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Ice Ingestion Causes Both Engines to Flame Out During Air-taxi Turboprop's Final Approach

The accident was attributed to the flight crew's failure to comply with procedures requiring the use of continuous engine ignition during and after an encounter with icing conditions.

FSF Editorial Staff

On Jan. 5, 1997, a Fairchild SA-227-AC (Metro III) was on final approach to Laughlin-Bullhead International Airport in Bullhead City, Arizona, U.S., when both engines simultaneously flamed out. The twin-turboprop airplane was destroyed in the subsequent forced landing 1.5 miles (2.4 kilometers) south of the airport. The captain and first officer sustained minor injuries; none of the 19 passengers was injured.

The U.S. National Transportation Safety Board (NTSB), in its final (brief-of-accident) report, said that the probable cause of the accident was the "failure of the pilot(s) to use 'override' [continuous] ignition as prescribed by checklist procedures during an encounter with icing conditions, which subsequently led to ice ingestion and dual-engine flameouts."

NTSB said, "Factors related to the accident were: the adverse weather (icing) conditions, the accumulation of airframe/engine ice and lack of suitable terrain in the emergency landing area."

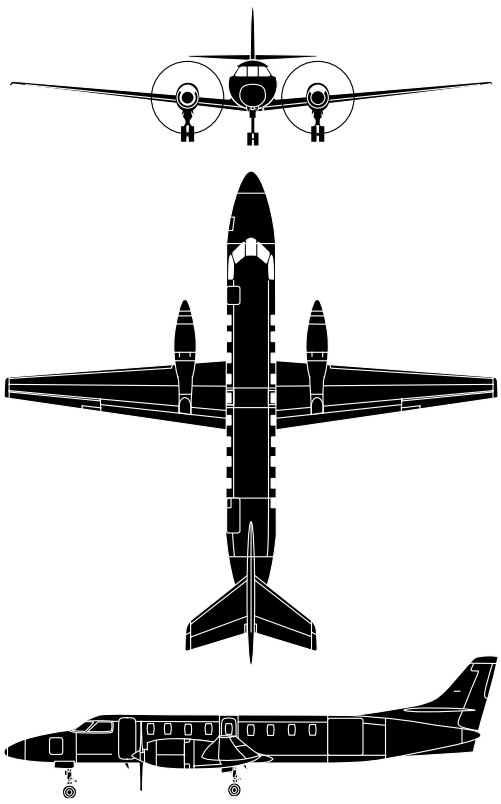
The aircraft was on an unscheduled air-taxi flight from Long Beach, California, U.S., to Grand Canyon, Arizona, when the crew diverted the flight to Bullhead City because of adverse weather conditions at Grand Canyon.

The aircraft was operated by FNG Aviation, doing business as Skylink Charters of Santa Monica, California. The aircraft was built in 1983 and had 25,110 hours in service. It had been flown 20 hours after a continuous-airworthiness-program phase inspection on Jan. 3, 1997.

The captain, 33, had an airline transport pilot certificate and an SA-227 type rating. He had 3,200 flight hours, including 300 flight hours in type. He was hired by the operator in September 1994. The NTSB report said that the captain attended a 19.5-hour AlliedSignal Aerospace TPE331 Engine Pilot Familiarization Course in September 1993.

"On May 18, 1996, the [captain] was awarded a certificate after 45 hours of ground-school training on the Metro III/SA-227 aircraft," said the report. On June 9, 1996, the captain successfully completed a U.S. Federal Aviation Regulations (FARs) Part 135 competency check, instrument-proficiency check and line check.

The first officer, 35, had a commercial pilot certificate and 640 flight hours, including 56 flight hours in type. He was hired by the operator in September 1996. The report said that the first officer received 93 hours of training on the Fairchild



Fairchild SA-227-AC Metro III

The Metro III twin-turboprop regional airliner is a version of the SA-226TC Metro, which was designed by Edward J. Swearingen and was first flown in 1969. The Metro has a maximum takeoff weight of 12,500 pounds/5,700 kilograms and is powered by AlliedSignal (formerly Garrett) TPE331-3U engines rated at 840 shaft horsepower (626 kilowatts) and three-blade Hartzell propellers.

Production of the Metro by Swearingen Aircraft began in 1970; the airplane was marketed by Fairchild Hiller. Fairchild Industries acquired Swearingen in 1979 and renamed the company Fairchild Aircraft in 1982.

The Metro series can accommodate 20 passengers and two pilots. Production of the Metro III began in 1975. The aircraft has more powerful engines than its predecessors, the Metro and Metro II, and a higher maximum takeoff weight. The Metro III's AlliedSignal TPE331-11U engines are rated at 1,100 shaft horsepower (820 kilowatts) each, and drive four-blade Dowty Rotol propellers. Maximum takeoff weight is 14,500 pounds (6,577 kilograms). The weight increase was achieved, in part, by a wing-span increase of 10 feet (three meters). Maximum landing weight is 14,000 pounds (6,350 kilograms). Maximum fuel weight is 4,342 pounds (1,970 kilograms).

Maximum rate of climb at sea level is 2,370 feet per minute (721 meters per minute). Maximum single-engine rate of climb at sea level is 690 feet per minute (210 meters per minute). Service ceiling is 27,500 feet. Single-engine service ceiling is 14,200 feet. Maximum cruising speed at mid-cruise weight (12,500 pounds) at 25,000 feet is 263 knots (487 kilometers per hour [kph]). Stall speed with flaps and landing gear retracted is 98 knots (181 kph). Stall speed in landing configuration is 87 knots (161 kph).

Source: *Jane's All the World's Aircraft*

SA-226 (Merlin), the Metro III SA-227 and the operator's operations manual. The first officer successfully completed two Part 135 competency checks in September 1996.

The aircraft departed from Long Beach in visual meteorological conditions (VMC) at 0900 California time (1000 Arizona time). The report said, "According to the operator, the aircraft departed ... with 2,345 pounds [1,064 kilograms] of fuel, which is the normal load for the flight to the Grand Canyon and back to Long Beach with reserve."

At 0917, the flight crew activated a visual flight rules (VFR) flight plan by radio with the Hawthorne (California) Automated Flight Service Station (AFSS). The report said that the crew also received weather information from the AFSS, including an advisory that VFR flight to Grand Canyon National Park Airport was not recommended.

Grand Canyon Airport is in north-central Arizona. The area forecast for the northern half of Arizona was for visibility occasionally four miles (six kilometers) in light snow showers, scattered-to-broken clouds at 7,000 feet, broken clouds at 9,000 feet and cloud tops at 25,000 feet. The area forecast outlook was for marginal VMC because of low ceilings.

The report said, "AIRMETS [airman's meteorological information (in-flight weather advisories issued to amend an area forecast)] were in effect for Arizona for occasional moderate turbulence below 16,000 feet, occasional ceilings ... below 1,000 feet, [occasional visibility] below three miles [five kilometers] and occasional mountain obscuration. ...

"Few PIREPS [pilot weather reports] were available for northern Arizona. However, there were numerous reports of light to moderate icing in the Phoenix area [approximately 160 miles (257 kilometers) south of Grand Canyon]. ... Generally, aircraft reported the icing conditions ranging from 10,000 feet to 20,000 feet. ... Data suggest that the freezing level in northern Arizona was about 6,000 feet mean sea level." (Elevation of Grand Canyon National Park Airport is 6,606 feet.)

Both pilots said that Hawthorne AFSS said that VMC prevailed at the Grand Canyon airport. The captain said, "The current Grand Canyon weather was reported as 10 miles [16 kilometers] visibility and ceiling 7,000 [feet] broken."

The first officer said, "The current weather Hawthorne Radio gave us for the Grand Canyon was conducive for a visual approach."

At 0928, the flight crew requested and received an instrument flight rules (IFR) clearance from Los Angeles (California) Center; the aircraft was flying at 15,000 feet and was 25 nautical miles [46 kilometers] north of Ontario, California. Los Angeles Center cleared the flight to climb to Flight Level (FL) 230.

The first officer said that the flight was conducted mostly in VMC before the climb to FL 230 was begun. "We remained in VFR conditions below, between or on top of layers for most of the flight," he said.

Both pilots said that the airplane was above the clouds at FL 230. The captain said, "The flight remained in VMC for the duration of the flight until starting the final descent [to the airport]. ... At the time of descent, all anti-ice equipment — pitot heat, windshield heat, engine inlet [heat], prop[eller heat], duct heat — was on although ice accumulation was minimal."

The first officer said, "We remained at [FL] 230 until we began a greater-than-1,000-feet-per-minute descent, at which time we entered the clouds. By the time we entered the clouds, the intake, prop, pitot and windshield heat were on."

The flight was cleared by Los Angeles Center to descend to 11,000 feet. At 1125 Arizona time, the flight crew requested vectors to intercept the localizer final-approach course and said that they had received the current information broadcast on the airport's automatic terminal information system (ATIS) frequency.

The captain said that the reported weather was six miles (10 kilometers) visibility and ceiling 2,300 feet broken. The NTSB report did not include the text of the ATIS broadcast. Nevertheless, the report said that the airport's automated surface observation system (ASOS) reported six miles visibility, light snow and mist, temperature zero degrees Celsius (32 degrees Fahrenheit), dew point one degree Celsius (33 degrees Fahrenheit) and 900 feet overcast, with the ceiling variable from 700 feet to 1,300 feet.

At 1128, Los Angeles Center instructed the crew to fly a holding pattern and to expect further clearance at 1138. The controller verified that the crew knew that the instrument-landing-system glideslope was out of service and, at 1137, cleared the crew to conduct the localizer approach and to change radio frequencies.

On initial radio contact with Grand Canyon Tower, the crew said that the aircraft was established on the localizer course and was inbound from the final approach fix. The tower controller provided weather information and cleared the flight to land.

The captain said, "Due to degrading weather at the Grand Canyon [airport], the instrument approach we executed was followed by a missed approach." When the missed approach was begun at 1139, the ASOS reported 1.5 miles (2.4 kilometers) visibility, 1,400 feet overcast and 800 feet broken, variable from 500 feet to 1,200 feet. The ASOS subsequently reported one-half mile (0.8 kilometer) visibility in moderate snow and freezing fog, 300 feet broken and 700 feet overcast.

Cockpit Voice Recorder Transcript, Fairchild Metro III, Bullhead City, Arizona, U.S., Jan. 5, 1997

(FSF editorial note: The following transcript begins during the flight's diversion to Bullhead City after a missed approach at Grand Canyon, Arizona, U.S. The transcript is as it appears in the U.S. National Transportation Safety Board accident report, except for minor column rearrangement and addition of notes defining some terms that may be unfamiliar to the reader. Times are local.)

Time	Source	Content
1235:45	**HOT-1**	uuuuh, OK, tell 'em air, runway in sight.
1235:49	**HOT-2**	cancel IFR?
1235:50	**HOT-1**	na, we got the runway in sight. we'll take the visual, * could give it to us now.
1235:54	**HOT-2**	what everybody else that's waiting for IFR? does it matter?
1235:57	**HOT-2**	all right, cancel it then.
1235:59	**CTR**	November five Sierra Whiskey, ident.
1236:04	**RDO-2**	and five Sierra Whiskey, we have uh, runway in sight. we can cancel IFR.
1236:08	**CTR**	Sierra Whiskey, roger, cancellation. your first aircraft is, aircraft you're following is at twelve o'clock and four miles at six thousand five hundred. squawk VFR. frequency change approved. have a good day.
1236:17	**RDO-2**	five Sierra Whiskey, thanks for your help.
1236:20	**HOT-1**	OK you want tower, twenty three point niner.
1236:24	**HOT-2**	twenty three niner.
1236:34	**HOT-1**	* *.
1236:36	**HOT-2**	OK, do they go by Laughlin or Bullhead?
1236:39	**HOT-1**	they're Bullhead. Bullhead tower.
1236:47	**HOT-2**	yeah, how far out are we? uuuh.
1236:49	**HOT-1**	we're n, let's see twenty three, thirteen out, thirteen out.
1236:52	**HOT-1**	nine thirteen out, thirteen out yeah.
1236:55	**RDO-2**	Bullhead tower, Tango November one six five Sierra Whiskey is thirteen out and have the airport in sight.
1237:02	**TWR**	Tango, November one six five zero Sierra roger uh, plan a straight in approach runway three four. traffic inbound from the south reported twenty south a couple minutes ago is a Navajo. uh, report him in sight if you see him and uh, say your altitude again.

1237:19	**HOT-1**	seventy two hundred.
1237:19	**RDO-2**	we're at seventy two hundred.
1237:24	**TWR**	Navajo one eight seven two echo, traffic's a uh, Metroliner in your vicinity uh, sir inbound descending out of seven thousand feet inbound from the south. uh, say your position now.
1237:34	**1872E**	I'm uh, fourteen outta Needles, leavin' uh, five thousand lookin' for the Metro.
1237:43	**TWR**	Navajo seven two echo roger and uh, you presently on the east side of the extended centerline runway three four?
1237:49	**1872E**	that's affirm.
1237:50	**TWR**	OK, why don't you stay on the east side uh, I'll try to get you in on a right base for runway three four. report about a five mile sou uh, correction, report five miles southeast of the airport.
1237:59	**1872E**	have the traffic, will do.
1238:01	**TWR**	Metroliner five zero Sierra, are you on the uh, west side of the extended centerline?
1238:03	**CAM**	[sound of horn similar to landing gear warning horn]
1238:04	**HOT-1**	we're on it, Sierra Whiskey.
1238:06	**RDO-2**	five Sierra Whiskey yes, we're on the west side and uh, we have them on our TCAS.
1238:12	**HOT-1**	tell 'em we're on the centerline.
1238:13	**TWR**	five zero Whiskey roger uh, I think they just reported the east side. stay on the west side report five miles south of the airport. I'll try to bring you direct into the uh, approach end of three four from that point.
1238:23	**RDO-2**	five Sierra Whiskey, we'll report five south of the airport and stay on the west.
1238:28	**RDO-1**	@, are you there?
1238:31	**UNK**	* on final, roger.
1238:32	**RDO-1**	OK.
1238:37	**UNK**	you on the ground Mel?
1238:39	**RDO-1**	nope, I'm about, oh eight mile final.
1238:48	**HOT-2**	twenty three, that would be at eighteen.
1238:51	**HOT-1**	OK, why don't you give me flaps to a half.
1238:53	**HOT-2**	flaps to a half.
1238:54	**HOT-1**	gear down, landing checks.
1238:56	**HOT-2**	gear coming down ... speeds are high. three down and green, concur.

While conducting the missed-approach procedure, the crew requested clearance from Los Angeles Center for another instrument approach to the airport. The controller provided a vector to re-intercept the localizer course. A few minutes later, however, the controller told the crew that the surface visibility now was one-quarter mile [0.4 kilometer] and below visibility minimums for the localizer approach.

The crew then requested clearance to Laughlin-Bullhead International Airport, which is in western Arizona. The controller cleared the crew to navigate directly to the airport and to climb to 16,000 feet.

The report said, "According to [recorded air traffic control] radar data, after the missed approach at 1139, the aircraft started a climb to 8,700 feet MSL [mean sea level] and reached cruise flight at 16,000 feet MSL at 1156. ...

"Both pilots reported that they had experienced minimal icing at the Grand Canyon. The captain estimated that about one-eighth inch [three millimeters of ice] had accumulated on the wings. The pilots stated that they exercised the deice boots one time. They also stated that they never used [continuous] ignition during the flight."

The captain said, "Anti-ice equipment remained on until leaving visible moisture with no significant residual ice remaining on the propeller spinners or engine intakes. As we proceeded westbound toward Bullhead City, VMC once again prevailed, and we remained clear of all visible moisture for the remainder of the flight, 20 [minutes to] 25 minutes."

The first officer said, "Within a few minutes after receiving a clearance to Bullhead City, we were between layers in VFR conditions and encountered increasingly clearer conditions as we neared Bullhead City."

At 1204, the crew began a descent from 16,000 feet to 12,000 feet. The transcript of the cockpit voice recorder (CVR) shows that, at 1215, the captain radioed, "I'm at twelve and, uh, between [cloud] layers."

The CVR then recorded a brief conversation between the captain and first officer regarding the aircraft's deice boots. The first officer said, "You want to blow the boots and see what it does?"

The captain said, "Not yet."

The first officer said, "Not really enough there."

The Metro III was flying approximately 10 miles (16 kilometers) behind an aircraft, N200PT, operated by the same company. At 1221, the Los Angeles Center controller told the crew of N200PT that most aircraft flying to Bullhead City had descended into VMC at 6,000 feet, canceled their IFR flight plans and made visual approaches to the airport. The controller said, "To get

you down that low, I will have to take you on a vector to the south. Would you like to do that?"

The crew of N200PT accepted a vector to the southeast and was cleared to descend to 6,000 feet. The crew reported the airport in sight, and the airplane was cleared for a visual approach.

At 1226, the Metro III first officer said to the captain, "If we go that way, we'll probably be able to get the same kind of visual they got. See how it's clear to the ground. ... Look at that, man. There's the ground right there."

The first officer then asked the controller for clearance to a lower altitude and a vector to the south. "Looks like it's clearing there," he said.

The controller cleared the crew to fly a heading of 180 degrees. "I'm not going to be able to get [you] lower for a while. I'm [going to] give you a hold clearance over Needles. I've got several aircraft that are wanting to get inbound into ... Bullhead City right now."

Nevertheless, moments later, the controller cleared the crew to descend to 10,000 feet and advised of VFR traffic. When the first officer said that they had the VFR traffic in sight, the controller cleared the crew to descend to 9,000 feet.

At 1232, while conducting the approach checklist, the first officer said, "OK, altimeters are set and cross-checked, ignition we didn't have on, approach check's complete."

At 1234, the crew was cleared to fly a heading of 340 degrees and to proceed direct to the airport. The crew also was cleared to descend to 8,000 feet. At 1236, the first officer reported the runway in sight and canceled the flight's IFR clearance. The center controller terminated IFR services and approved a frequency change.

The first officer radioed Bullhead Tower that the Metro III was 13 nautical miles [24 kilometers] from the airport and that the crew had the airport in sight. The tower controller said, "Roger, uh, plan a straight-in approach [to] Runway 34. Traffic inbound from the south ... is a [Piper] Navajo." The controller instructed the Navajo pilot to fly east of the extended runway centerline and the Metro III crew to fly west of the extended runway centerline.

The Metro captain said, "Before turning us northbound to Runway 34, I determined we had 1,000 pounds [454 kilograms] of fuel on board. The airplane was free of all ice. Leading edges of the wings, propeller spinners and engine inlets had no signs of ice whatsoever."

The first officer said, "By the time we were vectored onto a long final approach for [the] Bullhead City airport, the ice [that had accumulated on the airplane's wings] had dissipated.

1239:06	**HOT-1**	concur.
1239:12	**HOT-2**	OK, gear props sync speed levers yaw damper nose wheel steering, flaps to a half. before landing's done to half flaps.
1239:27	**TWR**	Metro five zero Whiskey, say your position now.
1239:29	**RDO-2**	five Sierra Whiskey we are uh, almost uh, about seven, seven six and a half miles south.
1239:36	**TWR**	roger, say your airspeed.
1239:39	**HOT-1**	one fifty.
1239:40	**RDO-2**	we're one fifty.
1239:41	**TWR**	seven two Echo say airspeed.
1239:43	**1872E**	uh, one forty five.
1239:45	**TWR**	seven two Echo roger uh, report a three mile final straight in three four. try to keep your airspeed up as best possible. I'll try to have that Metroliner follow you inbound.
1239:53	**1872E**	OK, I'll do it.
1239:54	**HOT-1**	go to full flaps.
1239:54	**TWR**	Metroliner uh ...
1239:56	**HOT-1**	tell 'em we're slowing to one thirty.
1239:57	**TWR**	... five zero Whiskey uh, report about a four mile final. stay uh west of the extended centerline until you see the Navajo. he's gonna try to keep his airspeed up for you.
1240:07	**RDO-2**	yeah, we're uh slowing to one thirty, staying west and I have the Navajo now, five Sierra Whiskey.
1240:13	**TWR**	five zero Whiskey, you're number two to follow that Navajo.
1240:15	**RDO-2**	thanks a lot, five Sierra Whiskey.
1240:19	**HOT-1**	why you sayin' zero? where is he.
1240:20	**HOT-2**	he's right there. just about to cross the road. there he is crossing the road. now he just crossed the road. you see him?
1240:33	**HOT-2**	he's ...
1240:41	**CAM**	[sound similar to engines decreasing in RPM]
1240:41	**HOT-?**	oooh.
1240:43	**HOT-1**	#.
1240:44	**HOT-1**	* *. dual failure. feather, feather 'em, feather 'em.
1240:48	**HOT-2**	which engine?
1240:50	**HOT-1**	both of 'em.
1240:52	**HOT-1**	feather 'em.
1240:57	**HOT-2**	uh, call for an emergency?
1240:58	**HOT-1**	yeah.

1241:01	**RDO-2**	uh, Bullhead City, we have uh, we have to declare an imung, emergency. we have a dual engine failure. we must have an uh, a landing must be assured.
1241:10	**TWR**	who am I talking to?
1241:11	**RDO-2**	five Sierra Whiskey.
1241:15	**TWR**	five Sierra Whiskey, five zero Whiskey say your position right now.
1241:20	**HOT-1**	four ...
1241:21	**RDO-2**	four miles south of the airport.
1241:22	**HOT-1**	... three, three, three, three.
1241:23	**TWR**	five zero Whiskey roger, proceed direct to the approach end of runway three four. you're cleared to land. Navajo seven two Echo uh, understand you're going around. remain on the east side of the uh, runway centerline.
1241:31	**HOT-1**	come on sweetheart. glide on me.
1241:35	**1872E**	* check, I've got it.
1241:37	**HOT-1**	dude we're not going to make it. [sound of heavy breathing]
1241:42	**HOT-1**	where should I put it? whew.
1241:48	**HOT-2**	no attempts on re-starts?
1241:50	**HOT-1**	yes, go through it. go through the checklist quick.
1241:54	**HOT-1**	get one re-started.
1242:04	**HOT-1**	dude, I'm gonna put it on this road.
1242:07	**TWR**	Navajo seven two Echo uh, say uh, you in a right turn now?
1242:09	**HOT-1**	[continued sound of heavy breathing]
1242:11	**1872E**	yeah, I was just going to back around. I'll hold out here to the southwest.
1242:15	**HOT-2**	that road?
1242:17	**1872E**	er the southeast.
1242:17	**HOT-1**	dude re-start, come on quick.
1242:19	**HOT-?**	oh #.
1242:21	**CAM-3**	minimums, minimums.
1242:22	**TWR**	Metroliner five zero Whiskey, you gonna be able to make the runway sir?
1242:25	**HOT-1**	nope, we're going for an off-site.
1242:27	**RDO-2**	no, we're going for an off-site, five Sierra Whiskey.
1242:30	**HOT-2**	where the hell is ...
1242:31	**TWR**	five zero Whiskey, say again.
1242:33	**RDO-2**	we're gonna do a re-start.
1242:34	**HOT-2**	speed lever, * *.
1242:35	**HOT-1**	come on dude, come on dude.
1242:37	**HOT-2**	power lever. quarter forward of flight idle. EGT RPM ...
1242:40	**CAM-4**	sink rate ...
1242:42	**HOT-2**	... OK stop and feather, OK let's try this left one.

The tower controller asked us to offset left of runway centerline and slow our forward speed to allow a Navajo to land ahead of us."

The captain said, "The Navajo was slower than us, so I called for gear down and landing checks to full flaps in order to slow [from 150 knots] to 130 knots and not overtake the Navajo. Seconds later, we experienced a simultaneous dual flameout. We were approximately four miles from the runway threshold. I had the first officer feather both propellers and run the emergency checklist."

The first officer said, "After identifying that both engines were dying, I received verification from the captain and asked for concurrence to pull both stop-and-feather controls. The captain concurred, and I feathered both engines. I notified the tower that we had an emergency and [that] we needed the runway.

"After determining that we were not going to make it to the airport, I scanned for a landing site and did not find one. ... I attempted to run a checklist for [engine] restart, but there was not enough time."

The captain said, "When it became apparent that we would not reach the runway, I maneuvered the airplane toward lower terrain in search of a suitable off-site landing area. An airstart of the left engine was initiated, but time ran out as we approached terrain.

"As I approached the main highway east of the river, I realized that there was too much automobile traffic to attempt a landing on the road. I maneuvered the aircraft to avoid striking the street lamps and rolled the wings level over an open area between the highway and the river. Sink rate was excessive, and I increased back pressure to try to reduce the impact with the ground."

The report said, "The accident site examination revealed that the aircraft first contacted the ground with its tail fin. The next visible signs of contact were the right main-gear dual wheels and the left [main-gear] dual wheels. The extended landing gear separated, leaving gear doors and belly antennas along the wreckage path, which measured to be 285 feet [87 meters] long on a magnetic heading of 355 degrees."

The captain said, "After impact, the aircraft slid to a stop within approximately 300 feet [93 meters]. [The first officer] immediately started the evacuation. I received facial lacerations as a result of the impact and was taken to the hospital for observation, later to be released that afternoon."

The first officer said, "After coming to a stop, I checked that the captain was OK, opened the cabin door and began evacuating the passengers. After the firemen arrived, I assisted them in making the airplane safe by turning off the batteries and showing them where the battery compartments were."

Investigators determined that 965 pounds [438 kilograms] of fuel remained in the aircraft's fuel tanks.

The report said, "The airplane was likely in IMC with light to moderate icing potential during the large majority of the time the airplane was in Arizona. Satellite imagery suggests that only in the Bullhead City area was the airplane likely in VMC."

The report said that the pilots did not activate the engine continuous ignition systems, as required by the airplane flight manual (AFM). "Use of [continuous] ignition was required [by the AFM] for flight into visible moisture at or below five degrees Celsius (41 degrees Fahrenheit) to prevent ice ingestion/flameouts," said the report.

The Metro III AFM also provided the following information:

- "Ingestion of slush, excessive quantities of water or ice shedding from [propeller] spinners, propellers and/or engine intakes may interrupt air flowing to the combustion chambers and cause engine flameout. Specific operating instructions for use of the continuous ignition system in the form of procedures, notes and warnings ... must be followed;

- "[When the ignition switch is in the override position], ignition is supplied to the engine continuously. ... This mode is provided for use during flight in known icing conditions, extremely heavy rain, severe turbulence encounters and before selecting engine and prop heat following inadvertent icing encounters; [and,]

- "Warning: Engine heat and continuous ignition ... must be used after leaving icing conditions until the pilot is confident that any residual ice on propellers, spinners, intake lips or intake throats will not be shed into the engines."

AlliedSignal Aerospace — which acquired the Garrett Turbine Engine Co., original manufacturer of TPE331 series engines — issued Pilot Advisory Letter 331-04R1 in November 1994. The letter said, "Regardless of whether operating in 'textbook' icing conditions, engine ignition should be ON ... any time ice is suspected or observed to be collecting on the propeller spinners, wing leading edges or unheated inboard propeller blade cuff areas. Remember, ice accumulation can, under some conditions, be difficult to detect visually."

In April 1997 (after the Metro III accident occurred), AlliedSignal Aerospace issued Revision 3 of Operating Information Letter 331-11. The letter said, "Typically, flameout events have occurred after departing icing conditions into clear air and especially after descending out of icing conditions into warmer air. ... [Continuous ignition should be used] during any approach and landing, if icing conditions have been previously encountered at any time during the flight. ... AlliedSignal strongly recommends that operators incorporate automatic ignition systems on their aircraft. Operators should contact the aircraft manufacturer to determine the availability of such systems for their aircraft."

An automatic ignition system, when selected by the flight crew, detects an incipient engine flameout and automatically activates the engine-ignition system. An automatic ignition system was available for the Metro III. Nevertheless, the accident aircraft had a pilot-activated continuous ignition system.

1242:43	**CAM-4**	sink rate ...
1242:45	**HOT-2**	OK, try it.
1242:47	**HOT-1**	which one?
1242:48	**HOT-2**	no no you got it yeah yeah, go to.
1242:51	**HOT-1**	dude some poles.
1242:52	**HOT-2**	OK man. you got it man, you got it man.
1242:55	**HOT-1**	whew.
1242:59	**HOT-1**	she's gonna stall.
1243:00	**HOT-1**	#, there she goes.
1243:01	**CAM**	[sound similar to stall warning horn]
1243:01	**HOT-1**	aarrrrr. [sound of grunt]
1243:02		**END of RECORDING**

HOT	=	Crewmember hot microphone voice or sound source
RDO	=	Radio transmission from accident aircraft
CAM	=	Cockpit area microphone voice or sound source
CTR	=	Radio transmission from Los Angeles Center controller
TWR	=	Radio transmission from Bullhead City control tower
1872E	=	Radio transmission from aircraft N1872E
170SA	=	Radio transmission from aircraft N170SA
UNK	=	Radio transmission received from unidentified aircraft
-1	=	Voice identified as captain
-2	=	Voice identified as first officer
-3	=	Voice identified as passenger
-?	=	Voice unidentified
*	=	Unintelligible word
@	=	Nonpertinent word
#	=	Expletive
[ ]	=	Editorial insertion
...	=	Pause
EGT	=	Exhaust gas temperature
IFR	=	Instrument flight rules
RPM	=	Revolutions per minute
TCAS	=	Traffic alert and collision avoidance system
VFR	=	Visual flight rules

Source: U.S. National Transportation Safety Board

In August 1998, NTSB cited the Metro III accident in recommending that the FAA require all TPE331-powered airplanes to have automatic ignition systems and AFM procedures for a dual-engine flameout.

NTSB said that another accident involving dual-engine flameout occurred on April 1, 1993. The accident involved a Fairchild SA-227-TT (Merlin IIIC) that struck terrain after both engines flamed out during an instrument landing system approach to Tri-Cities Regional Airport in Blountville, Tennessee, U.S. The four occupants were killed, and the aircraft was destroyed.

NTSB said that 25 incidents of ice-induced flameouts of TPE331 engines have been reported since 1974. "Many of these were dual-engine flameouts," said NTSB.

"The accident data show that pilots may fail to recognize icing conditions and to take appropriate action to prevent ice-induced engine failures," said NTSB. "Pilots can easily misinterpret icing conditions when the temperature is well above freezing, especially at night when they may be unable to observe ice formations.

"The data show that many ice-induced flameouts occur during approach and landing, which are periods of high crew work load. In all of these circumstances, it is difficult for the pilot to recognize icing conditions and then to manually select the appropriate ignition switch position."

Based on these findings, NTSB in August 1998 made the following recommendations to FAA:

- "Require that all TPE331-powered airplanes be equipped with an engine ignition system that is activated automatically (without pilot input) following an engine flameout. (A-98-65); [and,]

- "As an interim measure, until an automatically activated ignition system is installed, require that the [AFMs] or pilot's operating handbooks for all TPE331-powered airplanes be modified, if necessary, to incorporate dual-engine failure or flameout procedures. (A-98-66)."

FAA in October 1998 said that it was "working with ... Fairchild Aircraft to develop a design solution to address engine flameout ... [and was] considering changes to the [AFM] to incorporate dual-engine failure/flameout procedures."

NTSB in December 1998 said that these actions were a positive first step. "However, our recommendations were directed at all TPE331-powered aircraft," NTSB said. "In addition to Fairchild Aircraft, TPE331 engines are installed in aircraft manufactured by Beech/Raytheon, Dornier, Gulfstream, Mitsubishi, Pilatus and British Aerospace. Therefore, the FAA's response to our recommendations should also address the other TPE331-powered aircraft."♦

Editorial note: This report was based on U.S. National Transportation Safety Board (NTSB) Factual Report LAX97FA082, NTSB Brief of Accident LAX97FA082 and NTSB Safety Recommendation A-98-65 through -66. The 205-page factual report includes tables and photographs.

ACCIDENT PREVENTION

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