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National Transportation Safety Board
Washington D.C. 20594
Safety Recommendation

Date: August 15, 1996

In reply refer to: A-96-70

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On October 31, 1994, at 1559 Central Standard Time, an Avions de Transport Regional, model 72-212 (ATR 72), registration number N401AM, leased to and operated by Simmons Airlines, Incorporated, and doing business as (d.b.a.) American Eagle flight 4184, crashed during a rapid descent after an uncommanded roll excursion. The airplane was in a holding pattern and was descending to a newly assigned altitude of 8,000 feet when the initial roll excursion occurred. The airplane was destroyed by impact forces; and the captain, first officer, 2 flight attendants and 64 passengers received fatal injuries. Flight 4184 was a regularly scheduled passenger flight being conducted under 14 Code of Federal Regulations (CFR) Part 121; and an instrument flight rules flight plan had been filed.¹

¹For more detailed information, read Aircraft Accident Report--"In-flight Icing Encounter and Loss of Control, Simmons Airlines, d.b.a. American Eagle Flight 4184, Avions de Transport Regional (ATR), Model 72-212, N401AM, Roselawn, Indiana, October 31, 1994" (NTSB/AAR-96/01)

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The National Transportation Safety Board has determined that the probable causes of this accident were the loss of control, attributed to a sudden and unexpected aileron hinge moment reversal that occurred after a ridge of ice accreted beyond the deice boots because: 1) ATR failed to completely disclose to operators, and incorporate in the ATR 72 airplane flight manual, flightcrew operating manual and flightcrew training programs, adequate information concerning previously known effects of freezing precipitation on the stability and control characteristics, autopilot and related operational procedures when the ATR 72 was operated in such conditions; 2) the French Directorate General for Civil Aviation's (DGAC's) inadequate oversight of the ATR 42 and 72, and its failure to take the necessary corrective action to ensure continued airworthiness in icing conditions; and 3) the DGAC's failure to provide the Federal Aviation Administration (FAA) with timely airworthiness information developed from previous ATR incidents and accidents in icing conditions, as specified under the Bilateral Airworthiness Agreement and Annex 8 of the International Civil Aviation Organization.

Contributing to the accident were: 1) the FAA's failure to ensure that aircraft icing certification requirements, operational requirements for flight into icing conditions, and FAA published aircraft icing information, adequately accounted for the hazards that can result from flight in freezing rain and other icing conditions not specified in 14 CFR Part 25, Appendix C; and 2) the FAA's inadequate oversight of the ATR 42 and 72 to ensure continued airworthiness in icing conditions.

The investigation of this accident has revealed that the current methods of forecasting icing conditions are of limited value because they typically cover very large geographic areas and do not provide specific information about liquid water content (LWC) or water drop sizes. Present forecast techniques use only relative humidity and temperature. According to the scientist from National Center for Atmospheric Research (NCAR), who testified at the Safety Board's public hearing on this accident, it is not possible to infer the severity of icing using only temperature and humidity. The severity of the icing also depends on the LWC and the size of the water droplets, information which is not currently identified and forecasted.

A current state-of-the-art atmospheric model was employed by NCAR to determine if the icing conditions that are presumed to have been present in the accident area could have been forecast accurately. The atmospheric modeling did not generate a forecast of freezing rain or freezing drizzle for the area of the LUCIT intersection. The NCAR scientist testified that "...models aren't perfect, forecasts aren't perfect... even though it's the current state-of-the-art of atmospheric modeling."

No reliable methods exist for flightcrews to differentiate, in flight, between water drop sizes that are outside the 14 CFR Part 25, Appendix C, icing envelope and those within the envelope. Further, although side window icing was recognized as an indicator of ice accretions from freezing drizzle during flight tests of an ATR 72 after the accident, the crew of flight 4184 could not have been expected to know this visual cue because its significance was unknown to the ATR pilot community at the time. Moreover, in-service ATR incidents and pilot reports have shown that side window icing does not always accompany ice accretions aft of the deice boots, which ATR has stated only occurs in freezing drizzle and/or freezing rain.

The Safety Board acknowledges the efforts of atmospheric research in the meteorological community and hopes that its important findings will eventually provide the aviation industry with a better understanding of the freezing drizzle/rain phenomenon. The Safety Board concludes that the continued development of atmospheric measuring and monitoring equipment, such as atmospheric profilers, use of the WSR-88D [weather surveillance radar] and terminal Doppler weather radars, multispectral satellite data, aircraft-transmitted atmospheric reports, and sophisticated mesoscale models, and the development of computer algorithms, such as those contained in the FAA's Advanced Weather Products Generator program to provide comprehensive aviation weather warnings, could permit forecasters to refine the data sufficiently to produce more accurate icing forecasts and real-time warnings. Therefore, the Safety Board believes that the National Oceanic and Atmospheric Administration should develop methods to produce weather forecasts that define very specific locations of potentially hazardous atmospheric icing conditions (including freezing drizzle and freezing rain) and to produce short-range forecasts ("nowcasts") that identify icing conditions for a specific geographic area with a valid time of 2 hours or less. Also, all


significant findings resulting from this activity should be disseminated to the aviation community in an appropriate manner.

Therefore, as a result of its investigation of this accident, the National Transportation Safety Board recommends that the National Oceanic and Atmospheric Administration:

Develop methods to produce weather forecasts that both define specific locations of atmospheric icing conditions (including freezing drizzle and freezing rain), and that produce short range forecasts ("nowcasts") that identify icing conditions for a specific geographic area with a valid time of 2 hours or less. Ensure the timely dissemination of all significant findings to the aviation community in an appropriate manner. (Class II, Priority Action) (A-96-70)

Also, the Safety Board issued Safety Recommendations A-96-48 through -69 to the Federal Aviation Administration and A-96-71 through -73 to AMR Eagle.

Chairman HALL, and Members HAMMERSCHMIDT, GOGLIA, and BLACK concurred in this recommendation. Vice Chairman FRANCIS did not participate.

By: 
Jim Hall
Chairman