34 OPERATING RULES AND LEGISLATION

The Operating Rules

During the course of the hearings of this Inquiry, a considerable amount of evidence was heard indicating that the existing regulations and orders applicable to Canadian air carriers were deficient, outdated, and in need of overhaul or outright replacement. This was particularly true with respect to the air carrier operating rules, which are contained, for the most part, in Air Navigation Orders (ANOs) Series VII, Nos. 2, 3, and 6.

Flight dispatch requirements, minimum equipment list orders, shoulder harnesses for flight attendants, approval of aircraft operating manuals, and qualifications for air carrier managerial personnel were only a few of the items that were identified in evidence as areas of regulation that required strengthening or where regulation is nonexistent.

This concern is far from new. In 1981-82 the Commission of Inquiry on Aviation Safety under Mr Justice Charles L. Dubin recommended that Transport Canada adopt not only the airworthiness Federal Aviation Regulations (FARs) of the United States but also their companion operational regulations, the operating FARs. The airworthiness FARs were independently adopted by Transport Canada; the operating FARs were not. The following quotation from Mr Dubin's report, dated October 1981, highlights the reasons behind the recommendation:

> The proposal to adopt FARs 23, 25, 27, 29, 31, 33, 35 and 37, namely, the airworthiness FARs, caused a considerable debate during the hearings of this phase of the Inquiry. It is to be noted that the proposal of the DOT was to adopt the airworthiness regulations of the United States only, omitting from the proposed enactment the operational FARs previously referred to. It was the Department's position that the adoption of the operational FARs was not necessary because of the existence of adequate operation regulations in Canada. Following a request of this Commission, Mr Donald E. Lamont, Director of Licensing and Inspection, attempted to locate the regulations existing in Canada that would equate to those rules contained in operational FAR 121. Mr Lamont was of course handicapped by the fact that whereas FAR 121 contains all of the rules applicable to the subject, ANO Series VII, No. 2 must be read in conjunction with the Air Regulations, Air Navigation Orders and the Engineering and

> Inspection Manual. Mr Lamont presented to the Commission a detailed breakdown of equivalencies and differences. Some operating rules were to be found in flight manuals, and some other sections simply had no Canadian equivalent.
>
> (*Report of the Commission of Inquiry on Aviation Safety*, vol. 2, pp. 539–40)

This situation still exists today. The present Canadian aviation regulatory requirements reside in a mix of disjointed regulations, orders, manuals, and policy documents that are difficult to comprehend. During the course of the hearings of this Inquiry, many Transport Canada officials were unable to interpret the aviation regulations and orders clearly. A case in point was ANO Series II, No. 20, dealing with minimum equipment lists. The order uses the term "essential airworthiness item," but not one witness could with any degree of precision define an essential airworthiness item. The evidence of Mr Ronald Armstrong, then Ontario's regional director of aviation regulation, provides an example of this concern:

> Q. Nevertheless, the MEL order, as it is present – as it is currently drafted, simply does not help the pilots, because to interpret it, he's got to go on this goose chase from regulation to regulation and to documents, some of which may be in foreign languages.
>
> So the result is, the MEL order and the definition of minimum equipment – I'm sorry, essential aircraft equipment specifically is not helpful to pilots; right?
>
> A. No, it is helpful to them, but they have to apply interpretation and judgment in using it. But is it the ultimate answer?
>
> Is that what you're saying, that they can check off all the boxes to determine whether or not that particular piece of equipment is essential equipment?
>
> No, it's not at that level of specificity. Is it helpful? The pilot using it, I guess, will make that determination.
>
> Q. Well, I'm going to suggest to you that it's obvious that it's not helpful, because it refers the pilots to apparently other pieces of legislation which he wouldn't have, and that piece of legislation may refer the pilot to documents which he clearly wouldn't have, which maybe maintenance doesn't have and which may be in a foreign language.
>
> So the definition simply is not helpful to pilots. Can you not see that?
>
> A. In those bald terms, yes, I can see that.
>
> (Transcript, vol. 125, pp. 128–30)

Mr Justice Dubin in his 1981 report indicated that he was impressed by the evidence of Mr Robert Klein, then the chief airworthiness engineer with de Havilland Aircraft, who had stated the following:

> when you are trying to upgrade the total system, the only method available is to put into the operating rules that, after today, nobody may operate an airplane unless it has, for example, fireproof material in the inside and more fire extinguishers, and the upgraded standards.
>
> This sounds like an airworthiness standard, but it is in effect a retroactive application. The only way they can apply this is via the operating rules. But they fit together perfectly.
>
> The other thing that is very interesting is that an airplane that is designed on a certain date is operated in a certain manner, as laid down by the operating rules, and another airplane that is designed at a later date has a different set of operating rules. But one caters for the other in such a way that they seem like a great confusion. But they do fit together beautifully, and I admire the talents of the FAA to keep this can of worms sorted out and make it very clear as to just what everybody is supposed to do, and the operators and the designers understand this.
>
> (*Report of the Commission of Inquiry on Aviation Safety*, vol. 2, p. 540)

Another key area pursued with Mr Klein was the probability that a modification of an airworthiness standard might result in a corresponding change in the operating standard. Mr Klein pointed out that airworthiness certification rules, which are fixed, are interrelated with the operating rules, which are amended from time to time:

> You may upgrade one at a time if there is no need to make a corresponding change, but if they are inter-related, then the same amendment can be effective in Part 25 and 121. They are both upgraded simultaneously in the same Notice of Proposed Rule Making, and you get two different amendments to the two different books.
>
> ...
>
> The airworthiness rules are frozen. Once you have been certified to a certain basis of certification – for instance, the 727 that we are still buying new copies of, was designed to the standards of Part 4b. The Series 100 was the initial series and the Series 200 is the later series; but it is still to the original basis of certification, because the type is the 727, and there is nothing to stop them from coming out with a Series 300 and 400 and 600 and 900. For the next 50 years it will still be to the standards of Part 4b. So that there is no way that these later amendments of 25 [FAR 25] will ever show up.
>
> (Ibid., p. 541)

Mr Klein identified a fundamental problem with the structure of the Canadian regulations. While Canada has adopted the United States design and certification standards, we do not even today, some ten years

after Mr Justice Dubin made the specific recommendation, have in place an equivalent set of operating rules to ensure that when a change is made to a design standard that effects a corresponding operating rule, the operating rule is amended simultaneously.

In many instances the existing Canadian airworthiness rules do not have corresponding Canadian operating rules. For example, nothing is mentioned in either the Air Regulations or the Air Navigation Orders setting out a requirement that turbine-powered commercial aircraft be operated in conformity with the takeoff limitations specified in the approved aircraft flight manual. It is an obvious operating requirement that, at present, has no home within Canadian operating rules. The Transport Canada airworthiness authority deals with this issue in the aircraft flight manual requirements as an airworthiness requirement as part of the airworthiness manual, which is enabled by regulation.

Unfortunately, for a commercial or airline transport pilot, the requirement and the regulatory process that make it a rule are so convoluted that it is nearly impossible to ascertain, first, what is the Canadian requirement; second, in what publications is it located; and, third, what makes it a regulation. In contrast, in the United States, FAR 121.189 entitled "Transport category airplanes: turbine engine powered: takeoff limitations," sets out the requirement for a commercial operator to adhere to factors such as weight, altitude, temperature takeoff limitations, accelerate-stop distances, and takeoff distances. The irony of the situation is that the analogous Canadian requirements, notwithstanding the complicated and bewildering manner in which they are set out, find their origin in FAR 121. It would have made much better sense to have adopted FAR 121 in the first place.

As a further example, the United States operational rule FAR 121.141 requires that each commercially operated transport category aircraft shall have on board an aircraft flight manual or an aircraft operating manual with revised (and more readily accessible) performance data and procedures, approved by the administrator. Transport Canada has no requirement to approve air carrier-generated aircraft operating manuals to ensure that they are in conformance with and are no less restrictive than the approved aircraft flight manual. It is worthy of note that the two pilots on board C-FONF on March 10, 1989, carried two aircraft operating manuals, differing in form and content and neither having an amendment service (see chapter 19, F-28 Program: Flight Operations Manuals). The manuals were not approved by Transport Canada, since there was no regulatory requirement to do so. The ramifications for flight safety are obvious.

Mr Justice Dubin recommended the adoption of FAR airworthiness standards. He indicated that in his view it would be wasteful of expertise, manpower, and funds for Canada to draft its own code. The

evidence I have heard leaves no doubt whatsoever that he was right. However, he went beyond the airworthiness code and made recommendations for the adoption by Transport Canada of the corresponding FAR operating rules:

> Transport Canada has been moving towards the adoption of a series of the Federal Aviation Airworthiness Regulations, but proposes to delete from the Canadian code the Federal Aviation Operational Regulations. I am satisfied that to do so would be a mistake. What is needed is a complete code available from one source. The failure to adopt the Federal Aviation Operational Regulations which are interrelated with the Federal Aviation Airworthiness requirements would lead to future complication and uncertainty and would fail to achieve the necessary objective.
>
> (*Report of the Commission of Inquiry into Aviation Safety*, vol. 2, p. 542)

The point being made was that the United States operational rules were an integral part of the airworthiness regulations and were equally as important as the airworthiness regulations to airline safety:

> Although styled as the operational requirements, the Federal Aviation Operational Regulations include many airworthiness standards and, as is pointed out, the Operational Regulations are an integral part of an airworthiness code. The Operational Regulations update airworthiness requirements and are equally important in contributing to aviation safety. As previously noted, the current Canadian airworthiness standards are to be found in a myriad of documentation. A close study of them may disclose comparable standards to those that now form part of the operational FARs. In many cases, however, there is an absence of identical or equivalent standards. In my opinion the airworthiness FARs and operational FARs should be used and adapted as the model for a Canadian Airworthiness Code.
>
> (Ibid.)

These observations and recommendations are, in my view, as valid today as they were when they were made ten years ago. In 1982 the FAR design requirements, along with International Civil Aviation Organization (ICAO) Annex 6, Operation of Aircraft, and Joint Aviation Requirement (JAR) 22, were in fact adopted in Canada and now form the basis of certain chapters of the Transport Canada airworthiness manual. Inexplicably, Transport Canada did not adopt the FAR operational rules. Its failure to do so is very questionable.

Had Transport Canada adopted the FAR operational rules when it adopted the FAR design and certification requirements, Air Ontario aircraft C-FONF would in all probability have been equipped with flight attendant shoulder harnesses on March 10, 1989, and the flight crew of C-FONF would have been required to have a common and approved aircraft operating manual. Mr David Adams, an investigator from CASB seconded to this Inquiry, described the Canadian regulatory requirements for seats for flight attendants, as they existed at the time of the Air Ontario accident:

> Q. Now, I would like you to turn to page 110 of your report, and it deals with the FAR requirements and Transport Canada requirements for shoulder harness ... for cabin attendant seats.
>
> Can you discuss that for the Commissioner?
>
> A. Yes ... Canada, like many countries, accepts the U.S. specifications and regulations to do with a lot of things involved with aircraft operation.
>
> Now, the United States had a Federal Aviation Regulation 25.785, which is primarily a design regulation. And it basically said, okay, as of a particular date, all aircraft constructed and submitted for certification must have seats that provide back and arm and neck support, and they must have ... shoulder harnesses as part of the seat belt.
>
> Canada accepted that particular FAR.
>
> The Americans then introduced a second FAR which was a ... Federal Aviation Regulation – FAR 121.311. Now, it is an operational regulation as opposed to a design regulation.
>
> Now, that operational regulation basically said, all aircraft that are being used for major regular passenger transport services, irrespective of when they were designed or certified, must have the new seats that provide back and arm and neck support and shoulder harnesses.
>
> So, in effect, FAR 121 made FAR 25.7 retroactive so that it covered all aircraft.
>
> Whereas Canada accepted FAR 25.785, they had not at the time of the accident accepted FAR 121.311.
>
> So, in other words, in this country you were not necessarily required to have the new seats or the shoulder harnesses, depending on when your aircraft was certified. This was the case with the Air Ontario F-28 C-FONF. It was not, under Canadian regulations, required to have the shoulder harnesses or the new seats.
>
> (Transcript, vol. 157, pp. 81–84)

Adequacy of Canadian Operating Rules: The View of Transport Canada Operational Staff

The Transport Canada operational staff who testified at this Inquiry, when questioned about the adequacy of the existing ANO Series VII, No. 2, were unanimous in their view that the ANO was deficient in a number of areas. Mr Martin Brayman, a former superintendent of air carrier inspection for Ontario Region, gave the following evidence about the adequacy of the Canadian operating rules:

> A. There are numerous areas that are not covered specifically in the ANOs.
>
> ...
>
> Or in sufficient detail. And I would have to say that those areas dealing with dispatch centres, that's one area. There are several others.
>
> (Transcript, vol. 131, p. 112)

Mr Ian Umbach, Transport Canada's superintendent of air carrier operations (large aeroplanes) in Ottawa, was a witness whom I perceived to be genuinely committed to aviation safety. He expressed the obvious frustration that many Transport Canada witnesses, pilots, and air carrier officials who testified felt for the chronic inaction on the part of Transport Canada senior management in many areas of urgent concern, including the replacement of the outdated ANOs and regulations. Mr Umbach testified that more than eight years ago, "the department began a rewrite of the existing regulations and ANOs," but that "they have never appeared." He stressed that there is "an urgent need for current, topical and specific regulations." He stated that "in their absence, we end up improvising policy, publishing policy manuals, and the industry itself is advancing at such a rapid pace that we are having difficulty keeping up." He gave his view of what is necessary:

> A. ...
>
> And it's my strong belief that we need, as I said, current, topical regulations for the control and regulation of our air carrier industry, and we don't have them.
>
> (Transcript, vol. 139, p. 23)

Mr Umbach was asked whether, for large air carrier inspection, the Air Navigation Order Series VII assists him in the fullest extent in carrying out his duties and responsibilities. His reply was succinct and graphic:

A. No. It's outdated. It's vague. It's open to varied interpretation. It doesn't address a wide variety of the items now facing the air carrier industry and us.

(Transcript, vol. 139, pp. 23–24)

On his own initiative, Mr Umbach, while on the witness stand on November 17, 1990, presented a list of eleven recommendations for urgently needed regulatory changes, the first of which was: "Revise the air regulations and ANOs on a priority basis" (Transcript, vol. 139, pp. 23–24). When asked for his view of the United States operational rules, the FAR 121, Mr Umbach unequivocally stated before this Inquiry that the FAR 121 operating rules were exactly what is needed in Canada:

Q. What is your view of FAR 121?
A. I think it is exactly what we need. It is current, topical and specific.

(Transcript, vol. 139, pp. 25–26)

Mr Umbach agreed that special conditions, based on Canadian experience and required for Canadian aviation purposes, should be addressed in the context of an adoption of FAR 121. He was most emphatic when asked whether he recommended that the United States Operational Regulation, FAR 121, should be used and adapted for a Canadian airworthiness code:

A. Yes, I do.
Q. And when should it be done?
A. Immediately.

(Transcript, vol. 139, p. 26)

I could not agree more. The time is long past for action in this regard.

Mr William Slaughter, Transport Canada's director of flight standards, supported Mr Umbach's views in this regard. During his testimony before this Inquiry Mr Slaughter acknowledged that, although the *Aeronautics Act* has been rewritten to replace the original Act that dated back to 1919, "the regulations have not yet caught up with the Act." He gave the following evidence:

Q. Now, do you agree with me that at the time, five years ago, and still now, aviation safety legislation in Canada is in serious need of revision and overhaul?
A. Yes, sir, the regulations, I believe, and it has been documented here [during the hearings of this Commission of Inquiry], are woefully out of date.

(Transcript, vol. 147, p. 85)

Mr Slaughter testified that inadequate finances and personnel had a negative impact on the ability of the Aviation Regulation Directorate to carry out its daily tasks and to do the planning, developing, and reviewing of the regulations to meet the challenges of ongoing technology. He candidly admitted that given his workload and the resources available, he could not give the assurance that everything is being done in compliance with current regulations.

Mr Slaughter was unable to explain the failure by Transport Canada to adopt the operational FARs. He too left no doubt that adoption of the entire FAR system was appropriate and sensible:

> A. So the reason we did not adopt the FAR system as recommended by Justice Dubin, I don't know, and that's outside my area of responsibility and authority. But certainly I'm comfortable ... with using the FAR regulations and would be quite content if we adopted that system throughout, from my own opinion.
>
> (Transcript, vol. 145, p. 92)

Mr Slaughter's testimony implies that the reason for the failure to adopt the operational FARs lay beyond his area of jurisdiction and with the upper management of the Aviation Regulation Directorate. Mr Weldon Newton, director-general of aviation regulation, when questioned about the matter, simply indicated in his evidence that Transport Canada chose not to accept Mr Justice Dubin's recommendation for the adoption of the United States operational FARs concurrently with its adoption of the United States airworthiness FARs. Instead of following this recommendation, it is clear from the evidence that the Aviation Regulation Directorate has, in effect, attempted for the past ten years to restructure the Canadian air carrier operating rules so as to eliminate the ANOs and to have only regulations. According to Mr Newton's evidence, given in late January 1991, the draft regulations referred to by him had not yet been implemented but had recently been submitted to the Department of Justice for review.

It is a matter of major concern that the Aviation Regulation Directorate's decade-long waste of time, expertise, and resources on an as yet incomplete activity could and should have been avoided. Adoption of Mr Justice Dubin's recommendation regarding the United States FAR operational rules would have provided effective operating rules in many areas of Canadian regulations found deficient in the course of this Inquiry. In addition, although Mr Donald Douglas, in his report, identified a serious problem with Canadian air regulations as far back as 1986 (see chapter 30, Effects of Deregulation and Downsizing on Aviation Safety), the evidence before this Commission shows that little was done to address the problem effectively in the years that followed.

One of Mr Umbach's list of recommendations aimed at correcting the unsatisfactory state of Canadian air regulations concerned the issue of contracting-out within an international aviation environment:

> Q. Your next recommendation is improve regulations applicable to air carriers contracting maintenance, flight watch, et cetera.
>
> Can you generally deal with that recommendation?
>
> A. It generally refers to my first recommendation ... that we need better regulations to meet rapidly changing developments in the air carrier industry.
>
> New trends are developing constantly. Flight watch certification is inadequately addressed in current regulations. The present manuals, well, for flight watch, we don't have a manual. The certification manual isn't as specific as it should be to meet changing developments.
>
> New practices are being entered into on a global scale now that we are, at the moment, ill-prepared to meet.
>
> (Transcript, vol. 139, pp. 29–30)

The obvious solution to challenges posed by the new global aviation environment lies in the development and acceptance of uniform design, certification, maintenance, and operational regulations, a direction in which the European Community is now headed. It is known that Europe's Joint Aviation Authorities (JAA) and the FAA in the United States have both recognized the need for greater commonality not only in aircraft design and certification requirements but also in their respective operating regulations. In that regard, the JAA has set up a joint board of operations to address operational issues such as flight crew and cabin attendants' flight duty time limitations, crew operating procedures, aircraft operational procedures, flight operations, and aircraft operating manuals as well as carrier certification procedures. One of their prime objectives is to achieve close cross-reference compatibility with the FARs.

The international aviation community is thus, by necessity, being steadily drawn towards the development and adoption of universal, harmonized design, maintenance, and operating standards. The end product will no doubt be a compromise between upgraded versions of the FARs and the JARs. By adopting the FAR operating rules as the Canadian model, and enhancing these rules where warranted, Canada would be in a far better position to accommodate the changing international aviation environment than it would with its own unique code of operating regulations.

It is worth noting that Transport Canada's Airworthiness Manual uses a split-page approach displaying the FAR certification rule in the left column and the Canadian rule in the right column. If the two rules are

identical it simply indicates "no change." However, if there is a difference, it is noted in the right column. This seems a sensible approach that should have been used as well for Canadian air carrier operating rules.

During Mr Newton's testimony he undertook to provide to this Inquiry a copy of the proposed revised operating rules. This undertaking was subsequently withdrawn by Transport Canada's counsel in a letter to commission counsel dated February 15, 1991, claiming Queen's Privilege under the *Canada Evidence Act* (see chapter 43). I found this position both surprising and disappointing, given that these draft regulations had already been submitted for review to various associations representing different segments of the aviation industry. Nevertheless, they were denied to a Commission of Inquiry charged with the responsibility of examining matters pertaining to aviation safety with the pledged full support of the minister of transport. I am therefore unable to offer comment on the suitability of the proposed changes but I would strongly urge that if they do not fully address the concerns expressed herein, the entire issue of the draft Transport Canada air carrier operating rules be reconsidered, with a view to expeditiously adopting the United States FAR 121 operating rules, while monitoring any future harmonization between them and the European JARs.

In the event that the FAR 121 operating rules are adopted as a model for a revised Canadian regulatory scheme, I suggest that Transport Canada retain an expert in the application of the FARs to assist in their transition to the Canadian regime and to point out any deficiencies in their current application in the United States. The goal should be to have an improved set of FARs applied to the Canadian scene.

The Legislative Process: Undue Delay in Rule Making

The evidence before this Inquiry leaves no doubt that it takes an inordinate length of time to put into place adequate legislation related to aviation safety, a problem that causes delays in the timely introduction of, or urgently required changes to, the operating rules. The Transport Canada Review Group, in May 1990, published a report on the Evaluation of Aviation Regulation and Safety Programs, which was conducted by direction of the deputy minister (Exhibit 1323). That report made specific reference to the problem of such delay and included recommendations for resolution. The following are excerpts from that document:

5.2 TCAG Rulemaking – Efficiency

The 1989 Federal Regulatory Plan listed 200 regulations that Transport Canada intended to adopt, of which Aviation's total is 43.

The process is slow, and not many regulations have been pre-published in Part I of the Gazette. From January 1, 1987 to June 30, 1989, twenty-one of the proposed regulations of those considered were the subject of such notices. Of comparable interest, only nine of the 21 regulations pre-published have yet passed into law. At this rate, even discharging the present burden of planned [Transport Canada Aviation Group] TCAG regulations will take nearly five years. As an example, the regulations (old ANO Series VII) relating to air carrier operations had been in process for over 7 years.

Accordingly, given the current track record, it is difficult to see how unexpected new demands and priorities, such as the possible rule on compulsory de-icing of aircraft arising from the Dryden Inquiry can be properly addressed.

5.3 Priority Setting

None of the three organizations in TCAG's rulemaking structure presently carry out priority-setting for regulatory developments. Indeed, there is no mention of priority setting in the AR Rulemaking Policy and Procedures Manual. Any priority setting to the extent it currently occurs at all, appears to be done on an ad hoc basis by the Minister's office.

The current practice regarding the decision in TCAG on whether to develop a particular rule, is made by the Civil Aviation Rules Committee (CARC). Only if there is disagreement do the Directors General concerned in TCAG become involved to settle the matter.

It is often the case for branch directors who are members of the CARC to be represented by their Chiefs of Standards. It appears therefore that decisions on whether to develop a particular regulation are effectively made at the Chief level.

An improvement to this system would be the development of priorities (based primarily on safety or risk considerations) by a senior departmental committee, for approval or change by the Minister. This could be revised every six months or so, and would represent the basis for regulatory priorities and development.

> Such a committee would also ensure that there are appropriate challenges to both the priorities and the rules themselves, so that only the most important regulations would be developed and produced. The committee would also help to concentrate departmental effort on blockages in the system (both internally and, more significantly, externally), and press for appropriate action to deal with them.

The recommendations contained in this excerpt from the Review Group report are, in my view, appropriate and a step in the right direction. I would go further, however, and suggest that a senior member of the Privy Council staff be included in the membership of the recommended senior legislative review committee, thereby assuring recognition of the importance of the issues at a level that could influence facilitation of appropriate priority in the legislative process.

Findings

- The recommendation made in the 1981 *Report of the Commission of Inquiry on Aviation Safety* that "the airworthiness FARs and operational FARs should be used and adapted as the model for the Canadian airworthiness code" is as valid today as it was in 1981.

- The decision by senior management of Transport Canada not to adopt the United States FAR operating rules at the same time as it adopted the United States airworthiness FARs, contrary to the recommendation of the Commission of Inquiry on Aviation Safety in 1981, was a fundamental mistake.

- As a result of the failure by Transport Canada to adopt the United States FAR operating rules, the Canadian aviation operating rules continue to reside in disjointed regulations, orders, manuals, and policy documents that are difficult to comprehend, even by those responsible for their enforcement.

- The decision taken by senior management in the Aviation Regulation Directorate to attempt to rationalize the chaotic situation regarding Canadian operating rules by drafting its own operating rules to complement the United States airworthiness FAR, which, paradoxically, it willingly adopted, has been an unnecessary and wasteful exercise, and one that has not produced any tangible results.

- The views of working-level inspectors regarding the urgent need for adoption of the FARs was either not transmitted to, or not accepted by, senior Transport Canada aviation management.

- The Transport Canada operational managers and staff who testified on the point were unanimous in their view that the existing Air Navigation Orders and operating rules were ambiguous and deficient and that Canadian adoption of the operating FARs would represent a significant improvement.

- There is an urgent need for a legislative mechanism to enable the expediting or fast-tracking within Transport Canada of necessary changes to regulations and operating rules that have the greatest impact on aviation safety.

- The recommendations contained in section 5.2 and 5.3 of the May 1990 evaluation of Aviation Regulation and Safety Programs, conducted by the Transport Canada Review Group, if implemented, would offer significant improvements in the area of priority-setting for regulatory developments.

- Had Transport Canada adopted the FAR operating rules at the same time that it adopted the FAR airworthiness rules, the unnecessary commitment of human resources and expertise and the expenditure of public funds since 1981 in the pursuit of the questionable goal of producing made-in-Canada operating rules could have been avoided.

- Had Transport Canada adopted the FAR operating rules, as recommended in 1981, they would have required that the aircraft C-FONF be equipped with flight attendant shoulder harnesses and that the flight crew of C-FONF have a common and approved aircraft operating manual.

RECOMMENDATIONS

It is recommended:

MCR 140 That Transport Canada ensure that managers and inspectors responsible for the application of operating rules are consulted on proposed changes to such rules.

MCR 141 That if the proposed draft operating rules currently being developed by Transport Canada do not fully address and satisfy the concerns identified by this Inquiry and expressed herein, then the entire matter of air carrier operating rules be reconsidered by Transport Canada with a view to adopting the United States Federal Aviation Regulation operating rules applying to air carriers for the Canadian regulatory scheme, amended or supplemented as necessary to accommodate Canadian conditions and purposes, on the highest possible priority basis.

MCR 142 That in the event that the United States Federal Aviation Regulation (FAR) operating rules are adopted by Transport Canada for a required Canadian regulatory scheme, Transport Canada retain an expert in the application of the FARs to assist in their transition into the Canadian regulatory regime.

MCR 143 That in the event of adoption of the United States Federal Aviation Regulation operating rules for a revised Canadian regulatory scheme, all the recommendations contained in this Final Report and in my Interim Reports proposing amendments or changes to existing Air Navigation Orders and Regulations be incorporated accordingly in order to give full meaning and effect to the subject matter under consideration.

MCR 144 That Transport Canada monitor the efforts of the United States Federal Aviation Administration and the European Joint Aviation Authorities to achieve greater commonality in aircraft design and certification requirements and in operating regulations, with a view to achieving harmonization of Canadian airworthiness and operating rules with the changing international aviation environment.

MCR 145 That Transport Canada adopt the recommendations contained in sections 5.2 and 5.3 of the May 1990 evaluation of Aviation Regulation and Safety Programs, regarding priority setting for regulatory developments and the rule-making process.

MCR 146 That a senior member of the Privy Council staff be included in the proposed senior departmental review committee for priority setting.

35 COMPANY CHECK PILOT

A company check pilot (CCP) is a pilot, employed by a carrier or agency, who has been authorized by Transport Canada to conduct certain tasks on behalf of the department in accordance with the Air Regulations and Air Navigation Orders. The issues regarding company check pilots gave rise to a great deal of testimony from a number of Air Ontario flight operations staff and Transport Canada witnesses.

Delegated Authority

A CCP may be designated as having "A" authority, "B" authority, or both. "A" authority allows the CCP to conduct pilot proficiency checks and instrument rating renewals. "B" authority allows a CCP to carry out line indoctrination and to conduct line checks, a process that each air carrier pilot is required to follow before being approved as a line pilot on a large aircraft.

Mr Ian Umbach, superintendent of air carrier operations, Transport Canada, testified that CCPs normally conduct only recurrent checks on experienced pilots, whereas Transport Canada air carrier inspectors carry out all the initial ratings and upgrades. The evidence shows, however, that during the latter part of the 1980s even initial type ratings were assigned to CCPs because there were insufficient air carrier inspectors to cope with the large numbers of pilot proficiency checks.

Simply put, Transport Canada delegates authority to qualified individuals to conduct tasks that would otherwise have to be carried out by air carrier inspectors. The evidence indicates that, generally, the process has worked well over the years. It offers a convenience to the carriers as well as a cost saving to Transport Canada.

CCP candidates are subject to a Transport Canada screening process prior to their receiving delegation of "A" or "B" authority. In the screening, both the carrier and the designee are required to meet a number of prerequisites that are set out in Transport Canada's Air Carrier Check Pilot Manual.

Further Delegation to CCPs

Throughout the latter part of the 1980s, Transport Canada's air carrier inspectors were almost totally occupied with pilot proficiency checks and

certification paperwork. In-flight inspections were for the most part abandoned, notwithstanding the fact that the more experienced inspectors considered that in-flight inspections gave them the best picture of the health of a carrier's operation from a safety viewpoint.

Based on all of the evidence I have heard, I am of the view that Transport Canada should consider pursuing a program that would lead to further delegation of authority to CCPs with air carriers that have demonstrated an exemplary safety record and that have in place mature pilot training and checking programs. To such air carriers, the delegation of authority with respect to initial pilot proficiency checks and upgrades should be considered as well. It is essential, however, that Transport Canada provide a comprehensive CCP-monitoring program of both the designated CCPs and a representative cross-section of each air carrier's pilots, in order to ensure that the standards are being properly applied and maintained. Transport Canada should reserve the right to have its air carrier inspectors conduct any pilot proficiency check it sees fit, and without notice. Transport Canada should also conduct initial pilot proficiency checks and upgrades with every air carrier in cases where a new aircraft is being introduced, to ensure that the required standard is maintained within that carrier's operation.

The savings in person-years that might accrue to Transport Canada from such a program should be redirected to in-flight inspection and air carrier surveillance programs.

Air Carrier Check Pilot Manual Deficiencies: Conflict of Interest

The use of company check pilots raises a number of issues, including that of conflict of interest. This issue surfaced when it was disclosed in evidence that Captain Joseph Deluce, who had a significant financial interest in Air Ontario, was designated as an Air Ontario CCP. The Air Carrier Check Pilot Manual issued by Transport Canada (Exhibit 1022) contains two brief and extremely vague paragraphs pertaining to conflict of interest on the part of a CCP candidate, and nowhere does it define the term "conflict of interest":

> A pilot having an interest in a carrier will not be granted CCP authority where the facts and circumstances indicate a possible conflict of interest.
>
> (Exhibit 1022, Section 1, p. 3, section 1-11)

> The D.O.T. Manager Superintendent or Supervisor in the office of prime interest for a carrier may recommend approval of a nominee

> not meeting all of the stated requirements. Justification to be included on nomination for CCP form. A waiver to CCP qualification must be approved by Ottawa Headquarters.
>
> (section 1-14)

Although there was no evidence that Captain Deluce improperly exercised his authority as a company check pilot, the critical question, totally unanswered by the Air Carrier Check Pilot Manual, is under what conditions or circumstances is an interest in a carrier to be considered as representing a conflict of interest? According to the interpretation of Mr Martin Brayman, former superintendent of air carrier inspection (large aeroplanes) for Ontario Region, the appointment of Captain Deluce to the position of CCP within Air Ontario did not represent a conflict of interest. However, the existing Transport Canada criteria intended to provide guidance to the regulator in this regard are extremely sparse and, at best, a less than definitive basis upon which to determine conflict of interest. Mr Umbach, in his testimony, acknowledged discussing with Mr Brayman the possibility that Captain Deluce was in a position of conflict of interest because of his shareholdings in Air Ontario. He stated that he relied on Mr Brayman's advice that Captain Deluce could be considered a "working pilot," and therefore not in a conflict position. He conceded that conflict of interest was not well defined and that there were no guidelines provided to inspectors by which to assess financial interests in a carrier:

> Q. Now, in so doing, in granting the approval, did at any time you discuss – recall discussing with Mr Brayman or anyone else in Ontario region a matter of the issue of possible conflict of interest?
> A. I don't recall the details, but I recall Mr Brayman calling me about this matter.
> Q. And do you recall what – generally, what discussions took place?
> A. Mr Deluce had an interest in the company and that Mr Brayman had investigated it and that, in his opinion, the interest was small enough that Mr Deluce could be considered a working pilot for this purpose.
> Q. And I take it that you ... relied on Mr Brayman's recommendation?
> A. I did, totally.
> ...
> Q. But, as it stands now, conflict of interest is not really defined very well?
> A. No.

Q. Does Transport Canada, in your mind, have anything available to it to allow it to assess financial interests of any individual?
A. No.
Q. Would that be a good idea?
A. Yes.

(Transcript, vol. 139, pp. 19, 22)

The issue of conflict of interest, however, can have implications in areas other than a pure financial interest in a carrier. For example, a CCP who conducts a line check on a pilot with whom he or she has carried out line indoctrination could be seen as having a conflict of interest. A CCP who conducts a pilot proficiency check on a pilot who has been trained by that same CCP would be seen as in a conflict of interest. Clearly a pilot should not be put in the position of evaluating the product of his or her own training. Moreover, a CCP should not carry out pilot proficiency checks or line checks on his or her superiors. Such an arrangement would obviously be intimidating to the CCP because of the likely perception of potential career implications on the part of the CCP.

Mr Umbach, in his evidence, recognized that the term "conflict of interest," as it applies to CCPs, encompasses far more than financial interest in a carrier. His understanding of the term was as follows:

Q. Now, when you are dealing with conflict of interest, I take it – can you tell me what you mean – what your understanding of conflict of interest would be?
A. It would mean the person would have a division of desires or benefits in performing one task as opposed to the other.

In this case, it could mean he would have monetary benefits or other financial benefits by biasing himself towards his interest in the carrier rather than representing us as a CCP.

Q. And that's your interpretation?
A. That's mine.

(Transcript, vol. 139, p. 21)

These considerations are covered for the most part in the Air Carrier Check Pilot Manual, but were not always followed in the latter part of the 1980s owing to the fact that inspector workloads precluded strict adherence.

The inadequacies of the existing provisions should be reviewed by Transport Canada. The lack of criteria for use by the regulators in assessing conflict of interest on the part of CCP candidates is a problem that merits attention.

ACI and CCP Proficiency Requirements to Conduct Pilot Proficiency Checks

During the course of the hearings, evidence was heard that not all air carrier inspectors (ACIs) assigned to carry out pilot proficiency checks were type-rated on the aircraft in which they were conducting the checks. The Air Carrier Inspector (Large Aeroplanes) Manual indicates that air carrier inspectors conducting pilot proficiency checks on turbojet aircraft will normally be qualified and current, pursuant to ANO Series VII, No. 2, on the aircraft type used for the proficiency check. The manual further states that, when authorized by headquarters:

> (a) an inspector rated but not current on the aeroplane type may be used on temporary assignment or,
> (b) an inspector rated and current on a similar aeroplane type may be used on temporary assignment.
>
> (Exhibit 960, p. 1-11)

The key words are "similar aeroplane type."

According to a letter dated November 10, 1989, signed by Mr Richard Peters, chairman of the Aircraft Operations Group, to the then minister of transport, Mr Benoît Bouchard, air carrier inspectors were conducting proficiency checks on aircraft types for which they were not type rated. It was subsequently brought to my attention, during the Commission hearings, that the two aircraft types in issue were the Boeing 737 and the Boeing 747. My own view, and that of numerous inspectors and professional pilots who testified, is that the only similarity between the two aircraft is that they are both jet transport aircraft manufactured by the same company. Surely it is wrong in principle to assign a Boeing 737-qualified inspector to perform a proficiency check on a Boeing 747 pilot.

The evidence shows that this was not an isolated occurrence. Even Mr William Slaughter, Transport Canada's director of flight standards, agreed that this was a poor state of affairs. It was conceded by both Mr Slaughter and Mr David Wightman, assistant deputy minister, aviation, that action would have to be taken to ensure that such an occurrence would not be repeated. While acknowledging that the views expressed by Mr Wightman and Mr Slaughter in this regard are constructive, I believe it is essential that Transport Canada take appropriate steps to require that all pilot proficiency checks on aircraft over 12,500 pounds and on all turbojet aircraft be conducted only by air carrier inspectors or CCPs holding a current rating on such aircraft.

The Advanced Qualification Program (United States)

Dr Robert Helmreich in his testimony referred to a new program being instituted in the United States called the Advanced Qualification Program (AQP). This program provides a voluntary alternative that air carriers may use in order to meet the training and checking requirements of the Federal Aviation Regulations. If implemented, this program may result in different flight training and checking concepts. The AQP program is addressed in chapter 20, F-28 Program: Flight Operations Training.

Findings

- The system by which Transport Canada delegates authority to qualified individuals among the air carriers to conduct tasks that otherwise have to be carried out by Transport Canada air carrier inspectors has generally worked well, offering a convenience to carriers and a cost saving to Transport Canada.

- There is a strong case for further delegation of authority to CCPs with air carriers that have demonstrated an exemplary safety record and have mature pilot training and checking programs in place.

- There is an additional need for Transport Canada to conduct, from time to time, pilot proficiency checks on air carrier line pilots, without prior notice, to ensure that appropriate standards are maintained.

- Because of the inadequate number of air carrier inspectors it had throughout the latter half of the 1980s, the Transport Canada Aviation Regulation Directorate resorted to the unacceptable practice of assigning inspectors to perform pilot proficiency checks on aircraft types on which the inspectors themselves were not qualified.

- The existing Transport Canada provisions and criteria for use by air carrier inspectors, in assessing conflict of interest on the part of CCP candidates, are inadequate.

- Although the Transport Canada Air Carrier Check Pilot Manual prohibits the granting of CCP authority to a pilot "where the facts and circumstances indicate a possible conflict of interest," there is no definition in the manual of the term "conflict of interest."

- The lack of definition of the term "conflict of interest" in the Air

Carrier Check Pilot Manual is an omission requiring rectification.

- There is a lack of a clear definition of the term "generically similar aircraft" in all applicable Transport Canada regulations and supporting manuals.

- The air carrier inspectors are not provided by Transport Canada with any guidelines by which to assess financial interests of a pilot in a carrier in the context of a possible conflict of interest. This results in inconsistent decisions, varying from inspector to inspector, where consistency should be the norm.

- The Air Carrier Check Pilot Manual fails to spell out clearly that the issue of conflict of interest, as it relates to CCPs, can have implications involving matters other than pure financial interest.

RECOMMENDATIONS

It is recommended:

MCR 147 That Transport Canada pursue a program that would lead to further delegation of authority to company check pilots with air carriers that have demonstrated an exemplary safety record and have in place mature programs for training and checking pilots. To such carriers, delegation of authority with respect to initial pilot proficiency checks and pilot upgrades should be considered as well.

MCR 148 That Transport Canada provide a comprehensive monitoring program of both designated company check pilots and a representative cross-section of each company's pilots to ensure that standards are being properly applied and maintained.

MCR 149 That Transport Canada conduct, and reserve the right to conduct, pilot proficiency spot checks on all air carrier pilots, including designated company check pilots, as it sees fit and without notice.

MCR 150 That Transport Canada conduct initial pilot proficiency checks and line checks with every air carrier in cases where a new aircraft type is being introduced, to ensure that the

required standards are met in that air carrier's operation of the new aircraft type.

MCR 151 That Transport Canada ensure that all pilot proficiency checks on aircraft over 12,500 pounds and on all turbojet aircraft be conducted only by air carrier inspectors or company check pilots holding a current rating for the specific aircraft type on which the check is being conducted.

MCR 152 That Transport Canada ensure that pilot proficiency checks on non-turbojet aircraft and on aircraft under 12,500 pounds be conducted only by air carrier inspectors or company check pilots who are type-rated on that aircraft type or on a generically similar aircraft.

MCR 153 That Transport Canada develop a clear and unambiguous definition of "generically similar aircraft" to be placed in all applicable regulations and supporting manuals.

MCR 154 That Transport Canada, on a priority basis, rewrite the conflict of interest section of its Air Carrier Check Pilot Manual so as to include the following objectives:

(a) to provide a clear and unambiguous definition of what is meant by the term "conflict of interest" as it relates to company check pilots;
(b) to specify those areas in which a conflict of interest can arise, in addition to the area of financial interest.

MCR 155 That Transport Canada provide explicit guidelines to its air carrier inspectors on the subject of conflict of interest for use in evaluating individual candidates for the position of company check pilot.

MCR 156 That Transport Canada conduct an evaluation of potential conflict of interest with respect to each company check pilot candidate, and that a written record be kept of each such evaluation.

36 CONTRACTING OUT, WAIVERS, AND SPOT CHECKS

Contracting Out

In the years preceding economic deregulation, it was not usual for large air carriers with well-developed maintenance and flight operations departments to take on contract work from other carriers. However, with the advent of Economic Regulatory Reform (ERR) in the mid-1980s, contracting out of aircraft maintenance, flight training, and even flight dispatch/flight following services became a far more frequent occurrence. The pattern that Canada followed was similar, on a smaller scale, to that which had occurred in the United States. Mr Donald Douglas, formerly the director of Transport Canada's Licensing and Inspection Branch, described the Federal Aviation Administration's experience with deregulation as follows:

> A. On the airworthiness side, they were discovering that there were new methods of doing things. There was always a tendency to make cuts, if the bottom line was running the show, to the maintenance side.
>
> If they didn't have a maintenance organization, they would be contracting out maintenance and doing new things that hadn't been common practice before. And this made it more difficult for the airworthiness people.
>
> Contracting out might not necessarily even be in the United States. The maintenance might be done in another country, and this created more travel.
>
> (Transcript, vol. 143, pp. 42–43)

The Canadian situation relative to contracting out, following the introduction of ERR, was touched on by Mr Henry Dyck, Transport Canada's airworthiness superintendent of large air carriers:

> A. ... We also had the big increase in contract maintenance being carried out outside the country in foreign repair stations, because the new entrants did not and could not put together maintenance facilities adequate to handle their work. The existing carriers in Canada couldn't handle the additional work,

> so it was quite common to go outside the country to have aircraft maintained.
>
> (Transcript, vol. 135, pp. 16–17)

There were two problems that Transport Canada experienced as a result of contracting out. The first related to a great deal of international travel for the Transport Canada inspectors. While the costs of such travel were borne by the air carrier, the travel consumed an inordinate amount of time in a period when Transport Canada was faced with escalating workloads and diminishing qualified and experienced staff. Mr Ian Umbach, Transport Canada's superintendent of air carrier operations (large aeroplanes), addressed this issue in his testimony:

> Q. The contracting of maintenance and training, were you, as operations inspectors, facing the same problem of monitoring the airlines as a result of contracting out?
> A. Yes.
> Q. Can you describe that?
> A. Frequently, the carrier would take training where he could find it, it could be in the States, it could be in the U.K., it could be at more than one location.
>
> I recall one carrier, we had five inspectors simultaneously doing PPCs at five different simulators, and it placed enormous loads on our resources.
> Q. And these five different simulators were located at different places in the world?
> A. Different places in North America.
>
> (Transcript, vol. 138, pp. 83–84)

The second problem with contracting out related to the absence of regulations and guidelines. It was not always clearly understood that the air carrier, not the contractor, was responsible for ensuring that the work or service met the appropriate Canadian standard. In some instances the air carrier did not have qualified personnel to provide such assurance.

In the early stages of ERR, there were no guidelines for Transport Canada inspectors applicable to their inspections of contractors' work or service. Guidelines were subsequently developed for airworthiness inspectors, but have not been enabled by regulation. Consequently, airworthiness inspectors at times found themselves in foreign countries assessing facilities and maintenance procedures that complied with the standards of that particular state. The inspectors would have little recourse but to use their own judgement in ensuring conformity with Canadian standards and hope that they were not challenged by the carrier or the contractor.

The problem is addressed in the Douglas Report, "Aviation Safety in a Changing Environment," as follows:

> In recent years, certain practices among air carriers have changed, such as the degree to which air carriers contract out services. Present regulations do not appear to adequately address these new and complex practices. While the FAA continually reviews the adequacy of specific regulations, there is a need to perform a comprehensive analysis of the overall air carrier regulatory structure in the context of the changed airline operating environment. While this task will be large, actions of a more immediate nature are being taken to address these issues.
>
> (Exhibit 1057, p. 5)

It should be noted that this statement was produced on May 28, 1986. While the intent of the statement is to be commended, evidence before this Commission shows that little was done in the years that followed. On November 17, 1990, Mr Umbach provided a page of recommendations to the Commission. One of these recommendations was, "Revise the Air Regulations and ANOs on a priority basis." When questioned about that recommendation during his testimony, he stated:

> A. ... New trends are developing constantly.
>
> Flight watch certification are inadequately addressed in current regulations. The present manuals, well, for flight watch, we don't have a manual. The certification manual isn't as specific as it should be to meet changing developments.
>
> New practices are being entered into on a global scale now that we are, at the moment, ill-prepared to meet.
>
> (Transcript, vol. 139, pp. 29–30)

Mr William Slaughter, director of flight standards, confirmed Mr Umbach's view when he was questioned on certain regulatory deficiencies requiring attention:

> A. Yes, improve the regulations applicable to air carriers contracting maintenance, flight watch, et cetera.
>
> I think we have seen in the last few days that there are areas of the regulations that need changing, significant changes, so I would have to support and agree on that.
>
> (Transcript, vol. 146, pp. 190–91)

I support the recommendation by Mr Douglas for a comprehensive review of regulations to enable inspectors to respond in a timely manner to meet the demands of a changing airline operating environment. Such a review was needed in 1985 and it is still required today. The need for an overall safety regulation reform is dealt with in chapter 37 of this Report, Safety Management and the Transport Canada Organization.

Waivers

The *Aeronautics Act* gives the minister authority to grant exemptions or waivers to regulations and orders:

> (2) The Minister may, on such terms and conditions as the Minister deems necessary, exempt any person, aircraft, aerodrome, facility or service from the application of any regulation or order made under this Part if in the opinion of the Minister the exemption is in the public interest and is not likely to affect aviation safety.
>
> (*Aeronautics Act*, c.33, s.5.9/2)

Authority has been granted to incumbents of certain positions in the Aviation Regulation Directorate to grant waivers to some specific regulations or orders: such positions are delineated in the relevant document. Where authority to grant such waivers is not enabled by a particular regulation or order, the director-general of aviation regulation has been delegated authority, on behalf of the minister, to grant such waivers and conditions as they pertain to his aviation regulation responsibilities. Mr Weldon Newton, who held the position of director-general, gave evidence on this issue:

> A. Where the legislation does not provide for an exemption, where the regulation doesn't say the words "unless otherwise authorized by the Minister," where the regulation contains a total prohibition "no person shall" or "everyone shall" do something ... to be in compliance, and no exempting circumstances contemplated by the wording, that the Minister has delegated that authority to me, to make one by one determinations.
>
> (Transcript, vol. 161, p. 166)

In the course of his testimony, Mr Newton gave a good example of a carrier requesting relief from a regulation. On the evening of May 31, 1988, he received a phone call from a representative of Air Ontario who requested a waiver from the requirement to have floor track lighting installed in Air Ontario's HS-748 aircraft. The requirement stemmed in part from recommendations arising from the Air Canada DC-9 accident in Cincinnati in June 1983. Carriers were given two years to acquire and install floor track lighting. The effective compliance date of the requirement was June 1, 1988. The reason given for noncompliance by Air Ontario, according to Mr Newton, was that the company had intended to dispose of these aircraft prior to the compliance date of the regulation, but was unsuccessful in doing so. The request for a waiver was denied, a decision that, based on the evidence I heard, I fully support.

I cannot say the same for the decision made in the case of the seat-belt order, an issue that is discussed at some length in chapter 22 of this Report. In July 1987 a proposed amendment to Air Navigation Order Series II, No. 2, set out a requirement that every person on board an aircraft shall keep a safety-belt fastened when the safety-belt sign is illuminated. An exception to the order allows crew members to perform safety-related duties in other than the takeoff and landing phases of a flight while the seat-belt sign is illuminated. The carriers' representative, the Air Transport Association of Canada (ATAC), lobbied to have the exception include "other duties as approved by the captain" (Exhibit 1168, tab 5). The intent of the ATAC proposal was to enable meal and bar service to continue at the discretion of the captain after the seat-belt sign had been turned on. Transport Canada accepted the ATAC proposal.

The flight attendants' union, the Canadian Union of Public Employees (CUPE), vigorously intervened to have the order applied as it was written. Its concern was that accident statistics showed that cabin attendants had sustained injuries as a result of in-flight turbulence and that pilots were not always able to anticipate turbulence in sufficient time to warn cabin crew to take their seats.

The CUPE final submission to this Commission on the outcome of this dispute suggests that the evidence from Mr William Slaughter, director of flight standards, is "clear on the power of the regulated, namely the Air Transport Association of Canada, to regulate the conduct of the regulators" (Transcript, vol. 166, p. 46). In this instance, in spite of the advice and warnings of their own technical specialists, Transport Canada management acceded to air carrier influence and permitted meal and bar service to continue at the discretion of the captain while the seat-belt sign was illuminated.

If the regulators are to be given the latitude of judgement in applying the regulations, they should recognize that a waiver is a provision that is to be considered and granted only in the most exceptional circumstances and only after thorough technical advice has been obtained and considered. They should also be required to exercise the same prudence in determining the point at which industry consultation ceases to become consultation and becomes a lobby on behalf of a carrier.

Spot Checks or No-Notice Inspections

The use of spot checks or no-notice inspections was identified by numerous witnesses as an effective means of ensuring compliance with air carrier operating rules and as an essential element of the surveillance and monitoring process. Mr Slaughter testified that there is a place for

spot checks and that "the reason they aren't used more often is simply because we don't have the resources to do so." He stated that spot checks are used for "any number of reasons" and cited an example:

> A. ... If there was some reason to suspect there was a problem in a particular area of a company, we might just go in and do a spot check on that item.
>
> (Transcript, vol. 144, pp. 80–81)

The requirement for increased use of spot checks is recognized and supported as a means of ensuring that carriers are complying with the operating rules as a matter of standard every day practice and not just when regulatory authorities are on the premises conducting an audit.

Findings

- At the time of the hearings of this Commission, there were few definitive guidelines that set out the basis on which Transport Canada inspectors were to ensure that foreign contractors provided services that met Canadian standards.

- Transport Canada senior managers appeared in some instances to be most susceptible to industry demands to overturn safety-related regulatory amendments, in spite of advice to the contrary from their own Transport Canada technical specialists.

- No-notice inspections, although favoured by a number of witnesses as an effective means of ensuring regulatory compliance, were not often used owing to a lack of available inspector resources.

RECOMMENDATIONS

It is recommended:

MCR 157 That Transport Canada provide appropriate regulations governing the practice whereby air carriers enter into contracts with other companies or agencies for the provision of facilities or services required under the terms of the air carrier's operating certificate.

MCR 158 That Transport Canada inspectors be provided clear and direct guidance governing their aviation-regulation responsibilities for approval of arrangements and facilities to be contracted out to other companies or agencies by Canadian air carriers.

MCR 159 That Transport Canada set out a clear and unequivocal policy for senior managers specifying the basis upon which a waiver application is to be considered, ensuring that all safety implications are fully considered and satisfied before such waiver is granted.

MCR 160 That Transport Canada take steps to increase substantially the number of no-notice inspections of air carriers, with particular emphasis on safety-sensitive or high-risk areas.

37 SAFETY MANAGEMENT AND THE TRANSPORT CANADA ORGANIZATION

The Problem

The lack of a designated agency within Transport Canada charged with the responsibility for overall coordination of safety-related aviation activities was considered in various phases of the Inquiry. This became a matter of particular concern during the presentation of evidence concerning lineups of aircraft at Toronto's Lester B. Pearson International Airport during adverse winter weather conditions that caused wing contamination and required ground de-icing of departing aircraft.

In the *Second Interim Report* of this Inquiry I concluded that the evidence clearly confirmed the existence of a safety problem at Pearson International Airport, a problem that may also exist to a lesser extent at other Canadian airports. The evidence that led to this conclusion brought to light a concern with respect to Transport Canada's ability to monitor, identify, and correct safety deficiencies in the Canadian air transportation infrastructure. During the Transport Canada phase of the hearings, further evidence was heard which indicated that organizational problems within Transport Canada may have contributed to this safety assurance deficiency.

My mandate did not specifically direct an examination of the Transport Canada organization; in my view, however, it would be irresponsible to ignore the safety implications of organizational deficiencies such as were highlighted during this Commission's examination of the highly relevant aircraft contamination and aircraft ground de-icing issues.

The De-icing Example at Pearson International Airport

The evidence of witnesses regarding aircraft lineups at Pearson International Airport during periods of freezing precipitation provides

explicit examples of the inability of the current Transport Canada establishment to identify, analyse, and deal with aviation safety issues in a coordinated manner. The three primary witnesses examined in that regard were Mr Clare Vasey, a unit operations specialist with the Airport Control Services at Pearson International, Mr John Holm, superintendent of air operations at Pearson International, and Dr Lloyd McCoomb, director-general of safety and technical services of Transport Canada.

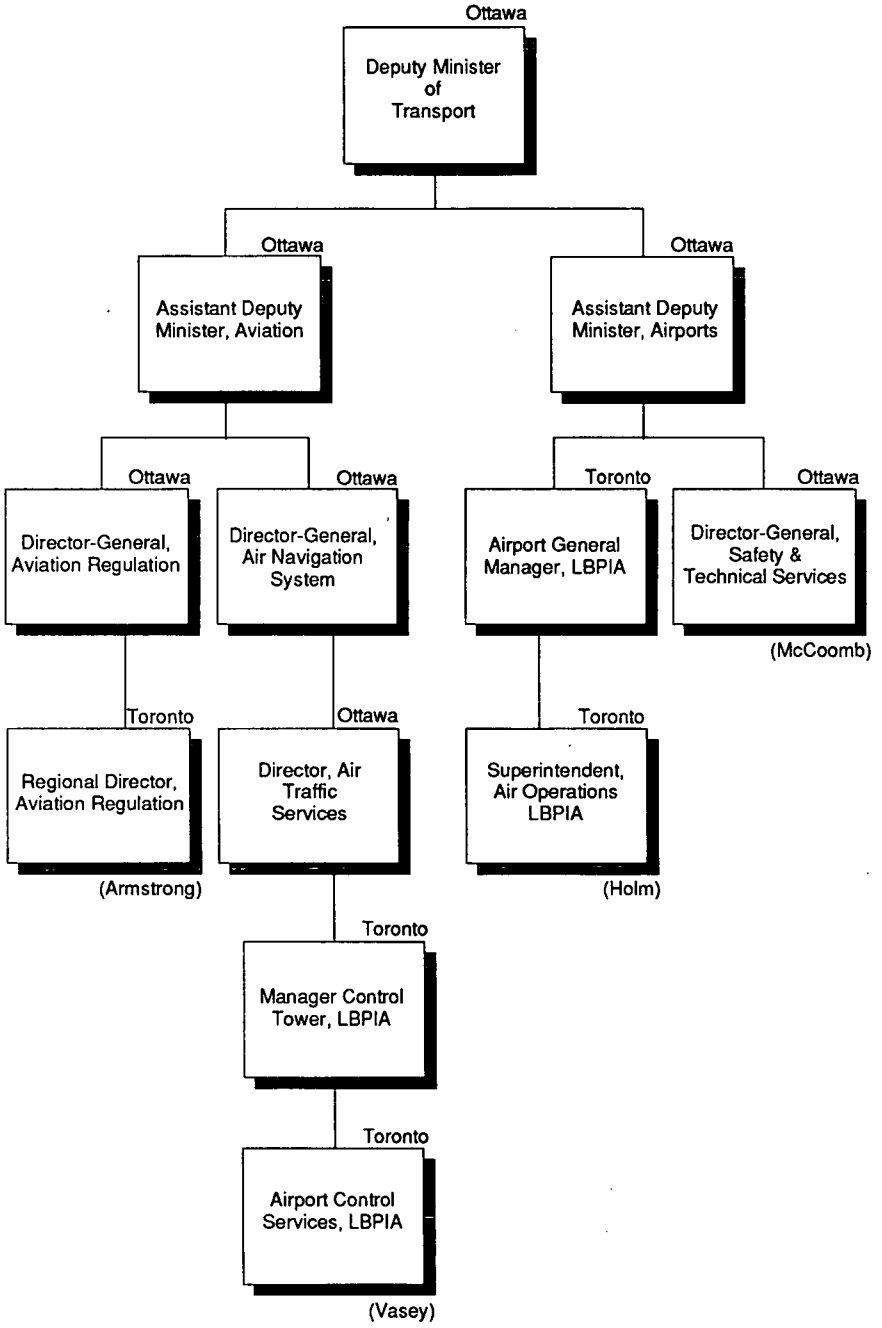
Mr Vasey described in detail the problems of ensuring that aircraft were capable of departing Pearson within a reasonable period of time after being de-iced. Mr Holm reiterated Mr Vasey's concerns about the safety aspects of lengthy takeoff delays after de-icing and testified that he had expressed them to the Transport Canada airport management at Pearson. Dr McCoomb gave the opinion that the safety aspects of aircraft de-icing are the responsibility of the air carrier in the first instance and that Transport Canada's Aviation Regulation Directorate has the responsibility of monitoring airline operations to ensure that aircraft do not depart in an unsafe condition. Mr Ronald Armstrong, Ontario Region's director of aviation regulation, later testified that he had not been made aware of any problems of aviation safety associated with such conditions at Pearson.

The evidence reflects the views of these four witnesses on a specific aviation safety-related problem as well as the differences of opinion as to whether in fact a problem existed and, if it did exist, how it should have been addressed. The fact that the problem was not universally recognized and addressed demonstrates a serious lack of communication and direction at appropriate levels of management in Transport Canada. Mr Holm made reference to two on-site committees he chaired at Pearson, the Civil Aeronautics Committee and the Airside Committee, before which some concerns on the subject were raised. The facts indicate, however, that these committees were ineffective either in gaining full recognition of the problems or in pursuing resolution to the necessary level.

The Problem Resolution Chain

It is not difficult to understand how such lack of communication and direction occurs when the reporting relationship of the four witnesses in question is examined. Figure 37-1 is designed to show that reporting relationship; it is not presented as an official organization chart. It demonstrates, however, that each of the witnesses reported through different channels and that there was no coordinating authority in the region.

Figure 37-1 Transport Canada: Reporting Relationships*



* Depicts selected relationships

Figure 37-1 illustrates the following significant points:

- Mr Vasey was aware of the operational problems at Pearson International Airport in conditions of adverse winter weather. His line reporting chain was to his superior, who in turn reported directly to the Ottawa office of the director, air traffic services, which reported to the assistant deputy minister, aviation, who reported to the deputy minister. Air Traffic Services, however, was not responsible for regulation of flight operations.
- Mr Holm recognized the problems. He reported them to his superior, who said they were airline problems. The airport general manager was responsible to the assistant deputy minister, airports, in Ottawa, who in turn reported to the deputy minister.
- Dr McCoomb, who was located in Ottawa, was responsible as director-general, safety and technical services, for policy regarding certain safety aspects at airports. He reported to the assistant deputy minister, airports, but was not in the line reporting relationship with the airport general manager at Pearson. He was not aware of the problems.
- Mr Armstrong, who was located in Toronto, was responsible for aviation regulation monitoring and enforcement in the Ontario Region. He stated that he was not aware of the problems.

Even if each of the four witnesses had been fully aware of the problem at Pearson and had sought direction for a resolution, the first level of authority at which Mr Armstrong's and Mr Vasey's views would have come together would have been that of the assistant deputy minister, aviation, in Ottawa. The first level at which Mr Holm's and Dr McCoomb's concerns would have been heard together would have been that of the assistant deputy minister, airports. The first level at which authority over all four of these areas of responsibility existed would have been that of the deputy minister.

It is in my view unacceptable and not in the interest of aviation safety that Transport Canada allowed such a segregated organizational approach to management of the aviation system to exist.

Background

The Canadian Air Transportation Administration (CATA) after 1982

The report of the Dubin Commission of Inquiry on Aviation Safety was published in 1981–82 following an exhaustive investigation spread over

two years. The report was critical of CATA's inability to enforce regulations and of its organizational mix of responsibilities for aviation regulation and air navigation services. The recommendations of that inquiry resulted in the consolidation of air navigation services under a single directorate in CATA headquarters and the establishment of an enforcement branch. Similar changes were made in the organization of each of CATA's six regions in that each region was directed by a regional administrator to whom the three major operational directors – air navigation services, aviation regulation (including enforcement branch), and airports – reported. That organizational structure provided a central authority in each region responsible for coordinating the activities of the three major functions, including safety-related problems, particularly those that cut across the areas of responsibility of the three functions. Similarly, aviation safety problems of a national or international nature could be dealt with by direction from the CATA headquarters administrator.

The Present Organization (1985–April 1, 1991)

In 1985–86 a major reorganization took place in which CATA was disbanded and separate Airports and Aviation groups were formed. The positions of the CATA administrator and those of the six regional administrators disappeared. The regional directors of air navigation services, aviation regulation, and airports now reported directly and separately to the individual Ottawa headquarters office responsible for their particular function.

This organizational change facilitated centralization of authority and the elimination of some managerial levels. The change, however, also eliminated the regional structure that had previously provided a common Transport Canada aviation response to aviation industry concerns and to safety-related aviation problems. The most significant result of this 1985–86 organizational change was that the office of the deputy minister of transport at that time became the first level at which there was overall authority over the activities of the three groups.

Problems Inherent in the Present Organization

The Management Consulting Services Branch of Transport Canada in 1990 prepared an organizational change proposal for the Aviation Group (Project Number 1682-342 dated January 1991). A copy of that document, provided to this Inquiry, outlines organizational problems within Transport Canada caused by centralization and as perceived by its staff and client groups:

ORGANIZATIONAL CHANGE PROPOSAL AVIATION GROUP

B. BACKGROUND.

...

Management of the Aviation Group has become highly centralized. The objectives of centralization included achieving economies of scale, and overcoming an autonomous approach to regional management which was evident in the previous CATA organization. That approach had resulted in inconsistent application of national standards, policies and procedures. However, management centralization brought its own set of problems.

C. CURRENT PROBLEMS IN THE AVIATION GROUP.

MEMBERS OF THE AVIATION COMMUNITY HAVE OBSERVED THAT IT APPEARS THE DEPARTMENT IS ORGANIZED TO MEET ITS INTERNAL NEEDS RATHER THAN THE NEEDS OF ITS CLIENTS. Two problems most frequently cited were:

- clients are forced to coordinate participation of several TC branches to resolve aviation (ANS), IFR, airports problems, and

- clients encounter delays in the delivery of the regional regulatory program because of procedural problems and the requirements for HQ approvals.

A number of regional managers and staff expressed concern regarding the increasing tendency for the aviation community to bypass regions and deal directly with HQ, to resolve problems or obtain approvals, undermining the credibility and sense of commitment of regional officials.

The Aviation community suggests that improvements are needed in the Aviation Group's approach to consultation: the process should be structured, and undertaken in the problem definition phase, rather than after the solution has been developed.

THE FOLLOWING PROBLEMS WERE IDENTIFIED BY MANAGERS AND STAFF IN THE AVIATION GROUP:

- The Aviation Group does not operate as a team. Problems requiring system-wide solutions are not resolved in a timely manner (eg, de-icing, noise abatement, environmental issues).

- The compartmentalized structure of Aviation in HQ and regions discourages a Group approach to establishing priorities and leveraging resources.

- The senior management forum in the Aviation Group comprises only HQ managers representing both functional and operational issues. The Regional Managers, who actually deliver aviation services, have no direct input to decisions in the Assistant Deputy Minister, Aviation's (ADMA) management forum.

- The [Air Navigation Services] ANS directorate, comprising 80% of Group resources, has not been successful in managing within its resource envelope. Part of this problem is due to the political difficulty of changing levels of service; a management culture that historically viewed additional resources as the sole solution to all problems also has made cost containment difficult.

- The Executive Director of Technical Services, with a span-of-control of 15, manages a capital program of nearly $250 million, which includes three MCPs [major crown projects]. Management layers in the ANS directorate do not permit compliance with Chapter 545 of the Treasury Board (TB) Administration Policy Manual (APM) which states that MCP project managers should be no more than two management layers below the Deputy Head.

- The Aviation Safety Programs activity has undergone an extensive review recently, and there is a need to clarify its external and internal responsibilities.

- There are as many as seven layers of management between the point of service delivery and ADMA. Layers are not only expensive, but they dilute accountability and filter information. Layers diminish ADMA's influence on service delivery.

The problems identified in the organizational change proposal are those that led to what I view as a fragmented approach to resolution of safety issues. The centralization of control at headquarters effectively reduced regional capability to deal with safety issues in a direct and coordinated manner. The many layers of management between regional branches, where the real work of inspection is done, and senior headquarters management created a gap in communications and a lack of understanding of existing problems.

Safety Assurance Issues

Although the de-icing situation at Pearson International Airport discussed above is the issue most relevant to conditions existing at the time of the Dryden accident, there is other evidence as to the inappropri-

ateness of the present organization to the provision of thorough aviation safety assurance.

Audit Organization

The effectiveness of air carrier audits in assuring aviation safety is addressed in chapters 32 and 33 of this Report. Although various opinions were expressed in evidence by Transport Canada witnesses as to the safety effectiveness of audits relative to other types of monitoring and surveillance, it is evident that there is a requirement for thorough and timely audits. However, Transport Canada has no established organizational structure that provides dedicated resources for the conduct of audits. The 1988 audit of Air Ontario is an example of the inadequacies of the present Transport Canada organization to provide that service. The convening authority who was located in headquarters in Ottawa appointed the audit manager, also from headquarters in Ottawa. Members of the audit teams, including the team leaders, were solicited from various regions. The audit manager did not have full control over the inspection staff provided for the audit. As a consequence, it was conducted in a poorly organized, incomplete, and ineffective manner.

If the convening authority, the audit manager, and the team leaders do not have dedicated personnel under their full control and authority, they cannot be expected to conduct a high quality audit.

Resource Allocation Process

Chapter 31, Aviation Regulation: Resourcing Process, deals at length with the inadequacies of the Transport Canada resource identification and allocation process. The cumbersome system of challenge and re-challenge for justification of requirements described by numerous witnesses was an example of the unwieldiness of the process and the organization itself. The evidence showed that the managers were unduly burdened with the extra justification paperwork, even though they already suffered from insufficient resources.

The staffing standard provided to the Aviation Regulation organization was particularly important to the inspector staff of the sections responsible for air carrier inspection both in the Airworthiness and Air Operations sectors. The estimation of the times required to perform their tasks and the frequency with which those tasks were to be performed was derived through an exhaustive challenge system, as described by Mr Armstrong in his testimony. The estimates of those frequencies and times were challenged again at each level of management, finally receiving the approval of the assistant deputy minister, review. The

resulting staffing standards were verified by a non-partisan review conducted by McGill University. The regional headquarters and Ottawa headquarters managers responsible for inspection services rightfully believed that the figures they put forward using such formulae represented the minimum numbers of persons required on their inspection staff to conduct the vital aviation safety inspection services required of them. Yet throughout this Inquiry, many witnesses testified that those recommended levels had never been provided.

The failure of Transport Canada to provide the number of persons that the aviation regulation program clearly required in the absence of any program modification is an anomaly that is patently unacceptable. In the earlier CATA organization, the regional administrator and the headquarters administrator had a one-on-one relationship, with regional perspectives and concerns being communicated directly to the administrator. The organization that came into effect in 1985–86 separated the assistant deputy minister from his regional directors, interjected resource management review levels, and deprived regions of direct access to plead their case and impress on the assistant deputy minister the serious implications of the lack of resources. As a result, the senior management levels within Transport Canada became unrealistically separated from the problems in the regions and the seriousness of the failure to deliver an aviation safety-related program.

Management Hindrance: Line-Manager Levels

The reorganization that took place in 1985–86 resulted in the allocation of person-years being made by the headquarters directors-general to individual directors and in the removal of all flexibility from regions in the disposition of the allotted resources. Under the previous CATA organization, regional administrators controlled and were accountable for all person-years relative to air navigation services, aviation regulations, and airports, and the financial resources provided to their region. If in their wisdom there was a requirement to direct utilization of resources temporarily to an area where aviation safety or other urgent demand required, the regional administrators had the power to do so. Within a reasonable length of time they were expected to correct that situation through the routine administrative process. In the meantime, the urgent situation could be managed by reallocating resources within the region. The system facilitated responsible and accountable management at the appropriate level.

The Management Consultant Services study mentioned above stated that one of the purposes of the 1985–86 reorganization was "overcoming an autonomous approach to regional management which was evident in the previous CATA organization. That approach had resulted in

inconsistent application of national standards, policies and procedures." Surely correction of ineffective or inconsistent management should have been pursued through counselling and direction rather than through a reorganization that centralized authority and discouraged managerial accountability at the program delivery level.

This lack of regionally centralized management authority resulted in underutilization of person-years in some branches, while other branches that could have used the excess person-years were not authorized to do so. Mr Fernand Mousseau, Aviation Group's director-general of the Policy Planning and Resource Development Directorate, during his testimony illustrated the misinterpretation that could be taken from such under-utilization. He maintained that the Aviation Regulation Directorate could not recruit the people to fill their allotment. The implication was that the lack of inspectors was not affected by allocation levels but by availability of qualified candidates. The evidence indicates, however, that managers were restricted in their pursuit of candidates because of limits on allocation levels. It is my view from the evidence that they were further restricted in their ability to staff their organization because of lack of managerial flexibility and by bureaucratic misunderstanding or obstinacy at the resource management and allocation levels.

Management Hindrance: Senior Levels

Within the Aviation Group, the assistant deputy minister, aviation, was responsible for putting forward the fully justified requirements for person-years for the Air Navigation and Aviation Regulation directorates. Problems in this area were outlined by Mr David Wightman, assistant deputy minister, aviation, Mr Claude LaFrance, former assistant deputy minister, aviation, and Mr Weldon Newton, director-general, Aviation Regulation Directorate. The assistant deputy minister, aviation, having been assigned a specific allotment of person-years, had some flexibility in assigning those person-years to these two major directorates. He was not entirely free, however, to allocate them to the most safety-effective groups. For example, Mr LaFrance testified that he was of the opinion there were certain navigational facilities that could be closed without affecting the safety of the system. The savings in person-years from those facilities could have been allocated to aviation regulation, thereby increasing their surveillance and monitoring capability. When such proposals were put forward they were frequently rejected: the political influences that come to bear on such decisions will be understood. The result, however, was an inability to direct resources to the most safety-critical areas.

It is difficult to understand how a reorganization of this nature could have been allowed to come into effect in 1986 considering that the

implementation of the recommendations of the Dubin Inquiry were only being completed about that time. The very principles of organization that had been recommended by that inquiry appear to have been violated in the attempts to centralize the organization with more control at headquarters. It was counterproductive for the senior management of Transport Canada to have approved an organization so ill-designed to ensure accountability for the taking of immediate and appropriate action to address serious aviation safety issues.

Transport Canada Safety Awareness

On July 5, 1970, an accident involving an Air Canada DC-8 occurred at Toronto International Airport, Malton, Ontario. One hundred and nine lives were lost in the crash of that aircraft. Mr Justice H.F. Gibson was subsequently appointed to conduct an inquiry to determine the causes of the accident.

Mr Justice Gibson determined that the captain had adopted a procedure concerning the operation of the aircraft spoilers that was contrary to that specified in the Air Canada DC-8 operating manual. Confusion arising out of this noncompliance with the manual resulted in the first officer inadvertently deploying the spoilers while the aircraft was about 60 feet above the runway during the landing flare. This premature deployment of the spoilers set in motion a sequence of events that led to the crash. Evidence presented to the Gibson Inquiry indicated that it was common practice among certain Air Canada pilots to follow a procedure concerning the arming and deployment of the spoilers that was contrary to the Air Canada DC-8 operating manual. Further evidence indicated that some Air Canada check pilots did not insist that certain Air Canada pilots adhere strictly to the operating procedures prescribed in Air Canada's DC-8 operating manual. It appears that one recommendation made by Mr Justice Gibson was designed to prevent such unauthorized practice from developing in future. That recommendation reads as follows: "Consideration should be given by the Ministry of Transport to strengthening its capability of monitoring flight procedures of Canadian air passengers carriers."[1] It is noteworthy that this recommendation is one of only eight made by Mr Justice Gibson and that the report is dated January 1971.

The director (now director-general) of aviation safety is assigned a role of promoting aviation safety through, among other things, participation in the organization of aviation safety education. I believe there is a clear

[1] "Report of the Board of Inquiry into the Accident at Toronto International Airport, Malton, Ontario, to Air Canada DC8-CF-TIW Aircraft on July 5, 1970," p. 111

need for such an educational program to be conducted within the senior offices of the groups responsible for aviation within Transport Canada.

Various reports on aviation accidents, inquiries, and investigations have produced findings and recommendations that have, over the years, been aimed at the adoption of policies designed to improve aviation safety. The Gibson and Dubin reports are but two examples. It seems logical that the Aviation Safety Directorate should be charged with the responsibility to review these reports and documents, to consolidate the findings and recommendations, to track the implementation of such recommendations, and to design and conduct an aviation safety course for all senior managers of Transport Canada aviation programs to familiarize them with respect thereto.

Overall Safety Management

The assistant deputy minister, aviation, Mr Wightman, stated emphatically in his testimony that it was his office that was responsible for overall aviation safety. I find his "buck stops here" attitude most admirable. The question remains, however, on what basis can Mr Wightman make this assertion. The evidence indicates that his concept of singular responsibility for aviation safety management is not held by all management members of Transport Canada, nor is it clearly stated in the policy documents or position descriptions. Questions remain as to the aviation safety responsibilities of the Aviation and Airports groups, the extent to which aviation safety levels can be assured through the regulatory process, and how safety effectiveness can be measured.

Responsibility for Safety

Although the *Aeronautics Act* is not specific in its assignment to the minister of responsibility for aviation safety, the role statements for the Airports and Aviation groups clearly include such responsibility. Indeed, most of the position descriptions of witnesses who appeared before this Commission, whether senior public servants, line managers, or inspectors, included definite statements of responsibility to participate in the assurance of aviation safety. The evidence of these witnesses when they were questioned indicated that each was quite conscious of such responsibility.

At the practical level at Transport Canada, however, there is no organization responsible for overall aviation safety and management of the department, and each organization at Transport Canada pursues its individual safety goals. Many of the witnesses expressed a preference for a separate office or agency responsible for the identification of aviation

safety issues, and with the authority to direct the actions of the relevant groups to resolve such issues.

The Inspector-General, Transportation Safety

The title of this position would seem to indicate that the appointed incumbent would hold the responsibility for and the authority to address the overall safety issues of Transport Canada. Such is not the case, however.

In the course of the hearings, Mr Ronald Armstrong, Ontario Region's director of aviation regulation, was questioned about the role of the inspector-general, transportation safety. A copy of the job description indicated, as did Mr Armstrong in his evidence, that the position would be responsible to investigate and advise the deputy minister regarding safety issues on a case-by-case basis for all three transportation modes: air, surface, and marine. It is obvious that the position could not be held accountable for overall aviation safety management of the department, particularly since the staff of the inspector-general consisted of a total of only five people to address all three modes of transportation.

I have been made aware that, as of October 1, 1990, the position of inspector-general, transportation safety, no longer reports directly to the deputy minister of transport but has been incorporated into the organization of the assistant deputy minister, review. There is no indication that the change in reporting relationship entails additional responsibilities or authority that will contribute to the improvement in coordination and direction of response to safety-related issues. In fact, the lowering in reporting level would seem to indicate the reverse.

Aviation Safety Programs: Transport Canada

The Aviation Safety Programs Branch of the Transport Canada Aviation Group reports directly to the assistant deputy minister, aviation. The title of that branch may give the impression that this organization is responsible for overall safety assurance in the Aviation Group. Such is not the case. The primary function of the branch is to enhance aviation safety through the promotion of safety education programs and to analyse aviation safety data for the information and action of the assistant deputy minister, aviation. The organizational change proposal mentioned above (Project 1682-342) proposes an extension of the responsibilities of the branch to include monitoring the overall Transport Canada Aviation Group system, including regulatory and air navigation branch activities related to safety. It also proposes the retitling of the organization to System Safety.

Although this organization change is an attempt to address a missing systems approach to safety through a clear assignment of such responsi-

bility to a particular directorate, it still does not address or include any safety issues that might affect airports or the Airports Group.

In summary, it appears that the various directorates are cognizant of their safety responsibilities. The Airports organization recognizes its responsibility to ensure that airport facilities meet reasonable safety standards; the Air Navigation organization is consciously responsible for providing safe services in the form of navigational aids, en route and terminal facilities, and air traffic control; the regulatory organization contributes to safety through ensuring compliance by the industry with the regulations and orders. It appears that all the functions and activities necessary to address aviation safety have been considered and assigned to these agencies. Missing, however, is an organizational structure with the positive control and authority necessary to direct a coordinated and practical aviation safety management program.

Transportation Safety Board of Canada

The mandate of the Transportation Safety Board is broad in scope. However, it does not extend to participation in the internal review or monitoring of Transport Canada in its role of providing assurance of aviation safety.

Enforcement and Education

In the latter stages of the hearings there was considerable discussion on the virtues of education as an effective means to enhance aviation safety. The report prepared by the consultant firm James F. Hickling in 1990 on aviation regulation and safety programs was critical of Transport Canada for spending too much energy on minor violations that were of little safety consequence, while not enough effort was being put into overall education and safety promotion.

Mr Wightman, assistant deputy minister, aviation, supports the need for increased emphasis on safety promotion and education and, accordingly, has increased both the stature and resources of his safety promotion organization. In his testimony before this Inquiry on January 22, 1991, he indicated that, in his view, there was good safety value to be obtained from such an investment. He also expressed a conviction that these initiatives would not be achieved at the expense of the surveillance and compliance/enforcement organization:

> A. ... I just wanted to conclude by saying that in increasing the emphasis on safety programs, safety educational programs and promotional activities, we are not going to take those resources from the Enforcement group to do that. We will find them

> elsewhere and the Enforcement activity will continue.
> (Transcript, vol. 166, p. 74)

I fully support the notion that safety promotion and education is an effective way to enhance aviation safety. I believe little benefit can be obtained from enforcing minor first-occurrence documentary and administrative violations to the full extent of the law. The imposition of licence suspensions and fines for these kinds of occurrences in all probability detracts from the promotion of a positive compliance attitude. Having so stated, I would urge the government to provide sufficient resources to Transport Canada's Aviation Group to ensure that the aviation community, and in particular the air carrier industry, is effectively monitored to comply with essential safety regulations and standards. Where noncompliance is detected, effective action must be taken by an appropriately staffed and trained enforcement organization. Aviation education and safety promotion should most definitely not be enhanced at the expense of surveillance and enforcement.

Safety Assurance Effectiveness

Safety Assurance Effectiveness of Aviation Regulation

Evidence before this Inquiry with regard to assessment of the effectiveness of aviation regulation in achieving aviation safety does not provide any conclusive and quantitative result. There is agreement that the monitoring of the industry for conformance with aviation regulations and orders does have a positive effect on assuring some degree of safety. The inspection, approvals, and licensing activities of aviation regulation assure minimum standards that contribute to an overall acceptable level of safety. There are, however, no sound detailed data and analysis available that will quantitatively demonstrate the effectiveness of regulatory activity in the prevention of accidents and incidents. The absence of such a formula leads to subjective analysis based on the experience and judgement of the senior review personnel such as those participating in the challenge procedure associated with the resource acquisition process as outlined in chapter 31, Aviation Regulation: Resourcing Process. The evidence indicates there is a significant gap in perception between incumbents of these senior positions and the operating regulators as to the safety effectiveness to be achieved by performance of various types and frequencies of regulatory activity. The result, of course, is the continual denial or return of resource submissions by the senior review committees, as described by Mr Claude LaFrance (see chapter 31).

The evidence indicates that a staffing formula known as ARASS, a refinement of the A-base review outlined in chapter 28, Conditions at Transport Canada, Early 1980s, was based initially on the considered input of the inspectors who conduct the actual inspection. Following detailed examination and dialogue at that level, the system was further reviewed by, and received the approval of, their supervisors, the relevant branch managers, directors, and directors-general of aviation regulation, as well as the assistant deputy minister of aviation. Development of that standard yielded agreement on the various tasks to be performed by aviation regulation and the frequencies at which they should be conducted in order to monitor adequately the safe performance of the aviation industry.

It would, of course, be of great value and convenience to have a clear-cut formula based on sound data and scientific analysis that would indicate conclusively the exact effect to be expected on aviation safety with each additional person-year assigned to the aviation regulation program. Such a system would be of particular value to departmental reviewing officers with little or no knowledge or experience of aviation on which to base their judgement.

The evidence indicates that the aviation regulation organization has given serious and sound consideration to development of the tasks and their appropriate frequencies necessary to achieve its stated regulatory objectives. These considerations appear to have been based on the best available data. Until more suitable and practical measurement systems evolve, it can be assumed that the methods adopted by the aviation regulation organization will assure an acceptable contribution to the overall level of safety, provided the program is properly directed, supported with the necessary resources, and monitored appropriately.

Safety Assurance Effectiveness Measurement Methods

The foregoing section of this chapter recognizes an ongoing need for improved methods of assessing the effective influence of various regulatory activities on aviation safety. Such improved methods should continually be sought in attempts to obtain the best results with available resources and in the establishment of task priorities. In order to achieve those aims, it is necessary to examine the factors influencing the achievement of aviation safety and to identify and define indicators to be used in measuring the effectiveness of those factors.

Numerous studies have been conducted by Transport Canada, by various consulting agencies, and by the United States Federal Aviation Administration (FAA) in attempts to identify and define such safety measurement indicators. One of the more recent studies was conducted

by Sypher-Mueller International Ltd, as part of an evaluation of the contribution of aviation safety regulation and aviation safety programs to aviation safety in Canada (Exhibit 1316). That study was successful in identifying a list of optimal indicators and proposed a model that could be developed to provide improved methods of analysing and assessing acceptable safety levels. The report also concluded, however, that deficiencies exist in the data-gathering process and that these deficiencies must be overcome prior to realization of significant progress in such analysis and assessments.

The FAA has expended considerable effort in the development and use of aviation safety measurement indicators, and the Aviation Safety Programs Branch of Transport Canada is cooperating with that agency towards further development in that regard. Although research and development of such safety measurement indicators and data collection process systems are expensive and onerous, the eventual values would appear to be significant.

During this Inquiry we have seen examples of the variations in opinion as to the effectiveness of different types of surveillance and regulatory activity in achieving aviation safety assurance. The advances and changes to be anticipated in the dynamic aviation industry dictate use of scientific and practical methods of assuring that scarce resources are directed to the most safety-effective issues and activities. It is encouraging to note that Transport Canada is now cooperating with authorities in the United States in such a worthwhile effort.

Future Management and Organizational Structure

Following the hearings, the Inquiry was provided with a copy of a Transport Canada news release announcing organizational changes within the Aviation Group effective April 1, 1991. A copy of that news release is reprinted below. The information provided in that news release consists of a simple outline and is not intended to describe fully the change in organization. Nevertheless, some comments are warranted regarding the proposed organizational structure's ability to resolve the type of safety issues discussed in Part Five of this Report.

With the changes indicated by that announcement, it appears that Mr Wightman, as the current assistant deputy minister, aviation, has attempted to rectify the situation to some degree. Each of the regions will now have a director-general, aviation, who will have overall control of both the air navigation services and aviation regulation in their region. The reorganization also provides a direct reporting relationship for those directors-general to Mr Wightman. The revised organization

will facilitate better communication between the air navigation and regulatory directorates and will provide a structure suited to prompt resolution of safety problems affecting those two areas of responsibility.

The Airports Authority Group (Airports Group), however, is not included in the reorganization. I have seen no evidence of an attempt to put Airports Group under a similar organizational umbrella, thereby assuring con-solidated response to aviation industry concerns and needs, nor any evidence that indicates there are measures to address the safety issues affecting the activities of both the Airports and the Aviation groups of Transport Canada. The measures taken, therefore, seem to be incomplete: they reflect Mr Wightman's enthusiasm within his specific areas of jurisdiction, but do not address cross-group issues such as the de-icing concerns addressed in my *Second Interim Report*.

This new organization will provide the regional directors-general with better access to the assistant deputy minister, aviation. It can be assumed that they will therefore have a better opportunity to express their concerns and provide direct communication regarding the need for resources and the establishment of priorities in the conduct of their duties associated with program delivery.

This reorganization applies to the Aviation Group only and does not, therefore, entail any changes outside this group such as the resource allocation process. I have concern that these important aspects have not been considered and that such organizational change was directed to only one group, Aviation Group, when the department's area of aviation responsibility in fact includes the current Airports Group. Accordingly, the reorganization should be re-examined, but at the departmental level rather than the Aviation Group level.

Transport Canada News Release

Annex A to Section H
(H.5.4)
Part 12
No. 53/91 For release
April 5, 1991

NEW REGIONAL DIRECTORS GENERAL NAMED TO TRANSPORT CANADA AVIATION

OTTAWA – Six Transport Canada directors have been promoted by the Public Service Commission to the position of regional director general in Transport Canada Aviation.

Robert W. M. Corbett of Moncton, N.B., is the Atlantic regional director general, aviation; André D. Perez of Montreal is the Quebec

regional director general; and Ronald I. Coulas of Toronto is the Ontario regional director general.

Frank M. Murphy of Winnipeg is the Central regional director general; Donald J. Douglas of Vancouver moves to Edmonton to become the Western regional director general; and David J.R. Larrigan of Vancouver is the Pacific regional director general.

Corbett, Perez, Murphy and Larrigan are former regional directors, aviation regulation; Coulas and Douglas are former regional directors, air navigation services.

The appointments are the result of a recent reorganization which calls for directors general to administer the department's aviation programs in each of the six regions across the country.

The reorganization has eliminated the positions of regional director, aviation regulation and air navigation system, and has assigned these functions to the new regional directors general. Each new director general has increased authority and responsibilities for air traffic control and the monitoring and evaluation of system safety.

All Instrument Flight Rules air traffic control staff now report to the regional director general instead of Transport Canada Aviation headquarters in Ottawa. This decentralization move is in keeping with the federal government's Public Service 2000 policies which encourage the delegation of authority to managers who are closer to the clients they serve.

The six regional directors general also have additional responsibilities for system safety. New resources are being allocated in Transport Canada Aviation to improve the way safety deficiencies in the national civil air transportation system are identified, analyzed and evaluated.

Aviation safety-education programs will be continued but with more emphasis on the acquisition and evaluation of "safety-deficiency data" as well as monitoring and consultation with the aviation industry.

Transport Canada Aviation is the new name for Transport Canada's Aviation Group.

Contact: Ron Armstrong
Aviation, Ottawa

Findings

- The *Aeronautics Act* itself is not specific in its delineation of aviation safety responsibility. Nevertheless, the raison d'être of the Transport Canada organization is to provide an aviation safety net.

- Throughout the Transport Canada phase of the Inquiry, I was, for the most part, impressed by the dedication of Transport Canada witnesses

at all levels, from the inspectors involved in day-to-day regulatory activity through to very senior managers. The critical conclusions that can be drawn relate to a lack of mutual understanding of the restrictions placed on various levels of management through enforced economies and the unprecedented increase in aviation-related activity in the latter half of the 1980s.

- Because of resource constraints, an inadequate regulatory framework, and organizational deficiencies, the present Transport Canada organization is ill-equipped to provide in an efficient manner a uniform level of safety. The existence of distinctly separated line reporting relationships to the top of the organization appears to foster rather than discourage fragmentation of management philosophy and activity. The apparent inability of the Air Navigation, Aviation Regulation, and Airports groups to work together in identifying and addressing aviation safety issues is troublesome.

- The segregated organizational structure within Transport Canada Aviation Group precludes any direct contact between regions and the assistant deputy ministers, and provides little opportunity for regional managers to influence the decisions of senior management and agencies such as Management Review Board in order to ensure that regional resource requirements are properly addressed.

- The evidence provided graphic examples of the problems faced by those charged with the responsibility of completing audits, inspections, certification programs, and other regulatory and surveillance functions, but who were not provided the resources so to do.

- The inability of lower and middle management to relay emphatically the safety concerns caused by such resource shortages to the most senior management of Transport Canada is, in my view, an abrogation of responsibility attributable to lack of effective organization and the inaccessibility of senior management. This basic problem hinders all aspects of the Aviation Group safety program.

- Compared with the system that existed under the CATA organization, managers in the regions now have little control over the allocation of resources to high-priority safety items. They are now restricted to specific allotments and are limited by staffing restrictions such as freezes and inflexibility of policy.

- The Aviation Group conducts audits on the industry to assure conformance with the *Aeronautics Act* and its regulations and orders.

- Although the Transport Canada organization has been studied and restudied, there seems to be an absence of will to review such studies and to implement programs that will effectively address genuine safety concerns.

- Considering all of the evidence, I find it difficult to understand why the April 1, 1991, reorganization left the Airports Group separated from the Aviation Group in the area of safety responsibility. The news release announcing these changes indicates that the new directors-general of aviation in each region will have "increased authority and responsibility for air traffic control and the monitoring and evaluation of system safety." The authority and responsibility do not extend to the positive action that is required to address safety problems identified and analysed in the "monitoring and evaluation process."

- The absence of such authority limits the ability of the regional directors-general to address such safety aspects unless they fall entirely within the purview of Air Navigation systems and/or Aviation Regulation; they have no authority over the Airports program.

- The evidence, particularly as it related to aircraft de-icing, demonstrated the weakness in an organization that does not provide clearly stated overall authority and responsibility for coordination of safety activities. Accountability cannot be expected unless it is supported by the necessary authority and responsibility.

- It would be erroneous to conclude that the organizational change of April 1991 will address the shortcomings which this Inquiry has uncovered regarding inattention to aviation safety management issues that cross both the Airports and Aviation groups' lines of responsibility. That will in all probability not occur unless a senior position in each region is made responsible for the functions of both of those groups and, similarly, unless a senior aviation position becomes responsible for the headquarters aspects of those functions as well as for line authority over the six regional senior positions. It appears that such an arrangement could be achieved with a reduction rather than an increase in numbers of senior positions.

- It is time that Transport Canada address lack of coordination of safety activities among its various aviation groups rather than proposing reorganizational attempts that go halfway towards proper safety supervision and responsibility.

- There is ample evidence before this Commission to show that Transport Canada, because of a variety of inadequacies in its organization, has fallen short of meeting its safety assurance responsibilities. Much of the evidence indicates that competition for scarce resources, both within the department itself and with other departments, has been a basic contributing factor to such inadequacy.

RECOMMENDATIONS

It is recommended:

MCR 161 That Transport Canada proffer for enactment an amendment to the *Aeronautics Act* to delineate clearly the minister's responsibility for aviation safety. Such amendment should emphasize the minister's responsibility to ensure that the department is organized in a manner to keep the minister accurately informed of the ability of Transport Canada to deliver its mandated aviation safety programs effectively.

MCR 162 That Transport Canada be organized in a manner to provide the managerial structure necessary to keep the minister and deputy minister fully and accurately informed of all matters having an impact on aviation safety, and to ensure that appropriate and timely action is taken to address aviation safety concerns.

MCR 163 That Transport Canada state clearly the goals that aviation safety–related programs are expected to achieve, and that it identify the extent of inspection, surveillance, and enforcement activities that must be conducted within a given time frame. Such program goals should be designed in consultation with the Aviation Group's operationally and technically qualified staff.

MCR 164 That Transport Canada create a single position in each region (e.g., a director-general) responsible and accountable for the delivery of the aviation programs assigned to the present Airports Authority Group and the Aviation Group. This position should report directly to a senior administrator or assistant deputy minister at headquarters, who is responsible

for the overall delivery of such aviation programs on a national basis.

MCR 165 That the regional directors-general (proposed in MCR 164 above) be authorized to manage their resources in a responsible and flexible manner. Such authority should be accompanied by firm insistence on accountability and a monitoring activity that will ensure responsible management.

MCR 166 That Transport Canada create the position of a headquarters' operational aviation safety officer with an appropriate support staff. This aviation safety officer should report directly to the most senior aviation position in the department and should be responsible for auditing the safety performance of both the Airports Authority Group and the Aviation Group.

MCR 167 That Transport Canada actively participate in the research and development necessary to establish safety effectiveness measurement systems that will lead to the most efficient use of resources in assuring safety. Cooperation with the United States Federal Aviation Administration and other international groups should be encouraged and resourced to obtain the maximum and most expedient benefits from such programs.

MCR 168 That Transport Canada aviation safety committees, with access directly to the headquarters' operational aviation safety officer, be established in regions and headquarters.

MCR 169 That Transport Canada establish a mandatory education program to ensure that senior managers and officials of the department who are responsible for or associated with aviation programs are aware of the basis for and requirement to support policies that affect aviation safety.

PART SEVEN

HUMAN FACTORS

38 CREW INFORMATION

Flight Crew

Captain George Morwood

George John Morwood: captain, C-FONF
Age: 52
Date of birth: March 27, 1936
Pilot licence: Airline Transport Pilot Licence YZA-001128
Pilot medical expiry: September 1, 1989
Total flying time: 24,100.00 hours
Total flying time F-28: 82 hours
Total jet experience: 673 hours (591 hours on Gulfstream II)
Total flying time last 90 days: 130 hours
Total flying time on aircraft type last 90 days: 80 hours
On duty March 10, 1989, prior to occurrence: 5.4 hours (approximate)
Off duty prior to March 10, 1989, work period: 14.5 hours (approximate)

Flying Background

Captain Morwood began flight training in Toronto in September 1953 with Central Airways, located on Toronto Island, and obtained a private pilot licence in January 1954. He then enrolled in a course for commercial pilots and received his licence in January 1955. After training, he achieved a flight instructor rating in May 1955 and commenced work for Central Airways as an instructor. He obtained an instrument rating in 1961 and continued to instruct and to fly charters for Central Airways until 1967. He accumulated over 12,000 hours flying for this company. Of this total, approximately 550 hours were on multi-engine aircraft. He then took a similar position with Millardair based at Lester B. Pearson

International Airport and flew there for about one year, accumulating a further 500 hours multi-engine experience on larger aircraft.

Captain Morwood joined Transport Canada as an air carrier inspector, conducting instrument rides and pilot proficiency checks on pilots located in the Ontario Region. He continued in this position until September 1970, when he joined Denison Mines as a pilot on a Grumman Gulfstream GII turbojet aircraft. This aircraft is similar in appearance to an F-28, and each is equipped with Rolls-Royce RB183 Mark 555-15 engines, more commonly known as Rolls-Royce Spey. Although the Grumman Gulfstream GII aircraft is lighter than the F-28, it has similar operational speeds and design characteristics, such as a hard wing, that is, a wing with no movable lift-generating device on the leading edge. Captain Morwood did his recurrent flight training on a GII flight simulator with Flight Safety Inc., and the records of his instrument rides indicate that his performance was consistently above average on this jet aircraft.

Captain Morwood joined Great Lakes Airlines, the forerunner to Air Ontario, in 1973. He was trained on a Convair 440 aircraft and upgraded to a Convair 580 turboprop aircraft in 1974. By 1988 he was an experienced airline transport pilot, having accumulated over 9000 hours on the Convair 580. Further, he had acquired management experience, having served as a company check pilot on the CV580 as well as chief pilot from 1978 to 1980.

In January and February 1988 Captain Morwood successfully completed the Piedmont Airlines F-28 ground school and simulator training. He completed his pilot proficiency check, and his licence was endorsed for the F-28 aircraft on February 26, 1988. After this training Captain Morwood went back to flying a Convair 580 aircraft for the remainder of 1988.

The company received its second F-28 aircraft in December 1988, and thereafter Captain Morwood attended a Piedmont F-28 Pilot's Recurrent Ground School, which consisted of 16 hours of classroom instruction and a written examination that he passed with 99 points out of a possible 100. Captain Morwood completed eight hours of recurrent F-28 simulator training and thereafter passed a proficiency check on January 9, 1989. He carried out his line indoctrination training and route check between January 18 and January 25, 1989, accumulating a total of 27.5 hours of line flying.

Captain Morwood's work schedule for the four months prior to the crash was examined and was not considered arduous. In the month of March he had worked six days and had three days off prior to the accident. All of Captain Morwood's flight schedules met the requirements for duty time limitations set out in the Air Navigation Orders.

Captain Morwood filed 40 company incident reports that the Commission is aware of during his employment with Air Ontario Inc. and Great Lakes Airlines. The reports were recovered in part from Air Ontario Inc., with the remainder coming from Captain Morwood's personal files. Many of the reports as filed involve occurrences that could affect the safe continued operation of an aircraft and provide an insight into the extent of his professional experience and knowledge.

A review of several representative incident reports demonstrates clearly that Captain Morwood had an established record of making sound decisions concerning the operation of an aircraft. He viewed these reports as a valuable source of information that could be used by company management and fellow employees to enhance the efficiency and safety of the operation. He was willing to file incident reports, even when not required to do so, and was able to accept full responsibility for any errors or omissions on his part.

A number of documents that belonged to Captain Morwood were recovered in the wreckage of the aircraft on March 10, 1989. It is curious that some of these documents dated back to 1979. Of particular interest was a letter of January 11, 1983, to Captain Morwood from Captain Robert Murray, director of flight operations at the time, on the subject of de-icing.

Aviation Management Experience

A compilation of 373 bulletins concerning a wide range of operational and administrative matters and primarily authored by Captain Morwood in the period 1977–80 was reviewed. A sample listing of some of the bulletins he produced during this period shows that he was providing both guidance and authoritative direction to the Great Lakes Airlines flight crews under his direction.

After reviewing these bulletins and other evidence, Mr David Rohrer testified before the Commission:

> A. A review of Captain Morwood's Air Ontario personal file, training file, and Department of Transport file indicate Captain Morwood consistently maintained a high standard during his pilot proficiency checks on various aircraft.
>
> Captain Morwood was generally described by many pilots who flew with him as an assertive Captain who was safety conscious and cautious. The company flight safety incident reports filed by Captain Morwood generally support this description of him.
>
> (Transcript, vol. 87, p. 110)

Captain Erik Hansen, an Air Ontario pilot, added to this description, based on his long association with Captain Morwood that began more than 20 years before the accident:

Q. What was your overall impression of Morwood as a pilot?
A. He was a proverbial instructor. He never shut up. And ... to him, there was no other way but to teach. He was just checking and checking and checking.

That's why I think a lot of the first officers we had – and captains too, for that matter – really didn't like flying with George too much. It was not because of his – it was just that you always felt you were on a check ride.

It took the, shall we say, the fun out of flying or the enjoyment out of doing a trip, because George was always on your case, asking you questions and crossing all the T's, dotting all the I's and all that good stuff in the log book. That was George.

...

But, other than that, like I say, I've known George for twenty-some odd years.

Q. From the way you knew Morwood, sir, can you see a first officer getting under his skin by telling him what to do?
A. No.
Q. How would he react to that?
A. Well, George would tolerate it to a certain extent, but I don't think George would ... let them get under his skin, as such. George would put him in his place. You wouldn't be in doubt as to who was in charge when you were flying with George.
Q. He was the boss?
A. He was the boss.

(Transcript, vol. 94, pp. 101–103)

A. He would always be concerned about the people in the back, are the people getting a nice ride or if it gets bumpy.

He would always be on the chimes, again George on the chimes, get the girls up front, tell everybody to buckle down. He may see a cloud 25 or 50 miles ahead and he says, maybe get a little bumpy, he says, you better get everybody strapped down and you get the coffee out of the way and pick up all the cups. And that would be George, concerned with passengers.

Whereas, you know, other pilots might be saying, well, you know, it may get bumpy, it may not.

Let's wait for the first bump before we do anything, kind of thing.

Q. That was not his style?
A. No, not George.

(Transcript, vol. 94, pp. 143–44)

Q .... Really, I want to come to my final area of questioning now, Captain. Everything we've heard about George Morwood is that ... he was a very careful, cautious pilot, maybe a little condescending from time to time to first officers, he was a born teacher, but he was a by-the-book kind of guy, and he was – he erred on the side of being a conservatively safe pilot.

Does that synopsis of George Morwood coincide with your own impression of the man?

A. That is correct, pretty well.

(Transcript, vol. 94, pp. 166–67)

Captain Morwood's Takeoff Limits

In order to determine Captain Morwood's takeoff visibility limit for the Dryden airport, it is necessary to refer to the Air Ontario Flight Operations Manual (FOM), the Canada Air Pilot (CAP), and the Air Regulations.

The Air Ontario FOM stipulates that:

a) Standard Take-Off Weather Minima

All take-offs must be carried out in weather conditions that are at, or better than, those published in the Canada Air Pilot, Jeppeson [sic], US National Oceanic and Atmospheric Administration, Company Approach Procedures manuals or Operations Specifications amendments as applicable.

(Air Ontario Flight Operations Manual, p. 6-5, s. 6.5.2 IFR Flights)

Operating specifications are contained in the operating certificate of an air carrier. A copy of the operating certificate with amendments is contained in the air carrier's FOM. Amendment No. 8 to Air Ontario Operations Specifications allows F-28 takeoffs where the reported visibility is RVR (runway visual range) 1200 feet (one-quarter mile) or more. One of the conditions for applicability is that the pilot-in-command (PIC) have at least 100 hours of PIC experience on the aircraft type.

The Air Ontario FOM continues:

Exception

If the take-off limits are lower than the published landing limits for the landing runway(s) at that airport, the take-off may be made provided that you have a take-off alternate meeting the requirements of ANO V, No. 8 within 60 minutes flying time on one engine in still air.

(Ibid. p. 6-5)

The FOM specifies the takeoff and landing limits that apply for new pilots-in-command as follows:

> a) New Pilots-in-Command (Captains)
> Until the Captain has achieved 100 hours on type, the ceiling and visibility will be increased one hundred (100) feet and one-half (½) mile respectively, above the limits published in the Canada Air Pilot/Jeppeson, Foreign Approach Manual, or approved Company approach procedures manual.
>
> (Ibid., p. 6-9, s.6.6 Specific Limits)

This requirement is in accordance with a Transport Canada policy.

According to the airport chart page in the Canada Air Pilot, the takeoff visibility minima for the Dryden Municipal Airport effective March 9, 1989, were one-half mile for both runway 29 and runway 11.

The lowest published landing ceiling and visibility data for the Dryden airport, effective December 15, 1988, and in effect on March 10, 1989, are for the instrument landing system (ILS) approach to runway 11. Although technically these data are not limiting, they are treated as limits by Air Ontario (FOM, p. 6-9, s.6.6). The limits are a decision height of 1554 feet above sea level, which equates to a cloud ceiling of 200 feet above ground level, and three-quarters of a mile visibility.

Air Regulation 554 reads in part as follows:

> (1) The Minister may establish standard procedures for air operations at specific aerodromes, which procedures may be published in a document entitled the *Canada Air Pilot*.
> (2) The instrument approach procedures established under subsection (1) shall specify and authorize
> (a) the minimum altitudes to which a pilot-in-command may descend during an approach to a landing;
> (b) the minimum visibility in which any pilot-in-command may conduct a landing or a take-off.

Air Regulation 555 defines the takeoff visibility for a runway as

> (a) the RVR [runway visual range] of the runway, unless the RVR is
> (i) fluctuating ...
> (ii) ... a localized phenomenon
> (iii) not reported ...
> (b) the ground visibility of the aerodrome for the runway, if
> (i) the RVR is as described in subparagraph (a) ... and

(ii) the ground visibility of the aerodrome is reported as set out in the definition "ground visibility";[1] or

(c) the visibility for the runway as observed by the pilot-in-command, if

(i) the RVR is as described in subparagraph (a) ... and

(ii) the ground visibility of the aerodrome is not reported as described in subparagraph (b)(ii).

The RVR was not reported at Dryden on March 10, 1989, and since the ground visibility of the airport was reported, paragraph (b) above applies. As stated in chapter 4 of this Report, the reported ground visibility for the Dryden airport at 12:00 noon CST was two-and-a-half miles and at 12:06 p.m. it was three-eighths of a mile. Because the ground visibility is reported at Dryden airport, a pilot-in-command must use the reported ground visibility as the takeoff visibility.

On March 10, 1989, Captain Morwood had fewer than 100 hours as pilot-in-command on the F-28 aircraft. Accordingly, he was governed by the limits as published in the Canada Air Pilot and not by the takeoff visibility as in Amendment No. 8 to Air Ontario Operations Specifications, and he had to add 100 feet and one-half of a mile to the applicable published takeoff and landing limits.

The published takeoff visibility limit for Dryden is one-half of a mile, which is less than the lowest landing visibility limit of three-quarters of a mile; therefore, three-quarters of a mile applies. Because he was required to add one-half of a mile to the published limit, Captain Morwood's visibility limit for takeoff from Dryden was one-and-one-quarter miles unless he filed a takeoff alternate.

If Captain Morwood had filed a takeoff alternate, the Exception referred to above would have applied and his takeoff visibility limit

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[1] "Ground visibility," in respect of an aerodrome, means the visibility at that aerodrome as contained in a weather observation reported by

(a) an air traffic control unit,

(b) a flight service station,

(c) a community aerodrome radio station operated under the control and supervision of the territorial government of the Northwest Territories or the Yukon Territory,

(d) a COMMET station, or

(e) a radio station that is ground based and operated by an air carrier.

(Air Regulations, p. 7)

The weather facility at the Dryden Municipal Airport was operated under contract with the minister of the environment. The weather observations made at Dryden were available through normal Environment Canada weather services to any of the above agencies.

would have been one mile. There is no evidence, however, that a takeoff alternate was filed.

Personal Profile

Captain Morwood was in good health. He was approachable, friendly, and well liked by his fellow workers. He was regarded within the company as somewhat of a father figure. He was a conservative, religious, and fastidious person and was generally viewed as being part of the "old school." It was the fastidious side of his nature that led to the only potentially negative comments that were made about him. He was a punctual man who disliked being late and who felt almost an exaggerated sense of contractual obligation to his passengers. In an interview, Mr Kothbauer, duty manager of Air Ontario's system operations control, stated: "If he [Captain Morwood] thinks you're going to inconvenience his passengers, you know, it's almost like a personal insult to him."

Captain Morwood was not a man who was easily intimidated. In one incident, he submitted a letter to Air Ontario management pointing out what he believed to be a safety deficiency in a particular aircraft. When Air Ontario management did not respond to his concerns, he sent a copy of his letter to the regional director of aviation regulation of Transport Canada. In general, however, Captain Morwood was reported as being happy with Air Ontario, happy with the F-28, and not contemplating any change in employment.

Approximately 14 months prior to the accident, Captain Morwood separated from his wife of 29 years. He was not initially happy with the separation, but, in time, he met someone else and was engaged to be married. In the six months prior to the accident he was described by everyone interviewed as being happier than they had seen him of late. His relationship with his wife was amicable and their financial separation was complete. Captain Morwood maintained a good relationship with his children and was, in fact, sharing an apartment with one of his daughters. He was financially secure, and he and his fiancée had purchased a block of land and were in the process of planning to build a house. Captain Morwood did not smoke and drank alcohol very moderately.

First Officer Keith Mills

Keith Benjamin Mills: first officer, C-FONF
Age: 35
Date of birth: February 24, 1954
Pilot licence: Airline Transport Pilot Licence YZA-143579
Pilot medical expiry: July 1, 1989
Total flying time: 10,000 hours plus
Total flying time F-28: 66 hours
Total jet experience: 3500 hours Cessna Citation (estimated)
Total flying time last 90 days: 93 hours
Total flying time on aircraft type last 90 days: 66 hours
On duty March 10, 1989, prior to occurrence: 5.4 hours (approximate)
Off duty prior to March 10, 1989, work period: 14.5 hours (approximate)

Flying Background

First Officer Mills began flying in 1973 and obtained a private pilot licence in 1974 from Peninsula Air Service in Hamilton. He enrolled in the commercial pilot course and obtained that licence in 1975 from the same company. He flew commercially for various companies, and was also a flying instructor for a parachuting school in Toronto.

In May 1979 First Officer Mills was employed by Austin Airways Ltd as a Twin Otter co-pilot for its northern operations. He became a captain in the Twin Otter aircraft and flew in this capacity until 1982. He moved to the air ambulance division of the company, where he flew the Cessna Citation aircraft, a light twin-engine jet with a gross takeoff weight of less than 12,500 pounds. He also flew the Cessna 402 aircraft and other small twin-engine piston-powered aircraft. After he qualified for Transport Canada's "A" and "B" authority as a company check pilot, he was authorized to conduct pilot proficiency checks and instrument rating renewals, as well as to carry out company line indoctrination and pilot route checks on both aircraft types. The air ambulance operation was administered through a contract with the Ontario government and often required short-notice flights under less-than-favourable weather conditions into remote settlements throughout the province.

First Officer Mills moved to Thunder Bay in February 1987 and flew a Twin Otter on an Air Ontario subcontract for Bell Canada, but the contract was cancelled in January 1988. He then trained on the Hawker

Siddeley HS-748 turboprop aircraft. He attended the Canadian Airlines International Limited initial pilot ground school on the HS-748 turboprop aircraft from January 11 to 22, 1988, and obtained a 96 per cent average. He successfully completed his initial company aircraft training and initial Transport Canada pilot proficiency check as a captain between January 25, 1988, and February 1, 1988. In February 1988 he was promoted captain on the HS-748. Between February 5 and February 29, 1988, Captain Mills was successful in completing his initial line indoctrination, accumulating 57.5 hours of line flying before assuming line flying duties as a captain. The base in Thunder Bay was subsequently closed and Air Ontario sold the HS-748 aircraft to another carrier. In late 1988 he applied to be first officer on the F-28, based in Toronto, and was awarded that position. In January 1989 he attended the F-28 ground school in Winston-Salem, North Carolina, conducted by USAir. His flight training on the F-28 aircraft began in February 1989, and he successfully completed a pilot proficiency check ride on February 10, 1989, exactly one month before the Dryden crash. First Officer Mills did not take any F-28 simulator training because time on the simulator was fully booked. He received his flight training in the F-28 aircraft. His instructor was Captain Joseph Deluce and the training was carried out in four flights from Winnipeg airport. All of these training flights were carried out late at night, when the aircraft were not being used in revenue flights.

First Officer Mills flew for Austin Airways and then Air Ontario for a total of 10 years. He was known as an assertive pilot who could be abrasive at times. His schedule in the four-month period preceding the accident was not unusual and all schedules were within the duty time limitations contained in the Air Navigation Orders.

First Officer Mills's flying abilities, as documented by his initial training, his recurrent training, and proficiency checks carried out by Transport Canada and company check pilots, were satisfactory. However, in reviewing his records, it was apparent he had from time to time experienced some difficulties, as set out hereunder.

In his first attempt to obtain a class I instrument rating, the inspector terminated the ride and provided the following reasons:

> Applicant experienced difficulty right from start, YYZ VOR off the air so he set up for V361 using London VOR – Flying erratic – x-[cross] check poor – holding at KF poor – no wind assessment – ADF approach barely acceptable – Timed turns poor – ILS entry and procedures OK up to Marker then Localizer steering became poor – Back Crs [course] again OK until Final then Localizer steering became very poor – ride terminated!
>
> (Exhibit 690)

First Officer Mills passed a reride test a short time later.

During and following his HS-748 training, First Officer Mills was involved in three reported incidents involving the HS-748 aircraft. On February 23, 1988, during the course of his initial line indoctrination with Captain Ross Woods, an engine overtemperature occurred in the aircraft during a takeoff from Thunder Bay. The takeoff attempt was aborted and the aircraft remained in Thunder Bay. An inspection of the aircraft revealed that the left engine plug covers had not been removed prior to the flight, resulting in an engine overtemperature condition that required the engine to be replaced. Captain Woods had carried out the walkaround and evidently neglected to remove the left engine plugs. Since First Officer Mills had not completed his training, Captain Woods would have been captain of this flight.

The second incident involving Captain Mills occurred on May 15, 1988, at Marathon, Ontario. The investigation of this incident by the Canadian Aviation Safety Board (CASB) determined that the aircraft was high on final approach and did not touch down until it was a considerable distance down the runway. The aircraft could not be stopped on the runway and it ran off the end to a distance of approximately 300 feet. The incident occurred when Captain Mills had 150 hours on type and while the first officer was flying the aircraft. In this occurrence, Captain Mills apparently failed to recognize that a go-around should have been initiated before touchdown and failed to take appropriate action.

As a result of the company investigation of this overrun on landing, Captain Mills was required to undergo a flight check. When this flight check was conducted, Captain Mills's performance proved to be unsatisfactory. He was then required to undergo an additional 50 hours of line indoctrination with a company check pilot. Captain Ross Woods, who was the captain mentioned in the first HS-748 incident referred to above, was assigned as the pilot to carry out this extra flying training with Captain Mills. Captain Mills demonstrated a lack of proficiency in handling the aircraft on approaches and landings. These difficulties, explained in notes taken by Captain Woods at the time, indicated problems that I find somewhat surprising in a pilot who appeared to have had no serious problems on his initial line training and who had already flown 150 hours as captain on the HS-748. In any event, Captain Woods recommended and the company required an additional 50 hours of line indoctrination, the latter portion of which was conducted by Captain Peter Hill.

Captain Mills's flying performance indicated considerable improvement after the second 50 hours and a check ride was carried out by Captain Larry Raymond on a three-day trip on July 20, 21, and 22, 1988. Captain Raymond considered the ride to be satisfactory and his report stated: "He had just completed an additional 100+ hours line indoc with

Captains Hill and Woods and appears to have absorbed and learned much from this extra training."

Mr David Rohrer, the CASB operations group chairman, commented as follows:

Q. And you've noted here that the accident occurred when he had 150 hours on type, and while the First Officer was flying the aircraft.

Could you explain the next sentence:

"Captain Mills failed to recognize that a go-around should have been initiated before touchdown. As a result he was returned to the line for further indoctrination. He completed another 100 hours of line indoctrination with company check pilots and was again released as a Captain on the HS748."

Just explain to us what that means?

A. Well, as a result of this occurrence, the company reviewed Captain Mills' performance and elected, at that time, to give him further line indoctrination in the amount of 100 hours.

This is basically flying the airplane in his role as Captain under supervision of a check pilot.

Q. From your experience, sir, would the 100 hours that he did, is that high or low or is that average when you put a pilot back on further training?

A. Well, I suppose as a sense of comparison, the line indoctrination Captain Morwood did as a captain on the F-28 was 25 hours. The line indoctrination that First Officer Mills did was 20.

Now –

Q. That's on the F-28?

A. On the F-28. Now, Captain Mills on the HS748s had already been line indoctrinated once and this was an additional 100 hours, which was about four times more than what a normal captain would receive.

Q. In your opinion, is that high?

A. Yes.

Q. In your opinion, is that demonstrative of anything?

A. Well, it indicates that he had some difficulties transitioning to that aircraft.

(Transcript, vol. 87, pp. 117–19)

The third incident involving Captain Mills occurred at Detour Lake on November 17, 1988. While he was taxiing the aircraft onto the runway in preparation for takeoff the right main landing gear settled in a soft spot off the prepared area. During the initial attempt to free the aircraft using its own power, the propeller was damaged by rocks that were thrown up by the propeller itself. Shortly after this incident the company sold the HS-748 aircraft fleet. Captain Mills applied to be first officer on the F-28 aircraft, and he commenced his training in January 1989.

With regard to these three incidents, it should be noted that they all occurred on the largest aircraft First Officer Mills had flown up to that date and in a relatively short span of time before he had acquired a significant amount of experience on the aircraft.

The record of pilot proficiency checks flown by First Officer Mills indicated some recurring problems with stall recovery on various aircraft types. Mr Randy Pitcher, civil aviation inspector in Transport Canada's Ontario Region, noted on one occasion when First Officer Mills was flying, the F-28: "Lost 200 feet because he allowed the nose to drop a little during recovery."

Personal Profile

First Officer Mills was 35 years old, married, and had one child. He had worked for Austin Airways Ltd and Air Ontario Inc. for 10 years. Interviews with company personnel portrayed him as an assertive individual who could be abrasive at times.

It is reported that First Officer Mills drank very little and did not smoke. He was in excellent physical condition, he worked out at the local gymnasium, and he played golf. In his youth he had been a successful athlete and had been drafted to play professional hockey.

First Officer Mills was apparently happy with Air Ontario and had no plans for changing employment. He was also happy with the F-28, but, according to his wife, he felt that his F-28 training had been a "little rushed."

Cabin Crew

Cabin Attendant Katherine Say

Katherine Lea Say: purser
Age: 31
Date of birth: November 30, 1957
Initial F-28 emergency procedures training completed: December 1, 1988
First-aid training completed: July 1, 1987
Fire-fighting training completed: November 1, 1988

Cabin attendant Say's work schedule for the four-month period preceding the accident complied with all crew rest restrictions in place on March 10, 1989.

Although Mrs Say had not originally been scheduled to fly on the F-28 aircraft between March 6 and 10, 1989, the manager of in-flight services, Mrs Ruthe-Anne Conyngham, assigned her to these flights to review and organize the F-28 trolley carts and cabin service. Mrs Say was given these duties in her supervisory capacity as an in-flight coordinator.

Cabin Crew Training

Air Navigation Order Series VII, No. 2, part V, section 42(5), requires an air carrier to "submit to the Director for approval, a detailed training syllabus for each crew member classification." Mrs Say was properly qualified and trained to perform her assigned duties as the purser cabin attendant on Air Ontario F-28 aircraft in accordance with existing company requirements as approved by Transport Canada. She had successfully completed her mandatory initial F-28 training in December 1988 and had obtained both current and valid first-aid and fire-fighting training prior to her assigned duties on the F-28. She was considered to be a qualified and experienced cabin attendant and was deemed competent by both her superiors and her peers.

Cabin Attendant Sonia Hartwick

Sonia Victoria Hartwick: cabin attendant
Age: 26 (on March 10, 1989)
Date of birth: January 24, 1963
Initial F-28 emergency procedures training completed: October 14, 1988
First-aid training completed: September 1, 1986
Fire-fighting training completed: October 1, 1988

Cabin attendant Hartwick's work schedule for the four-month period preceding the accident complied with all crew rest restrictions.

Cabin Crew Training

Mrs Hartwick was properly qualified and trained to perform her assigned duties as a cabin attendant on the Air Ontario F-28 aircraft in accordance with existing company requirements as approved by Transport Canada. She had successfully completed her mandatory initial F-28 training in October 1988 and had completed both first-aid and fire-fighting training prior to her assignment on the F-28 aircraft.

Mrs Hartwick had been employed by Air Ontario Inc. and one of its corporate predecessors, Air Ontario Limited, for two years and six months prior to the accident. She was considered to be a capable employee and was well liked by her superiors and peers. Although she was generally pleased with her duties as a cabin attendant, she had previously expressed reservations about the level of training she had received on other aircraft types in the company fleet. She had raised this concern in a memorandum to the manager of in-flight services, Mrs Conyngham, who, in response, assured her that she was a capable and dedicated cabin attendant who had been adequately trained for her position. Mrs Hartwick enjoyed her duties on the F-28 aircraft and had a good working relationship with Mrs Say. Mrs Hartwick's observations on her training at Air Ontario are further elaborated in chapter 20, F-28 Program: Flight Operations Training.

Crew Flight and Duty Times

ANO Series VII, No. 2, Part IV, sections 38 to 41, specify a number of crew-member requirements, including those that are common to both flight crew and cabin crew. A perusal of Part IV discloses an anomaly in the regulations regarding crew flight duty times. Section 41.1 requires an air carrier to set up a system that "establishes a maximum flight time, maximum flight duty time and a minimum rest period" for the air carrier's flight crew members for each 24-hour period. Section 41.1 also establishes a maximum flight duty time for a flight crew member of "15 hours in any period of 24 consecutive hours."[2] While maximum flight times and maximum flight duty times as well as minimum rest periods are specified in this section for flight crew members, there are no similar requirements in the ANOs for cabin crew members. The reasons for this distinction are not obvious.

Crew fatigue is one issue that must be addressed from the human performance perspective of aircraft accident investigation. Evidence as to the flight times and flight duty times worked by the air crew prior to an accident is relevant to this issue. The flight time and flight duty time

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[2] Exhibit 308, ANO Series VII, No. 2, Standards and Procedures for Air Carriers Using Large Aeroplanes, section 41.1(1)(5), pp. 12 and 12-A.

records of all of the aircraft crew members of C-FONF were examined by the human performance investigators for this Commission.

The Commission investigators determined that the maximum flight times and maximum flight duty times of the flight crew of C-FONF on March 10, 1989, were in fact well within the limits set for flight crew in Part IV of ANO Series VII, No. 2. In the case of the cabin attendants of C-FONF, because there are no similar flight time and flight duty time limitations prescribed for cabin crew in ANO Series VII, No. 2, it is not possible to make such a comparison.

However, it can be said that the flight time and the flight duty time records of both of the cabin attendants on C-FONF in the week prior to the March 10, 1989, crash did not exceed the total times recorded by the flight crew members of C-FONF.

Findings

- The maximum flight times and maximum flight duty times of the flight crew of C-FONF on March 10, 1989, were within the limits set for flight crew in Part IV of ANO Series VII, No. 2.

- There are no maximum flight time and maximum flight duty time limitations prescribed for cabin crew in ANO Series VII, No. 2.

- The flight times and flight duty times of the cabin attendants on C-FONF on March 10, 1989, did not exceed the total times recorded by the flight crew members of C-FONF.

RECOMMENDATION

It is recommended:

MCR 170 That Transport Canada address the anomaly existing in Air Navigation Order Series VII, No. 2, with respect to the lack of maximum flight times and maximum flight duty times prescribed for cabin crew members.

39 CREW COORDINATION AND THE COMMUNICATION OF SAFETY CONCERNS BY PASSENGERS

A number of individuals aboard flight 1363 were aware of an increasing buildup of contamination on the wings of the F-28 as it sat on the ramp at Dryden and as it taxied out in preparation for its fateful takeoff. Included in this group were the two flight attendants for flight 1363, Mrs Katherine Say and Mrs Sonia Hartwick, and two highly experienced professional pilots, Captain Murray Haines, an Air Canada DC-9 captain with 12,000 flying hours, and Captain David Berezuk, an Air Ontario de Havilland Dash-8 captain with 10,000 flying hours. Both of these pilots were travelling as passengers aboard the F-28, together with their families.

The question that was asked repeatedly during the Commission hearings, when it became clear that many of the passengers were concerned about the buildup of snow on the wings and recognized the potential for catastrophic results if a takeoff was attempted, was why did someone not bring this concern to Captain Morwood's attention. Yet, except for unsuccessful efforts by a Royal Canadian Mounted Police special constable, no one aboard flight 1363 made any attempt to check with the captain to see if he was aware of the contaminated condition of the aircraft wings.

The reasons for this apparent reluctance to bring to Captain Morwood's attention the condition of the wings, in the face of perceived danger, can be culled from the testimony of some of the survivors. Expert evidence was called in an attempt to rationalize the hesitance of Mrs Say, Mrs Hartwick, Captain Haines, and Captain Berezuk to speak to Captain Morwood regarding the wing contamination. Mr David Adams, chairman of the Commission's human factors group, and Dr Robert L. Helmreich, professor of psychology at the University of Texas and a social psychologist employed by NASA in the selection program

for astronaut candidates, gave evidence relative to the human factors and human performance aspects of the Dryden accident that may have had a bearing on the events of March 10, 1989.

The Evidence

Mrs Hartwick felt some concern about the presence of snow on the wings immediately after the passenger door to the aircraft was closed in preparation for departure. She testified she observed snow while the aircraft was in front of the terminal building and explained how she believed at the time that the aircraft would possibly be de-iced. Mrs Hartwick further testified that while walking through the cabin of the aircraft, after the door had been closed, she overheard passengers' concerns about the snow on the wings, some indicating they hoped it would blow off.

After the pre-takeoff cabin check was completed by the two flight attendants, they stood at the back of the aircraft as it taxied away from the ramp, only to be delayed short of the active runway while waiting for the Cessna 150 to land. Mrs Hartwick testified that thoughts of the Gander crash came to her mind and she was, at this time, becoming more apprehensive over the snow-covered condition of the wings. The snow was now starting to build up and a concern about the contaminated condition of the wings, and what the crew intended to do about it, was raised directly with the flight attendants by a passenger seated at the back of the aircraft. The passenger was Special Constable Dennis Swift of the RCMP, who was seated in aisle seat 13C.

Both Constable Swift and Mrs Hartwick testified before me in relation to this conversation about Constable Swift's concerns. He was a seasoned air traveller who had some knowledge of the theory of flight. He had an understanding that contamination adhering to a wing was capable of disrupting the lift-generating properties of the wing. Mrs Hartwick's evidence about that conversation is illuminating:

> A. He looked at Katherine, and he said, "At what stage do you de-ice?" And, at that time, Katherine looked at him, and she said, "Well, we have automatic de-icers, sir." And then, at that time, he looked at her, and he said, "Yeah, but only on the leading edges."
>
> And, at that time, Katherine just went like – she just shrugged her shoulders with this type of look, and she looked at me and –
>
> Q. She shrugged her shoulders and looked at you?
>
> A. Yes.
>
> Q. What did you feel at that point in time?

A. Uncomfortable.
Q. Why?
A. Because I was thinking of that Gander incident about the possibility of ice on the wings, and it just worried me seeing that white, fluffy snow on the wings. And then I thought, My goodness, if she's – you know, it just seemed so strange that – I just felt very uncomfortable with the snow on the wings, and Katherine, being a very experienced flight attendant.

(Transcript, vol. 10, pp. 229–30)

Constable Swift's recollection of the conversation corroborated Mrs Hartwick's version. He recalled being advised by Mrs Say that the snow on the wings would blow off on the takeoff roll and that the aircraft was equipped with a built-in de-icing device that would take care of the problem. Constable Swift testified he was sceptical of these claims:

Q. Would you tell the Commissioner about the substance of that conversation, Sir?
A. Well, Sir, I had indicated that I felt the aircraft should have been de-iced. In fact, I questioned, asking that, are they not going to de-ice the airplane prior to takeoff?

At that point, a reply came back, and I can't be certain who said that – I believe it may have been Katherine Say – said that it is light, fluffy snow and it will blow off on rollout.

I still found that a little hard to accept myself, and I may or may not have indicated, I don't think so, I don't believe it would.

And I believe it was told to me that not to worry, this aircraft has a built-in device and – thinking that that would take care of the problem.

Once again, I was skeptical in that remark. I didn't think that this particular aircraft had a built-in de-icer. It may have had an inflatable boot or ice boot at the leading edge of the wing, but I didn't think that it had a built-in de-icer, as the way it was – I was interpreting it.

(Transcript, vol. 18, pp. 79–80)

Mrs Say may have believed that the F-28 was equipped with some sort of ground de-icers, when in fact it was not. This apparent misapprehension on her part graphically demonstrates the need for air carriers to involve the cabin crew, jointly with the cockpit crew, in an education program related to the ground de-icing of aircraft and stressing the dangers of takeoff with contaminated wings. She might not then have entertained the belief that the snow would blow off or that a self-de-icing wing existed. More importantly, she would have been confident enough to communicate Constable Swift's valid concerns to the captain.

The evidence shows that both Constable Swift and Mrs Hartwick were of the view that the snow was not going to blow off the wings during takeoff. Mrs Hartwick was very clear in her recollection that the snow was wet and sticky. Being a resident of Northern Ontario, at Sudbury, she easily differentiated between dry, flaky snow that blows away and wet, sticky snow that adheres to objects on which it falls. She testified it was the latter type of snow she observed on the F-28 wings at Dryden.

It was clear to me that both Mrs Hartwick and Constable Swift were uncomfortable with the fact that the F-28 was not going to be de-iced. Both testified they did not believe that the snow would blow off. However, neither one of them pressed the issue with the in-charge flight attendant, Mrs Say, or with a member of the flight crew. Although Constable Swift and Mrs Hartwick possessed elementary knowledge of the effects of wing contamination and were sceptical of the reassurance offered by Mrs Say, neither one of them pursued their concerns any further.

Constable Swift testified that on March 10 he was experiencing pain in one of his ears because of altitude changes during flight. He was preoccupied with this pain and, although he was concerned about the contaminated wing condition, he resigned himself to the fact that the crew were "professional people" whose judgement he would respect:

> A. ... these are professional people, they make a living by flying these things and I don't. I make my living by riding on them.
>
> I had accepted the fact that this aircraft – perhaps someone had made the decision it was safe to fly.
>
> (Transcript, vol. 18, p. 81)

Constable Swift's eventual and understandable decision to rely on the professionalism of the flight crew reflects the attitude of the general air-travelling public. It does not explain, however, why the cabin crew and the two off-duty airline pilot passengers did not take some positive action in the circumstances described.

Mrs Hartwick, by virtue of her limited training, was not well versed in the theory of flight or in the technical aspects of the effect of contamination on the ability of the aircraft to fly. A number of prior experiences as a flight attendant had a bearing on her reactions to the pre-takeoff situation, however, and, in all probability, had a similar impact on Mrs Say.

The presence of snow on the wings of an aircraft was not a new experience for Mrs Hartwick. She testified that while she was working as an Air Ontario flight attendant on the Convair 580 aircraft, she had experienced a takeoff when the aircraft had snow on its wings. The snow on that occasion was dry and powdery, and it blew off during takeoff. She also recalled having observed pilots of the Convair 580 and Dash-8

aircraft check the snow on the aircraft fuselage with their hands before entering the aircraft. Mrs Hartwick testified that before March 10, 1989, she had never been in an aircraft that attempted a takeoff with wet, sticky snow on its wings.

There appear to have been a number of factors that mitigated against Mrs Hartwick or Mrs Say going to the cockpit and conferring with Captain Morwood about the contaminated condition of the wings. Mrs Hartwick testified that there was a feeling among flight attendants that pilots did not accept them as part of the crew in an operational context. She described what I regard as a serious dichotomy between the cockpit crew and the cabin crew:

> A. Well, we have – the pilots and the flight attendants have respect amongst one another as friends but when it comes to working as a crew, we don't work as a crew. We work as two crews. You have a front-end crew and a back-end crew and we are looked upon as serving coffee and lunch and things like that.
>
> (Transcript, vol. 11, p. 117)

Mrs Hartwick recalled instances where she had, on previous flights, gone forward to the cockpit with safety concerns, only to be told by the pilots not to worry, even though the pilots had conducted no visual checks to verify or dispel the concerns she had raised. In one instance she related, she saw what appeared to be a rivet sticking out of the wing and, in another case, she noticed some oil on the wing. Both of these incidents occurred on the Convair 580, when she was a relatively new flight attendant, and she was left with the impression that, by reporting such matters, she had appeared stupid inasmuch as the pilots did not seem to be interested in or concerned with her report to them.

There were other instances, Mrs Hartwick recalled, where the pilots had shown interest in her concern and had taken the time to make checks and to keep her informed. She observed that the attitude and cooperation of the pilots varied, depending on the character and disposition of the individual:

> Q. ... The kind of reactions that you would get from a pilot when you had a concern ... would it vary from pilot to pilot?
> A. Yes, it would. There's some pilots that took more of an interest to explain to you what something was.
>
> (Transcript, vol. 11, p. 118)

There was no doubt in Mrs Hartwick's mind that certain captains were not disposed to consider information from flight attendants seriously. Moreover, the evidence also shows that Air Ontario flight operations management, despite a history of previous incidents

involving takeoffs with contaminated wings, did not seem to grasp or understand the reluctance on the part of flight attendants to approach a captain with their safety-related observations and concerns. This lack of understanding by senior management was highlighted by two post-crash telephone conversations between Mrs Hartwick and Mrs Ruthe-Anne Conyngham, Air Ontario manager of in-flight services.

In view of Mrs Hartwick's expressed concerns about snow on the wings before the takeoff at Dryden, Mrs Conyngham was curious why Mrs Hartwick did not do something to satisfy her concerns, such as speaking to the captain. Mrs Hartwick testified as follows regarding her conversations with Mrs Conyngham after the Dryden crash:

> A. There was a specific question at that time that she mentioned to me. It was only in mentioning. She mentioned, well, the guys upstairs – and I don't know who she meant, who were these guys upstairs. I only figured out to myself they must be some sort of officials in upper management; brought the question, well, if Sonia had such a gut feeling about the snow on the wings, well, why didn't she say anything.
>
> And I said – and then Ruthe-Anne mentioned that she, in turn, explained to them that it was not my position to make such a decision or my position or job to actually go up and tell the captain that he required de-icing at that time.
>
> I have been asked this question twice on two different telephone conversations and during the second telephone conversation I mentioned to her that if she would like to do a little bit of investigating herself – because I felt very horrible that these people were trying to put this back on my lap, I said, well, there is an incident that occurred in December of 1987 out of Toronto. It was a Hawker 748 which took off from Toronto Airport.
>
> (Transcript, vol. 11, pp. 109–10)

The December 1987 incident referred to by Mrs Hartwick in her conversation with Mrs Conyngham concerned an HS-748 aircraft under the command of Captain Joseph Deluce, who later became chief pilot for Air Ontario's F-28 and Convair 580 aircraft and the project manager of the F-28 program. It is reviewed in detail in chapter 24, Flight Safety, and is referred to in this Report as the "December 15, 1987, incident."

The evidence showed that the December 15, 1987, incident involving Captain Joseph Deluce was a subject of discussion throughout the company. It involved a takeoff in inclement weather conditions with a snow accumulation on the aircraft surfaces, resulting in violent vibration on climb-out and the need to execute an emergency landing. The flight attendant on that flight, Ms Alana Labelle-Hellmann, who was called as a witness before this Inquiry, testified that she had expressed her own

concerns about the snow accumulation as well as those of passengers aboard the flight directly to Captain Deluce, but was told to take her seat. Captain Deluce, for his part, testified he had no recollection of this conversation with Ms Labelle-Hellmann. The first officer, Mr Scott Jensen, testified he could not remember whether Ms Labelle-Hellmann had come to the cockpit on this occasion. I found Ms Labelle-Hellmann to be a very credible witness, and I accept her evidence.

Mrs Hartwick's knowledge of this incident and the manner in which Captain Joseph Deluce was reported to have responded to the concerns expressed by the flight attendant and passengers on the flight clearly had a profound impact on her. Undoubtedly this incident influenced her conduct on March 10, 1989.

When asked why she had mentioned the December 1987 incident, Mrs Hartwick stated:

> A. Because it dawned on me after the incident, I thought, well – it seems that people were trying to push the blame on me and I feel guilty as it is but I thought of this incident [the December 15, 1987, incident] and it was a very specific incident that where a flight attendant actually went up to the flight deck to inform a captain of the snow on the wings and what his response was to that.
>
> (Transcript, vol. 11, pp. 111–12)

Regardless of the facts of the December 15, 1987, incident, I believe it crystallized the understanding of the respective roles of pilots and flight attendants at Air Ontario, as perceived and described by Mrs Hartwick. Even if the day-to-day pilot/flight attendant crew relationships varied, depending on the personnel involved, the perceptions created by the December 15, 1987, incident were to have a lasting effect at Air Ontario.

The testimony of Ms Labelle-Hellmann about the perceptions of flight attendants with respect to operational concerns on board aircraft corroborated that of Mrs Hartwick. I was struck by the similarity of the events experienced by Ms Labelle-Hellmann and the passengers involved in the December 15, 1987, incident to those at Dryden on March 10, 1989.

Ms Labelle-Hellmann's evidence was of considerable assistance in attempting to arrive at a rationale for, and an understanding of, the conduct of Mrs Say and Mrs Hartwick on March 10, 1989. Ms Labelle-Hellmann testified that, during her initial flight attendant training in 1985, she had been instructed that, with respect to safety-related matters, she had the "authority to go up there [the cockpit] and insist that it be taken care of" (Transcript, vol. 106, p. 60). However, following this initial training and up to the time of the December 15, 1987, incident, the practical aspects of being a flight attendant somewhat altered her views. She testified:

> A. I just got to know basically a pilot's role and a flight attendant's role. We ... were there for safety ... and serving and taking care of passengers, but ... for de-icing incidents and things like that, I wouldn't make a call like that. I would try to have enough faith in the pilots and hope.
>
> (Transcript, vol. 106, p. 60)

There was a further practical concern that may have influenced Ms Labelle-Hellmann not to be more forceful with Captain Joseph Deluce on December 15, 1987:

> A. Well, you could – you would probably be attached with – it was a smaller company ... it would become known and ... it would just be hard and you could get a bad schedule and different things like that could happen.
>
> (Transcript, vol. 106, p. 61)

Ms Labelle-Hellmann had experienced other HS-748 takeoffs when there was snow on the wings. Like Mrs Hartwick, she testified that such takeoffs did not involve wet, sticky snow, but dry snow that blew off on takeoff.

Having heard the testimony of Mrs Hartwick and Ms Labelle-Hellmann, it is not difficult to understand why flight attendants at Air Ontario may have come to the conclusion that management, as well as at least some pilots, were not interested in the opinions or observations of flight attendants on operational matters.

In addition to the factors enumerated, I am of the view that Mrs Hartwick's expressed fundamental respect for and trust in the professionalism of both Captain Morwood and Mrs Say was a compelling factor influencing her not to go to the cockpit to voice her own concerns. She testified as follows:

> Q. ... maybe you can tell the Commissioner in your own words why you didn't go up to the cockpit to tell Captain Morwood about what you observed on the wings. Why didn't you go up?
>
> A. Well, on March 10th it was not only obvious to myself and the passengers on board flight 1363 that it was snowing in Dryden, but it was something that the captain was aware of as well. It wasn't just snowing over the wings, it was snowing throughout Dryden, Ontario, at the time.
>
> And not only is the captain an expert and a professional with these types of things, the captain has in his possession the temperatures, the winds, the weather conditions, and at that time he is the expert to make the decision such as de-icing.
>
> Also, after conversation with Katherine Say, I looked upon her as a very professional person and I still do. She had ten years of experience and she was a very conscientious person and

> at that time I did not feel it was my place to overstep her as I respected her very much so as I did Captain George Morwood. He was a very special pilot.
>
> (Transcript, vol. 11, pp. 112–13)

As professional pilots, Captain Berezuk and Captain Haines had an in-depth understanding of the danger of wing contamination. In the context of the prevention of similar accidents in future, the reasons given by these two pilots for not bringing the wing contamination to Captain Morwood's attention before takeoff are equally as important, in my view, to those given by Mrs Hartwick.

The lack of affirmative action by Captain Berezuk and Captain Haines was most unfortunate in this instance since any indication of concern on their part would in all probability have been considered seriously by either flight attendant and by Captain Morwood. Knowing that a professional pilot was concerned would likely have convinced one of the flight attendants to relay such concern to Captain Morwood. If this had occurred, Captain Morwood would in all probability have been encouraged to assess the condition of the aircraft wings and to reconsider his injudicious decision to take off. Failing this outcome, both off-duty pilot passengers had the right, as did any passenger on board, to demand to be let off the aircraft when it appeared that the danger posed by the contaminated wings would not be rectified. In the case of flight 1363, it was obvious that the rectification required was de-icing of the aircraft.

The evidence of Captain Berezuk and Captain Haines differs somewhat on the particular reasons why they did not raise their concerns directly with the flight attendants, but there are two points on which they both agree. They had both assumed, prior to takeoff, that the pilots of the F-28 were aware of the condition of the wings and Captains Berezuk and Haines both believed that the aircraft was going to be de-iced. Captain Berezuk knew that the de-icing equipment at Dryden was at the ramp, so he expected they were going to return to the ramp. If the aircraft was not de-iced, he felt that takeoff would be aborted should the snow not come off the wings during the takeoff roll, a highly dangerous practice in itself (see chapter 24, Flight Safety).

Captain Berezuk stated:

> A. ... when we were waiting for the small airplane to [land], that we were sitting at that point for approximately five minutes, and at that point I told my wife that at that point we'd probably be delayed even further because we probably would have to go back for de-icing.
>
> Q. So you thought at that time the aircraft was going to go back or might go back and de-ice?

A. That is correct.
Q. Now, having seen – having seen the snow on the ice and you saw the – or snow on the wing as it was taxiing down the runway, and you had a concern, would you as a captain had you seen the snow on the wing gone back and de-iced?
A. Yes.
Q. Now, if you would have gone back and de-iced the aircraft had you seen as a captain the snow on the wings, can you tell me why you did not communicate your concern to the crew of the aircraft?
A. Up until the final point or final second before takeoff, I was not aware of the pilot's judgment or decision about regarding de-icing.
Q. Now, can you explain that to me. Why were you not aware of his decision or the crew's decision?
A. As making decisions as a captain of an aircraft, at any time you can stop the proceedings up until the point of power application.

Even after the point of power application if you deem necessary in order of safety or if something doesn't seem right, at any time you can stop the process.

Q. So when the aircraft was taxiing down backtracking to commence its takeoff, are you saying that you thought that the captain or the crew might go back and de-ice the aircraft?
A. Yes.
Q. And when was the first time – when did you realize that the – that the crew, the captain, was not going to de-ice that aircraft?
A. When the aircraft was rolling down the runway.

(Transcript, vol. 14, pp. 186–88)

As an Air Canada DC-9 pilot, Captain Haines did not operate into Dryden. However, he was quite familiar with the airport since he resided near Dryden and regularly commuted to work at Winnipeg by flying out of Dryden. He testified that he thought, during the initial taxiing away from the ramp and the backtracking on the runway, that the aircraft was proceeding to a remote de-icing area at the Ministry of Natural Resources (MNR). This was a natural assumption for him to have made, since Air Canada often de-ices its DC-9 aircraft at locations remote from the gate. There was no doubt in his mind that the aircraft had to be de-iced and he was convinced that the F-28 would be de-iced before takeoff:

Q. You fully expected de-icing?
A. They had to de-ice. I knew that.

(Transcript, vol. 19, p. 35)

Q. And there's no doubt in your mind that that aircraft had to be de-iced?
A. Absolutely none. It had to be de-iced. I just talked myself into it.
Q. Did you personally think it could fly with that amount of contamination on its wings?
A. Oh, I knew it couldn't.
Q. You knew it couldn't?
A. Yes.

(Transcript, vol. 19, p. 37)

Captain Haines offered a further surprising explanation for his lack of assertive action on board the aircraft. He stated in his evidence that he had assumed the wings had some fluid in them, or that there existed "some automatic de-icing system" he did not know about "built into the airplane to take care of the ice on the wings" (Transcript, vol. 19, pp. 36–37). He testified that had he known there was no such on-board deicing system, he would have prevented the takeoff:

Q. Captain Haines, if you would have known that there was no on-board-the-aircraft system to de-ice, what would you have done?
A. I would have prevented the aircraft from taking off.
Q. As a matter of fact, you used a little more graphic term when speaking to me.
A. I would have broken down the cockpit door, I would have done anything, had I known that the wing was not going to de-ice itself.
Q. Now, in hindsight, which is always great –
A. Yes.
Q. – I guess you were wrong in the assumption you made during those maximum 30 seconds?
A. Very wrong.
Q. And how do you feel about that today, Captain?
A. Terrible.

(Transcript, vol. 19, p. 38)

The evidence before this Inquiry leaves no doubt whatsoever that no built-in automatic de-icing system exists for the ground de-icing of aircraft. I view Captain Haines's explanation based on an imagined built-in automatic wing de-icing system in a 17-year-old aircraft as completely implausible. It likely constitutes an afterthought in his obviously sincere efforts to rationalize his reasons for not taking any action to prevent the takeoff.

In his testimony, Captain Berezuk offered a further and cogent explanation for his passivity in not communicating his concerns to any crew members on March 10. In so doing he identified what I perceive to

be an absence of guidelines to off-duty air crew members travelling as airline passengers in circumstances such as occurred at Dryden. Captain Berezuk stated:

> A. If I was an outside observer looking at an aircraft, there is no written-down procedure or set of rules that I could refer to on how to and when I should express my concern or state my observation to a crew member of that aircraft. There is nothing concrete.
>
> (Transcript, vol. 16, p. 74)

Captain Berezuk also adverted to a so-called "pilot professional courtesy" or "pilot-respect" theory within the professional pilot community, which purports to preclude an off-duty airline pilot, flying on board as a passenger, from drawing to the attention of the cockpit crew an observed safety concern. Because of the serious potential consequences of such a theory finding acceptance among professional pilots, relevant portions of Captain Berezuk's testimony are set out hereunder:

> Q. Now when questioning you about the crew of an aircraft, you stated in your evidence as follows, and I will just summarize it, but you – whether you knew the pilots in the front of the aircraft or not, it could have been one – it could have been one of 10,000 pilots, you wouldn't have changed your mind about not going up front, is that correct?
> A. Correct.
> Q. And you further stated that you were a pilot and they were pilots and you trusted them with your life and the life of the family and the passengers?
> A. Yes.
> Q. And you further stated you expected the same courtesy, respect and authority given to you as a pilot in command of your aircraft as you owed to the other pilots in the profession of aviation?
> A. Correct.
> Q. Now, am I correct in saying then that it was out of professional courtesy that you did not go forward or advise a flight attendant of your concern about the snow on the wings?
> A. Not as a fact of courtesy but, again, respect.
> Q. Out of respect for the competency and capability of that front-end crew?
> A. Yes.
> Q. So, is it fair to say that in your mind on March 10, 1989, this courtesy and respect, that imputed or regarded in the crew, outweighed your concerns for the amount of snow on the wings?

A. Yes.
Q. Now, is it fair to say then that you were placing this courtesy and respect for the crew before the safety of the aircraft and your safety on March 10, 1989?
A. Can you repeat the question?
Q. Is it fair to say that you place this courtesy and this professional respect before your safety and the safety of the aircraft when you saw the snow on the wings.
A. Yes.

(Transcript, vol. 15, pp. 9–11)

The most obvious inference that could be drawn from this evidence is that professional courtesy and respect among pilots are more important than safety. If true, this would represent a dangerous attitude and one that common sense would demand be expunged in no uncertain terms. However, later in cross-examination, Captain Berezuk displayed obvious discomfort with this statement. What he really meant, he indicated, was that he trusted Captain Morwood and that, as a pilot, he had a reluctance to interfere and to offer advice to another pilot who was actually flying the aircraft. He admitted his view of "professional respect" to be his own, and that he was not speaking for other pilots. As a captain, he personally favoured an open flight-deck environment and welcomed information from other crew members, including flight attendants:

Q. Now, I take it, Captain, that, in your mind, as one goes through the training to become even a basic pilot, you go through a rite of passage at the point in time at which you become licensed as a pilot in Canada, and you're something different at that point than you are before; is that right?
A. I guess it is a feeling that I had, yes.
...
Q. ... Even if you're a nervous passenger in a plane, because you're a pilot and because you know the person flying the plane is a pilot, you're reluctant to interfere and offer him advice about flying the airplane –
A. Yes.
Q. – generally? And that's kind of, in your mind, an ethic that pilots have?
A. I don't know if any other pilot feels that, but I guess I do.
Q. Now, on the one hand, you feel reluctant to offer advice to another pilot, correct?
A. Correct.
Q. On the other hand, you told my friend Mr Wells that you personally encourage an open-cockpit – I should say an open-flight-deck environment; is that right?
A. That's right.

Q. You welcome the flow of information from other members of your flight crew, including flight attendants, about matters of safety; is that right?
A. Yes.

(Transcript, vol. 15, pp. 113–14)

Captain Haines expressed the opinion that pilot respect or professional courtesy should not prevent a professional pilot passenger from drawing the attention of the cockpit crew to a safety problem. In his view there is no unwritten code of pilot respect or courtesy that prevents one pilot from communicating information to another pilot in matters affecting flight safety. He stated:

Q. And I believe you said the professional courtesy would be to tell the pilot what you know that could affect the safety of this flight?
A. Yes.
Q. Do you feel that most pilots would be of the same mind?
A. I hope so.

(Transcript, vol. 19, p. 143)

Given his stated belief that it was appropriate to do so, the obvious question is why Captain Haines himself did not do anything to draw Captain Morwood's attention to his professional opinion, unequivocally expressed in his testimony, that there was no way the F-28 would successfully take off with the wings contaminated as they were.

The common thread in the evidence of Constable Swift, Mrs Hartwick, Captain Berezuk, and Captain Haines was their expression of reliance on the professionalism of the pilots in the face of perceived danger. There was an assumption by each of them that the cockpit crew was aware of the condition of the wings and that they were dealing with the situation in a proper and safe manner. There is, however, a curious difference between the actions of Constable Swift and those of Captain Berezuk and Captain Haines. Constable Swift, who was not a professional pilot, did not hesitate to make his concerns known to both of the cabin crew members. In contrast, neither Captain Berezuk nor Captain Haines, the professional pilot passengers, made mention of their concerns to either of the flight attendants. Post crash, however, both of these captains testified that, in similar circumstances in future, they would take a different course of action. This is suggestive, in my view, of the validity of Captain Berezuk's notion of an unwritten code of professional courtesy or respect among at least some pilots that militates against the communication of even a perceived life-threatening safety concern to the cockpit crew. There are, however, at least four other factors that could influence an off-duty airline pilot on board an aircraft from making

known to the captain his perceived safety concerns: a simple act of faith in the professionalism of the captain; the fear of offending the captain and possible rebuke for unsolicited advice; the fear of embarrassment in the event that the concern expressed proved groundless; and a reluctance to interfere in the obviously busy cockpit routine prior to takeoff.

Whatever the reason, the evidence before this Inquiry points unerringly to the existence of a general reluctance on the part of the cabin crew and the off-duty airline pilot passengers on flight 1363 to intervene in any way with the conduct of the operation of the aircraft by the operating pilots, even in the face of apprehended danger.

Evidence was also heard with respect to several other unrelated occurrences in which there was a reluctance to communicate information to the cockpit crew. In other incidents, the operating pilots viewed information communicated to them with great scepticism or chose not to act upon it.

Mr David Adams recounted his personal experience on board an aircraft shortly after he had participated in the Canadian Aviation Safety Board (CASB) investigation at the crash site at Dryden. Mr Adams, who was en route from Thunder Bay to Toronto, boarded an Air Canada 727 aircraft that had been sitting at the gate overnight. On looking out a window prior to takeoff he noted that the wings had approximately a half inch of wet snow on them. He was extremely disturbed by this observation, but was initially hesitant to raise the issue with either of the flight attendants or the pilots. Finally, he spoke to a flight attendant, requesting her to ask the captain when de-icing would occur. The flight attendant complied with his request and, approximately one and a half minutes later, an announcement was made that the aircraft would be delayed while de-icing took place. It is of some significance that an experienced aircraft accident investigator felt an initial reluctance to deal quickly and assertively with what he perceived to be a dangerous situation.

To amplify the point further, Mr Adams referred in his evidence to the crash of a Boeing 737-400 on January 8, 1989, at Kegworth in the United Kingdom. The aircraft had developed an engine vibration and the pilots inadvertently shut down the wrong engine. The aircraft was, as a result, left flying on the engine that was actually experiencing a malfunction. The cabin attendants and a number of passengers on board the aircraft watched sparks, flames, and pieces of the engine being spewed out the rear of the malfunctioning engine, yet no one took the initiative to notify the captain. The aircraft crashed and a number of passengers were killed.

Mr Adams aptly summed up a problem that has been identified in several aviation accidents, including that at Dryden: "[I]t's one of those issues where ... the information to correct the situation is perceived accurately by somebody on board the aircraft, but is not brought to the

attention of the people who can do something about it'' (Transcript, vol. 157, p. 43).

In order to remove any possible vestige of doubt about the matter, I believe the time has come for air carriers to counsel their pilots that it is appropriate for off-duty airline pilots on board an aircraft as passengers to draw any perceived safety concern to the attention of the captain. In fact, the time has come for all components of the aviation industry, be they regulators, carriers, or industry associations, to support the notion that it is not only acceptable but expected that off-duty airline pilots on board an aircraft as passengers communicate perceived safety concerns without fear of rebuke.

Later in the hearings, Captain Charles Simpson, vice-president of flight operations for Air Canada, was asked whether an ethic existed that might inhibit a pilot from expressing a concern. He responded in the negative, and expressed the view that a pilot was obliged, as part of his responsibility as a citizen, to report his concern:

> A. No, I think that – I think in fact, I think it's an obligation of a pilot to do that. It's a little like what is the responsibility of a citizen. I think there is a definite responsibility there.
>
> (Transcript, vol. 123, p. 164)

It was refreshing to hear a respected senior officer of a major airline make such a clear and unequivocal statement of principle on a subject I consider to be of great importance to the advancement of aviation safety. Based on the evidence I have heard, and considering the complexity and the size of jet aircraft flying today, there can be little doubt that the cockpit crew can benefit from the eyes and ears of all aboard an aircraft, but especially from those possessing special skills.

I will now outline what I perceive to be the most effective solution to the basic flight crew communications problem identified during the hearings of this Inquiry.

According to the evidence, an environment of near-complete separation of cabin crew and cockpit crew responsibility appears to have been fostered by Air Ontario management and by some Air Ontario pilots. As a result, flight attendants were discouraged from becoming involved in operational matters and were led to believe they should simply trust the pilots to deal with any operational problems that arose in flight. Mr Adams offered some insight into this ill-advised and short-sighted attitude:

> A. If you look at almost any company, you will usually find that the cabin attendants and the flight crew are very very clearly separated. They work for different branches of the company in most cases. The culture is one of almost complete separation. Yet

> the fact of the matter is, in a safety situation, these two sections of the company have to work together. And the consequences of not efficiently working together quite often means a bunch of people get killed.
>
> (Transcript, vol. 157, p. 50)

At Air Ontario, prior to the March 10, 1989, crash, the evidence shows that new flight attendants were taught simply to have confidence in the pilots. The report of the human factors and survivability group, introduced into evidence by Mr David Adams, refers to an interview with and a statement given by Mrs Ruthe-Anne Conyngham, manager of in-flight services for Air Ontario, who was responsible for flight attendant training. Mrs Conyngham was asked the following question: "There's been a lot of reports about the contamination on the wings of this aircraft. Would that be something that the flight attendants would look at?" Her reply is telling and sets out what I believe to be the reason for the lack of assertive action by Mrs Say and Mrs Hartwick with regard to the pre-takeoff concern about wing contamination. Both flight attendants, in the view of Mrs Conyngham, conducted themselves in precisely the manner expected of them, based on their training:

> ... It's just not the mind set that I would be in. I can't believe there would be many flight attendants that would be in the mind set where they would be looking at something like that ... I think it would be a very unusual thing for somebody to look out the window and say gee, I think there is too much something on this wing. It would be remarkable if somebody did that. Extremely exceptional ... I have a lot of confidence in these pilot[s] and the whole safety system in Canada, particularly in Canada. And I think that's instilled in, I instill it certainly in new flight attendants and you have to have, to have confidence in the team and that would be my second reason. That it would sort of be out of character unless something is tremendously blatant, for the flight attendant to question that confidence ...
>
> Statements such as those made by Mrs. Conyngham indicate that Kathy Say and Sonia Hartwick did exactly what the system expected them to do. It also helps explain CA Hartwick's interpretation of Kathy Say's gesture to Officer Swift:
>
> "I don't know what that meant. I know what it meant in a way, but again, **ITS NOT UP TO US**."
>
> (Exhibit 1258, pp. 91–92)

The Need for Crew Cooperation

Having heard the testimony of flight attendants Hartwick and Labelle-Hellmann, and having reviewed the detailed expert testimony presented

before this Inquiry pertaining to the human factors elements of this crash, I find that the reluctance of Mrs Say and Mrs Hartwick to convey their own valid concerns, and those of passengers, to the cockpit crew was the product of a mind-set ingrained in them by virtue of their training, or lack thereof, and the failure of Air Ontario management to coordinate properly the activities and responsibilities of their cabin and flight crews.

A basic problem on board flight 1363 clearly appears to have been one of lack of crew coordination. While it would not be difficult specifically to direct flight attendants to raise operational safety concerns with the pilots and also to direct the pilots to treat such intervention seriously, in practical terms mere directives are not sufficient. Closer cooperation, or crew coordination, between pilots and flight attendants in operational safety matters is clearly desirable in the interests of aviation safety. Such crew coordination must, however, be structured and developed through appropriate training, with limits imposed that are realistic, practical, and understood by all concerned. A careful balance must be struck between ensuring that pilots are aware of all operational problems and discouraging flight attendants from intruding into the cockpit at random.

As a result of previous accident investigations, where interruptions and non-relevant conversations were found to be distractions that detracted from the pilots' concentration, the Federal Aviation Administration (FAA) of the United States implemented what is commonly referred to as the sterile cockpit rule. This rule, referred to by Dr Robert Helmreich in his evidence, is, in fact, Federal Aviation Regulation (FAR) 121.542, part of which states:

> (b) No flight crewmember may engage in, nor may any pilot in command permit, any activity during a critical phase of flight which could distract any flight crewmember from the performance of his or her duties or which could interfere in any way with the proper conduct of those duties. Activities such as eating meals, engaging in nonessential conversations within the cockpit and nonessential communications between the cabin and cockpit crews ... are not required for the safe operation of the aircraft.
>
> (c) For the purposes of this section, critical phases of flight includes all ground operations involving taxi, takeoff and landing, and all other flight operations conducted below 10,000 feet, except cruise flight.

Dr Helmreich and his colleagues conducted extensive research in an attempt to establish how stressful situations impact on the dynamics of crew interaction. Analysis of conversations from cockpit voice recorders recovered from accidents were used for this purpose. In his testimony

before me, he referred to two aviation accident investigations he had examined in some detail, both of which had on impact on the issue of pilot and flight attendant cooperation.

The first accident involved a Boeing 727 that crashed on takeoff at Dallas, Texas. The National Transportation Safety Board found that the crew failed to extend the flaps for takeoff. Dr Helmreich testified that the three pilots and one flight attendant were involved in social conversation that was dominated by the first officer. Just before the aircraft departed from the ramp, when a final check of the aircraft configuration should have been conducted, there was a flurry of social communications among the four crew members.

The second accident referred to by Dr Helmreich involved an MD-80 aircraft taking off at Detroit, Michigan, when the crew again failed to extend the flaps and slats prior to takeoff. The relevant taxi checklist was not completed. The crew was engaged in extensive social communications involving the two pilots and a flight attendant who was in the cockpit at the time.

The cases alluded to by Dr Helmreich demonstrated that whatever is ultimately done to ensure that flight attendants become part of a more effective flight safety team, it is critical that a delicate balance be struck and maintained whereby, on the one hand, pertinent information is exchanged between pilots and flight attendants, and on the other, an unnecessary intrusion into the cockpit is restricted at critical times. Mr Adams identified the nature of the on-board communications problems and outlined three elements essential to a solution:

> The real heart of the communications problem and therefore the potential coordination problem, is not that Cabin Attendants are universally discouraged from talking to the flight crew, but rather, they are discouraged from talking to the flight crew about specific subjects. For example, if a Cabin Attendant goes forward to the Flight Crew to point out that some emergency cabin equipment is not functioning, this would be almost universally accepted by both the flight crew and the cabin crew as a legitimate and acceptable communication. However, if a Cabin Attendant goes forward to the flight crew to point out to the Captain that he or she believes there is too much snow on the wings, this would in general not be considered by most flight crew and many cabin attendants as a legitimate or acceptable communication.
>
> In this type of scenario, the Cabin Attendant seems to have only three allies. They are: a clear and well-promoted company policy; a Captain who will consider any information from any source; or an individual Cabin Attendant characteristic of assertiveness.

> Air Ontario seemed to lack many of the elements that would be seen as providing clear and unreserved promotion of efficient operational communications between its flight and cabin crews.
> (Exhibit 1258, pp. 90–91)

The resolution to this communications problem would appear to be founded in well-planned and structured crew coordination or crew resource management[1] (CRM) training of both the pilots and the flight attendants. Dr Helmreich was firmly of the view that had the four crew members of flight 1363 completed extended CRM training and accepted its concepts, there may have been an exchange of information that would have prevented the attempted takeoff in the circumstances described.

It became very clear from the testimony of Dr Helmreich, Dr C.O. (Chuck) Miller, and Mr Adams that the effectiveness of any type of CRM training is contingent upon the commitment of the employer and the employees involved. The attainment of such a commitment is not easily achieved. Without a dedicated commitment by the employer to introduce, facilitate, and stand behind CRM training, such training is likely to have little or no impact on its primary goal of safety enhancement. Dr Helmreich stated:

> A. ... the organization has to sanction the new norms that you adopt. And that goes back to our issues about, if you will, about C.E.O.s and management and all of that.
>
> Because, you can provide that training from hell to breakfast, but if the organization doesn't sanction it, the training will have no impact. So, it requires organizational commitment.
>
> It also requires the establishment of norms through role models, and consistent reinforcement of it ...
>
> ...
>
> So the answer is, you have to have an organizational commitment to believe in what's important, you have to provide the mechanisms to train people, provide the opportunities, and

[1] The application of human factors concepts in the flight deck environment was initially known as cockpit resource management. More recently, as human factors programs have come to include other participants in the aviation system, such as cabin crews and maintenance personnel, the phrase crew resource management (CRM) has come into wide use. CRM refers to the effective use of all available resources – human, hardware, and informational. It encompasses optimizing both the person-machine interface and interpersonal activities, including effective team formation and maintenance, information transfer, problem solving, decision making, maintaining situational awareness, and dealing with automated systems. Training in CRM thus involves basic indoctrination and recurrent training of crews in human factors concepts as they relate to the aviation system.

> ultimately, you have to be willing to say, this behaviour is not only expected, it is required.
>
> (Transcript, vol. 158, pp. 139–40)

The kind of commitment described by Dr Helmreich will not be realized by simply mandating that CRM training be undertaken. The three expert witnesses who testified in the area of human factors, Dr Helmreich, Dr Miller, and Mr Adams, were firmly convinced that there needs to be a certain degree of economic trade-off between the regulator and the airlines in order to ensure that an appropriate program of CRM training is undertaken and conducted. There was no disagreement among them that, in the case of major airlines, CRM training should be mandatory. What was discussed, and merits further consideration, is a regulatory trade-off system whereby a major airline with a well-developed CRM training program in place is given leeway with respect to certain regulatory matters that are required in the absence of a CRM training program.

Dr Helmreich testified as follows regarding the FAA experience on the issue of trade-off or economic incentives:

> A. ... what the FAA has tried to do with the AQP [Advanced Qualification Program] is provide some very important incentives, aside from the true safety benefits which they recognize, but some economic incentives in terms of checking and standards that make it extremely desirable to implement training that they feel is important anyway.
>
> I think that does good things. It makes the organizations and it makes the people feel like they're not getting the program rammed down their throat.
>
> (Transcript, vol. 158, pp. 143–44)

Having considered the testimony of the human performance experts who appeared before this Inquiry, and the evidence of Mrs Conyngham, Ms Labelle-Hellmann, and Mrs Hartwick, I am convinced that had the crew of flight 1363 been exposed to extended CRM training, there is every likelihood that a full and complete exchange of information would have occurred between the flight attendants and the pilots of flight 1363, with the result the aircraft may not have attempted its fateful takeoff.

The issue to be addressed by CRM training, specifically in the context of contaminated wings, is relatively simple. Following the recommendation made in my first *Interim Report*, Canada has now adopted the clean wing concept and, by so doing, has removed the discretionary aspect of whether a takeoff may be attempted with a degree of contamination adhering to the wings.

Apart from the primary responsibility on the cockpit crew to ensure that the aircraft wings are free of contamination prior to takeoff, an additional safety factor, related to crew resource management, can be introduced at no cost. The implementation of a simple mandatory crew procedure, prior to departure from the gate, in adverse winter weather conditions would introduce a double-check against the possibility of takeoff with contaminated aircraft wings. Further to the relevant recommendations contained in my first and second interim reports regarding joint cockpit crew–cabin crew training related to wing contamination, it appears desirable to adopt the following procedures:

- That the captain of an aircraft operating in adverse winter weather conditions be required formally to advise the in-charge flight attendant, prior to departure from the gate, whether ground de-icing of the aircraft is to take place and, in order to eliminate potential apprehension on the part of the passengers, that they be advised of such intention on the public address system of the aircraft.

- That, at any time prior to commencement of the takeoff roll, in the absence of advice by the captain that ground de-icing of the aircraft in adverse winter weather conditions is to be conducted, the in-charge cabin crew member be required to report to the captain his or her own concerns, or any concerns conveyed to him or her by any cabin crew member or any passenger on board the aircraft, relating to wing contamination.

It is important, however, not to lose sight of the fact that CRM training is concerned not only with contaminated wings. The exchange of information between the aircraft pilots and flight attendants covers a multitude of areas I do not consider necessary to canvass in this report. The entire spectrum of cabin crew–cockpit crew communication can best be addressed by well-trained crews having an appreciation and understanding of their respective roles and operating as a team. Because the issue of information exchange between pilots and flight attendants involves many historical and, in some cases, institutionalized behavioural norms, only a serious commitment by all segments of the industry and the regulator to provide CRM training for both pilots and flight attendants will produce the necessary operational environment and standard operating procedures needed to enable the aircraft crew to operate safely as a team.

Air Canada introduced cockpit resource management training for its pilots in January 1989, and over half of its pilots have completed the course to date. All Air Canada pilots are expected to complete this training by late 1992. Mr William Deluce, Air Ontario president, testified

that Air Ontario has taken a corporate decision to introduce cockpit resource management training commencing in "the early part of 1991" (Transcript, vol. 153, p. 66). While clearly laudable in themselves, these initiatives must, in the interests of aviation safety, be expanded to involve the cabin crew jointly with the cockpit crew in a program of crew resource management training.

RECOMMENDATIONS

It is recommended:

MCR 171 That Transport Canada implement regulations requiring air carriers to provide approved crew resource management training and standard operating procedures for all Canadian air carrier flight crews and cabin crews. This training should be designed to coordinate the flight activities and information exchange of the entire air crew team, including the following particulars:

(a) As part of such crew resource management training, joint training should be carried out involving all captains and in-charge cabin crew members in order that each fully understand the duties and responsibilities of the other.

(b) All cabin crew members should be given sufficient training to enable them to recognize potentially unsafe situations both in the cabin and outside the aircraft. If it is necessary to prioritize such training, it should first be provided to all in-charge cabin attendants.

(c) As part of normal pre-flight announcements over the aircraft public address system, passengers should be advised that they may draw any concerns to the attention of the cabin crew members.

(d) All cabin crew members should be trained and instructed to communicate all on-board safety concerns they may have or that may be communicated to them by any passenger to the captain through the in-charge cabin crew member, unless time or other circumstances do not permit following this chain of command.

(e) All in-charge cabin crew members, after appropriate training, should be encouraged in adverse winter weather conditions to monitor the condition of the surface of the aircraft wings as part of the pre-takeoff cabin routine, in order to check for contamination, as a supplement to the captain's primary responsibility in that regard.

(f) Pilots should be made aware that concerns raised by cabin crew members should be taken seriously and investigated, where appropriate.

(g) Pilots should be instructed that when travelling as passengers on board an aircraft they should never assume that the operating crew is aware of any situation that they themselves perceive to be a safety concern. Such pilot passengers should be encouraged to raise such concerns with a cabin crew member and request that the information be given to the captain.

MCR 172 That, in order to dispel any possible notion of "professional courtesy" or "respect" precluding the communication of any dangerous situation, specifically addressing the case of off-duty airline pilots, all Canadian air carriers and the Canadian Air Line Pilots Association provide to each of their pilots a clear statement disavowing any notion that professional courtesy or respect precludes an off-duty airline pilot on board an aircraft as a passenger from drawing a perceived safety concern to the attention of the captain. The statement should indicate that, while it is not mandatory for them to do so, it is appropriate for off-duty pilots who are on board an aircraft as passengers to communicate to the captain, through the intervention of a cabin crew member, any safety-related concerns perceived on board the aircraft.

MCR 173 That the captain of an aircraft operating in adverse winter weather conditions be required formally to advise the in-charge cabin crew member, prior to departure from the gate, whether ground de-icing of the aircraft is to take place and, in order to eliminate potential apprehension on the part of passengers, that they be advised accordingly on the public address system of the aircraft.

MCR 174 That Transport Canada implement a regulation requiring that, at any time prior to commencement of the takeoff roll, in the absence of prior advice by the captain that ground deicing of the aircraft in adverse winter weather conditions is to be conducted, the in-charge cabin crew member be required to report to the captain his or her own concerns, or any concerns conveyed to him or to her by any cabin crew member or any passenger on board the aircraft, relating to wing contamination.

40 HUMAN PERFORMANCE: A SYSTEM ANALYSIS

In the first *Interim Report* of this Commission, issued in November 1989, I found that on the basis of the overwhelming evidence of the surviving passengers and other eyewitnesses, the upper surfaces of the aircraft C-FONF were severely contaminated with heavy, wet snow prior to its attempted takeoff and that such contamination was at least a contributing factor to the crash.[1] Although further investigative and expert testimony had yet to be heard, the evidence available to me at that time convinced me that steps had to be taken prior to the 1989–90 winter flying season to heighten the awareness of the aviation community to the dangers of wing contamination. Accordingly, I made three recommendations directed at implementing a "clean wing" policy in Canadian aviation.

Subsequent to issuing my first *Interim Report*, I heard expert evidence regarding the performance and flight dynamics of the Fokker F-28 Mk1000 in studying the crash of flight 1363. The essential task of these experts was to assess the physical "flight dynamic" causes of the crash by examining aircraft systems, structures, and engine performance.

Without the information from the flight data recorder (FDR) and the cockpit voice recorder (CVR), this technical analysis was more difficult than it might otherwise have been. The technical analysis of the accident was necessarily based upon wreckage examination, eyewitness and expert testimony, and computer reconstruction of the takeoff and flight path.

The performance, investigative, and flight dynamic evidence, considered at length in chapters 10–12, has satisfied me that:

- there were no discernible defects in the aircraft's structures, systems, or engines that directly affected the performance of the aircraft; and
- the immediate cause of the crash is attributable to the contamination of the aircraft lifting surfaces at the time of takeoff.

[1] *Interim Report*, p. 25

The Fundamental Question

The implication of the findings of the technical and performance aspects of this investigation is that the flight crew, in particular Captain Morwood as the pilot-in-command, erred in commencing the takeoff with contamination on the wings.

The flight crew represents one component in the air transportation system which must be evaluated in the investigation like any other component, such as aircraft engines or aircraft structures. If a failure of a component is identified, there must be an examination of both the causes of the failure and the backup systems or redundancies that are expected to prevent or mitigate the component failure. In the present case, having identified that there was a failure on the part of the flight crew of flight 1363, the following fundamental question must be addressed:

- Why did the pilot-in-command attempt to take off with contamination on the wings?

In keeping with the system analysis, two further questions are suggested:

- What caused or prompted the pilot-in-command to make the decision to take off?
- What system safeguards should have prevented or altered the decision to take off?

These questions, which relate to a failing of the human component of the air transportation system, are the subject of investigation and analysis by experts in the field of human factors.

Human Factors

Aviation occurrence investigations have historically involved inquiry into the human aspects of the occurrence. These may be divided into two broad categories:

- an inquiry into causes of injury and death among passengers and crew;
- an inquiry into the human error that was the immediate cause of the accident or incident and into other human involvement that could have, but did not, intervene to prevent the occurrence.

Internationally accepted conventions call for this investigative approach into the human factors of aviation occurrences.[2] The Transportation Safety Board of Canada also inquires into the human factors of any aviation occurrence.[3]

Cause of Injury and Death

The first inquiry is concerned with physical injury and death. The investigators are interested in matters such as the toxicity of combusted cabin interiors, the propagation of crash fires, the structural integrity of the aircraft, and the functioning of emergency exit and crash survival equipment. This aspect of the investigation was discussed in chapter 11, Aircraft Crash Survivability.

Human Performance

The second part of human factors investigation is that concerned with the human components directly and indirectly connected to the operation of the aircraft. It includes an examination of the flight and cabin crew to determine if there is anything in their recent history that could have influenced the circumstances surrounding the occurrence, either in a positive or in a negative way. Some of the investigative areas are training, experience, medical considerations, lifestyles, and personal circumstances. This area of investigation, referred to as the human performance investigation, is the focus of this part of the Report.[4]

Mr Gerard Bruggink, a former deputy director of the National Transportation Safety Board (NTSB) in the United States, describes a human performance investigation as follows:

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[2] Exhibit 429, International Civil Aviation Organization (ICAO), *Manual of Aircraft Accident Investigation, 4th ed.* (Montreal: ICAO 1970; amended February 1972), chap. 9, "Human Factors"

[3] Exhibit 428, CASB Manual of Investigation; Exhibit 1256, CASB Human Factors Preliminary Investigation Checklist (PIP); and *Transportation Safety Board Manual of Investigation Operations*, vol. 2, part 4: "Investigation Standards and Procedures – Air" (June 1, 1991)

[4] It should be noted that the terms "human factors" and "human performance" are often used interchangeably to describe the study of the interaction among "man, machine, and the environment" – particularly in the context of examining pilot behaviour. Because there are both crash survival and human operational aspects to human factors investigations, the operational aspect is more properly referred to as "human performance." This is the usage adopted here. Human performance is one aspect of a human factors investigation. See C.O. Miller, "Human Factors in Accident Investigation," *ISASI Forum*, spring 1980 (Exhibit 1243).

> The systematic search for the probable reasons why personnel directly involved in the operation of a flight did not, or could not, interrupt the event sequence that terminated in the accident or incident.[5]

While I concur with the above definition, I note that it refers only to personnel directly involved. My investigation went further, to include corporate and regulatory management levels that, although not directly involved in the operation of the flight, may well have had a significant influence on events and circumstances surrounding the flight.

The study of human performance has been applied to the aviation industry, and a body of data has been established that enables researchers in this field to improve their understanding of the decision-making processes of flight crews and the extent to which their decisions are influenced by other components of the air transportation system. These components are as follows:

- the regulatory component: Air Regulations, Air Navigation Orders, surveillance, and monitoring;
- the organizational component: the culture and behaviourial norms of the organization as influenced by morale, policies, standards, organizational stability, change, and resources;
- the physical component: weather, operating conditions, and the aircraft, including its condition and capabilities; and
- the crew component: interpersonal coordination and communication among and between flight crew, cabin crew, and support personnel; and the individual characteristics of the aircraft crew members, including training, experience, motivation, personality, attitudes, fatigue, and stress.

The Commission was fortunate to have as witnesses some of the leading experts in the field of human performance investigation to assist in the interpretation of the evidence as it applied to the actions of Captain George Morwood and First Officer Keith Mills. In particular, I was greatly assisted by Mr Gerard Bruggink, who was mentioned above, and Dr C.O. (Chuck) Miller, former director of the United States Bureau of Aviation Safety, NTSB. Dr Robert L. Helmreich, professor of psychology at the University of Texas in Austin, Texas, assisted this Commission by preparing an analysis of the human factors aspect of the crash. The analysis has been used in part in writing this section. Dr Helmreich's

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[5] Gerard M. Bruggink, "Assessing the Role of Human Performance in Aircraft Accidents," *ISASI Forum*, winter 1978

report, "Human Factors Aspects of the Air Ontario Crash at Dryden, Ontario: Analysis and Recommendations to the Commission of Inquiry," is included as number 7 in the Technical Appendices volume of my Report. In addition, I had the benefit of the investigative evidence of the chairman of the human factors and survivability group, Mr David Adams, in 1992 the acting director of the Australian Bureau of Aviation Safety in Canberra, who coordinated the Commission's investigation into the human factors aspects of the crash of flight 1363. Much of what follows in this chapter is based upon the work of these four experts.

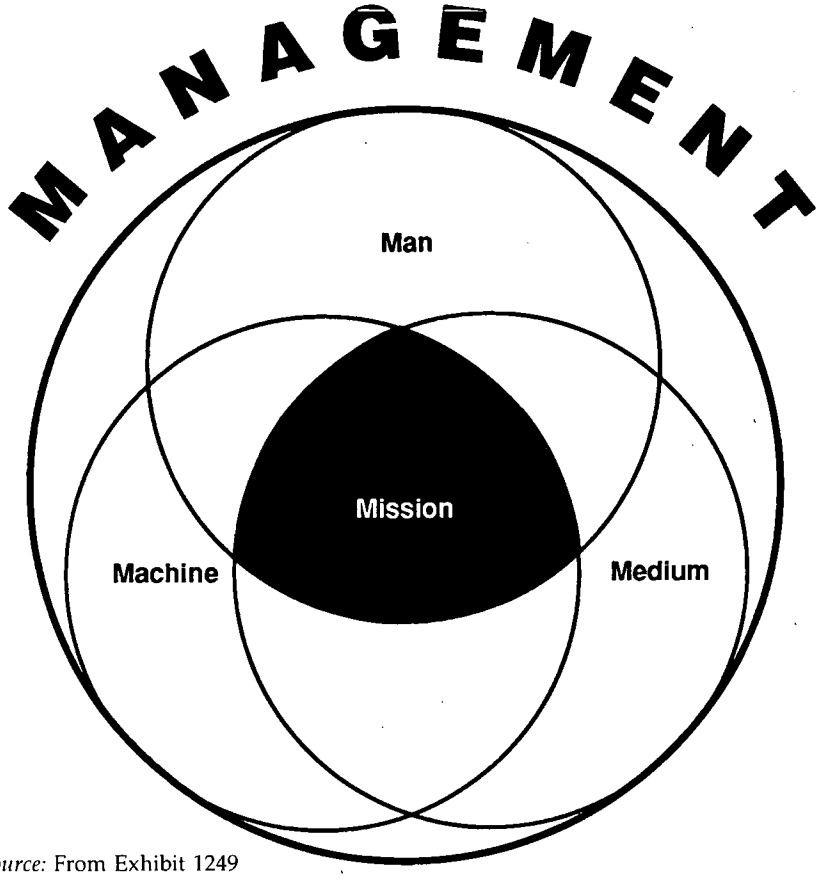
By way of illustrating how human performance fits into a systems analytical model, Dr Miller, in one of his publications, provided the following explanation:

> Figure [40-1] identifies the traditional man-machine-medium (environment) factors for either accident causation or prevention in a framework of system safety principles identified in the very definition of the term, namely, the influence of the mission and overall management in system safety. It shows not only the significance of an individual factor, for example, man, but also that factor's mutual subset relationship to other factors. In practical terms, it suggests a problem has not been analyzed completely until the investigator or analyst asks whether the case has really been examined from all key points in the diagram.
>
> For example, take the infamous 14th Street Bridge air carrier accident near Washington National Airport, January 13, 1982 (NTSB 1982).[6] The accident occurred under icing conditions. The aircraft struck a bridge less than two miles from start of takeoff roll. The machine came into question because of the aircraft's aerodynamic characteristics with ice-contaminated wings. The captain had quite limited experience in winter flying weather – the man factor. The weather was very snowy with severe visibility restrictions, and another part of the medium (environment) was the airport's relatively short runway.
>
> The man and machine came together at the cockpit instruments where, indeed, the influence of the medium was felt because of ice formation on critical engine thrust–sensing probes, which resulted in a false engine pressure ratio gauge readings (used to set takeoff thrust). The mission came into the equation based on recent airline deregulation, placing economic pressures on the airline and the crew. Management of the situation by the airline in terms of crew assignments, dissemination of icing-effects information, coordination of

[6] National Transportation Safety Board, *Aircraft Accident Report, Air Florida Inc. Boeing 737-222 ... Near Washington National Airport January 13, 1982* (NTSB AAR-82-8) (Washington, DC 1982)

ground servicing, and the like, was involved throughout the case. So was cockpit management, including the interpersonal relationships between the captain and the first officer. The first officer seemed to sense something was wrong during the take-off roll but never did challenge the judgement of the captain. Even FAA management involvement in the situation was a factor meriting close attention. Their oversight of the airline was minimal, and even the air traffic control procedures the night [evening] of the accident came into question. Most, but not all of these factors were addressed by the NTSB in the study of the accident.[7]

Figure 40-1 System Safety Factors



Source: From Exhibit 1249

[7] C.O. Miller, "System Safety," in E.L. Wiener and D.C. Nagel, eds., *Human Factors in Aviation* (San Diego: Academic Press 1988), pp. 63–64

While there are some similarities between the 1982 Air Florida crash and the Air Ontario crash of March 10, 1989, it must be stressed that the example is offered only by way of explanation of the investigative and analytical approach that I adopted with this Inquiry.

The pilot-in-command of flight 1363 made a flawed decision, but that decision was not made in isolation. It was made in the context of an integrated air transportation system that, if it had been functioning properly, should have prevented the decision to take off. Instead, it was revealed that there were significant failures, most of them far beyond Captain Morwood's control, that had an operational impact on the events in Dryden. In this chapter, the regulatory, organizational, physical, and crew components of the air transportation system are examined to determine how each may have influenced the captain's decision. Each of these system components is analysed from the perspective of the two previously cited fundamental questions:

- What caused or prompted the pilot-in-command to make the decision to take off?
- What system safeguards should have prevented or altered the decision to take off?

Much of the work in the field of human factors dealing with flight crew performance in operational situations is founded upon the interpretation of data recovered from cockpit voice recorders (CVR) and flight data recorders (FDR). Because neither the CVR nor the FDR information was available after this accident, analysis of flight crew interaction and actions during the station stop in Dryden, and particularly in the final minutes before the crash, is necessarily limited. Nevertheless, the expert witnesses were able to integrate historical data and their wealth of experience with the results of the investigation into the accident to provide possible scenarios of flight crew conduct.

Flight History: Summary

The crew of C-FONF reported in at Winnipeg at approximately 6:30 a.m. Central Standard Time (CST) Monday, March 6, for a five-day block in the F-28 aircraft, involving six flight legs per day ending at 3:30 p.m. CST each day. Captain George Morwood had flown with the two flight attendants before, but none of them had previously flown with First Officer Keith Mills. After flying on Monday, March 6, Captain Morwood was displaced on Tuesday by Captain Robert Nyman and on Wednesday by Captain Alfred Reichenbacher. Captain Morwood rejoined the crew on Thursday and Friday.

On March 10, the crew checked in at Winnipeg at approximately 6:40 a.m. CST and discovered that the auxiliary power unit (APU) was unserviceable. The flight pushed back off the gate at 7:35 a.m., 10 minutes late, and took a further 8-minute delay because Captain Morwood had the aircraft de-iced. The flight was airborne for Dryden at 7:49 a.m. It was further delayed at Dryden by poor weather at Thunder Bay. At Thunder Bay the flight was delayed because of a lack of communication and effective procedures for handling the extra passengers and the resultant need to defuel the aircraft after it had been refuelled. Prior to departure from Thunder Bay, two weather forecasts called for light freezing rain at Dryden. The aircraft departed 64 minutes late, arriving at Dryden at 11:39 a.m. CST. It was refuelled at Dryden with an engine running and with the passengers on board.

During the stop at Dryden, snow was falling and accumulating on the wings. First Officer Mills commented on the aircraft's radio to Kenora Flight Service Station (FSS) at 12:00 noon, "quite puffy, snow, looks like it's going to be a heavy one" (Exhibit 7A, p. 29). Shortly after the aircraft began to taxi, a passenger asked flight attendant Katherine Say when the aircraft was going to be de-iced. The flight attendants did not inform the flight crew of these expressed concerns about the need to de-ice.

The flight was delayed for approximately three minutes while a light aircraft in distress landed. At 12:07 p.m. CST the flight was cleared to Winnipeg, and at 12:09 p.m. First Officer Mills transmitted that the flight was about to take off. The aircraft crashed about one kilometre from the end of the runway.

The Regulatory Component

On March 10, 1989, the crew of Air Ontario flight 1363 was governed by the *Aeronautics Act*, the Air Regulations, and the Air Navigation Orders (ANOs) administered by Transport Canada. Several aspects of the regulations and orders that existed at that time provided an indirect, deleterious influence on the crew's operational environment. Certain regulatory requirements did not ensure the existence of safeguards that might have influenced Captain Morwood's decision to take off at Dryden, given the weather conditions and the aircraft's mechanical defect (the unserviceable APU) and the Air Ontario policy to shut main engines down during de-icing. The following issues are relevant to the regulatory environment:

- Transport Canada did not provide clear guidance for carriers and crews regarding the need for de-icing.

The regulatory requirement that existed at the time of the accident, ANO Series VII, No. 2, section 25(3), prohibited aircraft from commencing a flight "when the amount of snow, frost or ice adhering to the wings, control surfaces or propellers may adversely affect the safety of the flight." (Based on my first *Interim Report*, ANO Series VII, No. 2, has since been amended to remove a judgemental element in the original order.)

There were no regulatory requirements for training on the effects of aircraft contamination and associated phenomena such as cold soaking. Such requirements are now being considered by Transport Canada.

The information on aircraft icing contained in the A.I.P. Canada: Aeronautical Information Publication, produced by Transport Canada as an aviation reference manual, was very limited. The A.I.P. has since been amended to provide more comprehensive information; however, it contains no information about the cold-soaking phenomenon.

- Transport Canada did not rigorously monitor Air Ontario Inc. for regulatory compliance following its merger and during its initiation of jet service.

  Air Ontario operated the F-28 aircraft for a number of months without an approved minimum equipment list (MEL), yet deferred aircraft unserviceabilities to an MEL. Pilots used two different F-28 operating manuals on the flight deck. Neither Piedmont nor USAir authorized the use of these manuals for other than training, and an amendment service was not provided for either manual. These discrepancies were not discovered by Transport Canada, although Transport Canada reviewed and approved the F-28 flight-training program.

- A Transport Canada audit of Air Ontario was delayed and incomplete. It did not address the F-28 operation.

  A national audit of Air Ontario was scheduled by Transport Canada for February 1988. While the airworthiness, passenger safety, and dangerous goods portions of the audit were completed as scheduled, the flight operations portion of the audit was deferred and not completed until November 1988. In light of the recent and major changes that had occurred within the company, a thorough examination of flight operations was warranted. It is noteworthy that the audit that was eventually conducted failed to review the most significant operational change within the company, the initiation of jet service with the introduction of the F-28.

- Transport Canada regulations did not require licensing or effective training of flight dispatchers.

  Air Ontario operated with what it called a pilot self-dispatch system but employed flight dispatchers in that system to provide flight watch and assistance to flight crew as in a full-dispatch system. Since flight dispatchers were used in the system, it was important that they be properly trained. They were not. Transport Canada had no formal requirements for training and licensing of flight dispatchers.

- The Air Navigation Orders did not contain clear and definitive criteria for the qualification of persons in positions governed by regulations, that is, directors of flight operations, chief pilots, and company check pilots.

- Transport Canada did not have a comprehensive policy for the training and operational priorities of air carrier inspectors.

  The rate of turnover within the air carrier inspector ranks resulted in relatively inexperienced personnel being quickly pressed into service with little training for the task. Line checks, which may have revealed anomalies in Air Ontario line operations, were not routinely performed.

- Transport Canada did not have a clear definition as to what constituted an essential airworthiness item. Consequently, this left flight crews and management uncertain at times as to when and under what conditions an aircraft should, or should not, be dispatched.

  The evidence revealed that the Minimum Equipment List Order, ANO Series II, No. 20, provided little, if any, guidance to pilots as to what an essential airworthiness item was. Management interpretations of deferred snags or defects were therefore seldom challenged on the basis of stringent regulatory requirements.

In summary, the safety net that should have been provided through safety regulation, air carrier certification, inspection, and ongoing surveillance was lacking in a number of areas on March 10, 1989.

The Organizational Component

A number of Air Ontario's flight operations and overall management practices increased the potential for operational error. At the highest level, Air Canada, despite owning a controlling interest in the company, did not require Air Ontario to operate to Air Canada's operational standards, nor did it monitor Air Ontario operations or provide

resources to achieve these standards. Some significant safety-related deficiencies developed at Air Ontario that may have been prevented or discovered by Air Canada had it taken a more active role in the operational management of its feeder. The focus of discussion in this chapter is not on faulting Air Ontario or Air Canada for not going beyond regulatory requirements; rather, it is to discuss the impact of the organizational setting and practices that were present at the time.

Lack of Operational Support from Air Canada

During the introduction of F-28 service, Air Canada owned a 75 per cent controlling interest in Air Ontario, which was operating under shared (AC) flight designators. Air Canada has had long experience in jet transport operations and in stringent requirements for dispatch and flight following. The resources of this organization would have been valuable in facilitating the merger of Austin Airways and Air Ontario Limited and in initiating the F-28 jet service. According to testimony, there were financial and labour relations reasons for maintaining a separation between the two carriers, and there was no regulatory requirement that obliged the parent company to share resources and impose its standards on Air Ontario.

The Potential Disruptive Impact of Mergers and Strikes

According to Dr Helmreich, research pertaining to crew attitudes and behaviour has been conducted in several airlines that were the result of mergers. As part of the research, crew member attitudes towards flight-deck management were assessed. The data show significant differences in attitudes as a function of previous organizational membership, in one case nearly a decade after a merger. The results clearly indicate the existence of enduring subcultures within organizations. When cultural factors support the maintenance of differing attitudes about the appropriate conduct of flight operations, the effectiveness of flight crew performance is likely to be compromised.

The process of combining seniority lists from merging organizations frequently results in poor relations among crew members from different airlines. The research also indicates that pejorative nicknames are sometimes employed to label crew members from the opposite side of mergers, as indeed occurred within Air Ontario.[8]

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[8] Former Air Ontario Limited pilots referred to their Austin Airways colleagues as "bush pilots," while former Austin Airways pilots referred to their Air Ontario Limited counterparts as "401 pilots" – an allusion to the major highway running from Windsor to Toronto to Montreal.

The data indicate that labour-management strife can have a detrimental effect on crew members' morale and attitudes towards their organizations. There is no doubt that the negative climate fostered by poor pilot-management relations is not conducive to effective team performance. According to Dr Helmreich, relations among pilots and between pilots and management remain poor in some airlines for years after a strike.

In the course of the Air Ontario Limited–Austin Airways merger and in the period leading up to the pilot strike, there was apprehension among and a certain degree of animosity between the flight crews of the two companies. Several witnesses, however, testified that the strike served in some ways as a catalyst in bringing the two pilot groups together in a united front in their approach to management.

Although Captain Morwood and First Officer Mills came from different pre-merger companies and were involved with the strike, the evidence is that their relationship appeared to be normal. There is no evidence before the Commission that the pre-merger corporate subcultures or the pilot strike had any effect on the relationship of the two pilots of flight 1363.

High Personnel Turnover Following the Merger

The period between the merger of the two carriers and the accident saw substantial changes made in personnel. Part of the operation was sold, and the number of personnel in the combined organization was reduced from eight hundred to approximately six hundred. There was also turnover in two critical areas of management, the positions of vice-president of flight operations and director of flight operations. Similarly, the position of safety officer was filled, became vacant because of a resignation, and, after considerable delay, was subsequently refilled. The lack of continuity in management impeded needed supervision of operational issues, including the introduction of the F-28 aircraft and the standardization of operations following the merger.

Lack of Organizational Experience in Jet Operations

Air Ontario as an organization did not have experience in jet transport operations. At the time of the introduction of the F-28, efforts were made to acquire outside expertise in management, and representations to this effect were made to Transport Canada. Ultimately, Captain Claude Castonguay, who had substantial jet transport operational experience (including the F-28), was hired; but he resigned after one month, stating in his letter of resignation: "So much as I would like to keep working to establish your F-28 program, I have concluded that I cannot function in

my duties as a check pilot when I do not get the support I need" (Exhibit 805). His only further involvement with Air Ontario was six months later, when he was called back to conduct line indoctrination training for a very short period of time. No one was subsequently hired from outside the organization to fill this role. Air Ontario elected to manage the F-28 program with internal pilot resources, consisting of pilots with minimal F-28 experience and no previous experience on large jet aircraft.

Deficiencies in System Operations Control Practices

Air Ontario operated with a dispatch and operational control system that consisted partly of full co-authority dispatch and partly of pilot self-dispatch. Although this system was permitted by current Transport Canada regulations, it failed to provide crews with the same level of support and resources as in the parent organization, Air Canada.

In the absence of regulations mandating formal training and licensing for dispatchers, Air Ontario primarily employed on-the-job training for dispatch personnel. For the introduction of the F-28, brief training in the operation of this type of aircraft was provided only for duty managers. In contrast, Air Canada provided its dispatchers with formal training and operational guidelines, including rules that would forbid dispatching an aircraft with an inoperative APU into any station with no ground-start capabilities. That the Air Ontario system was deficient is indicated by errors in flight releases, including erroneous fuel load calculations. Indeed, the flight release for C-FONF contained such errors on the day of the accident. Further, the failure to accommodate for forecast freezing rain in Dryden on March 10, 1989, represented another deficiency within Air Ontario system operations control (SOC).

Lack of Standard Operating Procedures and Manuals for the F-28

Revenue passenger service was initiated without a specific Air Ontario operating manual for the F-28. There was also no approved minimum equipment list for some months after passenger service began. There were inconsistencies between cockpit manuals and between cockpit and cabin manuals provided to crew members. For example, the flight attendant manual required passenger disembarkation for refuelling with an engine running, but there was no parallel rule in the flight operations manual or the aircraft operating manual. Crews thus lacked standardized operational guidelines either from manuals available on the flight deck or from SOC.

Inconsistencies/Deficiencies in Training F-28 Flight Crew Members

Initial training of F-28 flight crew members, including both ground school and simulator training, was contracted with Piedmont Airlines. Piedmont itself was involved in a merger with USAir, which decided to achieve standardization of the merged operation by shifting all former Piedmont personnel to USAir procedures and manuals. There were several implications of this merger for Air Ontario flight crews. Some crew members received training from the Piedmont F-28 manual, and those training later worked with the USAir manual. Since Air Ontario had not developed its own manuals, some individuals returned from their training sessions with the Piedmont manual and others with that of USAir. Although Air Ontario management witnesses stated that the Piedmont manual was its standard, this was not clearly communicated to crews, and no efforts were made to provide all crews with the same manual. Air Ontario also failed to arrange an amendment service for the manuals it was using. Although the Fokker F-28 Flight Handbook was carried in the aircraft, there was limited training in the use of this manual; and there were variances between the Fokker and Piedmont manuals – for example, in computing corrections for runway contamination.

Another result of the Piedmont/USAir merger was that the Piedmont F-28 flight simulator was not available for the training of Air Ontario flight crews. Because of this, a number of Air Ontario F-28 pilots were trained in the aircraft itself, by newly qualified Air Ontario F-28 training pilots, rather than in the Piedmont simulator. There is consensus in the industry that a flight simulator provides broader and more effective flight crew training.

Fight crew members surveyed by the Air Ontario safety officer following the accident generally reported their line indoctrination at Air Ontario to be "fair" in quality. One deficiency noted was a failure to define clearly the duties of the pilot flying and the pilot-not-flying, indicating a weakness in training and in flight-deck operating procedures.

Leadership of the F-28 Program

Captain Joseph Deluce was simultaneously the F-28 project manager and the chief pilot for both the F-28 and the Convair 580 aircraft. Captain Deluce had numerous responsibilities, including line flying during the strike that preceded delivery of the F-28 aircraft and conducting flight

training and line indoctrination in the F-28 for new crew members. Captain Deluce, in addition to being overloaded with responsibilities, had limited operational experience on both the F-28 and the Convair 580 aircraft.

One incident that may have had a significant impact on the attitudes of crew members was the removal of an F-28 flight crew from a line trip to meet with the chief pilot, Captain Joseph Deluce, for allegedly writing up too many maintenance discrepancies in the aircraft journey logbook. One can easily understand how other F-28 pilots might interpret this event as a lack of leader support for optimal operating conditions and as strong pressure to operate at all costs.

The Informal Culture at Air Ontario

During the period of initiation of F-28 service at Air Ontario there was lax regulatory supervision, high management turnover, a self-dispatch system with SOC personnel who lacked knowledge of the F-28 and were generally inexperienced, and a lack of clearly specified and enforced standard operating procedures. Some crews, instead of entering mechanical problems or snags in the aircraft journey logbook, wrote them on loose pieces of paper and passed them on to relieving crews, thus permitting deferral of maintenance and avoiding the grounding of aircraft.

Another non-standard procedure was the "80-knot check," a visual examination of the wing surfaces during takeoff to ensure that contamination had blown off prior to rotation. Captain Deluce, who had been involved in at least two earlier reported incidents involving take offs with snow- or ice-contaminated surfaces that resulted in emergency landings, contributed to this lax attitude at Air Ontario. These examples suggest that crews may have been allowed considerable leeway in making decisions about whether to take off with surface contamination, a practice that, unfortunately, was not unequivocally proscribed by the then current Transport Canada regulations.

Former Austin Airways pilots, including Captain Joseph Deluce, who formed a large part of the leadership in Air Ontario flight operations management, were branded as "bush pilots" by former Air Ontario Limited pilots. No doubt the name refers to the roots of Austin Airways in charter and cargo operations in Northern Ontario and Quebec. The term is not necessarily pejorative. Some former Austin Airways pilots, for example Captain David Berezuk, were quite proud to describe themselves as bush pilots; in fact, the term can connote ability to fly

safely in particularly harsh operating environments with a certain independence and self-reliance and with a willingness to make every effort to complete a flight.

I read with great interest a special study of the National Transportation Safety Board (NTSB) on air taxi safety in Alaska, in which "bush pilot syndrome" was described:

> [S]tatements from operators, pilots, and regulatory personnel in the Alaskan aviation community suggest that the "bush pilot syndrome" may be an integral factor not only in high pilot involvement but also in the high accident rate in Alaska.
>
> Descriptions of the "bush pilot syndrome" range from a pilot's casual acceptance of the unique hazards of flying in Alaska to a pilot's willingness to take unwarranted risks to complete a flight. In Alaska it is not uncommon for pilots to fly in extremely poor weather or to attempt to land on runways that are in bad condition or off the airport on snow-covered strips or frozen lakes marginally suited for landing. Stories abound about pilots who have been involved in numerous accidents and have survived. These pilots have become near legends and are spoken of almost reverently by some young pilots ... Taking chances is considered a part of flying in Alaska by many Alaskans – not just the pilots, but also the passengers. Passengers affected by the "bush syndrome" demand to fly even in hazardous weather conditions, and if one pilot or operator will not fly, the passengers will go to another operator; occasionally they find one who will fly in hazardous weather conditions.
>
> The "bush syndrome" goes beyond the realm of poor judgment compounded by pressures and into the area of unreasonable risk-taking. Although the "bush syndrome" apparently exists, it cannot be unequivocally demonstrated by statistical data. However, it is clear that most operators, pilots, and others associated with Alaskan aviation believe that it does exist. The review of accident cases further supports the contention.
>
> ...
>
> Although the pilot is cited in a higher percentage of air taxi accidents in Alaska, that statistic does not tell the entire story and may even be misleading. The Safety Board determinations of detailed cause/factors in air taxi accidents in Alaska were compared with the determinations for accidents in the rest of the United States. This comparison indicated that when the pilot was cited as the broad cause/factor, several detailed cause/factors pointing to two general problem areas frequently appeared. These problem areas are: (1) inadequate airfield facilities and inadequate communications of

> airfield conditions, and (2) inadequate weather observations, inadequate communications of the weather information, and insufficient navaids.[9]

These NTSB observations were echoed by Mr Martin Brayman of Transport Canada, when he testified about the northern environment within which Austin Airways operated. Mr Brayman was shown the accident statistics for a number of carriers, including Austin Airways, that operated in northern and remote regions. In discussing the accident rates of these carriers, he stated that there is "a direct relationship between the number of accidents or incidents that a carrier has and the condition under which the carrier operates" (Transcript, vol. 131, p. 63). He pointed out that in northern Canada, in mountainous areas like British Columbia, in northern Quebec, and in the Arctic there are a number of factors that have to be taken into account with respect to operations.

Mr Brayman expressed his opinion with respect to the element of risk involved in the hostile environment of northern operations:

> A. ... there is no question that in remote areas where the population demands a reasonably high level of air service, and in Canada, our native peoples surely do that, the carriers are hard-pressed often to meet those demands.
>
> You are working in areas of bad weather, poor runways, little in the way of runway markings or approach aids, weak beacons often covered with ice. So ... it is a hostile environment.
>
> And if you take it even further to operations that extend out onto the sea ice, for instance, a lot of the northern operators land and take off from frozen lakes, from frozen sea ice, they touch down on frozen cracks in the sea ice. There is no question there's an element of risk.
>
> (Transcript, vol. 131, pp. 63–64)

He elaborated on the difficult conditions habitually faced by pilots in northern operations:

> A. You are getting in an area that has a paucity of aids to the pilot. You are dealing with basic single runway strips. You are dealing with heavy snowfalls, high snowbanks, drifting snow,

[9] National Transportation Safety Board, *Special Study: Air Taxi Safety in Alaska* (Washington, D.C.: September 16, 1980), pp. 19–20

> white-outs. It's a very difficult area to fly in successfully. Extremely cold temperatures, heavy icing during transitional periods, spring and fall. Yes, it's a very, very difficult area to fly in.
>
> (Transcript, vol. 131, p. 65)

One can easily imagine how the message communicated during training, and in the Fokker manual for the F-28, that no snow, ice, or frost should be present on wings, may have been discounted to some extent by crews who had successfully operated (albeit in different types of aircraft) with some degree of contamination. Combined with a "bush culture" which was attributed to much of the operational management of Air Ontario, this tendency would not have been properly checked by the F-28 chief pilot or the director of flight operations. In all likelihood, the permissive management environment at Air Ontario probably exacerbated such non-standard operational practices.

Additionally, the Transport Canada air carrier inspector appointed for the F-28 fleet, who was relatively inexperienced in the aircraft, may not have been in a strong position to impose appropriate standards.

Maintenance Problems with the F-28

A number of maintenance problems were encountered with the F-28. These were exacerbated by a lack of familiarity with the aircraft on the part of maintenance personnel and a shortage of spare parts. The journey log for the accident aircraft, C-FONF, listed a number of problems between June and December 1988, many of which were deferred for extended periods. These included earlier problems with the auxiliary power unit (APU) in August and October 1988. On several occasions in 1989 the cabin filled with smoke while passengers were aboard, and, in the week of the crash, the aircraft experienced cabin pressurization problems.

On the day of the accident, C-FONF was dispatched with an unserviceable APU and had three other deferred maintenance items, including roll and yaw in the autopilot and a fuel gauge that read intermittently. Other discrepancies that were brought to the attention of the flight crew by the cabin crew prior to the first flight on March 10 were inoperative exit lights, dim cabin emergency floor lighting, missing oxygen masks, and problems securing the main door handle because of a missing clip. Though these items, with the exception of the APU, do not have an appreciable safety significance, they reflect a haphazard maintenance philosophy that can result in accidents.

Flight Attendant Training

Flight attendant training at Air Ontario did not encourage flight attendants to bring operational issues to the attention of the flight deck or to question matters pertaining to flight operations. Training stressed the competence of pilots and fostered a position of total reliance on the flight crew. Two examples that demonstrate a separation of cabin and flight deck can be seen on the day of the accident: the hot refuelling of the aircraft in Dryden that was at variance with the flight attendant manual, and the failure of the flight attendants to relay passenger concerns about de-icing to the flight deck. In contrast to this lack of crew communication, the concepts taught in crew resource management stress the importance of complete information exchange between the flight deck and the cabin.

The Physical Component

A number of negative factors were present in the physical environment facing the crew on March 10. These included an aircraft with mechanical problems, no F-28 ground-start equipment in Dryden, poor weather with snow and freezing precipitation throughout the area of the flight, and a change in the passenger load in Thunder Bay that required an unplanned defuelling of the aircraft.

The Aircraft, C-FONF

The operations officers in Air Ontario SOC and the flight crew knew that the APU of aircraft C-FONF was unserviceable on the day of the crash. Mr Martin Kothbauer, the SOC duty manager, had even sent a message to Winnipeg, Thunder Bay, Dryden, and Sault Ste Marie to advise that C-FONF was operating without a serviceable APU and to ensure that the agents had the F-28 ground power and air start equipment ready. The message also stated that if air starts could not be provided, SOC was to be advised so it could set up hot refuelling. It was not determined what steps SOC would have taken to set up hot refuelling, if it was required, but Dryden had no F-28 start equipment, and there is no evidence that anything was done by SOC with regard to hot refuelling in Dryden.

There were other minor unserviceabilities on the aircraft that day, but none of them in isolation would pose a concern for any of the air crew. The accumulation of the unserviceabilities probably were frustrating for them.

The Weather

The weather conditions throughout the scheduled routing area of Air Ontario flights 1362 and 1363 were poor during March 10, 1989, and created complications for Captain Morwood. At Winnipeg he had the aircraft de-iced because it had frost on it, thereby causing the first delay of the day. Subsequently, because the weather at Thunder Bay was below published landing minima, flight 1362 was delayed on the ground in Dryden while it waited for the weather in Thunder Bay to improve. The alternate airport for all of the flight legs was Sault Ste Marie, rather than the normal closer alternates, which meant that more fuel had to be carried and that more attention had to be paid by the flight crew to the weather en route, at each destination and alternate airport, and to aircraft takeoff and landing weights. There was freezing precipitation, occasional freezing precipitation, or the risk of freezing precipitation forecast for all of the terminals in question, but the flight crew's knowledge of the implications of this forecast is not known. With regard to the operation of flights 1362 and 1363, there is no evidence that the forecast of freezing precipitation altered or otherwise played a part in Captain Morwood's decisions or in any of the decisions of the SOC personnel.

The weather in Dryden during the stopover of flight 1363 deteriorated from a VFR day with a ceiling of 4000 feet and visibility of 12 miles at landing to a low IFR day with the weather report at 12:06 p.m. CST, three minutes before the start of the takeoff roll, indicating a ceiling of 300 feet and visibility of three-eighths of a mile in snow. The lowest condition forecast for Dryden for the period of the flights was occasional ceiling 700 feet broken and visibility two miles in light rain and fog. The lowest condition forecast for Dryden in the forecast issued at 1630Z (10:30 a.m. CST and 11:30 a.m. EST), and available to the flight crew in Thunder Bay before takeoff for Dryden, was a broken ceiling at 3000 feet and visibility five miles in light rain, light freezing rain, and fog. This was the latest and last forecast issued for Dryden prior to the crash. There is evidence that SOC did not note the mention of freezing precipitation and that SOC did not pass the forecast to the crew of flight 1363.

The low ceilings and visibility encountered by the flight crew when they were preparing for the takeoff from Dryden may have surprised them somewhat. However, Canadian commercial pilots encounter poor weather conditions many times in their careers, and, for the most part, they accept poor weather as part of their job. Inevitably, though, poor weather conditions put extra pressures and workload on pilots both in flight planning and in flying the aircraft.

Activities in Thunder Bay

A number of decisions imposed by SOC resulted in flight 1363 falling further behind schedule. The decision to defuel in Thunder Bay after the aircraft had been refuelled, in order to take on board eight extra passengers, had an impact on the flight crew in many ways. The defuelling caused a further delay of 35 minutes in the departure, and Captain Morwood particularly disliked being late. Captain Morwood and First Officer Mills had to recalculate the takeoff and landing data to accommodate the increased passenger load and reduced fuel load. Captain Morwood's authority as the pilot-in-command, within Air Ontario's hybrid pilot self-dispatch and full co-authority dispatch system, to operate the flight as he deemed necessary with regard to fuel and passenger loads was effectively usurped by SOC in London, in that the SOC solution to the aircraft overweight condition (to defuel, rather than to off-load passengers) prevailed.

After the decision had been made to defuel the aircraft, both Captain Morwood and First Officer Mills got off the aircraft. Captain Morwood spoke to Mr Gary Linger, the owner of ESSO Flight Refuelling at the Thunder Bay airport and the person who defuelled the aircraft, and they discussed the amount of fuel to be taken off. During his testimony, Mr Linger described Captain Morwood in words such as "calm," "very professional," and "apologetic," in that Captain Morwood said to him: "Sorry to bring you down here again" (Transcript, vol. 56, pp. 82–89).

Flight attendant Sonia Hartwick testified that during the Thunder Bay station stop the crew were "becoming very frustrated." This frustration was expressed verbally and, in Mrs Hartwick's opinion, resulted from a combination of things that had happened earlier in the week and were happening to them in Thunder Bay. In testimony she stated:

> A. They were ... becoming very frustrated. They felt like we were all being ignored. No one was coming to our rescue. We sat there and we were actually delayed one hour in Thunder Bay.
> Q. As a matter of fact, did the captain to the best of your recollection make a bit of a comment that you recall?
> A. Well, he was very upset. He may have swore and said God damn it like this but ...
> Q. He felt ignored, didn't he?
> A. We all felt ignored. Passengers had connections to make in Winnipeg and we were delayed a total of an hour in Thunder Bay. So, we were worried about them as well.
> Q. Did you find that First Officer Mills felt slightly ignored and annoyed as well?
> A. Yes, they both –

Q. They both were?
A. Yes, they were.

(Transcript, vol. 10, pp. 191–92)

While Captain Morwood's frustration may not have been evident to Mr Linger, it was certainly evident to flight attendant Hartwick during discussions among the crew members. Although it is not conclusive from the evidence whether Captain Morwood's frustration influenced his decision making at Thunder Bay, it may well have manifested itself as a factor both in any consideration that should have been given to the option of overflying Dryden on the return leg to Winnipeg, having regard to the forecast freezing rain, and in the decision not to de-ice the aircraft with no operable APU and no ground-start facilities at Dryden.

The Crew Component

A number of factors present among the crew of the accident flight have been identified through research in other organizations as significant stressors that can serve to reduce flight crew effectiveness. These include situational factors surrounding the operation of the flight as well as characteristics of individual crew members.

Situational Factors

Crew Members' Knowledge and Training

Captain Morwood and First Officer Mills each had fewer than 100 hours of flight time on the F-28 aircraft. After completion of ground and simulator training at Piedmont, Captain Morwood returned to flying the Convair 580. His line transition to the F-28 was further delayed by the Air Ontario pilots' strike. The delay in reinforcing Captain Morwood's training on the line could have rendered him less effective initially. First Officer Mills received all of his training in the aircraft rather than the simulator. The lack of opportunity to use the simulator to acquire F-28 skills and confidence, particularly with respect to practising abnormal or emergency situations, could have affected First Officer Mills's ability with regard to abnormal and emergency situations on the F-28.

There is growing concern in the industry, based on several recent accidents in the United States, about the safety implications of pairing crew members new to an aircraft soon after completion of line indoctrination. It takes a significant amount of flight time to become comfortable with a new aircraft, particularly one substantially different from prior equipment. One of the basic premises of the crew concept of flight operations is that crew members support each other in safe and effective flight management. When both crew members are still becoming familiar

with the aircraft, the margin of safety is reduced. Efforts are under way in the United States to require newly qualified crew members to be scheduled with more experienced crew members for some time following completion of their initial operating experience (a mandated period after initial training of flying with a company check pilot while gaining familiarity with the aircraft in line operations). In that regard, the evidence of Captain Gert Andersson, a highly experienced pilot with Linjeflyg, a Swedish carrier flying F-28 aircraft in Europe, is worth noting. According to Captain Andersson, the Linjeflyg computerized crew-scheduling program precludes the scheduling of an inexperienced captain with an inexperienced first officer (Transcript, vol. 83, pp. 158–60). The crew-pairing problem caused by the introduction of a new aircraft type is, in my view, best addressed by bringing in outside expertise, as Air Ontario initially represented it was doing by hiring Captain Claude Castonguay, to support training, line indoctrination, and general flight operations until such time as company pilots have obtained the requisite experience levels to be paired together. Captain Castonguay, however, resigned after one month, citing lack of support by Air Ontario management.

Organizational Background and Experience Working Together

Several additional issues made the pairing of Captain Morwood and First Officer Mills potentially stressful. One was the fact that Captain Morwood came from Air Ontario Limited while First Officer Mills came from Austin Airways. Additionally, both men had been operating as captains in their prior aircraft. Individuals accustomed to acting as pilot-in-command have been noted to function less effectively when paired with one another, in that a captain wants to be a captain. A concern in that regard was expressed in evidence by Captain Erik Hansen, an Air Ontario F-28 pilot. He had no difficulty with the competence of First Officer Mills, but found that First Officer Mills had a tendency to make decisions that were not his to make (Transcript, vol. 94, p. 87). These factors, combined with the lack within Air Ontario of enforced standard operating procedures, including the noted failure to specify pilot-flying/pilot-not-flying duties in flight-training line indoctrination, could well have reduced the effectiveness of this crew as a team (Exhibit 744).

The week of March 6 to March 10, 1989, was the first time that Captain Morwood and First Officer Mills had flown together, and Captain Morwood was displaced by other captains for two days. At the time of the accident, their total time flying as a crew was just over two days. According to Dr Helmreich, experimental simulation research conducted by NASA-Ames Research Center found that crew

coordination and effectiveness are significantly increased by the simple fact of working together as a team.

Delays and Stresses Imposed by the Operating Environment

The initial flight segment on March 10 was delayed because the aircraft was de-iced in Winnipeg. As noted, there were also deferred APU unserviceability and minor mechanical problems with C-FONF. In a radio communication shortly after takeoff from Winnipeg, Captain Morwood commented, "everything else seems to be going wrong today" (Exhibit 375). Upon arrival at Dryden, flight 1362 was held on the ground for some 20 minutes while it waited for Thunder Bay weather to improve. Because of defuelling in Thunder Bay, departure from Thunder Bay was more than an hour behind schedule.

At Dryden, it was necessary to refuel flight 1363 with an engine running. It is not known why the passengers were not disembarked at Dryden during the hot refuelling. During the refuelling, snow was falling. As Captain Morwood had fewer than 100 hours in the aircraft type, he was required by Air Ontario policy to have higher takeoff weather limits than a more experienced pilot on type would have had. He may have been concerned that the visibility would be below his limits prior to departure. The flight was already running late, and a number of passengers had tight connections in Winnipeg. After the aircraft taxied for departure, a final delay of approximately three minutes was incurred waiting for the arrival of a Cessna 150 that was experiencing difficulties because of the poor weather. There is little doubt that the continual delays and problems encountered throughout the day added frustration and stress to the overall operation of flight 1363.

Personal Factors

Fatigue and Mood

The term acute fatigue is used to indicate short-term fatigue, such as the result of losing a night's sleep, while the term chronic fatigue is used to indicate long-term fatigue, such as the result of working long hours for an extended period of time. Acute fatigue is considered less serious because it can be relieved relatively easily, whereas chronic fatigue cannot. Further, acute fatigue is usually recognized by the person experiencing it, whereas chronic fatigue can be insidious because of a failure of the person involved to recognize it.

A review of the work schedules for Captain Morwood, First Officer Mills, and flight attendants Say and Hartwick for the period January 1, 1989, to March 10, 1989, indicates that none of them, based solely on

their work schedules, should have been suffering from chronic fatigue. They had days on duty and days off duty as follows: Morwood 31/38, Mills 39/30, Say 35/34, and Hartwick 33/36. Their flying schedule for the week of March 6 to 10 started each day at 7:30 a.m. and ended at 3:30 p.m.

The days on and days off, and the duty period each day are well within all of the maximum duty times for the flight crew (pilots) as specified in ANO Series VII, No. 2, section 41.1. While the flight attendants were also within the maximum duty times for flight crew, there are no regulatory requirements in the ANOs or elsewhere regarding maximum duty times for flight attendants. There was no evidence to indicate that any of the crew members were experiencing the effects of chronic fatigue.

There is some evidence that Captain Morwood, First Officer Mills, and flight attendant Say may have been experiencing mild acute fatigue. Flight attendant Hartwick stated in testimony that Captain Morwood had said in conversation that he had tossed and turned all week and was getting phone calls that interrupted his sleep. She also stated that Mrs Say had complained about her lack of sleep. First Officer Mills had complained that he had too much coffee, presumably a reference to his inability to get a good night's sleep (Transcript, vol. 10, pp. 156–58). Mrs Hartwick had had no difficulty sleeping and was not tired. "I was sleeping like a log. I got to bed really early that whole week, and I just bugged them [other crew members] about that" (Transcript, vol. 10, p. 158).

Mr David Adams, in testimony, discussed the investigation into possible fatigue of the crew:

> A. We collected as much information as was reasonably available in terms of what their duty times were, flight times, what their personal activities were in the week preceding the accident. We tried to determine where they had meals, what time they went to sleep, how many interruptions they went through during the evening, so on and so forth.
>
> And basically ... it's my opinion, that we exhausted all of those avenues of information.
>
> The information basically told me that Katherine Say, First Officer Mills and Captain Morwood were all probably suffering some degree of mild acute fatigue.
>
> The next step was to try and relate that condition, if it did probably exist, to the sequence of events leading to the accident. And I was not able to do that, other than to make the observation that one of the empirical findings of fatigue is an increased reporting of their subjective feelings of irritability by people who are fatigued.

> And I made the comment that if, in fact, this was the case, it may have contributed to Captain Morwood's feelings of frustration.
>
> But as far as I'm concerned, we exhausted the issue with the available information in this accident.
>
> (Transcript, vol. 159, pp. 184–85)

Dr Helmreich commented on Mr Adams's testimony as follows:

> A. I think Mr Adams put it perfectly. I certainly feel that the issue of fatigue is an important current research topic and it's one that's being investigated in a number of places. But I simply don't see it as having relevance to the scope of this Inquiry.
>
> (Transcript, vol. 159, p. 185)

The crew, according to flight attendant Hartwick, were in good humour throughout the week they flew together. When asked during her testimony about the mood of the crew members on March 6, the first day of their week's flying, she said, "They were in a very good mood ... They were happy, in fact, because they would be starting holidays the following week, so they were very happy" (Transcript, vol. 10, p. 134). Mrs Hartwick used the same type of words to describe the mood of the crew members each day that week. However, she did state that they were frustrated at times because of the defects on the aircraft and, particularly during the stop in Thunder Bay on March 10, 1989, with the delay and confusion regarding the extra passengers and defuelling.

Toxicology Results

Toxicological testing was completed on all of the deceased passengers and crew. The results for the crew members showed no evidence of alcohol or drugs. The results for flight attendant Say showed an elevated level of hydrogen cyanide in her blood. This finding is considered to be the result of inhalation of toxic gases that may be generated during the combustion of aircraft materials.

Captain George Morwood

Captain Morwood received 22 hours of F-28 simulator training following his initial ground school in 1988 and a further 8 hours 20 minutes during his recurrent training in 1989. At the time he commenced flying the F-28 as a line captain he had accumulated a total of 29 hours aircraft time, which included 27.5 hours of line indoctrination and 1.6 hours aircraft training. All of his check rides during training were well flown, and he received nothing but satisfactory comments on his training and check ride reports. At the time of the crash, Captain Morwood had 81 hours

on the F-28. I conclude that Captain Morwood was properly trained to fly the aircraft.

According to his record and the evidence of his peers, Captain Morwood was considered above average as a professional pilot. He had shown not only a concern, but a dogged determination in his pursuit of safety issues in his prior management positions. Captain Morwood during his F-28 training at Piedmont Airlines had been exposed to and was aware of the effects of icing on the F-28, including those caused by differential temperatures of fuel and ambient air. It should be noted, however, that, despite the best efforts of Commission staff, no direct evidence was found that either Captain Morwood or First Officer Mills was fully conversant with the cold-soaking phenomenon and its potential effect with respect to aircraft contamination.

The evidence of another senior Air Ontario captain, Mr Erik Hansen, who attended both the initial and the recurrent F-28 ground school with Captain Morwood, was that the sensitivity of the F-28 wing to contaminants was covered very thoroughly by Piedmont instructors. These same instructors, in response to Captain Morwood's questioning, insisted that the wings not only be clean for takeoff, but that they be "super clean" (Transcript, vol. 94, pp. 70–74).

Captain Hansen's evidence suggests that some Air Ontario Convair 580 pilots were not particularly concerned about wing contamination on that aircraft and that they had previously taken off with some contamination adhering to the aircraft. Captain Morwood may well have been one such pilot. He was reported by his colleagues to be a by-the-book pilot and, by Captain Hansen, "a proverbial instructor" when flying on the line (Transcript, vol. 94, p. 101). Another colleague described him as being "a little condescending," as coming from "the old school where the captain is the captain and the first officer is the first officer," and that he "wasn't quite as tied into the modern concept of the team concept" (Transcript, vol. 92, p. 61). In theory, this characteristic could have been an annoyance to highly experienced junior crew members such as First Officer Mills, who had considerable experience flying as a captain. Evidence from the surviving flight attendant and a company employee who occupied the flight-deck jump seat during the previous leg indicates, however, that the two pilots were getting along well together and were both in good moods.

Evidence from several witnesses shows that Captain Morwood had a strong commitment to on-time operations and a high level of concern for his passengers. A number of passengers had connecting flights in Winnipeg on March 10. Some of these passengers had expressed their concerns about missing their connections to the flight attendants, who in turn passed the concerns to the flight crew. In addition, Captain Morwood had a personal trip scheduled for the following day out of

Toronto. These factors could have heightened his motivation to complete the scheduled flying as near as possible to the schedule.

First Officer Keith Mills

First Officer Mills completed 8.3 hours of training and a 1.2-hour pilot proficiency check on the F-28 aircraft in February 1989; he did not have the opportunity to train in the simulator. He flew 20 hours of line indoctrination and then, with 29.5 hours on the aircraft, began duties as an F-28 first officer. His F-28 training and check ride reports, although incomplete, indicated that his training was satisfactory, although there were some elements of the training that were considered satisfactory only after debriefing.

First Officer Mills had a record of some difficulties with the aircraft-handling aspects of flying, but he met all regulatory requirements for competence. The fact that he did not receive simulator training in the F-28, along with Captain Morwood's long experience and reputation as a perpetual instructor, may have made First Officer Mills somewhat reluctant to practise optimal crew resource management concepts and to provide operational suggestions to Captain Morwood. First Officer Mills also had scheduled personal plans for the next day.

Flight Attendants Katherine Say and Sonia Hartwick

There was only one flight attendant activity that could have had a bearing on the captain's decision to take off: the flight attendants' going to the flight deck and expressing their concerns and those of the passengers regarding the accumulation of snow on the wings of the aircraft. Flight attendant Hartwick testified that she had heard passengers expressing their concerns about the accumulating snow, and she heard Special Constable Dennis Swift discussing the subject with flight attendant Say. Special Constable Swift, in testimony, corroborated Mrs Hartwick's testimony. Flight attendant Hartwick did not talk to the flight crew about the snow on the wings, and the evidence is overwhelming that flight attendant Say did not do so either. Cabin crew members are often reluctant to discuss operational problems with flight crew, as discussed in detail in chapter 39, Crew Coordination and Passengers' Safety Concerns.

Passengers and Ground Crew

There were two professional pilots on the flight as passengers, Captain David Berezuk and Captain Murray Haines. Although during their testimony they both stated they were very concerned about the buildup of contamination on the wings, neither of them, for their own reasons as discussed in chapter 39, passed his concerns to the cabin crew or the

flight crew. Two ground personnel, Mr Jerry Fillier and Mr Vaughan Cochrane, could have had an influence on the captain's decision to take off, although the accumulation of snow on the aircraft was not as great while the aircraft was at the ramp as it was later while the aircraft waited to take off. Mr Cochrane talked to the flight crew when he went to the flight deck to pass on information about the baggage, again when he passed the information about the fuel upload, and when he was asked by the captain about the availability of de-icing. There was some evidence that ground personnel are also reluctant to approach flight crew with operational concerns because of the fear of a rebuff, a cause for embarrassment.

The Situation on March 10, 1989

The picture that emerges from examination of the regulatory and organizational environments in which this crew was operating is one of an array of factors that served to undermine crew effectiveness and to increase their level of stress. I believe that none of these factors in isolation is likely to cause an accident – as evidenced by the fact that the F-28 was operated without an accident for several months prior to March 10. However, when these seemingly unrelated factors were combined with the particular conditions of the physical environment, the margin of safety was clearly reduced. Factors in the crew environment such as the operational unfamiliarity of the crew with each other and the aircraft, combined with absence of clear understandings with respect to communication within the crew, no doubt exacerbated the situation.

Operational Stressors

In considering the crew's actions on March 10, the operational factors that may have caused them stress should be reviewed. According to research in the field of human performance, psychological stress can serve to reduce individual and team effectiveness, especially in the areas of interpersonal communications and coordination and in decision making. Relevant classes of stressors include time pressure and frustrations associated with inadequate resources and suboptimal operating conditions. Captain Morwood and First Officer Mills faced a number of these conditions during March 10. It may provide a useful context for the situation at Dryden to summarize them.

- On accepting the aircraft in Winnipeg, the flight crew found the APU to be unserviceable. As noted previously, there were three more deferred maintenance items, as well as other items in the cabin that were reported by the flight attendants.

- The weather conditions throughout the region forced an initial delay for de-icing and the adoption of a more distant alternate, with a consequent requirement to carry additional fuel. Conditions also required the crew to be continually concerned about the weather.
- It was necessary to hot refuel during the stop in Dryden.
- The necessity to keep an engine running may have triggered concerns because of company policy, and a stated requirement in the Fokker Publication on Cold Weather Operation, that the aircraft could not be de-iced with the engines running.
- SOC dispatched the flight with a clearly erroneous flight release. It may have been a source of concern for the crew to have been dispatched with no explicit accommodation for the unserviceable APU under conditions of freezing rain.
- Both crew members had fewer than 100 hours in the F-28. In addition to the stress imposed by lack of familiarity with the aircraft, Captain Morwood had more restrictive company takeoff and landing weather limits because he had less than 100 hours on the aircraft type.
- The flight was delayed on its initial stop in Dryden because Thunder Bay weather was below Air Ontario landing limits.
- A major delay occurred in the departure of flight 1363 from Thunder Bay.
- There was considerable confusion surrounding the loading of additional passengers in Thunder Bay, and, after the aircraft had been refuelled, the need then to defuel the aircraft to meet weight restrictions. The defuelling added a further delay of 35 minutes to the already delayed flight.
- The crew had difficulty in Thunder Bay in obtaining assistance from Air Canada during the station stop.
- As the flight landed in Dryden, snow began to fall, with the intensity of the fall increasing during the stop. At the time of takeoff, the actual visibility was below the captain's takeoff minima.
- The date of the accident was the beginning of the March school break, and the aircraft was full. A number of passengers had flight connections to make in Winnipeg. If the connections were to be made, further delays, such as would have been necessitated by de-icing of the aircraft, could not likely be tolerated.
- Flight 1363 left the ramp at Dryden just over an hour behind schedule, only to be further delayed by the Cessna 150 that was caught in the snow storm.

While none of these issues alone can be considered an overwhelming stressor, taken together they indicate a taxing operational environment.

From the perspective of hindsight, it is likely that a change in any one of a number of conditions might have interrupted the sequence of events that led to the accident. The following four examples illustrate the point:

- A more stringently regulated and managed dispatch system should have precluded operations into Dryden on March 10, or at least on the return from Thunder Bay.
- A more stringent regulatory requirement and a mandatory training program on the effects of contamination, including the cold-soaking phenomenon, may well have created a greater sensitivity on the part of the flight crew to the potential for degraded airfoil performance.
- An effective training program in crew resource management could have resulted in a review of the operational situation involving both pilots and led to a critical evaluation of the appropriateness of the decision to take off without de-icing.
- Similarly, training that encouraged cabin crew members and ground support personnel to share operational concerns with flight crews and encouraged pilots to listen to such concerns might also have triggered further consideration of the implications of contamination on the aircraft.

The issues discussed in preceding sections have an empirical basis as significant influences on flight crew behaviour, but a weighting of each issue as a determinant of the outcome of flight 1363 cannot be made from the available record. Nor can the decision processes surrounding the takeoff from Dryden be specified in the absence of cockpit voice recorder evidence. However, considering the four components affecting crew behaviour, the regulatory, organizational, physical, and crew components, it is possible to construct a likely scenario for the crew's actions. It must be stressed that this scenario represents an after-the-fact reconstruction from the available evidence.

A Scenario for Crew Decision Making in Dryden

In retrospect, the operation into Dryden on the return from Thunder Bay, without a functioning APU and already behind schedule, is questionable. Certainly, making the stop would minimize passenger disruption. An alternative was to leave the extra passengers in Thunder Bay, carry additional fuel, and proceed directly to Winnipeg. The evidence of Captain Erik Hansen, an Air Ontario F-28 captain, is revealing:

> A. And the only thing I don't understand is why George decided to defuel in Thunder Bay to accommodate more passengers, because he was already late, I understand.

> And what I would have done differently was I would have told these passengers that just the space wasn't available. There are weight penalties, obviously. He had fuel to go all the way through to Winnipeg.

Later in the same discussion:

> Q. Supposing the decision in Thunder Bay to take on these passengers was not his but someone else's?
> A. It's still George's decision if he wants them or not. If he can give a good reason why he doesn't want them ...
> Q. Suppose he was told by SOC to take them on.
> A. I don't think George would be intimidated by SOC.
>
> (Transcript, vol. 94, pp. 172–76)

Although the latest forecast for the Dryden terminal available to the flight crew while they were in Thunder Bay forecast occasional light freezing rain, the forecast was not passed to the crew by SOC. There is no evidence to indicate whether the flight crew obtained the new Dryden forecast during the station stop in Thunder Bay. It is not known whether Captain Morwood considered the option of overflying Dryden; however, the option existed and would have been justified in light of the status of the aircraft, the fact that they were already behind schedule, and the forecast for freezing rain at Dryden.

The actual weather conditions on approach to Dryden were VFR. However, once the aircraft was on the ground in Dryden, the weather and the operational situation deteriorated. It should be noted that the crew was conducting a day of flying that must be considered stressful because of the mechanical problems with C-FONF, increasing delays, the frustrations experienced at Thunder Bay, the poor weather conditions, and the flight crew's relative inexperience in F-28 operations. While the aircraft was on the ground in Dryden, the following issues faced the crew:

- refuelling with an engine running;
- passenger connections at Winnipeg;
- de-icing with an engine running;
- the need to import ground-start equipment if both engines were to be shut down;
- the inconvenience and cost of stranding passengers in Dryden;
- snowfall during the stop, causing both aircraft and runway contamination;
- the implications of contamination on the aircraft;
- the implications of contamination on the runway;

- variance among Fokker, Piedmont, and USAir manuals regarding correction charts for takeoff from contaminated runways;
- deteriorating visibility that may have prevented the takeoff;
- the delay caused by the arrival of the Cessna 150; and
- personal plans of the crew for the next day.

According to Dr Helmreich, one of the effects of psychological stress, including that imposed by time pressure, is an inability to process multiple sources of information as effectively as under more relaxed conditions. As outlined in the previous section, a strong case can be made for a finding that the crew, and especially Captain Morwood as pilot-in-command, was under considerable stress by the time the flight stopped for the second time in Dryden. There is the evidence of Captain Morwood's demonstrated frustration during his telephone calls at the Air Ontario counter at Dryden. The aircraft load sheet containing aircraft weight and balance data was normally left with the station attendant immediately prior to departure from the ramp. According to the evidence of Mr Cochrane, the flight crew did not pass this document to him. In fact, after the aircraft was closed up and the second engine started, "First Officer Mills held the weight and balance up in the window to indicate that he had it in his possession" (Transcript, vol. 53, p. 163).

In addition, there was the evidence of Ms Jill Brannan, a Dryden Flight Centre employee on duty at the time of the accident, and of Mr Christopher Pike, who was near Ms Brannan at the time, that after flight 1363 taxied away from the ramp, there were two radio transmissions from the aircraft to the Dryden Flight Centre. Their evidence was that, during the radio transmissions, the pilot "seemed upset," "mad," "impatient," and "pissed off" at the prospect of yet a further delay caused by the Cessna 150 (Transcript, vol. 20, pp. 174–75; vol. 28, p. 22). The mood of the flight crew, combined with the lack of Air Ontario operational support and safety-oriented operating policies, may have precluded a rigorous crew evaluation of the operational situation.

The decision to take off raises several critical questions. One is whether the crew was fully aware of the safety implications of the accumulating snow. As noted, Captain Morwood had a history of concern and awareness of icing risks. He had delayed the initial flight of the day for de-icing. Testimony by a representative of Transport Canada described an incident when Captain Morwood insisted on going back to the gate in a Convair 580 for de-icing even though the Transport Canada inspector had remarked that the snow seemed dry and the propellers were blowing it off the wings. Also, a 1983 letter from Air

Ontario management endorsing a captain's authority to de-ice when circumstances require was found in Captain Morwood's flight bag at the accident scene.

Perhaps the most revealing incident of Captain Morwood's normally cautious attitude is an experience cited in evidence by a former first officer previously paired with Captain Morwood on the F-28, Captain Keith Fox. Captain Fox stated that while their aircraft was being de-iced in Toronto on February 26, 1989, both generators flickered on and off after engine start. He said it appeared obvious to them that the engines had ingested some de-icing spray:

> A. We shut the ... engines down and George, Captain Morwood said, well, it's probably something minor but, you know, we do not have bags of time on this aircraft. Let's get it checked out.
> (Transcript, vol. 51, p. 85)

This evidence reflects Captain Morwood's normally conservative approach, and it also serves to indicate that there was a concern for the possible consequences of ingestion of de-icing fluid should de-icing take place with an engine running.

A second question is whether the flight crew was aware of the accumulation of snow on the wings at Dryden. The captain walked across the ramp to the terminal and back in his shirtsleeves during the stop and would have been aware of snow falling. During a telephone conversation with Ms Mary Ward at SOC in London during the stop, he commented to her that the weather at Dryden was "going down." At 12 noon, First Officer Mills advised Kenora Flight Service Station to the following effect: "We're down to about a mile and a half in Dryden in snow right now, quite puffy, snow, looks like it's going to be a heavy one" (Exhibit 7A, p. 29).

The flight crew also had the ability to observe the outer portion of the wings from the cockpit, and the testimony of informed passengers indicated that snow was accumulating there. The fact that Captain Morwood inquired of the station manager at Dryden about de-icing suggests an awareness of the problem. It is, in my view, inconceivable that the flight crew would have been unaware of snow on the wings.

It seems most likely that Captain Morwood weighed costs and benefits surrounding the issues referred to above and concluded that the best course of action would be to leave Dryden as soon as possible. Several factors may have influenced this decision. The multiple stressors involved in the situation, along with Captain Morwood's focus on completing the trip, may have caused him to concentrate on the benefits rather than the risks of taking off. The ambiguity of the Air Ontario procedures for de-icing with an engine running, combined with his

earlier experience with Captain Fox in Toronto, could also have influenced his decision not to de-ice the aircraft in Dryden.

The role of First Officer Mills in Captain Morwood's decision-making process could not be determined. However, based on considerations of Captain Morwood's history, it is not likely that he would have heavily involved First Officer Mills in the decision-making process.

It is probable that, with wet snow falling, the flight crew did not consider the effects of the phenomenon of cold soaking. Air Ontario pilots who gave evidence during the hearings demonstrated that they were not fully aware of the concept or the implications of cold soaking, particularly as it related to weather conditions such as existed in Dryden on March 10. The Piedmont F-28 Operations Manual, which was used by Air Ontario pilots, addresses the cold-soaking phenomenon in its Cold Weather Operations section. It states as follows:

> When the tanks contain sufficient fuel of sub zero temperatures as may be the case after long flights at very low ambient temperature, water condensation or rain will freeze on the wing upper surfaces during the ground stop forming a smooth, hardly visible ice coating.
>
> During takeoff this ice may break awaõ¼y and at the moment of rotation enter the engine causing compressor stall and/or engine damage.
>
> (Exhibit 307, Piedmont F-28 Manual, 3A-24-1)

The caution relates to potential engine damage on takeoff rather than to the aerodynamic consequences of electing to take off with ice on the wing. Notwithstanding, the above information, combined with the other cautionary notes listed in the Piedmont and USAir manuals and the Fokker F-28 Flight Handbook, should have served to alert the flight crew of the need to inspect the wings prior to takeoff.

Given the large fluffy flakes coming down and the lack of accumulation on the tarmac surrounding the aircraft, the decision may well have been reached by the crew that the snow was melting and, therefore, would not adhere to the wing during the takeoff roll. The possibility that rough granular ice was developing under the snow on the upper surfaces of the wings because of the cold soaking was not likely considered by either Captain Morwood or First Officer Mills.

Once the aircraft was on the ground in Dryden, the implications of a long delay probably had an influence on the captain's decision to take off. Captain Morwood was clearly concerned about holiday passengers who were anxious to make connecting flights in Winnipeg, and both he and First Officer Mills had personal plans for the next day. Had the flight been cancelled in Dryden, it would have been necessary to fly in ground-start equipment, causing a lengthy delay and disruption of crew and passenger plans.

A last chance to re-evaluate the situation was probably missed when the flight took its final delay for the landing of the Cessna 150. It should be noted that a radio transmission from First Officer Mills to Kenora FSS in response to a request to hold for the Cessna 150 indicated that "we're down to about half a mile," referring to the visibility restriction caused by the snowfall. However, the accumulation of stress and frustration surrounding the day's operations had probably reduced the crew's effectiveness and decision-making capabilities by this time, as evidenced by the fact that the poor visibility did not affect the captain's decision to take off.

It is my considered opinion, after a thorough review of all the evidence, that the captain's decision to take off was made with the knowledge that snow was accumulating on the aircraft but with the mistaken perception and confidence that the snow was not adhering to the wings and would blow off during the takeoff roll. I do not believe that either Captain Morwood or First Officer Mills recognized the possibility that the cold-soaking effect could cause the wet snow to freeze to the upper surfaces of the wings; otherwise, based on his past performance, Captain Morwood would not have attempted to take off without first verifying his perception or having the aircraft de-iced.

Captain Morwood, as the pilot-in-command, must bear responsibility for the decision to land and to take off in Dryden on the day in question. However, it is equally clear that the air transportation system failed him by allowing him to be placed in a situation where he did not have all the necessary tools that should have supported him in making the proper decision.

Commercial and Operational Risk: Management Factors

Having examined the issues that most directly confronted the crew of flight 1363, I was particularly struck by certain evidence provided during the examination of Mr William Deluce, chief executive officer of Air Ontario Inc. The evidence related to the apparent difference in operating policy between Air Canada and Air Ontario regarding the dispatch of an aircraft with an unserviceable APU into a station with no appropriate ground-start facilities. The evidence is as follows:

> Q. Air Canada when it takes a jet like a 727 will not bring it into a place like Fredericton because there are no ground-start facilities in Fredericton, okay, that is a given.
>
> Bill Deluce and Air Ontario acquire a new fleet of jets and they require APUs. My question to you, sir, is: Would Air

> Ontario take your jet fleet that you could acquire tomorrow or next week and fly your jets into a place like Fredericton when there are no ground-start facilities available in Fredericton?
>
> A. Again, under those circumstances, we would make an assessment because ... the fact that you have or do not have an APU affects at the end of the day the reliability of that service, and ... I can only reiterate that there is nothing unsafe about flying into a place with no APU.
>
> Air Canada – and can't speak for Air Canada ... may have a policy like that .... I don't know why they have their policies the way they are. I can tell you that each company has – looks at ways – the commercial – we will call it the commercial risk differently and different companies may come to different conclusions about what level of commercial risk they are prepared to take.
>
> (Transcript, vol. 154, pp. 175–76)

Mr Deluce's evidence, when considered in isolation, appears quite innocuous. Certainly, different companies accept different levels of commercial risk as they see fit. There is nothing wrong with that; there is no flight safety consequence to the commercial risk that an airline is prepared to assume, provided that the commercial risk is not somehow translated into operational risk.

I interpret Mr Deluce to be saying in the cited quotation that Air Ontario was prepared to accept the commercial risk of grounding an aircraft at an outlying base that has no ground-start facility. Such commercial risk would include a consideration of:

- the inconvenience to stranded and downstream passengers, and resulting loss of goodwill;
- the cost of accommodating the stranded passengers; and
- the cost of replacement aircraft and crew.

Air Canada, apparently, is not prepared to accept such risk.

Mr Deluce also testified "there is nothing unsafe about flying into a place with no APU." Indeed, this is true if the operational personnel in a company clearly understand that the company is willing to accept the commercial risk of grounding an aircraft. I am of the view that, in such circumstances, the acceptance of commercial risk has no flight safety implication only if a documented operational policy exists reflecting the fact that conservatism and safety must prevail, and that such policy is clearly understood by flight crews, operational managers, dispatchers, and maintenance personnel.

If the prevalent operational management attitude in an airline was one where personnel are encouraged, either implicitly or explicitly, to push the limits of what is legal and sound operational practice, then the

commercial risk spoken of by Mr Deluce may be translated into operational risk. This is clearly not acceptable. For instance, when a pilot faced with the Dryden scenario clearly understands from published company policy that the company is willing to accept in such circumstances aircraft groundings or extended delays, then Mr Deluce may be right in saying that there is no flight safety implication to his company's policy regarding commercial risk.

In order to make an assessment as to whether Air Ontario was in fact willing to incur such delays and disruptions of schedules, with associated costs, it was necessary to review evidence that was indicative of the operational attitude of its management.

The following facts are representative of the Air Ontario operational management attitude in the months leading up to the accident on March 10.

- In an undated status report written by Captain Joseph Deluce, the F-28 project manager, in late June or July 1988, he pointed to reliability as the single most important problem with the F-28 program at that early stage. Inexperienced flight crews, low levels of expertise among maintenance personnel, and insufficient spares availability were identified as the causes of the reliability problems. To overcome the problems of inexperience and lack of expertise, Captain Deluce suggested in his report that aircraft utilization be significantly increased. Captain Deluce also suggested that if they did not fly the F-28 more, then their profit projections would not be realized.

  I find the suggestions of Captain Deluce to be very troublesome. In the normal course one would expect, and rely upon, operational management to advocate conservative operational practice in the face of production pressures coming from the financial side of the organization. Instead, the opposite was true, and I find that was a significant problem in the management of the F-28 program. In fact, in this case, the more conservative judgement of Mr Thomas Syme, who had no operational experience, carried the day and the more restrictive F-28 utilization continued.
- It was demonstrated throughout chapter 25 of this Report, Management Performance, that when Captain Joseph Deluce was unchecked in his supervision of the F-28 program, pilots were left to determine their own standards and operational practices; often prudence and conservatism were lost in the pilots' collective enthusiasm to see their first jet operation succeed.
- F-28 pilots, including the chief pilot, Joseph Deluce, passed along reports of aircraft defects on pieces of paper in order to avoid grounding the aircraft (apparent violation of ANO Series VIII, No. 2).

- Captain Christian Maybury, when questioned about the practice of passing such messages on pieces of paper, testified: "As pilots, we wanted this operation to be successful. And I think that's what influenced our thinking in a lot of ways and why we tolerated a lot of this stuff for as long as we did" (Transcript, vol. 92, p. 115).
- For a period of six months after F-28 service was introduced, maintenance of essential aircraft equipment was deferred, though there was no approved MEL against which deferrals could be made (apparent violation of ANO Series II, No. 20).
- When asked about his own maintenance deferral practices, the director of flight operations, Captain Robert Nyman, testified that they were against "the legal letter of the law."
- On April 5, 1989, Captain Perkins operated the F-28 aircraft on a revenue flight from Winnipeg to Toronto without a serviceable master warning light, an item that he agreed, in evidence before this Inquiry, was an essential airworthiness item. The item was improperly deferred in the aircraft journey log. In a memorandum to Mr James Morrison, then Air Ontario's vice-president of flight operations, Captain Joseph Deluce defended Captain Perkins's decision on the basis that Captain Perkins was "comfortable with the warnings that were available" and "comfortable with Maintenance's decision to defer this item." Captain Deluce then stated that "with hindsight and questions being asked," he questioned whether the item should have been deferred and that he would attempt to get a better interpretation from Transport Canada on "what and how items can be deferred and when they can not" (Exhibit 337). The incident was but another indication of a tendency to keep the operation on schedule and sort out the details later.
- Captain Alfred Reichenbacher and First Officer Monty Allan, surprised one day at the general state of unserviceability of their F-28 aircraft, recorded a large number of snags in the aircraft journey log, effectively grounding the aircraft until they could be rectified. For this they were taken to task and threatened with suspension by the chief pilot.

If the actions and attitudes of the Air Ontario F-28 chief pilot and of the vice-president of flight operations are an indication of the standards of operation that were permitted, if not encouraged, then it is apparent how Mr William Deluce's commercial risk of a grounded aircraft in a Dryden scenario could turn into an operational risk of an attempted takeoff. A pilot would want to avoid the grounding of an aircraft because there is a possibility that he would have to answer to the company for having put the aircraft in the position of being grounded.

Given this state of mind, in a "bending the letter of the law" operational environment, where less restrictive operational practices are preferred, a pilot may be encouraged to encroach upon the margin of safety and attempt a takeoff with contaminated wings.

Flight Safety: The Air Ontario Corporate Business Plan

From a corporate perspective, the 1988 Air Ontario Inc. business plan (Exhibit 936) contained a mission statement that referred in part to "the creation of a safe and reliable diversified regional airline system." Yet, I could find no evidence of a company safety policy that, at the corporate level, reflected an overriding commitment to safety other than the above-noted general statement. Since the statement was contained in the company's business plan, it is unlikely that it received company-wide distribution.

The position of flight safety officer within the company appeared to have an "on again–off again" history. The original flight safety officer, Captain Ronald Stewart, resigned in 1987 after two years in the position, largely because of a lack of management support. Captain James Byers turned the position down because of a lack of a documented job description. Captain Stewart accepted the position for the second time approximately six weeks before the March 10, 1989, Dryden accident. A review of Air Ontario's investigation into three Air Ontario incidents, all involving Captain Joseph Deluce and two of which were takeoffs with a contaminated aircraft requiring an immediate return to the airport, have convinced me that whatever flight safety organization might have existed had little if any management support and was largely ineffective.

It is clear from the evidence that flight safety management within Air Ontario was left to operational managers and their appointees. From a corporate perspective, the commitment to safety management was, in the years preceding the Dryden accident, largely cosmetic. In light of the corporate and operational management attitudes discussed in this chapter of the Report, combined with the lack of an effective regulatory safety net, I can readily understand how commercial risk would become operational risk.

Safety Management

In light of the preceding discussion regarding the cause-and-effect relationship between commercial risk and operational risk, I refer to the writings of Dr C.O. Miller. In a paper entitled "Investigating the Management Factors in an Airline Accident" presented in 1990 to the

Brazilian Congress of Flight Safety (Exhibit 1251), Dr Miller made some observations that are, in my view, highly relevant. In the interests of brevity, key points are summarized as follows:

- There is a general lack of understanding of what constitutes safety/accident-prevention management throughout many parts of the aviation community.
- Airline and other management must become more attentive to accident prevention management for reasons of potential liability personally, let alone corporate liability in the event of an accident.
- Airline executives should make a corporate commitment to vigorous, viable, and visible proactive flight safety programs.
- Investigation of accidents in civil aviation does not have a procedure or protocol that will encourage examination of management failures in a causal sense. As a result, the management system leading to the failure often goes unchallenged. In that regard, International Civil Aviation Organization Annex 13 has yet to address management failures. I would observe that the most recent Transportation Safety Board accident investigation manual addresses the issue, but in a peripheral rather than a comprehensive manner. Nor is there any requirement in Canadian aviation regulations for a Canadian air carrier to have in place a comprehensive safety management plan.
- Safety policy that simply says "safety is our total priority," but is unsupported by a meaningful safety plan, is unacceptable.

On January 30, 1989, the International Air Transport Association issued a policy item to its member air carriers entitled "Airline Safety Manager." The policy states:

1. All airlines should establish a professional Safety Manager.
2. All airlines should support the following Flight Safety functions:
   a. Organisation of Accident Prevention Programmes
   b. Collection/Analysis/Communication of Safety Information
   c. Technical and Safety Coordination
   d. Corporate Emergency Response Procedures

The reason stated for adoption of the policy is quoted as follows:

> Governments charge the airlines with the responsibility of satisfying the public need for safety and reliable air transport. This responsibility cannot be discharged without provision of adequate professional review of all safety related activities of each airline. To do this

> effectively and efficiently, it is imperative that a professional Flight Safety Management post be established and adequate safety management functions supported.
>
> (IHTA Technical Policy – Flight Safety Management)

I find the observations summarized by Dr Miller as well as the essence of the IATA policy document most appropriate to the evidence before me as they relate to the management aspects of this accident. I would go further and observe that they are not only relevant to air carrier management, but also to the management of regulatory bodies responsible for aviation safety.

Findings

- All of the air crew of Air Ontario flight 1363 on March 10, 1989, were certified and qualified for the flight in accordance with existing regulations.

- There was no evidence found that physical or psychological factors affected the air crew's performance.

- The facts derived from the Inquiry into the crash of Air Ontario flight 1363 are indicative of an operational environment that allowed an experienced captain to reach a flawed decision regarding the safety of takeoff during a heavy snowfall with accumulating contamination on the aircraft's wings.

- Neither Transport Canada in general nor Air Ontario in particular provided adequate information to pilots regarding the cold-soaking phenomenon and its effects on aircraft contamination after flight in conditions conducive to cold soaking.

- The preponderance of evidence indicates, and I find, that the fuel in the aircraft wing tanks of C-FONF was exposed to subzero temperatures in flight resulting in the manifestation of the cold-soaking phenomenon on the ground at Dryden.

- Captain Morwood was not sufficiently aware of or knowledgeable about the cold-soaking phenomenon to alert him to the possibility that fuel of subfreezing temperature in the aircraft wing fuel tanks could cause wet snow to freeze to the aircraft wings.

- The Air Ontario accident at Dryden, like similar aircraft wing contamination accidents, was preventable and should not have occurred.

- Had the required effective and adequate resources, regulations, procedures, training, and policies identified throughout this Inquiry been in place on March 10, 1989, it is possible, and indeed likely, that the event sequence that resulted in the accident would have been interrupted.

- A lack of understanding existed within the aviation industry in general and within Air Ontario in particular with respect to both safety and accident-prevention management, with a resultant lack of Air Ontario management attention and commitment to these important areas prior to the Dryden accident.

- The regulatory environment allowed decisions to be made that led to the lack of a complete safety net for the flight crew of flight 1363. I cite only two examples: the use of different aircraft operating manuals on the flight deck of the F-28, and the lack of a definitive regulation regarding aircraft contamination.

- The senior management of Air Ontario failed to ensure that commercial risk did not translate into operational risk. For example, C-FONF was allowed to land at Dryden in weather conditions that could have required that the aircraft be de-iced while the aircraft's APU was unserviceable and there was no F-28 ground-start equipment at Dryden.

- Air Ontario's efforts in the area of safety management in the critical months of the company's restructuring prior to the accident received little or no priority and can best be described as cosmetic.

- The Air Ontario policy that did not allow an F-28 aircraft to be de-iced while one of its main engines was running may have influenced Captain Morwood's decision not to de-ice the aircraft at Dryden. It is not known to what extent Captain Morwood was aware of this policy or what he thought of it.

- The weather conditions on March 10 were such that the flight crew of flight 1363 had to be concerned about the weather, but Air Ontario SOC personnel did nothing to assist the crew in operational decisions involving the weather, other than to delay the flight in Dryden on its first stop.

- The slush accumulation on the eastern end of the runway at Dryden contributed to a longer than usual takeoff roll by flight 1363.

- Air Ontario did not provide to its F-28 flight crews, nor did Transport Canada require, runway slush-correction charts that were readily usable in the aircraft cockpit.

- The aircraft C-FONF was not in a completely serviceable state, thereby putting additional pressure on the crew.

- The weather conditions on March 10, 1989, required that the flight crew of C-FONF use a more distant alternate airport, a situation that resulted in the crew's having to pay more attention to fuel and aircraft weight.

- Many of the events that occurred on March 10, 1989, served to increase the frustration levels of the crew members of flight 1363. Frustration can lead to hasty or ill-conceived decisions.

- In the investigation of accidents in civil aviation, there is no procedure or protocol that encourages examination of management failures relating to the cause of an aircraft accident. The most recent accident investigation manual of the Transportation Safety Board of Canada, while it addresses management failures peripherally, does not do so in a comprehensive manner.

RECOMMENDATIONS

The Human Performance chapter of this Report is, in many ways, a synthesis of all the issues that the crew faced on March 10, 1989, and recommendations on such issues have already been set out elsewhere. It is not my intent to repeat these recommendations in detail in this chapter, but, in the interests of continuity, a synopsis of the principal recommendations already addressed and relevant to Human Performance includes:

- A renewed air carrier certification and inspection program incorporating improved safety regulations, adequate resources, and properly qualified and trained personnel be implemented by Transport Canada on a priority basis.
- Formal training of all air carrier crew members in crew resource management be made mandatory by regulation.

- Crew-oriented training and evaluation be actively pursued jointly by Canadian air carriers and Transport Canada as a more effective means of training and evaluating air carrier flight crews.
- The appointment of an air carrier flight safety officer, approved by Transport Canada, and the establishment of an approved flight safety program by all Canadian air carriers be made a regulatory requirement.
- A systematic and comprehensive discussion regarding cold soaking, based on research such as was conducted for and on behalf of this Commission of Inquiry, be inserted in air carriers' flight operations manuals and/or aircraft operating manuals and in government publications such as the Aeronautical Information Publication in order to make all pilots and aviation operational personnel aware of the various factors that may cause contamination to adhere to lifting surfaces.

Recommendations not previously addressed and specific to this chapter are as follows:

MCR 175 That the Transportation Safety Board of Canada further develop its human factors investigation procedures into human factors aspects of aviation accidents to include a comprehensive section addressing the role of air carrier management in the area of flight safety management; and that the board encourage examination of management failures in a causal sense as part of its accident investigation procedures.

MCR 176 In conjunction with MCR 175 above, that the Transportation Safety Board of Canada actively pursue the amendment of appropriate International Civil Aviation Organization documents to address in a similar manner the role of air carrier management in the area of flight safety management.

PART EIGHT

LEGAL AND OTHER ISSUES BEFORE THE COMMISSION

41 THE AVIATION ACCIDENT INVESTIGATION PROCESS IN CANADA

As a result of the work undertaken by this Commission, several flaws were identified in the aviation accident investigation process in Canada.

In my first *Interim Report* of November 30, 1989, I pointed out that this Commission was born out of the public controversy surrounding the investigation by the Canadian Aviation Safety Board (CASB) of the Arrow Air DC-8 crash at Gander, Newfoundland, on December 15, 1985. Having recognized, early in the process, that an important objective of my Commission was to endeavour to re-establish public confidence in the accident investigation process in this country, I made the following commitment at the formal hearings of the Commission on June 16, 1989:

> If during the course of this investigation fundamental flaws were found in this process, then appropriate recommendations will be made by me.
>
> (*Interim Report*, p. 9)

This chapter of my report is written in response to that commitment.

At the outset it should be noted that the field phase of the Dryden crash investigation had already been completed by the CASB investigating team by the time that this Commission was constituted on March 29, 1989. Thus, I was not involved in the conduct of the initial phase of the investigation.

However, during the remainder of the investigation, conducted under the auspices of my Commission, I have had an opportunity to observe first hand the effectiveness of CASB's organizational structure, investigative methodology, and practices. I can state that I was generally favourably impressed with the calibre of individual CASB staff members who were seconded to this Commission to assist in the investigation of the Dryden crash. In particular, I must single out Mr Joseph Jackson, the investigator in charge, Mr David Rohrer, the chairman of the operations group, and Mr David Adams, the human factors expert working for CASB on secondment from the Bureau of Air Safety Investigation in Australia, all of whom were seconded on a full-time basis to my Commission from CASB. Each epitomizes consummate professionalism

in his work and each has made an invaluable contribution to this process.

A prerequisite for an evaluation of the Canadian aviation accident investigation process is a review of some of the basic principles laid down in the *Canadian Transportation Accident Investigation and Safety Board (CTAISB) Act*, S.C. 1989, c.3. The Act established the multi-modal Canadian Transportation Accident Investigation and Safety Board (CTAISB), which replaced CASB, as the aviation accident investigating authority in Canada. Subsequently the federal identity program formally changed the short title to the Transportation Safety Board of Canada (TSB).

As a result of observations that I have made in the course of the proceedings of this Inquiry, the briefs and investigators' reports received, and consultations with Commission of Inquiry investigators, counsel, and technical advisers, I have concluded that the *CTAISB Act* contains several provisions, as did its predecessor *CASB Act*, which impair the investigative process and compromise the independence of the Canadian investigating authority. Of particular concern are the Act's provisions dealing with:

- the granting of observer status to interested parties;
- the privileged status of certain factual evidence, including witness statements, on-board recordings, and air traffic control communications;
- the requirement for the TSB's draft report to be reviewed by interested parties.

In addition, six other areas of concern have come to my attention on which I feel obliged to report:

- the training of investigators;
- the taping and transcription of interviews;
- the lack of use of outside experts by the investigating authority;
- the lack of forensic training for TSB scientists;
- the need for greater emphasis by the board of the TSB on human factors in aviation accidents;
- the monitoring of TSB recommendations.

I will now deal with each of these concerns affecting the investigative process and comment upon them. I have confined my comments and the recommendations which follow to the matter of aviation occurrences.

The Granting of Observer Status to Interested Parties

It should be pointed out that in the case of a major aviation occurrence, such as the Dryden crash, the investigation is conducted by a team of investigators led by the investigator in charge (IIC). Investigators are generally assigned to specific investigating groups within the team in accordance with their area of expertise and under the leadership of a group chairman.

A party having a direct interest in the investigation of an aviation occurrence in Canada has no legal right whatsoever to attend at that investigation, even as an observer, unless invited by the board to so attend under the provisions of section 23(2)(*d*) of the *CTAISB Act*. Section 23(2) reads as follows:

> Subject to any conditions that the Board may impose, a person may attend as an observer at an investigation of a transportation occurrence conducted by the Board if the person
> (*a*) is designated as an observer by the Minister of Transport in order to obtain timely information relevant to the responsibilities of that Minister;
> (*b*) is designated as an observer by the Minister responsible for a department having a direct interest in the subject-matter of the investigation;
> (*c*) has observer status or is an accredited representative or an adviser to an accredited representative, pursuant to an international agreement or convention relating to transportation to which Canada is a party; or
> (*d*) is invited by the Board to attend as an observer because, in the opinion of the Board, the person has a direct interest in the subject-matter of the investigation and will contribute to achieving the Board's object.

Section 23(3) of the Act contains a provision for the removal of an observer from an investigation:

> The Board may remove an observer from an investigation if the observer contravenes a condition imposed by the Board on the observer's presence or if, in the Board's opinion, the observer has a conflict of interest that impedes the conduct of the investigation.

The investigation of a major air carrier accident is a formidable task under the best of circumstances. Since such an accident is a manifestation of failure in a complex system that is designed to operate accident-free, it would be logical to assume that the system's designers are in a

good position to identify and correct the flaws that underlie the accident. This, however, would mean that the investigation of an air carrier accident would be left in the hands of manufacturers, air carriers, regulators, and others responsible for the system's daily functioning. Although such an investigation would benefit from the expertise available, it would probably lack objectivity when one of these parties inevitably assumed a dominant role. After all, each of these parties has at risk a reputation or a financial stake, or both, depending on the outcome of the investigation.

To avoid the possibility of relying on any of the interested parties involved, most countries have established independent aviation accident investigating authorities in accordance with International Civil Aviation Organization (ICAO) guidelines. Canada has done so with the creation of CTAISB in 1990 and its predecessor CASB in 1984. Given proper staffing, training, and procedures, these authorities develop specialized skills in investigation management. It should be pointed out, however, that, unless investigators within such organizations have an opportunity to keep abreast of technological advances, there is a drawback inherent in the investigating authority's relying only upon a permanent staff of investigators. While gaining the necessary investigative skills, aviation accident investigators, over time, may lose some of their currency in the field of expertise that brought them to the authority in the first place. Periodic refresher courses do not necessarily give assurance that the investigators are fully familiar with the aviation system's current technological advances, peculiarities, and pitfalls.

I make these observations to emphasize the need to keep abreast of new technologies in the industry. It is wise for the investigating authority to avail itself of the expertise within the aviation industry by seeking, on an ad hoc basis, the services of persons with special expertise from within the aviation industry on investigative teams controlled by government investigators, as was in fact done by this Commission.

Practical experience has shown that a coordinated investigative effort is best achieved by using the group system of investigation, as recommended and explained in the ICAO Manual of Aircraft Accident Investigation. In my view the functioning of the group system is enhanced by granting to appropriate representatives of the interested parties, who possess special expertise, status as participants in the accident investigation. It is on this point that I find the Act fundamentally flawed in that it does not guarantee status for interested parties.

The only status for qualified representatives of the interested parties on aviation accident investigation teams, recognized by section 23 of the Act, is that of observer-invitee. By definition, the observer role is a limited role, and its limitations are exacerbated by the Act's prohibition

against the exchange of certain information as explained in the discussion of witness statements that follows.

Inasmuch as this Commission of Inquiry derives from the provisions of the *Inquiries Act* and was not bound by either the provisions of the *CTAISB Act* or the predecessor *CASB Act* in the conduct of its investigation, and seeking to benefit from the best expertise available, I granted to interested parties, on an experimental basis, the right to second persons with particular expertise from among their ranks as full-fledged participants in specific investigation groups (see pages 10–14, 17, and appendix D of my first *Interim Report*). This experiment provided to the investigating teams expertise that was not otherwise available and proved to be highly successful.

It is my recommendation that the Act be amended to provide to interested parties the right to full participant status on CTAISB investigating team groups, by secondment to those groups of individuals from among the interested parties who, in the opinion of the board, possess expertise enabling them to contribute to the investigation.

I am indebted to the parties who made the expertise available, to the participants themselves, and to the CASB investigators seconded to my Commission, under whose leadership the technical investigation of the Dryden accident was successfully completed.

The Privileged Status of Certain Factual Evidence

Sections 28 and 29 of the Act, respectively, provide, inter alia, that onboard recordings made on the flight deck of an aircraft, and a communications record relating to air traffic control or related matters, are privileged. Section 30 of the Act provides that statements relating to a transportation occurrence and the identity of the author are privileged.

Sections 28(5), 29(5), and 30(4), respectively, provide that such onboard recordings, communications records, and statements shall be made available to the following persons only:

> (*a*) a peace officer authorized by law to gain access thereto;
> (*b*) a coroner who requests access thereto for the purpose of an investigation that the coroner is conducting; or
> (*c*) any person carrying out a coordinated investigation under section 18 or designated as an observer by the Minister of Transport under subsection 23(2).

It is obvious from a reading of these sections that even those persons invited by the board itself to attend as observers, pursuant to section

23(2)(*d*), are effectively excluded, by virtue of these provisions, from examining the material in question.

It will also be seen that there is no specific provision in these sections of the Act by which any of this material could be made available to individuals who would be granted, pursuant to my previous recommendation, participant status on investigation team groups, as representatives of parties who have a direct interest in an aviation occurrence.

The analysis of the evidence begins well before the fact-gathering phase of an aviation accident investigation is completed. There cannot be a meaningful fact-finding process unless the potential importance of each new piece of evidence is analysed and used to determine the scope and direction of the investigative effort. A theorizing process is essential to a thorough investigation since it leads to the exploration of every possible avenue in the search for all of the facts.

To ensure that the collective expertise of the investigation team is brought to bear on the development and testing of theories, incoming factual information should be freely shared with all team members, including experts seconded from the participating parties. Unencumbered by the provisions of the *CASB Act* (now the *CTAISB Act*), and, after due consideration, I decided to direct that all participants on specific investigating team groups operating under my Commission of Inquiry would share in all factual material from the investigation, in return for an undertaking of confidentiality. I can report that there was a very satisfactory result and a clear benefit, in terms of the additional expertise provided, from this decision. The truth is that certain provisions of the Act hamstring the board in the application of this concept. In addition to permitting interested parties to participate at an investigation only as invited observers, sections 28, 29, and 30 of the Act list various items of evidentiary material, such as air traffic control tapes, cockpit voice recordings, and witness statements, that cannot be released to observers representing interested parties on the investigation team.

It is of interest to note that ICAO Aircraft Accident Investigation, Annex 13 to the Convention on International Civil Aviation (7th ed., May 1988), recognizes participants, not observers. Section 5.26 of ICAO Annex 13 recommends:

> Participation in the investigation should confer entitlement to:
>
> (a) visit the scene of the accident;
> (b) examine the wreckage;
> (c) question witnesses;
> (d) have full access to all relevant evidence;
> (e) receive copies of all pertinent documents; and
> (f) make submissions in respect of the various elements of the investigation.
>
> (Exhibit 430)

By legislating privileged status for witness and survivor statements, section 30 of the Act detracts from the effectiveness of the theorizing process, and raises two further possible problems:

1 Witnesses who are assured of the confidentiality of their statements and identities may be tempted to stretch their recollections to accommodate their preconceived notions or biases, as well as those of the investigator/interviewer, knowing that they will be unchallenged.
2 The withholding of such information from the individuals representing the parties as either observer or participants on investigating teams implies that the parties – and the public – have to accept the board's interpretation of that information on blind faith. The resultant appearance of lack of openness in the investigative process does not instil confidence in its outcome.

With regard to section 29, I fail to see the justification for giving air traffic control transcripts privileged status when any person on the same frequency had access to the transmissions involved. I firmly believe that, under properly controlled conditions, the sharing of pertinent portions of the cockpit voice recorder and flight data recorder information with the parties will contribute greatly to the timely and effective completion of the investigative process.

I recommend that the provisions of sections 28, 29, and 30 be amended to provide that statements and the other material referred to shall be made available on a confidential basis to individuals granted full participant status as representatives of parties having a direct interest in the accident investigation.

In order to avoid any misunderstanding, I re-emphasize that I fully endorse the confidentiality of statements made under the provisions of the board's confidential aviation safety reporting system. The subject of privilege with respect to pilot incident reports made on a confidential basis in connection with an air carrier's flight safety and accident prevention program is dealt with in detail in chapter 42 of this Report, Incident and Accident Reporting and Pilot Confidentiality.

Review of the Board's Draft Report

The stated object of the Transportation Safety Board is to advance transportation safety. Section 7(1) of the *CTAISB Act* lists five means by which this objective is to be achieved. That section reads as follows:

> The object of the Board is to advance transportation safety
> (*a*) by conducting independent investigations and, if necessary, public inquiries into transportation occurrences in order to make findings as to their causes and contributing factors;
> (*b*) by reporting publicly on its investigations and public inquiries and on the findings in relation thereto;
> (*c*) by identifying safety deficiencies as evidenced by transportation occurrences;
> (*d*) by making recommendations designed to eliminate or reduce any such safety deficiencies; and
> (*e*) by initiating and conducting special studies and special investigations on matters pertaining to safety in transportation.

Section 7(1)(a) charges the board to conduct "*independent* investigations and, if necessary, public inquiries into transportation occurrences." The obvious objective is to assure the public that the investigating authority will not hesitate to identify safety deficiencies, regardless of which government agency, corporate entity, or private individual played a role in the accident sequence.

With this objective in mind, the authority's formulation of its findings, conclusions, and recommendations for its final report is critical. It is essential for the authority to avoid even the appearance of influence from organizations or persons with a vested interest in the outcome of the authority's deliberations. Unfortunately, there is a provision in the Act that may well give the public reason to question the board's independence. Section 24(2) of the Act requires that the board, before making public an occurrence report, circulate its draft report to parties and ministers deemed by the board to have a direct interest in the board's findings and to permit representations with respect thereto:

> Before making public a report under subsection (1), the Board shall, on a confidential basis, send a copy of the draft report on its findings and any safety deficiencies that it has identified to each Minister and any other persons who, in the opinion of the Board, has a direct interest in the findings of the Board, and shall give that Minister or other person a reasonable opportunity to make representations to the Board with respect to the draft report before the final report is prepared.

Requiring the board to submit its draft report to interested parties, be they ministers or other persons having a direct interest in the board's findings, so they can make representations to the board, strikes me as being somewhat analogous to requiring a judge, after hearing the evidence at trial, to submit his or her draft judgement for review and comment by the litigants, before it is formally entered into the record. The board's conclusions, like the judgement of a court, should not be

subject to what on the face of it is a process which can only be described as demeaning to the integrity and independence of the board.

The public, including persons in the industry, has the full right to expect the board to reach its conclusions from the evidence before it, independently and free from outside influence. Section 4 of the Act requires that board members be knowledgeable in transportation matters. The chairman of the board has the responsibility to maintain a staff with the professional qualifications needed to conduct investigations that fully satisfy the public's and the industry's safety concerns. If properly followed, these requirements should bolster the public's trust in the board's integrity and competence. There is simply no logic to undermining this trust by legislation which gives the appearance that the board is to seek an imprimatur from interested parties for its final report.

The provision in the Act that charges the board to solicit representations on its draft report from interested parties probably finds its rationale in the desire to avoid shortcomings in the final report. However, this provision hardly represents a vote of confidence by the Government of Canada in the board it has created. The damage that this review by interested parties does to the credibility of the board and its reports is in my view too high a price to pay. If interested parties were granted full participant status with the right to assign experts to be full-fledged participants in the investigative process, as I have recommended, rather than being observers as is the case at present, their views on the facts would be made known at the investigative stage. This would then avoid the unseemly practice legislated by section 24(2) of the Act of inviting representations by the interested parties on the contents of a draft report formulated by the board after its review of the evidence.

Section 24(2) of the Act, which entitles interested parties to review and make representations regarding the board's draft report, should be replaced with a provision that gives to participants the right to make their own submissions to the board following completion of the investigation and prior to the preparation by the board of its final report. The logical time for those interested parties who have been granted participant status to exercise this privilege would be at the completion of the fact-gathering phase of the investigation or upon completion of a public inquiry conducted by the board. The changes to the Act that I advocate here would render superfluous the review by participating parties of the board's draft report. In such a case, the board, after completing its investigation, need only concern itself with the production of a final report in respect to a transportation occurrence.

Sections 26(1) and (2) of the Act empower the board to reconsider its findings and recommendations when, in its opinion, new evidence becomes available. Lacking in this section is a specific provision entitling

a party with a direct interest in an investigation or public inquiry to petition the board for reconsideration of its conclusions where it is shown that new and material evidence has been discovered that might reasonably affect such conclusions or where the board's factual conclusions are shown to be erroneous. I am of the view that the incorporation of such a provision in section 26 of the Act, together with my recommendation for giving parties the right to make formal submissions prior to the board's drafting of its final report, should ameliorate any concern by the interested parties over the loss of their present right to review and make representations with regard to the board's draft report.

The Training of Investigators

During the course of this Inquiry, I and my staff have read and reviewed the records of hundreds of witness interviews conducted by investigators on behalf of CASB, and later on behalf of this Commission. As is the case with every investigation, witness interviews provided the basis for virtually all of the Commission's investigative activity. There were large variances in the ability of individual CASB investigators to conduct witness interviews, as is evidenced by the interview transcripts and records. Many initial interviews were in fact well conducted. Numerous others, because of the investigator's lack of forethought and interviewing skill, did little to enhance the investigative process. As a result, numerous witnesses had to be re-interviewed by Commission staff.

In order to provide the direction required in the investigative process, an interview must be conducted in a manner that will, it is hoped, extract from each witness his or her best recollection of the events observed by that witness. To accomplish this task is by no means easy. The interviewer must be trained and well prepared for the interview, there must be a purpose to every question, and every answer must be immediately analysed to determine if follow-up questions are required.

A number of the interview records clearly demonstrated that some of the CASB investigators were not well trained or well prepared to conduct interviews. Interviewing of potential witnesses is a skill which is gained by practical training and experience. An interview is not conducted for the purpose of projecting the views and opinions of the interviewer to the witness, as indeed occurred in some of the initial interviews done under the auspices of CASB. It is of utmost importance to an ongoing investigation that witness interviews conducted shortly after an air carrier accident be carried out in the most professional

manner possible. One of my most vivid impressions from the investigative stage of the Inquiry is that there is a dire need for investigators trained in witness-interviewing techniques.

My concerns relating to the witness-interviewing skills of some of the accident investigators seconded to this Commission by CASB were made known to Mr Joseph Jackson, the investigator in charge, and to CASB, in the summer of 1989, while the Dryden accident investigation under the auspices of this Commission was still ongoing. It had been my intention in this Report to make a recommendation that the CTAISB should develop a mandatory training program whereby all its investigators undertake and complete initial and recurrent professional training in witness-interview techniques and report writing, as well as accident investigation generally, such training to be provided through recognized professional learning institutions specializing in the training of accident investigators or a senior police force. However, during the month of May 1991, it came to my attention that, following my expressions of concern and, commencing in the autumn of 1989, the TSB began discussions with professional consultants and in October 1989 contracted with the Public Service Commission's Training Programs Branch to develop a witness-interview training course structured specifically for TSB investigators. I have been advised that, as of March 1991, 77 TSB investigators have participated in newly developed courses in witness-interviewing techniques. I am further advised that such training is now mandatory. It has also been brought to my attention that TSB investigators will receive recurrent interviewing-technique training on a regular basis and that investigators are being encouraged to request additional training if they feel it will enhance their interviewing skills.

I am encouraged by the fact that the TSB has initiated what I consider to be an essential training program in response to the concerns identified by this Commission of Inquiry. I would commend the TSB for so doing and I am hopeful that the training program undertaken will improve the quality of aviation accident investigation. Only the passage of time will reveal whether the quality of this training program is sufficient to meet the challenge presented.

The Taping and Transcription of Interviews

While conducting pre-hearing interviews with knowledgeable persons and potential witnesses, my Commission staff, with the exception of a few occasions early in the process, endeavoured to record the witness interviews on tape. This was done not only to ensure accuracy, but also to expedite the interview process by ensuring an orderly flow of

questions and answers and to achieve a timely process by not having to write down everything that was spoken. Persons interviewed were, without exception, offered a transcription of their interview once completed, as well as access to the interview tape.

The Canadian Air Line Pilots Association (CALPA) initially objected to the recording of witness interviews and insisted that many of the interviews of pilots who were CALPA members not be taped. In such cases all questions posed by counsel and the answers given by CALPA members had to be transcribed by hand, a time-consuming process to say the least. In addition to increasing the work of Commission staff, this process did not add to the assurance of accuracy of the interview record.

Being fully aware of the frustrations experienced by my investigators and counsel who helped interview hundreds of witnesses during this Inquiry, I am of the firm view that all interviews conducted in connection with an air carrier accident should be tape recorded and transcribed, and I would recommend an amendment to the Act to so require. Such a procedure would not only be in the interest of the investigating agency, but also would protect those being interviewed. There is, in my view, no rational basis upon which a person being interviewed in connection with an air carrier accident investigation should be able to insist on handwritten notes of the interview being made, in place of accurate electronic tape recording.

The Use of Outside Experts

The success of an investigation depends on the logical and methodical gathering of all pertinent evidence. The quality of the evidence so assembled will, to some extent, reflect the skill and knowledge of the persons gathering and assimilating the evidence. The value of such evidence will largely depend upon the skill and ability of those analysing and interpreting it.

This Commission of Inquiry, in addition to utilizing CASB staff experts, relied extensively upon independent experts. Experts in aircraft ground de-icing, engines, aircraft performance, aerodynamics, meteorology, human factors and human performance, and aeronautical engineering were retained to assist with the investigation and in some instances to testify before the Commission. Such experts were retained partly because there was a lack of particular expertise within CASB, from which the majority of the Commission's investigators came, and partly because, as I stated in my first *Interim Report*, "I considered it important for my Commission to have the benefit of totally independent expert advice" (p. 6).

Having observed many witnesses testify before the Commission on complex technical matters, I am of the opinion that the TSB, the agency responsible for the investigation of aircraft accidents in Canada, would benefit from the assistance, on an ad hoc basis, of highly qualified professional experts from outside its ranks. It would be unrealistic to expect the TSB to maintain on staff all manner of expertise required in the investigation of an aircraft accident. Accordingly, I recommend that an expert witness roster be developed by the TSB, in consultation with the aviation industry, consisting of persons willing to be called upon to assist in any given investigation, upon very short notice. I would strongly recommend that the TSB establish close liaison with the National Aeronautical Establishment and the National Research Council Canada and utilize fully their facilities and staff experts in various disciplines, as this Commission has in fact done. Such lists of experts, when established, should be updated from time to time to reflect the highest degree of knowledge and expertise available. As a direct result of my experience on this Commission, I am of the firm belief that the utilization by the TSB of its own in-house experts as well as outside experts from such a list on an ad hoc basis is both a desirable and a practical way to enhance the quality of aircraft accident investigation in Canada.

Forensic Training for TSB Scientists

The TSB (previously CASB) employs a number of forensic scientists. The word forensic means "of or in relation to courts of law." Forensic scientists must, by definition, possess expertise beyond their scientific field in that they must be able to attend at a court, inquiry, or inquest and properly present their evidence with clarity. They must be able to explain, support, and extemporaneously defend their conclusions in the crucible of the witness box. To do so requires special training.

During the hearings of this Commission of Inquiry, I formed the impression that some CASB scientists who appeared as witnesses, although obviously experts in their respective scientific fields, were, through no fault of their own, ill-equipped to present their evidence adequately in a public forum. Some of the shortcomings I observed in the presentation of evidence by some of the TSB forensic scientific witnesses included:

- venturing an opinion clearly outside the area of expertise
- CASB did not understand fully the significance of protecting the continuity of an important piece of evidentiary material

- CASB did not appreciate the importance of requiring the designated CASB engine expert to attend personally at the initial post-crash disassembly by the manufacturer of the aircraft engines
- the attachment as an appendix to a scientist's report of a report from a manufacturer, when such report was not clearly understood
- obvious discomfort or unease on the witness stand, particularly during cross-examination.

These observations led me to direct inquiries to be made of Mr Doug Lucas, director of the highly regarded Centre of Forensic Sciences in Toronto. Mr Lucas has indicated that, when interviewing potential candidates for the position of forensic scientist at the centre, focus is exclusively on whether the scientist can cope with the demands of the witness box. Academic qualifications are taken as a given. Only one in ten otherwise qualified scientists meets this criterion. Thereafter, the successful candidate embarks on a two-year training program. At the end of the first year, the scientist's continued employment is contingent upon the successful handling of a mock court exercise where the candidate is the witness. Only rarely are candidates allowed to testify in court prior to completing the two-year training program. They are never allowed to testify prior to the completion of one year's training.

The training syllabus followed by the Centre of Forensic Sciences includes having candidates observe the testimony of others to familiarize them with different styles of examination and cross-examination. Mock exercises are videotaped and reviewed as a training tool. The candidate must complete a course of reading covering such topics as the rules of evidence, the structure of various tribunals and the functions of the associated officials, preserving continuity, note-taking, and the pitfalls associated with being an expert witness. All of this is in addition to continuing scientific training within the candidate's area of specialty.

By contrast, I have been informed that CASB scientists received a half-day lecture from CASB counsel devoted primarily to explaining the provisions of the *CASB Act*. It is therefore not surprising that some of the CASB scientists who testified encountered difficulty on the witness stand.

In order to advance the image of the TSB as a world-class investigative body, I am convinced it is essential that forensic training be provided to TSB scientists and that the TSB call upon such outside resources as are necessary to assist them in this endeavour.

Human Factors in the Investigation of Aviation Occurrences

From the beginning of the work of this Commission, I resolved that, if human error was a basic cause of the Dryden crash, as indeed has turned out to be the case, it would not be acceptable simply to identify pilot error as a cause without a thorough investigation of all factors which may have influenced the actions of the pilots. Although it was not difficult to identify pilot error as one of the factors in the Dryden crash, it was by no means the only factor, as can be seen from the body of this Report.

It is internationally recognized that human performance issues are major contributing factors in approximately 80 per cent of all aircraft occurrences. The ICAO clearly views human factors as a legitimate investigative pursuit. In its Manual of Aircraft Accident Investigation (4th ed.), ICAO postulates the following basic criteria for aircraft accident investigation:

> Reduced to simple terms, the investigator has to determine what happened, how it happened, and why it happened, applying these questions not only to basic cause but to all aspects relating to safety ...
>
> ... Similarly, if human error appears as a possible cause of the accident all factors which may have influenced the actions should be examined ... Experience has shown that the majority of aircraft accidents have been caused or compounded by human error, often by circumstances which were conducive to human error; this applies to design, manufacture, testing, maintenance, inspection and operational procedures both ground and air. Identification of this element is frequently difficult but it may be revealed by careful, skilful and persistent investigative methods.
>
> Some aircraft accidents have resulted from organizational defects or weaknesses in management; for example, an operator may have prescribed or condoned procedures not commensurate with safe operating conditions in practice. Similarly, ambiguous instructions, and those capable of dual interpretation may also have existed; these factors may well have stemmed in the first instance from uncritical scrutiny by regulating authorities. It may therefore be necessary to inquire closely into other organizations or agencies not immediately or directly concerned with the circumstances of the accident but where action, or lack of it, may have permitted or even caused the accident to happen.
>
> (Exhibit 429)

This broad approach to the search for all possible factors which may have influenced an aircraft accident, advocated by ICAO, represents the investigative methodology adopted by this Commission of Inquiry. In my view this is the only acceptable way to conduct a full and proper investigation of an aviation occurrence. The subject of human factors or human performance in the context of aviation accidents was canvassed in depth during the hearings of this Commission and is covered at length in Part Seven of this Report, Human Factors.

The 1981 Report of the Commission of Inquiry into Aviation Safety, which recommended the establishment of the Canadian Aviation Safety Board (CASB, now the TSB), also suggested that the Canadian investigative authorities should improve human performance investigations.

Although the TSB now has a human factors unit and a number of human factors specialist researchers and investigators, it would appear that the board has not yet fully perceived human factors as a legitimate pursuit. This conclusion is reached in part on the basis of an analysis of board decisions which indicate an approach predicated on the view that, if something cannot be quantified as a fact, then it is not used in statements of cause. This approach certainly does not work for human factors considerations. Any reticence to draw inferences, or conclusions, on the basis of a preponderance of evidence is in my opinion detrimental to the conduct of a full investigation of an aviation occurrence and is totally counterproductive to an investigation of human factors issues. I am strongly of the view that the board should adopt a policy recognizing that the investigation of human factors is a legitimate pursuit in the investigation of and reporting on an aviation occurrence.

The Monitoring of TSB Recommendations: One Example

The proceedings before me revealed that, from time to time, the TSB, and its predecessor, CASB, have made recommendations for consideration and action in the interest of aviation safety to the minister of transport. The evidence before me further revealed that on some fundamental safety issues an inordinate amount of time passes between the date of a TSB (or CASB) safety recommendation and consequent action by the minister. This unsatisfactory state of affairs can be illustrated by describing what has occurred, and is continuing to occur, in relation to the issue of carry-on baggage.

Civil Aviation Inspector Randy Pitcher, in his testimony before the Commission, described the problem of carry-on baggage in the following terms:

> A. I appreciate the fact that it doesn't appear that the carry-on baggage may have been a factor in the number of people that unfortunately lost their lives at Dryden, but I do understand that the overhead rack was, to some extent, limiting in terms of people being able to escape the aircraft.
>
> But specifically, the problem that exists today primarily is a situation where you have passengers deplaning or changing from a large airplane, for example, a 767, off of Air Canada or Canadian, and joining an Air Ontario Dash 8, F-28, or indeed a Canadian ATR 42. They may have very, very bulky carry-on baggage, and it's been my experience, sir, that flight attendants are forced to deal with this difficult problem right on board the airplane. It creates unnecessary stress for the flight attendant. It certainly is not a pleasant situation for the passenger.
>
> And my recommendation would be that flight attendants, first of all, should not have to deal with these problems on the airplane, that carriers must take measures to screen this kind of carry-on baggage, that overhead bins often times, although they are designed for hats and coats, often times passengers do load very, very heavy pieces of luggage which become projectiles, which become very dangerous in an accident situation.
>
> (Transcript vol. 128, pp. 6–7)

The problem described by Mr Pitcher is not new. In fact, it was known to Transport Canada at least as far back as October 24, 1985, when Mr Donald Douglas, then director of Transport Canada's Licensing and Certification Branch, noted in a memorandum that the director general of air regulations "has been advised that Donna Richard will be taking on the carry-on baggage project" (Exhibit 1174).

By correspondence dated January 28, 1986, Mr William Tucker of CASB wrote to Mr William Slaughter, then director of Transport Canada's Aviation Safety Programs Branch, expressing concern about the amount of cabin baggage being brought aboard aircraft:

> Three confidential aviation safety reports have been received from flight attendants employed by different airlines expressing concerns about the amount of cabin baggage being brought aboard aircraft.
>
> (Exhibit 1175)

Mr Tucker noted in his correspondence that the carry-on baggage issue had been discussed with Air Canada, CP Air, Nordair, and PWA, and that there was common agreement that the issue could only be resolved on an industry-wide basis. Mr Tucker's letter described the safety concern in the following terms: "The resultant situation could lead to unnecessary injury and perhaps even obstruct evacuation routes in the event of a serious occurrence involving a large passenger aircraft."

The evidence indicates that Mr Slaughter transmitted these concerns to Mr Douglas, the Transport Canada officer responsible for air carrier passenger safety standards. On February 27, 1986, Mr Douglas communicated with Mr Slaughter, stating in part: "if consultation with the carriers does not prove beneficial, or at the completion of the survey it is evident there is no improvement, consideration will be given to developing more stringent legislation" (Exhibit 1176).

Ms V.M. Doll, the acting manager, passenger safety, made a note on her file, dated December 11, 1986, indicating that amendments to Air Navigation Order Series VII, No. 4, Carry-On Baggage Order, were prepared and that air carriers had been consulted. However, the fact is that no amendments to the ANO were passed to restrict carry-on baggage.

Almost four years later, on July 25, 1990, the TSB drew attention to a potentially serious aviation safety deficiency and released four safety recommendations, based on more than 60 incident reports, relating to the lack of clear guidelines concerning carry-on baggage. The TSB recommendations state in part:

> It appears that this potentially serious aviation safety deficiency is the result of air carriers failing to comply with existing legislation, a lack of clear definition as to the size, weight and amount of carry-on baggage that is permitted, and a lack of understanding on the part of passengers of the safety implications of this issue.
>
> (Exhibit 1179)

Pursuant to the *CTAISB Act*, the minister of transport had 90 days in which to reply to the recommendations. Accordingly, the ministerial response was, by law, required by October 25, 1990.

As of the date of writing this section of my Report (June 28, 1991), there have been at least five consecutive years of documented, legitimate expressions of concern by CASB or the TSB on the issue of carry-on baggage, with no meaningful action on the part of Transport Canada. Surely it is totally unacceptable that, within a five-year period, there has been no regulatory change enacted to eliminate a serious and legitimate aviation safety concern.

Despite repeated warnings and recommendations from CASB (and the TSB) to Transport Canada, the issue of carry-on baggage remains unresolved, largely, based on the evidence before this Inquiry, because of the lobbying of the Air Transportation Association of Canada (ATAC).

In my view, the TSB's responsibility for safety recommendations should extend beyond merely notifying the minister of transport of a safety concern. The TSB should have the responsibility under law for tracking and following up on the action taken by the minister of transport on a safety recommendation, and if no action is taken within

a specified time frame, it should have the authority to require an explanation from the minister. Any legislation conferring upon the TSB the power to follow up its safety recommendations should include a legislated mode of procedure which causes Transport Canada to commit itself to a resolution date rather than allowing the regulator simply to indicate that a matter is being studied or considered.

RECOMMENDATIONS

It is recommended:

MCR 177 That the *Canadian Transportation Accident Investigation and Safety Board Act* be amended and regulations be passed to provide that, at any major aircraft accident investigation, parties having a direct interest in the investigation have the right to nominate, in consultation with the investigator in charge, individuals with specific expertise from among their ranks to be involved in the investigation as participants (as opposed to observers) on specific investigation team groups, such as operations, human factors, records, systems, engines, or site survey.

The terms and conditions of such participant involvement should be determined by the Transportation Safety Board of Canada and ought to include provisions placing participants under the authority of and responsible to the investigator in charge, as well as provisions to ensure the absolute confidentiality of all information and documentation gathered relating to the investigation.

MCR 178 That sections 28, 29, and 30 of the *Canadian Transportation Accident Investigation and Safety Board (CTAISB) Act* be amended to provide that witness statements, on-board recordings, and communications records referred to in those sections be made available on a confidential basis to those individuals who have been granted full participant status as representatives of parties having a direct interest in the accident investigation; and that all other provisions of sections 28, 29, and 30 of the *CTAISB Act* be amended accordingly in order to give full meaning and effect to the recommended amendments.

MCR 179 That section 24(2) of the *Canadian Transportation Accident Investigation and Safety Board (CTAISB) Act* be repealed. The Transportation Safety Board of Canada, in order to preserve its independence, should not be required to send a copy of any draft report on its findings and safety deficiencies that it has identified to each minister, or to any other person with a direct interest in the findings of the board, to provide them with an opportunity to make representations to the board with respect to the draft report, before the final report is prepared.

The other provisions of section 24 of the *CTAISB Act* should be amended accordingly in order to give full meaning and effect to the recommended repeal of section 24(2).

MCR 180 That a section be added to the *Canadian Transportation Accident Investigation and Safety Board Act* to provide to each minister and to each party having a direct interest in the findings of the board an opportunity, after completion of the aviation occurrence investigation and the gathering of the evidence, to make formal submissions within a time frame to be prescribed by the board, for consideration by the board in its deliberations.

MCR 181 That section 26 of the *Canadian Transportation Accident Investigation and Safety Board Act* be amended to incorporate a specific provision entitling a party with a direct interest in an investigation or public inquiry to petition the board for reconsideration of the conclusions of its final report where it is shown that new and material evidence has been discovered subsequent to the conclusion of the investigative process and which might reasonably affect such conclusions or where it is shown that the board's factual conclusions are erroneous.

MCR 182 That the *Canadian Transportation Accident Investigation and Safety Board Act* be amended to provide that all witness interviews conducted by investigators in connection with an aviation occurrence shall be tape recorded and transcribed.

MCR 183 That the Transportation Safety Board of Canada add to its roster the names, addresses, and telephone numbers of highly qualified Canadian and international professional experts,

learned in the various disciplines, who are willing to be called upon to assist in any given aviation occurrence investigation. Such a roster should be maintained and updated in consultation with the Canadian aviation community.

MCR 184 That the Transportation Safety Board of Canada, as a matter of policy, establish a closer liaison with the National Aeronautical Research Establishment and the National Research Council Canada and, on an ad hoc basis, utilize to the fullest their facilities and staff experts in various applicable disciplines, to assist in the investigation of aviation accidents.

MCR 185 That sections 24(5) and 24(6) of the *Canadian Transportation Accident Investigation and Safety Board (CTAISB) Act* be amended to empower the board with the responsibility and authority under law to track and follow up on an ongoing basis the action taken by the minister of transport with respect to each board safety recommendation and, if no action is taken by the minister within a specified time frame, to require an explanation in writing by the minister therefor. There should be a legislated mode of procedure that causes Transport Canada to commit itself to a resolution date, within a specified time frame, with respect to all board recommendations that are accepted by the minister, with an explanation for the time frame contemplated. In the event that the minister's action varies from the board recommendation, or if the minister proposes to take no action with respect to a recommendation of the board, then written reasons therefor should be provided to the board, and such reasons should be made available to the public.

The other provisions of section 24 of the *CTAISB Act* should be amended accordingly in order to give full meaning and effect to the noted recommended amendments.

MCR 186 That the annual report of the Transportation Safety Board of Canada continue to set out, as it now does, all of the recommendations, whether interim or final, that have been made by the board to the minister in the preceding year, but that it add comment regarding the actions taken by the minister in regard thereto.

MCR 187 That the Transportation Safety Board of Canada provide forensic training to all its scientists and that the board call upon such outside resources as are necessary to assist them with such training.

MCR 188 That the Transportation Safety Board of Canada formally adopt a policy recognizing that the investigation of human factors involved in an aviation occurrence is a legitimate pursuit and an important element of the investigatory process.

MCR 189 That the Transportation Safety Board of Canada formally adopt a policy recognizing that it is appropriate for the board to draw inferences of fact based on a preponderance of evidence and to refer to such inferences in its decision-making process.