ASPECTS

This accident was non-survivable.

1.16 TEST AND RESEARCH

Not applicable



1.17 ORGANIZATIONAL AND MANAGEMENT INFORMATION

Aviateca conducts passenger and cargo carrying operations to and from the U.S (Miami, Houston, & Los Angeles) under 14 CFR 129. Additionally Aviateca operates scheduled flights to Mexico, El Salvador, Nicaragua, Costa Rica, Belize, and Panama. Aviateca does not operate utilizing Long Range NAV, ETOPs, circling approaches, or CAT III approaches. The FAA Flight Standards office having primary responsibility for Aviateca's operations is the Miami International Field Office. The Principal Operations Inspector (POI) and the Principal Maintenance Inspector (PMI) are both out of that office.

Aviateca, S.A. employees about 850 people and reports the following categories and numbers of company employees:

Pilot In Command	<u>26</u>	Maintenance Inspectors	<u>9</u>
Second In Command	<u>24</u>	Certificated Mechanics(A&P's)	<u>24</u>
Check Airmen(Line)	<u>7</u>	Non-Cert. Mech.(DGAC Only)	<u>74</u>
Flight Attendants	<u>67</u>		

Aviateca's U.S. operations specifications authorize three B-737-200 and two B-737-300 aircraft for operation in and out of the United States; N125GU, the aircraft involved in the accident, is one of these aircraft. Aviateca's Guatemala DGAC approved operations specifications reflect five B-737-200 aircraft and six B-737-300 aircraft (5 of the -300 aircraft are operated through an interchange agreement with TACA). The company advises that all the -200 and -300 aircraft have standard configurations and like models have little or no significant differences.

The civil aviation authority of Guatemala (DGAC) was in the process of re-certificating Aviateca in accordance with new Guatemala aviation regulations. Two retired U.S. FAA inspectors were hired as inspectors/consultants to provide major changes to Guatemala Civil Aviation oversight capabilities, such as new regulations, inspector training, airline certification and continuing surveillance, etc. The two individuals were passengers on Aviateca FLT 901 and were fatally injured when the accident occurred.

1.18 ADDITIONAL INFORMATION

As part of the DGAC's process of re-certification of Aviateca, training programs had been submitted to and/or approved by the DGAC. Many of the required programs had not yet been submitted and/or approved. Many training programs were required by ICAO Annex 6 such as: pilot upgrade, transition, initial, instructor, check airman, ground, simulator, flight, emergency, door, flight attendant, dispatcher, mechanics, hazardous materials, aircraft differences, security, etc. The Aviateca Flight Standards & Training Captain was also the pilot in command of flight 901.



There were two air safety inspectors on official business on board flight 901. The principal operations inspector for the Guatemala DGAC and El Salvador DGTA was in the cockpit carrying out an en-route inspection at the time of the crash. The principal maintenance inspector for the Guatemala DGAC and El Salvador DGTA was in the cabin carrying out an en-route inspection at the time of the crash.

1.18.1 CREW RESOURCE MANAGEMENT

At the time of the accident Aviateca did not have it's own Crew Resource Management (CRM) training program. The Captain of the accident flight, in conjunction with an outside consultant, was developing a new CRM training course. In June 1994 the Aviateca flight crew members received CRM training from TACA instructors.

1.18.2 GROUND PROXIMITY WARNING SYSTEM

Ground proximity warning systems are intended to supplement flight instrument data and warn pilots when there is imminent danger of inadvertent ground contact. Specific observations with regard to GPWS are as follows:

Minimum Equipment List (MEL): The MEL allows for the GPWS to be inoperative for dispatch, provided the altitude alert system is working normally and repairs are made within three flight days.

Boeing 737 Operations Manual: Reference the Note: "The GPWS will not provide a warning/alert of flight toward vertically sheer terrain, or of slow descents into unprepared....."

Aviateca Operations Manual: Reference pages 12-7 & 12-8, paragraph 12.1.11
 ".....The GPWS alert is a warning that the crew must immediately focus their attention to terrain proximity and make a determination as to whether the warning is valid. If there is any doubt as to the validity of the warning, positive action to alter the flight path to stop the warning should be initiated immediately. This action is particularly appropriate under the following conditions:

- (a) While maneuvering for an approach at night or in instrument conditions.
- (b) When established on an approach where vertical guidance is unreliable.
- (c) In maneuvering for, or established on, an approach when ambient conditions such as turbulence or wind shear cause the approach to become unstabilized."

Aviateca does not include any GPWS specific training in their simulator/flight training initial or recurrent. They do have "wind shear" training on take-off & approach, plus engine failure on take-off training which does exercise various modes of the GPWS system. Specific training for mode 2 activation's (excessive terrain closure rate) or mode 4 activation's (unsafe terrain clearance, not in landing configuration) is not addressed.



Aviateca, S.A. has a Flight Safety Office which is shared with the Chief Pilot. Each flight crew member has a company mailbox for receiving pertinent information, such as changes to Jeppesen charts, etc. Three company safety bulletins pertinent to this accident investigation were distributed by the company and are as follows:

Winter Is Here: Discussion of the winter season with increased thunderstorms with emphasis on hydroplaning, braking and approach speeds on wet/slippery runways.

Lack Of Communication Causes Mistakes: Specifically the paragraph on altitude deviation on descent emphasizing errors brought about through phraseology with resulting clearance confusion

T.E.A.M.: Approach deviation due to new ILS installation and possible modulating signal errors.



2. ANALYSIS

2.1 General

The Captain of flight 901 was properly certificated and qualified in accordance with applicable Guatemalan regulations, ICAO, and company requirements to conduct the flight. The co-pilot's records documented his initial B-737 qualification, and a yearly proficiency checks. However, there was no evidence of his having received two proficiency checks per year as required by ICAO Annex 6.

The airplane was maintained in accordance with applicable regulations and/or the company's requirements. An examination of the previous logbook pages revealed no record of maintenance discrepancies remaining uncorrected. There was no evidence of preexisting discrepancies or pre-impact mechanical failures of the structure, systems, flight controls, or engines that would have adversely affected the performance of the aircraft or the ability of the flight crew to perform their required duties.

The airplane was equipped with a functional CVR, which provided useful information to aid in the analysis of the accident. Although records indicate the aircraft had a flight data recorder installed and operating, to date it has not been located.



The airplane was properly fueled and the recorded weight and balance figures were within limits. The flight was released in accordance with Aviateca flight following requirements and Guatemalan regulations.

The weather at the destination airport included low ceilings, restricted visibility, and thunderstorm conditions. Pilot reports of thunderstorm activity at various enroute locations had been received by the flight crew and the CVR transcript indicated that thunderstorm activity was observed during the descent phase. The accident occurred when the flight crew of Aviateca flight 901 attempted to deviate from the normal arrival routing in order to avoid this severe weather. The pilot of an airplane landing at San Salvador airport about 14 minutes prior to the accident stated that thunderstorm induced windshear on final approach was moderate with heavy rain.

The El Salvador airspace is a non-radar environment. No malfunctions of the airport landing aids, radio frequencies or communications were reported, and therefore, do not appear to be a factor in the cause of this accident.

The flight crew of Aviateca 901 was familiar with the arrival airport. Their apparent loss of positional awareness with regard to their location relative to the Chichontepec Volcano suggested other areas for investigation and analysis. Consequently, the Direccion General De Transporte Aéreo's investigation attempted to determine why the pilot elected to turn east and accept a lower altitude when he was familiar with the higher terrain in that area. Flight crew training, air traffic control procedures, weather, flight standards, and DGTA oversight were also examined.



2.2 The Company

Aviateca has three flights per day from Guatemala City to San Salvador (MSLP). With the 50 pilots employed by the company this allows for each pilot to be scheduled for approximately four flights into SAL each month. The investigation determined that this schedule provided ample opportunity for all crewmembers to be familiar with the destination airport.

During interviews with the DGTA operations group, company representatives stated that they were not aware of the ICAO Annex 6, paragraph 9.4.4, requirement for both captain and first officer to receive two proficiency evaluations per year. The Direccion General De Transporte Aereo believes that, although proficiency did not appear to contribute to this accident, ICAO rules are established for the overall good of the world aviation community and should be followed as closely as possible.

2.3 The Accident Flight and Crew Performance

Company crew members were interviewed; all were very familiar with the captain and had flown many trips with him. They all commented on his professionalism, not only in the cockpit, but in the classroom as well. In his position as Flight Standards and Training Captain, the captain routinely instructed recurrent training classes. One First officer remarked that the captain believed it was absolutely necessary to do things "by the book", and that he learned something from every flight he flew with him.



In a large portion of the world and particularly in Latin America, an air carrier captain is a position that is highly regarded. In addition to being the Pilot-In-Command (PIC) of flight 901 the Captain was the company's Flight Standards & Training Captain². One could conclude that a person of lesser stature, such as an ATC controller or co-pilot, might find it difficult to correct or disagree with such a Captain. However, all the individuals interviewed felt the captain was an easy going person, comfortable to work with/for, and did not display aloof behavior.

2.4 Weather

The initial weather briefing was completed with the Captain by the dispatcher, at 2330 UTC. The flight did not depart on schedule due to maintenance requirements however, the Captain was provided with a weather update at 0112 UTC, at the aircraft. When the aircraft departed and the crew called in after take-off, they were given updated weather information indicating thunderstorms and rain at their destination, San Salvador. The Direccion General De Transporte Aereo believes that the crew was fully aware of the destination weather conditions prior to takeoff.

2.5 Training

The Direccion General De Transporte Aereo reviewed the content and frequency of training received by both the Captain and the First Officer. The ground

² With regards to CRM techniques.



training and flight training requirements met the minimum requirements as set forth in ICAO with reference to training.

Investigations into the causes of air-carrier accidents have shown that aircrew human error is a contributing factor in 60 to 80 percent of all air carrier incidents and accidents. Research has demonstrated that these events share common characteristics associated with poor group decision-making, ineffective communication, inadequate leadership, and poor task or resource management. These observations have led to the generation of training programs that place emphasis on factors which influence crew coordination and the management of crew resources. The application of team management in aviation is known as CRM.

Aviateca does not have its own Crew Resource Management (CRM) training. In June 1994 Aviateca flight crew members received CRM training utilizing another airline's instructors. It is evident from the conversation in the cockpit that the Captain was in charge of the flight and the First Officer did what he was told. It is also evident that when the workload increased, because of the deviations for bad weather, the First Officer became more subservient and repeated whatever the Captain wanted without hesitation. There was little interaction between the Captain and the First Officer other than the latter doing exactly what the Captain told him to do. In fact, there is CVR evidence that the First Officer had some concern regarding the reported positions of the airplane, however he did not state his concern to the Captain in a clear and direct manner. The DGTA believes that the presence of the operations inspector in the cockpit may have been a contributing factor to the pattern of behavior described above, and the manner of communication between both pilots in the cockpit. Shortly after the controller cleared the flight to descend to 5,000 feet, the First Officer stated to the Captain



“then direct to the station, he said.” The First Officer most likely realized that when the controller cleared the airplane to descend, it was essential to go direct to the station. At 2012, about 30 seconds later, the First Officer again voiced his concern by saying “are you going to fly direct to the station?” When the Captain replied with a negative response, the First Officer’s reply was a softly spoken “OK.” The Direccion General De Transporte Aereo finds that the manner in which this flight crew interacted was deficient and indicates a need for effective team training. It therefore believes that Aviateca should initiate and maintain a CRM program tailored to their specific needs.

Aviateca does not include any GPWS specific training in their simulator/flight training, either initial or recurrent. They do have “wind shear “ training on take-off & approach, plus engine failure on take-off training which exercises various modes of the Sundstrand Mark II GPWS system which was installed in the accident airplane. Specific training for mode 2 activation’s (excessive terrain closure rate) or mode 4 activation’s (unsafe terrain clearance, not in landing configuration) is not addressed.

The time between the first activation of the GPWS and the impact was 12 seconds. Allowing 2 to 3 seconds for the crew to hear and comprehend the sounds and another 2 to 3 seconds to react, at least 6 seconds was available for the escape (for the engines to spool up and the aircraft to rotate to maximum pitch attitude.) The CVR indicates that the Captain stated “Let’s go up” 6 seconds after the GPWS first activated and repeated that 5 seconds later adding “...we are climbing, tell him.” Evidence at the crash site indicated that the pitch attitude of the aircraft at impact was about 3 degrees nose up.



The terrain continued to rise sharply in the area of the crash site, making it debatable whether an immediate, proper escape maneuver would have been sufficient to avoid the accident. The Direccion General De Transporte Aereo could not determine whether the reaction time of the crew to the GPWS alert was timely. However, a quicker response may not have prevented the accident. Even so, the investigation board believes that Aviateca and the Government of Guatemala should consider the use of more modern GPWS system in their fleet and that more emphasis should be put on an aircrew's immediate reaction time to GPWS activation's, especially in conditions where there is mountainous terrain in the area.

On February 16, 1996, the International Civil Aviation Organization (ICAO) published and sent a letter to all its members on the subject of the continuing occurrences of controlled flight into terrain (CFIT). The letter referenced a major accident prevention activity taking place on a world-wide basis and mentioned that ICAO is working in conjunction with an Industry CFIT Task Force on the development of a program for the prevention of CFIT. ICAO has urged member states to expand the programs to include the carriage of GPWS in domestic as well as international operations. A CFIT checklist, developed by the ICAO and Industry CFIT Task Force as a means to evaluate risks and identify actions that should be taken to reduce the risk of CFIT accidents, is included in appendix D of this report. The Direccion General De Transporte Aereo believes that Aviateca and the Civil Aviation Authority of Guatemala should implement the CFIT checklist in all air carrier flight operations.

2.6 Air Traffic Control and the Descent Below Altitude Limitations



The CVR transcript indicates that the Captain of flight 901 requested deviations from the intended route at 2003 hours because of bad weather. The controller then asked if the deviations would be to the north or the south of the airway. The Captain responded that they would be to the north. The controller then further inquired "to the left?" This use of left and right as opposed to general compass headings continued throughout the remainder of the flight. The Direccion General De Transporte Aereo believes that more emphasis should be given to training Air Traffic Controllers to use proper terminology when communicating with aircraft.

The scenario leading to this accident involved many instances in which the pilots were not communicating with each other, nor was the air traffic controller communicating with the pilots. Ambiguity was present in many transmissions, with neither party making any clarification efforts. In a non-radar situation, when an aircraft is flying a published route, an occasional position report is all that is needed to keep the controller informed of the progress of the flight. However, when an aircraft is deviating off of a published route or approach without radar assistance, the occasional position report is no longer adequate. Pilots and controllers must communicate with each other in very precise terms.

In one instance, at 2004:48 hours, the controller asked the pilot "which radial are you crossing or are you established inbound?" When the pilot answered that they were "on the radial three ten", the controller could have interpreted the reply to mean that they were inbound, because they didn't say "crossing." The pilot should have advised the controller that they were crossing the radial and were not inbound. The controller never requested a position report in both radial and distance at the same time until after he issued a descent clearance. Had he done so



it would have helped him visualize the position of the traffic, allowing for a more concise "mental picture." The controller could have also asked the flight crew for the heading of the aircraft during the weather deviations. This also would have helped the controller visualize the progress of the airplane in the non-radar environment.

In another instance, at 2006:50 hours, the controller asked the pilot to "confirm the inbound radial." The pilot should have noted that the controller expected the aircraft to be coming inbound. Instead the pilot simply answered "315," and did not tell the controller that they were not inbound. Again, had the controller gotten a radial and distance, and then asked the aircraft's cockpit crew its heading, he would have had a concise picture of what the aircraft was doing.

Another example of the ambiguity that existed resulted when the controller issued the descent clearance to 5,000 feet. Two and 1/2 minutes prior to that clearance the flight crew requested and was cleared to fly direct to the VOR. According to the CVR, the first officer then repeated "we will call one five maintaining 8,000..." The controller then asked the flight crew to confirm if it was continuing the deviation to the left to which and the First Officer replied "affirmative" and later reported crossing the 320 radial. The ambiguity was present because while the flight crew requested direct to the VOR, it appears they were still intending to deviate. The flight crew should not have requested direct to the VOR if they were still intending to deviate.

One minute prior to the descent clearance, the flight crew reported "13 miles" and later indicated that they would be deviating to the left. One half minute before the descent clearance, the controller asked the flight crew if it was possible



to maintain the descent. The flight crew did not reply to that question but requested "the 12-mile arc over 135, to the right for runway seven." The controller replied by telling the flight to descend and maintain 5000 feet, that it was cleared for the approach via the 12-mile arc to runway 7, and to notify over the station. The Direccion General De Transporte Aereo believes, that with the reports given by the flight crew, it should have been evident that the aircraft was still north of the VOR and could not have been in an area where it was safe to descend to 5,000 feet. Again, had the controller taken away all ambiguities and asked the flight its radial and distance from the VOR and then made a determination that the aircraft was not going direct to the VOR, but was east-bound, he most probably would not have issued the descent.

The flight reported leaving 8,000 ft and reported 12 miles, which the controller verified by saying, "twelve miles, roger." One half minute after the descent clearance was issued, the controller asked the flight what radial it was crossing, and the flight replied that it was "at the 360." A minute after the descent clearance was issued, the flight reported to the controller that it would maintain the arc of 12 miles because of bad weather. The controller replied, the arc to the south? The flight replied, "correct." This incorrect report by the flight crew reinforced the controller's conviction that the flight was now south of the VOR, in "safe" terrain.

A minute and a half after the descent clearance, the controller asked what their position was, and the First Officer replied "at the moment we are in the zero twenty." The controller asked to confirm the distance and the First Officer replied, "12 miles always." At this point with many of the prior transmissions filled with ambiguities and the controller having had it set in his mind that the aircraft was



south of the VOR, the controller probably did not believe the report, still thinking that the aircraft was south of the VOR.

The Direccion General De Transporte Aereo believes that when flight crews become accustomed to operating in a radar environment, operating in an environment without radar can increase the cockpit workload and requires the flight crew to be more vigilant. In a non-radar environment, there are no minimum vectoring altitudes because there is no radar. If a flight crew is going to deviate within the 25 nautical mile (nm) Minimum Safe Altitude (MSA) area, off of the published route, transition, or instrument approach, all of which have specified altitudes, the flight crew must then look to the 25 nm MSA depiction at the top of the approach plate. The Captain is ultimately responsible for terrain separation. When he accepted the descent to 5,000 feet, the only safe altitude at that time was the 8,200 foot MSA. The flight crew knew where they were. They should have planned on maintaining their altitude until they were in the 2000 foot MSA area, begun their descent to 5,000 feet, and asked the controller if they could continue descent to 2,000 feet. Because the 155 degree radial is not a published transition with a depicted altitude, they should have planned to maintain 2000 feet until intercepting the 12-mile arc, then begun descent to 1300 feet and executed the approach as published. The Direccion General De Transporte Aereo believes controllers should require position reports from airplanes under their jurisdiction that contain both distance and azimuth in order to determine aircraft heading and more accurate position information.

The cockpit crew of flight 901 should have been well aware of their general position and, because of their familiarity of the area, aware of the higher MSA's for the sectors north of the VOR. Additionally, the DGTA believes that the



lack of communication and apparent ambiguity between pilots and air traffic controller may have been caused, at least in part, by the mere presence of the inspector in the cockpit.

2.7 DGAC Surveillance

The Civil Aviation Authority of Guatemala (DGAC) was in the process of re-certificating Aviateca in accordance with new Guatemala aviation regulations. Two retired U.S. FAA inspectors were hired as inspectors/consultants to provide changes to Guatemala Civil Aviation oversight capabilities, such as new regulations, inspector training, airline certification and continuing surveillance, etc. Unfortunately the operations inspector was conducting en-route surveillance and was in the cockpit jump-seat, while the airworthiness inspector was doing an en-route inspection in the cabin of Aviateca flight 901 and were fatally injured during the accident. Although the continuing re-certification of Aviateca had been set back, it is continuing on a fast track.

3. CONCLUSIONS

1. The Captain ^{FIRST OFFICER} and flight attendants were trained and qualified to conduct the flight in accordance with DGAC regulations.
2. N125GU was properly certificated and maintained with no significant maintenance discrepancies remaining uncorrected.



9. From the CVR transcript it appears that the CRM training was not completely effective with this flight crew to counteract the possibility of the intimidation factor caused by the presence of the inspector, and insufficient to preclude this accident.

10. The Mark II GPWS may not have prevented the accident because of a combination of the crew's reaction time and the rapidly rising terrain.

4. PROBABLE CAUSE

The Direccion General De Transporte Aereo determines that the probable cause of the accident was the flight crew's lack of situational awareness in relation to the 7,159 foot obstruction, the flight crew's decision to descend below the MSA while deviating from a published transition or approach, and the ambiguity of position information between both the flight crew and the air traffic controller which resulted in the controller's issuance of an altitude assignment that did not provide terrain clearance. Contributing to the accident was the failure of the First Officer to direct his concern of reported positions to the Captain in a more direct and assertive manner and the failure of the controller to recognize the aircraft's reported position relative to obstructions and give appropriate instructions/warnings. An ineffective CRM program at Aviateca also contributed to the accident.

5. RECOMMENDATIONS

1. Aviateca's Flight Training Programs should be modified to combat CFIT per ICAO initiatives, initiate a full CRM program, increase situational



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3. The investigation indicated that the DGAC surveillance of Aviateca was being conducted in accordance with their newly established procedures.

4. Both pilots were experienced in the Boeing 737 and with operations in and out of San Salvador. Each Aviateca pilot is scheduled for approximately four flights into SAL each month. The last flight into MSI.P for the Captain was Flt 901 on August 5, 1995.

5. Despite general familiarity with the Salvador area, the flight crew was apparently unaware of where they were in relation to the 7,159-foot obstruction.

6. Communication ambiguities existed between both the pilots and the controller.

7. When the controller issued the descent to 5,000 ft, he had not determined specifically where the aircraft was. He did not solicit or receive a report from the pilot in terms of both radial and distance from the VOR simultaneously, and did not ask them their heading in order to get a clear understanding of their location.

8. The flight crew knew their general location, and knew that they were not on a published transition for the approach. Given this knowledge, they should not have descended below 8,200 feet in the non-radar environment regardless of their clearance.



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awareness during weather deviations, and increase GPWS warning recognition and recovery techniques.

2. Due to route structure (non-radar and geography), Aviateca should equip their fleet with the most up to date GPWS as soon as possible.

3. Aviateca should investigate possibility of setting up operational procedures to emphasize the use of the Global Positioning System (GPS) in all airplanes that fly in non-radar areas in mountainous terrain with limited navigational aids.

4. The government of El Salvador should investigate the possibility of installing an air traffic control radar as soon as possible.

5. The government of El Salvador should caution all controllers regarding the use of "left" and "right" in position reports and insist on the use of appropriate directional terms such as "North, South, East & West."

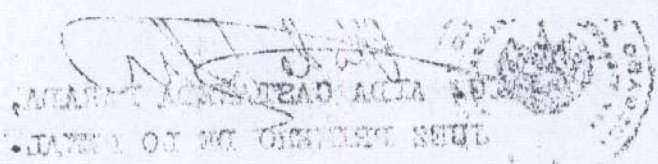
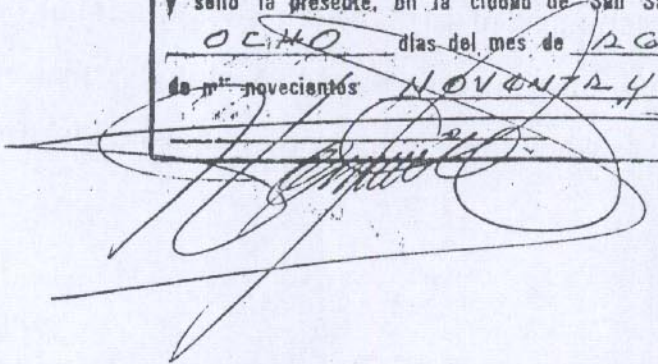
6. The government of El Salvador should instruct controllers that during pilot deviations in a non-radar environment, they should receive position reports in both distance and azimuth simultaneously, and then determine the aircraft's heading in order to have accurate position information.

7. The government of El Salvador should remind pilots that when deviating near airports, they must observe the MSA altitudes that are published at the top of the approach plate when they are not on a published instrument transition or instrument approach.

El suscrito Notario CERTIFICA la fidelidad y conformidad de la presente fotocopia con el Original que tuvo a la vista y para los efectos del Art. 30 de la Ley del Ejercicio Notarial de la Jurisdicción Voluntaria y de otras Diligencias, extendo, firmo y sello la presente, en la ciudad de San Salvador, a los

OCHO días del mes de AGOSTO

de mil novecientos NOVENTA Y SEIS.



SECRETARÍA DE ADMINISTRACIÓN
DIRECCIÓN GENERAL DE REGISTRO Y NOTARÍA PÚBLICA