



Final Report

The Commission of Inquiry into Bilingual Air Traffic Services in Quebec

10 August 1979

ACCESS CODE CODE D'ACCÈS	<u>ADVS</u>
COPY / ISSUE EXEMPLAIRE / NUMÉRO	<u>c.1</u>



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Hull, Quebec, Canada K1A 0S9

Catalogue No. CP 32-30/1979
ISBN 0-660-50395-6

Canada: \$10.00
Other countries: \$12.00

Price subject to change without notice.

The Honourable Donald Mazankowski
Minister of Transport
Tower "C", Place de Ville
Ottawa, K1A 0N5

Dear Mr. Minister:

We, the Co-Commissioners appointed under Order in Council, P.C. 1976-1588, of 28 June 1976 to inquire into Bilingual Air Traffic Services in Quebec, submit our Final Report.

W. R. Sinclair

Julien Chouinard

Darrel V. Heald

Ottawa
10 August 1979

TABLE OF CONTENTS

	Page
Chapter 1 - Introduction	1
1. The Interim Report	2
2. Implementation of the Interim Report	2
2.1 St-Hubert	2
2.2 Mirabel	3
2.3 Montreal TRSA	3
2.4 Bilingual Class I NOTAM Service	4
2.5 Effect of implementation of Interim Report	4
3. Other changes since the Interim Report	4
3.1 Amendment to ANO Series V, No. 19. NOTAM 089	4
3.2 Certificate for operation of aircraft radio	5
3.3 Other changes	5
4. Activities of the Commission following the Interim Report	6
5. Extension of time to submit the Final Report	7
Chapter 2 - Object of the Final Report	9
Chapter 3 - Hearings	11
1. Notice of Hearings and submissions received	12
2. Hearings	12
Chapter 4 - Bilingualism in Air Traffic Services in Quebec	19
1. Availability of French language in Air Traffic Services in Quebec today	20
2. Availability of Aeronautical Publications in the French language	20

Chapter 5 - The Bilingual IFR Communications Simulation Studies	25
1. Introduction	26
1.1 General	26
1.2 Authorship of the BICSS report	29
2. Related Studies	29
2.1 Montreal Area Bilingual Air/Ground Communications study	29
2.2 Monitoring in the real world	30
2.3 Visits to Europe and Mexico	31
3. The parameters of the simulation study	31
3.1 The objectives	31
3.2 The simulation programme	35
4. The detailed conduct of the study	36
4.1 The Project Team	36
4.2 Methodology	36
4.3 Simulation facilities	38
4.4 Choice of airspace sectors	39
4.5 The simulation exercises	41
a) Phase I - Enroute	41
b) Phase II - Terminal	42
c) Phase III - Terminal Exceptional Situations	43
d) Phase IV - Enroute Exceptional Situations	43
e) Summary	44
4.6 Participation of representatives of the aviation industry and associations	44
4.7 Monitoring by representatives of the Commission	45
5. The findings of the BICSS report	46
5.1 General	46
- Communications data	46
a) Communications characteristics	46
i) Number of ground-to-air calls by each controller position	46

ii)	Average duration of ground-to-air calls by each controller position	46
iii)	Number of ground-to-air and air-to-ground calls for each position	46
iv)	Mean latency or delay by each controller in responding to an air-to-ground communication	46
v)	Number of ground-to-ground (hotline) calls initiated and received at each controller position	46
b)	Communications errors	47
i)	False start	47
ii)	Change in language	47
iii)	False identification	47
iv)	Change in identification	47
v)	Mid-sentence correction	47
vi)	Incorrect readback	47
vii)	Confirm	48
viii)	Say again	48
ix)	Extra calls	48
-	Losses of separation	48
5.2	Findings - Communications data	48
a)	Communications characteristics	48
b)	Communications errors	49
5.3	Findings - Losses of separation	49
5.4	Findings - Problem areas or weaknesses in the existing system not related to bilingualism	49
6.	The procedures developed	50
6.1	The procedures	50
a)	Language identification on flight data strips	51
b)	Replacement of strip when language changes from French to English	51
c)	Exchange of traffic in the holding pattern	51
d)	Exchange of traffic for merging targets	52
e)	Relay of clearances in language of pilot	53

f)	Use of phonetics for civil aircraft	53
g)	Use of phonetics for identification of low frequency airways and air routes	54
h)	Identification of VHF airways	55
i)	Use of language initially chosen by pilot unless requested to change	55
j)	Inadvertent use of wrong language by controller	55
k)	Inadvertent use of wrong language by pilot	56
l)	Initial radio contact where pilot language unknown	56
m)	Relay of clearances by pilot of another aircraft	56
n)	Coordination of language between two IFR units	57
o)	Coordination of language between IFR units and towers and Aeradio stations	57
p)	Clearance readbacks	57
q)	Provision of seldom used phraseology at the controller position by means of plasticized reference cards or by OIDS display	58
r)	Establish local procedures for unilingual French pilot forced into English only airspace	58
s)	A requirement that the Montreal Terminal Arrival Controller provide the tower controllers with the information on the position of all arriving IFR aircraft	59
6.2	The testing of the procedures	59
a)	Exchange of traffic in the holding pattern	60
b)	Exchange of traffic for merging targets	60
c)	Use of phonetics for civil aircraft	60
d)	Clearance readbacks	61
e)	Establish local procedures for unilingual French-speaking pilot forced into English only airspace	61
6.3	Application of bilingual procedures to other IFR units	61
7.	The documentation required pertaining to the various procedures developed in order to facilitate evaluation of those procedures	62

8. Criticisms directed at the conduct of the study, at the findings reported, at the procedures recommended and at the adequacy of the methods used in developing and testing the procedures	63
8.1 Criticisms relating to the conduct of the study	63
a) The length of simulations was not adequate to establish a data base capable of revealing the actual detrimental impact of the use of a second language	63
b) The controllers' workload	65
c) The constraints	68
i) Simulation equipment	68
ii) Aircraft characteristics	69
iii) Pilot characteristics	69
iv) Experience of controllers	70
v) Presence of observers	70
vi) Controller motivation	70
vii) Noise in communications	71
viii) The simulations were carried out under "sterile" conditions	71
ix) The Enroute and Terminal sectors were not simulated coincidentally	72
x) The physical arrangements of the pilot positions	72
xi) The traffic used was for the most part identical on each day	72
d) The lack of realism	74
e) The lack of pilot or user input and the failure to test the pilot function	75
f) The associations were not invited to participate in the preparation of the BICSS report, in the monitoring in the real world carried out as a related study nor in the visits to Europe and Mexico, another related study	79
g) Limitations inherent in simulation	79
8.2 Criticisms relating to the findings	81
a) The reliability of the statistics upon which the analysis was performed, and upon which the findings are ultimately based	81

b)	The exclusion of the data from the CATCA runs	82
c)	The reduction of the losses of separation	83
d)	No tests were carried out to evaluate stress on the part of the controllers in bilingual control	85
e)	The assumption on which the objective of the simulation was pursued that "the existing air traffic control system in Canada provides an acceptable level of safety"	86
f)	Language related errors	90
g)	The lack of other evidence	92
8.3	Criticisms relating to the procedures	93
9.	Monitoring	102
9.1	Monitoring carried out by Commission consultants	102
9.2	Monitoring conducted by Department of Transport	103
10.	Conclusions	104
Chapter 6	- Language use and aviation accidents	109
1.	Situation throughout the world	110
1.1	Findings of Interim Report	110
1.2	Studies made since Interim Report	111
1.3	Results of subsequent studies	114
1.4	Incident data sought by consultants	115
1.5	Conclusion	117
2.	Situation in Quebec	117
Chapter 7	- Languages used in Air Traffic Control	119
1.	Introduction	119
1.1	The Interim Report	119
a)	Recommendations of ICAO	119
b)	Language used in air traffic control systems in other countries	121

1.2	Further investigations conducted on behalf of the Commission	121
1.3	Studies made by the Department of Transport	122
1.4	Views of CALPA and COPA	122
2.	Languages currently available for Air Traffic Control	122
3.	Detailed on-site investigation of several Air Traffic Control systems conducted by Commission consultants	123
3.1	Introduction	123
3.2	The investigation made by the consultants	124
a)	Overview	125
b)	Sections describing area control centres, certain airports, their control towers and other facilities	125
c)	Summary of findings	125
i)	Language use	126
ii)	Special procedures	126
iii)	Special practices	126
iv)	VFR/IFR mix	126
v)	Incidents/accidents	126
vi)	Publications	126
vii)	Lexicon	126
viii)	Radio/Telephone licenses	126
3.3	Tokyo, Japan	127
a)	Facilities visited	127
i)	Tokyo Area Control Centre (ACC)	127
ii)	Tokyo International Airport, Control Tower and Approach Control	127
iii)	Chofu Airport Control Tower	127
b)	Summary of findings	127
3.4	Rio de Janeiro and Sao Paulo, Brazil	129
a)	Facilities visited	129
i)	Brazilia Area Control Centre	129
ii)	Galeao International Airport, Control Tower and Approach Control	129
iii)	Sao Paulo Airport, Control Tower and Approach Control	129
iv)	Santos Dumont Control Tower	129
b)	Summary of findings	129

3.5	Mexico City and Guadalajara, Mexico	131
a)	Facilities visited	131
i)	Mexico City International Airport Control Tower and Approach Control	131
ii)	Mexico City Area Control Centre	131
iii)	Guadalajara Airport, Control Tower and Approach Control	131
b)	VFR/IFR mix	132
c)	Summary of findings	132
3.6	Rome, Italy	133
a)	Facilities visited	133
i)	Rome Area Control Centre	133
ii)	Rome International Airport, Control Tower and Approach Control	133
b)	Summary of findings	133
3.7	Geneva, Switzerland	135
a)	Facilities visited	135
i)	Geneva Area Control Centre	135
ii)	Geneva Airport Control Tower	135
b)	Summary of findings	135
3.8	Frankfurt, Germany	138
a)	Overview	138
b)	Facilities visited	138
i)	Frankfurt Area Control Centre, Frankfurt Airport Control Tower and Approach Control	138
c)	Summary of findings	139
3.9	Paris, France	141
a)	Facilities visited	141
i)	Le Bourget Airport Control Tower, Charles de Gaulle Airport Control Tower and Approach/Departure Control, Orly Airport Control Tower and Approach/Departure Control, Area Control Centre at Orly	141
b)	Summary of findings	141
4.	Visits made by the Department of Transport	143
4.1	Investigations carried out	143
4.2	Belgium	144

5. Eurocontrol	144
6. Views of CALPA and COPA	146
6.1 CALPA	146
6.2 COPA	152
7. Conclusions	152
 Chapter 8 - Arguments relating to the safety of the introduction of Bilingual IFR Air Traffic Services in Quebec	 169
1. The party line element of a listening watch and the need for complete comprehension	 170
1.1 General	170
1.2 The BICSS listening watch study	173
a) The study	173
b) Conclusions of the study	175
1.3 Measuring the effect of the listening watch	180
1.4 Conclusions of the Commission	184
2. The VFR-IFR mix	186
2.1 What is the VFR-IFR mix?	186
2.2 The VFR/IFR mix and the Interim Report	187
2.3 Can the VFR/IFR mix be simulated?	191
2.4 The Montreal Area Bilingual Air/Ground Communications Study and VFR/IFR Mix	194
a) VFR overflights through the TRSA	195
b) VFR flights enroute to a PCZ underlying the TRSA for landing	195
c) Segregation of VFR flights from IFR flights within the Dorval PCZ	196
d) Segregation of VFR flights from IFR flights within the Mirabel PCZ	196
e) Sequencing of VFR and IFR arrivals and departures at Dorval and Mirabel	196
f) Segregation and sequencing of VFR and IFR flights at St-Hubert	197
g) Segregation and sequencing of VFR and IFR flights at St-Jean	197
2.5 The VFR/IFR mix in other countries	199
a) Procedures and airspace structure	200

b)	VFR/IFR traffic interface	200
c)	Transponder equipment	200
d)	Airport runway utilisation	201
2.6	Position of CALPA and CATCA	201
a)	CALPA	201
b)	CATCA	202
2.7	Conclusions of the Commission	202
3.	The possibility of unilingual French-speaking pilots flying into airspace controlled in the English language only.	205
3.1	Introduction	205
3.2	The experience in Canada	205
3.3	The situation in other countries	206
3.4	The BICSS Report	207
a)	Pilot exceeding his language abilities	207
b)	Forced deviation into English-only airspace	208
3.5	Argument of CALPA	210
4.	The opinion of Mr. R. Dixon Speas	217
4.1	Mr. R. Dixon Speas and PRC-Speas	217
4.2	Mr. Speas' submission of May 31, 1978 and the PRC-Speas comments of November 1978	222
4.3	Conclusion	228
Chapter 9	- Introduction of bilingual IFR Air traffic Services in Quebec.	231
1.	Safety and the introduction of bilingualism for IFR flights	232
2.	Conclusion	233
3.	Recommendations	233
Chapter 10	- VFR flights at Dorval	239
1.	Air Traffic within the Dorval Positive Control Zone (PCZ)	240
2.	The Dorval International Airport PCZ	241
3.	Runways at Dorval	241
4.	Air Traffic Control in the Dorval PCZ	241

4.1	The Montreal Terminal Control Area	241
4.2	The Dorval Control Tower	242
4.3	Segregation of VFR flights from IFR flights within the Dorval PCZ	243
4.4	Sequencing of VFR and IFR arrivals and departures at Dorval	243
5.	The Montreal Area Bilingual Air/Ground Communications Study	243
5.1	The objectives	243
5.2	The study team	245
5.3	Methodology	245
5.4	Findings and recommendations of the study team	248
5.5	Implementation plan recommended by the study team	251
5.6	Impact on the present system	253
6.	The positions of CATCA and CALPA	254
6.1	The position of CATCA	254
6.2	The position of CALPA	255
7.	Conclusion	255
8.	Recommendations	256
Chapter 11 -	VFR flights at Mirabel	259
1.	Introduction	260
2.	Conclusion	260
3.	Recommendations	261
Chapter 12 -	Uncontrolled Airspace	263
1.	General	264
2.	Recommendations	268
Chapter 13 -	Implementation	273

Chapter 14 - Operational efficiency and implementation costs	289
1. Operational efficiency	290
2. Implementation costs	291
Chapter 15 - Recommendations	293
1. IFR Air Traffic Services in Quebec	294
2. VFR flights at Dorval	298
3. VFR flights at Mirabel	299
4. Uncontrolled airspace	300

FIGURES

		Following Page
Figure A	Languages available for Air Traffic Control in ICAO countries	154
Figure B	Contracting States of ICAO	154
Figure C	List of the matters investigated by the Commission's consultants in Japan	154
Figure D	Extracts from Exhibit 278 relating to R/T license requirements	211
Figure E	Curriculum vitae of Mr. R. Dixon Speas	228
Figure F	Arctic, Northern and Southern control areas	269
Figure G	Present boundaries of Montreal FIR	281
Figure H	Boundaries of Montreal FIR proposed by NASP-E	281
Figure I	Boundaries of Montreal FIR proposed by the Odynski study	281

Chapter 1
INTRODUCTION

Section 1. THE INTERIM REPORT

On June 23, 1977 the Commission submitted to the Minister of Transport an Interim Report recommending in summary:

that air traffic control services for VFR flights in the St-Hubert Positive Control Zone be provided in both languages;

that air traffic control services in both official languages be made available within the Montreal Terminal Radar Service Area (TRSA) for VFR flights; and

that air traffic control services in both official languages be made available to VFR flights that communicate with the control tower while traversing the Mirabel Positive Control Zone to another destination without landing at the airport.

These recommendations were accompanied by suggestions, and were made subject to conditions which will be mentioned when the implementation of the Interim Report is discussed later. The Commission made no findings or recommendations as to Dorval. With respect to VFR flights landing and taking-off at Mirabel, the Commission recommended that no changes should be introduced pending the results of the simulation tests then under way.

Section 2. IMPLEMENTATION OF THE INTERIM REPORT

2.1 St-Hubert

Provision of bilingual air traffic control services at St-Hubert was authorized as of July 8, 1977, the day on which the Minister of Transport tabled the Interim Report in the House of Commons. The Automatic Terminal Information Service (ATIS) has been provided in both languages since that date. Schedule II of Air Navigation Order (ANO) Series I, No. 1 was amended to include St-Hubert in the list of airports where bilingual services are available to VFR flights.

As suggested by the Commission, operations at St-Hubert were reviewed periodically by DOT. Four reports have been filed with the Commission.

It appears that traffic at the airport has increased by 2% since the use of both languages has been authorized. However, in no month has the record of 35,397 movements for May, 1977 been reached. As mentioned in the Interim Report, Mr. Richard Lemay, a controller at St-Hubert, estimated that in January, 1977 English and French were being used in the proportion of 75%-25%. The proportion is now approximately 70%-30%, although during a busy period in November, 1978 it was measured at 60%-40%.

Operational acceptance of the two languages has been achieved and that acceptance has eased the workload of the controllers.

2.2 Mirabel

Bilingual services to aircraft traversing the Mirabel Positive Control Zone were authorized as of October 1, 1977. A Class I NOTAM to that effect was issued on September 27, 1977. The Commission had specified that "before the service is provided, the legend and other explanatory material on the Montreal VTA Chart must be available in both official languages." This was done, although in the first instance all the information was not yet translated. It was, however, reported that there was sufficient bilingual information to meet the users' needs. The fourth edition of the Chart, published in May, 1978, does provide all the information in both languages. ATIS has been provided in both languages on two separate frequencies since January 5, 1978. As recommended, the users were consulted before implementation of the service. There was an increase of 1.6% or 198 flights in "Runway 88" flights (flights traversing the Control Zone) for the first nine months of 1978 as compared with the same period in 1977. English is used in approximately 70% of these flights, and French in 30%.

2.3 Montreal TRSA

Bilingual control services in the Montreal TRSA commenced on January 1, 1978 following a Class I NOTAM issued on December 1, 1977. The Interim Report stipulated that "the service must be provided from a dedicated position at least 16 hours per day, and at all times on a discrete frequency." It appears that this was not always done, and that the TRSA was closed at times. However, an Operations Bulletin was issued on January 16, 1979 stating that suspension of the TRSA service is prohibited at any time. The Commission has been assured by Mr. Pierre Proulx, Director of Air Traffic Services, that the last time the TRSA was closed was on November 10, 1978 and that the Operations Bulletin has been complied with since. The TRSA movements have increased by an average of 333 flights per month in 1978 over 1977. Language used is approximately 80% English and 20% French.

2.4 Bilingual Class I NOTAM Service

Recommendations were made in the Interim Report with regard to providing information in both languages concerning the three locations just mentioned in the event that Class I NOTAMs were not available in French. However, bilingual NOTAM Class I service for Quebec has since been provided, commencing January 1, 1978.

2.5 Effect of Implementation of Interim Report

It should be noted that the implementation of the recommendations contained in the Interim Report appears to have gone smoothly, and that airports where the French language is authorized for VFR flights are operating normally.

Section 3. OTHER CHANGES SINCE THE INTERIM REPORT

3.1 Amendment to ANO Series V, No. 19. NOTAM 089

ANO Series V, No. 19, in force since September 8, 1971, imposes restrictions affecting training flights for unlicensed pilots. The Order originally applied to Calgary International, Dorval International, Vancouver International and Winnipeg International airports. The ANO was amended on December 9, 1977 to include Mirabel International, as well as Edmonton International and Toronto International airports.

At the same time the ANO was further amended to give Regional Controllers of Civil Aviation the authority to restrict VFR flights for safety reasons at the seven airports to certain times of the day, to aircraft with specific communications equipment or to pilots having specific qualifications.

Pursuant to this amendment, and on the same date, NOTAM 089 was issued so as to place restrictions on VFR flights at Mirabel. The NOTAM prohibits VFR arrivals and departures by student pilots and by private pilots who are not licensed to operate aircraft under IFR conditions.

The Commission requested its consultants to compare the VFR/IFR mix of traffic at Mirabel for similar periods before and after the issuance of NOTAM 089. Their report is entitled "Mirabel Traffic Analysis, January-September 1977 vs. January-September 1978."

The report first notes that VFR activity at Mirabel actually increased after the NOTAM was issued. During the periods under review the VFR operations in 1978 amounted to 39% of the total operations as opposed to 34% in 1977. However, while VFR operations increased, the VFR and total activity levels by single-engine aircraft decreased during the same periods. "As such, it can be seen that the VFR and total mix became more sophisticated, which is evidenced by the fact that Mirabel experienced an increase in air carrier training flights." In fact, airline training flights increased from 8% to 10% of total activity. In the 1977 period under review single-engine aircraft performed 24% of VFR operations and 8% of total activity. In the corresponding period of 1978 these percentages decreased to 17% and 6% respectively.

3.2 Certificate for operation of aircraft radio

On November 22, 1978 the Minister of Communications of Canada announced that "Unilingual Francophone pilots will no longer be required to have a knowledge of English in order to obtain the Department of Communications certificate needed to operate aircraft radios." Until then the matter was governed by Telecommunications Regular Circular, TRC-20, effective date December 2, 1974 which provided that "Examinations may be conducted in either of the official languages. However, a candidate examined in French shall demonstrate that he is capable of exchanging communications in English relative to control and safety in the Aeronautical Mobile Service before a certificate is issued."

3.3 Other changes

The Dorval PCZ was modified so as to raise the ceiling from 2,000 to 3,000 feet above sea level (ASL). The change does not appear to have an impact on the subjects under consideration.

Section 4. ACTIVITIES OF THE COMMISSION FOLLOWING THE INTERIM REPORT

By their Terms of Reference the Commissioners are required, among other things, "to consider, evaluate and report upon:

- c) the detailed conduct of the Department of Transport's studies and participation therein of representatives of the aviation industry and associations by monitoring, as appropriate, through specially appointed professional advisers if considered necessary, and by means of interim recommendation to the Department of Transport, the aviation industry and associations."

As will be seen later, the simulation tests to which this excerpt refers were designed by an experimental psychologist, Dr. Paul Stager, Associate Professor of Psychology at York University. To better monitor the tests, it was felt that an experimental psychologist should be attached to the Commission's team of technical advisers. The latter retained the services of Dr. Jean-Yves Frigon, Professor, Department of Psychology, University of Montreal.

Dr. Frigon attended the simulation tests at Hull during several days as an observer on behalf of the Commission. Another member of the consultants' team, Mr. John Keitz, was present throughout the tests except for 5 days of tests when, for personal reasons, he was unable to attend. During the period he was absent Mr. Keitz was represented by Mr. M.A. Warskow. Mr. Roger Pelletier attended the tests for almost as many days as did Mr. Keitz. Both Mr. Pelletier and Mr. Warskow were members of the consultants' team.

In addition, the Commission assigned numerous specific tasks to its consultants. For instance, a detailed on-site investigation was conducted of the Air Traffic Control (ATC) systems at Mexico City, Tokyo, Rome, Geneva and other locations which will be discussed later.

The Commissioners held monthly meetings with their counsel and consultants in Ottawa, Montreal or Quebec City. At these meetings progress reports on the simulation tests, and on the various tasks undertaken by the consultants were received.

In mid-November, 1977 the Commissioners spent several days in Dallas, Texas with their counsel and consultants in order to visit the Federal Aviation Administration Air Route Traffic Control Centre, the Dallas-Fort Worth airport tower and Terminal area radar room, and to better familiarize themselves with such procedures as profile descents, standard terminal arrival routes (STARS) and standard instrument departures (SIDS).

During the period in question Mr. O.F. Plouffe of Montreal has served as Executive Director of the Commission. Mr. W.A. Riel of Gatineau, Quebec was engaged as Administrative Secretary in October, 1978. He also acted as registrar at the hearings.

In September, 1978 the Commission moved its offices to Room 817, 151 Sparks Street, Ottawa.

Section 5. EXTENSION OF TIME TO SUBMIT THE FINAL REPORT

The Terms of Reference of the Commission provide that the Commissioners shall submit "a final report with all reasonable dispatch and within ninety days of the receipt of the final results of the study based on the use of the air traffic control electronic simulator."

As early as August 31, 1976 the Commissioners wrote to the Minister of Transport indicating that the ninety day time limit might be impossible to achieve and "to signal that an extension may be required at such time as the situation can realistically be appraised."

On January 16, 1979, the day the report of the Bilingual IFR Communications Simulation Studies (the BICSS Report) was received, Commission counsel, as instructed by the Commissioners, wrote the Minister a letter in which they stated:

"The results of the study conducted by the Department of Transport have today been received by the Commissioners.

Notice of public hearings to consider that and other matters included in the Terms of Reference has already been given. This notice was published in all daily newspapers between December 27 and 29, 1978.

Public hearings are indeed the only means by which an opportunity can be provided to all interested parties to express their views on the results of the study and on any additional evidence that may be adduced.

The Hearings will commence February 5, 1979.

Based upon their experience to date, including that arising from the first series of hearings leading to the Interim Report made June 23, 1977, it is the opinion of the Commissioners that, proceeding with all reasonable dispatch, it may not be possible for them to submit a final report within 90 days.

May we remind you that following a meeting held by them in Quebec City on August 23 and 24, 1976 the commissioners wrote to you on August 31 concerning the Terms of Reference. Attention was drawn to paragraph (e) so as to point out that an extension might be required at such time as the situation could be realistically appraised.

Today's letter is to inform you that an extension will likely be required to enable the Commissioners to submit a final report. The Commissioners will continue to proceed expeditiously, but they cannot at this stage say when the report will be ready. They will be in a better position to make a realistic prediction during the course of the public hearings."

The hearings did begin on February 5, 1979. The last witness was heard March 30. Oral argument by the representatives of some of the parties was completed on April 5. By then 79 days had already passed since the receipt of the BICSS Report. The parties were given until May 3 to submit written argument, a date well beyond the original 90 days. As a matter of fact the last written argument was received from counsel for the Department of Transport on the 14th of May, thus concluding the hearings.

It was for these reasons that, as instructed by the Commissioners, Commission counsel wrote to the Minister on March 21, 1979 requesting that the Order in Council be amended so that the 90 days would run from the conclusion of the hearings. The Order in Council was so amended on April 12, 1979.

The first part of the report is a general introduction to the subject of the study. It includes a brief history of the subject and a statement of the purpose of the study. The second part of the report is a detailed description of the methods used in the study. This includes a description of the subjects, the materials, and the procedures used. The third part of the report is a presentation of the results of the study. This includes a description of the data collected and a discussion of the findings. The fourth part of the report is a conclusion and a list of references.

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Chapter 2

OBJECT OF THE FINAL REPORT

This report, which constitutes the Final Report of the Commission, is a result of both phases of the Inquiry and deals with all matters included in the Commission's Terms of Reference which were not the subject of recommendations made in the Interim Report.

In general, the Report considers the introduction of bilingual IFR Air Traffic Services in the Province of Quebec, the introduction of bilingual VFR Air Traffic Services at Dorval, the introduction of bilingual Air Traffic Services for VFR flights landing and taking-off at Mirabel, and the implications in relation to aviation safety, implementation costs and operational efficiency.

To that end, the Report deals with the present situation with regard to bilingualism in Air Traffic Services in Quebec, the BICSS Report, language use and aviation accidents, ATC systems of other countries, operations at some Quebec, Canadian and foreign airports and arguments relating to the safety of the introduction of bilingual IFR Air Traffic Services in Quebec including the uncontrolled airspace in that province.

Chapter 3
HEARINGS

Section 1. NOTICE OF HEARINGS AND SUBMISSIONS RECEIVED

Between December 27 and 29, 1978 there was published in all Canadian daily newspapers a notice of hearings to commence in Montreal on February 5, 1979. The notice invited the Department of Transport, aviation associations, air carriers and other interested parties to file written submissions on or before January 29, 1979.

Twelve submissions were received:

Department of Transport

J.M. Greavette

F.R. Matthews, Q.C.

Canadian Owners and Pilots Association (COPA)

Canadian Air Line Pilots Association (CALPA)

Canadian Air Traffic Control Association (CATCA)

Air Transport Association of Canada (ATAC)

Canadian Business Aircraft Association, Inc. (CBAA)

Harry Devereux

E.L.R. Williamson

Geoffrey Wasteneys

Robert G. Graham

Section 2. HEARINGS

The following parties appeared before the Commission:

Department of Transport (Canada)

The Department was represented throughout the hearings by Bernard Deschênes, Q.C.

Air Transport Association of Canada (ATAC)

ATAC was represented by its Director of Operations, George C. Capern, who was present during the first four days of the hearings, and occasionally thereafter. Mr. Capern did not participate in the examination of witnesses.

Canadian Air Line Pilots Association (CALPA)

Captain R.E. Cook, President of CALPA, appeared on the first day of the hearings to make an opening statement on behalf of the Association. The Association was thereafter represented by First Officer Robert MacWilliam and by Captain R. Daley. Most of the examination of witnesses on behalf of CALPA was conducted by Mr. MacWilliam. He also appeared as a witness.

Canadian Air Traffic Control Association (CATCA)

CATCA was represented throughout by Ms. Catherine H. MacLean, assisted by Mr. Michael Tonner and Mr. Donald Redden of CATCA. Ms. MacLean was also advised by Mr. James Kouk of CATCA.

The minority of CATCA on behalf of the Quebec controllers

The minority viewpoint within CATCA was represented by Mr. Yves Aubry during the early stages of the hearings, and thereafter by Mr. Robert Fleury and Mr. Jean-Luc Patenaude.

Canadian Owners and Pilots Association (COPA)

An opening statement was made by Mr. Peppler. The President of COPA, Mr. Russell Beach, was heard as a witness. COPA did not otherwise take an active role in the proceedings.

The Commission was represented throughout by its counsel, L. Yves Fortier, Q.C. and W.C. Graham, Q.C.

All witnesses were witnesses of the Commission. The parties were invited to submit the names of persons who might give material evidence.

Simultaneous translation was provided so that any person might use either French or English during the hearings. A transcript of the evidence and a transcript of the simultaneous translation tapes were made available each day.

The hearings were held in public. The use of cameras, microphones or related equipment was not, however, allowed while the hearings were in progress.

Witnesses were heard during 25 days, and oral argument during two. As previously mentioned, at their request the parties were given until May 3 to submit written argument. Taking into account 34 days of hearings in 1977, a total of 61 days was spent by the Commission in hearing witnesses and oral argument.

The transcript of evidence and oral argument covers some 4,000 pages which, when added to the transcript of the first phase, makes a total of over 9,000 pages. One hundred and ninety exhibits were filed during Phase 2, for a total of 363 during both phases of the hearings. One of these exhibits, the Report of the Bilingual IFR Communications Simulation Studies, consists of three volumes and six working documents, containing a total of 1,897 pages.

In all 13 witnesses were heard in this phase. In order of their appearance they are:

Walter M. McLeish

Administrator, Canadian Air Transportation Administration. Received B. Eng. degree at McGill University and Master's degree in Aeronautical Engineering, University of Michigan. Graduate of National Defence Staff College. Served as flying instructor in World War II. Chief Airworthiness Engineer, Central Experimental Improvement Establishment, RCAF. Chief of Maintenance with NATO Command in Europe. Joined Department of Transport in 1964 as Chief Aeronautical Engineer. Served as Director of Civil Aviation and as Director General of Civil Aviation.

Pierre Proulx

Director of Air Traffic Services, Department of Transport. Started as air traffic controller in 1957. Has served as airport controller in the Quebec and Montreal control towers, IFR controller in the Montreal Area Control Centre (ACC), ATC instructor at the Quebec Regional School, Regional Training Officer, supervisor in the Montreal ACC, member of the ATC implementation team, Regional Superintendent of Procedures Atlantic Region in Moncton, and Regional Manager - ATS Atlantic Region, also in Moncton. In August 1976 Mr. Proulx was appointed Director - Bilingual IFR Communications Simulation Studies, and has acted as such throughout the studies.

Brian R. Walsh

Acting Chief, Navigational Aids Engineering, Telecommunications and Electronics Branch. A professional engineer, Mr. Walsh joined DOT in 1958 after completing his bachelor degree in Electrical Engineering at McGill University. Has successively worked as field installation engineer, Montreal Region; Engineer-in-charge, Maintenance Engineering Navigational Aids Facilities, Ottawa; Superintendent of Training and Manuals, Telecommunications and Electronics Branch, Ottawa; Regional Manager, Telecommunications and Electronics Branch, Toronto. He was the Deputy Director of the Bilingual IFR Communications Simulation Studies.

T.R. Fudakowski

Standards officer, Air Traffic Services Branch, Department of Transport. Joined DOT in 1965 and served first as a surface meteorological observer. Has served as airport controller in the Montreal Tower for one and a half years and as IFR controller in the Montreal ACC for nine years, performing the duties of an enroute, terminal and precision approach radar controller, as well as a crew training specialist and shift supervisor. Has been a licensed pilot since 1964 with over one thousand hours of experience. He holds a commercial pilot's licence and a glider pilot's licence. He joined the BICSS team in April, 1977.

Dr. Paul Stager

Associate professor, Department of Psychology, York University, Toronto. Dr. Stager holds the following degrees: Honours Bachelor of Arts, Department of Psychology, University of Western Ontario, 1963; Master of Arts, Department of Psychology, Princeton University, 1965; Doctor of Philosophy, Department of Psychology, Princeton University, 1966. Since 1967 he has been a consultant to the Canadian Armed Forces Personnel Applied Research Unit in Toronto. From 1971 to 1973 he was Director of the Graduate Programme in Psychology at York University. From 1973 to 1975 he took leave to work at the Defence and Civil Institute of Environmental Medicine in Toronto. He is a member of both the Canadian and American Psychological Associations, the Human Factors Society and the Human Factors Association of Canada. He is the author or co-author of numerous publications. Dr. Stager, who possesses a private pilot's licence and is active in this field, joined the BICSS team in April, 1976.

E.L. Taylor

Operational Requirements Specialist, Department of Transport, determining requirements for ATC systems and equipment. Mr. Taylor was Project Manager, Montreal Area Bilingual Air/Ground Communications Study. He started as an air traffic controller in 1956 at Gander performing the duties of airport, terminal and ground controlled approach controller. He was transferred to Toronto in 1960 where he acted as airport, terminal and precision radar controller. In 1964 he was assigned to ATS Headquarters as Procedures Specialist, developing and updating ATC procedures. From 1965 to 1971 he was Precision Approach Radar Instructor at Ottawa School. He was appointed Radar Operations Officer, ATS Headquarters in 1971 and in 1973 assumed his present duties. Mr. Taylor obtained a B.A. degree in Political Science, Carleton University in 1970 and has post graduate credit in Public Administration, Carleton University.

Nicholas Odynski

Since 1977, Standards Officer, ATS Headquarters. In that capacity has served as Project Manager for provision of bilingual Air Traffic Services, Province of Quebec (otherwise known as the Odynski Study). Mr. Odynski was first a pilot with the RCAF from 1952 to 1958 and as such flew the Harvard (T-6), Expeditor (C-45), Silver Star (T-33) and Canuck (CF-100). After four years from 1958 to 1962 as Inspector, Retail Credit Co. for the Eastern Townships region of Quebec he served until 1966 as an air traffic controller for the RCAF at St-Hubert. He then became a DOT controller at Dorval where until 1971 he acted as airport controller in the Tower, and as Enroute IFR controller in the ACC. He was Instructor, Air Services Training School in Ottawa 1971-73, and Airspace Utilization Officer, ATS Headquarters, 1973-77.

Robert MacWilliam

Pilot with Air Canada as First Officer on Boeing 747s with an overall 16,000 to 17,000 hours flying experience. Mr. MacWilliam joined the RCAF in 1956. Did tours of duty in CF-100s in Germany until 1962. Returned to Canada as flight instructor on Harvard and Tudor aircraft. Left the service in 1965 to spend one year with the Australian airline, Qantas, as second officer on Boeing 707s. Joined Air Canada in 1966, and was based in Montreal until 1974. Since then has been based in Toronto. In the course of his civilian career has flown Boeing 707s, Vandguards, DC-8s and Boeing 747s in both domestic and international flights. A member of CALPA, he served for one year as safety chairman for the Montreal Council. He was then head of CALPA's Technical and Safety Division before becoming a member of CALPA's Board of Directors for a term of two years. Was member of the BICSS team as representative of CALPA. At the Simulation Centre he also represented the interests of CBAA, ATAC and COPA, to whom he would report periodically on the progress of the proceedings. Mr. MacWilliam represented CALPA during the second phase of the Commission hearings, and was active in the examination of the witnesses. He also appeared as a witness.

Russell Beach

Has for 8 years been President of the Canadian Owners and Pilots Association, Inc., an organization that has 15,000 members, all licensed pilots. For six years has also been Vice-President of the International Council of Owners and Pilots Associations. He has had a Private Pilot Licence for over 22 years, with a single-engine, multi-engine land and sea rating, night endorsement and instrument rating. He owns and flies an eight-passenger turbo-prop Cheyenne business aircraft, largely in Eastern Canada and the Eastern United States.

Eric St. Denis

Enroute air traffic controller on the West Side of Toronto ACC since September, 1976. He joined DOT in 1969. After school and Dorval Tower training he was first assigned to the Baie Comeau Tower. Four months later was transferred to the Quebec Tower where he served as a VFR controller, also for four months. In June, 1970 he was assigned to the Dorval Tower where he served until November of the same year. He then underwent training to become an IFR controller, and worked as a terminal controller in the Montreal ACC from April, 1971 until 1976, when he moved to Toronto.

Pierre Beaudry

Air traffic controller, Quebec City Airport. Mr. Beaudry started flying in 1968 and has held a professional pilot's licence since 1970. He has an IFR rating and has flown approximately 1,000 hours. He holds an instructor's licence for IFR flying. He joined DOT as a controller in 1970. After training was assigned directly to Terminal Control at Quebec City where, from 1972 until 1978, he acted as an arrival and departure, as well as an enroute, controller. Was then granted leave of absence to complete his third year of studies in law at Laval University. Is at the same time working on an MBA programme, the first year of which was to be completed in April, 1979.

Dr. Jean-Yves Frigon

Professor and Deputy Director, Department of Psychology, University of Montreal. Dr. Frigon holds the following degrees: B. Ped. (Bachelor's degree, Pedagogy.) University of Montreal, 1966; Teacher's Certificate "A", Department of Education, Quebec, 1966; B.Sc., Psychology, University of Montreal, 1969; M.A., Psychology, University of Montreal, 1970; Ph.D., Psychology, University of Montreal, 1972. He is a member of the Canadian and of the Inter-American Psychological Associations. Dr. Frigon is the author or co-author of many publications. He has a private pilot's license and was a member of the team of Commission consultants.

John F. Keitz

Has B.Sc. in Engineering Physics, New York University, 1961. Completed a Professional Certification Course in Meteorology, Texas A&M University, 1962. Obtained 36 credits in graduate meteorology, New York University, 1965-69. Received an M.Sc. in Management, Long Island University, 1972. Was a member of the United States Air Force from 1962 to 1965. Served as an Air Weather Officer at the Military Airlift Command, North Atlantic Forecast Center, McGuire Air Force Base, New Jersey, and as such made local

forecasts, briefed aircrews, and prepared surface and upper air forecasts for the North Atlantic area. Participated in the development and evaluation of the Military Airlift Command computer flight planning system. Mr. Keitz has been with PRC-Speas since 1965. Until 1970 was a staff meteorologist and Chief of Operations in the Computer Services Division. He was then appointed General Manager of Computer Services, directing the firm's computer flight planning service which, during that period, made about 750,000 flight plans for some 50 airlines throughout the world. In 1976 assigned to the PRC-Speas Consulting Services Division. Member, American Meteorological Society.

R.H.J. Smith

Captain Smith had intended to testify. The Commission was informed that his testimony would have been substantially in conformity with that given by First Officer MacWilliam, with whose evidence he was entirely in agreement. Captain Smith was in the RCAF from 1951 to 1958, including 3 years in Germany as an instructor. Joined Air Canada in 1958 where he is a flight instructor for DC-8s. CALPA, Headquarters, Chairman, Technical and Air Safety, 1974-1979. Regional Vice-president, North Atlantic, IFALPA since 1976, and its CALPA Director since 1978. Chief Accident Investigator of CALPA since 1977. Winner, 1978, of CALPA Founders Flight Safety Award. Member: International Society Air Safety Investigators, IFALPA ATS Study Group and R/T Phraseology Group. ICAO: IFALPA representative on Aeronautical Charts Use in Cockpit. CALPA's Corporate representative to Flight Safety Foundation.

Chapter 4

BILINGUALISM IN AIR TRAFFIC SERVICES IN QUEBEC

Section 1. AVAILABILITY OF FRENCH LANGUAGE IN AIR TRAFFIC SERVICES IN
 QUEBEC TODAY

The availability of the French language in Air Traffic Services in Quebec as at June 23, 1977 was the subject of Chapter 13, Section 3 of the Interim Report. The matter was dealt with under two main headings: the first, Air-Ground Communications, was concerned with VFR flights at certain airports, advisory services, special aviation events, emergency situations, ATIS and UNICOM. The second, Ground-Ground Communications, related to inter and intra ATS unit coordination and to vehicular traffic at airports.

Since the Interim Report, and as recommended by it, the following developments have occurred:

The use of the French language is authorized for VFR flights at St-Hubert, in the Montreal TRSA, and for VFR flights traversing the Mirabel PCZ to another destination. A bilingual ATIS is now provided at Mirabel.

It should be mentioned that there was evidence during the second phase of the hearings to the effect that, although not authorized, French has been used in IFR flights at Quebec City during the past three years. According to one controller witness, Mr. Pierre Beaudry, the French language is currently being used to the extent of some 20% at Quebec City. This has not been the case at Montreal.

Other than for the developments mentioned in the two preceding paragraphs, the situation as described in the Interim Report still exists.

Section 2. AVAILABILITY OF AERONAUTICAL PUBLICATIONS IN THE FRENCH
 LANGUAGE

A review was made in the Interim Report of aeronautical publications or work instruments, and the extent to which they were then available in both official languages.

Recommendations were made as to the translation of some of those documents for the purposes of implementation of the Interim Report. It has already been mentioned that the legend and other explanatory material on the Montreal VTA chart has been made available in both official languages, and that bilingual Class I NOTAM service for Quebec commenced January 1, 1978. Class II NOTAMs were already available in French at the time of the Interim Report.

During the second phase of the hearings evidence was heard, and exhibits filed, which showed the current availability of aeronautical publications in the French language. An examination of the exhibits shows that a substantial amount of work has been accomplished. Some 70 work instruments have already been translated and published, while another 71 are in the process of being verified before printing and distribution.

In the Interim Report work instruments which are the responsibility of the Department of Transport or of some other department were classified as falling into two groups: those pertaining to aeronautical information services, and those relating to air traffic control.

Those instruments pertaining to aeronautical information services were in turn divided into two categories: pre-flight and in-flight. The latter category was further subdivided into VFR in-flight information, and IFR in-flight information.

As described in more detail in the Interim Report, the pre-flight information publications include:

- i) Air Regulations and Air Navigation Orders, already available in both languages when the Interim Report was issued.
- ii) Designated Airspace Handbook (DAH), now available in both languages.
- iii) Flight Planning and Procedures - Canada and North Atlantic, now available in both languages.
- iv) Flight Information Manual (FIM), now available in both languages.

The VFR in-flight information publications are dealt with at some length in the Interim Report. So far as concerns their present availability in both French and English it is as follows:

- i) Charts. As already mentioned, the Montreal VTA Chart is now available in both languages. The others have been translated, and are being reproduced progressively.
- ii) VFR Chart Supplement. Now available in both languages.
- iii) Water Aerodrome Supplement. Now available in both languages.

The Interim Report mentioned several IFR in-flight information publications, and pointed out that none had been translated, but that since the first phase of the Inquiry was concerned with VFR operations the need to have IFR documents available in both languages had not yet been considered by the Commission. The availability of these documents will be discussed later in this Section.

Turning now to work instruments pertaining to air traffic control, as pointed out in the Interim Report, where they are fully described, these fall into two main groups: MANOPS and Lexicons. As to MANOPS, suffice it to say that both volumes 1 and 2 of this important document are now published in both French and English. So far as the Lexicons are concerned, at the time of the Interim Report there already existed two: TP-135 for the use of controllers, and TP-415 for use by pilots where air traffic control service in the two languages was available for VFR operations.

Consideration was given throughout the simulation exercises to the adequacy of the existing documents relating to lexicon and phraseology. On the whole it was found there were only minor inadequacies contained in the published material. The BICSS Report reads:

"The findings fell into the following three categories:

- a) There were a number of differences noted between TP-135 and TP-415. The majority of these were of a minor nature being terms or phrases appearing in one document and not the other.
- b) There were a few phrases identified which were not contained in existing documents.
- c) There were a few terms found in European source documents which were considered appropriate to replace or to add to existing documents.

In view of the minor nature of the above findings associated with the French lexicon and phraseology no detailed review is contained in this report. The suggestions developed and differences noted have been forwarded to the Air Traffic Services Branch for consideration. This branch is currently incorporating the complete French lexicon including phraseology into their Manual of Operations. On completion of amendments to the Manual of Operations an appropriate revision to the pilot's handbook (TP-415) will be considered."

This assessment of the situation was confirmed by the evidence given by Mr. Fudakowski.

It is now appropriate to look at the subject of publications from the point of view of those essential for the conduct of IFR flight in the French language. The following list was established:

Radio Navigation Charts:
Enroute Low Altitude
Enroute High Altitude
Terminal Area

IFR Supplement

Designated Airspace Handbook

Flight Planning and Procedures

Canada Air Pilot (East)

NOTAMS Class I and II

Air Regulations

Air Navigation Orders

Aviation Notices

Information Circulars

Water Aerodrome Supplement

ATC Pilot Procedure NOTAM

ATC Lexicon

Flight Test Standards and Guide for Private and Commercial Pilot
Licenses

Manual of Operations (MANOPS)

All the work instruments listed above are available in both languages except for the Radio Navigation Charts, the IFR Supplement and the Canada Air Pilot (East). However, these have been translated, and are ready to go to print. They could be published within 6 months at the maximum.

From the foregoing review it can be concluded that the availability of aeronautical publications would not constitute an obstacle to the introduction of bilingual IFR Air Traffic Services in Quebec.

Chapter 5

THE BILINGUAL IFR COMMUNICATIONS SIMULATION STUDIES

Section 1. INTRODUCTION

1.1 General

A simulation study such as the one under review is, generally speaking, an experiment, a laboratory experiment as it were, where the conditions that obtain in the real world are reproduced as closely and as realistically as possible in order to determine what would or could take place if a change which is contemplated were introduced, and to determine whether the personnel involved are able to do the task they are required to do.

Simulators representing the cockpit or flight deck of an aircraft have long been used in the training of pilots. The use of simulation for air traffic control purposes is a more recent development. In the present instance the facility used was considered "well suited for the particular tasks of simulating communications, air traffic, radar displays and the environment experienced by air traffic controllers in their normal work."

During the first phase of the Inquiry Mr. Walter McLeish described the use of simulation in aviation:

"Q Are flight simulators used in this process of certification of airports, radar, electronic aids and so on? Is this a tool which is resorted to?

A Well, a flight simulator is used in the training of pilots, because it is an economical tool, and it is being developed to the degree that it is now possible to simulate most of the important procedures and operations of an aircraft, on the electronic flight simulator.

Q Yes?

A And the certifying agencies have all recognized the role of the flight simulator in this respect.

For example, it is possible for a pilot to check out on a new type of airplane in a fraction of the time that it used to take before flight simulators became an accepted means.

Q Are ATS procedures in fact developed on simulators?

A Well, the advent of the Air Traffic Services simulator came some time later, really than the flight simulator, and it is really only in this decade that the Air Traffic Services simulator, of which there is one in Canada, has begun to play an important role in the development of Air Traffic Services procedures, as well as in the training, as well."

In an article entitled "An Appraisal of Real-time Simulation in Air Traffic Control", filed as an exhibit, V. David Hopkin, Head of the General Psychology Section of the Royal Air Force Institute of Aviation Medicine says this:

"Real-time simulation, in which part of a current or future air traffic control system is replicated, has been in common use for many years as a technique for training, research and evaluation."

As part of the author's conclusions we find this:

"Despite these caveats, real-time simulation is an indispensable technique in air traffic control. It aids procedural training and familiarization. It allows procedures and skills to be rehearsed and perfected. Although in seeking general answers it has tended to neglect individual differences, it can be used to study them."

In the simulation tests with which this Report is concerned, and subject to some constraints which will be discussed later, controllers operated in the simulation centre at Hull just as if they had been operating in the Montreal Centre, with one fundamental difference: on certain days the control was done in both official languages, on other days only English was used. The purpose of the exercise was of course to compare the results of operations conducted only in English with those in which both languages were involved.

The persons manning the other end of the communications link - the pilot position - were not all pilots. These positions were operated by personnel who became known as "back-room pilots." They were trained to simulate pilot behaviour. The radar, aircraft generation and control were provided by a computer system.

There was, however, participation by instrument-rated pilots because the ATC simulator in Hull was linked to three Air Canada flight simulators located in Montreal - a DC-8, a DC-9 and a B-727, and to a King Air A-90 simulator in Ottawa belonging to the Department of Transport. One hundred

and fifty pilots, of whom 100 were members of major commercial carrier flight crews, took part in this aspect of the simulation studies. Since some of the flight simulators were in operation at the same time, a total of 300 hours of flight simulator time was contributed during the simulation programme of 200 hours.

The BICSS Report refers to the ATC simulator at Hull as "among the most advanced of its kind in the world." It is further stated that "the findings contained in this study represent the most in-depth review of Air Traffic Control communications ever conducted in Canada and is likely the most comprehensive ever done in any country."

John Keitz, a member of the consultant's team who attended the simulation exercises on behalf of the Commission, said that his firm had reviewed the capabilities of a number of air traffic control simulation centres throughout the world. He continued in these words:

"Q And based upon this review, what judgment does your firm pass on the ATS simulator at Hull?

A Well, I think considering what we found of the capabilities at the other centres, we feel that to our knowledge the ATS simulator at Hull is probably as good as or better than any other air traffic control simulator in the world.

There were a number of things accomplished at this centre and particularly in the bilingual simulation studies, which we believe are firsts based upon our review.

For example, the ability to simulate the weather activity, or the thunderstorm activity in the TERMINAL phase is probably the first time that that has been done in any air traffic control simulator and also to our knowledge the data link which allowed the participant, the data link with the flight, Air Canada flight simulators which allowed and the King Air simulator which allowed the participation of real pilots is also unique where at all the other air traffic control simulators, although the capability might, the technological capability might exist for them to do the same thing, the fact is that the others use what we have called the backroom computer operator pilot in their air traffic control simulators and this is the only time that there has been significant participation of real pilots through the flight simulator data link."

1.2 Authorship of the BICSS Report.

The following statement from the BICSS Report should be kept in mind:

"While many experts and professionals in the aviation field contributed to the conduct of this study, this report represents the findings, conclusions and recommendations of Transport Canada and should not be interpreted as representing the opinions, in whole or in part, of other Canadian aviation organizations."

Section 2. RELATED STUDIES

The BICSS Report deals with several studies that were conducted in addition to those involving the use of the simulation facilities. This section deals with these studies.

2.1 Montreal Area Bilingual Air/Ground Communications Study

It will be remembered that in its Interim Report the Commission made no findings or recommendations regarding Dorval. Indeed, during the first phase of the hearings no report with respect to this subject had been submitted to the Commission, no evidence adduced, and no proposals made. As mentioned in the Interim Report, the Department of Transport was of the view that the study of VFR procedures at Dorval should await the study of IFR procedures.

The first matter dealt with in the Montreal Area Bilingual Air/Ground Communications Study concerns communications with VFR flights operating within the Dorval PCZ and at the Dorval International Airport. In this respect the study was conducted along the same lines as the earlier ones relating to St-Hubert, Mirabel and the Montreal TRSA, and which were considered in the Interim Report. It will be appropriate to deal with this aspect of the Study separately in Chapter 10, which is entitled "VFR Flights at Dorval."

The second matter considered in the Montreal Area Bilingual Air/Ground Communications Study is the VFR/IFR mix of traffic in the Montreal area, including the adequacy of existing procedures for the segregation and sequencing of VFR and IFR flights, and the development of any new procedures that might be required by the expansion of bilingual air/ground communications to IFR and VFR flights in the Dorval PCZ. This feature of the Study will be considered in Section 2 of Chapter 8.

2.2 Monitoring in the real world

The relevance of this kind of a study to the simulation studies can be seen from the following passage from the BICSS Report:

"In order to meet the informational requirements of the study, the air traffic control simulation had to have at least two kinds of validity - face validity and external validity. Face validity refers to the degree to which a measurement system appears to be measuring what it purports to measure. External validity refers to the extent to which data from a measurement system - such as the ATC simulation - can be generalized to the real world. The face validity of simulations and other assessment devices is known to affect the attitude or approach which is taken by the participants. Simulations with a high degree of face validity elicit a more genuine response and a higher level of involvement. In the present study it was important that the controller should believe that the simulation adequately represented their control environment in the Montreal Centre and that the results of the simulations, therefore, would be applicable to the real-world situation.

The external validity of a simulation may be inferred from the extent to which various measurements obtained in the simulation correlate or agree with the same measurements made in the real world system. Confidence that the results obtained from the simulation will be applicable to actual operations is enhanced when the measures from the two sources agree. Obviously, the external validity and face validity of a simulation are not independent of each other. In the present study, the level of sophistication and complexity inherent in the ATC simulation and the concomitant positive attitudes of the participating controllers together provided the potential for the required levels of face and external validity."

In the words of the BICSS Report, such real world measurements were obtained "through monitoring audio tapes from a wide variety of air traffic units inside and outside of Canada and by an in-flight monitoring program." The subject will be discussed elsewhere in this Report.

2.3 Visits to Europe and Mexico

Officials of the Department of Transport, who were also members of the BICSS team, visited Mexico, several European countries and Eurocontrol to gather data and background information on bilingual communications. These visits are discussed in Section 5 of Chapter 7.

Section 3. THE PARAMETERS OF THE SIMULATION STUDY

3.1 The objectives

The principal objective of the project is described in the BICSS Report as follows:

"To develop the procedures necessary for the introduction of bilingual IFR air-ground communications in the province of Quebec while maintaining the existing level of air safety."

The Report goes on to add:

"Also, as a companion objective the team was to consider the effect that the new procedures proposed might have on system efficiency and the associated costs anticipated with the implementation of bilingual communications in instrument flight rules."

Before the simulation exercises began an agreement was entered into in September, 1976 between the Department of Transport and CATCA. As will be discussed shortly, the principal objective to be found in that agreement appears to be described differently from that contained in the BICSS Report, and to which reference has been made. For the time being, however, it is desirable to mention another section of the DOT-CATCA agreement, a section which adds to the objectives taken from the BICSS Report, and which touches upon the parameters of the simulation study:

"PROCEDURES

The study will encompass the following items and simulated exercises will be used where possible:

- a) the introduction of programmed conflict situations, which could presently be detected because of the 'party line' nature of VHF communications and the effect of loss of redundancy due to the introduction of a second language.

- b) the impact of unilingual French VFR/IFR pilots being forced into English only airspace (e.g. United States airspace) as a result of weather conditions or other reasons.
- c) a study of the implications for aviation safety of the use of more than one language in IFR flight procedures in uncontrolled airspace.
- d) in simulation exercises, air traffic controllers with various degrees of experience, ranging from 'on-the-job' trainees to the more experienced levels.
- e) the introduction of a unilingual Francophone IFR pilot qualified at the Private or Commercial level.
- f) the introduction (in simulation exercises) of a fully bilingual Terminal Control Area and TRSA with varying percentages of bilingual communications."

The Agreement between the Department and CATCA concludes:

"STUDY RESULTS AND FINDINGS

Any results and findings of the Bilingual IFR Communications Study shall be submitted to the Presidents of the participating aviation industry organizations prior to the presentation of a final report. Where an agreement cannot be reached, the statements from the dissenting organizations shall be attached to the Bilingual IFR Communications Study Team's final report prior to submission to the Commission of Enquiry."

So far as concerns statements contemplated by the passage just referred to, it may be appropriate to mention that a statement was addressed to the Department of Transport by l'Association des Gens de l'Air du Québec on November 6, 1978. Statements by CALPA, the CATCA majority, ATAC, COPA and CBAA took the form of submissions forwarded to the Commission.

There was much discussion during the hearings concerning the objectives of the simulation studies. The discussion centred around a comparison of the principal objective stated in the BICSS Report with that contained in the DOT-CATCA Agreement. The difference in wording is apparent when the two provisions are set out together:

The BICSS Report:

"To develop the procedures necessary for the introduction of bilingual IFR air-ground communications in the province of Quebec while maintaining the existing level of air safety."

The DOT-CATCA Agreement:

"OBJECTIVE

To determine the effect of the proposed introduction of bilingual air ground communications on the existing unilingual IFR Air Traffic Control System and to develop procedures to ensure the maintenance of existing safety standards."

In the latter document the first task is accordingly to determine the effect on the existing unilingual IFR system of the introduction of bilingual communications, and then to develop procedures to ensure the maintenance of existing safety standards. The passage from the BICSS Report makes no mention of a determination of effect. It has been argued that the BICSS studies proceeded on the basis that the introduction of bilingual air traffic control for IFR flights was a foregone conclusion, and that there remained only to develop procedures to maintain the "existing level of air safety", if one uses the words found in the BICSS Report, or to maintain "existing safety standards", if one has regard to the DOT-CATCA Agreement.

The Commissioners find this reasoning difficult to follow. The BICSS Report does refer to the need to consider the effects of a change in the system, at least insofar as concerns "system efficiency and associated costs." In discussing the composition of the project teams, the Report contains this significant statement:

"The focal point of participation was that of qualified Air Traffic Controllers whose performance would be examined to assess the effects of introducing bilingual communications and the necessity for developing special procedures."

It seems to the Commissioners that a determination of the effects of the introduction of bilingual communications is inherent in the measurement of safety and in the development of procedures.

In considering the objectives of the Study it is worth recalling the following words of the Minister of Transport, at the press conference held at the Montreal Air Traffic Control Centre on December 13, 1975:

" . . . hopefully by early February, the aviation associations and the aviation industry would be invited to actively participate in experiments and demonstrations on Transport Canada's new Air Traffic Control Computer Simulator, with a view to then developing procedures which could allow the introduction of bilingual communications in IFR operations in Quebec, while respecting the requirements of safety."

The Minister was of course speaking many months before the signing of the DOT-CATCA Agreement in September, 1976. It will be recalled, however, that after the signing of that agreement, but before the commencement of the simulation exercises, Mr. McLeish, when giving evidence during the first phase of the Inquiry, said the purpose of the exercises was "to identify and to solve problems by developing procedures that will enable us to certify that the procedures for two languages in IFR will be equally safe as they are in the single language."

The Commission's attention was drawn to yet other documents where the description of the principal objective of the studies was worded differently from that eventually set forth in the BICSS Report. However, when one examines closely the objective contained in each of those documents it will be seen that two key elements are included: the maintenance of safety, and, if required, the development of procedures to achieve that end.

Finally, if there were some concern that the emphasis of the principal objective of the BICSS project had somehow changed it is important to remember that the simulation study is not the only matter to be considered by the Commission. By their Terms of Reference the Commissioners are required to:

" . . . inquire into the safety of the introduction of bilingual IFR Air Traffic Services in the Province of Quebec, and report upon the implications in relation to aviation safety, implementation costs and operational efficiency, and upon the procedures (and methods of their development) being developed by the Department of Transport in conjunction with the aviation associations and the aviation industry . . .".

And, further, they are obliged:

". . . to consider, evaluate and report upon:

- d) the IFR procedures finally developed . . . in terms of adequacy of the method used in developing and testing the procedures and the implications in relation to aviation safety, implementation costs and operational efficiency."

In the result, the Commission does not believe the variations found in wording of the objectives of the BICSS studies are of any practical significance.

3.2 The simulation programme

The programme was designed:

- a) to examine differences between unilingual and bilingual control under normal conditions,
- b) to examine differences under unusual conditions, and
- c) to examine new procedures being proposed for the bilingual environment.

The studies were to encompass both the enroute and terminal portions of IFR flights. Four sets of simulations were decided upon:

- Phase I - Enroute
- Phase II - Terminal
- Phase III - Terminal - Exceptional Situations
- Phase IV - Enroute - Exceptional Situations

The differences between unilingual and bilingual control were to be examined in each phase. The examination of new procedures proposed was to be carried out during Phases III and IV.

In addition, the programme provided for the monitoring of tapes from air traffic units to serve as a check or verification that simulation data was representative of the real world situation.

Section 4. THE DETAILED CONDUCT OF THE STUDY

4.1 The Project Team

The Report describes the composition of the team:

"The project team was comprised of a combination of Transport Canada employees seconded from various organizational units and of representatives of Canadian aviation organizations, some of whom were also Transport Canada employees. A serious attempt was made to insure that adequate and full participation was secured from both controller and pilot elements of the aviation community. Additionally there were many authorized observers to the simulation exercises themselves who provided feed-back to the permanent members of the team during debriefing sessions."

The members of the team were divided into specialty groups. A number of ad-hoc committees were also formed. Of these, perhaps the most important were the Operational Review Committee, the Communication Review Committee and the Listening Watch Committee. Finally, a Steering Committee was established to follow the progress of the simulation study, and to deal with problems which the Director of the study might from time to time encounter. The members of the Steering Committee were drawn exclusively from the Department of Transport.

4.2 Methodology

The methodology employed is best described in the Report itself:

"The overall methodology for conducting the simulation program was guided by an experimental psychologist Dr. P. Stager, (...) who was engaged as a consultant to the team by Transport Canada. His design work was conducted in consultation with team members at periodic meetings called by the Director or Deputy Director. These meetings were called as the need arose and were attended by the permanent members of the team including association representatives. Where it was not possible to arrive at an agreement on any significant point the final decision was made by the Director or Deputy Director in consultation with Dr. Stager."

The development of the simulation exercises themselves was done by Transport Canada team members who based their work on the design criteria established and on their knowledge of the Montreal area. Some adjustments to the flight plan scenarios, equipment configuration, aircraft characteristics, etc. were usually made following one or more dry runs during which all participants had an opportunity to comment and make suggestions.

Following each set of simulation runs, a large amount of data was gathered from various recorded sources. This data represented communications workload and error data as well as operational data such as the application of correct procedures and losses of separation. This data was collected in different ways and most members of the team participated in some phase of this activity. The following lists the data gathered for analysis.

<u>Data Type</u>	<u>Source</u>
Communication Workload Data	- Computer Analysis Program
Communication Error Data	- Audio and Video Tapes
Losses of Separation	- Computer Analysis Program verified by committee through review of video tapes
Operational Data	- Review of video tapes to verify observer comments
Procedures Data	- Review of video tapes and observer comments

Quantitative data, such as communications workload and error data, was statistically analysed while other data of an operational nature was analysed by team members to assess its relevance to bilingual communications. Procedures identified as being required were formulated by team members and examined during the later phases of simulation where exceptional situations such as weather and navigational facility outages were injected into simulations."

4.3 Simulation facilities

The Department of Transport's Air Traffic Control simulation facility is located at Hull. The facility consists of two computer systems, one providing radar display, aircraft generation and control, the other communications between all elements of the radar simulation system.

Four controller positions were available. They could be physically rearranged to represent a portion of any Air Traffic Control Centre or Terminal Control Unit in Canada. There were a total of eight pilot positions in the system, of which six were used exclusively to fly "aircraft". Although theoretically 15 aircraft could be flown from each position, the system was in fact limited to 80 at any one time.

Two support controller positions were available. The role of such a position was to represent for the controller all communications links other than the pilot. The position thus represented adjacent sectors inside or outside Canada, terminal or tower, aeradio stations, meteorological briefings and so forth. Two of the eight pilot positions previously mentioned were used in conjunction with the support controller positions.

A supervisor's position was equipped with facilities which allowed full monitoring and control of all aspects of an exercise.

An observers room with special viewing and listening devices was provided to accommodate the several accredited observers. At the same time this special area ensured that exercises in progress would not be subjected to inadvertent interference on the part of the observers.

The Centre at Hull was linked to the Air Canada DC-8, DC-9 and B-727 flight simulators in Montreal, and to the DOT King Air A-90 flight simulator at the Ottawa airport, thus enabling the participation in the exercises of qualified instrument rated pilots.

While the facilities were designed to reproduce as faithfully as possible the tools with which a controller normally works in the Montreal Centre, there were, however, differences:

a) Presentation of the "targets" on the radar screen. When an aircraft is transmitting on a transponder code not selected by the controller, the target is represented by a single slash in the Montreal Centre, and by an asterisk in the simulation facility. Where the controller has selected the code, the target in Montreal would be identified by a double slash, in Hull by a triangle.

b) Radar sweep. In the Montreal Centre the radar information is fed from a rotating antenna. Since the sweep associated with the rotation

is visible on the scope the information is updated as the sweep rotates. In the simulation facilities at Hull there is no sweep. The information is updated all at one time, at the end of the period normally required for a complete rotation of the antenna.

c) Radar scope range rings. The radar scopes at Montreal are equipped with range rings consisting of circles displayed at predetermined distances from the centre of the radar antenna. There are no such rings in the facilities at Hull, and the distances had to be marked on the terminal map.

d) History trail. In the Montreal facilities the path of an aircraft can be seen as the slashes of its previous positions remain behind in diminishing intensity. In the case of the simulation facilities the previous position history trail was provided by means of dots. There were four dots behind a target, representing the four previous positions of the aircraft.

e) Clarity of display. The clarity of the display in the simulation facilities is much better than that provided at the Montreal Centre.

f) Pilot voices. In the real world there is a different voice from each aircraft in communication with the controller. This assists the latter in identifying the aircraft. In the simulation facilities it is necessary to use one pilot voice for several aircraft at the same time.

g) Aircraft performance. Controllers are conditioned to expect certain performance from certain types of aircraft. It is not possible to reproduce those characteristics with complete fidelity in simulation.

These differences of course existed during both language conditions. Since the object of the tests at Hull was to compare operations conducted in a unilingual English environment with those carried out under bilingual conditions, it does not necessarily follow that the differences mentioned invalidated the results of the exercises. More will be said on the subject later in this Report.

4.4 Choice of airspace sectors

In the Interim Report it was pointed out that Canadian Domestic Airspace has been divided into seven subsections known as Flight Information Regions (FIR). These are: Gander (Domestic), Moncton, Montreal, Toronto, Winnipeg, Edmonton and Vancouver.

The way in which the airspace used in the simulation studies was chosen is described in the following extracts from the BICSS Report:

"The airspace currently controlled from air traffic control units located in the Province of Quebec is depicted in Appendix E. IFR aircraft operating in this airspace are controlled from sectors located in the Montreal area control centre, the Quebec terminal control unit and the Bagotville terminal control unit (operated by DND). Each of these sectors and units controls the movement of IFR traffic within well defined geographical and vertical limits. Together these units provide IFR control services to IFR aircraft within the Montreal Flight Information Region (FIR) and coordinate with adjacent control units in Moncton, Toronto, Winnipeg and the U.S.A. for transfer of control of aircraft entering or leaving Montreal FIR controlled airspace."

"Since bilingual communications is proposed only for the province of Quebec the simulation team considered that the logical choice for the simulation study was the Montreal Area Control Centre which controls the major portions of the Montreal FIR (. . .) The Montreal ACC is divided into three segments; East sectors, West sectors, and Terminal sector. Each of these segments can have one or more sectors of control which will vary with the amount of air traffic at any particular time. The study chose to simulate the East sectors in phase I because a) the controllers were already certified for bilingual ground-ground control and b) it afforded the team the opportunity of studying both a radar and a non-radar enroute sector. In phase II, the Montreal Terminal comprised of low arrival, arrival sequencer and departure positions was selected. The Montreal Terminal positions control all arriving and departing aircraft within a 40 N.M. radius of Montreal to and from the Dorval, Mirabel, St. Hubert and St. Jean airports."

It was not felt necessary to simulate the West sectors because simulation of the East sectors provided sufficient information for the purposes of the study. Mr. Proulx, Director of the Studies, gave the reasons in this way:

"A Well, the testing of the radar environment was adequately tested in that we simulated the Granby/Sherbrooke and the Terminal Sector, three of the terminal sectors, where we gathered data, which were the low arrival sector, the arrival sequencer and departure sectors, and to simulate a West Sector would have been repeating a radar environment and the Granby/Sherbrooke sector gave us adequate data."

4.5 The simulation exercises

The project began its work in earnest in the fall of 1976. The first simulation took place in January, 1977. Work proceeded through 1977 and early 1978, with the final simulations being conducted on May 5, 1978.

As previously mentioned the exercises were run in four phases:

- Phase I - Enroute
- Phase II - Terminal
- Phase III - Terminal - Exceptional Situations
- Phase IV - Enroute - Exceptional Situations

a) Phase I - Enroute

During this phase traffic in the James Bay (non radar) and in the Granby-Sherbrooke (radar) sectors was simulated concurrently. Exercises were conducted from March 16 to June 1, 1977. There were 11 two-day sessions. Each day there were four hours of simulation - two hours in the morning, two in the afternoon. Exercises were conducted during a total of 88 hours. Information collected during three of the sessions - 24 hours in all - was not included in the data which was the subject of the analysis upon which the findings of the BICSS Report are based.

The first of the sessions excluded was that which took place on May 4 and 5, 1977. The Granby-Sherbrooke (radar) sector was involved. On that occasion the experimental controllers were furnished by CATCA. As a rule, controllers taking part in the exercises were from the Montreal ACC, had been trained and certified in the French lexicon, and were certified to control in the sectors selected for simulation. It had, however, been agreed with CATCA that, in order to obtain a different sample on given days, controllers from other locations would be furnished by CATCA. These sessions became known as the "CATCA days" or "CATCA runs".

A note to the BICSS Report states:

"The CATCA furnished controllers did not form an integral part of the design package and hence the associated data collected is not analysed in this report."

It does not follow that the CATCA data was simply ignored. Dr. Stager explained that the information was compared with that obtained from the other controllers, and that all the data from the CATCA runs was analyzed. What is more important, Dr. Stager said that "... the data would not have changed the results of what we found, based on the non-CATCA controllers." It will be convenient to mention here that CATCA runs were also made in Phases II and III. The data from these exercises was treated in similar fashion.

Data collected from the last two sessions of Phase I was not included for the purposes of analysis. During the first of these sessions exercises were conducted in English only, and during the second both days of tests were done using the two languages. The data was to be used as a control base for assessing the impact of the learning effect.

In the result, therefore, of the 88 hours of simulation exercises conducted during Phase I, 64 hours were used for the purposes of the Report.

Sixteen controllers from the Montreal ACC took part in the Phase I tests. In each exercise the same traffic sample for a given sector was used. The sample represented a block of Montreal Centre traffic which had been compressed so as to increase the volume for the purposes of the study. The increase was in the order of 42%. For each unilingual English day there was a corresponding bilingual one. During the latter days some 25-35% of the traffic was designated as French-speaking.

b) Phase II - Terminal

The terminal experimental controllers rotated through the low arrival, arrival sequencer and departure positions.

Seven sessions, each of two days, were run from November 16 to December 21, 1977, and on January 19 and 20, 1978. Four and a half hours of exercises were conducted each day, divided into three periods of one and a half hours, of which two were held in the morning, and one in the afternoon. In all, there were 63 hours of simulation, of which information was retained for analysis from 54, the nine hours of data accumulated during the last two CATCA days being excluded.

Eighteen terminal controllers from the Montreal Centre participated in the Phase II exercises. The traffic sample used reflected the characteristic shifts in peak volume between Dorval and Mirabel airports that occur during the course of a normal day. Operations were intensified by compressing the shifts into a four and a half hour exercise, and by including additional traffic. As a result, the traffic load during this phase of the tests was about 20% higher than an average peak period in Montreal. Two runways were in use. Traffic shifted from one to another in each exercise. The runway initially used in each test and the time of the runway change brought on by wind shift, were varied systematically. Thirty percent of the aircraft were designated as French-speaking during the bilingual days.

c) Phase III - Terminal Exceptional Situations

Twelve terminal controllers from the Montreal Centre were involved in these exercises which lasted from April 1 to April 11, 1978. Most of the controllers had taken part in the Phase II terminal exercises.

There were four two-day sessions in all. Exercises were run for three and three quarter hours each day, made up of two one and a quarter hour sessions in the morning, and another in the afternoon. A total of 30 hours of simulation took place. Two CATCA runs were made on May 4 and 5, 1978, for a total of seven and one half hours.

The traffic sample, the shifts in peak volume between Dorval and Mirabel, the increase in traffic and the percentage of French-speaking pilots were all basically the same as for Phase II. However, the design of the exercises included situations involving (a) operations at IFR limits and the sudden closure of the airport due to loss of hydro power, (b) closure of either airport due to loss of runways at Mirabel and Dorval during the passage of a frontal system, and (c) vectoring aircraft during a one-runway operation at Dorval.

d) Phase IV - Enroute Exceptional Situations

During these exercises, which were run between April 20 and May 3, 1978, eight enroute controllers from the Montreal ACC participated. Most of the controllers had taken part in the original enroute exercises conducted during Phase I almost a year before.

As in Phase III, there were four sessions, each of two days. Three and three quarters hours of tests were run each day, divided into three sessions. A total of 30 hours of simulation took place. There were no CATCA runs.

Unlike Phase I, only the James Bay (non radar) sector was simulated. The traffic sample represented a block of Montreal Centre traffic which had been compressed in time so as to increase the volume for the purposes of the study. On the bilingual days some 30% of the aircraft in the exercise were designated as French-speaking. The exceptional situations may best be described in the words of the Report:

"During each period of a given exercise the controllers encountered either a) the loss of the peripheral frequency at Chibougamau, b) the loss of the VOR navigational facility at Val d'Or, or c) weather below limits at Rouyn which required aircraft to be held. The occurrence of these events were specified in such a manner that each of the six combined periods in the English and bilingual exercises represented a unique traffic and event combination."

e) Summary

Some of the procedures developed as a result of the experience gained in Phase I were tested during Phases II, III and IV. Not counting the days and hours required for briefings and debriefings, dry runs and controller lexicon training, there were 54 days of simulation exercises, half conducted in English only and half conducted in both French and English. Data collected from 44 of those days is reflected in the results of the analysis which forms the basis for the findings contained in the BICSS Report. If one includes the CATCA runs and the four days of control runs made at the end of Phase I, there was a total of 218½ hours of simulation. If the CATCA and control runs are excluded, simulated exercises were conducted during 178 hours.

4.6 Participation of representatives of the aviation industry and associations.

The following associations participated in the simulation exercises:

- Air Transport Association of Canada (ATAC)
- Canadian Owners and Pilots Association (COPA)
- Canadian Business Aircraft Association, Inc. (CBAA)
- Canadian Air Line Pilots Association (CALPA)
- Canadian Air Traffic Control Association Inc. (CATCA)
- L'Association des Gens de l'Air du Québec (AGAQ)

AGAQ's participation in the BICSS studies began in November, 1977 with Phase II. Controller and pilot representatives to the simulation team were appointed, as well as observers. The Association's comments concerning the BICSS Report were submitted to the Department of Transport by Robert Fleury and Donald Boyce, controllers, and by Captain Michel Hamel, a pilot.

Michael Tonner and Donald Redden represented CATCA as members of the team. Other members participated as observers. CATCA's views on the BICSS study took the form of a written submission to the Commission.

CALPA was represented on the BICSS team throughout the simulation project by First Officer Robert MacWilliam. Captain Robert Daley participated as an observer. CALPA's comments on the BICSS Report were submitted to the Commission in written form.

Neither ATAC, COPA or CBAA had representatives acting as members of the BICSS team. However, Mr. MacWilliam acted as ATAC's technical representative for the simulation exercises. He also represented the other two associations in the sense that he kept them informed of the proceedings by means of progress reports. Both ATAC and CBAA sent observers to the simulation exercises. All three groups submitted their views on the BICSS Report to the Commission.

CALPA, CATCA and AGAQ each appointed a representative to serve as a member of the Montreal Area Bilingual Air/Ground Communications Study team.

Fourteen controllers took part in the Phase I tests, eighteen in Phase II, twelve in Phase III and nine in Phase IV. Others were involved in the dry runs, and in the CATCA runs.

As mentioned, 150 pilots participated by flying the four flight simulators. Of those, 100 were members of major commercial carrier flight crews. Flight simulation hours were apportioned between DOT and the various associations in approximately the following percentages:

Air Canada	DC-8, DC-9)	CALPA 35	ATAC 25
	and B-727)	AGAQ 25	DOT 15
DOT King Air	A-90)	AGAQ 5	DOT 25
)	COPA and	CBAA 70

4.7 Monitoring by representatives of the Commission

Four representatives of the Commission, John Keitz, Jean-Yves Frigon, M. Warskow and Roger Pelletier, monitored the simulation on its behalf. All were members of the Commission's team of technical consultants. Dr. Frigon and Mr. Keitz testified at some length during the hearings.

John Keitz and Roger Pelletier were the Commission's principal observers during the tests. Mr. Keitz described his role as follows:

"I was assigned to be an observer and in effect I considered myself to be the eyes and ears of the Commissioners in Hull, but not the mouth, I did not participate and speak for the Commission or make any recommendations or comments."

Mr. Keitz told how he had been selected to attend the simulation exercises among the members of the team put together by the firm of consultants engaged by the Commission, and which was to participate in assignments recommended to the Commission by the consultants:

". . . when we were first given the assignment of monitoring the simulation, we had 23 people on our team and we thought it would be nice to have a controller and a pilot and a bilingual controller and a psychologist, but I think that was quashed pretty quickly, when either Mr. Proulx or Mr. Walsh told us that we were going to have room for maybe one seat in the observers' room, maybe two, so, and just

obviously, it was impractical to send an expert in every aspect of the study, so we had to settle for one who was familiar enough for all of the aspects of the study, so that he could accurately convey to the Commissioners what he saw and heard there."

The parties had the opportunity to freely cross-examine both Dr. Frigon and Mr. Keitz as to their duties on behalf of the Commission, and in particular as to their observations and conclusions concerning all aspects of the simulation exercises and of the BICSS Report. Mr. Keitz was also made available for cross-examination concerning several studies made for the Commission by its technical advisers, and which were filed as exhibits.

Section 5. THE FINDINGS OF THE BICSS REPORT

5.1 General

The simulation exercises sought to determine the differences, if any, between unilingual and bilingual air traffic control. This objective was carried out by comparing the data obtained under one linguistic condition with that derived from the other. Data that could have an impact on safety, operational efficiency or implementation costs would, of course, be especially valuable. The principal data that was compared may be divided into the following categories:

- Communications data:

a) Communications characteristics:

- i) Number of ground-to-air calls by each controller position.
- ii) Average duration of ground-to-air calls by each controller position.
- iii) Number of ground-to-air and air-to-ground calls for each position.
- iv) Mean latency or delay by each controller in responding to an air-to-ground communication.
- v) Number of ground-to-ground (hotline) calls initiated and received at each controller position.

b) Communications errors:

i) False Start - Controller begins a communication in the incorrect language to an aircraft for which the preferred language has been determined and self corrects by changing to the preferred language after stopping in mid-sentence and beginning the transmission again.

ii) Change in Language - Controller completes a communication in the incorrect language to an aircraft for which the preferred language has been established, waits for a reply and receiving none repeats the communication in the preferred language.

iii) False Identification - This category refers to an action which potentially precludes reliable contact with the intended receiver and parallels the false start category. The controller begins with the incorrect aircraft call sign and self corrects by changing to the correct aircraft call sign after stopping in mid-sentence and starting again. If both language and identification are initially incorrect and both are corrected, the instance is categorized only as a false start (i.e. language is given priority over identification error).

iv) Change in Identification - This category refers to an action which potentially delays reliable contact with an intended receiver and parallels the change in language category. The controller completes a communication using an incorrect call sign, waits for a reply, and receiving none repeats the communication using the correct call sign. If both language and call sign are initially incorrect and both are corrected, the instance is categorized only as a change in language (language having priority).

v) Mid-sentence correction - The controller transmits a control instruction or control inquiry and changes the vector, altitude, speed restriction, fix, or other data within the same transmission.

vi) Incorrect readback - These are categorized either as corrected or uncorrected.

Corrected: - Controller corrects incorrectly read back clearance, vector, or other flight control information.

Uncorrected: - Controller fails to note that controller-issued flight information has not been correctly read back to pilot. This category excludes correct but incomplete readbacks and also excludes any controller or pilot correction of his own initial instructions.

vii) Confirm: - This category applies only when an inquiry indicates that an error or problematic instruction has been detected.

By controller - the controller asks the pilot to confirm that the information the pilot has just given is correct.

By pilot - the pilot asks the controller to confirm that the flight instructions or information the controller has just given is correct.

viii) Say again - The controller asks for information again from a given aircraft or asks aircraft calling (arrival, etc.) to say again the identification. This category includes instances of either missed, uncertain, or not understood communication but excludes confirmation requests pertaining to error or problematic information.

ix) Extra calls - Controller calls more than once (without changing content of message or identification) and each time receives no reply.

- Losses of separation:

A loss of separation occurs when the distance between two aircraft operating in the same airspace has become shorter than that prescribed by regulations thus creating a safety hazard.

5.2 Findings - Communications data:

a) Communications characteristics

The findings of the BICSS Report are to the effect that communications characteristics were largely determined by individual differences between the controllers and other factors, and were little affected by the factor of bilingual, as opposed to unilingual, control. Such differences as were found were so small in absolute terms as to be insignificant from a practical stand point.

It was found that there was no significant evidence which would indicate that bilingual control imposed a greater workload or additional stress on the controllers. Communication measures were not differentially affected in the two language conditions by the programmed exceptional situations.

b) Communications errors

The findings of the BICSS Report are to the effect that there were no significant differences between a unilingual and a bilingual communication system that would have an impact on safety, operational efficiency or implementation costs. False starts and changes in language are, of course, categories of errors peculiar to the bilingual system, and add to the possible communication errors in the system. However, such errors are similar to the false identification and change in identification categories existing in the unilingual system. They can also be compared to the extra calls category. As will be seen, procedures have been developed in an attempt to prevent the occurrence of such errors, and to find ways to correct them.

5.3 Findings - Losses of separation

The conclusion in the BICSS Report concerning losses of separation reads:

"The data obtained on losses of separation indicated that there were no statistically significant differences between language conditions. Further, from an operational viewpoint, language was not found to be the cause of any separation loss, and there was no evidence that language had influenced any particular operating irregularity."

The overall finding of the Report concerning safety is this:

"The impact on safety which bilingual communications may have on the air traffic control system has been reviewed. It is considered that no detrimental impact on safety will result and that some improvements in system safety may be achieved if the recommended procedures are implemented and rigorously applied."

5.4 Findings - Problem areas or weaknesses in the existing system not related to bilingualism

During the course of the simulation exercises the techniques of the controllers were under the very closest of scrutiny. The BICSS team identified a number of problem areas or weaknesses which existed in the system, and which it described as "questionable practices". These matters are discussed at pages 51 to 53 of Volume 1 of the BICSS Report.

None of the weaknesses was considered by the team to be related to language. Accordingly, while not entirely irrelevant, these matters do appear to fall outside the Commission's Terms of Reference. Accordingly, the Commission does not propose to deal with them except to recognize that this accessory benefit accrued from the simulation studies, and that action was taken where it should and could be taken.

An example will perhaps best serve to illustrate the kind of problem which was identified and corrected. It had to do with a rule known as the One Minute Departure Separation Minimum. The Report states:

"The team identified an interpretation problem among controllers on the application of MANOPS 385.2 dealing with the application of one minute separation between successive departures."

It was found during the simulation exercises that individual controllers were applying the rule in different ways. Mr. Proulx explained the problem in this way:

"Controllers in the application of the one minute would issue to the first aircraft a turn either to the right or to the left and allow the second aircraft to depart one minute behind.

The procedure states that you must assign a heading which diverges by 45 degrees."

An investigation carried out in three Flight Information Regions confirmed that the rule was not being applied in a consistent manner. Two Air Traffic Service Directives were thereupon issued so as to rectify the situation.

Section 6. THE PROCEDURES DEVELOPED

6.1 The procedures

The following is from the Report:

"During simulation exercises a number of specific procedures were identified as being required for implementation of bilingual communications in IFR."

The procedures would require changes to be made to MANOPS, Air Regulations and inter-unit or local procedures. The procedures identified in the Report, and the changes proposed are as follows:

a) Language identification on flight data strips.

"The most effective method of identifying the language of a flight was the use of a yellow highlighter felt marker colour over the aircraft identification box of the flight data strip. In practical terms where the language is identified as French at the flight planning or clearances delivery stage, the appropriate strips will be marked by the assistant prior to the strip being at the controller's position. With this procedure the controller will normally be aware of the language of the flight in advance should he need to originate a call to the aircraft prior to the pilot initiating contact."

A paragraph 631.1 would be added to MANOPS:

"631.1 Identify flights which have chosen to use the French language by marking the aircraft identification (radio call sign) with a yellow highlighter felt marker."

b) Replacement of strip when language changes from French to English.

A paragraph 631.2 of MANOPS would read:

"631.2 When you approve an aircraft to subsequently change from French to English, replace the original strip to ensure that there will be no confusion as to the language being used by the aircraft involved."

Both these procedures have already been implemented at locations where bilingual services are provided to VFR Flights.

c) Exchange of traffic in the holding pattern.

"One of the more critical phases of control, where the party line aspect of the listening watch has been identified as a significant feature, relates to aircraft cleared to holding patterns over a navigational fix. When this is done with several aircraft they will normally be stacked at 1,000 foot intervals in altitude. In the unilingual system where listening watch may afford the pilot the knowledge of the presence of other flights above and below their altitude in

the hold he can monitor the clearances issued by the controller. Should an error occur, such as two aircraft cleared through the altitude of another, the pilot may in some cases detect such an error.

It is recommended that a procedure be implemented which would require the controller to exchange traffic information with pilots of aircraft in a holding pattern and using different languages in order to restore the information normally available through the listening watch. The three conditions for traffic exchange are:

- a) aircraft cleared to the same fix
- b) aircraft separated by minimum vertical standard
- c) aircraft using different languages

Paragraph 632.2 of MANOPS would read:

"632.2 In a bilingual environment, exchange traffic information between IFR aircraft when all of the following conditions are met:

- A. cleared to hold at the same fix;
- B. separated from each other by not more than the minimum vertical separation; and
- C. using different languages for communications."

It is worth mentioning that, as originally conceived, the controller would be required to inform each pilot about aircraft located above and below. It had not, however, been intended that the controller would be obliged to advise the pilot when the aircraft below was cleared out of the holding pattern. As a result of cross-examination on this point by Mr. MacWilliam, the Department of Transport revised its position, and decided that the controller would be required to give such information. Mr. Proulx advised the Commission to this effect on March 1, 1979.

Criticism directed at the procedure will be considered later, in Section 8.3.

- d) Exchange of traffic for merging targets.

"It is also considered that, for similar reasons, a general expansion of required traffic exchange be provided by the controller when

- radar targets appear likely to merge
- not more than minimum vertical separation is assured and
- aircraft are communicating in different languages"

Paragraph 632.3 of MANOPS would read:

"632.3 In a bilingual environment, exchange traffic information between all radar identified IFR aircraft when all of the following conditions are met:

- A. radar targets appear likely to merge;
- B. merging aircraft are separated from each other by not more than the minimum vertical separation; and
- C. the aircraft involved are using different languages for communication."

The merging target service envisaged here is examined at some length in Section 8.3.

e) Relay of clearances in language of pilot.

"In the application of control procedures the IFR controller is sometimes faced with relaying complicated clearances to the pilot via an intermediate agency which could be a control tower, aeradio station or in a few cases a private radio station. Due to the inherent danger of translation of complex information by individuals who are not fully trained in IFR control procedures, it is recommended that no translation of clearances be permitted.

This recommendation implies that the intermediate agency must establish the language which the pilot will use, obtain the clearance in the correct language and transmit the clearance verbatim in the designated language."

Paragraphs 633.1 and 633.2 of MANOPS would read:

"633.1 Issue clearances in accordance with 310."

"633.2 If a communication agency will be used to relay clearances or instructions to aircraft, determine the language used by the pilot and issue the clearance or instruction in that language.

Note: Under no circumstance will the clearances or instructions be issued in a language other than the one used by the ATC unit issuing the clearance or instruction."

f) Use of phonetics for civil aircraft.

"To minimize the impact of change of language use by the controller the team recommends the use of phonetics when the controller transmits the aircraft callsign. This will ensure contact with the aircraft concerned regardless of the language used by the controller. The phonetics should be used in a bilingual environment as follows:

- a) express the last four characters of a Canadian Civil aircraft registration using phonetics.
- b) provided communication has been established and no likelihood of confusion exists, abbreviate the aircraft callsign to the last two characters of the registration using phonetics."

Paragraphs 634.1 and 634.2 of MANOPS would read:

"634.1 Identify civil aircraft in ATC communications in accordance with 2316."

"634.2 In a bilingual environment:

- A. express the last four characters of a Canadian civil aircraft registration using phonetics;
- B. provided communication has been established and no likelihood of confusion exists, you may omit the manufacturer's name or type of aircraft and abbreviate to the last two characters of the registration using phonetics."
- g) Use of phonetics for identification of low frequency airways and air routes.

"Low frequency airways and air routes in Canada have traditionally been identified by colour codes; a system which has its origins in Europe where all airways are colour coded. In a bilingual environment the designation of such airways can be a problem. As (an) example G33 on an airway chart would be Green thirty-three in English but Vert trente-trois in French.

The team recommends that the use of phonetics for identification of such airways so that commonality exists between languages. Thus G33 becomes GOLF thirty-three or GOLF trente-trois."

Paragraphs 635.1 and 635.2 of MANOPS would read:

"635.1 Issue a detailed route description in accordance with 322."

"635.2 If an aircraft will be proceeding on a low frequency airway or air route, use phonetics to describe the airways or air routes to be followed."

Some observations concerning the use of phonetics will be found in Section 8.3.

h) Identification of VHF airways.

Paragraph 635.3 of MANOPS would read:

"635.3 If an aircraft will be proceeding on a VHF low level airway or high level airway, use the terms "Victor" or "haute altitude" as appropriate."

i) Use of language initially chosen by pilot unless requested to change.

"The use of the wrong language in initiating transmissions may occur and may be originated by either the pilot or the controller. If both were fluently bilingual there would be no resultant problem. However, the system must provide for the case where the controller has bilingual capability and the pilot is unilingual whether French or English. The pilot must be encouraged to use one language during his flight as it would be inherently dangerous to have indiscriminate switching of language by pilots."

The procedures described in Paragraphs 636.1, 636.2 and 636.3 would deal with this situation.

Paragraph 636.1 would read:

"636.1 Communicate with an aircraft only in the language initially chosen by the pilot unless a specific request is received to change to the other language or is considered necessary for safety of flight."

j) Inadvertent use of wrong language by controller.

Paragraph 636.2 would read:

"636.2 If you inadvertently initiate a call to an aircraft in the language not chosen by the pilot for communications, return to the language originally being used as soon as you realize the error.

Note: Under these circumstances it may be necessary to confirm with the pilot that he has received and understood that part of the transmission that was transmitted in the wrong language."

k) Inadvertent use of wrong language by pilot.

Paragraph 636.3 of MANOPS would read:

"636.3 When an aircraft initiates a call in the language not chosen initially for communications, advise the pilot of the change in language and request confirmation of the language to be used.

Note: Random switching from one language to the other may result in confusion and cannot be permitted under normal operating conditions."

l) Initial radio contact where pilot language unknown.

"It is not anticipated that this will occur frequently, however in the remote eventuality that the controller is uncertain which language to use he will call in both languages."

Paragraph 637.1 of MANOPS would read:

"637.1 Use both languages as required when initiating radio contact with an IFR aircraft whose choice of language has not been determined."

m) Relay of clearances by pilot of another aircraft.

"Where another aircraft must be used to relay information the controller must determine that the pilot of the aircraft to be used can transmit in both languages."

Paragraph 637.2 of MANOPS would read:

"637.2 When using another aircraft to call an aircraft whose choice of language has not been determined, confirm that the pilot will be capable of initiating a call in both languages, if required, before making the request."

n) Coordination of language between two IFR units.

"Between IFR units and also between IFR and VFR units and Aeradio Stations in the Province of Quebec, it will be necessary to transmit the language of use in the coordination message which occurs between data controllers prior to the arrival of a flight on the frequency. This will provide a double check to insure flight strips are already marked and to allow strips to be marked for the exceptions."

To this end the procedures described in the proposed Paragraphs 639.2 and 640.1 of MANOPS have been developed.

Paragraph 639.2 would read:

"639.2 When forwarding flight data and control information in a bilingual environment, include the language being used for communications in addition to the flight data and control information as required in 391.3."

o) Coordination of language between IFR units and towers and Aeradio stations.

Paragraph 640.1 would read:

"640.1 When forwarding flight data to a tower or aeradio in a bilingual environment, include the language being used for communications in addition to the flight data as required in 392.1A."

p) Clearance readbacks.

"The team established that the whole question of readbacks required a serious review by existing authorities. This review would of necessity, embrace the legal requirement for pilots to read back critical portions of all clearances and instructions as well as the requirement for controllers to listen to pilot readbacks and correct errors. It would appear from results obtained, both in simulation and in the real world reviews, that the frequency of controllers detecting incorrect readbacks is too low."

As a result, a recommendation is made in the BICSS Report in the following terms:

"Appropriate regulations be enacted to legally compel pilots of VFR and IFR flights to readback the critical portions of air traffic clearances and instructions.

In addition, controllers should be alerted to the need to attentively listen to readback of clearances to detect errors."

It must be emphasized that this procedure is not related to the use of two languages. It is simply mentioned here because the need for such a procedure was detected during the simulation study.

- q) Provision of seldom used phraseology at the controller position by means of plasticized reference cards or by OIDS display.

"That plasticized reference cards be provided at each control position containing air traffic control phraseology not frequently used. These reference cards to be provided in both English and French. Such phraseology pertaining to the following should be included:

- holding instructions
- fuel dumping

Note: Other methods may be more appropriate to display this information such as the Operational Information Display System (OIDS) when available."

This recommendation also does not appear to be directly related to bilingualism, but rather to the existing system. The need for such a procedure was, however, identified on the occasion of the simulation study.

- r) Establish local procedures for unilingual French pilot forced into English only airspace.

This subject will be dealt with in Section 3 of Chapter 8 of this Report. For the present the following excerpt from the BICSS Report will serve as an introduction:

"Throughout the conduct of the Bilingual IFR Communications Simulation Studies, a continuing topic of discussion was the impact of a unilingual French pilot who is forced to deviate into airspace in which he is unable to communicate. A different but related topic is the importance of any pilot not exceeding his language capabilities."

The BICSS Report further states:

"For deviation into adjacent controlled airspace, local procedures could be developed and coordinated with the appropriate units. These procedures, which could be included in an inter-unit agreement if considered necessary, would allow for the formulation of a clearance to be issued by the appropriate Quebec-based control unit before the aircraft leaves their area of radio contact. Such clearances would have to be complete, including the approach clearance and, if necessary, instructions for manoeuvring on the ground."

At this stage it is sufficient to say that no procedures have been developed to deal with this potential problem. As one means of handling the situation the Report recommends that local unit procedures be established and promulgated to controllers covering such points as maintaining communications, coordinating with an adjacent English-only unit and issuing an appropriate clearance to safely direct the flight to an alternate destination.

- s) A requirement that the Montreal Terminal Arrival Controller provide the tower controllers with the information on the position of all arriving IFR aircraft.

There is no need to comment further on this procedure which was recommended by the Montreal Area Bilingual Air/Ground Communications Study.

6.2 The testing of the procedures

Except for the five cases described below, the procedures discussed were tested during the simulation study. They were found appropriate, and the BICSS Report recommends that they be implemented. That is not to say that the testing of such procedures, including those not evaluated in simulation, has gone unchallenged. This aspect of the matter is dealt with in Section 8.3.

The five procedures recommended in the BICSS Report which were not tested in simulation are:

a) Exchange of traffic in the holding pattern

This procedure was conceived after the simulation exercises had been completed. It was considered unnecessary to test this procedure since it was already in use to a large extent. The Airspace and Procedures Division of Air Traffic Services of the Department of Transport was advised of the proposal to introduce this type of procedure. Its reply reads as follows:

"The provision of traffic information to aircraft holding at the same fix with minimum IFR separation would not invoke a noticeable increase in workload at any location in Canada.

If a procedure were to be introduced requiring the passing of this information, it would be done on a normal basis as an ATS Directive or MANOPS Amendment. It is our opinion that this is such a low workload, and whenever aircraft are stacked, this information is passed anyway, so that no special training or introduction is necessary."

The subject is further discussed in Section 8.3.

b) Exchange of traffic for merging targets

This procedure was also developed following the simulation studies. It was tested in the real world in both Toronto and Montreal. The study in Montreal involved 85 hours of observation and data collection in the Area Control Centre. Among other things it was found that this kind of traffic information was provided to pilots as a matter of practice in some 80% of merging traffic situations.

There is further discussion of this procedure in Section 8.3.

c) Use of phonetics for civil aircraft

Although this procedure was conceived after the simulation exercises had taken place, it was tested at certain airports, particularly those at Sept-Îles and Halifax. The procedure was found to be appropriate, and its implementation was planned for April 1, 1979.

The matter is further considered in Section 8.3.

d) Clearance readbacks

As already mentioned, this is not a procedure which is directly related to the use of two languages. It more properly falls into the category of weaknesses in the present system. Furthermore, the practice of reading back of clearances is currently carried out, but on an inconsistent basis. The need identified was for a rule that would ensure universal compliance.

e) Establish local procedures for unilingual French-speaking pilot forced into English-only airspace

It goes without saying that since these local procedures have not yet been developed but are to be worked out in the future, they could not have been tested during the simulation exercises. The question is discussed in Chapter 8, Section 3.

Although not arising out of the simulation study, there is another procedure that may conveniently be mentioned at this point. It is a recommendation arising out of the Montreal Area Bilingual Air/Ground Communications Study to the effect that the Montreal Terminal Arrival Controller provide the tower controllers with information as to the position of all arriving IFR aircraft.

6.3 Application of bilingual procedures to other IFR units

This subject has to do with the Quebec and Bagotville Terminal Control Units. The latter TCU is operated by the Department of National Defence.

Members of the BICSS team visited the Quebec TCU so as to observe the operation, and to review proposed procedures with the local management. The BICSS Report gives the results of the review in these terms:

"The review of the proposed procedures with unit management, observation at the positions and discussions with the controllers confirmed the appropriateness of the bilingual procedures."

And further:

"In general, the procedures developed in simulation based on the Montreal Centre sectors was considered directly applicable to the terminal unit at Quebec City."

It should be noted, however, that the merging target service was not discussed with the controllers at Quebec City.

As for Bagotville, an exchange of letters between the Deputy Ministers of Transport and of National Defence confirms the intention of the latter Department to implement a bilingual IFR service at Bagotville coincident with DOT. It is planned that the responsible staff at DND will work closely with the appropriate members of the DOT staff "so that both our Departments may proceed concurrently on this matter", to use the words of the Deputy Minister of National Defence in his letter of November 6, 1978. There was, of course, no discussion of the specific procedures since the BICSS Report had not been issued at that time.

Section 7. THE DOCUMENTATION REQUIRED PERTAINING TO THE VARIOUS
PROCEDURES DEVELOPED IN ORDER TO FACILITATE EVALUATION OF
THOSE PROCEDURES

Among other things, the Terms of Reference require the Commission to consider, evaluate and report upon

"(b) the documentation required pertaining to the various procedures developed in order to facilitate evaluation of those procedures;"

While no suggestion as to any such documentation was made to the Commission, it could perhaps be said that two recommendations contained in the BICSS Report touch on the subject.

The first is Recommendation 1 to the effect that an implementation team be established and maintained for a minimum period of one year after implementation. Such a team would be able to monitor the operations and evaluate the procedures.

The second recommendation in the BICSS Report that could be said to be related to Paragraph (b) of the Commission's Terms of Reference is Recommendation 7, which reads:

"Transport Canada investigate the establishment of an aviation safety reporting program for the voluntary reporting of incidents, hazards and discrepancies in the Canadian aviation system. Such a program should be administered by an independent agency."

Such a programme, not related to the use of two languages, and which would presumably operate on some kind of an immunity basis, would no doubt encourage the bringing to light of safety-related situations requiring attention.

The suggestions made in both recommendations appear highly commendable.

Section 8. CRITICISMS DIRECTED AT THE CONDUCT OF THE STUDY, AT THE
FINDINGS REPORTED, AT THE PROCEDURES RECOMMENDED AND AT THE
ADEQUACY OF THE METHODS USED IN DEVELOPING AND TESTING THE
PROCEDURES

Not all the major criticisms will be dealt with in this section since several may more appropriately be discussed elsewhere in this Report. Such is the case with the listening watch study, with the possibility of unilingual French-speaking pilots straying into airspace where services are available in English only, and with the subject of uncontrolled airspace. Criticism directed to the objective of the simulation study has already been dealt with.

8.1 Criticisms relating to the conduct of the study

a) The length of simulations was not adequate to establish a data base capable of revealing the actual detrimental impact of the use of a second language.

This statement is to be found in the brief submitted to the Commission by CATCA, which adds: "Our worst fears in this area have been realized and this shortcoming has been aggravated by the refusal of the project Director to include the statistics produced during the simulations conducted by CATCA-nominated controllers."

In the view of the Commission the criticism relating to the length of the simulations is not substantiated by the evidence adduced.

The matter of the CATCA runs will be addressed in subsection 8.2(b).

Excluding always the CATCA runs, 64 hours of exercises were conducted in Phase I. During Phase II there were 54 hours of tests. However, three positions were simulated at the same time so the data collected represented a total of 162 hours. As for Phase III, there were 30 hours of simulation at each of three positions for a total of 90 hours of data. Taking into account the 30 hours of simulated exercises that were run in Phase IV, data was collected for analysis during a total of 346 hours.

Dr. Stager was of the opinion that the exercises were sufficiently long, and that more than sufficient data was gathered. Speaking of Phases III and IV, each of which consisted of four sessions, or weeks, as they were sometimes called, Dr. Stager said:

"And there was always the proviso that if we made observations during those four weeks that indicated to us that more data was to be collected, then we would go ahead and collect it."

In fact, the collection of additional data was not required. Moreover, it was not thought necessary to analyze all the data that had been collected. Dr. Stager put it this way:

". . . But what I can say here is that I concurred with the suggestions that we not analyse as a first go-around in any case that we analyse a portion and then if we found that the results were such that we had to analyse a complete set, then we would do so."

Dr. Frigon was quoted as saying: "The more observations you can get, the better it is, of course." (Translation) This remark should not be taken in isolation because he went on to say:

"Q Now, you indicated that in undertaking their task, the Transport team was faced with a very large undertaking, and I take it that it is something that is new in terms of simulation?

Do you feel that in a sense, one could almost regard the work of the team as initial work; and that a second design which was established, having the information which Dr. Stager and his team produced, might be able to either design the experiment in a different way, or direct themselves to more particular problems?

A In the experimental field, one usually states that any experiment is a starting point for another experiment, but we must stop at some point, and I believe that if the experiment conducted is satisfactory in terms of what one wishes to study, then one can study different aspects, one can always add, but I am not sure whether this is what you were referring to.

In a certain sense, one never stops experimenting if one wishes to do so." (Translation)

Nowhere in the testimony of Dr. Frigon is there any suggestion that there was not enough data collected during the experiment.

b) The controllers' workload

This criticism was expressed in various ways. At times it was said that there was not enough traffic, or that it lacked complexity. In the written submission of CALPA the complaint is put in this manner:

"No attempt was made to stress the system. In fact the team purposely structured the traffic to levels that the controllers could handle."

Such criticism finds little to support it in the evidence.

As we have seen, the traffic for Phase I was based on that encountered at the Montreal Centre but was increased by some 42% for the purposes of the exercise. During Phase II the level was about 20% higher than that of an average peak period at Montreal.

After giving evidence that in his opinion as Director of the Project there was sufficient traffic, Mr. Proulx explained why he would not have attempted to add to it:

"Well, I think this point was discussed with team members, all the team members including the associations on one or two occasions and once with other people who came to the simulation centre and I always felt that the controller can control his workload in this way, that once he has sufficient traffic on his frequency he can stop the traffic by advising in the real world the other coordinators or the other sectors to hold the aircraft within their airspace in the simulation centre, and in this case it would be in the back room with the coordinators and the people working there.

So, we could not break him, because that is something that that he is trained to recognize when he has enough.

If we had told the controllers that they were not to stop the traffic that was being fed, you know, to their sector, then at one point maybe after one or two over his limit he would just probably throw up his hands and say Okay, fine, you win. Because controllers are - I don't think would like to play that game of going too far with traffic, because that is not normal, because he always has the right to stop the traffic and that is what he does in the real world and we expected that that is what he would do in simulation and I thought that that would be an exercise that would get us nowhere, or prove anything."

The same point is made by the CATCA Minority in the comprehensive written argument they submitted to the Commission.

Eric St. Denis, a controller who had formerly worked in Montreal, and who participated in the CATCA runs for both the Enroute and Terminal exercises, said this:

"I approached the concept of the simulation quite honestly and since that I knew that - I knew what I was there for, I intended to do the best job that I could.

At the same time, I was much more relaxed that I would have been sitting in the same situation involving real airplanes."

Mr. St. Denis was of the opinion that the Enroute East exercise was "realistic in volume but lacked some of the possible complexities that would show up in a combined Granby/Sherbrooke operation." Mr. St. Denis had "checked out" as an Enroute East controller for the purposes of the exercises, but had not performed in that capacity when he worked in Montreal.

However, with regard to the Terminal exercise, in which he took part, Mr. St. Denis said:

"I felt, based on my own experience, that the terminal exercise was extremely realistic, the volume was above average for the - what I would expect, or what I had personally seen in the Dorval Terminal with the exception or possibly some pre-Olympic days, or traffic just prior to the Olympics, or some peak summer periods in the past, but in most occasions I found that the terminal exercise was heavier than you would have anticipated at Dorval, sorry, at a combined Dorval/Mirabel operation."

He also had this to say:

"Yes. The complexity was in the terminal exercise.

All the little things that you would expect to see, flights crossing over to Dorval area into St. Hubert, the Mirabel arrivals, the problems that occur on everyday occasions, they were there, okay.

There can't be 100 per cent accuracy, for instance, you couldn't simulate a snowstorm, or an airport being shut down, but small things like runway changes, COMM failures. Excuse me, I don't recall exactly if there was a COMM failure, but most of the complexities that you would see in the everyday operation over a period of time were all built into the exercise."

And he continued:

"When, in the terminal exercise, the runway change came about, I found that we became quite intense about what we were doing.

As a matter of fact, you almost felt like you were in a real pressure environment. Okay. It was really busy.

Probably during that period, more than anything else, the exercise became quite real.

But other than that, I think most of the time we were conscious of the fact that it was an exercise."

With respect to the same exercise, Mr. Fudakowski, who had been a controller with much experience in the Montreal Centre, said this:

"The first hour and a half session represented what I would characterize as an extremely busy morning period in the Montreal Terminal area."

"It represented an unusual situation of peak traffic situation which would occur and last probably in a 45 to an hour or to a 60-minute period in Montreal normally, but we sustained that level of activity for four and a half hours, so it did not represent the Montreal situation."

As a matter of fact, the traffic in the Phase II Terminal exercise had to be reduced for the second session as a result of complaints by the participating controllers. Mr. Fudakowski explained what had happened:

"Well, I think that we can go back to the first - the first week of Phase 2 simulation as an excellent example of that situation.

The traffic loading was such, in my opinion in any case and in the opinion of the controllers who participated in the test during that week, that it was barely, it was just too much for them, and there was quite a debriefing session that particular evening. As a result of that we did reduce the number of flight plans for the following week, even though the controllers agreed that they would come back and work the same level of traffic for the second day, which in the first week happened to be the bilingual day.

So, you know, we compensated for that and there was a minor reduction in traffic and we continued on for the further five or seven weeks left."

Somewhat paradoxically, as pointed out in the written argument of the CATCA Minority, CATCA also said that there should have been longer periods of relative inactivity during the runs.

The Commission is of the view that the criticism directed at the workload of the controllers during the simulation exercises is unfounded.

c) The constraints

As recognized in the BICSS Report itself, the simulation programme was conducted under a number of constraints which must of course be taken into account in assessing the data generated by the exercises. The Report describes the constraints in these terms:

i) Simulation Equipment.

"The simulation facility, while providing excellent simulation, produced a different radar presentation than that used by controllers in their every day work. On the one hand, the presentation was clear and precise (being digital computer based) while on the other hand, the target characteristics were different and the radar presentation lacked the normal radar sweep and range rings. This was significant in the case of Terminal Simulations where controllers rely heavily on range rings and radar sweep in

the performance of their control duties. The net result was a requirement for the controller to adapt to different equipment in the short period of a few hours. Whereas some found the adaptation difficult, others did not and on balance the adaptation was considered adequate."

ii) Aircraft Characteristics.

"Controllers are conditioned to expect certain performance from individual aircraft types and will of course use that expectation to make certain control decisions. In simulation it is not possible to duplicate the real world with 100% fidelity. Certain aircraft types were not faithfully reproduced in simulation and hence the simulation environment placed a heavier burden on the controller to the extent that the unexpected occurred more frequently."

iii) Pilot Characteristics.

"The nature of the communications generated by specially trained simulation pilots was difficult to categorize. On the one hand, it could be claimed that the communications of simulation pilots were too perfect in that they performed by the book, while on the other hand, they were a burden to the controller since they took up more time and created greater workload. The other factor related to the simulation pilot's ability to interact with the controller where problematic situations occur. Real pilots may question controller decisions to a greater degree than simulation pilots while simulation pilots may understand the controller less quickly.

The other factor which was perhaps of greater significance was the necessity of using one pilot voice for two to four different aircraft at the same time. This necessity caused a degree of 'lack of realism' which at times burdened and even confused the controller during exercises.

Both the above factors were minimized by the addition of flight simulators (consequently real world pilots) to the simulation facility and by adding additional voices to the back room pilots (often by qualified pilots and controllers.)"

iv) Experience of Controllers.

"All controllers in Canada including those in the Montreal centre, regardless of their mother tongue, have been trained and have worked in a single language-English. It is evident therefore that the facility of communications for any controller today in the English language, because of training and experience, will be greater than in the French language.

Transition to a bilingual communications system can be expected to take time and the controller's facility in the second language and the facility of switching between languages can be expected to improve with time. For some controller test subjects it was the first time, except for three days of lexicon training, where they were exposed to using two languages in the practical application of control procedures and hence they were not afforded the luxury of time to improve their use of the French lexicon nor to develop their language switching skills."

v) Presence of Observers.

"The controller is used to working in a relatively undisturbed atmosphere without the presence of a large number of observers who are, in effect, assessing his performance. During the bilingual simulation exercise, there were up to fifteen or more observers from various organizations viewing the proceedings. While these observers were in separate viewing rooms and not looking over the shoulder of the controller, they were present and no doubt had some impact on the performance of some controllers. The extent of this impact is hard to assess but it did not become a sensitive issue with any controller who participated."

vi) Controller Motivation.

"Because of the emotional aspects of the bilingual communications issue, one early concern, expressed by some, was the motivational question in terms of its possible impact on controller performance.

This possibility never seriously concerned the team because of the expectation that controllers, who are professionals in their work, would approach their tasks in the manner in which they are accustomed regardless of their personal

opinions or leaning on the subject of bilingual communications. Indeed, there is no evidence, when all the data is reviewed to support any other conclusion. Any variation in performance detected can be attributed to normal variation in individual performance."

vii) Noise in Communications

"The simulation programs did not attempt to specifically reproduce the noise or poor quality of transmissions which sometimes occur in the real world. The controller was faced with normal occurrences of frequency blockage when two aircraft call simultaneously or where the controller is called by an aircraft while he is busy on his coordination lines.

During planning for simulation the aspect of circuit noise was not identified as a major consideration recognizing the much-improved quality of radio circuits in today's real world environment. The occasional poor radio was adequately represented during simulation by the transmissions emanating from the Air Canada and Transport Canada flight simulators which varied in quality from day to day due to the telephone circuits joining the simulators."

In a written submission to the Commission CATCA made a number of observations concerning the tests, and which could be characterized as constraints in the sense in which that term has just been used. It will be convenient to assign a paragraph number to each of them:

viii) The simulations were carried out under "sterile" conditions.

"(The BICSS Report) states that the controller is used to working in a relatively undisturbed atmosphere. In the normal environment there is a great deal of personal movement (coffee and meal breaks etc.), cross talk, ambient noise, movement of maintenance staff and much more. This produces something far less than a 'relatively undisturbed atmosphere.' The fact that the simulations were carried out under rather 'sterile' conditions placed a constraint on the validity of simulations."

- ix) The Enroute and Terminal sectors were not simulated coincidentally.

"Because the necessary control personnel could not be released from Montreal, it was not possible to simulate the enroute and terminal sectors coincidentally. This was considered to be a serious constraint and a great departure from the normal air traffic control scenario."

- x) The physical arrangements of the pilot positions.

"The physical arrangement of the pilot positions, in very close proximity to each other, placed constraints on the normal communications loading. Since the pilots were, for the most part, within eye contact of each other, they could tell when one of them was communicating with a controller, or perhaps even about to communicate. This is a drastic alteration from the real life situation."

- xi) The traffic used was for the most part identical on each day.

"The traffic which was used was, for the most part, identical on each day. The controllers were aware of this and tended to remember the traffic and the problem situations. This is substantiated by comments contained in Working Document No. 3. The effects of any designed problem could be diminished on successive simulations."

A few preliminary remarks are in order:

Constraint (iv) - lack of experience of the subject controllers in performing in French. If that hypothesis were valid one would have expected a poorer performance on the part of the controllers in the bilingual condition. Such was not, however, the case as shown by the results, and as explained by Dr. Frigon when he was cross-examined by Mr. Patenaude.

Constraint (vi) - controller motivation, or "arousal", as it should more properly be called according to Dr. Stager, could, in the opinion of the psychologists who testified, have acted either way so as to cause a better or a poorer performance. However, no arousal effect was observed. Dr. Frigon put it this way:

"...if your hypothesis is correct, the result, the effect of that hypothesis would be that the results would have been clearly better for the condition you were referring to, that is the bilingual condition, than for the unilingual condition, which does not seem to me to be the case."
(Translation)

Constraint (viii) mentioned by CATCA seems to be in contradiction with constraint (v). In the latter case the constraint is described as a lack of the habitual activity to be found in a control room: in the former the constraint is said to be the distracting effect caused by the presence of observers.

So far as concerns constraint (xi), it is a fact that the traffic was "for the most part, identical each day." It was pointed out, however, that the times of the occurrences were changed systematically so that the controllers could not anticipate them. Furthermore, the controllers themselves changed positions, and would not meet the same conditions in the same positions.

In looking at the overall situation it must be emphasized that apart from the lack of experience of the controllers in controlling traffic in both languages, a subject already mentioned, the constraints were present under both linguistic conditions. That being the case, and since the object of the exercises was to measure the differences between the two conditions, the constraints would not affect the results. The situation could have been different had, for instance, the object of the exercise been to compare data obtained in simulations with that collected from the real world where the operations were all being conducted in, say, the English language.

Mr. Proulx explained that the constraints would affect the simulation tests, but not their validity from an operational point of view.

That the constraints ought to be considered in this way is supported by Dr. Stager's opinion:

"In other words, the answer is, no, I don't think that they did invalidate the conclusions.

It is obvious, from the comments that Mr. Proulx has made, that: yes, these things do have an effect.

But I don't think the effect is such that it would invalidate the data; or that it would preclude its being used in a predictive sense to say what we can anticipate in terms of controller performance."

d) The lack of realism

The lack of realism considered here is not related to the volume of traffic, or to its complexity. Rather, it involves the point raised by COPA in its submission to the effect that the pilots furnished by COPA to man the King Air simulator spoke of a feeling of unreality "mainly because they stepped into the simulator which was already cruising at 10,000 feet."

The feeling was described by Russell Beach, COPA's President:

"The synthetic atmosphere of walking into a simulator room and stepping into an airplane at 10,000 feet, and flying a pre-determined course, or flight plan, and stopping for coffee an hour later and stepping out and breaking the sequence of the flight, and then getting back in and take a few more instructions and then finally stepping back out of it again 12 or 14,000 feet was not very realistic."

Mr. Beach modified his position somewhat when cross-examined by Jean-Luc Patenaude on behalf of the CATCA minority:

"Q In your testimony, you said that in the simulator, the simulator flight was quite different - that the simulator of the size that you went through was quite different from that of when you fly your own aircraft.

Is that because you didn't take off in the simulator, and start engines, and take off, and climb to altitude and level off?

A Partly, yes.

Partly because I wasn't familiar with the airplane, too, you know.

Any flights that I make personally, I don't - it may not be useful from that point of view for me to talk about how I use my airplane, but when I make a flight, well, it is a well planned flight. It is one that starts - you know, I am going to Chicago in the middle of next week, and I have had my flight plan, and the approach plates, and so on, out for a week, now, just in case there was something I didn't have that I might want to get more information on, and so on.

I don't go to Chicago - or I haven't been there for a few months. So, you know, I plan these things ahead of time, and I look at the approach plates, and I look at the minimums, and I think about the kind of weather I am going to want to have if I am going to make that flight, and these sort of things.

Well, all that was missing in this simulator exercise.

Q I see.

But would you say that the part - like when you are levelled off at altitude, let's say, 10,000 feet, your aircraft is capable of maintaining 10,000 feet?

A Yes. I normally fly at 29,000 for anything over an hour and a half trip.

Q Right.

When you are levelled off in your aircraft, at a certain altitude, and the procedure you went through in the simulator, would you, you know, that flying at 10,000 feet to a sector was a pretty well similar experience?

A Oh, yes.

Q That portion of the flight in the simulator was quite similar to what you encounter in your aircraft?

A Yes."

e) The lack of pilot or user input and the failure to test the pilot function.

This is perhaps CALPA's fundamental objection to the simulation studies. Expressed in another way, the criticism is that the tests were "controller biased" rather than "pilot biased." CALPA's concern is expressed in the words of Mr. MacWilliam as he gave evidence:

"Well, in my opinion, there are a lot of unanswered questions regarding the user or the pilot population, because that's the side that I represent.

I feel that a lot more could have been done during the simulation, regarding perhaps pilot workload, perhaps even some stress tests that we talked about with Dr. Stager before; I think, more work, perhaps, in the area of the communications of the actual pilots, and not the back room pilots.

I would personally have liked to have seen a lot more than talking about volume, now, testing of the listening watch.

I think they are those sorts of areas that, from the user point of view, I don't think were very adequately covered by the simulation."

As concerns testing of the listening watch and of procedures, these matters are dealt with later in the Report.

As stated in its written argument CALPA's position is that:

"... air traffic control involves, indeed depends upon the interface of pilots and controllers between themselves and with each other; the 'loop'. To our mind, one of the most serious limitations or constraints on a simulation exercise or its results is the fact that even if the aforementioned constraints from the controllers' point of view did not exist, the simulation exercises are testing or assessing only one side of the equation, only one part of the loop, the controller side. To close the loop, you not only need pilots but you must also assess the pilots, their input, their reactions, their performance, their error rate or lack thereof. To do otherwise you are not testing or assessing the loop, the system, but only one part of it. A chain is only as strong as its weakest link."

CALPA's initial criticism concerning the orientation of the simulation stems from the fact that Mr. MacWilliam, an experienced airline pilot, was the only professional flyer who was a full-time member of the BICSS team throughout its existence. He said that in the early stages of simulation he had suggested to Mr. Proulx that a pilot from DOT's Safety Division be added to the team on a continuous basis, but the suggestion was not acted upon.

Mr. MacWilliam was not the only professional pilot who was in fact a member of the BICSS team. Starting with Phase II of the exercises in November, 1977 four members of l'Association des Gens de l'Air du Québec (AGAQ) who were professional pilots became involved in the exercises as representatives of their Association. Only one such AGAQ pilot acted as a representative at a given time, however.

Two other full-time members of the BICSS team were pilots - Mr. Fudakowski and Mr. Lloyd Simms, both from the Department of Transport. Other departmental officials who were qualified as pilots contributed to the tests in various ways, including testing or verifying traffic information, clearance readbacks and phonetic alphabet procedures.

CALPA's belief that the pilot's side of bilingual communications should be investigated was made known during the early stages of the tests, if not before they began. It would appear that the initial thrust of Mr. MacWilliam's representations concerned the devising of a means of testing the effect of bilingual communications on the party line aspect of the listening watch. Planning to this end began in the later stages of Phase I, and will be considered in Section 1 of Chapter 8.

No other major point of user concern appears to have been raised during the course of the exercises by the pilots, whether as members of the BICSS team or through the use of the questionnaires. Mr. MacWilliam testified before the Commission that, aside from the party line, he would liked to have seen the pilot side tested and data gathered with respect to such testing. He referred to pilot workload and to stress, in connection with the latter mentioning an uncomfortable feeling he has himself experienced while flying in bilingual airspace in France ". . . when you hear something and you don't know what it is, gives you cause to wonder what it is." As to this, it is perhaps worth recalling Mr. Beaudry's evidence to the effect that French-speaking pilots who choose to speak French are now more comfortable and under less stress in communicating with the controller.

Mr. MacWilliam says that no attempt was made to separate and to analyze the data generated by the real pilots during the tests. It would appear that no such suggestion was made by anyone during the course of the exercises. According to Dr. Stager it would have been possible to do this, but, in terms of the information to be obtained, he did not believe it was worth the effort.

It should be mentioned, however, that in the course of evidence, Mr. Walsh, Deputy-Director of the BICSS studies, provided an analysis (Exhibit 315) of the pilot latencies during Phases II and IV obtained from the flight simulators which indicated no difference between the unilingual and bilingual conditions. The data demonstrated that the primary function of the listening watch (receiving and responding to controller communications) was not affected, and that there was no evidence that pilot performance in this respect would deteriorate in a bilingual environment.

It is clear from the evidence and from the BICSS Report itself that the simulation exercises were controller oriented. As stated in the Report:

"The focal point of participation was that of qualified Air Traffic Controllers whose performance would be examined to assess the effects of introducing bilingual communications and of the necessity for developing special procedures."

As has already been mentioned, however, there was significant participation by pilots in the tests. Information concerning the 150 pilots who took part in the exercises by manning the flight simulators has been given in Section 4.6. The data link between the flight simulators and the Simulation Centre at Hull speaks to the fact that the designers of the programme were conscious of the user side. As pointed out by Mr. Keitz, the Commission consultant:

". . . to our knowledge the data link which allowed the participant, the data link with the flight, Air Canada flight simulators which allowed and the King Air Simulator which allowed the participation of real pilots is also unique where at all of the other air traffic control simulators, although the capability might, the technological capability might exist for them to do the same thing, the fact is that the others use what we have called the backroom computer operator pilot in their air traffic control simulators and this is the only time that there has been significant participation of real pilots through the flight simulator data link."

While one of the principal reasons why pilots became involved in the tests was to provide them with a means to experience bilingual communications in action, it should not be overlooked that their observations concerning the exercises were sought by means of questionnaires.

In the opinion of Dr. Stager a simulation programme designed to evaluate both the pilot side and the controller side of the air traffic control system at the same time would have been unmanageable. He felt the design which was in fact used, and which incorporated pilots into the simulation so as to get their reaction, and to collect some data, was an effective and efficient approach to take.

Dr. Frigon, the experimental psychologist who was a member of the Commission's consulting team, expressed his opinion as to the orientation of the tests in the following terms:

"Yes. The experiment focused on the controllers, and I believe this is normal."

It would have created some concern if this was not the case.

On the basis of my understanding of the situation, the controllers are the ones who must control in both languages, and not the pilots who have to fly in both languages.

So, I feel that it is quite normal to focus on the controller aspect." (Translation)

- f) The associations were not invited to participate in the preparation of the BICSS Report, in the monitoring in the real world carried out as a related study, nor in the visits to Europe and Mexico, another related study.

As to participation of the associations in the preparation of the Report counsel for the Department made these observations in his written argument:

"In its testimony the panel indicated that it would have been extremely difficult to write the report in committee and it was therefore intended to produce a reasonably completed draft which could be reviewed in detail with the Associations in order to incorporate appropriate changes. This draft was given to the Associations at a Meeting on October 23, 1978 . . . and a two-day review meeting was set for November 6 and 7, 1978. At that meeting all Associations with the exception of Les Gens de l'Air declined to provide any detailed comments or to enter into any productive discussions. They however, preferred to present their comments directly to this Commission."

It would serve no useful purpose to review the evidence concerning reasons given for the non-participation of the associations in the monitoring study, or in the visits that were made by DOT members of the BICSS team to Europe and Mexico. Suffice it to say that the Commission deplores even a suggestion that all members of the team were unable to participate fully in all aspects of the BICSS studies, and in the preparation of the Report. In saying that, however, it must be recognized that such a criticism does not necessarily affect the quality of the work accomplished.

- g) Limitations inherent in simulation

Simulation is an important tool in studying ATC systems but it is, however, only a tool. Its limitations in the examination of stress and workload, for instance, are expressed in the following way in the paper of Dr. Hopkin filed as Exhibit 308:

"Current fashionable topics for investigation include stress and workload. It is unfortunate that the concept of stress has been overemphasised in air traffic control. It has been treated as intrinsic to air traffic control which it almost certainly is not. The reason that the emphasis on stress has been unfortunate is that it has obscured what is potentially the much more serious problem of boredom. Both boredom and stress are very difficult to estimate validly by real-time simulation methods because participation in a real-time simulation itself has effects on what is being measured. The simulation environment and the interest of others in task performance both render the job potentially less boring in simulation and a great deal of boredom cannot be generated in a simulated task without losing the collaboration of the participants in the simulation. Stress, in contrast, tends to be reduced in simulation because controllers know that they are not controlling real aircraft and do not have people's lives in their hands. In simulation, they may therefore be willing to issue instructions for manoeuvres which they would not countenance in real-life."

Speaking as a participant in the CATCA runs, Eric St. Denis, the controller from Toronto, said this:

"I approached the concept of the simulation quite honestly and since that I knew that - I knew what I was there for, I intended to do the best job that I could.

At the same time, I was much more relaxed than I would have been sitting in the same situation involving real airplanes.

I would say that whereas we knew that it was an exercise that was to simulate a real life environment, a real life, or real life situations.

We made light of it a little bit, like we weren't always totally serious about that we were doing, like we were more relaxed while we were doing it."

There is, however, no evidence that the attitude of Mr. St. Denis was shared by all the controllers who took part in the simulation exercises.

As described by Mr. MacWilliam in his testimony, much of the most vital training and testing of airline pilots is carried out in simulation.

Simulation requires verification in real life. As was said by Dr. Stager in his comments on Dr. Hopkin's study:

"This has been an implicit assumption in the present study. It is anticipated that implementation of bilingual control would be conditional upon there being a specified monitoring system for field evaluation."

And, as will later be seen, the first of the many recommendations contained in the BICSS Report is that an implementation team be established to issue directives and to closely monitor the application of procedures.

While it must accordingly be emphasized that a simulation experiment cannot by itself conclusively prove whether or not bilingual air traffic control is safe, such an experiment can, however, provide valuable information. It will be seen that this limitation inherent in simulation has been recognized by those involved in the BICSS studies, and, moreover, by the Commission's consultants. The need to supplement information to be provided by the simulation tests was recognized by the Commission from the outset, and led to the carrying out on its behalf of the real world studies that are considered in various parts of this Report.

8.2. Criticisms relating to the findings

- a) The reliability of the statistics upon which the analysis was performed, and upon which the findings are ultimately based.

The following statement is taken from the CATCA submission:

"There are a large number of discrepancies in the statistics used in the report from those which were actually gathered during the simulation studies. These discrepancies are sufficient in a number of cases to completely discredit the conclusions which are drawn in the report. In particular, one such discrepancy is sufficient to throw into doubt any claims that the report makes to have 'external validity.'"

In our view there is little in the evidence to support such a statement. It is acknowledged that an element of judgment entered into the compilation of statistics from the communications data. Such was bound to be the case in determining, through a review of video tapes, whether a communications error had been made, and if so, how it should be categorized. It was perhaps inevitable that different groups of persons reviewing the same tapes would arrive at different figures. The collection of data on latency also had its problems.

It was, however, the unequivocal evidence of Dr. Stager and of the BICSS team Departmental members involved that, applying the recognized techniques governing this type of data collection, and following the applicable rules, there were no discrepancies or margins of error that would affect the validity of the data. That being the case, Dr. Frigon, the experimental psychologist who was a member of the Commission's team of consultants, said this:

"Q And in your opinion are the various analysis of the results carried out by Dr. Stager valid?

A Yes.

Q And according to you, would any other experimental psychologist using the same techniques have reached the same conclusions as Dr. Stager?

A Yes. Any other experimental psychologist - it is a well known methodology - using the same techniques, applying the same methodology would reach the same conclusions.

This in terms of significant differences, statistically significant, between the experimental conditions."
(Translation)

b) The exclusion of the data from the CATCA runs

The following observations are from the CATCA submission:

"The test data that was obtained during the 'C.A.T.C.A.' runs was not included in any of the analyses. This is an unnecessary constraint on the overall findings of the simulation study. It must surely be the purpose of any study of this nature to gather all the information possible and then to use it in any analyses that are done."

As previously mentioned, and as noted in the BICSS Report, the controllers furnished by CATCA "did not form an integral part of the design package and hence the associated collected data is not analysed in this report."

The reasons for not including such data were further developed in that evidence. In the first place, the runs did not form an integral part of the programme design. In addition, the controller sample was different. The controllers whose exercises were included in the design were all certified bilingual controllers currently working in the Montreal Centre. Although the CATCA controllers were bilingual, only one came from the Montreal Centre. While the other CATCA controllers had worked in Montreal

in the past, one had transferred to Ottawa, another to Toronto. Each had, however, been provided with a special course of training before taking part in the simulation exercises.

The CATCA runs were different. In Phase I, only the Granby-Sherbrooke sector was simulated, not the James Bay. In Phases II and III the simulation was limited to 16½ hours in each phase. There were no CATCA runs in Phase IV.

It does not follow that the data collected from the CATCA days was simply ignored. In the words of Dr. Stager:

"The data from the CATCA performance participation is looked at in the sense of understanding it, interpreting it, comparing it against the data that we got from each of the design packages.

In other words, we never exclude any of the data that is available to us for review.

Perhaps review would be a more suitable word than analysis.

All the CATCA data was reviewed."

While a nice argument might be developed as to whether the CATCA data should have been included with the rest of the information that was analyzed, such a discussion would be pointless since it is well established that inclusion of the CATCA data would not have changed the results of the exercises.

c) The reduction of the losses of separation

Through the use of several techniques, the number of losses of separation observed in the exercises was reduced to that appearing in the BICSS Report: during the enroute exercises (Phases I and IV) a total of 14 - divided equally between unilingual English and bilingual days; during the terminal exercises (Phases II and III) a total of 85 - 40 on unilingual English days, 45 on bilingual days.

Each loss of separation was reviewed a number of times. In his written argument counsel for the Department explains how these reviews were carried out:

"This included watching the video tapes and listening to the communications to assess language related factors as well as other factors. The impact of system errors within the computer were considered as well as the influence that

perception may have had on controller performance using the simulation radar scopes. Further, the losses were categorized as to seriousness from both a controller and from a pilot point of view. These steps were taken in an effort by the team to thoroughly evaluate the data from as many perspectives as possible as well as to insure that the measurement of controller performance as perceived through losses of separation was not confounded with other factors such as system error or controller perception. These steps or stages of evaluation were applied equally to both the bilingual and unilingual days and quite apart from the question of validity of the approach the application is the same in both language conditions and hence has inherent comparative validity."

Mr. Keitz testified that this process of evaluation had caused him some concern. He accordingly made an analysis of his own to determine whether the reduction in the number of losses of separation would affect a comparison of the two linguistic conditions. Mr. Keitz continued:

"... the result was that there was just no significant difference, whether you leave them in or out, no matter how you cut it, there was just no real significance between the number of losses that occurred on the bilingual day and the number that occurred on an English day."

During her oral argument counsel for CATCA said:

"In terms of the numbers and the reductions not to use the words that Mr. Proulx didn't like, the reduction of the losses of separation, initially this reduction did appear to be disturbing, but after the analysis was done by Mr. Keitz it becomes quite clear that even if no reductions were done and others were not done, that none of the differences would test significant."

The process therefore only becomes disturbing, or rather only is disturbing because of the possibility that there was a certain attitude which was being demonstrated by the team in this particular regard, I simply say here on reading the report there is the implication that in fact there is an eagerness to show that there weren't any serious problems, or that there were no differences for example in the technical as opposed to the critical distinction."

CATCA also refers to the evidence of Mr. MacWilliam to the effect that because of all the variables involved in assessing losses of separation it is not possible to characterize a loss as critical, as opposed to

technical. The Association also commented adversely upon the assessment made by Mr. de Niverville, Chief, Aviation Safety Analysis, Aviation Safety Bureau, pointing to his observation, found in Exhibit 285, that his evaluation would have to be very subjective "for the simple reason that a pilot in flight has no means of accurately determining his distance from other aircraft." CATCA also drew attention to the evidence of Messrs. Proulx and MacWilliam in support of their submission that to effectively assess the seriousness of a loss of separation it is necessary to talk to the controller or pilot involved. However, in view of the uncontradicted and persuasive evidence of Mr. Keitz to the effect that the reduction in the losses of separation had no impact on the finding that there was no difference between the two linguistic conditions, the Commission is of the opinion that the criticism directed towards the reduction in the number of losses of separation does not in any way affect the validity of the simulation experiment.

- d) No tests were carried out to evaluate stress on the part of the controllers in bilingual control.

There has already been some discussion of this subject. After explaining at some length why no valid tests as to stress could be conducted in the simulation study Dr. Stager concluded:

"If one wants to continue to think about it, and we want to, sort of, evaluate it post-hoc then we would be looking at performance detriment, but not any other indicators of stress."

An analysis of the data does not disclose any such detriment because there are no differences in performance in the bilingual as compared with the unilingual days.

Granting that subjective assessment is not always entirely reliable, considerable weight must nevertheless be given to the evidence of controllers who actually control in both languages, who have been doing so for some years, and who insist with vigour that they find their work less stressful when they provide service in both languages.

Pierre Beaudry, a terminal controller at the Quebec City airport, expressed his feelings this way:

"So what has happened is that with the use of French, illegally in Quebec, cooperation has brought about an increase in exchange of information and greater efficiency.

People are more at ease, they are also less 'stressed.'

And for my part, I think in any case I am convinced that stress is directly and equally related to safety.

It is intangible but nevertheless real." (Translation)

It will be recalled that during the first phase of the hearings Richard Lemay, a controller at St-Hubert, spoke of the decrease in stress that he had observed in the operations at that airport after both French and English were used for communicating with aircraft. Mr. McLeish was asked about this question during the present phase of the Inquiry:

"Q Now, insofar as air traffic controllers in the towers at these airports are concerned, have they, to your knowledge, been subject to more stress than which is normally associated with the performance of an air traffic controller?

A I have seen no evidence that they have any different attitude or reaction to controlling traffic in two languages than those who control in one language."

e) The assumption on which the objective of the simulation was pursued that "the existing air traffic control system in Canada provides an acceptable level of safety."

Because of the number of losses of separation identified during the simulation exercises some doubts were raised as to the validity of the assumption that "the existing air traffic control system in Canada provides an acceptable level of safety." While it was not claimed that the present system is unsafe, Mr. MacWilliam, for one, put it that if it were found there were as many losses of separation in the real world he would certainly ask questions.

Those who attack the validity of the simulation exercises urge that if the assumption as to the safety of the existing system is invalid, a study based on such an assumption would be vitiated. It has, however, been insisted upon throughout the hearings by the designers of the simulation programme that no such extrapolation of losses of separation could be made because that would result in the comparison of two things that bear no relation to each other.

The simulation exercises were not designed to make such comparisons. They were designed to measure differences between a unilingual and a bilingual condition. The results of the programme were to be expressed in terms of differences, not in terms of absolute numbers. A comparison of differences between the two conditions in simulation, and of differences between the two conditions in the real world at the Montreal Centre, would be valid.

However, such a comparison cannot be made because differences between the two conditions in the real world cannot be determined since only one condition - unilingual English - exists at present.

While the differences between the two conditions in simulation can be predicted for the real world, a comparison of absolute numbers obtained in the simulation exercises with absolute numbers in the real world would have no value.

These concepts were perhaps best described by Dr. Frigon:

"Q Could you please give your opinion to the Commissioners as to whether or how, as the case may be, one can transfer the results obtained from the simulation centre to the real world?

A Yes, I believe that the simulation experiments should not be taken for what they are not.

These are not situations where one tries to assess what happens exactly in the real world as it exists today.

The simulation experiment is an experiment, as such, an experiment that was set up in order to check the effect of independent variables on dependent variables; in order to assess then the effect of the language factor on the variable that are being measured, including the variable losses of separation.

So, the comparison between the conditions that were reproduced in the simulation centre should not be taken for exact measures, in absolute terms of what takes place in the real world.

If we had tried to measure what happens in the real world we would have found technical means, we would have used technicians to do so in the field; and a simulation experiment is valid in terms of a comparison between independent and dependent variables and between the differences.

But not as a measure in absolute terms of what happens in the real world.

Q If I can summarize you then:

The simulation experiment is aimed at comparing different aspects of air traffic control under two distinct conditions: one unilingual, the other bilingual?

A Exactly.

Q And you indicated during your testimony that the various variables studied in the experiment made it possible to draw comparisons between one and the other condition because they were all collected under similar conditions?

A Exactly, yes. We have the same situation under both conditions, so we can compare the two.

Q When we try to transfer the data to the real world, then you say that we must have reservations?

A Yes, we have to be cautious. We have to know what we - what exactly we want to transfer.

Q Then, when as we see occasionally in the report, in some chapters where there are generalizations, or extrapolations of the simulation results to the real world, I am speaking of this simulation that we have all lived, do you believe that this is an attempt to generalize from the unilingual condition to the real world?

A To the unilingual condition in the real world?

Q Yes?

A No.

Q Why?

A That is not what the experiment has been set up for."
(Translation)

As for the differences, however, which were observed in the simulations, according to Dr. Frigon they can be extrapolated to the real world because it is to such an objective that the exercise was directed:

"A Well, if no differences are observed during the simulation experiment between losses of separation under bilingual or unilingual conditions, if there are no losses of separation or no differences, rather, then we can say that in real world conditions there would be no differences either.

Q But the number of losses of separation observed does not make it possible to determine in absolute terms the number of losses of separation in the real world?

A No, not at all.

The generalizations are always done in relative terms and we cannot generalize in absolute terms.

The evaluation methods are different and they are - there are fundamental differences."

The Commission is in any event of the view that the assumption upon which the tests are based has not been disproven.

The words of Captain Richardson in his oral argument to the Commission at the conclusion of the first phase of the hearings will be recalled:

"However, that type of approach (Captain Richardson then refers to research and study processes) to the problems in our industry has produced the safest mode of transportation in the world. As a matter of fact, we have seen from expert witnesses that the transportation in our industry is so safe, so unbelievably safe, that statistically we cannot quantify for a statistical base accidents or incidents, they are so few."

The words of Captain Richardson were echoed by Mr. Gravenor in his argument on behalf of CATCA at the conclusion of the first hearings:

"Now, since safety is a relative thing, my Lords, and since we have up until now bar none the safest air traffic control system in the world, we have a difficult yardstick to live up to and we also have a barometer by which we can measure any changes that are proposed."

The only real world measure or "yardstick" that exists is the number of accidents or incidents. As pointed out by counsel for the Department of Transport in his written argument there is no evidence any ATS related accidents have occurred during the two years that have elapsed since the first hearings were held. The evidence discloses that there has been no increase in the number of incidents investigated by Fact-Finding Boards in Quebec.

The Air Transport Association of Canada (ATAC) did not appear to consider the system less safe than had been assumed to be the case when, in its final comments to the Commission dated April 30, 1979, it wrote:

"We are confident that its (The Commission's) subsequent recommendations to the Minister will reflect an ability to maintain and improve the level of safety that exists today, in Canada."

ATAC's letter concluded:

"In expressing our gratitude for the opportunity to participate, we wish to commend the sincere efforts of all parties, and to comment on the efficient manner in which the hearings were conducted. It is to the credit of the Commissioners, and to their capable and dedicated staff."

f) Language related errors

False starts and changes of language are types of communications errors peculiar to a bilingual system. As stated by Dr. Stager:

"Yes. We have said that that represents an additional source of error."

The written argument of CALPA draws attention to statistics in the BICSS Report which show that for the enroute and terminal phases of the simulation exercises approximately 8% more errors were committed on bilingual days than on English days, and that some 12% of the errors committed on the bilingual days were due to language use. It is CALPA's position that an equivalent level of safety cannot be maintained in a system which adds a new source of error.

The BICSS Report notes that the false start and change of language are categories of communications errors which have similarities to other errors present in the existing system. The Report characterizes changes of language as being more critical from the standpoint of safety than false starts. From an operational viewpoint, the false start, which is not unlike the false identification present in the existing system, is not of as much concern as a change in language since the transmission is immediately corrected by the controller. The change in language presents more of a problem because the interval between the initiation of a transmission and the establishment of two-way communication may be greater.

It is worthwhile at this point to refer to Exhibit 279, the Air Traffic Control Tower Tape Monitoring Report that was prepared for the Commission by its consultants, and which is described in Section 9.1. Comparisons are to be found in the report concerning the frequency of false starts and changes in language observed at the airports of Quebec City, St-Hubert, Geneva-Cointrin and Mexico City.

Two monitoring exercises were carried out at Quebec City, the first on October 28, 1977 when 324 operations were performed at the airport between 7:00 AM and 4:00 PM. Eighty percent of the communications between controller and pilot were conducted in French. On this occasion there were four false starts and eleven changes in language, amounting respectively to 0.10% and 0.28% of total communications.

A second study at Quebec City was undertaken on April 6, 1978, between 11:00 AM and 7:00 PM, at which time 464 operations were monitored. The statistics are:

<u>Operations</u>	No.	(%)	<u>Language used (%)</u>	
			<u>French</u>	<u>English</u>
Air carriers	- 38	(8%)	25	75
General aviation	- 406	(88%)	69	31
Military	- 20	(4%)	40	60

Ten false starts and 45 changes in languages, or 0.26% and 1.19% of total communications, were observed.

The study observes:

"Both controllers and pilots continually used alphabetic letters in call signs, rather than the phonetic alphabet. This leads to problems based on the differences between the French and English alphabet pronunciations."

A control tower tape from Geneva-Cointrin Airport covering 401 operations between 10:00 AM and 6:00 PM on April 9, 1978 was monitored. The relevant figures are:

<u>Operations</u>	No.	(%)	<u>Language used (%)</u>	
			<u>French</u>	<u>English</u>
Air carriers	- 185	(46%)	9	91
General aviation	- 216	(54%)	60	40

One false start and 24 language changes were observed, amounting to 0.03% and 0.82% of total communications.

The report refers to the use of the phonetic alphabet in these terms:

"The phonetic alphabet is consistently used by the controllers and pilots, which decreases the chance for errors that result from the varied pronunciation of letters in the English and French alphabets."

A tape from Mexico City International Airport was monitored. It covered 296 operations performed between 8:00 AM and 4:00 PM on March 26, 1978. The statistics are:

<u>Operations</u>	No.	(%)	<u>Language used (%)</u>	
			<u>Spanish</u>	<u>English</u>
Air carriers	- 120	(41%)	71	29
General aviation	- 169	(57%)	97	3
Military	- 7	(2%)	100	Nil

No false starts or changes in languages were observed.

Having due regard to the limitations involved in making comparisons of this kind of data, as noted in the report itself, it seems to the Commission that the monitoring carried out by its consultants underlines the need for procedures aimed at reducing the potential for communications errors related to language. In Section 8.3 of this Chapter it is pointed out that the phonetic alphabet is of little assistance in the identification of aircraft, such as those belonging to carriers, that do not have letters for call signs. As will have been noted, however, a substantial proportion of the operations conducted at the Geneva-Cointrin and Mexico City airports consists of movements made by general aviation. If rigorously and consistently applied, it would seem that the use of the phonetic alphabet as recommended in the BICSS Report will have a significant effect in reducing the potential for language induced communication problems with civil aircraft, which are expected to be the majority users of the French language in Quebec.

The BICSS Report says it is expected that the frequency of language related errors will diminish with experience. The associations point out, however, that the latest report on St-Hubert made by a Departmental review team on December 11 and 12, 1978 concludes that there are frequent controller language changes. The tower tapes for November 12, 1978 disclosed 22 language changes by controllers and five by pilots over a five hour period. Notwithstanding, the review team concluded that the controllers at St-Hubert were providing a safe and efficient service. The team recommended that attempts should be made to further reduce controller language changes. The Commission agrees with this recommendation since the evidence before it is clear that language changes could become disruptive if they occurred too often.

g) The lack of other evidence

In his oral argument on behalf of CALPA at the conclusion of the second phase of the hearings, Captain Daley said: "To our surprise, no evidence presented at this phase of the hearings added anything to the BICSS report."

Later, in its written argument, CALPA referred to "the very serious inherent danger in directing all essential consideration of the matter of the safety of the introduction of bilingual IFR air traffic control in the Province of Quebec to the simulation project and its results as contained in the BICSS report."

It must be said quite frankly that it is difficult for the Commission to follow this kind of reasoning, which, with great respect, seems to have overlooked the significance of a number of important studies undertaken for the Commission by its technical consultants since the Interim Report of the Commission was filed. The reports of those studies were entered as exhibits during the hearings and, of course, became part of the evidence. Although reference to the studies is made in various parts of this Report it will be convenient to list them here:

i) VFR/IFR Traffic Survey at airports in Mexico City, Mexico; Geneva, Switzerland; Minneapolis-St. Paul, Minnesota and San Diego, California. (Exhibit 275)

ii) Aircraft Accident Record Review. (Exhibit 276)

iii) Mirabel Traffic Analysis: January-September 1977 vs. January-September 1978. (Exhibit 277)

iv) Detailed On-site Investigation of Selected ATC Systems. (Exhibit 278)

v) Air Traffic Control Tower Tape Monitoring Report. (Exhibit 279)

Finally, it must be pointed out that a great deal of relevant evidence was presented to the Commission during the first phase of its hearings. The following observation in the Interim Report is pertinent:

"While the hearings were directed specifically to VFR flight operations, much of the evidence related to IFR operations since the two kinds of flight cannot usually be considered in isolation."

8.3 Criticisms relating to the procedures

In its written argument CALPA makes this observation:

"At the outset it should be made clear that the Canadian Air Line Pilots Association considers that the procedures developed by the Ministry of Transport, including those designed to compensate for the loss of redundancy, such as the holding patterns and merging target services, are unproven, untested and likely to be woefully inadequate."

CALPA complains that most of the procedures were totally unknown to the active participants in the simulation project until long after the tests were completed and the BICSS Report was being drafted. In CALPA's view, most of the procedures were an afterthought, were prepared in haste and are premature and untested. Their representative, Mr. MacWilliam, put it this way:

"Q. . . . Did you participate, as a member of the team - did you have a hand in the formulation of the procedures which we find in Volume 1?

A. No.

Q. Not at all?

A. No.

Q. Did you expect that you would be consulted as a member of the team?

A. Well, I think I would have expected, if procedures were to be developed, that applied to how a controller might do his job, that I probably wouldn't have been included in those procedures.

But I would have thought that if we were going to produce procedures which more directly applied to pilots, that yes, if those were the procedures we are talking about, I would have expected that I would have been included.

Q. So, your evidence is that you were apprised of these recommended procedures for the first time when the draft report was submitted to you, in October or November of 1978?

A. That's the first time I saw the actual procedures themselves, yes."

To put this issue in its proper perspective it will be worthwhile describing briefly the process by which a number of the procedures recommended in the BICSS Report came to be developed. Mr. Keitz, who was monitoring the tests on behalf of the Commission, said that the need for a procedure was usually identified by one of 20 to 25 persons who were observing a run, or during the debriefing that followed.

A Departmental ATC procedures specialist who was a member of the BICSS team during the tests would draft a procedure when such a need had been identified.

Mr. MacWilliam was a full-time member of the Operations Review Committee which, following the Phase I exercises, proposed a number of procedures to be found at page 301 and following of Working Document 1, prefaced by these remarks:

"SUPPLEMENTARY PROCEDURES FOR IFR CONTROL IN A BILINGUAL ENVIRONMENT

Review of the enroute simulation exercises indicates several specific areas where additional supplementary procedures may be required when providing ATC service using two languages.

As a result, in addition to normal MANOPS procedures, the attached supplementary procedures have been developed for use during subsequent simulation exercises. These procedures are limited to use for simulation exercises only and will be monitored for effectiveness as the BICSS study continues."

Mr. MacWilliam says, however, that he ". . . was not aware at any time of how those procedures were being put into the simulation program, how they were being tested or who was doing the testing, for that matter."

The procedures relating to the use of phonetics for civil aircraft, and to the exchanging of traffic with respect to the holding pattern and merging targets were not developed until after the simulation exercises had been completed.

Mr. Keitz said he felt the manner in which the evaluation of procedures had been carried out had been a weakness in the BICSS programme. He mentioned that it "would have been nice" had the procedures been evaluated in a more formal way.

It seems to the Commission that, for reasons which are obscure, there was an omission to make clearly known to those involved in the simulation exercises the method by which proposed procedures were being tested during Phases II, III and IV. More seriously, there appears to have been a failure on the part of the Departmental members of the BICSS team to consult with the CALPA representative concerning the procedures developed after the simulation, procedures which were directly related to safety in the air, and directly applicable to pilots. The Commission believes it deplorable that such a state of affairs should have occurred.

Before turning to consider the effect of these matters, it may be helpful to mention the methods by which rules and procedures are developed by the Air Traffic Services Branch of the Department of Transport.

As was explained generally in the historical background presented during the first phase of the Inquiry, at the inception of air traffic control in Canada the basis for many of the rules, procedures and separation minima was taken from the existing system in the United States. The practice of control service in that country over a number of years was viewed as empirical evidence of the acceptability of those rules, procedures and separation minima. Later, in the early 1960's, the first group of air traffic control specialists specifically charged with the development of rules basically followed the methods that had been in use since the 1940's.

A second method used for the evaluation of procedures is to submit them to a team of procedures specialists. Based on their training, experience and expertise, the specialists assess proposed changes to rules and procedures for their impact on safety and operational efficiency. The changes are then coordinated with other air traffic control experts and Air Administration branches interested in the proposal. Changes contemplated to existing separation minima, and the introduction of new minima, are processed by criteria specialists who apply a number of mathematical formulae to ascertain the acceptability of the proposal.

A new procedure may be subjected to a test in the real world environment. This third method is normally used to test the impact of the new procedure on controller workload or system efficiency. When this kind of testing is done the controller has the option of discontinuing its use when, in his judgment, safety may be compromised. This process may also be used by operations or procedures specialists monitoring a real world environment to evaluate the potential impact of a proposed procedure without actually requiring the controller to apply the procedure.

The fourth method employed is to submit a procedure to simulation testing. Simulation is normally used when operation and procedure specialists, relying on their experience and expertise, cannot judge the impact of the proposed procedure or when the complexity of procedure precludes accurate judgment. According to Mr. McLeish, when the simulation route is followed, there should be some period of time between the results of the simulation study and the actual implementation.

It will be appropriate to consider the procedures recommended in the BICSS Report in the light of this background.

During Phase I of the BICSS study, team members and observers identified a number of procedures required for the implementation of bilingual communications in IFR. A procedures specialist assigned to the BICSS team developed the procedures that were required, and they were then submitted to the Air Traffic Services Branch for acceptance. The procedures were, overall, found to be appropriate and were accepted for use in simulation. These supplementary procedures were then provided to the Operations Review Committee, and incorporated in their report.

The air traffic controllers who participated in the subsequent phases of the BICSS study were briefed on these procedures, and asked to apply them during the tests in order to monitor their effectiveness and adequacy. Subsequent to the completion of the last phase of the simulation, a procedures specialist, Mr. Simms, carried out an analysis and review of the supplementary procedures. His review revealed that the procedures adequately provided for the identified potential problem areas peculiar to IFR control in a bilingual environment. Mr. Simms' report was filed in evidence as Exhibit 301.

It will be convenient to deal first with the procedures tested during simulation. The data collected during those exercises of course reflects the use of such procedures.

The procedures providing for the relaying of clearances in the language of the pilot and for the use of phonetics for the identification of civil aircraft and of low frequency airways and air routes have been described by CATCA as having the effect of increasing safety in a bilingual environment. The proposal concerning clearance readbacks has met with the approval of CALPA, as has the plan to provide plasticized reference cards (or an OIDS display) of seldom used phraseology at the controller position.

Mr. Keitz was of the opinion that these kinds of procedures were obvious in that once the problems were identified, and means to handle them devised, no testing was really required although, in fact, that had been done in the simulation. For example, once it had been determined that a means to identify the language used by an aircraft would help a controller to remember that language, and thus to avoid false starts or language changes, in Mr. Keitz' view the use of a yellow marker to identify an aircraft whose pilot was using the French language was acceptable, as was the procedure by which the marked strip would be replaced when the language was changed to English. Similarly, there would be no need, according to Mr. Keitz, to test a procedure requiring a controller wishing to relay a message to one pilot through another to ask the latter if he or she is capable of initiating a call in both languages.

Let us now turn to consider the three procedures whose need was identified after the last phase of simulation:

1. Use of phonetics for civil aircraft.
2. Exchange of traffic in the holding pattern.
3. Exchange of traffic for merging targets.

Although not tested in simulation, the procedures were accepted by the ATS Branch and considered adequate. Two of the procedures were subjected to further analysis.

Dealing first with the procedure relating to the use of phonetics in the identification of aircraft, the value of such a practice has of course long been recognized. However, the use of phonetics in Canada has fallen off. And as Mr. Proulx said when being cross-examined by Mr. Fleury, the practice was certainly not rigorously respected during the simulation exercises.

The procedure was tested in the real-world environment at the Halifax and Sept-Iles control towers. The tests were successful. The implementation of the procedure was planned for April 1, 1979. It must be recognized that the use of phonetics in the identification of aircraft will only apply to aircraft that have letters for call signs. Most airlines use numbers rather than letters so the practice will not be effective so far as concerns their aircraft. However, the witnesses who dealt with the subject of phonetics were unanimous that the procedure would be helpful, at least to some extent.

The procedure that would require a controller to exchange traffic information with pilots of aircraft in a holding pattern, and using different languages, in order to restore the information normally available through the party line aspect of the listening watch, was subjected to the the second type of evaluation described above - an evaluation by procedures specialists. The procedure was accepted by the ATS Branch, which was of the opinion that the provision of such information would not involve a noticeable increase in workload. The Branch reported that whenever aircraft are stacked, the information is passed anyway, and that no special training or introduction was necessary.

Mr. MacWilliam said that holding "is not a terribly common occurrence nowadays." The Toronto controller, Eric St. Denis, confirmed that it was the practice to pass such information, if only on a time permitting basis. Pierre Beaudry, the controller from Quebec City, testified to the same effect.

Mr. Beaudry was of the opinion that the procedure is relevant, and would benefit the entire system by ensuring that pilots in a holding pattern receive more traffic information directly from a controller than they would by relying upon the party line feature of the listening watch. On the other hand, Mr. MacWilliam expressed the view that the procedure would not restore the total information available to the pilot in a unilingual environment because the pilot would lose a portion of the party line capability in the bilingual condition. He said the proposal might compensate in normal circumstances, but would not do so where one or more persons were making mistakes.

John Keitz believed the bilingual situation in the simulator had been the spark that identified the need for a holding pattern procedure which was just as necessary in the unilingual condition.

The third procedure not tested in simulation is the merging target service. This proposal was evaluated by using the third of the methods mentioned earlier, that is to say, by testing in the real world. The tests were carried out in Montreal and Toronto.

Nearly 85 hours of observations were carried out in the Montreal Area Control Centre between January 4 and January 10, 1979. It was found that traffic information was provided to pilots in approximately 80% of merging situations. All traffic exchanges were performed voluntarily and without prompting by observers. This is apparently normal practice, particularly when flight conditions are known to permit traffic sighting. The traffic was exchanged so as to assist pilots in spotting the respective traffic, but in a manner which would not permit provision of approved horizontal separation. At the traffic levels experienced during the survey the provision of the merging traffic information did not detract from other essential duties required to be performed by the controllers.

The study group that conducted the survey was composed of three procedures specialists and an operations specialist. They were of the opinion that the implementation of a "traffic exchange" service similar to that which is now voluntarily provided would result in no significant additional workload. While radiotelephone workload in the enroute sectors would not increase significantly, that of the terminal sectors could increase during heavy traffic periods, particularly in the arrival position, to the point where it would interfere with essential control duties. The group reported that pilot reaction to the proposed service could not be deduced from observation of the current operation.

The following were among the recommendations made by the Montreal study group:

- "4.1 The decision to implement a Merging Radar Target Service throughout the ATS system should not be based on observations of Montreal ACC alone. Detailed discussions with other Regions and the users are necessary to examine and clarify the need for the service, the means of provision and the operational/procedural implications.
- 4.2 Provision of the service should not be made mandatory in Montreal Terminal Airspace at this time."

As previously mentioned, the merging target service was not discussed with the controllers operating at Quebec City. The subject was, however, dealt with by Pierre Beaudry, the Quebec City controller, in the course of his testimony.

As explained during the hearings, the merging traffic service would only apply to radar-identified IFR traffic. The service would be mandatory everywhere in the radar environment, including the terminal. The service, as such, would not apply between VFR and IFR targets in the mix. That is not to say, however, that no traffic information would be provided for the sequencing of IFR and VFR traffic on the final approach course, because, as explained by Mr. Proulx, that kind of information is the very basis of airport control.

Mr. Fudakowski said that because a controller's primary function is to separate aircraft, and since the provision of the merging target service is to be mandatory, on occasion it might be necessary to restrict the flow of traffic so that safe, orderly and expeditious air traffic control services could be maintained. Mr. Proulx added that in some instances there might be a short period of time when the controller might not be able to provide the merging traffic information until the traffic flow was reduced.

It was estimated that the merging target service could result in a 10%-15% increase in the kind of transmissions already involved in providing this type of information. As has been mentioned, the Montreal survey carried out in January, 1979 reported that the radiotelephone workload in the terminal sectors, particularly at the arrival position, could increase during heavy traffic periods to the point where it interfered with essential control duties. The Commission's attention was also drawn to the Montreal Area Bilingual Air/Ground Communications Study where one of the problems identified was that of frequent congestion on the Airport Control frequency at Dorval, a consequence of which was that "Essential traffic information cannot be effectively provided between conflicting traffic due to congested frequency and workload." It is, however, clear that the recommendations contained in 22.4.2 in Volume I of the BICSS Report, which deal with frequency congestion, are addressed to this problem.

Mr. MacWilliam said that if the merging target service were religiously applied it would help restore some of the benefits of the party line element of the listening watch which he feels will be lost if two languages are used. On the other hand Mr. Beaudry expressed the view that, without wishing to split hairs, the listening watch is of no value in merging target situations. He supported his opinion by explaining that, as far as he knew, reports made by pilots of infractions are always based on the pilot seeing a loss of separation, not in picking up its position on the radio. Mr. Beaudry considered that the mandatory exchange of traffic would provide pilots with more information about other aircraft than is presently available to them.

Some of the parties took exception to the statement in the BICSS Report that the effect of the procedures for the mandatory exchange of traffic information would be "to restore the information normally available through the listening watch." That observation is correct since, strictly

speaking, the procedures would not restore the opportunity to detect, by the use of the party line, an error made by others. It seems clear that what is meant by the statement in the Report is that, in a bilingual environment, the procedures will provide pilots directly with information concerning the presence of other aircraft that, in a unilingual environment, would only be available to them through listening in on other transmissions on the frequency. If one accepts Mr. Beaudry's account, pilots in merging target situations will in fact be provided with more such information.

CALPA and CATCA are of the view that these procedures concerning the exchange of traffic information should have been tested in simulation since it is possible to examine them in this way.

Dr. Stager is of a contrary opinion. He said this:

"... Research on these specific questions would not have been warranted given the information that we would be able to obtain.

Q Given the information that was obtained which was that there was no significant differences between the results which were found in the English only condition, and the results which were found in the bilingual condition?

A Yes."

Despite his initial concern, Mr. Keitz believes that, based on the evidence presented at the hearings, the manner in which the evaluation of the procedure was in fact carried out did not adversely affect the overall validity of the simulation experiments. He would, moreover, prefer to test the procedures requiring the exchange of traffic in the real world since he considers that a more practical way to evaluate their effect.

There was an additional criticism that the procedures recommended for exchanging traffic were restricted to the cases of merging targets and holding patterns. Since they did not cover other areas such as, for example, the VFR/IFR mix, it was said that before bilingual IFR was implemented procedures covering these other areas should be developed and certified. It would seem to the Commission that this situation is meant to be taken care of by NOTAM 5/76 which provides that "... traffic information essential to each pilot will be provided as required in the appropriate language. In addition, air traffic controllers and aeradio operators will provide traffic information on request from pilots." The NOTAM is directed to all areas, and the merging target and holding pattern services merely add specifics to the general direction.

Before leaving the subject it is worth noting once more that in none of the locations in various parts of the world where the Commission's consultants conducted detailed on-site investigations of ATC systems did they find special procedures were required to accommodate the provision of air traffic control in more than one language. As mentioned in Chapter 7 of this Report, by "special procedures" the consultants have in mind "... written instructions to controllers or pilots contained in manuals or other official air traffic control documents, which instructions have been designed to insure that controllers or pilots will follow certain procedures because of the fact that the ATC system is bilingual rather than unilingual, for example, special separation minima or requirements for exchange of traffic."

Finally, so far as concerns criticisms directed at procedures relating to the possibility of a unilingual French-speaking pilot straying into English-only airspace, this subject will be dealt with in Section 3 of Chapter 8.

Section 9. MONITORING

9.1 Monitoring carried out by Commission consultants.

Detailed monitoring of control tower tapes at two bilingual foreign airports was conducted by the Commission's consultants so as to provide a means of evaluating similar data obtained from the Quebec City and St-Hubert airports. Since this project was carried out before the receipt by the Commission of the BICSS Report, the monitoring data would also assist in the evaluation of that report. The tapes monitored were those of tower control positions that cover arrival and departure movements. The report of the consultants was filed as Exhibit 279.

The airports of Geneva-Cointrin and Mexico City International were selected because they provided a volume of traffic and traffic mix that could be usefully compared to airports in Quebec, including Dorval. In addition, San Diego-Lindbergh Field and Minneapolis-St. Paul-Wold Chamberlain Field were examined as being unilingual airports where traffic flows were sufficiently similar to those prevailing at Dorval that an analysis of the types of communications at those two airports would be of use in considering the statistical data obtained from all sources. Obviously, occurrences peculiar to bilingual air traffic communications would not be applicable to the two American airports. However, certain common types of communication occurrences could be identified, and these were addressed in the appropriate part of the study. Descriptions of all the airports involved may be found in the exhibit.

An analysis of the control tower tapes revealed a number of categories of repeating communications occurrences, statistics for which are set out in respect of each airport examined. A description of the occurrences involved is provided in the exhibit in transcript form. While the categories of occurrences used by the consultants are not identical to those used in the BICSS Report, the same kinds of communications occurrences, or errors, were observed by the Commission's advisers in their monitoring of the airport tapes as were identified during the simulation exercises. It is clear that all such occurrences, other than those pertaining to false starts and changes in language, take place in unilingual systems as well.

The report of the consultants makes these observations:

"The several measures of communications occurrences at Quebec City and St. Hubert are comparable to those studied at the other airports examined all of which are similar in size and number of operations.

The level of occurrences shown for each airport is not necessarily typical for that airport because the sample size represented the performance of a small number of controllers relative to the number that routinely participate in the system's operation. This qualification is not important to the observations regarding similarity of occurrences, inasmuch as our interest was essentially to see if these occurrences are typical of all airport traffic control operations."

9.2 Monitoring conducted by Department of Transport

At the beginning of Phase II a review of tapes from several airports in Canada, the United States and Europe was carried out by the Department. A little later a number of flights were made on behalf of the Department in the regions of Montreal, St-Hubert, Quebec City and Mirabel.

The primary purpose of the monitoring was to see if the type of data being produced in the simulation exercises in fact occurred in the real world. It was found that, in general, all categories of communications problems occur in varying degrees in the real world.

A secondary object of the monitoring carried out by the Department was to compare the rates in each category of communications error found in the simulation exercises with those occurring in operating facilities. The BICSS Report deals with a comparison that was made involving the arrival sequencer and departure positions of the Montreal terminal sector, and the Granby/Sherbrooke enroute radar sector.

The Commission's attention was drawn to the difficulty of comparing rates obtained from the simulation exercises with those of the real world. Several reasons were mentioned: the number of hours involved in the samples, disparities in traffic levels and a significant variation in the number of controllers - an important element in view of the impact of the differences in performance from one controller to another.

Dr. Stager stated that the comparison data obtained through the monitoring was one of the indexes that enabled him to say:

"yes, I think that the simulation data that we are getting is comparable to the real world and that we would be safe in extrapolating conclusions from the simulations to the real world setting."

Q And that it is from there, then, that you go on to assume that the procedures that were developed in simulation would equally be applicable to real world, is that it?

A Yes."

Section 10. CONCLUSIONS

No one has questioned the professionalism and the seriousness which marked the conduct of the simulation study.

In a statement concerning the BICSS Report which it forwarded to the Department CATCA said:

"The report itself is very exhaustive and detailed, and, except for the specific criticisms listed below, the Project Team is to be congratulated for the professional manner in which the studies were conducted and the report presented."

The following is taken from the comments of l'Association des Gens de l'Air du Québec addressed to the Minister of Transport:

"We must point out the interest and fascination we have felt in reading, analyzing and dissecting this document. We wish also to emphasize the admiration, at times amazement, created by the exhaustiveness and relevance of the study. Generally speaking, we note initiative and dedication of the most professional kind, whether in organizing and carrying out the different experiments or in extracting, compiling and analyzing the results." (Translation)

And further:

"We wish to express our satisfaction with the report as a whole, and to thank the team for the immense task accomplished." (Translation)

Dr. Jean-Yves Frigon, who specializes in experimental psychology, is particularly interested in experimental methodology, statistical analysis and research methodology. As has already been pointed out, he attended a number of the simulation exercises as an observer on behalf of the Commission. He studied the experimental design, the statistical analyses and the BICSS Report. Except for a day or two he attended the entire second phase of the hearings. In particular he was present during the whole of the testimony given by Dr. Stager, and by Messrs. Proulx, Walsh and Fudakowski.

Dr. Frigon was of the view that Dr. Stager had done a thoroughly competent and professional job in designing the simulation programme. The Commission's adviser thought the choice which had been made of a repeated-measures design (in which the performance of a controller in one language condition would be compared against his performance in the other) was particularly wise. The selection of this kind of design required the counterbalancing of conditions, a step that was well done since Dr. Frigon is convinced no errors were made in the counterbalancing such that the results would be affected one way or the other. He said that the methodology used for the statistical analysis is well known. The important thing was to select the appropriate model, which was in fact done. In Dr. Frigon's opinion the various analyses of the results done by Dr. Stager are valid.

Before reaching this conclusion, however, Dr. Frigon had been concerned about two areas of the simulation studies. He had, first of all, felt uneasy about the order interactions - the order in which the exercises were conducted. The fact, for instance, that the English-only days were done before the bilingual days could bring results which would not necessarily be the same as if the order had been reversed. Dr. Frigon therefore

examined Dr. Stager's work sheets and graphs dealing with this aspect of the studies, and which were not reproduced in the BICSS Report. He satisfied himself that the differences were not such as to justify a different type of analysis, which Dr. Frigon concluded would give the same overall results.

Dr. Frigon's second concern about the simulation exercises related to the Terminal phase, where each day was divided into six intervals. The data was analyzed by position and by interval, the subject controller changing positions as the exercise progressed. The type of analysis used by Dr. Stager was that designed for cross-factors, whereas it was Dr. Frigon's view that it would have been more appropriate to employ the hidden factors method. Once again Dr. Frigon reviewed Dr. Stager's working papers and graphs in depth. The Commission's adviser came to the conclusion that while he would himself have chosen the hidden factors type of analysis, the results would have been the same.

Dr. Frigon said that if one takes an objective look at the simulation experiment organized by the Department of Transport it must be recognized that it was a very large and complex undertaking. Having regard to the whole of the work that was accomplished, and despite several hurdles along the way, Dr. Frigon said it must be acknowledged that the team had accomplished a tremendous piece of work in bringing the project to a conclusion.

In an experimental simulation study the proper choice of what are known as dependent variables is fundamental. In the context of the tests carried out in Hull the dependent variables included such factors as the delay by a controller in responding to a call, false starts, changes in language and mid-sentence corrections, to mention but a few. Dr. Frigon testified that had he designed the programme he would have chosen the same variables.

Finally, Dr. Frigon explained that because the experiment had demonstrated there were no significant differences in the number of losses of separation, he had come to the conclusion that a bilingual air traffic control system would be as safe as a unilingual one.

John Keitz, a member of the Commission's team of technical advisers, was asked for his views about the simulation studies. He had been selected to monitor the simulation exercises because of his extensive experience in the use of computers for flight planning, and for his familiarity with air traffic control procedures on a global basis. His role as the Commission's principal observer at Hull is described in some detail in Section 4.7. Except for five days when he was replaced by Mr. Warskow, Mr. Keitz was present during all 54 days of the simulation exercises. To all intents and purposes he was in attendance throughout the second phase of the hearings. He was familiar with the BICSS Report.

Mr. Keitz considered that the simulation exercises were at all times conducted in a very professional manner. In his view the associations had had the opportunity to participate in the experiment to whatever extent they desired. He believed the BICSS Report accurately depicts the tests which were conducted in Hull. He qualified as minor some anomalies that occurred at times during the runs, but which in his view had no impact on the overall results:

"I think we have heard mention of the periods of time, maybe that a sector was closed, a low sector in a terminal might have been closed for ten minutes at the end of a run.

There were days when, maybe a particular back room pilot was especially bad in his performance, and there were some fear that these type of anomalies might alter that day's data, or partially corrupt the results, and I was somewhat concerned on my first reading of the report, that all of these were not thoroughly explained, but I think we have had subsequent testimony by the panel here that has satisfied me that there was no, no impact on the overall results of the experiment by these particular anomalies."

According to Mr. Keitz there had been two shortcomings or weaknesses in the study. One was the way in which the evaluation of the procedures was handled, with many opportunities of testing during the simulation being missed. The second was the manner in which losses of separation had been evaluated. Mention has already been made of both these points. Mr. Keitz testified that evidence presented to the Commission during the hearings convinced him neither point had adversely affected the experiments, whose overall validity he accepted.

Those, then, are the opinions of the Commission's principal consultants.

It is fair to say that, in general, similar views were expressed by Walter McLeish, Administrator, Canadian Air Transportation Administration, and by Dr. Stager, Mr. Proulx, Mr. Fudakowski and Mr. Walsh, who were, of course, very much involved in the simulation study, and in the preparation of the BICSS Report.

As earlier discussed, many points were advanced, and criticisms made, concerning the simulation tests through the cross-examination of witnesses, and in the testimony of Mr. MacWilliam, Mr. Beach and Mr. St. Denis. There was, however, no evidence to the effect that the rules of experimental psychology had not been properly applied, that the methodology and technical approach were inappropriate, or that improper techniques of analysis had been used.

In the result, the BICSS Report concludes that there are no significant differences between a unilingual and a bilingual communication system such as would have an impact on safety, operational efficiency or implementation costs. In particular, the Report considers that no detrimental impact on safety will result, and indeed that some improvements in system safety may be achieved if the recommended procedures are implemented and rigorously applied.

Chapter 6

LANGUAGE USE AND AVIATION ACCIDENTS

Section 1. SITUATION THROUGHOUT THE WORLD

1.1 Findings of the Interim Report

In December, 1976 the Commission directed its consultants to examine the records of flying accidents that had happened throughout the world in the past 20 years. The Commission wanted to find out from official sources how many accidents during that period had been caused by the use of two or more languages in air traffic control throughout the world.

The study was made, and the results presented to the Commission in March, 1977 by way of a document entitled "Status Report on Accident Analysis", filed in the first phase of the hearings as Exhibit 167. The findings of this study were dealt with in Chapter 8 of the Interim Report. The conclusions of the Commission at that time were:

"The Commission's experts have examined the records pertaining to every accident that has happened anywhere in the world during the past 20 years, and which involved a plane belonging to a commercial airline, or a heavy or medium-weight aircraft owned by another type of civil operator.

These accidents are included among a total of 17,635 reviewed by the experts.

In only one case - that in Brazil in 1960 - does an official report suggest that the use of two languages for air traffic control could have had anything to do with the accident, and this report states specifically that the language problem did 'not attain the status of immediate causes(s) of the accident.'

If one stops to think of the number of flights that must have been made, and of the miles flown, and passengers carried, during the past 20 years in 83 countries throughout the world where air traffic control services are provided in two or more languages, one is left with an abiding conviction that there is nothing inherently dangerous in bilingual air traffic control."

1.2 Studies made since Interim Report

The Commission asked its consultants to continue to review accident report services for data in several categories:

Additional information or documentation on the original 33 occurrences which the consultants thought might possibly be relevant to the study.

More comprehensive world wide data on general aviation accidents.

More comprehensive data on incidents which did not result in accidents.

Accidents that had occurred since March, 1977.

This work was undertaken by the consultants, and their findings, dated January, 1979, were filed as Exhibit 276 during the second phase of the hearings in a report entitled "Aircraft Accident Record Review." A further exhibit, 347, provides additional information.

In preparing their original study, Exhibit 167, the consultants had reviewed reports on 17,635 aircraft accidents that happened throughout the world between 1956 and 1977. Since then an additional 7,590 occurrences have been reviewed, for a total of 25,225. While the possibility of some duplication exists, the consultants are satisfied that, for the most part, the 25,225 figure represents unduplicated accident reports.

The consultants are certain they have examined reports of all accidents involving air carrier type aircraft. They have also examined reports concerning general aviation accidents, but it is unlikely that any source or combination of sources are sufficiently comprehensive for the consultants to say confidently that all worldwide general aviation (1) accidents have been examined. Most of the reports of general aviation accidents that were reviewed were from sources in Canada, the United States, and the United Kingdom, and largely involved accidents to aircraft registered in those countries.

The aim of the accident review was to identify those accidents or incidents in which language or language related factors had caused, or could have caused, the accident or contributed to it. Four categories of language related factors in accidents were used by the consultants:

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- (1) General Aviation: in broad terms, civil aviation other than air carriers and large commercial operators.

Language Difficulties: Accidents influenced by the fact that more than one language was being used for ATC purposes at the time of the accident or where imperfect communication was achieved because one or more parties was using a foreign language which he did not comprehend fully.

Misunderstanding: Difficulties in understanding even when all parties were fluent in, and using, the same language.

Phraseology: Misunderstandings that resulted from improper or non-standard phraseology.

Redundancy (1): The occurrence of an accident which was influenced by a pilot's taking some action, or failing to take some action as a result of his overhearing transmissions, or failure to overhear transmissions, to other aircraft. This category does not include accidents that happened due to controller or pilot error, but where it was impossible to hear the erroneous communication because different frequencies were being used.

The Commission made the following observation in the Interim Report:

"A careful look at the first category, 'language difficulties', shows that it really contains two sub-categories, and that two kinds of language difficulties were considered. Firstly, the experts were looking for accidents influenced by the fact that more than one language was being used for air traffic control purposes at the time of an accident. Secondly, they were searching for accidents involving imperfect communication because one or more parties was using a language he did not understand. As the Commission is inquiring into the safety of bilingual air traffic services - that is to say, into the safety of the use of two languages for air traffic control purposes - the first of the sub-categories is particularly relevant."

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- (1) In their recent report the consultants made the following observation: "Although the definition still is quite appropriate, the word 'redundancy' has been commonly and frequently replaced by 'party line communications monitoring'. Since redundancy and redundant communications have other, more general meanings, the latter phrase is more suitable to the factor defined above and 'party line' or 'party line communications' will be used in this report where 'redundancy' was used in the past."

In discussing the criteria used by them in deciding in which of the four categories of "language related factors" an accident should be placed, the consultants said this in Exhibit 167:

"One feature of all accidents reviewed which must be noted is that a series of causal effects were involved. In those accidents in which language related factors were identified, some other factors have been identified by the reports as the principal cause of the accident and the language related factor is only listed as a contributing factor."

There was considerable discussion during the hearings concerning the causes of accidents, and whether one should look for a "single identifiable cause", a "primary cause" or a series of causes or factors which contributed to the occurrence. In the United States, for instance, it appears the regulatory authorities require a single accident cause to be identified, with other factors listed as contributing factors. In Canada, on the other hand, a different procedure is followed in that a single cause for an accident need not be identified.

For the purposes of the study made by the consultants of accidents on a world wide basis, it does not seem to the Commission to make much difference which system was used. The consultants were well aware of the theories involved. They consulted the recognized data sources. As they pointed out in Exhibit 167, these sources "were searched for accidents in which language or language related factors were, or could have been, causes or contributing factors in the accident."

Of the 17,635 accidents reviewed in the first report of the consultants, 33 were found or assumed by them to have been influenced by one of the four language factors just described. However, in only 22 (1) of the 33 cases was sufficient detail available at that time for the consultants to be able to confirm that a language related factor was involved. While five of those accidents were identified as falling within the category of "language difficulties", the Commission found that in only one of the five cases was it clear the accident had taken place in an environment where two languages were being used for air traffic control purposes.

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- (1) In their final study the consultants note that a full accident report now available to them discloses that one of the 22 accidents proved to be unrelated to language.

1.3 Results of subsequent studies

So far as concerns the 11 cases where insufficient detail was available in 1977 for the consultants to confirm they were language related, full accident reports or more complete information available since then revealed that seven were not relevant to the study. Final reports still have not yet been received for four of the 33 accidents mentioned in the Interim Report. One of the four concerns the collision that occurred in Zagreb, Yugoslavia on September 10, 1976, and of which mention is made in the Interim Report.

From the 7,590 accident reports reviewed by them since March, 1977 the consultants identified 12 additional accidents and one incident of potential interest to the Commission. Of these, three accidents and the incident proved subsequently to be unrelated to any of the four language factors. In the case of two other accidents, it seems unlikely that any such factor contributed to the accident.

It thus appears that during the period March 1977 to January 1979 the consultants identified seven accidents throughout the world in which language related factors were, or might have been, a factor or cause. Only one of these accidents was said to concern the category of "language difficulties." In that case a Saudi Arabian national was taking flight training at Daytona Beach, Florida on June 23, 1977. His plane left the runway surface. While the damage caused to his machine was relatively minor, a more serious collision with a B-727 landing behind was narrowly averted. The accident report indicated that the pilot apparently did not understand some of the controller's instructions. The transcription of the tower tape revealed that his command of English was not very good. Crash rescue personnel said the pilot communicated in "extremely broken English."

In the other six accidents involving language related factors "misunderstanding" was reported by the consultants to be a contributing factor. In two of these six accidents phraseology was found to be an additional factor. One of these two accidents - at Niagara Falls, New York on April 23, 1976 - occurred after dark when the pilot became disoriented and attempted to take off across, rather than along the runways. In their statements the controller claimed he could not easily understand the pilot due to his heavy accent while the pilot, a British citizen taking flight training in the United States, claimed he could not understand the controller due to his "poor pronunciation" and "faulty terminology."

The second of the two accidents in which, according to the consultants, the language related factors of "misunderstanding" and "phraseology" were both present, was that involving the loss of 572 lives which occurred at Tenerife, in the Canary Islands, on March 27, 1977, two days after the Commission's first series of hearings concluded. In its Interim Report

the Commission said it would "endeavour to obtain authoritative information as soon as possible with a view to ascertaining if language was a factor in this accident where the Spanish air traffic controllers, and the crews of the Dutch and American aircraft, were all reported to have been communicating in English."

The investigation of the Tenerife accident has been completed by the Spanish authorities, and the full report examined by the Commission's consultants. Their summary is as follows:

"The accident report indicates that this accident between the KLM B-747 which was on takeoff and the Pan Am B-747 which was taxiing on the runway was caused by certain improper actions on the part of the KLM captain. Two relevant contributing factors were listed. The report cited 'inadequate language' and the failure of the Pan Am Aircraft to exit from the runway at the point to which it had been cleared. All persons involved were speaking English. According to the definitions used in this report the contributing factor involved was improper phraseology. The accident report cites the use of the phrase, 'we are at takeoff' as being the reason for including 'inadequate language' as a contributing factor. The report cites the Pan Am aircraft's failure to exit at the correct point as a contributing factor and the transcripts of cockpit and tower recordings indicate that there was some misunderstanding among the crew members as to whether they were to leave the runway via the third intersection from their position, the third from the end, or the one marked 'C-3'."

It seems reasonably clear from the reports examined by the consultants since March, 1977, that in none of these cases was the accident influenced by the fact that more than one language was being used for ATC purposes although some of the reports were incomplete and lacking in sufficient detail.

1.4 Incident data sought by consultants

The Commission's consultants continued to search for more sources of incident (1) data so that the analysis would be more extensive. The results of their search is reported in these terms:

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- (1) An incident must be distinguished from an accident. An incident is an occurrence where a loss of separation takes place but an accident is fortunately avoided. A loss of separation occurs when the distance between two aircraft operating in the same airspace has become shorter than prescribed by regulations thus creating a safety hazard.

"It soon became quite clear that it would not be possible to find sources that would provide a comprehensive listing of incidents. An increase in the publication of incident reports was noted with 384 included in the last 6,100 occurrences that were reviewed but this could represent but a very small portion of all incidents.

Incident reports are sparse for several reasons. First, since an incident usually means that an accident was averted there is a tendency to breathe a sigh of relief and forget about it or there may be a fear of liability and punishment. This was the case in the Glendale, California PSA incident identified in the last section.

The pilot of the Cessna apparently had no intention of reporting the near miss until he noted that it was reported on the evening news. The National Aeronautics and Space Administration has suggested in a report on the Aviation Safety Reporting System that, based on analysis of some of the ASRS data, it is likely that only 10 percent of all incidents are reported.

A second reason for the low number of incident reports is the rather recent establishment of anonymous reporting systems. Systems such as ASRS, which provide for anonymous incident reports in the interest of safety, have been established only in the last few years and only in a very few countries. Prior to that time, and even now in Canada, one risked possible punitive action or the revocation of one's license if an incident was reported for which he was responsible.

For the purposes of this analysis there is a third problem with incident reports. Those that are reported, and approximately 150 incidents that appear to involve the language related factors have been reviewed, are frequently anonymous unverified reports such as those in the NASA ASRS reports. The aircraft, location, date of occurrence, or conditions surrounding the incident are not known and, therefore, it is difficult to verify that the language factor was present. It was therefore decided that they not be included in this report. (One of these, number 22, was included in the previous report before this decision was made.) One can only conclude that it is likely that incidents do occur that are the result of the language related factors but that it is not possible to quantify their impact on this accident/incident analysis."

1.5 Conclusion

The records relating to some 25,225 accidents that have happened throughout the world during the past 22 years have been examined by the Commission's consultants. The accidents reviewed include all those involving air carrier type aircraft but not all general aviation accidents.

As mentioned at the beginning of this chapter, in only one case - that in Brazil in 1960 - does an official report suggest that the use of two languages for air traffic control could have had anything to do with the accident, and that document, as pointed out in detail in the Interim Report, states specifically that the language problem did "not attain the status of immediate cause(s) of the accident."

In the final analysis, in the cold light of day, the safety of any method of transportation must be measured by the number of accidents it produces. There are 79 countries throughout the world where air traffic control services are provided in varying degrees in two or more languages. Recognizing that differences in conditions exist in various parts of the world, differences that include weather, terrain, density and mix of aircraft, quality of control services and the origin, destination and duration of flights, if one stops to think of the number of flights that must have been made in those countries, of the miles flown and passengers carried, of the take-offs and landings safely accomplished, one is left with an abiding conviction that there is nothing inherently dangerous in bilingual air traffic control, to restate the conclusion reached in the Interim Report.

Section 2. SITUATION IN QUEBEC

To the Commission's knowledge there has never been an accident in Quebec related to the use of the two official languages in Air Traffic Control.

So far as incidents are concerned, the reports of fact-finding boards established by the Department of Transport to investigate several incidents that occurred in Quebec in 1976, 1977 and 1978 were filed as exhibits during the second phase of the hearings. In four cases transmissions were being made in both English and French (Ex. 312, 336, 340, 342). The Commission has examined the reports of the Boards, and is satisfied that the use of two languages was not a factor contributing to the situation being investigated.

An internal company report filed by a pilot concerning a situation where French was being used between the tower and another aircraft was tendered as an exhibit, and accepted under reserve (Ex. 313). No fact-finding board was ever established. While it is impossible to determine the relevant facts from the pilot's report, his description of what took place does not, in the Commission's view, indicate that the French-language transmission was the reason for the problem encountered as the pilot was preparing to land his aircraft.