Chief Executive Officer
Tel. 33 (0)5 62 21 63 05
Fax. 33 (0)5 62 21 68 00

By Registered Mail

Mr. Thomas E. Haueter
Chief Major Investigation Division
Office of Aviation Safety
National Transportation Safety Board
490 L'Enfant Plaza East S.W.
Washington, D.C., 20594

O/Ref. : DG 148/99

22 September, 1999

Re: NTSB Aircraft Accident Report PB96-91041, NTSB/AAR-96/01, DCA95MA001; In-Flight Icing Encounter and Loss of Control Simmons Airlines, d.b.a. American Eagle Flight 4184, Avions de Transport Régional (ATR) Model 72-212, N401AM, Roselawn, Indiana, October 31, 1994

Dear Mr. Haueter,

Pursuant to 49 CFR 845.41, Avions de Transport Régional, GIE ("ATR") hereby petitions the National Transportation Safety Board ("NTSB") to modify the Board's conclusions and determination of probable cause for the referred accident. As more fully described in the attached Petition for Reconsideration of the NTSB's Findings and Probable Cause, ATR strenuously objects to and disagrees with, amongst others, the unfounded allegations contained in findings n° 21, 22, 23, 24, 25 and 35.

As the NTSB is aware, ATR has consistently maintained since the adoption of the NTSB Report that the NTSB failed both to consider all evidence and to correctly analyze the evidence that resulted from the investigation of this accident.

Finally, and as shown in the attachment, ATR believes that the NTSB Report on this accident is not compliant with the spirit of Annex 13 and the ICAO Manual of Aircraft Accident Investigation, and that certain findings are entirely inconsistent with the Board's recommendations and the Probable Cause statement.

.../...

Based on the evidence described in the attached Petition for Reconsideration of the NTSB's Findings and Probable Cause, ATR requests that the Board carefully review and modify substantial portions of its accident report and modify its Findings accordingly. Also, ATR respectfully submits that the Board should change its determination of Probable Cause to state "that the probable cause of this accident was the lack of recovery of the aircraft from its loss of control, attributed to a sudden and unexpected aileron hinge moment shift that occurred after a ridge of ice accreted beyond the de-icing boots following a prolonged operation of the aircraft in hazardous icing conditions well outside the certification envelope and for which no airplane is certified".

Sincerely,

Antoine Bouvier
Chief Executive Officer

Encl.

cc: Chairman James E. Hall
Vice Chairman Robert T. Francis II
Member John Hammerschmidt
Member John J. Goglia
Member George W. Black, Jr.
The Federal Aviation Administration
Direction Générale de l'Aviation Civile

AVIONS DE TRANSPORT REGIONAL, GIE

PETITION FOR RECONSIDERATION OF THE AIRCRAFT ACCIDENT REPORT OF THE NATIONAL TRANSPORTATION SAFETY BOARD ON THE SIMMONS AIRLINES FLIGHT 4184 ATR-72 ACCIDENT NEAR ROSELAWN, INDIANA

OCTOBER 31, 1994

TABLE OF CONTENTS

PAGE

INTRODUCTION 1

DISCUSSION 3

1. The Development and Certification of the ATR Aircraft Did Not Disclose the Aerodynamic Phenomenon Involved in the Roselawn Accident 3

2. The Previous ATR-42 Icing Incidents Were Different from the Roselawn Accident, and Provided No Warning of the Unique Roselawn Accident Aerodynamic Phenomenon 7

   2.1. Summary of Previous ATR-42 Icing Incidents and Comparison to the Roselawn Accident 8

      2.1.1. AMR Eagle/Simmons ATR-42/SN 91, Mosinee, Wisconsin, December 21, 1988 8

      2.1.2. Air Mauritius ATR-42/SN 208, April 17, 1991 over the Indian Ocean 10

      2.1.3. Ryanair ATR-42/SN 161, August 11, 1991 over South Wales 11

      2.1.4. Continental Express ATR-42/SN 259, March 4, 1993 at Newark, New Jersey 12

      2.1.5. Continental Express ATR-42/SN 153, January 28, 1994 at Burlington, Massachusetts 13

   2.2. The Unique Circumstances of the Roselawn Accident 14

   2.3. Conclusion: The Previous ATR-42 Icing Incidents Involved Different Circumstances from that of the Roselawn Accident and thus Provided No Warning of the Mechanics of that Accident 16

   2.4. Significant NTSB Report Errors 17

3. ATR's Actions in Response to the Previous ATR-42 Icing Incidents Were Correct and Complete Responses to the Circumstances Present in Those Incidents 21

   3.1. Summary of Corrective Actions Taken After Previous ATR-42 Icing Incidents 21

      3.1.1. AMR Eagle/Simmons ATR-42/SN 91, Mosinee, Wisconsin, December 21, 1988 21

TABLE OF CONTENTS

PAGE

3.1.2. Air Mauritius ATR-42/SN 208, April 17, 1991 Over the Indian Ocean 23

3.1.3. Ryanair ATR-42/SN 161, August 11, 1991 Over South Wales 23

3.1.4. Continental Express ATR-42/SN 259, March 4, 1993 at Newark, New Jersey 24

3.1.5. Continental Express ATR-42/SN 153, January 28, 1994 at Burlington, Massachusetts 24

3.2. Conclusion: The Corrective Actions Taken by ATR Correctly Addressed the Phenomenon Which Was Common to Each of the Prior ATR-42 Incidents 25

4. Additional Erroneous NTSB Report Findings 26

5. The Certification Process Under the Bilateral Airworthiness Agreement Between the United States and the Government of France Regarding ATR Series Aircraft Was Conducted Properly 29

6. The NTSB Report is Contrary to the Spirit of Annex 13 and the ICAO *Manual of Aircraft Accident Investigation*, and Is Internally Inconsistent 30

CONCLUSION 33

AVIONS DE TRANSPORT REGIONAL, GIE PETITION FOR RECONSIDERATION OF THE AIRCRAFT ACCIDENT REPORT OF THE NATIONAL TRANSPORTATION SAFETY BOARD ON THE SIMMONS AIRLINES FLIGHT 4184 ATR-72 ACCIDENT NEAR ROSELAWN, INDIANA ON OCTOBER 31, 1994

INTRODUCTION

Avions de Transport Regional, GIE (ATR) hereby submits its Petition For Reconsideration of the Aircraft Accident Report of the National Transportation Safety Board on the Simmons Airlines Flight 4184 ATR-72 accident near Roselawn, Indiana October 31, 1994 (the Report). Pursuant to 49 CFR Section 845.41(a), ATR's Petition is based upon a showing that many of the Safety Board's findings are seriously flawed and erroneous. In the interests of aviation safety, ATR strongly encourages the NTSB to substantially modify its Report to correct the Safety Board's erroneous findings.

As the NTSB is well aware, ATR has maintained since long before the adoption of the NTSB's final Report, that the NTSB failed both to consider all of the evidence involved in the Roselawn accident, and to correctly analyze the evidence it did consider during the course of the Roselawn accident investigation. For the record, ATR is in full agreement with the French Bureau Enquêtes Accident's (BEA) Annex 13 Comments to the Board's Report, the Direction Générale de l'Aviation Civile's (DGAC) Petition For Reconsideration, and the Federal Aviation Administration's (FAA) comments thereon, particularly with regard to the disagreement of all of those agencies with the NTSB's erroneous conclusions regarding: (1) the ability of the FAA, DGAC, and ATR to predict the unique Roselawn accident by analyzing previous incidents which were entirely different aerodynamically, and (2) the responsibilities of the FAA and the DGAC under the U.S.-France bilateral airworthiness agreement.

As discussed in more detail below, ATR strenuously contests as erroneous considerable portions of the factual and analysis sections, as well as many of the findings and the probable cause statement contained in the Report. Among these findings ATR finds most objectionable findings Nos. 16, 19, 21, 22, 23, 24, 25, 29, 35 and 36. First, the Safety Board's technical misunderstanding concerning the aileron activity in the pre-Roselawn icing-related ATR-42 incidents, versus the aileron activity involved in the Roselawn ATR-72 accident, has resulted in an erroneous premise upon which the entire Report is based. Specifically, the NTSB alleges that five pre-Roselawn icing-related ATR-42 incidents presented sufficiently similar characteristics to the Roselawn accident to have provided ATR, the DGAC, and the FAA with an advance warning of the Roselawn accident. Thus, according to the NTSB, these parties failed to adequately alert operators and pilots of the "previously known" effects of freezing rain/drizzle on the aircraft and especially on aileron behavior.

ATR will demonstrate that these NTSB findings, as well as others discussed below, are simply wrong because they are based upon the NTSB staff's failure to understand the fundamental aerodynamic issues involved. In essence, the NTSB blurs the significant aerodynamic distinction between normal post-stall aileron activity (a hinge moment characteristic which is common to all aircraft with unpowered flight control systems) which occurred in all of the prior ATR-42 incidents, with the aileron hinge moment shift which occurred in the Roselawn accident.

A thorough review and analysis of the prior ATR-42 icing incidents which the NTSB felt were of interest clearly demonstrates that four of these events were fundamentally different from the Roselawn accident and that the level of turbulence involved in the one other incident (Newark incident) made it, and still makes it, impossible to determine the exact nature of the roll departures involved. None of these events involved the Roselawn phenomenon. Each event involved a fundamentally different aerodynamic mechanism i.e., a conventional aerodynamic stall of the wing at slow airspeeds and high angles of attack at or near the stall warning threshold in severe icing conditions. Simply stated, the prior ATR-42 incidents were conventional stall events in icing conditions which occurred at or about the angle of attack where stalls normally occur in such conditions. They did not involve an aileron hinge moment shift, which in turn caused an uncommanded aileron deflection and roll departure, as was the case in the Roselawn accident.

Unfortunately, the NTSB Report lacks clarity in this respect, consistently failing to accurately distinguish the two phenomena -- ice-induced lift loss vs. aileron hinge moment shift. These are entirely different phenomena. The difference is particularly significant with regard to their respective angles of attack (AOA's) of occurrence. The NTSB's blurring of these phenomenon is inexcusable, particularly since representatives of ATR, the BEA, the DGAC, and the FAA repeatedly explained this issue to the NTSB during the course of the NTSB's investigation of the Roselawn accident. It also is stunning that the NTSB also ignores its own earlier investigations of prior incidents, which did not find the Roselawn aerodynamic phenomenon in prior incidents. The NTSB's failure to acknowledge that the prior ATR-42 incidents are not aerodynamically similar to the Roselawn accident has resulted in formal submissions to the NTSB from the BEA, the DGAC, the FAA and now ATR. The NTSB should take note that the BEA's Annex 13 comments, the DGAC's Petition For Reconsideration, the FAA's comments to the DGAC's Petition, and ATR's Petition For Reconsideration are all largely premised on the fact that the Safety Board's findings are erroneous on this fundamental issue.

The Safety Board also alleges that ATR discovered the abnormal aileron behavior displayed in the Roselawn accident during the development and certification of the ATR-42/72 series aircraft. This finding is simply wrong. It is not supported by any facts in the NTSB's record of investigation, and it ignores the results of the FAA/DGAC Special Certification Review team, formed at the NTSB's request, which found the opposite to be true.

In addition, the NTSB finds that the actions of the aircraft manufacturer regarding the previous icing-related incidents were not adequate responses to the circumstances of these events. This finding is erroneous. ATR has never failed to take corrective actions following

incidents, has never concealed information from either operators or airworthiness authorities, and has always responded in a prompt and accurate manner following each and every incident occurring before or after the Roselawn accident.

ATR will also address other significant errors contained in the findings of the Report, which are derived from the NTSB staff's inaccurate technical analyses of the prior incidents and the Roselawn accident. These findings relate to ATR's All Weather Operations Brochure and the 1989 simulation package developed by ATR. Additional technical inaccuracies contained in the Report will also be addressed and corrections suggested. Finally, the Safety Board raises concerns regarding certification and continued airworthiness of foreign manufactured aircraft under the Bilateral Airworthiness Agreement which exists between the Governments of the United States and France. The manufacturer does not agree with the NTSB. The BAA is a technical agreement that has been correctly applied by the DGAC and the FAA since its inception in 1973, including its application in the Certification of the ATR-42 and ATR-72 aircraft.

ATR will discuss each of these points below.

DISCUSSION

1. The Development and Certification of the ATR Aircraft Did Not Disclose the Aerodynamic Phenomenon Involved in the Roselawn Accident

The development and certification of the ATR-42 and ATR-72 aircraft for flight in icing conditions was the result of an exhaustive program involving elaborate computations and intensive flight test campaigns. Complete effectiveness of the anti-icing/de-icing devices was successfully demonstrated against Appendix C certification requirements during natural icing flight tests. Complete assessment of aircraft handling and performance characteristics was also achieved for each phase of flight during flight tests with artificial ice shapes, including simulation of anti-icing and de-icing failure cases.

However, because FAR 25, Appendix C is vague in respect to aircraft handling and performance requirements in icing conditions, a comprehensive Special Condition was established by the DGAC, the French airworthiness authority, and was part of the ATR-72 certification basis. The main purpose of Special Condition B6 is to assess handling characteristics and performance aspects taking into account the aerodynamic penalties due to ice accretion in terms of drag, lift, and other aerodynamic characteristics. The demonstrations were thus performed with respect to criteria well beyond the current FAR/JAR 25 airworthiness standards. Contrary to the NTSB's assertion on page 176 of the Roselawn accident Final Report, no aileron hinge moment anomaly comparable to that observed on Flight 4184 was ever encountered during the various test campaigns conducted during the development and certification of ATR aircraft. Thus, the NTSB's allegations in this regard are not supported by the facts or the NTSB's record of investigation.

Following the Roselawn accident, and at the NTSB's request, a comprehensive ATR Special Certification Review (SCR) of Model ATR-42 and ATR-72 series airplanes was conducted by a joint FAA/DGAC review team. Among its numerous tasks, the review team focused on icing, the roll control system, and autopilot regulatory compliance and approval criteria and procedures. The NTSB also recommended that flight test and/or wind tunnel tests be conducted as part of the review in order to determine the aileron hinge moment characteristics of the airplanes while operating at different airspeeds and in different configurations during ice accumulation, and with varying angles of attack following ice accretion.

Six certification specialists from the FAA and four certification specialists from the DGAC formed the ten-member SCR team. During a six-month period, at eight venues both in the United States and in France, the team spent hundreds of hours investigating the certification and performance of ATR-42 and ATR-72 series aircraft. The SCR team issued its final report on September 29, 1995, under the title: *Federal Aviation Administration/Direction Générale de l'Aviation Civile Special Certification Review Report-Aerospatiale Model ATR-42 and ATR 72 Series Airplanes, September 29, 1995* (SCR Report). Although the NTSB attached excerpts of the SCR Report as Appendix C to its Aircraft Accident Report, the NTSB largely ignored critical information concerning the SCR review team's findings which directly refute NTSB's erroneous conclusions regarding the development and certification of the ATR-42 and ATR-72 series aircraft. The SCR team's conclusions are discussed in more detail below.

As the DGAC noted in the Petition for Reconsideration on the Roselawn accident report, which it filed with the NTSB, the SCR Report of the FAA and DGAC concluded that during the development and certification of the ATR aircraft there was no evidence whatever of any unsafe aileron hinge moment characteristics. Instead, the SCR Report concluded that the aileron activity which was noted at or near the stall regime during the certification and development flight tests of the ATR, is a classic characteristic of a non-hydraulic flight control system. The SCR Report concluded that this characteristic was at the time of certification, and is today, fully acceptable. Contrary to the statements of the NTSB, this post-stall aileron movement is normal and expected. It also is an entirely different phenomenon from the roll departure caused by the aileron hinge moment shift which resulted in the massive, abrupt, stall unrelated, very low angle of attack ("AOA"), uncommanded aileron deflections in the Roselawn accident. Further, as the NTSB well knows, the aileron deflection phenomenon that occurred at Roselawn was discovered, analyzed, and experimentally replicated for the first time during the post-accident investigations and testing at Edwards Air Force Base (or EAFB). With respect to the unsafe aileron hinge moment characteristics, which the NTSB incorrectly alleges were observed during the DGAC's certification of the ATR, page 30 of the SCR Report states:

Analysis of Aileron Hinge Moment Characteristics

Introduction

"The SCR team used all previously available certification data and data from new tests conducted by the team and Aerospatiale to reach an understanding of the lateral control wheel displacement and force characteristics. The team found one task of special interest, to determine if the tests conducted for certification under

FAR/JAR 25 and DGAC Special Condition B6 gave an indication of any unsafe lateral control wheel characteristics even with hindsight of the accident data. Such information would be important in developing additional certification criteria".

Page 34 of the Report continues with the following:

Discussion of SCR Team Findings (Hinge Moments/Lateral Control)

Certification Flight Test Data

"During the SCR team's research and analysis of the certification flight test data, no adverse aileron hinge moments or lateral control anomalies were found. Data for the ATR-42 were not analyzed specifically because the aileron servo tab gearing on that airplane provided more lateral wheel force per aileron deflection than on the ATR-72. Therefore, it was considered less critical in terms of producing uncommanded aileron characteristics". (Emphasis added.)

Finally, page 47 of the Report states:

Summary of Aileron Hinge Moment Characteristics

The flight test data and qualitative assessments made by the DGAC during certification of the ATR-42, ATR-72 basic, and ATR-72-211/212 did not indicate that any unsafe or atypical lateral control wheel force characteristics existed. This conclusion also was based on the comprehensive assessment of the airplane in icing conditions conducted in accordance with Special Condition B6. Results of tests performed at Edwards AFB with the 40 micron droplets, i.e., within Appendix C requirements, have confirmed this conclusion. (Emphasis added.)

The following excerpt from the SCR report (page 37) describes ATR stall characteristics:

Stall Characteristics

Stall characteristics tests with and without ice shapes and with natural ice were reviewed. The NTSB requested that a member of the accident investigation team from the National Aeronautics and Space Administration (NASA) conduct an extensive review of the certification stall data to determine if there were any lateral control anomalies. Some minor uncommanded aileron activity was noted on several stalls, but under the criteria of FAR/JAR 25.203, this activity was (and is) considered acceptable. All of these small uncommanded aileron movements occurred just at or after activation of the stick pusher. Additionally, for these tests conducted with ice shapes on the ATR-72-100/200, the stall stick pusher on the test airplane was set at the AOA threshold of the no-ice configuration (i.e., approximately 5° more than the AOA threshold for the ice configuration). These aileron force anomalies are indicative of some aileron snatch tendencies following asymmetric left and right wing airflow separation as the stall progresses. All airplanes with aerodynamically balanced control surfaces can be affected in a similar manner. Therefore, these

characteristics were not considered unusual at wing stall AOA, and were fully acceptable from a certification criteria point of view. The airplane was always controllable with normal use of the controls". (Emphasis added.)

In light of these SCR Report findings, it is clear that the ATR aircraft did not exhibit any unacceptable roll control system characteristics, contrary to the Safety Board's erroneous conclusions.

Significantly, the SCR Report also reconfirmed that the ATR-42 and ATR-72 series aircraft fully comply with all icing certification standards, as noted by the NTSB in its report (NTSB Finding No. 3). Moreover, the following excerpts from the FAA/DGAC SCR Report indicate that the Edwards AFB tanker tests demonstrated that the ATR-72 performance in icing conditions exceeds all certification standards. Page 2 of the SCR Report states:

During the icing tanker testing conducted at Edwards Air Force Base (AFB), California, the proper functioning of the wing deicing boots was observed to correlate with Aerospatiale (ATR) test data within the Appendix C envelope.

In addition, page 53 of the SCR Report states:

Tests performed with droplets of MVD approximately 75 percent greater than those contained in Appendix C have shown no anomalies in ice accretion characteristics or aircraft handling qualities. Therefore, these tests validate the DGAC and FAA original certification for flight in icing conditions (FAR 25/JAR 25.1419 and French Special Condition B6).

Notwithstanding the SCR results, no aircraft are certified for flight in freezing rain/freezing drizzle conditions. In addition, the FAA/DGAC SCR Report concluded that the icing conditions in which the Roselawn accident occurred were outside the FAR/JAR Part 25 Appendix C certification envelope limits. Page 3 of the SCR Report states:

Weather observed in the area of the accident appears to have included supercooled water droplets in the size range of about 40 to 400 microns. This weather phenomenon is defined by the SCR team as Supercooled Drizzle Drops (SCDD)... Considering all available data, the SCR team has determined that the icing conditions of the accident environment were well outside the Appendix C icing envelope... (Emphasis added.)

Page 29 of the SCR Report also provides:

The complex icing environment at temperatures near freezing likely included a range of large droplets having diameters outside the envelopes for continuous maximum and intermittent maximum icing conditions required for certification. (Emphasis added).

Thus, the Roselawn accident occurred while the aircraft was being operated in an icing environment which the FAA's Advisory Circular AC 20.117 had, since 1982, warned the aviation community about by specifically stating: "flight in freezing rain should be avoided where practical."

2. The Previous ATR-42 Icing Incidents Were Different from the Roselawn Accident, and Provided No Warning of the Unique Roselawn Accident Aerodynamic Phenomenon.

As part of the Roselawn accident investigation, the NTSB reviewed five ATR-42 icing incidents which it considered pertinent to the investigation. In its report, the NTSB erroneously concluded that data from these incidents should have warned ATR of the phenomenon that caused the Roselawn accident. The five incidents, which will be discussed in more detail below, are: 1) AMR/Simmons ATR-42, Serial No. 91, on December 22, 1988, on approach to Mosinee, Wisconsin; 2) Air Mauritius ATR-42, Serial No. 208, on April 17, 1991, over the Indian Ocean; 3) Ryanair ATR-42, Serial No. 161, on August 11, 1991, over South Wales; 4) Continental Express ATR-42, Serial No. 259, on March 4, 1993, at Newark, New Jersey; and 5) Continental Express ATR-42, Serial No. 153, on January 28, 1994, at Burlington, Massachusetts.

As mentioned, ATR strenuously disagrees with the NTSB's findings (e.g. findings No.21-25 and 35), that the manufacturer should have been able to foresee the highly unusual circumstances that caused the unfortunate Roselawn accident based upon evidence provided by the prior incidents. ATR will demonstrate that the circumstances of the Roselawn accident differ greatly from the pre-Roselawn incidents. Simply stated, the prior ATR-42 incidents were not, and cannot be considered to be, precursors to the Roselawn accident. It was erroneous for the NTSB to conclude otherwise.

In the Roselawn accident, the specific chain of events which caused the aileron hinge moment shift resulted from the prolonged operation of the accident aircraft in SLD conditions (icing conditions which far exceed the icing certification envelope for all aircraft) at an airspeed close to VFE (Maximum Flap Extension Speed) while using a 15 degree flap holding configuration. This caused an accretion of a ridge of ice aft of the de-icing boots, in front of the aileron on only the outer portion of the wing. The aileron hinge moment shift occurred when the flightcrew retracted the flaps to the 0 degree flap position and the aircraft's angle of attack reached approximately 6 degrees, far below the 11.2 degree stall warning threshold. The ridge of ice, which had accreted only on the outer wing aft of the de-icing boots upstream of the ailerons, altered the pressure distribution chordwise. This initiated a double airflow separation, both immediately aft of the ridge and at the trailing edge of the wing. The limit of this aft airflow separation was unsteady and moved forward as the angle of attack increased and merged with the forward airflow separation zone. At low angles of attack, this airflow separation was not sufficient to create any noticeable aileron hinge moment modification. However, when the AOA increased as a result of the flaps retraction, the trailing edge separation zone moved forward and merged with the forward airflow separation zone, thus causing a local airflow disturbance over the aileron which resulted in an aileron hinge moment shift mechanism and a pre-stall

uncommanded aileron deflection. The roll experienced by the accident aircraft was caused by this uncommanded aileron deflection. This event was not caused by a stall.

Unlike the Roselawn accident, the pre-Roselawn incidents were characterized by roll-offs, followed in some cases by, but never caused by, normal and expected aileron activity. These incidents, all of which involved ATR-42s (as opposed to the ATR 72 aircraft which was involved in this accident), also occurred in the flaps 0° configuration, and were thus very different from the Roselawn accident. Most importantly, none of the prior ATR-42 incidents were caused by an aileron hinge moment shift resulting in an uncommanded aileron deflection.

2.1. Summary of Previous ATR-42 Icing Incidents and Comparison to the Roselawn Accident.

The NTSB report focuses on five ATR-42 icing incidents which occurred prior to the Roselawn accident and alleges that these incidents demonstrated characteristics which were sufficiently similar to the characteristics of the Roselawn accident that they provided to ATR a warning of the phenomenon which was involved in that accident. An accurate technical review of these incidents will demonstrate that they provided no warning whatever of the Roselawn phenomenon, which became known to ATR, the FAA, the DGAC, the BEA, and the NTSB (which itself had investigated several of the previous incidents) only after the Edwards Air Force Base icing tanker tests. The following is a summary of the facts of each of these prior ATR-42 icing incidents.

2.1.1. AMR Eagle/Simmons ATR-42/SN 91, Mosinee, Wisconsin, December 21, 1988.

This event occurred in classic freezing rain conditions well beyond the aircraft's certification envelope, with an associated temperature inversion. The NTSB's own record of investigation regarding this incident shows that the aircraft flew through an inversion layer and encountered severe freezing rain icing conditions. Further, the crew failed to activate the airframe de-icing system, which was improperly turned "OFF", while the aircraft was accreting ice (ATR was initially informed by the operator that the de-icing system was "ON"; the ATR investigation of this incident was thus based upon this assumption). During approach in level flight at 3,200 feet and during a right turn with the flaps at 0° and the autopilot engaged, during a steady deceleration passing through 157 kt (engine torque 22-23%), at an AOA of 10.2 degrees, the aircraft progressively rolled out to a 0° bank angle, while aileron and rudder positions were maintained. The autopilot disconnected as the AOA reached 11.5°, just below the stall warning threshold associated with ice accretion conditions, and the ailerons immediately deflected to about 12.5° while the aircraft was rolling to the left up to an 80° maximum bank angle. DFDR data indicates that the roll was induced by an asymmetrical lift loss followed by an aileron self-deflection. The aircraft experienced the uncommanded roll before the ailerons deflected, unlike the Roselawn accident where an aileron deflection initiated the roll.

The crew was able to recover the aircraft by promptly applying control wheel inputs opposite the roll and maximum power in order to bring the wings back to a level position. The loss of altitude was 600 feet.

DFDR traces conclusively prove that the initial roll involved in the Mosinee incident was not caused by an uncommanded deflection of the ailerons as was the cause in the Roselawn accident. Although there was a modification of the aileron hinge moment which induced an aileron deflection, this hinge moment shift occurred only after the aircraft had experienced a roll due to asymmetrical lift loss. As mentioned above, post-stall aileron activity like this is normal for aircraft with aerodynamically balanced control surfaces. This characteristic is not considered unusual at wing stall AOAs and is fully acceptable from a certification criteria point of view.

The NTSB, as the primary aviation accident and incident investigative authority of the United States, was responsible for conducting the investigation of this incident since it occurred on U.S. soil. However, in its report on the Roselawn accident, the NTSB minimizes its role in the investigation of this incident, preferring to refer to ATR's analysis that the NTSB claims it did not receive a copy of "until after the Roselawn accident" (page 77 of the Report). This is simply untrue. The NTSB was actively involved in the investigation, receiving assistance from the FAA, the French Bureau Enquêtes Accidents (BEA), the DGAC and ATR. The NTSB did in fact receive the full content of ATR's analysis from the BEA during the March 2, 1989 meeting on this incident at NTSB headquarters. Participants in this meeting included the NTSB, Aerospatiale, the DGAC, the BEA, the FAA, and ATR Support, Inc.

The NTSB did not issue a final report for this incident, only findings and a simple probable cause statement which stated that the probable cause of the incident was "a stall induced by the accretion of moderate to severe clear icing" (as noted on page 77 of the Roselawn Report). However, the NTSB states on page 79 of the Report that the Mosinee incident differs from the Roselawn accident in that the flight crew in the Mosinee incident failed to activate the de-ice system before the event. Then, the NTSB states that the Mosinee crew was not able to recognize the severe icing conditions that it encountered during the flight. This information, presented in a rather dispersed manner in the factual section, is not correctly taken into consideration by the NTSB in the analysis section. Consequently, the NTSB's analysis regarding this incident never refers to the non-use of the airframe de-ice system and the lack of recognition of the severe icing condition by the flight crew as an aggravating and contributing factor in the Mosinee incident, as observed by the BEA in its report on the Roselawn accident. Further, the NTSB ignores the fact that the Mosinee incident occurred while the aircraft was operating in severe freezing rain icing conditions -- conditions which no aircraft is certificated for or permitted to operate in.

This is all the more surprising, considering that the NTSB issued a Preliminary Report Aviation, a Factual Investigation Report of approximately 450 pages, and a Probable Cause Report on the Mosinee incident. Further, the NTSB's simple probable cause statement on the Mosinee incident is very different from the Probable Cause Statement which was originally proposed by the NTSB's Investigator-In-Charge on March 5, 1990, to the NTSB's Director, Bureau of Field Operations, which stated: *The National Transportation Safety Board determines that the probable cause of this incident is a loss of control induced by the accretion of moderate*

to severe clear icing. Factors contributing to the incident are the lack of a hazardous weather advisory for severe icing being issued by the National Weather Service, lack of recognition of the severe icing condition by the flight crew, and the non-use of the airframe de-ice system by the flight crew. (Emphasis added.)

The Safety Board also fails to place ATR's analysis of this incident in its correct historical context. The ATR analysis, quoted in the Report, was made in early 1989, and the NTSB implies that ATR could have identified at that time the nature of ice accretions in SLD environments and their potential effects in terms of flow separation and of aileron hinge moment alteration, as a function of the angle of attack. Such an interpretation is directly contrary to the facts, is misleading, and is firmly denied by the manufacturer. The freezing rain encountered by the aircraft in the Mosinee incident led ATR to speculate that large unusual ice accretions occurred due to freezing rain, and that a larger accretion of ice on one side had produced a lift asymmetry between the right and left wings, as well as an asymmetrical modification of the hinge moments of the ailerons at a high angle of attack. However, the aileron activity was not the primary cause of the roll excursions experienced by the aircraft. The roll excursions were caused primarily by lift differential, not as a result of any aileron behavior similar to the Roselawn aileron behavior.

The knowledge of the aviation community in regard to different SLD environments (namely freezing drizzle vs freezing rain) was still very limited at the time of the Mosinee incident. Neither ATR nor the authorities involved in the investigation (including the NTSB) had the knowledge at that time to differentiate their potential effects or even to describe the different characteristics of these environments. Thus, the Mosinee incident provided no information or evidence that could indicate that under a different environment, and in a different flap configuration, ice might accrete in such a way as to cause a particular airflow disruption and a much deeper aileron hinge moment modification, at an AOA less than half of the AOA of the Mosinee incident. In other words, the Roselawn accident scenario could not possibly have been anticipated from what occurred during the Mosinee event. Based on the foregoing, finding No. 23 of the Board's Report is clearly erroneous and should be deleted.

2.1.2. Air Mauritius ATR-42/SN 208, April 17, 1991 over the Indian Ocean.

In this incident, the aircraft was cruising at flight level 160 in clouds with a static air temperature (SAT) of about -3°C with the autopilot engaged, the anti-icing system "ON", and the pneumatic de-icers in the "OFF" position. Significantly, the crew had improperly selected an Np setting of 77%. The airplane decelerated progressively from 183 kts to 160 kts at a rate of 10kt/mn. At 160 kt, two roll excursions were controlled by the autopilot. When the crew disconnected the autopilot, the AOA increased to 11°, which is at or near the icing stall warning threshold, and the aircraft rolled to the right achieving a 40° maximum bank angle. The pilot released the pressure applied on the control wheel on the roll axis during the nose-down maneuver. The crew recovered the aircraft to a wing's level attitude by applying full power and reducing the AOA without any control difficulty. Drag build-up on the DFDR data suggests that the flightcrew had encountered icing conditions outside the aircraft's certification envelope. Prior

to the roll, the aircraft did not experience an aileron hinge moment shift resulting in an uncommanded aileron deflection.

DFDR data traces indicate that this incident clearly involved a conventional ice-induced asymmetric wing stall, consistent with a significant airspeed decrease, resulting from increased drag and lift loss due to ice accretion on the airframe. This was a direct consequence of the flightcrew's failure to comply with the Airplane Flight Manual (AFM) and Flightcrew Operating Manual (FCOM) icing procedures by not activating the de-icing system and by improperly setting the propeller at 77% RPM, instead of the minimum required 86%, as required in icing conditions. The speed decrease, high AOA and the absence of any aileron hinge moment alteration distinguish this incident from the Roselawn accident scenario.

2.1.3. Ryanair ATR-42/SN 161, August 11, 1991 over South Wales.

This incident occurred while the aircraft was cruising at flight level 180 with the autopilot engaged, with the anti-icing system "ON", the airframe de-icing system "OFF" (the system was switched on only 2 minutes and 30 seconds before the incident), and an Np setting of 77% (instead of Np at 86%, as required in icing conditions). The aircraft's DFDR recorded a constant deceleration from 180 kt to 145 kt at 8 kt/mn. When the aircraft reached an airspeed of 145 kt, with an AOA of 10°, a significant G-break was recorded, then the stall warning and stick shaker were activated and the autopilot disconnected. The DFDR recorded significant elevator input by the crew (5° nose-up), leading to an AOA that varied between 10° and 13°, well above the icing stall warning threshold. The aircraft stalled with an initial roll of 12.6° left wing down, immediately followed by a right wing down to a 49.9° angle. The crew continued flight for 12 seconds with the stall warning "ON".

The crew was able to recover the aircraft by performing a stall recovery. AOA was decreased, restoring the wings to a level position. Drag build-up recorded on the DFDR data indicates that this incident occurred in icing conditions beyond the aircraft's certification envelope. DFDR traces do not indicate any uncommanded aileron movement during the stall. The ailerons were used to counter the roll. Significantly, on the same day, a similar event occurred while a British Aerospace ATP was in cruise at about 16,000 feet, in the same cold front in freezing rain conditions.

The Ryanair incident is similar to the Air Mauritius incident in that the flightcrew failed to comply with AFM and FCOM icing procedures and had improperly selected an Np setting of 77%, while the aircraft was operating in icing conditions exceeding the aircraft's certification envelope. The DFDR also recorded a constant deceleration. As is the case with respect to the Air Mauritius incident, the NTSB description of the Ryanair incident in the Roselawn report fails to emphasize the prolonged deceleration, high AOA (11.5°) and the absence of an uncommanded aileron movement at any time during the stall.

Based upon the foregoing, it is evident that these two incidents demonstrate significant factual differences when compared to the Roselawn accident. Neither the Air Mauritius nor

Ryan Air aircraft experienced an aileron hinge moment shift which in turn caused an uncommanded aileron deflection at a low or high angle of attack. Further, the "aileron hinge moment reversal" discovered in the post-Roselawn accident investigation was not involved in either incident. ATR seriously questions the relevance of these incidents to the Roselawn accident and suggests that the references to them should be deleted from the NTSB Report. The NTSB's suggestion that these incidents are in any way related to the Roselawn accident is erroneous.

2.1.4. Continental Express ATR-42/SN 259, March 4, 1993 at Newark, New Jersey.

In this incident, the aircraft had leveled off at 3,150 feet to intercept the final approach descent path and remained at this altitude for 17 minutes, at flaps 0° and with TAT varying between 0°C and -2°C. Severe turbulence and icing conditions prevailed, inducing load factor variations ranging from 0.8 to 1.4 g. The Np was improperly set at 77% (instead of the minimum required 86%), while the anti-icing system was "ON", with the airframe de-icing system also "ON". The autopilot was engaged with noticeable activity to maintain a wings level altitude because of the turbulence. The airspeed fluctuated between 170 -190 kt with peaks between 140 -208 kt.

After the aircraft initiated its final descent, a banking tendency developed to the right. The crew set engine torque at 30%. The autopilot disconnected (AOA of 7°; VC = 170 kt) and the ailerons deflected to the right 7°. The ailerons were then positioned on the opposite stop (14°). The roll excursion was limited to 52° right. Significantly, the aircraft experienced a 1.32g spike at 7° as the autopilot disconnected. The crew was able to recover, even though controllability remained difficult due to the high level of turbulence.

The investigating parties for this incident (NTSB, BEA, DGAC, and ATR) found that icing conditions encountered during this incident were probably outside the scope of the JAR/FAR 25 Appendix C certification envelope. However, these conditions could not be more precisely analyzed and confirmed by the BEA because the NTSB never responded to the BEA's requests for further information and meteorological data regarding this incident. Further, ATR takes exception to the fact that the NTSB, the primary investigative authority for this incident, has yet to issue findings concerning this incident and has ". . . delayed the issuance of a probable cause pending the results of the investigation involving flight 4184" (page 86 of the Report) without clearly indicating the reasons for this highly unusual behavior. Even today, over six years after the incident occurred, the NTSB has yet to issue a probable cause finding for this incident.

At the time of the incident, the BEA, DGAC, and ATR concluded that the aircraft's DFDR data, particularly the acceleration, AOA and airspeed traces, indicated that the aircraft encountered an extremely high level of turbulence during the final descent portion of the flight. In this regard, the amplitude of the prevailing wind gradients could have caused, or greatly contributed to, the aircraft upset and roll oscillation. Furthermore, the extreme level of turbulence seriously hampered the analysis of the aircraft's performance and controllability from

the DFDR data traces. Consequently, interpretation of the autopilot disconnection, the roll excursions, and the aileron deflections was, and still is, extremely difficult. All aircraft responses are consistent with the documented effects of the turbulence itself. Wind gusts and roll motion could have created local wing tip angles of attack much higher than the recorded fuselage angle of attack and could have triggered unsteady airflow separations responsible for asymmetrical lift loss and rolling moments. Abrupt pilot inputs and induced roll oscillations cannot be neglected either. Significantly, Aerospatiale later duplicated the incident aircraft's behavior with turbulence and wind gust data only using 6 degree of simulation computer study.

As mentioned, the interpretation of the DFDR data traces was, and still is, extremely difficult because: 1) the characteristics of the icing conditions could not be determined because of lack of pertinent data; 2) the flightcrew observations did not correlate with any previous observations noted by, or reported to, ATR; and, 3) the flightcrew failed to respect the minimum Np setting in a severe icing environment, which was a contributing factor. None of the investigating parties, including the NTSB, BEA, DGAC or ATR could identify the exact contribution, if any, of an ice-induced pollution of the airframe in the Newark incident. None of the same parties' studies of this event included any indication that an aileron hinge moment modification was involved.

ATR does not understand why the NTSB states in the analysis section of the Report that ATR "attributed (the incident) to turbulence and freezing rain..." and omits that the NTSB itself issued a factual report stating that the upset occurred in "severe turbulence with strong horizontal gusts and icing conditions". The NTSB now fails to acknowledge the high level of turbulence as a definitive contributing factor in this incident when clearly, the turbulence factor alone distinguishes this incident from the other pre-Roselawn icing-related incidents. The NTSB also fails to acknowledge that its factual report also states that the incident aircraft was "flying in freezing rain while being vectored." ATR regrets that the NTSB did not take these facts into consideration in its shallow discussion of this event in the factual and analysis sections of the Report. The NTSB has no grounds upon which to base its assertion that the Newark incident involved any aileron behavior similar to that of the Roselawn accident scenario.

2.1.5. Continental Express ATR-42/SN 153, January 28, 1994 at Burlington, Massachusetts.

In this incident, the aircraft was cruising at flight level 160 with the airframe de-icing "ON" (Level III) and the autopilot engaged. The aircraft's DFDR recorded a constant deceleration from 200 kts to 145 kts at 6kt/min. Further, the engine torque decreased from a cruise setting of 72% to 66% in the same period. Progressive drag increases occurred, which is consistent with significant ice accretion and a lack of crew awareness that the flight was operating in significant icing conditions.

At an AOA of 11.5° (stall warning), the autopilot self-disconnected. A stall occurred at the icing stall warning threshold, associated with a significant G-break before the autopilot self-disconnected. The aircraft then experienced a roll to the left with a maximum bank angle of

54° while the ailerons deflected to the left to about 10°. Although aileron activity occurred after the stall commenced; this aileron activity was not the cause of the aircraft's roll. The crew recovered the aircraft by promptly reducing the AOA and by applying full aileron deflection in a direction opposite to the initial roll upset. After analyzing the DFDR data and other information, ATR determined that the crew operated the aircraft below the minimum speed required during flight in icing conditions, and that the crew did not increase propeller RPM to control the possible deficiency of propeller de-icing, as required by AFM Procedures, which led directly to this incident. In sum, the Burlington aircraft did not experience an aileron hinge moment shift which caused an uncommanded aileron deflection. Thus, the NTSB suggestion that this incident is in any way related to the Roselawn accident is erroneous.

2.2. The Unique Circumstances of the Roselawn Accident

Post-accident investigation and the Edwards Air Force Base testing have established that the Roselawn accident resulted from a very specific combination of factors. Some of the factors which contributed to the sudden aileron hinge moment modification are:

1. Icing conditions far exceeding the limits of the Appendix C certification envelope (freezing drizzle or what is broadly referred to as an SLD environment);

2. An extended holding period in these conditions (approximately 24 minutes) while flying in a holding pattern that lasted almost 45 minutes;

3. The relatively high speed at which the aircraft was set (VFE, approximately 175 knots) at a flaps 15° configuration not provided for in the ATR AFM, leading to a negative AOA, thus favoring ice accretion aft of the de-icing boots and in front of the ailerons (when combined with the second factor); and,

4. Subsequent retraction to a flaps 0° configuration, leading to a positive AOA and causing an airflow disruption at low AOA.

These factors, among others, created a unique chain of events which were not sufficiently addressed by the NTSB Report. For example, nowhere in the analysis section of the Report does the NTSB refer to the unique combination of the flaps 15° configuration leading to negative airfoil AOA during the holding pattern and the existence of large supercooled drizzle drops in the size range of about 40 to 400 microns (known as SCDD), as a causal factor in the Roselawn accident scenario. During the exhaustive post-Roselawn testing performed by ATR, the particular ice formation that resulted from this combination was shown to create much more detrimental effects, once the flaps are retracted, than ice shapes accreted in the flaps 0° configuration, which was the only holding configuration provided for in the Aircraft Operating Manuals. Also, it should be emphasized that it is not the flaps 15° configuration itself that is so damaging, but the low AOA that may result from such a setting, especially close to VFE. This low or negative AOA increases the wing upper side exposure to large droplet impingement in a recognized icing environment.

At the time of the accident, there was no published information for holding in any flight configuration other than the "clean" configuration (flaps 0°). A Flaps 15° configuration was not provided for in the American Eagle AOM or ATR's AFM or FCOM manuals for holding. Based on the information discovered for the first time in the investigation of this accident, use of a flaps 15° configuration has since been explicitly prohibited by ATR during holding in icing conditions, which clearly indicates that ATR was not previously aware of the potential effects of such a setting. Moreover, the NTSB quote of ATR's chief test pilot on page 192 of the Report stating that "... nobody knew the pattern associated with the large droplets but even more, nobody knew that it would have (been) aggravated in the flaps 15 (configuration)..." also provides evidence to this effect. These facts also demonstrate why it is critical that flightcrews not experiment with aircraft configurations not specifically authorized by the manufacturer's AFM.

On page 48 of the factual section of the Roselawn Accident Final Report, the NTSB states that it found "...that there are neither FAA regulations, ATC procedures, nor Simmons' policies that would prohibit aircraft from holding in known or forecast icing conditions". This statement ignores basic, fundamental airmanship principles that require awareness and vigilance on the part of the flightcrew regarding the conditions in which a flight is being operated, especially when adverse weather conditions such as icing are encountered. As a matter of fact, on page 116, the NTSB Report quotes the December 1993 issue of the Simmons Flight Operations Newsletter, which reminds flightcrews to "stay out of icing conditions" when possible because "any encounter with severe ice - including freezing rain - for a prolonged period of time may cause problems beyond that of the intended design".

As noted by the DGAC and the FAA in their SCR Report, at the time of the Roselawn accident, the aviation community lacked adequate scientific knowledge about the impact of supercooled large droplets beyond FAR Part 25, Appendix C conditions on accretion of ice on airplane wings, particularly after prolonged exposure to such conditions. For this reason, certification standards and testing required by the FARs and JARs do not encompass the SLD environment. The threat resulting from prolonged exposure to large supercooled drizzle drops beyond FAR Part 25, Appendix C conditions, and from the associated ice accretions, were identified for the first time during the investigation of Flight 4184. It was during extensive tanker testing conducted by ATR at Edwards Air Force Base that the ice-induced (freezing drizzle) abrupt aileron deflection phenomenon was first identified. These tests confirmed that the flap configuration was a critical factor in the development of the ridge of ice that formed aft of the de-icing boots during the lengthy holding period. For this reason the tests were also essential to understanding the difference between ice accreted at positive AOAs (flaps 0° configuration), as opposed to negative AOAs (flaps 15°), which can potentially lead to a sudden and pronounced aileron anomaly at low AOA. Unfortunately, when the NTSB Report refers to the ATR-72 icing tanker tests, it fails to accurately describe the conclusions which were drawn from them, especially those concerning flight in flaps 15° configuration in icing conditions, as described above. This is quite surprising since the NTSB was actually involved in the testing process and even encouraged it and thus had complete knowledge of the results obtained.

The Roselawn accident is also unique in that the accident aircraft did not experience the noticeable performance degradation typically associated with flight in severe icing conditions, i.e., lift loss, drag increase. These characteristics, specific to the Roselawn accident and never

before observed in earlier icing-related events, can also be attributed to the effects of the SLD environment encountered during the holding period. Post-Roselawn investigations determined that the absence of a substantial drag increase prior to the roll event was due to the extension of the flaps to 15°, the speed that was selected, and the outer wing negative AOA, all of which, when combined with the existing icing conditions, led to the unusual accretion that eventually caused the local airflow separation and the aileron anomaly when the flaps were retracted. Unlike the previous ATR-42 icing-related incidents, the Roselawn accident thus occurred at a very low AOA (below 6°) that was well below, and in fact, less than half of, the AOA of the previous incidents.

2.3. Conclusion: The Previous ATR-42 Icing Incidents Involved Different Circumstances from that of the Roselawn Accident and thus Provided No Warning of the Mechanics of that Accident.

The NTSB's findings and conclusions regarding the pre-Roselawn ATR-42 icing incidents reveal the Safety Board staff's fundamental misunderstanding of the aerodynamics involved in these prior incidents and the phenomenon that occurred in the Roselawn accident.

It has been established that the Roselawn accident occurred while the aircraft was being operated in an icing environment outside the certification envelope that included the presence of Supercooled Drizzle Droplets (SCDD), a relatively new phenomenon, not well understood by the aviation industry at the time of the accident. The aerodynamic effects of the Roselawn accident icing conditions, namely a complex airflow separation pattern over the aileron, greatly differ from the ice-induced aerodynamic wing lift losses involved in the previous ATR-42 icing incidents.

Contrary to the Safety Board's findings, the prior ATR-42 icing incidents did not reveal the abrupt, massive, stall unrelated, very low AOA, unsteady and uncommanded aileron deflection phenomenon which was involved in the Roselawn accident. This phenomenon was not involved at all in the pre-Roselawn incidents. Also, none of these incidents exhibited the very unique combination of factors involved in the Roselawn accident -- specifically, an outer wing flow separation at an AOA well below the icing stall warning threshold --without a noticeable drag build-up or a significant manifestation of asymmetrical lift loss. The Ryanair and Air Mauritius incidents showed absolutely no sign of a hinge moment modification at all. The Mosinee and Burlington incidents involved a modification of the hinge moment, which accompanied the asymmetrical lift loss or stall. This modification was not causal of the roll, and is a normal and expected behavior of unpowered ailerons post-stall. In the Newark incident, the turbulence was such that it is still impossible to determine with certainty the origin of the roll upset.

Further, in each of the pre-Roselawn incidents, the roll upset was caused by an ice-induced asymmetrical lift loss, whereas in the Roselawn accident, the roll was caused by an aileron hinge moment shift which in turn caused a sudden deflection of the ailerons. The abrupt shift of the ailerons in Roselawn, which appeared at autopilot disconnection, was not associated

with any of the characteristics of an asymmetrical lift loss. Unfortunately, the NTSB Report lacks clarity in this respect, consistently failing to accurately distinguish the two phenomenon (aileron hinge moment shift vs. ice-induced lift loss), especially with regard to their respective AOAs of occurrence.

It is simply wrong for the NTSB to persist in its characterization of all aileron activity as "aileron hinge moment reversals" without ever defining the phenomenon. As mentioned in the introduction, the NTSB Report's blurring of these phenomenon is inexcusable, particularly since ATR, the BEA, the DGAC and the FAA all repeatedly explained this issue to the NTSB staff during the course of the NTSB's investigation of the Roselawn accident.

Finally, it is significant to note that the SCR team, in reviewing the previous ATR icing-related incidents concluded that there is no evidence that the ATR-72 had any problems with icing conditions for which it was certified. Page 27 of the SCR Report provides:

> *Review of Pertinent Service Difficulty Information*
>
> *Events of unacceptable control anomalies were associated with severe icing conditions such as freezing rain/freezing drizzle and, in a few cases, the icing was accompanied by turbulence. These other roll anomaly events provided no evidence that the ATR-72 had any problems with any icing conditions for which it was certified. (Emphasis added.)*

2.4. Significant NTSB Report Errors

ATR wishes to remind the NTSB that on two separate occasions (August 24 and October 24 1995, respectively), ATR submitted to the NTSB ATR's written comments concerning initial drafts of the factual portion of the Roselawn accident Report. These written comments supplemented the numerous conversations ATR's representatives had with the NTSB regarding many of these same issues. The NTSB staff persistently failed to incorporate the bulk of ATR's comments or rectifications on the factual portion, despite repeated promises to do so. Because the NTSB staff did not incorporate many of ATR's suggested changes to the drafts of the factual portion of the Report, the Final Report contains numerous misconceptions and erroneous statements, some of which are illustrated below.

On page 74-5 of the Report, the NTSB Report discusses the ATR-42/72 Lateral Control System Development History:

> *Several ATR-42 developmental aileron configurations produced aileron hinge moment reversals at low AOAs. According to ATR engineers, the final ATR-42 aileron design was a 'compromise of acceptable roll rates and hinge moments,' and resulted in the aileron hinge moment reversals being delayed to about 25° AOA. ATR indicated that the aileron hinge moment reversals were linked to aerodynamic stall. The susceptibility to hinge moment reversal from aerodynamic stall is a*

characteristic of aerodynamically balanced control surfaces at high AOAs, and the characteristics can vary among configurations".

These statements are erroneous and extremely misleading. They are used by the NTSB to suggest that ATR developed the stick pusher system for the sole reason of preventing alleged "hinge moment reversals". This is simply wrong, and the NTSB's implication in this regard is not supported by the facts or the NTSB's own record of investigation.

The stickpusher system was installed initially to address the potential of a deep stall phenomenon, which was subsequently proven not to exist in the ATR-42 or ATR-72. Nevertheless, the stick pusher was retained in order to provide a clear and distinctive stall identification. In the subsequent evaluation of the stall characteristics, only minor aileron activity was observed just at or beyond the activation of the stick pusher. The control wheel forces were found to be neither abnormal, excessive nor unsafe. All corresponding flight test data was reviewed after the Roselawn accident, and the Special Certification Review team confirmed the full acceptability, as per all certification criteria, of such characteristics, at wing stall AOAs. Therefore, contrary to the Safety Board's assertion, signs of an impending Roselawn icing scenario cannot be found in the low-speed handling characteristics development history of the ATR.

The NTSB continues with another erroneous and misleading statement:

ATR engineers agreed in principle that airfoil contamination, such as icing, could tend to lower the AOA at which the aileron hinge moment reversal occurs, and that icing conditions beyond those specified for certification could lower the AOA at which the aileron hinge moment reversals occur to below the certified icing stall protection system (SPS) AOA thresholds.

Unfortunately, the NTSB has failed to indicate in the Report that prior to the full scale icing tanker tests conducted at Edwards Air Force Base, there was no theoretical or experimental evidence available to ATR, or to the aviation industry, to substantiate the suggestion that an increase in the severity of icing conditions, combined with several other independent factors, could cause an abrupt change of the aileron hinge moment, without any prior performance alteration, at an AOA so far below the certified SPS AOA threshold. It was only after the Edwards Flight tests that experimental evidence became available to suggest that this was possible. Once again, the NTSB has failed to accurately incorporate in its Report the conclusions of the testing conducted at Edwards Air Force Base. Further, the NTSB improperly uses this statement to again blur the significant distinction between post-stall aileron hinge moment activity, which is common to all aircraft with unpowered control systems, and the aileron hinge moment activity seen in the Roselawn accident. They are not the same.

The Report also states that ATR discussed installing hydraulically powered ailerons during the preliminary design of the ATR-42 and that the issue was once again discussed "informally" among ATR engineers after an incident involving a Simmons Airlines ATR-42 in Mosinee, Wisconsin, in December 1988. The Report also asserts that "ATR management has

since stated that hydraulically powered ailerons have never been officially considered for either the ATR-42 or 72".

ATR would like to set the record straight. There is absolutely no support for these statements in the NTSB's record of investigation, nor is there any support for these statements in ATR's documentation. On the contrary, for the yaw control, a hydraulically powered alternative was seriously considered, and existing documentation describes the concept and its performance. Contrary to the NTSB's erroneous findings, a hydraulically powered aileron system was never considered by ATR for either the ATR-42 or the ATR-72.

ATR also strongly objects to the following statement on page 169 of the Report:

> *... the Safety Board remains concerned whether, even with the improvements, the airplane can be controlled under all naturally occurring combinations of conditions of liquid drop size and content, temperature, airplane configuration, load factors, speeds, and time of exposure.*

It would appear as though the NTSB is implying in this statement that ATR aircraft require additional precautions to protect against certain environmental conditions, while other aircraft do not. As is well recognized by the entire aviation industry and by pilots as a matter of basic airmanship, the hazards associated with flight in icing conditions concern all types of aircraft. As the NTSB is well aware, the ATR72 aircraft was subject to icing testing at Edwards which was more severe than that to which any other aircraft has been subjected. Further, the NTSB has not put forth any data to suggest that an unsafe condition existed or that one exists on either ATR-42 or ATR-72 series aircraft. ATR, on the other hand, has provided ample evidence that the post-Roselawn implemented procedural and hardware changes (extension of boots, visual cues, flap utilization) minimize the risk of a Roselawn reoccurrence. Certainly, as the FAA, BEA, and DGAC repeatedly have stated, no airplane is (and no airplane should be expected to be) designed or certified to handle every adverse environmental condition that may be present in nature. For this reason, flight safety in icing conditions is an issue that must also be addressed through improvements in pilot awareness and training, improved air traffic control, as well as through improvement of the forecasting models currently used in predicting freezing rain/freezing drizzle. Therefore, ATR requests that the above referenced statement be deleted.

The NTSB Report continues with the following statement:

> *Moreover, the Safety Board found that ATR's post-Roselawn brochure entitled, "ATR Icing Conditions Procedures", still does not adequately address or clearly represent the exact nature of the ATR ice-induced aileron hinge moment reversal.*

ATR would like to point out that ATR solicited comments from the NTSB before distributing the brochure, but received none. Therefore, it is quite unseemly for the Safety Board to criticize the brochure in the Final Report. In fulfilling its transportation safety mission the Board should assist during the preparation of such a document rather than withhold such assistance and instead criticize the document once it is completed.

Finally, ATR would like to comment on the NTSB's flagrant mischaracterization of ATR's chief test pilot's testimony at the NTSB Public Hearing on 2 March 1995. Page 117 of the Roselawn Accident Report states:

> *Also, with respect to Flight 4184, the chief test pilot for ATR testified that the type of roll anomaly the flight crew experienced would not have been recoverable by the average line pilot.*

This statement is simply untrue. Mr. Defer's testimony has been grossly misrepresented and taken out of context by the NTSB. Mr. Defer was trying not to be openly critical of the flight crew during the public hearing, out of respect for their families in the audience, and simply testified that the flight crew "did what they could." This testimony was then grossly misrepresented in the draft report. Mr. Defer was personally assured by the NTSB that the error would be corrected. It was not. If not corrected now, it will be a sad commentary to future witnesses who would like to assist the NTSB to avoid passionate public hearings. In addition, a review of the 2 March 1995 Public Hearing transcript and video, makes clear that the test pilot did not testify that an average line pilot would not have been able to recover from a Roselawn-type roll event. On page 1072, line 12, of the Public Hearing transcript, Mr. Pereira asks the following question: "How long after the initial upset, based upon your experience with this phenomena, do you think a recovery becomes difficult?" After which the chief test pilot response was (lines 21-23): "And I cannot and I do not want to take advantage of that work to go into judging what that crew did. I believe they did what they could". In response to the following question, asked by Mr. Pereira (lines 25 -25): "Do you feel that the average line pilot can recover from this type of event?", the chief test pilot referred back to his previous answer by stating "It is the same answer, Sir." It is highly improper for the NTSB to take this statement and transform it into something quite different, as has been done in the Report.

The post-Roselawn testing at Edwards AFB and in Toulouse conducted by the chief test pilot confirmed that Flight 4184 was recoverable, despite the fact that the control wheel forces were heavier than normal. Given the factual record, and given ATR's previous objections to the mischaracterization in the draft factual portion of the Report, which the NTSB has still not addressed, ATR must ask whether the Safety Board intentionally misinterpreted the sworn testimony of the chief test pilot.

Finally, at the Technical Review Meeting in Washington, D.C. (12-13 October 1995), the chief test pilot specifically explained his position to the NTSB staff, regarding the issue of whether Flight 4184 was recoverable or not. He clearly indicated that the two lines in the Final Report misrepresented his testimony at the hearing. The NTSB agreed to either delete these lines or introduce the exact wording extracted from video recordings. The Safety Board has done neither and has thus incorrectly misrepresented crucial testimony regarding the Roselawn accident.

3. ATR's Actions in Response to the Previous ATR-42 Icing Incidents Were Correct and Complete Responses to the Circumstances Present in Those Incidents

The following is a summary of ATR's response to each of the previous ATR-42 icing incidents. It demonstrates that, contrary to the allegations of the NTSB, ATR's responses to these incidents constituted appropriate and complete corrective actions for the circumstances of those incidents.

3.1. Summary of Corrective Actions Taken After Previous ATR-42 Icing Incidents

3.1.1. AMR Eagle/Simmons ATR-42/SN 91, Mosinee, Wisconsin, December 21, 1988

Although the NTSB at the NTSB Public Hearing and Sunshine Meeting, tried to minimize the role it played in the investigation of this incident, the NTSB, as the primary investigative authority of the State of Occurrence, was responsible for the investigation of this incident. In fact, the Safety Board appointed an Investigator in Charge for this incident, conducted a full investigation, and released the probable cause statement previously discussed above. ATR assisted the NTSB in its investigation, (as did the FAA, BEA and DGAC), and took appropriate actions following this incident, based on the available facts, studies and applicable policies.

On January 17, 1989, ATR issued an All Operators Telex providing a briefing about the incident and reporting that it had occurred in freezing rain. In the telex, ATR emphasized the hazards associated with flight into such conditions by quoting FAA Advisory Circular 20.117 that specifies "flight in freezing rain should be avoided where practical".

On January 24, 1989, ATR generated a complete incident analysis based on the DFDR read-out that was provided to the DGAC and the BEA. Based upon the initial pilots' report, ATR assumed in its analysis that the airframe de-icing had been selected "ON" prior to the incident. ATR later learned from the NTSB during the Roselawn investigation that the pilots had changed their initial statement and that apparently, the airframe de-icing was <u>not</u> selected "ON" prior to the event.

ATR proposed corrective actions which were jointly reviewed and discussed by the FAA and DGAC in Seattle on April 21, 1989. These actions included a proposal to the DGAC, and through the DGAC to foreign Airworthiness Authorities (including the FAA), to revise the AFM Limitations section and an Operation Engineering Bulletin (to be included in the FCOM) in order to further emphasize the risk associated with flight in freezing rain and to incorporate simple procedures in the event of an inadvertent encounter; and to develop a design change (vortex generators) aimed at moving the ice-induced type of asymmetrical lift loss and associated lateral control problems experienced by the Mosinee crew beyond the icing stall warning threshold. The FAA determined that long-term continued operational safety would be better assured by the

proposed design change than by the adoption of special operating procedures. Consequently, the proposed manual changes were not incorporated in the US or France. Other Authorities (DOT Canada, German LBA) nevertheless requested that the ATR information and operating procedures be included in their Operators' documentation, in addition to the design change.

The DGAC and ATR proposed to retrofit the entire ATR-42 fleet with vortex generators. The DGAC monitored the retrofit, but no French Airworthiness Directive (AD) was published. However, the FAA issued an AD requiring the installation of the vortex generators on all U.S.-registered ATR-42 aircraft, terminating the FAA's initial AD prohibiting the use of the autopilot when operating in icing conditions, imposed just after the incident.

ATR thus added vortex generators on all ATR-42 aircraft. This design change was implemented in order to delay the onset of lateral control problems due to severe asymmetrical icing, so that the stall warning would occur first, in case of a decelerated flight leading to high AOA. Contrary to the NTSB's statement, ATR did not add the vortex generators "... to provide an additional AOA margin of several degrees between the normal operating AOA and the aileron hinge moment reversal AOA" (page 80). The NTSB's statement incorrectly suggests that ATR focused on the aileron hinge moment change in Mosinee. This is not supported by ATR's analysis of the incident or the NTSB's record of investigation. ATR properly addressed an asymmetrical wing lift by delaying beyond the stall warning the AOA at which lateral control problems could occur in severe icing conditions.

Therefore, ATR's actions in response to the Mosinee incident were entirely appropriate and complete and were consistent with the international aviation community's knowledge at that time.

The NTSB Report's analysis of the adequacy of actions taken by ATR following the Mosinee incident is erroneous because of an incorrect interpretation of the facts. On page 177, the NTSB asserts that "The Operators Information Message (OIM) did not indicate that an ice accretion behind the de-ice boots in front of the ailerons, could cause them to overpower the autopilot..."(page 79 of the report). First, there is no evidence that the Mosinee incident involved an "ice accretion behind the de-ice boots in front of the ailerons." For that reason, ATR's OIM did not indicate that there was such accretion. Nevertheless, the OIM did provide flightcrews with significant accurate information regarding the circumstances involved in the Mosinee incident. In this regard, ATR's OIM stated in part: " . . . freezing rain affected control forces on the ailerons in such a manner that the autopilot was no longer able to maintain the bank angle in the procedure turn. As a consequence, the A.P. (autopilot) was normally disconnected by its monitoring system." (Emphasis added.)

In conclusion, ATR consider the allegations contained in the Report's finding No. 23 as totally unfounded and requests the NTSB to delete or, at least, modify that finding in accordance with the facts described above.

3.1.2. Air Mauritius ATR-42/SN 208, April 17, 1991 Over the Indian Ocean

After this incident, Air Mauritius transmitted the DFDR, pilot reports and pertinent meteorological information to the BEA and to the manufacturer, with the approval of the Civil Aviation Authority of Mauritius. ATR concluded that the aircraft experienced an aerodynamic stall caused by ice accretion resulting from the crew's failure to comply with AFM and AOM procedures for flight operations in icing conditions.

ATR presented its analysis of the incident (factual data, DFDR traces, simulation analysis, probable scenario, and findings) to the BEA and the DGAC in Toulouse, on June 12, 1991. The conclusions were accepted by the BEA and DGAC and provided to the Civil Aviation Authority of Mauritius on October 17, 1991. The investigation report was not sent to the FAA by the DGAC because the incident did not "raise technical questions regarding the airworthiness of [the ATR aircraft]."[1] ATR did, however, include a brief of this incident in its April 1991 Monthly Report and sent it to all ATR operators and Airworthiness Authorities (including the FAA's Washington, Seattle and Brussels offices). Also, ATR and the DGAC undertook a study aimed at determining the effects of polluted propellers on wing icing, since the crew selected an Np of 77% instead of the minimum required 86% in icing conditions. ATR actions in response to this incident were therefore entirely appropriate and complete.

3.1.3. Ryanair ATR-42/SN 161, August 11, 1991 Over South Wales

The actions taken by ATR following this incident were virtually identical to those initiated by ATR after the Air Mauritius incident, as the two incidents presented a number of similarities.

The DFDR data, pilot reports, weather condition reports, and other information provided by pilots operating other aircraft in the same area, were provided to the BEA and the manufacturer by the airline with the agreement of the Irish Civil Aviation Authority. ATR concluded, as in the Air Mauritius incident, that the cause of the incident was an ice-induced aerodynamic stall which resulted from the crew's failure to comply with AFM and AOM procedures for flight operations in icing conditions.

ATR presented the results of its investigation in Toulouse to the BEA and the DGAC on September 13, 1991. The conclusions were accepted and then provided to the Irish Civil Aviation Authority in Dublin, Ireland on November 7, 1991. The FAA did not receive the investigative report from the DGAC since the incident did not "raise technical questions

---

1 According to the French-U.S. Bilateral Airworthiness Agreement and Annex 8 to the Convention on International Civil Aviation, the DGAC is not obligated to transfer airworthiness information to the FAA on incidents which the DGAC has determined do not raise technical questions regarding the airworthiness of a type-certificated aircraft and, thus, do not require mandatory corrective actions.

regarding the airworthiness of [the ATR aircraft]" and thus did not require mandatory corrective action. ATR did, however, report this incident to all ATR operators and Airworthiness Authorities (including the FAA's Washington, Seattle and Brussels offices) in ATR's August, 1991 Monthly Report.

Following the Air Mauritius and Ryanair incidents, in order to ensure proper dissemination of the information available at the time concerning freezing rain, its potential effects, and the ATR recommended procedures in cases of inadvertent encounters and of roll control anomaly, ATR developed an "All Weather Operations" brochure, which was made available to all ATR pilots starting in 1991.

ATR's actions in response to this incident were thus entirely appropriate and complete.

3.1.4. Continental Express ATR-42/SN 259, March 4, 1993 at Newark, New Jersey

The NTSB, as the primary investigative authority of the State of Occurrence, was responsible for the investigation of this incident. The NTSB thus forwarded the DFDR traces to the BEA. ATR received copies of these traces from the BEA and also provided the NTSB (at its request) a copy of ATR's study regarding the effects of a Np 77% setting on the propellers. However, neither the NTSB nor the FAA provided any further information concerning the investigation of this incident to the BEA, DGAC or ATR. Consequently, the DGAC, the BEA and ATR were not able to successfully complete their investigations of this incident.

Nevertheless, ATR was still able to determine from analyses of the DFDR read-outs that the incident involved a high level of turbulence and that the crew failed to comply with the AFM and AOM procedures (Np at 77%, instead of the required 86% with anti-icing systems "ON"). In fact, the NTSB Report on the Roselawn accident states with regard to the Newark incident (page 86): "The analytical descriptions made by ATR are consistent with the FDR data."

Yet, as previously stated, the NTSB has "delayed the issuance of a probable cause [regarding the Newark incident] pending the results of the investigation involving the Roselawn accident", without offering an explanation for the delay. This type of delay in issuing probable cause determinations on the part of an investigative authority is not in the best interests of aviation safety.

Thus, ATR's actions in response to this incident were entirely appropriate and as complete as possible under the circumstances.

3.1.5. Continental Express ATR-42/SN 153, January 28, 1994 at Burlington, Massachusetts

The NTSB, by virtue of its being the primary investigative authority of the State of Occurrence, was responsible for investigating this incident as well. However, it is unclear

whether the NTSB ever investigated the event, since the NTSB never forwarded any information pertaining to this incident to either the BEA, the DGAC or ATR.

ATR received the pilot reports and the DFDR data from the airline and then forwarded the information to the BEA for its analysis. ATR investigated the incident with the available information and presented its preliminary conclusions to the BEA and the DGAC on February 15, 1994. ATR's draft report was provided to the DGAC on March 17, 1994. Based on the DFDR data, ATR was able to determine that the flightcrew failed to respect applicable AFM and AOM procedures for operations in an icing environment, such as maintaining a minimum airspeed. As a result, the aircraft lost speed due to an accretion of ice, which eventually caused the aircraft to stall and the autopilot to disconnect.

The DGAC questioned the "envelope" simulated ice-codes used for the ATR-42, given the unusual lift loss and drag increase experienced by the aircraft, and thus required ATR to conduct an additional investigation regarding the determination of ice accretions within the Appendix C envelope. This research was underway at the time of the Roselawn accident. The SCR subsequently validated the DGAC and FAA original certification for flight in icing conditions (FAR 25/JAR 25.1419 and French Special Condition B6) for ATR aircraft.

Thus, ATR responded in a timely, appropriate, and complete manner, following this incident.

3.2. Conclusion: The Corrective Actions Taken by ATR Correctly Addressed the Phenomenon Which Was Common to Each of the Prior ATR-42 Incidents

A review of ATR's responses to the pre-Roselawn incidents presented above clearly demonstrates that ATR's corrective actions addressed the phenomenon which was common to each of those incidents: classic wing lift losses, occurring at or near the icing stall warning threshold, in freezing rain conditions, due to an accumulation of ice, accompanied most often by the non application by the flightcrews of icing procedures for flight in icing conditions. ATR's actions were entirely consistent with ATR's, and the international aviation community's, understanding at that time, of the hazards of flight into freezing precipitation, and were compliant with the rules prevailing at that time.

The NTSB knows that the international aviation community has been able to greatly increase its understanding of the effects of flight into freezing drizzle/freezing rain because of the results of the Roselawn accident investigation. The Edwards testing program findings enabled the aircraft manufacturer to subsequently address the abrupt, massive, stall-unrelated, unsteady, aileron-uncommanded deflection phenomenon that was brought to light as a result of the testing. Based on such post-accident research and newly acquired knowledge, ATR extended the wing boots up to 12.5% of the wing chord on all ATR aircraft as a corrective response to the accident. The modification was tested and received approval from both the FAA and the DGAC. The Edwards testing also provided the whole aviation community, and in particular flight crews, with new tools (the so-called "Visual Cues") to recognize with a greater certainty than before that the

in-flight icing conditions in which the airplane is flown may be beyond the airplane's capabilities or exceed certification limits, and to escape from such conditions before they become a safety issue.

On the basis, as demonstrated above, that the corrective actions taken by ATR correctly addressed the phenomenon which occurred in each of the prior ATR 42 incidents, and which was different from the Roselawn phenomenon, the allegations made several times by the NTSB in its Findings that "ATR had sufficient basis to modify the airplane and/or provide operators and pilots with adequate, detailed information regarding this phenomenon" are totally unfounded and should be corrected.

4. Additional Erroneous NTSB Report Findings.

The NTSB's misunderstanding regarding the distinction between the phenomenon involved in the previous icing-related incidents and the phenomenon involved in the Roselawn accident, is the basis for the numerous erroneous allegations contained in the Report's findings. As discussed above, the NTSB alleges that ATR was aware of the potentially dangerous effects of freezing precipitation on aircraft and on aileron behavior, and concludes that ATR concealed this information from operators and did not adapt its simulation packages accordingly. Further, the NTSB states that the ATR brochure entitled All Weather Operations was misleading and minimized the catastrophic potential of ATR operations in freezing rain.

ATR provides its comments in respect to these erroneous findings below.

> NTSB Finding No. 22: The 1989 icing simulation package developed by ATR for the training simulators did not provide useful training for pilots to recognize the onset of an aileron hinge moment reversal or to execute the proper recovery techniques.

ATR wonders how the NTSB was able to arrive at this erroneous conclusion since the factual section of the Report is completely devoid of critical information regarding training, simulator data packages and unusual attitude training for flight operations in icing conditions. The NTSB is aware that ATR continuously updates the data and algorithms for its training simulators on the basis of acquired knowledge resulting from the analysis of in-service reported incidents. The corresponding software is then incorporated in the Toulouse ATR simulator and is made available to other training centers.

The NTSB also knows that ATR modified the ATR-42 and ATR-72 flight simulator data packages to incorporate a model of ice accretion effects on aircraft handling and especially on lateral stability at AOAs greater than the icing stall warning threshold. The model was based upon ATR's knowledge of all previously identified and quantified ice accretion effects. The changes to the data package were provided to Flight Safety International in 1989/1990 for the ATR-42 and then for the ATR-72, and to ATI/GAE Electronics Limited in 1989. The ATI equipment (ATR-42 simulator) was later acquired by AMR Eagle. ATR provided evidence of the transmission of the data package change to the NTSB. The roll anomaly upset involved in the Mosinee incident was properly incorporated into ATR's simulator software. For this reason,

the statement made by the NTSB on page 117: "...there were no data or algorithms to support roll anomalies in the ATR-42/72 simulators", is blatantly erroneous. What is the most disturbing is that the NTSB completely ignored the fact that American Eagle never utilized this critical software to train its ATR-42/72 pilots.

It also is important to point out that factual information available at the time of the Mosinee incident did not enable ATR to establish any model of hinge moment alteration that could be used for simulations or training purposes. For this reason, the NTSB is being unfair and misleading when it states (page 80) that ATR's icing simulation packages ". . . do not include any change that would demonstrate rapid and uncommanded aileron and control wheel deflections to near their full travel limits with high, unstable control wheel forces." These characteristics, representative of what occurred at Roselawn, could not have been incorporated in the 1989 simulator package, because they only describe the Roselawn accident sequence and not the circumstances of the previous incidents. None of the parties involved in the investigation of the Mosinee incident, including the NTSB, recognized these characteristics in 1989. Only after the Roselawn accident investigations and the unprecedented post-accident testing at Edwards Air Force Base did ATR have the necessary information to develop a simulator package that would include these characteristics. On January 30, 1996, ATR provided Flight Safety International with a post-Roselawn "freezing drizzle" simulation package containing the distinctive features of the Roselawn accident.

Based on the foregoing, the NTSB is being unduly critical and misleading when it states on page 177 of the analysis section that: "The 1989 icing simulation package provided to simulator manufacturers and aircraft operators by ATR for use in their ATR-42 training programs did not adequately present the effects of the icing event experienced by the Mosinee flightcrew or the crew of Flight 4184". ATR can only regret that the NTSB report has taken the liberty of passing judgment on ATR's 1989 icing simulation package on the basis of what is, in fact, a total misrepresentation of the facts regarding not only the Roselawn accident scenario, but the pre-Roselawn incidents as well. In response to this, ATR can only reiterate that the 1989 simulator package could not possibly have presented the effects of the icing event experienced by the crew of Flight 4184, for the reasons discussed above. As far as the Mosinee incident is concerned, the 1989 simulator package did address an asymmetrical wing lift loss, which is precisely what actually occurred in this event.

NTSB Finding No. 24: The 1992 ATR All Weather Operations brochure was misleading and minimized the known catastrophic potential of ATR operations in freezing rain.

ATR's highly praised *All Weather Operations* brochure was first published in 1991. It is consistent with ATR's philosophy of ensuring that the safety level and margins in icing conditions, as defined by regulations, remain equivalent to what exists without ice. After the Ryanair and Air Mauritius incidents, ATR was also eager to disseminate the information acquired from these incidents. ATR was especially intent on reviewing the basics of icing operations and the long-established procedures for operating the aircraft in these conditions. This stems from the fact that the flightcrews in these two incidents had not respected these procedures. In 1992, ATR issued a second edition of the brochure. There were no significant differences between the first and second editions.

In general, the brochure described freezing rain and addressed the potential hazards associated with flight in freezing rain conditions. Contrary to what the NTSB Report states, the brochure does not refer to freezing drizzle, a phenomenon that was not widely understood before the Roselawn accident investigations and testing that followed. The brochure notified operators and flightcrews of the effect of freezing rain conditions on aircraft performance and handling characteristics and gave the means to facilitate the recognition and avoidance of these conditions. In this respect, the brochure advised pilots to exit freezing rain by either climbing to a higher altitude or by altering course. However, in the event that these conditions were experienced, the brochure clearly addressed the appropriate recovery procedures for escaping a roll control anomaly

The NTSB Report's analysis of the contents of the brochure on page 179 of the Report is based on the NTSB's erroneous assumption that ATR could have anticipated the Roselawn accident phenomenon from prior incidents As stated above, ATR could not have addressed "the rapid and uncommanded aileron and control wheel deflections to near their full travel limits with unusually high, unstable control wheel forces" in the brochure because, at the time, ATR could only highlight the known hazards of flight in icing conditions. These specific flight characteristics were not observed during the previous icing-related events. Thus, ATR could not possibly have described in the brochure icing effects that were not observed in the previous incidents. To suggest that the ATR brochure was "misleading" or that it "minimized the known catastrophic potential of ATR operations in freezing rain" is itself misleading and preposterous. The brochure could only be an accurate reflection of ATR's understanding of the impact of icing at the time, which was based on aerodynamic lift loss events at AOAs close to the stall warning threshold

This NTSB finding also implies that ATR did not prepare the brochure in the interest of safety, whereas ATR has been commended by both the FAA and the Airline Pilots Association (ALPA) for its research on the impact of icing on aircraft. Further, the brochure has always been properly and widely distributed to all ATR operators worldwide and has been found by pilots to be a useful document. Copies of the brochure are systematically placed in the cockpits of all ATR aircraft before delivery to operators, including the aircraft involved in the Roselawn accident.

Since the Roselawn accident, the brochure has been updated to include what was learned from this accident, especially from the extensive post-Roselawn testing conducted at Edwards Air Force Base. The entire aviation industry has benefited from ATR's consistent efforts to inform all concerned with the dangers of icing.

> NTSB Finding No. 25: ATR failed to disseminate adequate warnings and guidance to operators about the adverse characteristics of, and techniques to recover from, ice-induced aileron hinge moment reversal events, and ATR failed to develop additional airplane modifications, which led directly to this accident.

As stated above, the previous ATR icing related incidents were not "ice-induced aileron hinge moment reversal events". This phenomenon was disclosed for the very first time during the Roselawn accident investigation and later confirmed by post-Roselawn testing. The NTSB

encouraged the testing, participated in the testing and is thus fully aware that the testing disclosed this phenomenon for the first time. It is therefore evident that prior to the Roselawn accident, ATR could not have warned operators about the characteristics of, and the techniques to recover from, a phenomenon that had not yet been discovered.

The NTSB report erroneously fails to acknowledge the adequacy of the actions taken by ATR following the previous incidents that addressed the problems related to flight in icing effects that were known at the time. As noted above, the vortex generators were added to ATR aircraft following the Mosinee incident in 1988. The other incidents did not warrant any further modifications to the aircraft, but ATR did take appropriate follow-up actions wherever warranted by these incidents. Therefore, to suggest that ATR deliberately withheld information from ATR operators or that ATR purposely failed to develop additional airplane modifications is patently wrong and offensive. As previously mentioned, the corrective measures undertaken following the incidents and those implemented after the Roselawn accident addressed entirely separate issues.

Prior to the Roselawn accident, the All Weather Operations brochure, which was widely distributed by ATR, provided adequate warnings and guidance to operators and flightcrews about the hazards of flight in icing conditions known before the Roselawn accident. Even before distributing the brochure, ATR consistently provided its operators with adequate, comprehensive information and warnings to avoid prolonged exposure to icing conditions outside those specified in the Appendix C certification envelope. Operators and flightcrews were also provided with a description of the appropriate recovery procedures, which were included in ATR's All Weather Operations brochure, training programs and simulator packages. However, as stated previously, these procedures could only be representative of ATR's, as well as the aviation industry's, pre-Roselawn knowledge of the hazards associated with flight operations in adverse weather conditions.

5. The Certification Process Under the Bilateral Airworthiness Agreement Between the United States and the Government of France Regarding ATR Series Aircraft Was Conducted Properly

Although ATR believes that the certification process under the Bilateral Airworthiness Agreement (BAA) between the United States and the Government of France is an issue that more directly concerns the airworthiness authorities of France and the United States, ATR nevertheless feels that it is essential to correct the record with respect to the NTSB Report's erroneous statements regarding that process in respect to the certification of ATR-42 and -72 series aircraft under the BAA. The Report questions the scope and effectiveness of the agreement, which has been in effect between the two countries since 1973. The Report also raises the issue of the continuing airworthiness of foreign-manufactured airplanes certified under the BAA. It is quite clear from the NTSB's statements in this regard that the NTSB staff is, unfortunately, not sufficiently knowledgeable about the bilateral airworthiness process in particular and the international certification process in general.

On page 186 of the Report, the NTSB erroneously states that the ATR-42/72 series aircraft does not appear to have been improperly certificated but "... excessive reliance on a foreign airworthiness authority could result in improper certification of an aircraft." As noted by the BEA in its Annex 13 comments, the DGAC in its Petition for Reconsideration, and by the FAA in its Comments on the DGAC's Petition, the Safety Board's allegations reveal that the staff apparently misunderstands how the BAA between the FAA and the DGAC operates. The FAA and the DGAC amply demonstrated during the course of the investigation that application of the BAA resulted in the proper certification of ATR-42 and ATR-72 series aircraft, as shown by the results of the SCR Report. The FAA and the DGAC also amply demonstrated that the existing BAA, as well as the provisions of the Convention on International Civil Aviation, and the Annexes thereto, adequately ensure the safety of imported aircraft, such as the ATR-42/72 series aircraft. It is indeed regrettable that the NTSB ignored the valuable input from the BEA, the DGAC and the FAA on these points.

6. The NTSB Report Is Contrary to the Spirit of Annex 13 and the ICAO *Manual of Aircraft Accident Investigation*, and Is Internally Inconsistent.

What is most disturbing to ATR about the NTSB Report is paragraph 1 of the NTSB's proposed probable cause statement, which directly and openly accuses ATR of causing the Roselawn accident by failing "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 was operated in such conditions . . ."

ATR strongly objects to this statement, which it finds completely erroneous and biased. As the above comments have demonstrated, it is entirely wrong and is based on erroneous and incomplete findings. The statement is also in complete contradiction with the safety recommendations made by the NTSB as a result of its investigation. This glaringly unsupported conclusion has led ATR to believe that the NTSB has, for whatever reason, sought to single out the foreign aircraft manufacturer, while failing to address all the critical causal factors which led to the Roselawn accident.

An example of the biased attitude of the NTSB is Finding No 38 of the Accident Report, which states: "...if the crew had been able to observe the ridge of ice building behind the deice boots or otherwise been provided a means of determining that an unsafe condition was developing from holding in those icing conditions, it is probable that they would have exited the conditions." (Emphasis added.) Such a purely hypothetical and speculative statement is inappropriate in an Accident Report according to the rules of the ICAO Manual of Aircraft Accident Investigation (MAAI) (Chapter II, Part 4, para. 2). This is only one of the numerous examples in the Report demonstrating an apparent NTSB intention to single out only the foreign aircraft manufacturer, the French DGAC and the FAA. The same comment applies to Findings Nos.8, 17 (second sentence), and 23.

Almost consistently throughout the Report, but particularly in its Findings, critical, highly relevant factual factors not related to the foreign aircraft manufacturer are either ignored, or labelled as irrelevant to the accident (Findings Nos.33 and 39) or deliberately excused by all sorts of strained arguments (Findings Nos.10, 31, 32, 33, 34 and 37), including arguments based on strained readings of applicable regulations (Findings Nos 36, and 40), in stark contrast to the very different treatment of factors relating to ATR. On the other hand, in circumstances where the applicable regulations support the conduct of the foreign aircraft manufacturer, the NTSB staff appears to go out of its way to interpret the regulations in a specious manner which appears to be designed to cast ATR in as unflattering a light as possible (Finding Nos.14 and 17 (second sentence))

The NTSB's statement of Probable Cause, and indeed, the Board's Report, is contrary to the spirit and intent of Annex 13 to the Convention on International Civil Aviation, which, in para. 3.1, Chapter 3 states "The fundamental objective of the investigation of an accident or incident shall be the prevention of accidents and incidents. It is not the purpose of this activity to apportion blame or liability." In addition Chapter 1, Part I of the MAAI published by the International Civil Aviation Organization in order to facilitate the work of investigators provides: "The nature of the inquiry into an aircraft accident should not be accusatory..." and "... similarly the assessment of blame or responsibility should not be included in the duties of an aircraft investigation authority..." However, the tone and content of the NTSB's Report regarding the Roselawn accident are otherwise

A faithful striving to achieve the objective of the prevention of future accidents and the promotion of aviation safety would have obliged the NTSB to examine all the causal and contributory factors involved in the Roselawn accident. Indeed, it is a well-established fact that aviation accidents are the result of a specific combination of factors that, taken individually, would not cause an accident. In this respect, the Roselawn accident is no exception The NTSB Report's failure to formally address all of the diverse factors, causal and/or contributory, that constitute the Roselawn accident scenario has resulted in an incomplete and fallacious analysis of the reported facts, which appears to be aimed primarily at finding fault with the foreign manufacturer. As a result, the probable cause statement furthers the Safety Board's erroneous thesis for the accident, but unfortunately, does little to further the cause of aviation safety

It also appears that the NTSB has failed to follow the guideline set forth in the MAAI, Chapter 4, Part IV, para. 4.12, which states: "It is . . most important that the 'Final Report' is complete and accurate" and that the "investigation is conducted with great care and integrity" (para. 4 3) The examples given above clearly show that the manner in which this Accident Report was prepared does not meet this standard.

Accordingly, in regard to the determination of the accident's probable cause, ATR fully supports the positions taken by the BEA, DGAC and the FAA that the NTSB should have considered, reported on, and analyzed all factors involved in the accident including, but not limited to, the prolonged operation of the aircraft in icing conditions beyond the Appendix C certification envelope, ATC's release, control, and monitoring of Flight 4184, AMR Eagle Company policies and procedures regarding proper cockpit conduct and flight in icing conditions, and the crew's extremely unprofessional conduct during the extensive holding period

in which Flight 4184 was being operated. Instead, the Report ignores these highly significant safety issues, the explanation of which is so necessary for a complete understanding of the accident. As a result, the prevention of further accidents and incidents which, as mentioned above, is the fundamental objective of accident investigation is not met in this Report, at least in those areas and with respect to those matters which the report has failed to correctly address

Because the Report ignores many significant factors involved in the accident, there is a lack of coherence between certain findings and the probable cause statement on the one hand, and the NTSB's Safety Recommendations on the other. This is especially true regarding the NTSB's findings and subsequent Safety Recommendations to the FAA concerning aircraft certification and freezing drizzle/rain conditions. In this regard, the NTSB makes five very broad recommendations urging the FAA to reevaluate current icing criteria, icing certification requirements and advisory material, and icing certification testing regulations so that they more accurately account for the hazards associated with flight into icing conditions The recommendations also call for a more reliable means of defining and forecasting freezing drizzle (SLD) conditions and improved flightcrew training in unusual attitude recovery techniques.

The substance and wording of these Safety Recommendations indicate that the Roselawn accident investigation has provided the international aviation community with valuable, new information on SLD ice accretion characteristics, as recommendation A-96-54 referring to "recent research into ice accretion" suggests. Indeed, prior to the Roselawn accident, aviation authorities and the aviation industry worldwide did not yet have sufficient information concerning the dangers of prolonged flight into an SLD icing environment. The fact that most of the NTSB's recommendations in the Report emphasize the need for substantive changes in the rules and regulations governing flight into adverse weather conditions confirms that the aviation community's increased knowledge of the potential effects of flight into freezing drizzle/freezing rain conditions was derived from the post-Roselawn investigation, and in particular from the effort made by ATR in the Edwards Air Force Base testing program and by the FAA and DGAC in the Special Certification Review. These Safety Board's recommendations are in direct conflict with the NTSB's thesis of prior knowledge by ATR of the effects of SLD on aircraft and ATR's alleged failure to disclose such information to operators and to relevant authorities.

Moreover, the very broad scope of the NTSB's Safety Recommendations stands in stark contrast to the very selective focus of the findings and probable cause statement. In this regard, there is a clear pattern to the NTSB's findings and recommendations. The Report persistently fails to acknowledge the acts or omissions of the crew and AMR Eagle in the findings, disregarding their behavior as a contributing factor in the accident. Findings Nos. 37 and 40 provide pertinent examples in that the Report fails to acknowledge the relevance of the significant human factors issues involved in this accident. Although the NTSB's record of investigation clearly reveals that the female flight attendant spent an extraordinary amount of time in the cockpit, that the captain and first officer were engaged in extensive distracting conversations, that the captain left the cockpit immediately after the icing warning chime was activated, and that there was absolutely no discussion between the flightcrew regarding the severe icing conditions in which the aircraft was holding, the Report fails to address these issues. Despite this omission, and in contradiction to it, the Safety Board recommends that the FAA "evaluate the need to require a sterile cockpit environment for airplanes holding in such weather

conditions as icing and convective activity, regardless of altitude" The Safety Board then recommends that AMR Eagle "encourage captains to observe a "sterile cockpit" environment when an airplane is holding. . ." The NTSB's findings and recommendations in this regard are patently inconsistent.

In several findings (Nos. 1,2,8,9,31,32,33, and 36-41, respectively) the Report completely exonerates ATC, AMR Eagle and the crew based on the assumption that these parties acted in accordance with the existing rules and procedures before, during, and after the roll upset involved in the Roselawn accident and therefore they could not have contributed to the accident. However, as ATR has pointed out above, there are a number of Safety Recommendations which are specifically aimed at a revision and modification of the same rules that the NTSB found were complied with by all the parties, except ATR. This only reinforces ATR's belief that the NTSB has, for whatever reason, sought to single out the foreign aircraft manufacturer in its probable cause statement, as well as in the analysis and findings of the Roselawn accident Final Report

CONCLUSION

ATR would like to conclude this Petition by reiterating its profound disagreement with the NTSB Report on the Roselawn accident. Regrettably, the Report focuses on the aircraft manufacturer's and airworthiness authorities' responses to certain ATR-42 prior incidents instead of addressing the important safety issues involved in the accident. The Report also ignores the significance of the NTSB's own involvement in the investigations of three of the prior incidents and the NTSB's own failure to predict the Roselawn scenario in advance, which makes the NTSB criticism of ATR on this point all the more preposterous and offensive.

As discussed above, a thorough review of the prior ATR-42 icing incidents demonstrates that four of these events were fundamentally different from the Roselawn accident and that the level of turbulence involved in the one other incident made it, and still makes it, impossible to determine the exact nature of the roll departure in that incident. None of these events involved the Roselawn phenomenon Each event involved a fundamentally different aerodynamic mechanism, i.e., a conventional aerodynamic stall of the wing at slow airspeeds and high angles of attack at or near the stall warning threshold in severe icing conditions. Simply stated, the prior ATR-42 incidents were conventional stall events which occurred at or about the angle of attack where stalls normally occur in such conditions. They did not involve a roll departure caused by an aileron hinge moment shift, which in turn caused an uncommanded aileron deflection, as was the case in the Roselawn accident.

The NTSB Report is fundamentally flawed because it consistently fails to accurately distinguish between the two completely different phenomena. The Report's blurring of these phenomenon is inexcusable, particularly since representatives of ATR, the BEA, the DGAC, and the FAA repeatedly explained this issue to the NTSB representatives during the course of the NTSB's investigation of the Roselawn accident. The Report's failure to acknowledge that the prior ATR-42 incidents are not aerodynamically similar to the Roselawn accident has resulted in formal submissions from the BEA, the DGAC, the FAA, and now ATR. The NTSB should take

note that the BEA's Annex 13 comments, the DGAC's Petition For Reconsideration, the FAA's comments to the DGAC's Petition, and ATR's Petition For Reconsideration all are largely premised on the fact that the Safety Board's findings are erroneous on this fundamental issue. Finally, ATR finds to be completely unfounded the Report's suggestion that the NTSB is concerned about whether the ATR aircraft can be controlled in all types of environments present in nature. As noted above, no airplane is, and no airplane should be expected to be, designed or certified to handle every adverse environmental condition that may be present in nature, no matter how extreme. For this reason, flight safety in severe icing and other extreme environmental conditions will never be effectively achieved by focusing solely on the airplane design. Rather, there must also be a thorough consideration of pilot awareness and training, improved air traffic control, and improved weather forecasting issues. Regrettably, the Report's analysis of these issues is woefully inadequate.

In light of the foregoing, ATR strongly encourages the NTSB to substantially modify its Report to correct the Safety Board's erroneous findings and probable cause statement.