PART V

Recommendations With Respect to Aviation Safety

Foreword

Changes Already Made by Air Canada and Honeywell

Many of the recommendations in this report have been formulated as a direct result of information gathered from other airlines whose evidence we took in Canada, the United States and in Europe. We obtained information relating to fuelling procedures and practices; dispatch procedures; and corporate structures and practices relating to the maintenance, operation and servicing of the various aircraft fleets.

All the recommendations made by counsel and the representatives of the parties have been considered.

Many of the recommendations that would have been made no longer need to be made because of changes already implemented by Air Canada. Air Canada, to its credit, has already made significant improvements to its operation and corrected some of the obvious deficiencies which contributed to the Gimli accident.

Honeywell has improved the design and quality of the fuel gauge processor which contributed directly to the Gimli accident.

Before outlining my recommendations, it is noteworthy that Air Canada has already made, as a result of its own investigation and as a result of the evidence at the Inquiry, the following improvements to its fuelling procedures and some related matters:

i) *Drip Charts*

The drip charts have been amended in order to simplify the conversion of the fuel depth reading in centimetres on the drip sticks. Previously, drip stick readings on the 767 had to be converted from centimetres to litres and then from litres to kilograms. The drip charts were used to convert centimetres to litres. The conversion from litres to kilograms was done manually. Now the drip charts enable a direct conversion to be made from drip stick readings in centimetres to weight in kilograms.

A further recommendation is made below regarding drip sticks, in recommendation 6 (viii).

ii) *Assignment of Fuel Load Calculation*

The task of fuel load calculations in abnormal situations was previously not assigned specifically to flight crew or to maintenance personnel. Now the task has been assigned jointly to maintenance personnel and flight crew. The procedure established requires both the flight crew and maintenance personnel independently to read the inclinometers and to determine the weight of fuel on board by use of the drip charts. They are then required to compare their findings. A check form, part of Exhibit 190, outlines the procedure to be followed which includes a gross error check.

iii) *Fuel Form: Removal of "Specific Gravity"*

Air Canada has removed the term "specific gravity" from the fuel slip and has replaced it with the term "Fuel Weight Conversion Factor". The fuel slip has also been changed to include both the before and after fuel figures for each tank.

iv) *Minimum Equipment List*

Air Canada has made changes to the wording of the MEL. Unfortunately, while Air Canada has tried to improve the wording of the MEL it is, in its present version, still in need of improvement.

v) *Manuals*

Air Canada has also made significant revisions to the pilots' 500 Flight Operations Manual and to the 81 Fuelling Manual used by the fuellers. The 500 Manual has been reorganized and combined with the 50 Flight Operating Manual and re-issued as the 550 Flight Operations Manual. In addition, the 81 Manual is presently being reassessed and a new format for it is being prepared.

vi) *Training*

Air Canada has attempted to provide additional training with respect to both communications and applicable ramp practices and procedures.

vii) *Spare Parts*

The number of spare fuel processors has been increased.

viii) *Log Book*

Air Canada has introduced a new format for its log book. It is in three parts, the Aircraft Journey Log; the Aircraft Defect Log; and the Cabin Defect Log. Of particular note is the introduction of the Aircraft Defect Log. Its pages are numbered and coloured so as to provide for better tracking of and access to outstanding defects.[279]

ix) *Uplift Check*

Air Canada has introduced as part of its normal fuelling procedures for the 767 an automatic uplift cross-check using the ACARS. If the ACARS is inoperative, Air Canada has provided for a manual uplift check.[280]

Thus, Air Canada has made an effort to improve many of its practices and procedures. However, there is still much to be done to make commercial flying safer for the travelling public.

I now list what I consider to be recommendations which, if implemented, would improve aviation safety in Canada.

1. Standardization Within the Air Canada Fleet

I recommend that Air Canada move with reasonable dispatch towards the standardization of measurements in its fleet of aircraft. At the moment, Air Canada's fleet contains both metric and non-metric aircraft. Some of the aircraft have instruments and gauges measuring in metric units and others have instruments and gauges measuring in Imperial units. There should be one standard of measurement.

One of the contributory causes of the accident was the fact that Air Canada, following the expressed policy of the government of the day, introduced aircraft into its fleet which used units of weight and volume different from those used in the rest of its fleet. It is obvious that there is an inherent danger in maintaining a mixed fleet of aircraft.

It should be emphasized that the most important issue is standardization. Whether it is accomplished by the complete metrication of the Air Canada fleet or by a reversion to Imperial units of measurement is a secondary consideration. What is paramount is that there be a standard unit of measurement throughout the airline. Although cost should not be a factor when it is a question of aviation safety, the evidence at the Inquiry was that it would cost $65,000 U.S. to convert each Boeing 767 back to Imperial readings, that is, fuel quantity in pounds; fuel flow rate in pounds per hour; air flow rate in cubic feet per minute; engine oil quantity in litres; airplane gross weight in pounds; fuel measuring sticks in inches; and placards reflecting fuel volume in Imperial gallons.[281]

Air Canada, along with Pacific Western Airlines, another Canadian carrier, were the only two airlines that the Inquiry was made aware of, which operated a mixed fleet of aircraft. Since Air Canada has recently arranged to acquire Pacific Western's two Boeing 767's, Pacific Western will no longer be operating any metric aircraft. Pacific Western, of course, continues to buy aviation fuel in litres as do all other carriers in Canada. Air Canada continues to fly the Boeing 767 and, with the acquisition of the two from Pacific Western, will have fourteen. This aircraft in itself contains a mixture of metric and non-metric units of measurement, resulting in a metric and non-metric mixture within the Air Canada fleet.

Other major airlines, including Trans World Airlines, American Airlines, United Air Lines, Delta Air Lines, Swissair, Air France, Lufthansa German Airlines, British Airways, Aer Lingus and El Al Israel Airlines, all have standardized fleets. Air Canada should have a standardized fleet as well.

It is of the utmost importance that Air Canada embark upon a policy to standardize its units of measurement and, therefore, its aircraft instruments and its procedures. The evidence shows that the most forward looking, the most modern and the most widely accepted unit of measurement in the aviation industry throughout the world is metric. Thus, I recommend that Air Canada move towards standardization of units of measurement based on the metric system.

Standardization by changing to the metric system seems to have taken somewhat longer in some European airlines than in others.

British Airways officials, in answer to questions put to them by Inquiry Counsel, testified as follows:

"MR. PROBER: Did you change by acquiring new aircraft in metric, or did you recalibrate, reconvert fuel gauges on some of the aircraft to use kilos?

CAPTAIN JESSOP: I think the Comet came to us in kilos anyway.

MR. STAFFORD: It was not a conversion; it was new aircraft."[282]

Captain Jessop pointed out that prior to World War II, everything "was not measured in weight but was measured in volume" and "therefore, ... our airplanes in the U.K. were — the fuel gauges were all in Imperial gallons".

He went on to point out that:

"... as airplanes got bigger and more sophisticated and people realized that the volume was not all that important, the weight was the most important thing, that virtually — my only personal experience anyway was when we went from Imperial gallons to kilos rather than go to pounds. I think that was sort of fairly general. But all of that happened and was virtually completed by the mid-1950's."[283]

Captain Jessop told us that the changeover to metric was accomplished as a practical thing and not as the result of a political decision.

The evidence from Lufthansa in Frankfurt was that they have ordered metric gauges on all aircraft, with the exception of the DC-8's, since 1959. Before that time they had been flying many different kinds of aircraft with instruments in many different kinds of measurement. When the airline committed itself to metric conversion in 1959, the other measurements were phased out as rapidly as possible. It became a high priority within Lufthansa that this conversion be effected and that the entire fleet be standardized quickly.[284]

Counsel for Air Canada in his argument pointed out that after the Gimli accident, Air Canada resolved neither to demetricate the 767 nor to metricate fully the Air Canada fleet. This is apparent as well from the minutes of the Fuelling Committee established by Air Canada after the Gimli accident.[285]

Counsel for Air Canada submitted that the evidence seems to indicate that the European carriers whose evidence the Board took followed the procedure that Air Canada is now following, that is, metrication as each new aircraft type is introduced into the fleet.[286] I question the validity of this argument in view of what the Board was told by Lufthansa and in view of the fact that British Airways was the only European carrier to say that it had converted to metric by the acquisition of each new aircraft type.

I also question the validity of the argument in view of the fact that the new Lockheed L-1011-500 was acquired by Air Canada as a non-metric aircraft. Moreover, nothing was done to metricate the Douglas DC-8 cargo fleet of Air Canada. This fleet would seem to have been a natural candidate for metrication since all of its aircraft have recently been refitted with new engines which extend the life of the fleet by twenty years.

It is obvious that metrication and, more importantly, standardization took place more rapidly in the United Kingdom and West Germany than it is taking place in Canada. It took place rapidly in countries which have larger populations, and considerably less airspace than there is in Canada. The potential for danger in these circumstances was much greater in Europe than it could be in Canada. There is no evidence that rapid conversion did result in an increased number of accidents and I

doubt very much whether such evidence exists. These facts alone would seem to belie the argument of Air Canada that the method they are now using could not be accelerated very considerably with little, if any, additional danger.

My recommendation on this issue, therefore, is that Air Canada urgently reconsider its position on standardization. It should study the methods used in Europe to achieve full metrication. The study should particularly concentrate on the experience in the United Kingdom, which, until recently, used the Imperial system of measurement in common with Canada and North America in general. The study should be made with a view to proceeding to complete standardization as rapidly as possible.

2. Establishment of a Flight Safety Organization

I recommend that Air Canada establish a flight safety organization using as a model the British Airways Board Air Safety Review Committee as described in evidence by Captain Jessop. The Chairman and most members of the Review Committee are members of the Board of Directors of the airline. The air safety branch, called Safety Services, is completely independent of any other department in the airline. It is chaired by an experienced line pilot who is himself a member of the Review Committee. Safety Services employs 6 fully qualified air safety coordinators who investigate all incidents and accidents. The Review Committee itself meets once a month to consider the reports of the investigations. A principal feature of the organization is the fact that the Chairman of the Air Safety Review Committee is also the Chairman of the Board of Directors of British Airways. This ensures that the organization gets the money it needs to operate effectively.

The Board of Directors of Air Canada should play a greater role in flight safety.

The main role of such a flight safety organization would be to investigate incidents or accidents with a view to preventing similar incidents or accidents in the future. It would do so by identifying trends which might well enable the airline to prevent a recurrence. As Captain Jessop put it:

> "It is obviously to identify trends and to prevent a recurrence, and that really is our role right through".[287]

There is need for such a continuous review rather than isolated investigations on those occasions when incidents or accidents occur. Air Canada has the equipment to facilitate such a continuous review. It is called the data playback system. Discussions have been taking place between Air Canada and the Canadian Air Line Pilots Association to try to reach agreement about use of the system for such a purpose.

I make this recommendation keeping in mind that Air Canada has an excellent safety record and that each of the witnesses from Air Canada displayed a sincere commitment to aviation safety.

I further recommend that Transport Canada take heed of this recommendation with a view to its implementation in other commercial airlines in Canada.

3. Re-evaluation of Training of Flight Crew

There is an urgent need to re-evaluate the training of flight crew for the 767. This, of course, includes the need to reassess any retraining programmes. The Gimli accident is an indictment of the training programmes set up for the introduction of this new aircraft. It calls into question the adequacy of the need-to-know approach to the training of pilots as implemented by Air Canada.

It is true that in theory the need-to-know method of training today's pilots is appropriate because of the complexity of modern aircraft. However, the manufacturer, the operator and Transport Canada all appear to have failed properly to identify what pilots need to know about the 767. This comment is particularly applicable to their knowledge of the fuel system.

At present, pilots learn mainly by experience and often as a result of incidents and accidents. Unfortunately, as pointed out by witnesses from IFALPA, the need-to-know philosophy of training is largely tailored to economic factors which results in the teaching of the minimum amount of knowledge. The content of this method of training is also geared to the optimistic forecasts of the manufacturers, and is developed in contemplation of ideal situations. According to one experienced witness from IFALPA it does not cope with the real world.

Thus, I agree with the submission of CALPA that the need-to-know method of training flight crews is defective and should be the subject of re-evaluation. I also agree that any committee set up to make such re-evaluation should include representatives from the regulatory authority, Transport Canada, from the major Canadian airlines, from CALPA and from the manufacturers. It is essential that active line pilots be involved in the work of such a committee.

I therefore recommend that the manufacturer, the Boeing Company, Air Canada and Transport Canada re-evaluate the need-to-know method of training pilots with a view to more adequately defining what pilots need to know and to giving pilots more knowledge and information about the aircraft.

4. Re-evaluation of Training of Maintenance Personnel

There is a need to re-evaluate the training of maintenance personnel who perform line work on the 767 and to re-assess their refresher courses.

It appears from the evidence that the maintenance technicians who worked on aircraft 604 on July 23, 1983 did not have sufficient knowledge of the aircraft systems, particularly the fuel system. Mr. Morawski pointed out that:

> "... the man on line maintenance is dealing with all types of aircraft, although now we limit them to three types. And he deals with all systems on that aircraft. And his degree of competence, of course, is not at the same level as the specialist back in the hangar."[288]

The degree of competence of all line maintenance personnel should be equal to, if not greater than, the maintenance technicians in the hangars. After all it is the line maintenance personnel who deal with scheduled passenger flights.

It is not suggested that the line maintenance personnel should be trained to repair the "black boxes" or computers. However, they should have a working knowledge of such systems to help them in their troubleshooting.

This recommendation is directed not only to Air Canada but also to the manufacturer, the Boeing Company, and to Transport Canada.

5. Re-evaluation of Training of Flight Attendants

I recommend a re-evaluation of the training of flight attendants for the 767, particularly that relating to emergency procedures. This recommendation is not a reflection on the performance of the cabin crew during the Gimli emergency. Their performance was described by Mr. Stewart as

commendable. It was their training with which he found fault.[289] The recommendation is rather based on the evidence and on recommendations made by Mr. Stewart and by the Canadian Air Line Flight Attendants Association, that is, by the flight attendants themselves.[290]

This recommendation is directed to having the flight attendants better informed about what to expect during an emergency; to the need for consistency in emergency procedures from aircraft to aircraft; and to providing more information to the flight attendants about the aircraft, its equipment, and its capabilities.

6. Establishment of Improved Fuelling Procedures

There are nine recommendations to be considered under this heading. They are dealt with separately under the following sub-headings:

i) Trained Fuellers Within Air Canada;

ii) Approval and Audit of Fuellers by Transport Canada;

iii) Independent Confirmation of Fuel Load by Fuellers;

iv) Fuel Log;

v) Increased Drip Procedures;

vi) Computerized System Including Computerized Drip Stick Readings;

vii) Verification of Drip;

viii) Kilogram Drip Sticks; and

ix) Independent Fuel Load Check on DC-9 in Normal Fuelling Situations.

i) *Trained Fuellers Within Air Canada*

I recommend that Air Canada consider developing and training a special unit of personnel to be specialists in fuelling. In this regard they should follow the lead of several other major airlines in the world.

United Air Lines uses company employees who are specialists in fuelling. British Airways uses approved ground engineers responsible for fuelling. Trans World Airlines uses its own mechanics, its own ramp service personnel or, in smaller stations, contract fuellers for fuelling. Even the contract fuellers are trained by T.W.A. Within West Germany, Lufthansa uses fuellers from fuelling companies trained in Lufthansa procedures. Outside the country they use their own mechanics. Swissair uses their own company specialists referred to as the "tanker team" in Zurich. Elsewhere fuelling is the responsibility of what they call the Swissair maintenance team. Delta Air Lines' own station personnel are responsible for fuelling. In some stations where Delta uses contract fuellers they are under the supervision of Delta personnel and are trained in Delta's standard practice for fuelling. American Airlines uses contract fuellers who are trained in the fuelling procedures set down by American Airlines.

United Air Lines has even recently established a new group within its maintenance division called the Fuel Technical Services. This unit handles all matters relating to fuelling including the storage and handling of fuel, fuelling procedures and the development of related manuals.

As a major airline, Air Canada should pay particular attention to its fuelling procedures and should, in my view, have its own fuelling specialists or fuelling group. At stations where that is impractical, contract fuellers should be specially trained in Air Canada fuelling procedures.

ii) *Approval and Audit of Fuellers by Transport Canada*

Transport Canada should be authorized to inspect and approve private fuellers who are involved in the fuelling of aircraft, particularly passenger aircraft, at Canadian airports. It should also be authorized to ensure that all fuellers are competent, qualified and adequately trained to fuel both metric and non-metric aircraft.

Transport Canada should, as well, be authorized to perform a regular audit of fuellers so as to be satisfied that a high standard of competence is maintained.

There is provision in section 3.9(t) of Bill C-36 to amend the *Aeronautics Act* to enable the government to make regulations concerning the handling, marking, storage and delivery of fuel used during or in connection with the operation of aircraft.

I recommend that the Canadian government enact the necessary legislation and regulations to give Transport Canada the authority to approve and inspect fuellers.

iii) *Independent Confirmation of Fuel Load by Fuellers*

If Air Canada is going to continue to use contract fuellers then they should be specifically trained in Air Canada fuelling procedures both for two-man crew aircraft such as the 767 and the DC-9, and also for three-man crew aircraft. They should be specifically trained in how to calculate the fuel load for all aircraft but especially for the 767 and the DC-9, neither of which carries a third crew member to look after fuel. The fuellers should be trained to calculate the fuel load for both metric and non-metric aircraft.

Once the fuellers were so trained they could then independently calculate the fuel load in weight as a double check on fuel calculations and on the gauge readings. It should be remembered that Mr. Wood, a CAFAS fueller in Edmonton, did this calculation for Captain Weir on his own initiative and without being required to do so.[291] He obviously knew how to make the calculations which served as an independent cross-check for Captain Weir.

This procedure should be followed as a matter of course in both normal and abnormal fuelling situations.

iv) *Fuel Log*

I recommend that the remaining fuel on board be recorded by the incoming flight crew before leaving the aircraft. This recommendation refers only to the 767 and the DC-9 aircraft. In the case of those aircraft in the Air Canada fleet which carry a three-man crew, there is a separate fuel log for which the second officer is responsible.

This recommendation does not necessarily mean the introduction of a separate fuel log book. The recommendation could, if accepted, be effected by the inclusion of a separate box in the journey log in which the remaining fuel could be recorded.

Most other major airlines which operate the 767, the 757 or the Airbus, such as United Air Lines, British Airways, Air France, Swissair, and Trans World Airlines, follow the procedure of manually recording the remaining fuel on board in a log book. This enables the outgoing crew to use this figure to perform a check on the calculation of the total fuel load. This is done by adding the fuel remaining, as recorded, to the amount boarded and comparing the total to the gauges or to the calculations done by the fuellers to make sure that the figures are within tolerance.

Such information about the amount of fuel remaining could be used when making a check during fuelling on the 767 if the ACARS is not functioning properly. It could also be used as an independent check in DC-9 normal fuelling procedures, a recommendation which is made below under sub-heading (ix).

v) *Increased Drip Procedures*

Another recommendation to be considered is the dripping of all aircraft after each refuelling.

Swissair requires that, even during normal fuelling procedures, its fuelling personnel perform a drip measurement of the fuel load after every fuelling when the aircraft is at Zurich, its home base, or when the next leg of the flight is to exceed five hours.

I am aware of the fact that this may be considered impractical in Canada because of the number of fuellings which take place every day. However, if used, it would be an added safety precaution in ensuring that the correct fuel load is on board.

The safety value of this procedure has to be balanced against the time factor. It may well be that it would only be practical to drip each aircraft prior to long flights or at major stations after each fuelling.

vi) *Computerized System Including Computerized Drip Stick Readings*

I recommend that Air Canada consider adopting a computerized fuelling system similar to the one recently established by Trans World Airlines. It should not, however, be a substitute for the independent checks in normal and abnormal fuelling situations required to be done manually by the flight crew, maintenance personnel or fuellers, as the case may be.

Trans World Airlines has approximately 180 aircraft including ten 767's. Its fleet, therefore, is comparable in size to that of Air Canada. In the recent past they have moved from a manual operation to a computerized operation. The dispatcher in New York determines the planned fuel load for the flight. This is transmitted to the station where it is fed into the computer. The computer determines the distribution of the fuel as between the left wing tank, the right wing tank and the centre tank. Distribution is determined in order to achieve balance in the aircraft. The distribution figures are given to the fueller. In the case of an inoperative fuel gauge, the computer also indicates what the drip stick readings should be. In all cases, the fueller is told the amount of fuel in volume to be pumped. The conversion from fuel weight to fuel volume is done by the computer, into which is fed the figure for fuel density. Therefore, instead of having to use drip manuals and do manual calculations using the fuel weight conversion factor, all this is now done by computer. As a further precaution against error in an abnormal situation, when the drip stick readings have to be noted, T.W.A. requires verification of the drip stick readings by a second person. The requirement for the second verification came in with the advent of the computerization of fuel load calculations.[292]

I recommend a consideration of this computerized system in addition to any manual checks which already exist and to those which I have recommended.

vii) *Verification of Drip*

I recommend that, where a drip is done, particularly in an abnormal situation, it be verified by a second person.

Where fuel gauges are functioning and a drip is done pursuant to my previous recommendation under sub-heading (v) this verification as an extra safety precaution may not be necessary. However, where a fuel gauge is not functioning and a drip is required, then a second person should verify the drip stick readings and any calculations that have to be made.

viii) *Kilogram Drip Sticks*

I recommend that Air Canada standardize the drip sticks for all aircraft. They should all be standardized to read in weight. They would then be calibrated in the same measurement as the fuel gauges. They would be calibrated in the measurement by which the aircraft burns fuel.

At the moment, drip sticks on different aircraft read in gallons, inches and centimetres. Such a mixture is not satisfactory. The drip sticks should be either in pounds or kilograms, as the case may be. In the case of the 767, the drip sticks should be calibrated in kilograms. This is not something unusual. The following airlines who operate 767's have drip sticks which read directly into kilograms: El Al Israel Airlines, Trans Brazil, Braathens, Brittania, Ethiopian, and Egypt Air.[293]

I am aware of the fact that even if the drip sticks read directly into kilograms, there would still have to be a further calculation to take into account the attitude of the aircraft. However, the readings obtained would be, for the most part, within the range of the required fuel load. The adoption of this recommendation would make it simpler for the person doing the drip to calculate the fuel load.

Furthermore, the standardization would add an additional element of safety when fuel loads are being calculated in abnormal situations.

ix) *Independent Fuel Load Check on DC-9 in Normal Fuelling*

I recommend the introduction of an independent check on the fuel load as part of the normal fuelling procedures on the Douglas DC-9. The check should be done by flight crew and also done independently by either maintenance personnel or by fuellers.

All aircraft in Air Canada's fleet except the DC-9 have such an independent check as part of their normal fuelling procedures. At the present time, the DC-9 is a two-man aircraft in which the flight crew depends only on the fuel gauges to determine the fuel load in a normal fuelling situation.

This check could be done, once the fuel remaining has been recorded, by adding the fuel remaining to the uplift and comparing that to the figures on the gauges. If this independent check is not introduced then DC-9's should be dripped after each fuelling.

7. Standardization of Manuals

I recommend that Air Canada review all its manuals with a view to standardization and clarification. I am referring to the Maintenance Manuals, the Aircraft Operating Manuals, including the MEL's, the Fuelling Manual, and the Operations Manuals.

There is a need for manuals to be consistent from aircraft to aircraft. There is also a need for manuals to be eminently clear and precise.

I am particularly concerned about the lack of consistency between the MEL's from one aircraft to another. The lack of clarity in the MEL's is also a concern. I have already outlined earlier in this

report some of the problems with the manuals in general, and with the MEL in particular. There is a need to delineate more specifically in the MEL those tasks which are to be carried out by the flight crew and those to be carried out by ground personnel in those cases where there are qualifying conditions to be satisfied.

It is my suggestion that this recommendation be undertaken immediately.

8. Status of the MEL

It is imperative that Air Canada make it absolutely clear to all its personnel, especially pilots and those who work in Maintenance Control, that the MEL on board the aircraft is binding in its terms and qualifying conditions, and is the one and only MEL which is to be considered in the dispatch of an aircraft. It must be made absolutely clear that the Master Minimum Equipment List is not to be used or relied on to grant relief from the obligatory conditions of the MEL.

As seen earlier, in the discussion of the contributory causes of the accident, there was a great deal of misconception on the part of some individuals in Maintenance Control and on the part of some pilots as to the nature of the MEL and the role of the MMEL. Illegal relief had been granted from time to time before the Gimli accident. There was even one particular case of disregard for the binding nature of the MEL after Gimli of which the Inquiry was made aware. This cannot be allowed to continue. It is potentially a very dangerous practice indeed.

There have been attempts by Flight Operations, including the use of a video presentation, to emphasize to pilots that the terms of the MEL are obligatory and that reference to the MMEL is not to be made. I am concerned that the current presentation may still leave some pilots in doubt as to the true status of the MEL. I am also concerned that the presentation is directed only to pilots. It should be directed as well to all line personnel and to all personnel in Maintenance Control.

The status of the MEL should be clarified immediately.

9. Personnel in the Cockpit

It is recommended that Air Canada consider restricting the number of persons in the cockpit at the time of or just prior to departure. This obviously would not apply to Air Canada personnel necessary for the safe dispatch of the aircraft.

The number of persons allowed in the cockpit is left to the captain's discretion. However, I question whether his discretion in the matter should have to be exercised at all at the very busy time of departure. If visitors and unnecessary personnel were excluded by policy then the captain would normally not even have to deal with the problem.

10. Improvements to Equipment

A matter of some urgency came to our attention during the last few weeks of my mandate. It appears that the Boeing 767's acquired by Air Canada are still having problems with the fuel quantity indication system.

The Inquiry received documents from Air Canada on March 20, 1985, now marked as Exhibit 261, which reveal that the two newest 767's, aircraft 611 and 612, have experienced many snags in the fuel system including, on some twenty occasions, blank fuel gauges. From October 1, 1984 to March 4, 1985 there were forty-eight snags recorded in relation to the fuel system on these two

aircraft. The snags appear to have been rectified on each occasion. However, it was necessary to change or replace the fuel processor eight times. It is a matter of concern to discover that there are ongoing difficulties with the fuel processor and with the fuel quantity indication system despite the efforts by Honeywell and Boeing to improve them.

It is important that Honeywell Inc. and the Boeing Company continue to try to correct the problems with the fuel processor and the fuel quantity indication system and I so recommend although I am sure that these two companies recognize the urgent need to do so.

In addition to the foregoing recommendation I make the following recommendations in relation to equipment:

i) consideration of the relocation of the magnetic compass;

ii) the introduction of a vertical speed indicator connected to an emergency power supply;

iii) the use of hard collars for deactivated circuit breakers so they cannot readily be pushed back in;

iv) the development of a better and more effective labelling system for inoperative equipment;

v) consideration of the introduction of longer emergency chutes;

vi) better instruction to passengers on how to prepare for an emergency landing and particularly to those passengers sitting behind empty seats;

vii) a review by Air Canada of its policy on spare parts to try to ensure that they carry more than the bare minimum of items which are considered essential to the operation of an aircraft;

viii) additional emergency lighting which would last longer than fifteen minutes and would continue to function after impact;

ix) the introduction of a transponder on the 767 which would continue to be powered by the aircraft's emergency power supply even after the electrical system of the aircraft has automatically disconnected all non-essential electronic equipment. This would ensure that essential information such as aircraft identification, altitude and ground speed is not lost during an emergency;[294] and

x) the flight data recorder and the cockpit voice recorder should be powered by an emergency power supply to ensure their continued operation during an emergency.

11. Improving Accident Investigations

This recommendation is directed to the new Canadian Aviation Safety Board which now includes the former Aviation Safety Bureau. It is recommended that the Board review the procedures of the former Bureau with a view to improving investigative procedures.

The accident investigators should be better trained in investigative techniques. They should be trained in the taking of statements from potential witnesses. They should be instructed that one investigator at a time interview one witness at a time. They should be supplied with the equipment necessary to enable them to do their job properly. They should at least be provided with and use adequate recording equipment and an environment in which there is no extraneous noise to interfere with the recording of the statements. The Board should ensure that it has personnel capable of accurately transcribing the statements so taken.

It is further recommended that no telephone calls or interviews be taped without advising the subject of the interview.

All personnel who are involved in the taking and presentation of evidence during an accident investigation, and all those personnel who are likely to be involved in the presentation of such evidence before a tribunal, should be trained not only in the taking and presentation of the evidence, but in the presentation of such evidence and in their own comportment before a tribunal.

12. Re-evaluation of Certification Procedures

I recommend that the familiarization process by which Transport Canada certificated the 767 be reassessed. Let me say at the outset that the airworthiness team headed by Mr. David Heakes, Chief of Engineering, Airworthiness Branch, and including Mr. Jack Bohay, Superintendent of Avionics and Electrical Systems, Mr. Peter Cowling, Mechanical Engineer, Mr. Bertrand Wormworth, Acting Chief of Test Flying and Mr. John Campbell, Superintendent of Air Carrier Inspection, were all highly qualified individuals who performed their functions competently. The problem appears to be one of manpower and resources. Because of the lack of manpower and resources, the airworthiness authority in Canada must depend on the manufacturer's expertise and on the certification by the Federal Aviation Administration in the United States.

Transport Canada, the regulatory authority, certificated the Boeing 767 aircraft as safe to be used in Canada for the carriage of passengers. The process covered approval of the aircraft systems including its equipment and, in particular, the aircraft's instruments for emergency use. It also certificated its approval of the various manuals, including the MEL, which contain procedures relating to the operation of the aircraft.

Notwithstanding the approval of the 767 by this process, the Gimli accident revealed general deficiencies in the equipment of the aircraft and in the manuals relating to its operation. In particular:

i) the MEL was approved in spite of the fact that it was unclear in its format, in its wording and in its delineation and assignment of responsibilities to flight crew and maintenance personnel;

ii) the stand-by magnetic compass was badly located in the cockpit and could not be accurately read either by Captain Pearson or First Officer Quintal;

iii) the aircraft had no vertical speed indicator to indicate the rate of descent; and

iv) there was no ready reference in the Quick Reference Handbook to the emergency procedure for the lowering of the landing gear.

I therefore recommend that steps be taken to improve the ability of the Canadian airworthiness authority, Transport Canada, to certificate new passenger aircraft from outside Canada in a more thorough and independent fashion. It should be more than a "familiarization process".

13. Increase in Number of Resident Airworthiness Inspectors

I recommend that there be more resident inspectors across Canada. At the time of the Gimli accident there was only one.[295]

The one resident inspector was Mr. Martel who was at Air Canada in Dorval. He testified, and understandably so, that he found it virtually impossible to fulfil all his responsibilities as outlined in Exhibit 226, Document no. 46, despite the good cooperation from Air Canada.[296]

The need for more resident inspectors was recognized prior to the Gimli accident. When the Inquiry heard evidence on this point approval for additional inspectors had still not been given. It is

hoped that such approval will soon be given and that additional inspectors will be assigned to centres throughout Canada. Assistance should also be provided to Mr. Martel at Air Canada in Dorval.

14. Establishment of a Flight Operations Inspectorate Within the Civil Aviation Authority

It is recommended that Transport Canada review the duties and powers assigned to its air carrier inspectors who conduct line flight checks. Air carrier inspectors should not simply review what Air Canada check pilots review but should go beyond that to examine and scrutinize the whole support system, including air traffic control, loading, flight planning, maintenance and other services designed to ensure the safe carriage of passengers.

In this regard, Tansport Canada should examine the Flight Inspectorate Division of the British Civil Aviation Authority. Captain Taylor, Executive Secretary of IFALPA, in the evidence taken in Egham, England, described the Flight Operation Inspectorate, a department of the British Civil Aviation Authority, which carries on an ongoing safety check of airlines throughout the country. He described the system in the following words:

> "General responsibility for the civil air transport industry rests with the Department of Transport, but it delegates virtually all of that to Civil Aviation Authority. The one item it does not delegate to the Civil Aviation Authority is accident investigation and that is a separate department in the Department of Transport and reports directly to the minister...
>
> Now turning to the Civil Aviation Authority, I already mentioned the general control is exercised by issuing and perhaps, too, withdrawing the Air Operator's Certificate. I already talked about the initial issue of the Air Operator's Certificate but clearly there is a need to have a continuing review made of — almost a safety audit.
>
> Now, the Civil Aviation Authority has set up a Flight Operations Inspectorate. It is manned by Flight Operations officers who have been recruited from the industry. The pilots who left the employment of an airline and have joined that Flight Operations Inspectorate, they have got different levels of experience, but if they came, for example, from British Caledonian Airways they would not be assigned back to British Caledonian Airways as an inspector, they would always go to another carrier.
>
> When a Flight Operations inspector is assigned to do a check by his own manager on a particular flight on the conduct by a particular aircraft, it is normal for him to arrive unannounced but to be supported by other people from the Flight Operations Inspectorate because his role is not to examine the level of performance of the pilot and the rest of the flight crew, but to examine the level of performance of the airline.
>
> So he would arrive at the point of departure, the base, and he would, with his aides, he would check, for example, that the airplane had been or was being loaded in accordance with the regulations, that the fuel sufficient for flight was on board, that the safety equipment which is required is on board: the life jackets, the amplifier for passenger address in an emergency case. He really would examine the whole of the operation. He would make himself known to the captain of the aircraft or would have authority to board the aircraft with or without the permission of the aircraft commander. But on board I must emphasize he is not there to check on whether he is flying with a particularly able or marginal pilot but to check that the airline has in fact the organization and structure to enable its employees to carry out a good job. He would examine the documents, the manual provided, the log provided for the pilot, whether the crew had had adequate rest before the flight. He is an observer; he does not participate. If he needs information he will ask for it. He performs this very important role of checking on the whole operation, not just on one facet of it.
>
> So he does in fact look at the engineering procedures at a transit stop or at the point of origin and even on arrival. He would, for example — which is a point under discussion — he would, for example, almost certainly check the fuel that was in the tanks at arrival and also fuel uplifts. He would look for discrepancies of this kind. He would be checking to see if the airline's fuel — carriage

of fuel policy was providing sufficient margins, and quite often this could be detected from examining flight logs and the fuel uplifts.

... So really it is an ongoing safety audit of the airline.

... His reports are made to the department. If it were necessary to discuss it with the operator, arrangements would be made to do so. I believe that quite often small changes that may have been identified as being required are achieved without a great deal of formality.

Just a suggestion is enough. But it is a very potent tool of the Civil Aviation Authority and it becomes increasingly important with the easier access, which is pretty worldwide, for people to be able to set up an air transport undertaking. In order to protect the interests of the travelling public this kind of an arrangement to make sure the air transport undertaking is competent, you know, seems to us to be necessary."[297]

The recommendation is, therefore, that Transport Canada review its own procedures with a view to remodelling them on the basis of those established by the British Civil Aviation Authority in its Flight Operations Inspectorate.

15. Procedural Recommendations

There are two recommendations under this heading:

i) *Time Limit in Originating Document Establishing an Inquiry*

It is recommended that when Commissions or Boards of Inquiry are established, the time limit in the originating document should be set in consultation with the Chairman and should be consistent with the size of the task to be performed.

ii) *Contempt*

The *Inquiries Act* should be amended by the addition of a section granting a Judge presiding as a Commissioner or as a Chairman of a Board of Inquiry all the powers he normally has in the exercise of his judicial duties.

16. Improvements in Communication

Unless communication within Air Canada at all levels improves, there may be other incidents or accidents with more tragic consequences than the Gimli accident. The lapses in communication were the most glaring and disturbing aspect of the circumstances surrounding the Gimli accident.

This is a matter which requires the immediate and urgent attention of the Minister of Transport, of Air Canada and, particularly, of the Board of Directors of Air Canada. The Board is made up of men and women experienced in business matters and private corporate organization. Their experience should be used. They should play an active role in assessing and dealing with this problem of communication within Air Canada as it relates to aviation safety.

A similar problem was recognized by the Honourable Mr. Justice Hugh F. Gibson, fifteen years ago as a result of his Inquiry into the Douglas DC-8 disaster at Malton Airport in Toronto. Among other recommendations he made one which, in its general terms, is strikingly similar to the recommendation now being made in this report. It was:

"(v) As the method of disseminating vital information was ineffective, a better communications system between Air Canada's operations and engineering personnel on one side and the pilots

and the Ground School Instructors of student pilots on the other side, should be established to ensure that all flight safety information and instruction reaches all the pilots and Ground School Instructors at all times; and specifically that action should be taken to ensure that all pilots and Ground School Instructors of student pilots be fully informed of all features of the operation of the spoiler systems and their limitations on DC8 series aircraft."

The same problem of communication still exists. It is a sobering thought that such an important recommendation made so long ago, arising out of a very serious accident indeed in which all 109 persons on board an aircraft were killed, has to be repeated in its general terms in this report.

It is recommended that the Minister of Transport, Air Canada, and especially its Board of Directors, study and, whenever necessary, reorganize Air Canada's corporate structure to improve communications.

I make the following specific recommendations related to communications:

i) there should be better communication between Flight Operations and Engineering;

ii) the Vice-President of Flight Operations should be directly responsible to the President and should be able at all times to communicate directly with him;

iii) there should be better access for pilots to the full maintenance history of the aircraft to which they have been assigned by modifying the computer programme available at the terminals at major flight planning centres across Canada;

iv) there should also be better access by maintenance personnel to the full maintenance history of the aircraft with which they are involved;

v) there should be a pre-flight briefing by a captain for the whole crew, including the flight attendants, similar to the one used by Lufthansa;

vi) consideration should be given to the publication and distribution of a flight safety review similar to that put out by the British Airways Board Air Safety Review Committee;[298] and

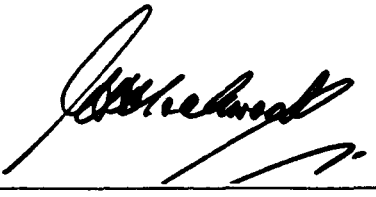
viii) morning meetings to review all the outstanding deviations on Air Canada's fleet that day should also take place on weekends and holidays.

It is essential that this problem of communication in Air Canada be addressed forthwith in the interests of aviation safety.

That completes the main body of the report together with the recommendations.

The following pages contain Part VI, References to the Evidence and Exhibits and Part VII, the Appendices.

In closing, I once again acknowledge the assistance and advice of Counsel to the Inquiry, Mr. Jay Prober. He devoted his energies to the work of the Inquiry on what was virtually a full-time basis at the expense of his private law practice. Without his help the work could not have been done.



The Honourable Mr. Justice George H. Lockwood
Chairman

Dated this 9th day of April, 1985