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Airframe Icing and Captain's Improper Use of Autoflight System Result in Stall and Loss of Control of Commuter Airplane

The crew's performance was adversely affected by limited sleep, a demanding day of flying and a time of day associated with fatigue, official report says.

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The in-flight loss of control and subsequent forced landing of an Embraer EMB-120 RT Brasilia operated by Continental Express Inc. has resulted in a recommendation by the U.S. National Transportation Safety Board (NTSB) that the U.S. Federal Aviation Administration (FAA) require that Federal Aviation Regulations (FARs) Part 135 air carriers provide aircrews information on fatigue countermeasures relevant to the duty/rest schedules being flown by the company. The airplane's one flight attendant and 12 passengers received minor injuries in the April 29, 1993, accident.

The crew was climbing to an assigned cruising altitude of Flight Level (FL) 220 (22,000 feet [6,706 meters]) when the airplane stalled and went out of control. The airplane lost 12,000 feet (3,658 meters) of altitude before the flight crew regained control. During the descent the captain, believing there was an engine overspeed, shut down the left engine and feathered the propeller. After regaining control of the airplane, the flight crew found that the left engine nacelle was extensively damaged, three of the four propeller blades were missing and the airplane was unable to maintain level flight. The crew declared an emergency and made an unscheduled landing at the Pine Bluff, Arkansas, U.S., airport. During the landing, the airplane went off the end of the runway and came to rest in a rice field, according to the NTSB accident report. The report said that the flight attendant was "thrown out of the cockpit during loss of control, but managed to get back to her crew station during recovery."

The NTSB said that "the probable causes of this accident were the captain's failure to maintain professional cockpit discipline, his consequent inattention to flight instruments and ice accretion, and his selection of an improper autoflight vertical mode, all of which led to an aerodynamic stall, loss of control, and a forced landing. Factors contributing to the accident were poor crew discipline, including flightcrew coordination before the stall and the flightcrew's inappropriate actions to recover

from the loss of control. Also contributing to the accident was fatigue induced by the flightcrew's failure to properly manage provided rest periods."

The Embraer (owned by Continental Airlines Inc. and operated by Continental Express Inc. as Jet Link Flight 2733) was a scheduled passenger flight from Adams Field Airport, Little Rock, Arkansas (LIT), to Intercontinental Airport (IAH), Houston, Texas, U.S. Flight 2733 departed LIT on an instrument flight rules (IFR) flight plan at 1516 local time. After contacting the Memphis FAA Air Route Traffic Control Center (ARTCC), the crew was instructed to climb and maintain Flight Level 220. As the airplane climbed through 8,000 feet (2,440 meters), the cockpit voice recorder (CVR) recorded the voice of the flight attendant saying "Hi," the report said.

"At 1528:49, the flight attendant and the captain began conversing and continued to do so until the time of the loss of control at 1533:16, 4 minutes and 27 seconds later. The first officer later said that he had been making log book entries and eating his crew meal during this period. … The flight attendant requested that the captain 'climb faster' as she wanted to begin cabin service, and she would have trouble moving the beverage cart 'uphill' during the climb. The captain agreed and subsequently said, 'Okay, we'll try to get up a little more,' and 'yeah we're almost there, another 6 thousand feet another 6 minutes,'" the report said.

The crew lost control of the airplane at 17,000 feet (5,182 meters) and regained control at 5,500 feet (1,676 meters).

"This exchange was followed by more non-pertinent conversation between the captain and the flight attendant, during which the first officer commented that the airplane was not climbing very fast. The captain replied, 'heavy really heavy' and continued with the conversation. At 1533:11, the captain interrupted the conversation with the flight attendant and said to the first officer, 'Frank, hang on something ain't right.' This was followed by the sound of the autoflight system disconnect … and stick shaker activation … . [Two seconds later], the aural stall warning activated, and the captain said, 'airspeed.' The stick shaker and aural stall warning continued until the end of the CVR recording. At 1533:22.7, the captain again said 'hang on,' and at 1533:24.6, the first officer said, 'power up power's.' This was followed by increasing engine noise … and the beginning of vibrations through the airframe. At 1533:39.7, the engine noise decreased and was then no longer audible on the CVR. The CVR recording ended 12 seconds later …" the report said.

The crew lost control of the airplane at 17,000 feet (5,182 meters) and regained control at 5,500 feet (1,676 meters). They then declared an emergency to Memphis ARTCC, stating that they had "lost an engine and needed to put her down." At first, the crew told the controller that they wanted to go to LIT, but then said that they needed to land immediately and that they were losing altitude. The controller told them there was an airport about three miles away. The crew responded that they wanted to go to LIT, then decided it was too far away, and again asked to land at the first available airport. The closest airport had neither an instrument approach nor weather reporting.

The NTSB report said: "The ARTCC controller then reported the weather at PBF [Pine Bluff, Arkansas] as a 4,500 foot [1,372 meter] broken ceiling, but later provided conflicting information that conditions were IMC [instrument meteorological conditions]. The pilot decided to land at PBF after reporting to the ARTCC controller that they needed an IFR approach if they could not land under visual flight rules (VFR) conditions. The pilot then requested the actual weather at PBF but never received it from the ARTCC controller. The ARTCC controller learned that men and equipment were on the runway and that only 5,000 feet [1,524 meters] of the 6,000-foot [1,829-meter] runway were available, but relayed only to the pilot, 'five thousand feet of runway at Pine Bluff.' The controller then told the pilot that he should be able to get into the airport visually, and to contact Little Rock Approach Control."

The crew was told by approach control that the PBF weather was 4,500 feet broken, with five miles (eight kilometers) visibility. "As the flight reported descending through 2,200 feet [671 meters], 8 miles from the airport, the controller reported that the instrument landing system (ILS) was out of service. This was the first time that the pilot was given this information. Another advisory was then given that men and equipment were on the runway, but that the runway would be available. This was also the first time that the pilot was advised of this situation," the report said.

On the day of the accident, the runway lighting system on Runway 17 at PBF was undergoing upgrade construction, and the south 3,000 feet (914 meters) of the 6,000-foot runway was closed. Information about this construction was contained in a notice to airmen (NOTAM). The approach controller reported the inbound emergency flight to the airport manager, who then took action to clear the construction equipment from the runway.

"The airplane broke out of IMC about 1 mile from PBF. The captain stated that he overshot the right turn to final for runway 17 due to control problems. The investigation revealed that the airplane touched down with 1,880 feet [573 meters] of runway remaining. The captain further stated that he applied the brakes at touchdown and the airplane immediately began hydroplaning on the wet surface and went off the departure end onto wet rough sod, avoiding the vehicle and construction personnel that remained near the end. Both flightcrew members stated that braking action was nonexistent on the runway and that both braking and steering were nonexistent in the wet grass

off the runway. Landing gear tire tracks were found on the runway consistent with those associated with hydroplaning," the report said.

The report added: "As the airplane departed the pavement, the right main gear traveled over a 3-foot [0.9-meter] deep runway end lighting ditch. The landing gear tracks then veered to the left away from the ILS equipment building. The building was mounted on a 3-foot high shale pad. The right main landing gear track went up the 45° slope of the pad, while the nose gear traveled along the left edge of the pad and the left main gear track traversed level ground. In addition, evidence of slash marks from the right propeller were found forward of the gear imprint on the pad. After passing over the pad, the tracks entered a wet rice field. The ground scars were consistent with the airplane yawing nose right and eventually coming to rest on a heading of 220°, about 75 feet [23 meters] beyond the building and 687 feet [209 meters] beyond the departure end of runway 17. The crew and passengers immediately evacuated the airplane uneventfully. The right engine gas (-powered electric) generator could not be shut down by the crew or aircraft rescue and fire fighting personnel and continued to run in a pool of Jet A fuel for about 15 minutes."

The airplane was substantially damaged. When examining the left engine nacelle, investigators found that the forward and aft inboard and outboard cowling doors had separated in flight. They were not recovered. The nacelle skin was bent, torn and extensively damaged. The aft engine-mount brackets had separated from the frame. Three of the four propeller blades had separated in flight and were not found. The fourth propeller blade remained loose in the hub.

The backgrounds and qualifications of the flight crew were reviewed. The captain held a U.S. airline transport pilot (ATP) certificate with airplane single- and multi-engine land privileges. At the time of the accident, he had 3,600 total flight hours, with 2,600 hours in the same make and model as the accident airplane. In the preceding 90 and 30 days, he had flown 204 hours and 77 hours respectively, all in the same type and model as the accident airplane. The captain held a current FAA Class I medical certificate, with a limitation for the use of corrective lenses. He was hired by Continental Express Inc. in 1989 and had qualified as captain in the EMB-120 in 1990.

"According to the operator's domicile chief pilot, the captain's greatest strength as a pilot was his ability to establish an open cockpit environment with first officers. According to the accident first officer, the captain was easy to get along with and not intimidating. Two first officers who had flown previously with the captain agreed and indicated that he set up a 'relaxed' cockpit climate," the report said.

The first officer held a U.S. ATP certificate with airplane single- and multi-engine land privileges. At the time of the accident, he had 3,300 total flight hours, with 700 hours in the same make and model as the accident airplane. In the previous 90 and 60 days, he had flown 199 hours and 68 hours respectively, in the same type as the accident airplane. He held a current FAA Class II medical certificate, with no limitations. He was hired by Continental Express Inc. in 1990.

"The first officer's training records and employment background were unremarkable," the NTSB said. "The domicile chief pilot stated that the first officer's greatest strength as a pilot was his ability to give input and demonstrate the principles of crew resource management (CRM) and assertiveness. The captain of the accident flight stated that the first officer's greatest attribute as a pilot was vigilance and attention to detail in the cockpit. He described the first officer as a 'good pilot who loved aviation' and who had taught him a lot."

When investigators examined the accident airplane, "no evidence of primary or trim flight control system malfunction or failure was found."

Seven hours after the accident, blood and urine samples were taken from the captain, first officer and flight attendant. The samples tested negative for alcohol and other major drugs of abuse.

Investigators reviewed the accident airplane's maintenance records and found "no outstanding discrepancies that would have affected its airworthiness, and all of the applicable airworthiness directives (ADs) and service bulletins had been complied with in accordance with the operator's maintenance management procedures. The airplane was dispatched from LIT on the accident flight in accordance with FAA and company procedures and was within prescribed limits for weight and center of gravity," the report said.

When investigators examined the accident airplane, "no evidence of primary or trim flight control system malfunction or failure was found. The FDR [flight data recorder] data, coupled with the crewmembers' statements, indicated that the controls were functioning normally before, during, and after the loss of control. Cable continuity, tensions, and routing were found to be in accordance with maintenance manual specifications. All of the airplane's lift-enhancing devices remained attached during the accident. The components and functions of the stall warning system, including the sensor heating elements, were tested and found to have been operating within normal specifications," the report said.

The investigation revealed that the cockpit area microphone channel of the CVR was inoperative during the accident flight. "According to the flightcrew, they had checked the CVR operation when they boarded the airplane … and had not noted any discrepancies. The normal self-test of the CVR, as outlined in the company and manufacturer's aircraft operations and

maintenance manuals, only checks the recorder itself and does not check the continuity of any of the signals to the recorder. During the postaccident investigation, a broken wire was found between the area microphone and the recorder," the report said.

In 1990, the NTSB issued a safety recommendation to the FAA that asked "all air carriers [to] establish procedures requiring the use of a headset to further verify that the area microphone is functioning properly." In its response, "the FAA stated that it had issued guidelines to all of its POIs [principal operations inspectors] requiring them to ensure that all aircrew training programs include procedures to properly check the CVR and to verify its operation by using a headset," the report said.

The report said that the crew "elected not to wear headsets" on the accident flight. "The captain stated that the headsets 'get bothersome at the end of the day … and it would have been uncomfortable to put them on,'" the NTSB said.

In its report, the NTSB cited a 1991 runway collision between two air carrier aircraft, where the CVR in one of the aircraft had not recorded any information regarding the accident. "This is the type of problem that should have been detected had appropriate CVR preflight procedures been used. This CVR failure occurred four months after the issuance of FAA Handbook Bulletin 91-27. Thus the Board is concerned that the FAA's action has failed to remedy the problem," the report said.

The loss of control, descent and recovery occurred in IMC, the report said.

The accident airplane was equipped with a multi-mode autoflight system. "A review of the Continental Express Aircraft Operations Manual, the training syllabus, and discussions with the chief pilot indicated that crews were instructed to climb in either the 'climb' or 'indicated airspeed' modes. Contrary to this guidance, the captain stated that he had selected the 'heading' and the 'pitch hold' modes during the flight. He further stated during the interview that he thought the 'pitch hold' mode would give him the best climb performance. This was in direct contradiction to the airplane operations manual, which clearly states that the 'climb' mode would provide the best performance. The 'pitch hold' mode maintained a constant airplane attitude regardless of airspeed and would not prevent the airplane from flying into a stall situation. By contrast, both the 'climb' and 'indicated airspeed' modes allowed the autoflight system to monitor airspeed and provide stall protection," the NTSB report said.

Investigators analyzed the FDR data associated with the loss of control. When the flight attendant asked the flight crew whether they could climb faster to their assigned cruising altitude, the accident airplane was climbing through 15,800 feet (4,816 meters) at 420 feet per minute (FPM [128 meters per minute]) and at 180 knots indicated airspeed (KIAS). The pitch angle was about 3.2 degrees. Eighteen seconds later, "the pitch angle increased to about 5.2°, and the altitude was 16,100 feet [4,907 meters]. The rate of climb increased to about 900 [FPM (274 meters per minute)] as the airspeed slowed from 173 KIAS to 166 KIAS within the next 20 seconds," the report said.

The report added: "The pitch angle further increased to about 6.4°… while the airspeed was about 160 KIAS. The altitude was about 16,700 [feet (5,090 meters)], and the rate of climb increased very little, to 1,000 [FPM (305 meters per minute)] within the next 10 seconds. Within an additional 10 seconds … the climb rate decreased to 900 [FPM] while the airspeed decreased to 152 KIAS. Within the next 45 seconds … the climb rate decreased to zero, and the airspeed decreased to 143 KIAS. The stick shaker activated … at an airspeed of 141 KIAS, and the roll angles started to develop 1 second later. Within 7 seconds after the stick shaker onset, the airplane developed a high rate of descent that reached in excess of 17,000 [FPM (5,182 meters per minute)] during which the roll oscillations continued. Roll oscillations as high as 90 degrees in each direction and pitch attitudes as low as 67° airplane nose down were recorded during the descent. Coincident with the roll oscillations, the airspeed reached about 210 KIAS, and the airplane, while remaining near a stall condition, developed a positive load factor between 2 and 3 Gs."

The airplane descended to 5,600 feet (1,707 meters), then climbed rapidly and entered a secondary stall at 6,700 feet (2,042 meters). Controlled flight was regained at 5,500 feet (1,676 meters). The loss of control, descent and recovery occurred in IMC, the report said.

Investigators compared theoretical performance with the actual airplane performance at the time of the accident, and found "that for the conditions present, the stick shaker should have activated at 127 KIAS, and the airplane would have stalled at 117 KIAS. The stick shaker on the accident airplane activated at 141 knots, or 14 knots higher than expected," the report said. The stick shaker activated at an angle of attack of 10 degrees, which was normal. " … the activation of the stick shaker and the loss of lateral control at airspeeds 14 [knots] and 22 knots higher than the theoretical speeds for those events indicated that the aerodynamic performance of the airplane was affected by still other factors. Two of these factors were examined on the EMB-120 engineering simulator: drag due to sideslip and ice accretion."

Investigators determined that the rudder trim on the accident airplane was set 10 units to the right, which resulted in a left sideslip as the airplane approached the stall. Because this sideslip condition was of short duration, the NTSB did not believe the out-of-trim condition was a factor in the loss of control, the report said.

A review of meteorological data and reports by other pilots indicated that icing conditions were present at the time of the accident. "The airplane was in clouds as it climbed above the freezing level at 11,500 feet [3,505 meters] and was exposed to freezing temperatures and visible moisture for over 7 minutes before the loss of control occurred. … Embraer had aerodynamic performance data available for a wing having an inch or more of rough rime ice on the leading edge. When these data were examined in the simulator, the noted degradation in the airplane's climb performance was far greater than the degradation evident for Flight 2733. Although the captain and first officer both stated that they had not observed ice on the wings, there is no evidence that they looked for ice at any time during the climb … ," according to the report.

Investigators interviewed a passenger, who reported seeing a whitish substance on the windscreen. The NTSB believed this substance was snow, which was evidence of some ice accumulation, according to the report.

A review of meteorological data and reports by other pilots indicated that icing conditions were present at the time of the accident.

"The Safety Board believes that an accretion of ice on the wing is the only reasonable explanation for the occurrence of stick shaker activation and loss of roll control at higher-than-expected airspeeds. … If the airplane accumulated ice during the climb above 11,500 feet while at a relatively low angle of attack, the ice would have formed at the stagnation point associated with that angle of attack. As the airplane slowed, the corresponding increase in angle of attack would have resulted in a movement of the stagnation point lower on the leading edge. Thus, the ice that had formed at the higher speed would be above the new stagnation point and produce a greater disruption of the air flow over the wing upper surface leading to a premature boundary layer separation. The result would be a progressive reduction in the lift produced by the wing and a stall at a lower angle of attack. In past aviation accident investigations, the Safety Board has determined that almost imperceptible amounts of ice, 1/4 of an inch [0.64 centimeters] or less, on the wing leading edge has significantly increased the stall speed and lateral control capability of the airplane," the report said.

[The stagnation point is the point on the leading edge of the airfoil where the relative airflow diverges to pass above and below the wing so that the local airflow velocity is zero. The boundary layer is the airflow immediately adjacent to the wing surface.]

The NTSB concluded that "while it is likely that the accretion of ice alone would not have led to a stall had the captain attempted to maintain a target airspeed instead of a target pitch attitude, the Safety Board cites the captain's inattention to ice accretion as a factor in the accident."

The captain's actions to recover from the stall and subsequent loss of control were analyzed. "The FDR and CVR correlation [shows] that within 2 seconds of stick shaker onset and autopilot disconnect, the airplane entered a sudden and uncontrollable roll oscillation. The data then show that instead of relaxing control column force, the captain increased back force to hold the control column aft and introduced roll commands through the control wheel that were initially out of phase with the proper corrective deflections. Thus, the captain's initial control deflections following the stick shaker onset and the almost immediate loss of control aggravated, rather than corrected, the out-of-control maneuvers," the report said.

The NTSB acknowledged that the crew was faced with a difficult situation, in attempting to recover from unusual attitudes while IMC with high lateral and vertical acceleration loads. Nevertheless, the NTSB concluded that "this accident illustrates the need to emphasize to pilots the aerodynamic fundamentals of a stall-induced loss of control and the need to move the control column to reduce the angle of attack to recover from such a loss of control."

The in-flight separation of the three propeller blades on the left engine was analyzed. Evidence indicated that the propeller blades starting separating about 35 seconds after the loss of control. "The evidence indicated that the composite blade retaining rings fractured and led to the blade loss. During departure from normal flight attitudes, the roll and yaw oscillations cause significant angle-of-attack changes on the blades, which produce increasingly severe propeller cyclic loads. Damage signatures observed in the left propeller hub were consistent with the blade departing the hub by rocking in the plane of rotation. The rocking motion of the blades would load the retaining rings so as to produce a fracture," the report said. The NTSB believed that "the loss of the propeller blades was initiated when the crew attempted to feather the left engine in the belief that an engine overspeed had occurred."

Investigators reviewed the possibility that fatigue could have contributed to the accident, because the accident flight occurred at the end of the crew's three-day flight schedule. "The first day of the schedule was demanding and culminated in a reduced rest period. The second day was short, with the crew going off duty about 1130 and not having to report back until 0530 the next day. The last day was perceived by the crew as being the most demanding because it was the end of the trip, and as the first officer said, 'one is just ready to go home and see the family.' The captain stated that the workload was slightly heavier on the last day due to having seven legs to fly in IMC," the report said.

The NTSB found that the rest periods for the flight schedule were within company guidelines and the FARs. The investigation revealed that "for the two nights before the accident, the pilots averaged only about 5 to 5 1/2 hours of sleep per night. The accident occurred after a long and relatively difficult day of flying and on the last leg when the crew anticipated getting home. Further, the accident occurred late in the afternoon when the human body normally reaches a physiological low level of performance and alertness. The Safety Board believes that the combined effects of cumulatively limited sleep, a demanding day of flying, and a time of day associated with fatigue had an effect on crew performance," the report said.

The NTSB also found that a complacent and lax atmosphere existed among the three crewmembers during the flight. The captain had allowed the flight attendant in the cockpit and the two were engaged in casual conversation for more than four minutes before the loss of control occurred. Meanwhile, the first officer was making airplane log book entries, and neither he nor the captain were monitoring the flight instruments. "All three individuals [crewmembers] should have done more to prevent the accident situation from developing, and good crew coordination and resource management principles certainly would have assisted them," the report said.

The flight crew's communications with air traffic control and controller actions were also analyzed. "A review of the ATC communications transcript revealed that the flightcrew did not describe the full nature of their difficulties to the controller until very late in the accident's sequence of events. … When the flightcrew stated their intention to land at PBF, the air traffic controller should have informed the pilot that men and equipment were working on the runway. Additionally, the information concerning the ILS outage should have been issued to the pilot sooner than it was. This information was carried on a NOTAM that was not available to the ARTCC controller, but was available to the approach controller. Another controller on the ARTCC sector controlling the aircraft was aware that navigational aids (navaids) were not available at PBF, but the information never reached the pilot. Therefore, the Safety Board believes that the coordination and passing of information from approach control to the ARTCC was insufficient. … In spite of these anomalies, the Board believes that the failure to pass on information about the ILS outage and about men and equipment on the runway did not contribute to the accident sequence of events," the report said.

The NTSB developed 18 findings as a result of its investigation. Some of the more pertinent findings in the report were:

- "The Continental Express operations and maintenance procedures pertinent to the conduct of the accident flight were found to be logical, clearly presented, and in accordance with the FARs. In many instances, the operator's procedures and requirements exceeded the minimum standards set by the FAA;

- "All of the flight control, autoflight, stall warning, and flight instrument systems were operating normally up to the time of the loss of control. No evidence of primary or trim flight control system malfunction was found;

- "The freezing level was near 11,500 feet and the potential for icing existed up through 19,000 feet [5,795 meters]. The airplane was in clouds with zero visibility, and the tops of the clouds extended above 21,000 feet [6,405 meters];

- "The entire crew violated the sterile cockpit rule as the airplane was passing through 8,000 feet [2,440 meters]. In addition, the flight attendant was present in the cockpit as the airplane climbed above 10,000 feet [3,050 meters], engaging in nonpertinent conversation with the captain, for 4 minutes and 27 seconds up to and during the loss of control;

- "The captain and the first officer failed to adequately monitor the progress of the flight during the climb, and the first officer failed to adequately monitor the captain's actions;

- "The captain engaged the autoflight system in the 'heading' and 'pitch hold' modes during the climb, obviating the stall and speed protection afforded by the other vertical modes. This autoflight system configuration was contrary to the company's training and procedures;

- "During the climb, the pitch was increased by the captain, using the autoflight 'pitch hold' mode, in the minutes before the loss of control;

- "The increase in pitch, and subsequent loss of airspeed, resulted in an aerodynamic stall. The stall and loss of control at a higher-than-expected airspeed was caused by aerodynamic performance degradation due to wing ice contamination;

- "The captain did not respond immediately to the stick shaker warning, which was followed within 2 seconds by a loss of lateral control. Thereafter, the continued exertion of back force on the control column was inappropriate;

- "The airplane recovered from the out-of-control descent when control forces were relaxed and the landing gear was lowered;

- "The operation of the engines and propellers was normal until after the loss of control. The captain shut

down the left engine and feathered the propeller, mistakenly believing that there was an engine overspeed. Three of the four left propeller blades and the cowlings separated after the beginning of the event, during the post-stall gyration;

- "Following recovery, due to asymmetric aerodynamic drag caused by the damaged engine, propeller, and cowl, the airplane was unable to maintain level flight, and precise airplane control was not possible;

- "Because of the inability to precisely control the airplane after the recovery, the flightcrew landed long. This, and the fact that the runway was wet, precipitated the overrun landing roll, subsequent airplane damage, and injuries;

- "The crew rest periods scheduled for the trip sequence were within company guidelines and [the] FARs. However, the crew did not take advantage of the rest periods, and the combined effects of cumulatively limited sleep, a demanding day of flying, and a time of day associated with fatigue were factors in the crew's inadequate judgment and performance; and,

- "Although coordination between Little Rock Approach Control and Memphis ARTCC could have been much improved, it did not contribute to the accident."

As a result of its findings, the NTSB recommended that the FAA "require that Part 135 air carriers provide aircrews, as part of their initial and recurrent training, information on fatigue countermeasures relevant to the duty/rest schedules being flown by the company." ♦

Editorial note: This article was adapted from *Aircraft Accident/ Incident Summary Report: In-flight Loss of Control, Leading to Forced Landing and Runway Overrun, Continental Express, Inc., N24706, Embraer EMB-120 RT, Pine Bluff, Arkansas, April 29, 1993*, Report No. NTSB/AAR-94/02/SUM, prepared by the U.S. National Transportation Safety Board. The 49-page report includes illustrations and appendices.

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