SUMMARY OF DISCUSSIONS

OF THE

THIRD MEETING OF THE NAT SYSTEMS PLANNING GROUP

(Paris, 17 - 28 April 1967)

PART I

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Note :- The Summary of Agenda Item 2 is contained in Part II of the Summary of Discussions of the Third Meeting of the NAT/SPG.

Introduction

1. The Third Meeting of the North Atlantic Systems Planning Group was held in the European Office of ICAO in Paris from 17 to 28 April 1967. On 17, 25 and 27 April the Group met in closed session to discuss parts of Agenda Item 5, Item 6 and a number of matters which were not included in the Agenda. During the remainder of the meeting all participants listed on page iv were present. Iceland and Portugal, which had also been invited to participate in the meeting, did not send representatives to the meeting.

2. Mr. G.E. Enright, the member designated by Ireland, acted as chairman of the meeting in accordance with the decision of the Group, taken at its Second Meeting. Two Sub-Committees were established, one to deal principally with Items 2 and 4 and the other with Item 3. Mr. Villiers from France was elected chairman of the sub-committee dealing with Items 2 and 4 while Mr. E.B. Powell from Canada was elected chairman of the sub-committee dealing with Item 3.

3. Mr P.G. Berger and Mr. A. Azzaoui, both from the European Office of ICAO, served as secretaries of the meeting. Mr. U. Schwarz participated in the discussions on Item 3 in order to provide MET advice.

A G E N D A

Item 1 : Progress Report on the Data Collection and Analysis Programme regarding navigational capability of aircraft in the NAT Region.

Item 2 : Vertical separation applied to aircraft operating above FL 290 in the NAT Region.

Item 3 : Review of the NAT Air Reporting Procedures.

Item 4 : Exchange of views on criteria for the assessment of system performance.

*Item 5 : Any other business.

*Item 6 : Election of Chairman of the next meeting (reference paragraph 8.2.1. of Summary of Second Meeting).

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*Reserved for consideration by members of the Group only unless decided otherwise by the Group for specific subjects brought up under Item 5.

LIST OF PARTICIPANTS

Note: Names marked with an asterisk are those of Members of the Group.

State or Organization	Name
CANADA	A.K. Beak A.L. Elliott K.J. Davis L.D. Nemesvary E.B. Powell *R.H. Smith E.B. Thompson
FRANCE	Y. Goetzinger J.A. Maigret *J.F. Sapin J. Villiers
IRELAND	*G.E. Enright P.J. Flanagan
KINGDOM OF THE NETHERLANDS	A. Pool *J. Ten Velden H.C. Vermeulen
UNITED KINGDOM	V.W. Attwooll *D.A. Blake B.K. Drew P.H. Hemming C. Hinkel V.C. Hunt B. Job K.I. Pearson P.J. Reich J.B. Robertson D. Wilkie
UNITED STATES OF AMERICA	R. Dressler J.R. Fleming *R.F. Huard A.B. Johnson A.J. Nixon S. Ratomsky J. Szymkowicz
I.A.N.C.	J. Archer C.H. Gullen J.J. Dimopouws A. Fleury W. Freeman M. Vermeulen R.H. Waldman
I.A.T.A.	L. Cook L. Enderlein E. Forsberg J. Glickman L. Lee J.B. Nairn P.G. Powell F.S. Tanner D.C. Wasson
I.F.A.L.P.A.	A. Carriou X. D'Artemare P.H. de Guerké H.V. Hart Y. Marchais W. Masland L. Mouton V. Nicolaieff H. Van Zandt

GENERAL MATTERS

1. Introduction

1.1 During the correspondence stage following the Second Meeting of the Group, and especially that part of it preceding this Meeting, a number of items had come up which were not included in the Agenda but on which the Group took action. In addition, the Group was provided with information of interest to more than one single item of the Agenda. A brief record of proceedings concerning these matters is given below.

2. Participation of EUROCONTROL in the Meeting

2.1 Prior to the Meeting, Mr. G.E. Enright, the designated chairman of the NAT/SPG, had received a letter from EUROCONTROL indicating their interest in the items on the agenda of the Group's third meeting and suggesting that they be invited to participate in this meeting. Mr. Enright informed the Group that he had notified EUROCONTROL that this question would have to be decided by the Group and he therefore requested that such a decision be taken.

2.2 After careful consideration of the matter, the Group came to the conclusion that there was a slight misunderstanding on the part of EUROCONTROL as to the work intended to be undertaken by the Group at this meeting and it therefore believed that it would not be of real benefit to EUROCONTROL if they participated in the meeting. It was therefore decided to send a telegramme, expressing these views to EUROCONTROL.

3. Reply to a query by Germany concerning Item 4 of the Summary of the Second Meeting

3.1 Following distribution of the Summary of Discussions of the Second Meeting of the Group to NAT States, the European Office of ICAO received a query from Germany regarding the prominence attributed to the "see and be seen" principle in the analysis of data expected to be obtained from the data collection programme and on the application of the mathematical model to other ICAO Regions. This query had been referred to the Group and a suggestion for a reply has been prepared for onward transmission to Germany via the ICAO Regional Office.

4. Presentation of studies made on vortices by Canada and the USA

4.1 As mentioned in para. 4.15.13.2 of the Summary of the Second Meeting of the NAT/SPG, the influence of vortices on lateral separation has been considered by the NAT/SPG. In view of this, the US Member of the Group made available a film and data on experiments conducted by the FAA in order to study the development of vortices created by aircraft and their effects on other aircraft. The Canadian Member also gave information on experiments which were conducted in Canada on the same subject. The Group was grateful for the information provided and the US Member stated that he would suggest to his Administration to establish contact with the Canadian authorities in order to agree on the joint and coordinated continuation of these studies, thus avoiding duplication of effort and expense.

1. Summary of Agenda Item 1 : Progress Report on the Data Collection and Analysis Programme regarding navigational capability of aircraft in the NAT Region.

1.1. General

1.1.1 At its second meeting, held in November/December 1966, the NAT/SPG had agreed to arrange for a data collection and analysis programme regarding navigational capability of aircraft in the NAT Region. It had also agreed on the organizational and technical details of this programme based on information available at that time.

1.1.2 In the meantime it had become apparent that, in the light of developments since the meeting, it would be necessary to make a number of amendments to this programme in order to ensure its success.

1.1.3 In fact, the Group found that the following aspects of the programme required amendment or refinement in order to eliminate possible sources of difficulties or ambiguities :

i) dates of the data collection programme;
ii) analysis of the flight log data;
iii) provision of ATC data and use of SSR in the programme;
iv) overall data flow;
v) aeronautical information publications and other publicity relative to the data collection programme;
vi) review of the method of analysis of the data collected.

1.1.4 The French member of the Group suggested, and this was accepted by the Group, that the data obtained during the programme could, with very little extra effort, also be used to obtain information on the longitudinal separation situation in the NAT Region. It was therefore agreed that the programme should be modified accordingly and that a method of analysis of this data should be developed.

1.1.5 It was also found that in view of the importance of the programme and because it was expected that there may still arise a number of problems requiring a speedy ad-hoc solution, it would be necessary to have a coordinator designated to whom such problems could be referred for resolution. It was therefore agreed that this coordinator should be the US Member of the Group, Mr. R.F. Huard.

1.1.6 As regards the provision of additional navigational facilities, the Group noted that Loran A chains "C" and "D" will operate 24 hours a day from 1 July to 31 December 1967, and that negotiations aimed at keeping these chains in continuous operation after this period would be needed. (Para 5.6. of the Summary of Discussions of the Second Meeting of the NAT/SPG refers.)

1.2 Review of dates of the data collection programme
(Appendices C and E of Item 6 to the Summary of Discussions of the Second Meeting of the NAT/SPG refer.)

1.2.1 The US Member informed the Group that, due to a number of unavoidable circumstances, delivery of the radar data recording equipment could only be effected at a date slightly later than that envisaged in Appendix E to Item 6 of the Summary of Discussions of the Second NAT/SPG Meeting. Because of this and because of experience to be accumulated with the prototype equipment, the final check-out of the radar data collection techniques at shore-based or ship-borne radar stations has been eliminated since it is no longer believed to be required.

1.2.2 As a result of this and of the latest traffic forecasts the following material changes to the programme, as described in Appendix E to Item 6 of the Summary of Discussions of the Second Meeting of the NAT/SPG should be made :

i) the sample period for Configuration C is extended from 21 to 23 days;

ii) in view of the increase of jet flights expected by summer 1967, combined with the extension of the sampling period, the yield in Configuration C is now estimated to be 4 600 flights (200/day x 23 days);

iii) with respect to Configuration D, the sampling period is also extended to 23 days;

iv) the sampling period of Configuration A is also extended to 23 days;

v) in respect of Configuration E it was noted that Gander radar would operate with automatic recording of data by about 21 July 1967. At Kilkee radar it is expected that manual recording of radar observations will commence on 1 July 1967; automatic recording of data will commence by about 29 August 1967. Consequently, both Gander and Kilkee will operate on an automatic recording basis from that date until 31 March 1968. A useful additional contribution, besides that made during Configurations A and C, should therefore be made to the data required for a study of longitudinal separation and for the across-track accuracy as required.

1.2.3 The table shown in Appendix A to the Summary of this Item presents, therefore, the revised schedule of radar data collection activities and related events. It supersedes in toto the tentative schedule previously presented on page 6-E-5 of the Summary of Discussions of the Second Meeting of the NAT/SPG.

1.2.4 As regards the flight log data collection, it was confirmed that it was necessary to provide for a certain overlap between this and the radar data collection, as a means of cross-checking flight log data with data derived from the radar sampling, in order to establish its validity. The agreed dates on which flight log data collection should be made are given in Appendix B to this Summary. In addition, this Appendix specifies the requirement for the retention of flight records for all flights conducted throughout the data collection programme.

1.3 Analysis of the flight log data
(Appendices D, G and H to Item 6 of the Summary of Discussions of the Second Meeting of the NAT/SPG refer.)

1.3.1 With regard to the recording, collection and analysis of flight log data and its forwarding for automatic processing, the Group found it necessary to review these in detail in order to obtain optimum uniformity in the presentation and evaluation of the flight log data. To this extent, it was felt necessary to up-date and amplify the material produced on this subject at the Second Meeting of the NAT/SPG and contained in the Summary on Item 6 of that meeting and Appendices D, G and H thereto.

1.3.2 The first item which thus required amendment was the subject of flight records which should be maintained for the data collection programme by all flights carried out during the duration of the programme. (Regarding their retention see Appendix B.) The revised requirements are shown in Appendix C to this summary.

1.3.3 The next item concerned the post-flight analysis form. A review of the form developed at the Second Meeting of the NAT/SPG (see Appendix G to Item 6 of the Summary of Discussions of the Second Meeting of the NAT/SPG) revealed that this required amendment. A revised form has, therefore, been prepared and is shown in Appendix D to this summary. In order to facilitate reference to this form in any correspondence made during the data collection programme, it was agreed that it should be referred to as "Form 1-D". In addition, a completed example of Form 1-D has been added in order to give an indication of the manner in which it should be completed.

1.3.4 As regards the composition of the analysis teams which have been recommended by the Second Meeting of the NAT/SPG (see para. 6.18 of the Summary of Discussions of the Second Meeting of the NAT/SPG) it was realized that the decision on how such teams will be composed will, of course, be the prerogative of the State concerned. Should guidance be required, it may be of use to mention that in the case of Canada it is expected that the team will consist of :

Two navigators employed by the Department of Transport

One representative from the Canadian Air Line Pilots' Association

One representative from the Canadian Air Line Navigators' Association

One, or more, representatives from a Canadian airline.

Accommodation and secretarial support will, in this case, be arranged by the Canadian Department of Transport and the team will do its work at Ottawa. In other cases, however, it might prove more desirable for the team to visit the airline concerned.

1.3.5 As regards the number of flight logs which should be examined by the analysis teams in order to ensure the validity of the evaluations made by the operators concerned when transferring such data on to Form 1-D, it was believed that this should be left to the discretion of States concerned. However, in order to arrive at a reasonably uniform figure it is suggested that not less than 10% of the flight logs should be checked.

1.3.6 As to the methods used for post-flight reconstruction, these have been revised and the amended version of them is shown in Appendix E to this summary.

1.3.7 The flow of forms from their initial distribution to States and operators to their collection for automatic processing after completion has also been reviewed in more detail and a diagram showing this has been prepared and is contained in Appendix F to this summary. The Group noted with appreciation that the Canadian Department of Transport had confirmed its willingness to print the required forms. It was also noted that Canada would prepare and distribute a number of Forms 1-D, completed in accordance with the example given in Appendix D-2 to this summary, in order to ensure that forms are correctly completed.

1.3.8 With regard to the number of forms required, the Group was provided with information provided by States to the ICAO Paris Office following distribution of the Summary of Discussions of the Second Meeting of the NAT/SPG. This information was up-dated by the Group where possible and the Paris Office was requested to approach States again on this subject, in the light of the changes made to the programme, in order to complete this information at the earliest possible time. Appendix G to this summary shows the present status.

1.4 Provision of ATC data and use of SSR

1.4.1 When reviewing the procedures for the provision of ATC data the Group felt that, at this stage, it was necessary to be more specific than was possible at the time of its second meeting. It therefore reviewed the material contained in Appendix A to Item 6 of the Summary of the Second Meeting of the Group and decided to replace it in toto by the attached Appendix H.

1.4.2 The same applied to the procedures for the use of SSR and the Code Assignment Plan and a revised procedure has been prepared and is shown in Appendix I to this summary.

1.4.3 A detailed examination revealed that the decision of the Group to use the data collection programme to also review the situation with regard to longitudinal separation in the NAT Region did not result in any additional requirements for ATC data beyond those already required by the initial programme.

1.5 Up-dating of the overall data flow

1.5.1 Based on information provided by the UK and the USA Members of the Group and because of the changes made to previous stages of the data collection programme, the Group found it necessary to modify the overall data flow as previously intended. The attached Appendix J shows the amended provisions which supersede those contained in Appendix I to Item 6 of the Summary of the Second Meeting of the NAT/SPG.

1.6 Aeronautical information publications and general publicity relative to the data collection programme

1.6.1 It was noted that during the course of the Second Meeting of the NAT/SPG limited consideration had been given to the question of prior notification of the data collection programme to all concerned. Particular attention had been drawn to the need for an Information Circular (para.6.15 and Appendix F, page 6-F-1, Summary of the Second Meeting of the NAT/SPG) but other means of dissemination had not been specifically considered.

1.6.2 It was agreed that, in order to achieve the active support and cooperation which was needed from all parties concerned it would be necessary to give further guidance in the matter of publicity. It was considered that this should cover the publication of information by national administrations and other agencies in order that the risk of any misinterpretation of the procedures would be minimised.

1.6.3 The FAA hoped to issue, by 1 July 1967, the publication intended for general aviation pilots operating non-routine flights across the North Atlantic (para 5.14, Summary of the Second Meeting of the NAT/SPG refers). Although this action was not specifically dependent upon the data collection programme it was recognized as being a useful step towards a more general adherence to the procedures promulgated for the NAT Region.

1.6.4 Immediately upon conclusion of the Third Meeting of the NAT/SPG the ICAO European Regional Office would provide all interested States and Organizations with the Summary on Item 1 of this Meeting, drawing their attention to the arrangements for the data collection programme. The ICAO letter to States and Organizations, supplemented by the Summary of Discussions on Item 1 and the Summary of Discussions of the Second Meeting of the Group would therefore constitute adequate background and reference documentation for all concerned. It was important to include Poland and the USSR in the distribution in view of their stated intentions to operate NAT flights.

1.6.5 About four weeks before the commencement of the data collection programme, Canada, France, Ireland, the Kingdom of the Netherlands, the UK and the USA would issue national Information Circulars notifying the general arrangements for the data collection and detailing the action required by aircraft operators and aircrews. The text of a draft Information Circular is included in Appendix K to this summary. This replaces the text shown in Appendix F of Item 6 of the Second Meeting of the NAT/SPG. It was hoped that the Icelandic and Portuguese authorities and other North Atlantic States would take similar action. It was believed, however, that in a few States it might be equally effective to approach those affected by the programme of data collection using normal correspondence methods.

1.6.6 In addition to notification by Information Circular, Canada, Ireland, the UK and the USA also agreed to promulgate information by Class II NOTAM similar in terms to those included in the Information Circular. A draft NOTAM is included in Appendix L to this summary. It was hoped that Iceland and Portugal would take similar action. The benefits of NOTAM circulation are :

i) The methods of promulgation by NOTAM are widely standardised.

ii) Prior to the commencement of a NAT flight, aircrews can normally be briefed on the contents of relevant NOTAMs.

1.6.7 In order to ensure widest possible publicity, AIS offices should be informed of the importance of the data collection programme and they should be instructed to display the related NOTAM information prominently.

1.6.8 To supplement the foregoing measures action would be taken by IANC, IATA and IFALPA to use the channels of communication available to them to alert aircrews to the data collection procedures. IFALPA indicated that, immediately after the Third Meeting of the NAT/SPG, they would circulate preliminary information, by news letter, to all member associations. About six weeks before the commencement of the data collection IFALPA would make a determined attempt to address all pilots in the member associations, recommending them to treat data collection as an unbiased attempt to evaluate navigational capability objectively. Throughout the data collection period they should navigate in a normal manner.

1.6.9 States should ensure, as far as possible, that sensational publicity on this programme is avoided and that the publication of information on this subject is factual. Close contact with the technical press on these aspects is highly desirable.

1.6.10 Further publications would be initiated at the discretion of the States concerned in order to maintain the effectiveness of the procedures adopted.

1.7 Up-dating of factors affecting the analysis of the data

1.7.1 The Group found that, in the light of new and up-dated information, it was necessary to amend some of the factors specified in the method of analysis developed at its second meeting. The required amendments are shown in Appendix M to this summary.

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SCHEDULE OF ACTIVITIES

NAT RADAR DATA COLLECTION PROGRAMME

(This replaces in toto the tentative schedule shown on page 6-E-5, Agenda Item 6 of the Summary of Discussions of the Second NAT SPG Meeting)

EVENT	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	JAN.	FEB.	MARCH
1) Delivery of first digitizer/recorder (D/R) system	17									
2) Indoctrination of maintenance personnel (at NAFEC)	26-30									
3) Vessel SSR/Antenna testing		1----------	---19							
4) Complete second maintenance briefing (CSV crew)		14								
5) Gander D/R system installation (first D/R package)		17-21								
6) Delivery of D/R systems 2, 3, 4 and 5			8							
7) Complete Loran A AN/UPN-22 installation (see 12 below)			23							
8) Kilkee D/R system installation			24-29							
9) Complete all D/R systems installations on vessels			30							
10) Main core data collection (Configuration C) - est. sample 4600 flights				16------	--9					
11) Complete oceanic center tabulation of ATC data related to: Configurations B, C, A, and D					17(B+C)		1(A+D)			
12) Data collection - Configuration D (Area #6) - est. sample 200 flights						1---24				
13) Data collection - Configuration A - est. sample 1000 flights						1---24				
14) Complete NAFEC coordinate conversion/data processing (all radar except Kilkee)							22			
15) Configuration E Radar and ATC data collection throughout period	Gander 21- Kilkee 1--*(i)	--------- --	--------- 29---	--------- --*(ii)-	--------- ---------	--------- ---------	--------- ---------	--------- ---------	--------- ---------	----31 ----31
16) All radar and ATC data for Configurations B,C,A,D and E (part) on hand at RAE								1		

* (i) Manual recording

* (ii) Auto recording

FLIGHT LOG DATA COLLECTION

1. Flight log data collection periods

1.1 The following dates in 1967 are scheduled for flight log data collection. They have been chosen to ensure an overlap between the radar data collection and the periods of the flight log collection. If the dates of the radar data collection are changed these dates will also be changed. In any case the exact dates will be notified by NOTAM.

18 - 20 JULY	TUE-WED-THU
18 - 20 AUG	FRI-SAT-SUN
18 - 24 SEP	MON to SUN inclusive
18 - 20 OCT	WED-THU-FRI
18 - 20 NOV	SAT-SUN-MON
18 - 20 DEC	MON-TUE-WED

1.2 It is noted that with the above type of schedule, airlines operating flights once or twice weekly in the data collection area (para. 3.2, Agenda Item 3 of the Summary of Discussions of the Second Meeting of the NAT/SPG) will be accommodated within the sample.

1.3 All flights which operate in the data collection area during any portion of the days given above should be included in the flight log data collection. For this purpose "day" is taken as commencing and finishing at midnight GMT. Flights having entered the area prior to the beginning of the data collection period or leaving the area after a collection period has ended are expected to provide a full report on the entire flight portion covered by the data collection programme.

2. Retention of records

2.1 Flight records relative to flights included in the flight log collection should be held until the operator has received notification, originating from the coordinator, that they can be disposed of.

2.2 In addition, aircraft operators are requested to retain all flight records in respect of North Atlantic flights carried out between 1 July 1967 and 31 March 1968 for a period of 6 months from the date of a flight. In this way, if additional flight log data is later required, either in support of additional collection periods or for cross-checking with radar observations, access to these records can be obtained.

FLIGHT RECORDS TO BE KEPT FOR THE FLIGHT DATA COLLECTION

(This Appendix supersedes Appendix D to Item 6 of the Summary of Discussions of the Second Meeting of the NAT/SPG.)

Note: For retention of flight records see para. 2 of Appendix B.

1. It is essential that all records of each flight (flight log and chart, COM logs and ATC clearances, including such working papers as would assist a detailed post-flight analysis) be retained and made available if required to the administration of the State of registration of the aircraft.

2. In order to preclude the possibility of any bias being introduced into the results, it would have been desirable for crews to take no observations and to make no reports which they would not normally make. However, in order to make possible the post-flight reconstruction of the route followed it may be necessary to record some extra details. Additionally, in order to enable correlation to be made with radar observations, it is desirable that during the entire 9 month period of data collection the flight logs should record the SSR code which was assigned to the aircraft for each flight conducted in the OCA.

3. Important parameters which should be noted in the record made in the aircraft, in so far as they are normally recorded by individual operators, are, for example :

i) the component parts of each position fix together with GMT, navigation computer along and across track readings, or inertial read-outs as necessary to enable each fix to be re-plotted, Loran, Consol and sextant readings, VOR radials, ADF bearings, radar observations, etc.;

ii) all doppler or inertial computer settings with GMT;

iii) GMT at which each compass system is unslaved and re-slaved and the north reference (grid, true, or other) to which the freed compass is set;

iv) which compass system is being used for guidance;

v) the directional reference used for bearing measurements by ADF, airborne radar, etc. (i.e., true, grid, magnetic, compass, or relative - and in the latter two cases, the compass used);

vi) method of track guidance; e.g., following VOR radial, steering headings passed by navigator, following computer cross-track indication or doppler or inertial auto-pilot tie-in, giving GMT at which changes of method occur;

vii) at least one of the following with relevant GMT or position :

- headings steered and true airspeeds or Mach numbers flown, or
- tracks set on computer and cross track indications and up-dates, doppler/computer system in use, or
- read-outs of inertial system in use;

viii) when available, spot winds, compass checks, and other such information which could prove useful in reconstruction.

4. In addition to the above examples, which would be recorded in the normal flight documentation, it may be desirable for aircraft to carry on board a form on which to record such extra details as might be needed to complete Form 1-D. Such a form might include the following blocks from Form 1-D :

Name of Operator.
Aircraft Type
Flight Number
Registration
SSR code used
Navigation Equipment
Remarks.

Whilst it may not be necessary for all operators to carry such a form on their aircraft, IATA London will print and supply an adequate number to all IATA airlines operating in the NAT Region, except the following :

PAA, TWA, AC, BOAC, DLH, AF.

As an alternative, operators may prefer, in some cases to issue a standard printed reminder with flight documentation.

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FORM 1-D

NAT. POST-FLIGHT ANALYSIS FORM

(See Summary 3rd NAT/SPG Meeting 1967)

ICAO · OACI

THIS FORM PRODUCED BY DEPARTMENT OF TRANSPORT CANADA

TO BE COMPLETED BY OPERATOR* FROM REVIEW OF FLIGHT LOG AND CHART

Name of OPERATOR	Aircraft Type -	Flight No. -	Registration	SSR. Code Used -
MARK BOX IF NO DEVIATION OF 30NM OR MORE ☐	DIRECTION OF FLIGHT MARK BOX E OR W ☐	Time in Oceanic Area: - TOTAL ☐ Hours ☐ Min.	Time Spent LESS than 30NM Off Track: - TOTAL ☐ Hours ☐ Min.	

ATC CLEARED TRACK -

LONG	OAC BOUNDARY	50° W	40° W	30° W	20° W	OAC BOUNDARY
LAT						
FL						

DATE/TIME GMT W BOUNDARY	DATE/TIME GMT E BOUNDARY

NAVIGATION EQUIPMENT -

EQUIPMENT -	ON BOARD	USED
ADF -		
VOR/DME -		
LORAN "A" -		
DOPPLER AND COMPUTER -		
DOPPLER - SENSOR ONLY -		
INERTIAL -		
RADIO ALTIMETER -		
CELESTIAL - FIXING ☐ HEADING CHECKS ☐		
CONSOL -		
OTHER (specify)		

NAVIGATION IN OCA BY CREW MEMBER WHOSE SOLE DUTIES WERE NAVIGATION? YES ☐ NO ☐

OFF TRACK DETAILS 30NM OR MORE -

30-44 NM OFF TRACK -				45-59 NM OFF TRACK -				60 NM OR MORE OFF TRACK -			
TIME-OFF	BETWEEN**	NORTH/SOUTH	MAXIMUM	TIME-OFF	BETWEEN**	NORTH/SOUTH	MAXIMUM	TIME-OFF	BETWEEN**	NORTH/SOUTH	MAXIMUM
Hours Min.	W W		NM	Hours Min.	W W		NM	Hours Min.	W W		NM
Hours Min.	W W		NM	Hours Min.	W W		NM	Hours Min.	W W		NM
Hours Min.	W W		NM	Hours Min.	W W		NM	Hours Min.	W W		NM

REMARKS:- (E.G. STATE WHAT ARE BELIEVED TO HAVE BEEN THE CAUSES OF ANY OFF-TRACK ERRORS RECORDED ABOVE)

* FOR GENERAL AVIATION INCLUDE UNDER REMARKS, CREW COMPOSITION AND CAPTAIN'S NAME AND ADDRESS

** EXPRESS THIS IN TERMS OF LONGITUDE E.G. 45°W 39°W

FORM 1-D

NAT. POST-FLIGHT ANALYSIS FORM
(See Summary 3rd NAT/SPG Meeting 1967)

TO BE COMPLETED BY OPERATORS FROM REVIEW OF FLIGHT LOG AND CHART

ICAO · OACI

EXAMPLE

THIS FORM PRODUCED BY DEPARTMENT OF TRANSPORT CANADA

Name of Operator	Aircraft Type -	Flight No -	Registration	SSR Code Used -
KURITANA AIRLINES	B 707	100	K-ANXY	21
MARK BOX IF NO DEVIATION OF 30NM OR MORE: [ ]	DIRECTION OF FLIGHT — MARK BOX E OR W: E	Time in Oceanic Area - TOTAL 5 Hours 00 Min.	Time Spent LESS than 30NM Off Track:- TOTAL 4 Hours 05 Min.	

ATC CLEARED TRACK -

LONG	OAC BOUNDARY	50° W	40° W	30° W	20° W	OAC BOUNDARY
LAT	52	53	53	52	51	49
FL	330	330	330	350	350	370

DATE/TIME GMT W BOUNDARY: 27 NOV / 2100

DATE/TIME GMT E BOUNDARY: 28 NOV / 0200

NAVIGATION EQUIPMENT -

EQUIPMENT -	ON BOARD	USED
ADF -	✓	
VOR/DME -	✓	✓
LORAN "A" -		
DOPPLER AND COMPUTER -		
DOPPLER - SENSOR ONLY -	✓	
INERTIAL -		
RADIO ALTIMETER -		
CELESTIAL - FIXING [✓] HEADING CHECKS [✓]	✓	✓
CONSOL -	✓	✓
OTHER (specify)		

NAVIGATION IN OCA BY CREW MEMBER WHOSE SOLE DUTIES WERE NAVIGATION? YES [✓] NO [ ]

OFF TRACK DETAILS 30NM OR MORE -

30-44 NM OFF TRACK -

TIME-OFF	BETWEEN **	NORTH/SOUTH	MAXIMUM
0 Hours 10 Min.	48 W 46 W	N	44 NM
0 Hours 10 Min.	43 W 41 W	N	44 NM
0 Hours 20 Min.	16 W 12 W	S	43 NM

45-59 NM OFF TRACK -

TIME-OFF	BETWEEN **	NORTH/SOUTH	MAXIMUM
0 Hours 15 Min.	46 W 43 W	N	47 NM
Hours Min.	W W		NM
Hours Min.	W W		NM

60 NM OR MORE OFF TRACK -

TIME-OFF	BETWEEN **	NORTH/SOUTH	MAXIMUM
Hours Min.	W W		NM
Hours Min.	W W		NM
Hours Min.	W W		NM

REMARKS:- (E.G. STATE WHAT ARE BELIEVED TO HAVE BEEN THE CAUSES OF ANY OFF-TRACK ERRORS RECORDED ABOVE.)

1. Doppler Sensor was unserviceable for entire crossing
2. Jet Stream which was not forecast caused aircraft to get north of track between 48°W and 41°W
3. Between 16° and 12°W there was CAT, and difficulty in receiving Consol.

* FOR GENERAL AVIATION INCLUDE UNDER REMARKS, CREW COMPOSITION AND CAPTAIN'S NAME AND ADDRESS

** EXPRESS THIS IN TERMS OF LONGITUDE EG. 43°W 39°W

METHODS OF POST-FLIGHT RECONSTRUCTION

(This Appendix supersedes Appendix H of Item 6 of the Summary of Discussions of the Second Meeting of the NAT/SPG.)

1. Although details will vary, depending on modes of operation, the following steps would appear to be essential:

i) all position information should be checked, re-plotting where necessary;

ii) the path of the aircraft should be reconstructed with reference to:

a) headings steered, compass checks, measured winds and probable change of wind, and/or

b) doppler/computer tracks set and compass checks, or

c) inertial settings;

iii) judgement would need to be used, in weighing the fix reliability against the consistency of the residual system tracking error found between successive fixes;

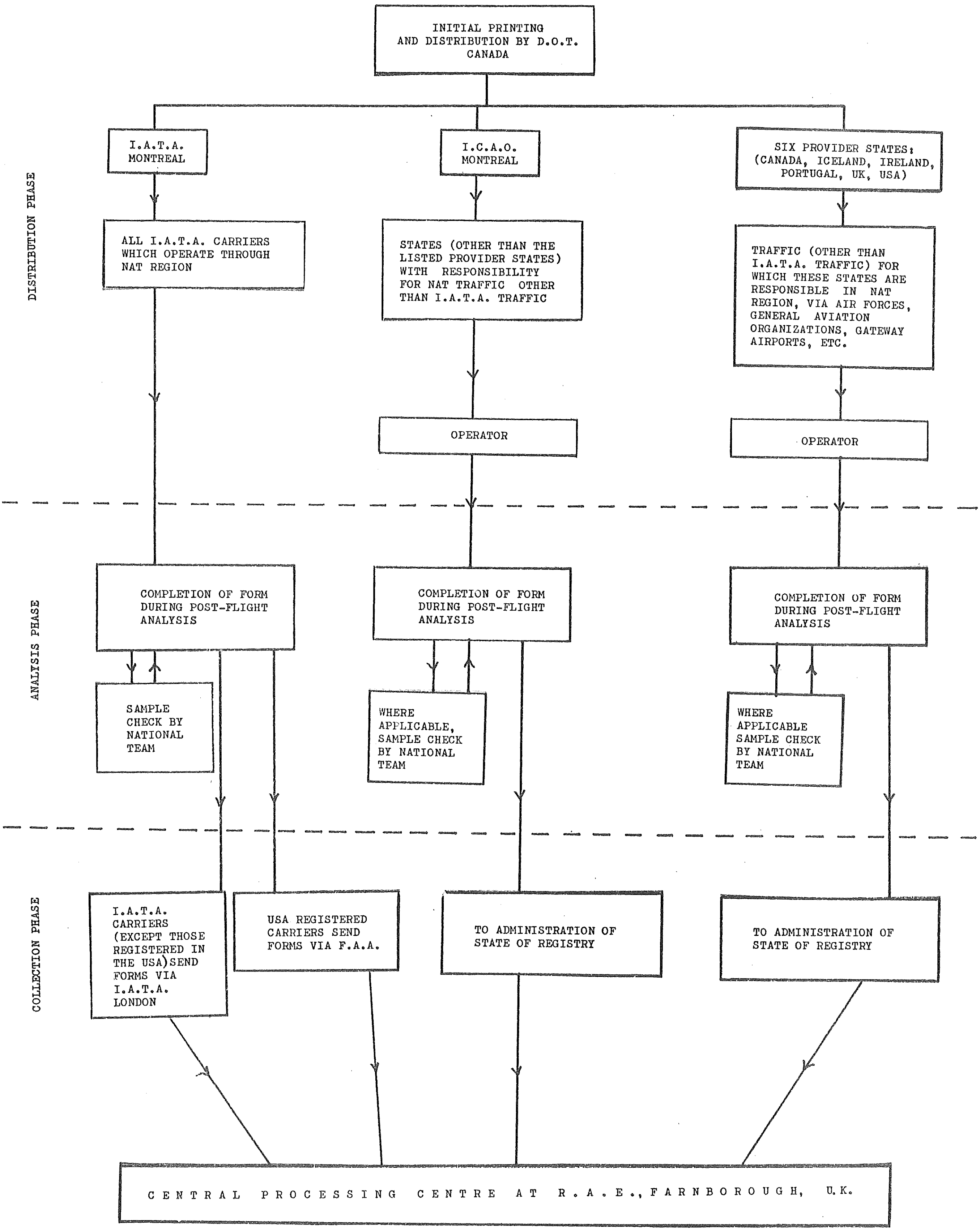
iv) where inadequate records or uncertainty of interpretation precludes reconstruction of any portion of the flight path, this should be stated under "Remarks" in Form 1-D.

2. Any deviations from track should be measured perpendicular to the cleared great-circle track.

3. It should be kept in mind that Doc. 7030 stipulates that "all flights shall be operated on a great circle track joining successive significant points". This applies also in those cases where radar data is referred to other navigational data.

DIAGRAM OF FLOW OF FORMS INTENDED FOR THE EXTRACTION OF DATA FROM FLIGHT LOGS AND CHARTS

(FORM 1-D)



It is desirable that completed forms should not be delayed unnecessarily by intermediate agencies but should be forwarded, if possible on a weekly basis, to R.A.E., Farnborough.

Note : This diagram amplifies part of the diagram of data flow shown in Appendix J.

NUMBER OF FORMS 1-D REQUIRED

(As of 1 May 1967)

State or Organization	Number of forms required	Remarks
1	2	3
Ireland	500	
Italy	1 600	
United Kingdom	2 000	
United States	3 030	30 for U.S. Coast Guard flights: Address: Cdr. J. Stewart, Commandant (OAN) U.S. Coast Guard WASHINGTON, D.C. 20226
I.A.T.A.	25 000	

Requests for Form 1-D by States should only be made to cover the needs for military and for non-IATA civil operations.

AIR TRAFFIC CONTROL FACILITY DATA

(This Appendix supersedes Appendix I of Item 6 of the Summary of Discussions of the Second Meeting of the NAT/SPG.)

1. In developing the data collection programme every effort has been made to minimize the amount of support activities imposed on Oceanic ACC personnel. This is especially important since much of the data collection effort will be conducted during busy summer months.

2. In view of the automatic radar data acquisition capability, which will probably be operated by maintenance rather than controller personnel, the principal support required from Oceanic centres will relate to SSR code assignment and cleared track/flight level details. The requirements can be summarized as follows :

i) A daily record (the day being based on GMT) of all oceanic code assignments plus notation of any turbo-jet aircraft operating without a functioning SSR transponder. Thus this would be a complete record of jet aircraft flights.

ii) A daily record, based on GMT, of cleared track, cleared flight level(s) and amendments thereto, reported times at reporting meridians, and corresponding aircraft identification details appropriate to the radar collection areas active at the time.

iii) Radar system and auto acquisition equipment serviceability records where these are kept at the ACC.

iv) Retention of all jet aircraft flight data (including teletype messages and flight progress strips), weather maps used in plotting flight plan tracks, MTP's and datum lines, co-ordinates of organized tracks and other pertinent operational data for the period of the data collection and afterwards until such time as authorization is given for its destruction.

Note: As much of these data will be required on an "on call" basis the greatest care should be taken to ensure their retention in an orderly and accessible manner.

3. With regard to the above, standard procedures for handling the data and standard forms have been agreed. The specimen form on page 1-H-5 would be for use at Gander ACC for recording data on Westbound aircraft only. For Eastbound aircraft in Gander Oceanic FIR the order of listing of longitudes (30°W, 40°W and 50°W) would be reversed in order to facilitate both the recording of data and its subsequent extraction. A similar arrangement at other Oceanic Control Centres is required, with the insertion of the longitudes applicable to particular centres (see the table in para 5 below).

4. ATC data forms will be printed and provided by the USA for the New York ARTCC and Lisboa OACC. Canada will provide forms for Gander ACC and the UK for Shanwick OACC and Reykjavik OACC. Data will be recorded daily (GMT day) and it will commence on 1 July 1967 and will terminate on 31 March 1967. The completed ATC data sheet should be dispatched at approximately weekly intervals to the addresses below :

Data from Gander, New York, Lisboa :

Chester E. Dunmire,
Department of Transportation,
Federal Aviation Administration,
RD625,
800 Independence Avenue S.W.,
WASHINGTON, D.C. 20590,
U.S.A.

Data from Shanwick, Reykjavik :

P.G. Reich,
Maths. Department,
Royal Aircraft Establishment
FARNBOROUGH,
Hants.,
ENGLAND.

It is recommended that copies of data sheets be retained to guard against loss in transit.

5. Detailed requirements are as indicated below :

5.1 All main radar collection periods (Configuration C).

Oceanic ACC	Data Requirements (Westbound Flights)	Data Requirements (Eastbound Flights)
Shanwick	In respect of each flight: 1. Date (related to GMT entry time Oceanic CTA) 2. SSR Code 3. Ident. and aircraft regist. 4. Operator 5. Aircraft Type 6. Cleared latitudes at 20°W and 10°W (or Bdy) 7. Reported times at 20°W etc. 8. Cleared flight levels at 20°W etc. 9. Cleared Mach No's. (see note a) below)	(As Westbound Flights)
Gander	In respect of each flight: 1. Date (related to GMT entry time Oceanic CTA) 2. SSR Code 3. Identification 4. Operator 5. Aircraft Type 6. Cleared latitudes at 30°W, 40°W and 50°W. 7. Reptd.or est.times at 30°W etc. 8. Cleared flight levels at 30°W etc. 9. Cleared Mach No's. (see note b) below)	(As Westbound Flights)
Lisboa Reyjavik	1. Daily list of jet flights with SSR codes (see note c) below)	1. Daily list of jet flights with SSR codes (see note c) below)
New York	———	1. Daily list of jet flights with SSR codes (see note c) below)

Notes: a) Best estimated time for 10°W (or boundary) permissible for item 7.

b) Should a ship or ships be positioned East of 35°W longitude for any reason, cleared latitude and flight level for 20°W may also be required. Effective coordination with Shanwick will be necessary for this purpose.

c) Detailed coordination arrangements will be needed between centres and/or agencies collating data.

d) Appropriate cleared track, flight levels and reported times are required if a flight is predominantly N-S through the data collection area. Normally these would be given in 5° latitude increments for the vicinity of radar coverage.

5.2 Land-based radar collection periods (Configuration E).

As 5.1 except 20°W, 30°W and 40°W data not required from Gander.

5.3 Additional data requirement for supplementary ship radar collection periods (Configurations B and D).

Oceanic ACC	Data Requirement (Eastbound and Westbound Flights)	Remarks
New York Lisboa Gander	1. Date related to GMT entry time Oceanic Area. 2. SSR Code. 3. Identification. 4. Operator. 5. Aircraft Type. 6. Cleared latitude at longitude X and Y. 7. Reported times at longitude " " " 8. Cleared flight level(s) at longitude X and Y. 9. Cleared Mach No's.	These items are only required when requested by the appropriate data collation centre (see Appendix J) after the processing of the radar records.

ATC DATA FORM WESTBOUND

DATE	CODE	FLIGHT	TYPE	AIRLINE	Long	Lat	Time	FL	Mach
					30				
					40				
Time of entry					50				
					30				
					40				
Time of entry					50				
					30				
					40				
Time of entry					50				
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Time of entry					50				

THE USE OF SSR AND SSR CODE ASSIGNMENT PLAN

(This Appendix supersedes Appendix I of Item 6 of the Summary of Discussions of the Second Meeting of the NAT/SPG.)

1. The use of SSR

1.1 The following codes will be available for allocations within the 64-code system capability :

01 to 07, 10 to 17, 20 to 26, 30 to 37,
40 to 47, 51 to 57, 60 to 62 and 72 to 75.

These 52 codes should be assigned to aircraft in the manner indicated in the table below.

1.2 The computer analysis program in the reduction of radar data permits the assignment of the same band of codes for opposite direction traffic. In view of the anticipated hourly flow rates of jet aircraft, it is unlikely that a single code will be assigned more than once in any given hour, if codes are allocated sequentially by time over a given datum. As radar observations will be time referenced there should be no problem in deriving correct identification of aircraft. However, should exceptionally a single code be allocated within a period of less than 40 minutes from its previous allocation, a note should be made accordingly on the relevant ATC data sheets.

1.3 Codes will be allocated to all jet aircraft at levels up to and including FL 420, and in order to achieve the complete success of the data collection exercise, concerned national authorities will issue unambiguous instructions to all Area Control Centres concerned. These will embrace the methods by which codes will be allocated to aircraft and the time at which aircraft will be instructed to transpond in the code allocated. Attention will have to be given to procedures authorizing aircraft to change code to and from codes in use in continental domestic airspace so that data is not lost. In general, once a code is assigned, an aircraft should transpond in that code from the time it enters the oceanic FIR until it leaves oceanic airspace. It should only otherwise switch off or switch to stand-by operation if specifically instructed to do so by the oceanic ACC controlling the aircraft.

1.4 It will be necessary for five control centers to maintain daily records of SSR code assignment, viz. Gander, New York, Shanwick, Lisboa and Reykjavik. These records should be maintained on a daily basis (GMT day) using the same forms as are required for ATC data (see Appendix H).

2. SSR (MODE A) CODE ASSIGNMENT PLAN

- ALL DATA COLLECTION CONFIGURATIONS

Oceanic ACC responsible for issue of clearance (and SSR code)	Provisional No. of codes allocated	Direction of Flight	Categories of jet traffic to which codes will be allocated
GANDER	13 to 17, 20 to 26, 30 to 37, 40, 41, 51 to 57, 60, 61, 62	Eastbound only	All flights
NEW YORK	01 to 07, 10, 11, 12	Eastbound only	All flights expected to enter the radar data collection area
SHANWICK	01 to 07, 10 to 17, 20 to 26, 30 to 37, 40, 41, 51 to 57, 60, 61, 62	Westbound only	All flights
LISBOA	43 to 47	Eastbound Westbound	1. All flights not having a code previously allocated by another centre and entering the radar data collection area. 2. All flights expected to enter the radar data collection area.
REYKJAVIK	42 to 45	Eastbound Westbound	1. Aircraft within Reykjavik Oceanic CTA and subsequently entering Shanwick and crossing 10°W longitude South of 56°N. 2. Aircraft within Reykjavik Oceanic CTA and subsequently entering Lisboa Oceanic CTA. 3. Aircraft not having a code previously allocated by another centre and entering the radar data collection area.

Notes: a) If necessary codes will be shared between Gander and New York centres after daily appraisal of the traffic situation.

b) If the traffic situation warrants, additional code allocation for Lisboa or Reykjavik will be temporarily requested from either Shanwick or Gander/New-York centres as appropriate and the transaction recorded on the daily code allocation list at both the cooperating centres.

c) For "round robin" type flights (flights proceeding into Oceanic airspace and then returning without intermediate landing) code assignment will be determined after inter-centre coordination.

d) Codes 51 to 57, 60, 61 and 62 have been released by the State concerned for use during this programme. In the event that for unforeseen reasons any of these codes are withdrawn by the State, New York OAC will coordinate with Gander ACC who will in turn inform Shanwick and Reykjavik OACs.

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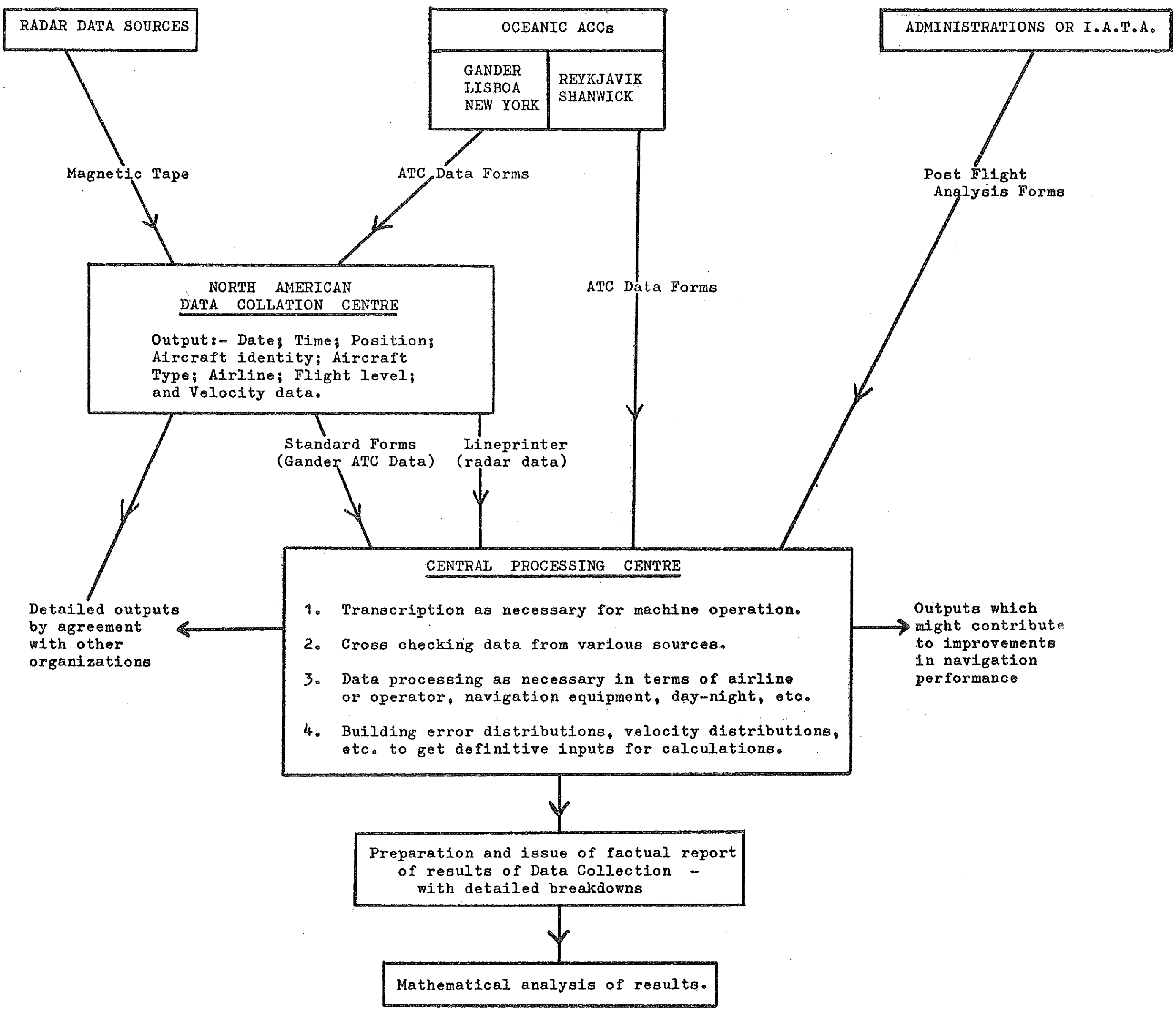
SCHEMATIC PRESENTATION OF THE DATA-FLOW

(This Appendix supersedes Appendix 6-I to the Summary of Discussions of the Second Meeting of the NAT/SPG.)



DRAFT INFORMATION CIRCULAR

PROGRAMME OF DATA COLLECTION IN THE NORTH ATLANTIC REGION

1. In order to obtain up-to-date information on the navigational capability of turbo-jet aircraft in the North Atlantic Oceanic Control Areas, a programme of data collection will be conducted over a period of approximately nine months, commencing 1 July 1967.

2. During the data collection period automatically recorded Secondary Surveillance Radar observations will be made on a daily basis from stations at Gander in Newfoundland and at Kilkee on the West coast of Ireland. In addition specially equipped vessels will be located at strategic positions and will make similar radar observations during a number of scheduled periods. SSR equipment on aircraft will be used in accordance with instructions issued by the responsible ATC unit. The use of SSR will be based on the 64 code configuration in Mode A/3.

3. Within the overall data collection period, there will be a number of short periods, each of several days, during which an analysis of each flight should be made by reference to the flight documentation (logs, charts, etc.). During these periods every turbo-jet flight operating at flight levels up to and including FL 420, which passes through the area described in paragraph 11, should be analysed.

4. For this post-flight analysis, a special form (referred to as "Form 1-D") has been developed and will be made available to operators by State Administrations or designated organizations. In the case of ...(name of State issuing Circular)... forms may be obtained .....(specify)..... .

5. In the case of airlines, the analysis will be made by the airline concerned and the completed analysis forms will be submitted to .....(State agency)....., unless prior authorization has been obtained to forward the forms directly to the appropriate IATA office.

6. For general aviation operations, the analysis will be made by the operator concerned with the assistance of (State as appropriate) The completed form will, as soon as practicable after completion of the flight, be sent to ..(give address of agency).. .

7. To assist airlines and general aviation a special analysis team will be formed under the general direction of .... and including representatives from .... This team will assist operators by reviewing a proportion of the analysis forms together with the associated flight documentation. Operators should let the director of this team know how many flights take place during each short analysis period.

8. In the case of military operations, special arrangements for the post-flight analysis will be made by the national administration concerned.

9. The records to be kept for each flight and the method used for post-flight reconstruction are shown in Appendices A and B to this circular.
(Note to Editor: Appendix A to consist of Appendix C to this summary
Appendix B to consist of Appendix E to this summary.)

10. It is requested that great care be taken by operators to ensure that an accurate and complete record of the in-flight details is kept for the purposes of post-flight analysis. As access to flight records may be requested at times other than when they are required for routine analysis, e.g., for correlation with radar data, it is important that all operators should retain log forms and charts for all NAT flights in the area described below, during the overall period of the programme, for a period of six months from the date of the flight concerned.

11. <u>Description of data collection area</u>

Northern limit: 70° North.

Eastern limit: between 70°N and 61°N the Greenwich meridian, thence Westwards along 61°N latitude to 10°W and along the Eastern boundary of Shanwick and Lisboa Oceanic FIRs to Madeira.

Southern limit: the great circle between Nantucket and Madeira.

Western limit: the Western limit of Sondrestrom, Gander Oceanic and New York Oceanic FIRs from 70°N to its intersection with the Southern limit.

12. <u>Periods of flight log analysis</u>

12.1 Flight logs and charts will be analysed during the following periods in 1967 :

18 - 20 JULY
18 - 20 AUGUST
18 - 24 SEPTEMBER
18 - 20 OCTOBER
18 - 20 NOVEMBER
18 - 20 DECEMBER

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DRAFT NOTICE TO AIRMEN (NOTAM)

1. In order to obtain up-to-date information on the navigational capability of turbo-jet aircraft in the North Atlantic Oceanic Control Areas, a programme of data collection will be conducted over a period of approximately nine months, commencing on 1 July 1967.

2. The basic methods of data collection will be by Secondary Surveillance Radar observation and, as a supplementary feature, by analysis of aircraft flight logs and charts.

3. During the data collection period, automatically recorded Secondary Surveillance Radar observations will be made on a daily basis from radar stations at Gander and Kilkee on the West coast of Ireland. In addition, specially equipped ships will be located at selected positions in the NAT Region and will make similar radar observations during a number of scheduled periods. Discrete SSR codes in Mode A/3 (in the 64 code configuration) will be assigned to individual flights together with the Oceanic ATC clearance.

4. The Oceanic Area Control Centre first concerned with a flight which is planned to enter Oceanic airspace affected by this programme will assign a specific code to that flight. The aircraft will retain this code allocation throughout that portion of its flight conducted in Oceanic airspace unless otherwise instructed by the responsible Oceanic Area Control Centre.

5. The aircraft should, without further instruction, commence to transpond in the assigned code immediately on entry into Oceanic airspace and continue to do so until :

i) instructed to switch to stand-by operation or switch off; or

ii) the aircraft leaves Oceanic airspace when it will cease transponding in the code without further instruction.

6. Exceptions to this operating procedure shall only be made on specific instructions by the ATC unit controlling the flight.

7. On a selected number of days during the data collection programme aircraft flight logs and charts will also be analysed. Special arrangements have been made, as explained in Information Circular N° ....

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UP-DATING OF FACTORS AFFECTING THE ANALYSIS OF THE DATA AGREED AT THE SECOND MEETING OF THE NAT/SPG

(The Summary on Item 4 of the Second Meeting of the NAT/SPG refers)

Up-dating of factors affecting the analysis of the data

1. The Group reviewed a number of features which had been left pending in the method for assessing the risk :

a) the target level of safety (cf. para 4.11 and 4.12 of the Summary of the Second Meeting of the Group). The number of accidents which had occured in the civil jet air transports in the period January 1959 through 28 September 1966 has been found to be 36 accidents in approximately 15 ½ million flying hours, giving a rate of 23.4 jet aircraft fatal accidents per 10 million aircraft flying hours.

Consequently the "target level of safety" from collision for any of the three separation standard over the North Atlantic would be to keep the fatal accident rate in the range from 0.4 to 0.15 per 10 million aircraft flying hours.

b) influence of vortices on the dimensions of the collision slab. Determination of W (λ_x). The US member of the Group made available a film on experiments conducted by the FAA in order to study the development of vortices created by aircraft and their effects on other aircraft. The Canadian member gave information on experiments conducted in Canada on the same subject. In view of the interest these studies had for the mathematical evaluation of separations the Group was grateful for the information provided and the US member stated that he would suggest to his Administration to establish contact with the Canadian authorities in order to agree on the joint and coordinated continuation of these studies, thus avoiding duplication of efforts and expenses.

c) the risk due to the "ATC Loop" errors. The Second Meeting of the Group agreed that it had to be satisfied that the number of errors due to the ATC loop for pairs of aircraft in both the same and opposite directions, is in the order of 1 or less in order to neglect the risk due to this kind of errors. This was a provisional estimate and the Group noted that the French member is conducting studies in this respect which will provide a check of these estimates.

2. The Group also agreed to issue a corrigendum to the Summary of the Second Meeting as follows :

Page 4 - 6, para 4.15.4, line 6, amend "Appendix A" to read "Appendix B".

Page 4 - 7, para 4.15.5.5.1, second sub-para, delete the sentence commencing "The Group agreed that if the observed data..." up to "scaling factor".

Page 4 - 8, para 4.15.5.5.2 3) amend this paragraph to read :

"3) The intermediate case is where the data are not sufficient for a precise determination of risk without assumption on shape, and where precise determination of shape is also not possible. Past experience of across-track errors has indicated that it would be a reasonable and almost certainly a safe procedure to use a flat distribution between "flat" and "exponential" shape assumptions. The DS method treatment for w $[P_y(\text{std})]$ would then be to replicate the quantity

$$W\,[P_y\ (\text{std})] = k.w\ (\text{tail area}).\ w\ (\text{tail shape})$$

in which w (tail shape) is uniformly distributed between the limits set by the "level" and "exponential" models and k is a scaling factor."

Page 4 - A - 1, para b), add an asterisk after "number of collisions" in the 11th line and add the following footnote at the bottom of the page :

"*It should be noted that a collision involves two aircraft accidents (page 4 - 4, para 4.13 refers)."

Page 4 - C - 1, amend the first sentence of the Appendix to read :

"The theory given in Appendix B, with the slight changes listed below, leads to the following expression for the expected number N_{ay} of aircraft accidents per 10 million flying hours occurring, due to failure of lateral separation :

$$N_{ay} = \frac{2 \times 10^7 P_y}{H} (std) \left\{ \frac{T_y \ (same)}{S_x} \left[\frac{\Delta \bar{V}}{2} Pz(0) + \gamma \Lambda_x N_z(0) + \frac{\Lambda_x \overline{|\dot{y}|} P_z(0)}{2\lambda_y} \right] + \frac{T_y \ (opp)}{S_x} \left[\bar{V} P_z(0) + \gamma \Lambda_x N_z(0) + \frac{\Lambda_x \overline{|\dot{y}|} P_z(0)}{2\lambda_y} \right] \right\} \quad .....(1)"$$

- delete the last sentence of paragraph 2, commencing with " α is a reduction factor ....",

and add the following sentence at the end instead :

"H is the total number of aircraft flying hours in the period considered."

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2. Summary of Agenda Item 2 : Vertical separation applied to aircraft operating above FL 290 in the NAT Region.

The method to be adopted in assessing a safe vertical separation standard

2.1 Introduction

2.1.1 The Group agreed that many of the basic principles described in the Summary of Discussions of Agenda Item 4 at the Second NAT/SPG Meeting (Ref.1) are valid for assessing vertical separation standards. In particular, Sections A and B, as amended by the present Appendix A, and Appendices A and B of Ref.1, remain valid.

2.2 The calculation of the estimates of risk

2.2.1 The basic equation for the collision risk associated with loss of vertical separation is given in Appendix A to this report. For simplicity, the equation has been written on the assumption that there is a negligible risk of fatal accidents due to wing-tip vortex penetrations. Should the investigations on vortex effects in cruise, initiated in Canada and the USA, lead to the conclusion that this risk cannot safely be neglected, a more complicated equation would be necessary, perhaps making use of the sort of model suggested in Ref.2.

2.2.2 The Group discussed the quantities in the equation given in Appendix A. It agreed that all terms can be treated either as constants which have been estimated with sufficient accuracy or as constants which will be accurately determined from the results of the forthcoming radar data collection. The only exception is P_z(std), (the probability that a pair of aircraft assigned to adjacent flight levels are separated in the vertical dimension by less than an aircraft's thickness). It was therefore agreed that the estimated risk associated with the 1 000 ft. vertical standard can be simply expressed as follows :

$$N_{az} = k_z \, P_z \, (1\ 000)$$

where N_{az} is the number of aircraft fatal accidents per 10 million flying hours and k_z is a constant. In this respect the Group noted that an analysis made in the UK study (Ref.3) had shown k_z to be of the order of 600 per hour when vortex effects are ignored and the 1 000 ft. standard is applied only to same-direction traffic. The latter restriction was imposed because of the difficulties of reliably estimating future flows of opposite traffic; on present information k_z would be very roughly twice as large if opposite direction traffic were included. It was also noted that k_z increases in inverse proportion to the standard deviation of across-track errors and assumed that this s.d. will remain constant at the same value as that estimated from past measurements.

2.2.3 The Group noted that there are considerable difficulties in obtaining a sufficiently large and representative sample by measurements of vertical separation which lead directly to estimates of P_z (1 000 ft.). Moreover, direct measurements would not in themselves give understanding of the mechanism of significant errors in height-separation. In the UK approach described in Ref.3 the total height-separation error has been broken into three main components which can be studied separately and then statistically summed. These components are defined in detail in Ref.3 and may be briefly described as follows :

ΔE (flight technical): the separation error resulting from the "flight technical errors" of a pair of aircraft, i.e. due to the deviation from the required flight levels as indicated to the pilots.

ΔE (random altimetry): the separation error due to all those measuring errors which are not common to the pilots' and copilots' altimetry systems in the same aircraft. This is mainly associated with the instrument systems and static ducts in the same aircraft.

ΔE (static calibration): the separation error mainly due to the discrepancy between the pressure at the static vents, corrected by the recommended amount, and the free-stream pressure.

2.2.4 Relatively abundant data can be obtained on the "flight technical" and "random altimetry" errors from data collections by NASA and ICAO. The analysis of these data is described in Sections 4.1 and 4.2 of Ref.3. New data on the "random altimetry" errors are at present being collected by IFALPA.

2.2.5 The Group observed that because of the data collection methods used to sample these errors there are three possible causes of height-separation errors which are not included in the summation process described above, i.e. :

a) Errors in workshop barometric reference standards, which may have the same effect on the pilots' and co-pilots' altimeter instruments, and are not therefore shown up as a discrepancy on the flight-deck.

b) Similarly, instrument drift may also be common to the pilots' and co-pilots' altimeter readings.

c) Deviations from standard temperature cause variations in the spacing of flight-levels.

As regards a), it should be noted that there is one possible source of large systematic errors in altimeter instruments which is not included in the data used in Ref.1. This is the pressure reference equipment against which the altimeters are calibrated. Since the pilot's and co-pilot's instruments in an aircraft are likely to have been calibrated in the same laboratory, any systematic error in the reference barometer would have a similar effect on both and, unlike other forms of altimeter instrument error, would not be obvious on the flight-deck. There is no technical difficulty in maintaining the accuracy of the reference equipment within about $\pm$ 0.2 mb., and it is encouraging to note that the recent PAMC for Type II altimeters and the draft material on PAMC for Type III altimeters include specifications for reference barometer tolerance.

One condition for reducing the vertical separation standard should be that maintenance of reference equipment to the required standard should be mandatory.

After some discussion it was agreed that b) and c) may be neglected, at least for as long as the assumption made on the distribution of ΔE (static calibration) ensures that it is treated as the dominant source of large errors.

2.2.6 Evidence on the static pressure error has been obtained from a further analysis by the R.A.E. (Section 8 of Ref.3) of data from radio and pressure altimeters collected by IATA for the study reported in Ref.4. Since Ref.3 was published, new data have become available from trailing-cone tests, published by ATA in Ref.5. Even with this additional information the sample of data on the static pressure error remains small. It was, however, not possible to handle the analysis in a manner similar to that of the lateral problem, because insufficient measurements were available on the total static pressure system error and therefore on the total height-keeping error.

2.2.7 In this connection, the UK presented a different approach (Ref.3) which concentrates on the possibility of persistent uncorrected large static pressure error. The principle is to use the data on "flight technical" and "random altimetry" errors to find the margin left for a permissible "static calibration" error corresponding to the acceptable levels of risk at 1 000 ft. vertical separation. These margins were represented by distribution functions specified by "tail areas" and of a form likely to be associated with cautious estimates of P_z (1 000 ft.), and hence of collision risk (Section 4.3 of Ref.3). Having thus related collision risk to the tail areas of an assumed family of distributions of static pressure error, the actual data on static pressure error mentioned above could be analysed to give an estimate of the effective durability of an initial static pressure error calibration. From the arguments given in Sections 7 and 8 of Ref.3 it was then possible to give a pessimistic estimate of how often each aircraft's static pressure system should be re-checked if the frequency of large changes in pressure calibration error were to be brought down to a level compatible with an acceptable collision risk. If the data mentioned above can be regarded as randomly taken samples of the errors of the aircraft flying over the North Atlantic in the near future, the required period between these re-checks of the static calibration error is found to be 1 1/4 and 3 years for the limits of the range of acceptable collision risks given in Section 4.12 of Ref.1. As new data on the static pressure error become available the period between re-checks can be revised.

2.2.8 During the discussion it was requested that supplementary calculations be made on the required time interval between re-checks which will be implied by alternative models. No definite expansion of the method could, however, be completed during the meeting. On the other hand it was pointed out that the data on the durability of the initial static pressure error had been obtained from the sampling of a limited number of types of aircraft and that this could be different for other types of aircraft. It might therefore be necessary to specify a relatively short period between re-checks for each freshly introduced type of aircraft and to lengthen this period as more data become available on this type.

2.2.9 The Group noted that the available data on static pressure calibration error had been obtained almost exclusively on aircraft operated by US airlines and that additional data on aircraft operated by other operators and on other types of aircraft would become available in the near future. It is therefore agreed that it could not as yet indicate a definite procedure by which it could be shown that a vertical separation of 1 000 ft. would be safe for operation over the North Atlantic.

2.2.10 Contradicting views were offered on the question of initially checking the static pressure calibration of aircraft flying on NAT routes. On the one hand it was asserted that perhaps only a small fraction of aircraft need be checked; on the other it was held that safety of the 1 000 ft. separation standard could not be established without checking initially all, or nearly all, NAT aircraft. It seemed to the Group that the onus was on the protagonists of the "small fraction" assumption to prove their case.

2.2.11 The Group agreed that these data are safely representative of current air carrier jet operations in the NAT Region and that the estimates of P_z (1 000 ft.) obtained for this traffic by the UK approach are unlikely to err on the optimistic side, assuming that errors associated with workshop reference barometer are made negligible. However, the Group noted that the data discussed above do not include any observations from military or general aviation aircraft.

2.2.12 The Group, noting that the Special NAT/RAN Meeting (1965) recommended the convening of a Limited NAT/RAN Meeting to discuss the problem of vertical separation, agreed that in view of the above such a meeting would be of interest only after a further meeting of the Group on the subject had been held. As regards the date of the latter, the Group agreed that it should be held after sufficient results of the following had become available :

a) trailing-cone tests and performance check by NAT operators;

b) the IFALPA navigational survey - 1967;

c) the forthcoming data collection exercise on track-keeping accuracy.

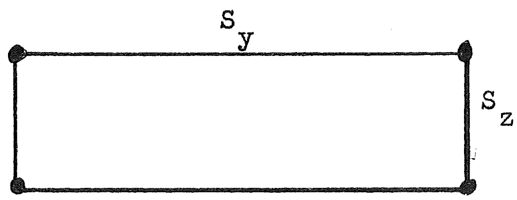
2.2.13 During a further meeting the Group agreed that two subjects deserve discussion in much more detail than could be done at the present meeting :

a) the problems of transition from 1 000 ft. vertical separation over the North Atlantic to the larger separations over the continental areas;

b) the possibility of increasing the capacity of the North Atlantic airspace by applying some sort of staggering to the flight paths of aircraft flying on adjacent tracks and/or flight levels.

2.2.14 With respect to the staggering of the so-called organized tracks, the Group requested its members to give consideration to the following proposal and that a full study should be made of both the relative improvements in risk and the relative effects of such systems upon the normal operation of ATC.

"The present track system can be visualized in cross-section as a matrix of points within a large rectangle, each point relative to adjacent points being at the corner of some small rectangle. The basic pattern is this :



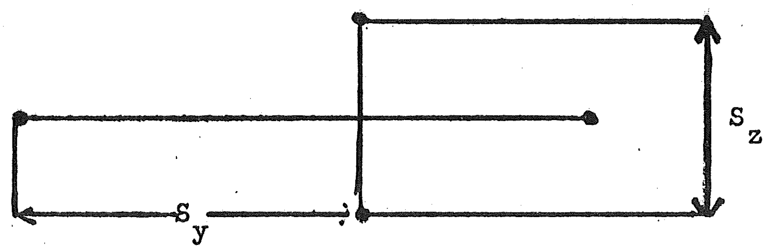
where S_y and S_z are the prescribed lateral and vertical separation standards respectively. It is immediately obvious for such a rectangular matrix that any improvement in altimeter accuracy will automatically reduce lateral safety and any improvement in lateral navigational accuracy will likewise reduce vertical safety. For these reasons many persons in various countries have, in the past years, advocated the adoption of some form of "staggered" track pattern to eliminate or suppress this present paradoxical situation. There are fundamentally two possible categories of staggering :

1) staggering is achieved in conjunction with longitudinal control of one aircraft in relation to aircraft on adjacent tracks;

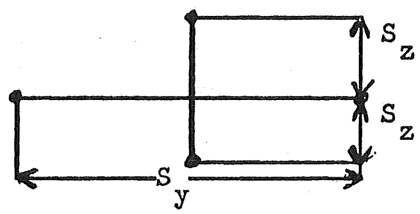
2) staggering is independent of longitudinal control and only the geometrical pattern of the flight-track matrix is altered.

The Group agreed that category 1) would probably present undesirable complications to ATC and excluded such methods from future consideration. The Group agreed, however, that staggering methods of type 2) present obvious safety advantages, and a recommendation was adopted for prompt comprehensive analyses of such systems so that a detailed discussion may be made of the entire problem as an Agenda Item at its next meeting with a view to possible adoption of some such system.

A symmetrical staggered pattern can be achieved in two obvious ways : one can raise (or lower) alternate columns (tracks on same great circle route) by ½ S_z. This results in the symmetric basic pattern :



For such a pattern future improvements in altimetry will then improve lateral safety (although improvements in lateral accuracy will still decrease vertical safety). The alternative procedure would be to shift all alternate rows (tracks at same altitude) north (or south) by ½ S_y. The symmetric basic pattern will then be :



and for which the safety characteristics will be reversed. Other non-symmetrical patterns can be achieved by shifting less than ½ the nominal separation in either direction with less safety improvements resulting. Furthermore, combination of both types of unequal partial shifts could result in patterns where no reduction in safety will result from any improvements in accuracies."

2.3 Methods for executing static pressure error calibrations

2.3.1 General

2.3.1.1 The discussion of this subject started with a warning by the Secretary that the Group should not infringe upon tasks which were the responsibility of other bodies in the ICAO organization (in this case the Airworthiness Committee). The Group agreed that any aspects of this subject which might be under the responsibility of the Airworthiness Committee should be referred to that body before any firm recommendations could be made. However, as there were many operational aspects to this subject and as a number of members had brought along specialists in order to be able to discuss the methods, it was decided that at least a short discussion was desirable.

2.3.2 The trailing-cone method

2.3.2.1 The Group considered the applicability of the trailing-cone method for the static pressure calibrations necessary for introducing 1 000 ft. vertical separation. As regards the accuracy, some regret was expressed that the Airworthiness Committee has not specified the reliability of the accuracy figures which it gives in its Report of the 7th Meeting (Doc 8653 - AN/887). The Group agreed, however, that the accuracy of the trailing-cone system, specified in the PAMC given in the above mentioned report, was sufficient for the present purpose.

2.3.2.2 A short discussion of the costs of the application of the trailing-cone method showed that these could be divided into :

a) Costs of modification of aircraft to accomodate the trailing-cone : experience has shown that they are not very large, except in exceptional cases. In future aircraft the trailing-cone attachment will probably be specified during the design.

b) The cost of the equipment : no prices of the equipment were mentioned, but it was indicated that experience had shown that a large number of static pressure determinations could be made with one trailing-cone set if care was taken that the cone was retracted during take-off and landing.

c) Cost of execution of the tests : it was indicated that experience with the use of this method by airlines had shown that installation took about 10 man-hours. The actual flying time required was about 15 minutes if such tests could be executed during normal performance test flights; the costs were, in this case, not large. If, however, special flights would have to be made, for instance because the period between calibrations is shorter than the normal period between which test flights are executed, then the cost might be significant.

2.3.3 The performance-check method

2.3.3.1 The Group noted that a different method for checking the static pressure error had been indicated by the Netherlands. It found that this method had the following characteristics :

a) It would not require any special equipment in the aircraft and its data can be collected during routine flights.

b) It would provide a continuous monitoring of the static pressure error throughout the service life of the aircraft.

c) The data reduction could be executed as a simple addition to a performance monitoring system used by many, though perhaps not all, airlines.

2.3.3.2 A short discussion revealed that the application of the performance-check procedures to the checking of static pressure errors could be performed in different ways. Preliminary tests executed in the UK and in the Netherlands had indicated two different approaches. A description of the basic principles and of the different procedures is given in Appendix B.

2.3.3.3 The Group noted that further evaluation of the performance-check method would be necessary before it could be established whether this method could be used in connection with the reduction of vertical separation and that recognition of the method by the Airworthiness Committee might be required. It was pointed out that, even if the method should be adopted, this should not in any way delay implementation of Recommendation 1/2 of the 7th Meeting of the Airworthiness Committee, which reads as follows :

"RECOMMENDATION 1/2 - TEST PROGRAMMES OF SELECTED IN-SERVICE AEROPLANES USING THE TRAILING CONE METHOD

> That Contracting States be requested to conduct, on a sampling basis, static pressure system position error measurements of selected in-service aeroplanes, using the trailing cone method, and that the results of these test programmes be reported to ICAO."

In this respect the Group strongly supports this Recommendation and urges States to ensure that operators under their jurisdiction implement a programme of trailing-cone measurements as soon as practicable to provide a body of data in support of studies leading toward more accuracy in altimetry.

2.3.3.4 It was remarked that even if the method could not be accepted as an alternative to the trailing-cone method its application could provide new data on the static pressure error which could be taken into account in the statistical analysis of the collision risk. It was pointed out that the use of these data would not only affect the tail area of the assumed distribution function of the static pressure error but might also lead to a reconsideration of the assumption on tail shape.

2.3.3.5 In view of what was discussed the Group unanimously expressed the desire that this method should be further evaluated. An evaluation programme should provide information on both the UK and the Netherlands approaches to the performance check method and should provide comparisons with trailing-cone tests. It requested IATA to investigate whether it could organize such a data collection programme along the lines indicated in Appendix B. In view of the considerable experience of KLM Royal Dutch Airlines in the application of this method, the Group requested the Netherlands' Member to investigate whether that airline could do the data reduction for this programme along the lines indicated in Appendix B. In addition the UK and the Netherlands were requested to assist in the preparation of the exercise and the drawing-up of a final report on the results of the programme.

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MATHEMATICAL MODEL FOR THE

TREATMENT OF VERTICAL SEPARATION

1. Let N_{az} be the expected number of aircraft accidents per 10 million aircraft flying hours, due to failure of vertical separation.

Suppose, for simplicity, that the effects of wing-tip vortices are assumed to be negligible, so that the only accident risk is that due to metallic collision. Counting a collision as two aircraft accidents, N_{az} is given by:

$$N_{az} = \frac{2 \times 10^7}{H} P_z \text{ (std)} \left\{ \frac{T_z(\text{same})}{S_x} \left[\frac{\overline{\Delta V}}{2} P_y(0) + \lambda_x N_y(0) + \frac{\lambda_x |\bar{\dot{z}}| P_y(0)}{2\lambda_z} \right] + \frac{T_z(\text{opp})}{S_x} \left[\bar{V} P_y(0) + \lambda_x N_y(0) + \frac{\lambda_x |\bar{\dot{z}}| P_y(0)}{2\lambda_z} \right] \right\} \quad \text{..... (1)}$$

Where:

P_z(std) is the probability that the separation, in the vertical direction, of a pair of aircraft assigned to adjacent flight levels is less than an aircraft's thickness.

$P_y(0)$ is the probability that the separation, in the across-track direction, of a pair of aircraft assigned to the same track is less than a wingspan.

$N_y(0)$ is the expected frequency with which the across-track separation of a pair of aircraft, assigned to the same track, shrinks to less than a wing-span.

$\overline{\Delta V}$ is the average difference of the cruising speed in proximate pairs of same-direction aircraft.

$\bar{V}$ is the average cruising speed.

$\overline{|\dot{z}|}$ is the average relative vertical velocity of a pair of aircraft assigned to adjacent flight levels when the actual separation in the vertical direction is less than an aircraft's thickness.

H is the total flying time (in aircraft-hours) during the period, and in the region, considered.

T_z(same) and T_z(opp) are the vertical proximities, as described in Appendices 4-A and 4-B to Ref.1, aggregated over the period considered for, respectively, same-direction and opposite-direction pairs of aircraft.

S_x is the along-track separation, within which a pair is counted as proximate.

λ_x is aircraft length.

λ_z is aircraft thickness.

Equation (1) above is derived from equations (5), (15) and (16) of Appendix 4-B in Ref.1. It is subject to the "Blind-flying" assumption: that is, no allowance is made for any change in collision risk which is due to visual collision avoidance.

2. In the case of lateral separation the effect of wing-tip vortices was represented (equation (1) of Appendix 4-C to Ref.1) by simple coefficients applied to the metallic length of the aircraft. For the vertical case, the representation would be more complicated because the vortices are propelled downwards (Ref.2), and may therefore be penetrated when much less than the whole of the standard vertical separation has been lost. To take account of vortex penetrations

it would be necessary to replace P_z(std) by a function of the standard vertical separation and the along-track distance between the aircraft. There is insufficient knowledge of the accident risks, if any, due to penetrating vortices in cruise to serve as a basis for a realistic model at present.

3. In the UK approach described in Ref.3, the "metallic" collision slab, $\lambda_x \times \lambda_y \times \lambda_z$, was taken to have the following dimensions:

λ_x = 150 ft.

λ_y = 150 ft.

λ_z = 40 ft.

These are the same as the values agreed at the Second Meeting of the Group (Ref.1, Item 4). Other numerical values used in Ref.3 were as follows:

$P_y(0)$ = 0.0011

$N_y(0)$ = 1.1 per hour (to derive this figure, a value of 52 knots is taken for the mean across-track relative velocity, $|\overline{\dot{y}}|$, of a pair of aircraft; $N_y(0)$ is then calculated from equation (5) of Appendix 4-B to Ref.1)

$\overline{\Delta V}$ = 12 knots

$|\overline{\dot{z}}|$ was taken to be of the order of 1 knot when the contribution of the flight - technical error is small compared with the total height-separation error (cf. Appendix A of Ref.3)

H = 1.5×10^6 hours, for the period 1966 through 1971

T_z(same) = 1.6×10^5 hours, for the period 1966 through 1971

S_x = 120 NM

In Ref.3 estimates were made of the collision risk associated with the application of the 1 000 ft. vertical standard to same-direction traffic only, (vortices neglected). In this case, equation (1) is reduced to

$$N_{az}(\text{same}) \doteqdot 600\ P_z\ (1\ 000\ \text{ft.}); \qquad \ldots\ldots (2)$$

T_z(opp) could not be forecast reliably; recent traffic forecasts suggest that it is probably of the order of 10^4 hours, for the period 1966 through 1971. Hence from equation (1), and taking V to be 480 knots, it would then appear that N_{az}(same) is of the same order as N_{az}(opp).

4. It is to be noted that many of the numerical values used in Ref.3 can be checked, and revised where necessary, in the light of the data collection discussed under Agenda Item 1.

APPENDIX B

PERFORMANCE - CHECK METHODS FOR MONITORING STATIC PRESSURE ERRORS

1. Synopsis

1.1 A static pressure error causes the indicated Mach number and airspeed to differ from their correct values. An aircraft with such an error therefore tends to use more or less thrust than is normally needed to cruise at a given indicated Mach number or airspeed. Thus the effect of a static error can be observed as a change from the normal indication in cruise of any of the instrumental measures of thrust, such as fuel flow, engine pressure ratio, rpm.

1.2 Static error is not the only possible cause of such a change. Variations in drag and engine performance may give similar effects. However, these can probably be distinguished from the effects of static errors by observing the change in a thrust parameter at two speeds, for example, at cruising Mach numbers which differ by about 0.03M. Although the quantities which can be measured are insensitive to static error when the speed is at or below the long range cruise value, their sensitivity increases rapidly with speed above this value. The precision with which a persistent static error can be measured depends not only upon the speed but also upon the instrumental and recording errors made in observing the thrust parameters and ambient conditions; significance improves with the number of flights on which the observations are repeated.

1.3 In the first method, a set of data consists of readings of a number of instruments taken at only one Mach number. For some airlines, such data can be obtained in sufficient number from the flight engineer's logs normally made during each long-range flight. In the second method, one set of data consists of two sets of instrument readings, each taken at a different Mach number during the same flight. This has the advantage that several causes of error can be eliminated, and a direct estimate of static error, unconfused by drag and engine effects, can be made from one flight. However, whereas the first method has received some operational evaluation, the second has so far not been tried.

1.4 The objective of the suggested programme of data collection and analysis is to assemble results from a representative set of aircraft types and operators to show:

(a) The sensitivity of each method as a continuous monitoring device, in terms of the number of flights needed to reveal static errors of a given size, and also in terms of the "false alarm" rate.

(b) The precision attainable if each method were to be applied as a means of initially checking static systems of individual aircraft, relative to the average for all aircraft of the same type.

2. The effect of a static pressure error on aircraft performance.

2.1 If an aircraft flies with an uncorrected static pressure error, its indicated pressure altitude and its indicated Mach-number will differ from the true values, even if the instrument errors are zero. If the pressure measured in the aircraft is higher than the true static pressure, then the true pressure altitude and the true Mach number will both be higher than the indicated values. If the measured pressure is lower than the true static pressure, the reverse will be true. The engine thrust required to make an aircraft fly at a certain indicated altitude and Mach number will, therefore, be different from what could be expected if the aircraft has an uncorrected static pressure error.

2.2 This effect can be easily shown on a generalized cruise performance chart, such as given in fig. 2-B-1 for a modern four-engined jet airliner. On this chart the engine pressure ratio (EPR) is given as a function of W/δ and Mach number (the meaning of the symbols is explained in section 7 below). Similar charts can be made for other "non-dimensional" engine parameters such as $N/\sqrt{\Theta_t}$, $FF/\delta_t\sqrt{\Theta_t}$, EGT/Θ_t, etc.. In the figure it is shown that if the true pressure altitude and the true Mach number are higher than the indicated values, the EPR value will also be higher than would be expected from the indicated altitude and Mach number. If the true pressure altitude and the true Mach number are lower than their indicated values, then the EPR will also be lower than its expected value. The figure also shows two properties which are of importance for the application of the performance-check method:

a. for a given value of the static pressure error the effect on the thrust parameter will be larger if the true pressure altitude is higher than the indicated altitude, than if the true pressure altitude is lower than the indicated altitude

b. for a given value of the static pressure error the effect on the thrust parameter will increase progressively as the cruising Mach number increases.

3. The principle of the performance-check method.

3.1 In the performance-check method this effect is used to determine the static pressure error. The principle of this method can be described as follows:
During stabilized cruise at least the following parameters are recorded, measured as close in time as possible:

- captain's altitude
- captain's Mach number
- aircraft total weight (determined from take-off weight and fuel consumed)
- the data required for determining one "non-dimensional" engine parameter, such as EPR or $FF/\delta_t\sqrt{\theta_t}$.

On the ground the recorded value of the engine parameter is compared to the value of this same parameter, determined from the performance chart such as fig. 2-B-1 at the recorded values of Mach number, altitude and weight. The difference between these 2 values of the engine parameter can then be transformed into an "apparent" static pressure error by means of a graph such as shown in figure 2-B-2, which can be easily constructed from the performance graph.

3.2 The quantity found in this way is called "apparent" static pressure error because its value can be influenced by a number of other factors than the static pressure error. The most important effects which can cause differences between the "apparent" and the true static pressure are:

- errors in the recorded values of the engine parameters, pressure altitude and Mach number. These can, for instance, be due to instrument errors, to reading errors or to the fact that not all readings have been taken at the same instant
- errors in the estimate of the aircraft gross weight at the moment that the readings were taken
- deviations of the aircraft drag characteristics from those, on which the performance chart was based
- deviations of the engine performance from those on which the performance chart was based. These can include differences between individual engines, effects due to ageing, to the use of fuel with a different calorific value, to the use of different bleed configurations, etc.
- deviations of the required engine thrust from its normal cruise value. These can, for instance, be due to the fact that the aircraft was not completely stabilized or that it was flying in a region with non-horizontal isobaric planes.

Some of these effects, such as reading errors of the instruments, parts of the errors in the weight estimate, etc. are transient, i.e. they are different for each flight. The influence of these effects can be reduced by using the mean value of a number of "apparent" static pressure errors determined from sets of data obtained from different flights. Other effects have, however, a more persistent character. These include, for instance, individual differences in drag and in engine performance. Such effects may persist for a long time, even during the complete service life of an aircraft.

3.3 It will be clear that an unfavourable combination of the effects mentioned in paragraph 3.2 may cause the "apparent" static pressure error to be very much different from the true static pressure error. This means that a simple application of the principle described in par. 3.1 will not even be accurate enough for the detection of the large static pressure calibration errors (larger than 300 feet) which will, according to the theory developed in ref. 3, endanger the safe application of 1000 feet vertical separation. It would seem, however, that refinements in the application could greatly increase the attainable accuracy. The best way to achieve this can only be found after more data on the method have become available. Two possible methods, which are based on a small amount of tests done by two different airlines, are described in the next sections. The "one Mach number per measurement" method commends itself by the fact that no special flying procedures will be necessary for its application. Although its accuracy is not very high, preliminary tests seem to indicate that it is sufficiently high to give an alarm that there is a possibility of a static pressure error of the order of 200 or 300 feet; special procedures are then available to establish whether there is a large static pressure error or not. The "two Mach number per measurement" method requires a somewhat more elaborate procedure during flight, but will produce results which are much less influenced by the errors mentioned in par. 3.2.

4. Application of the performance-check principle by the single-Mach-number method.

4.1 For the application of this method in principle only the parameters mentioned in section 3.1 are required. For the cross-checks described in section 4.2 some redundant information is necessary. If possible the following parameters should be recorded:

- the readings of 2 altimeters
- the readings of 2 Machmeters
- the readings of 2 airspeed indicators
- the aircraft total weight (determined from take-off weight and fuel consumed)
- the data required to determine at least 2 of the "non-dimensional" engine parameters for each of the engines.

The readings must be taken as close in time as possible during stabilized cruise in the normal ranges of cruising altitude, weight and speed. Because the method becomes less sensitive as the Mach number is reduced (compare fig. 2-B-1), it will be necessary to specify a minimum cruising Mach number for useful information. These measurements will in most cases be recorded a few times during long-distance flights in the flight engineers log, so that in most cases there will be no need to apply any modification to the cockpit procedures.

4.2 The first step is to eliminate gross errors, introduced by errors in the recording of the values on the log sheet, by errors in transcribing these for further use, by errors introduced by the fact that all values have not been written down simultaneously, etc. This will involve the following steps:

- checking whether there are no intolerable differences between recordings of the same parameter from different sources, i.e. comparison of the readings of the different altimeters, Mach meters and airspeed indicators
- checking whether the Mach number computed from the readings of the altimeter and airspeed indicator does not differ too much from that read from the Machmeters
- comparison of the mean values for all four engines of the two different "non-dimensional" engine parameters, in order to check whether they are consistent with each other
- checking aircraft performance (Naut. miles/lb) and comparing this with the performance of the engines (fuel consumption-thrust relation) and of the airframe (thrust required).

The reason for this procedure is to eliminate the obvious gross errors. The margins for which the data will be rejected will have to be established after some more experience is available. In some cases it may be possible to find the cause of the gross error and to correct it. In most cases it will, however, be easier to reject the complete set of data.

4.3 If the data have been accepted by the gross error check, the "apparent" static pressure error can be calculated by the procedure described in paragraph 3.1. Further experience must indicate whether in this calculation the mean value of all altimeter readings and Mach readings must be used, or whether the calculation must be based on the readings of the captain's instruments only. If the mean values are used, the effect of small reading errors will be reduced but the difference of the static pressure errors of the different static ports is introduced. The calculation of the "apparent" static pressure error will be based on the mean value of the most suitable of the "non-dimensional" engine parameters.

4.4 If the method is used for periodic checks, then a comparison with previous values will show immediately whether large changes have occurred. Persistent errors can be eliminated if one of the previous measurements has been compared with an absolute measurement (trailing cone test) and a "calibration" of the performance check method has thereby been established. First results with the application of the method seem to indicate that not all aircraft will have to be tested by a trailing cone, but that a few of these tests will establish the calibration of the performance-check method for all aircraft of one type.

If the "apparent" static pressure error, even after application of the calibration, should be found to be too large, there is still a possibility that this is not due to a true static pressure error but that it is caused by one of the effects mentioned in par. 3.2. This can be established from a special investigation, for which a number of procedures are available. These include visual inspection of the aircraft, more detailed performance measurements (including the "two Mach number per measurement" method described in section 5) and in extreme cases a trailing-cone test.

5. Application of the performance-check principle by the "two Mach number per measurement" method.

5.1 For the application of this method it is necessary to introduce a special flight procedure: the pilots must be requested to stabilize the aircraft at 2 different Mach numbers within a short time (the shorter the better, as long as the aircraft has attained a steady state) during the same flight. The difference between these 2 Mach numbers must be of the order of 0.03. If the cruising Mach number is high enough to ensure sufficient speed stability, the measurement at the lower of the 2 Mach numbers can be made during normal cruising. For each Mach number the same data must be recorded as for the single-Mach-number method (see paragraph 3.1), and in addition the change in weight between the 2 recordings must be known (from time and mean fuel consumption).

5.2 Gross errors can be eliminated by the method described in paragraph 4.2. Then the "non-dimensional" engine parameters P_1 and P_2 are calculated together with the values they should have at the measured altitude, Mach number and weight according to the cruise performance chart such as shown in figure 2-B-1. If these latter are called P_1' and P_2' for the 2 Mach numbers, then the value D can be calculated from the following formula:

$$D = \frac{P_1}{P_1'} - \frac{P_2}{P_2'} .$$

The extent to which D differs from zero provides an estimate of the static pressure error. Its value can be calculated from the aircraft performance characteristics or from a graph graph developed from it.

5.3 The scatter in these estimates of static pressure error obtained by this method is expected to be less than that obtained by the other method, and the errors in the mean value will probably almost be eliminated.

6. Comparison of the two methods.

6.1 There is as yet insufficient experience with these methods to give a complete appraisal of their characteristics. The following remarks can, therefore, only be regarded as preliminary.

6.2 The main advantage of the "one Mach number per measurement" method seems to be its operational simplicity. The required data are recorded as a routine operation during long-range flights of the majority of the airlines. A problem is, that sufficient sensitivity is only obtained at Mach numbers which are somewhat above the normal cruise Mach number of many airlines. A first analysis by KLM showed that in their case a sufficient number of flights at the higher Mach numbers is made by each aircraft to ensure that enough data become available. Further experience with other airlines will have to show whether this is a general rule. If it should not be the case, special procedures may be required to ensure that usable data become available at sufficiently short intervals.

6.3 Whether the "two Mach number per measurement" method really can provide a much higher accuracy will have to be demonstrated. It seems that BOAC has experienced some difficulty in preliminary trial runs for this method, in achieving sufficiently stabilized flight conditions before the measurements are taken. This problem is absent in the "one Mach number per measurement" method if the data are obtained during normal cruising flight. It may, however, also occur there if too few data become available at sufficiently high Mach numbers.

7. Outlines of an evaluation programme for the performance-check method.

7.1 In this section the broad outlines will be given of an evaluation programme, which was requested by the Group. They are intended as a guideline to those who will participate in such a programme.

7.2 It is proposed that the data collection be made on both methods described above. The absolute accuracy of the method can best be established by a comparison with an absolute static pressure calibration which is made during or shortly before the period in which the measurements are made. It will not be possible to execute such an absolute calibration for all aircraft concerned, but the measurements should include a number of aircraft which are being, or have been, subjected to trailing-cone tests or to some other absolute calibration.

Data for the "one Mach number per measurement" method can be obtained from past data on flight logs available in the files of the airlines. For data used for this method it should be stated whether they have been obtained from normal flight logs or whether the crew was aware that measurements were taken especially for this data collection.

7.3 The number of data necessary to establish the validity of the method will depend on the scatter in the results. For a first survey it would seem to be desirable that the sample for each of the 2 methods should consist of about 100 aircraft, distributed over about 10 different operators and over about 10 different types. For each aircraft 10 to 20 independent sets of data should be supplied.

7.4 The data should be supplied only for flights under normal cruise configurations. Flights with abnormal bleed conditions (de-icing) should not be included. Any card corrections used with the instruments should be stated. All data listed in par. 4.1 should be supplied. It is to be preferred if one of the "non-dimensional" engine parameters should be fuel flow.

8. Symbols.

EGT = exhaust gas temperature

EPR = engine pressure ratio

FF = fuel flow rate

M = flight Mach number

N = rpm of the engine (for 2-spool engines either spool can be used)

PA = pressure altitude

W = instantaneous total weight of the aircraft

δ = ratio between static pressure at flight altitude and standard pressure at sea level

δ_t = ratio between total pressure on the aircraft and standard pressure at sea level

θ_t = ratio between total temperature on the aircraft and standard temperature at sea level

Fig. 2 - B - 1

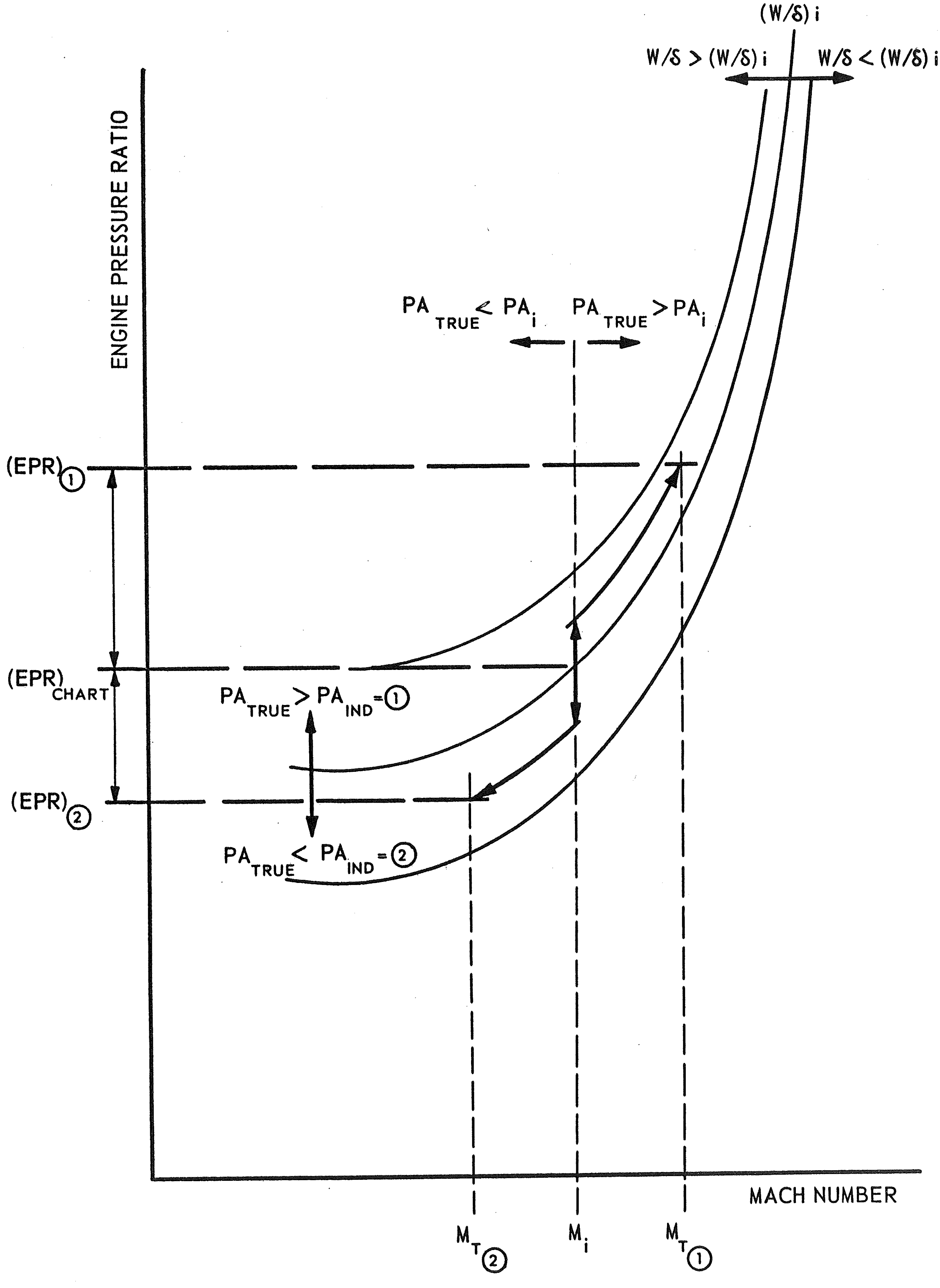
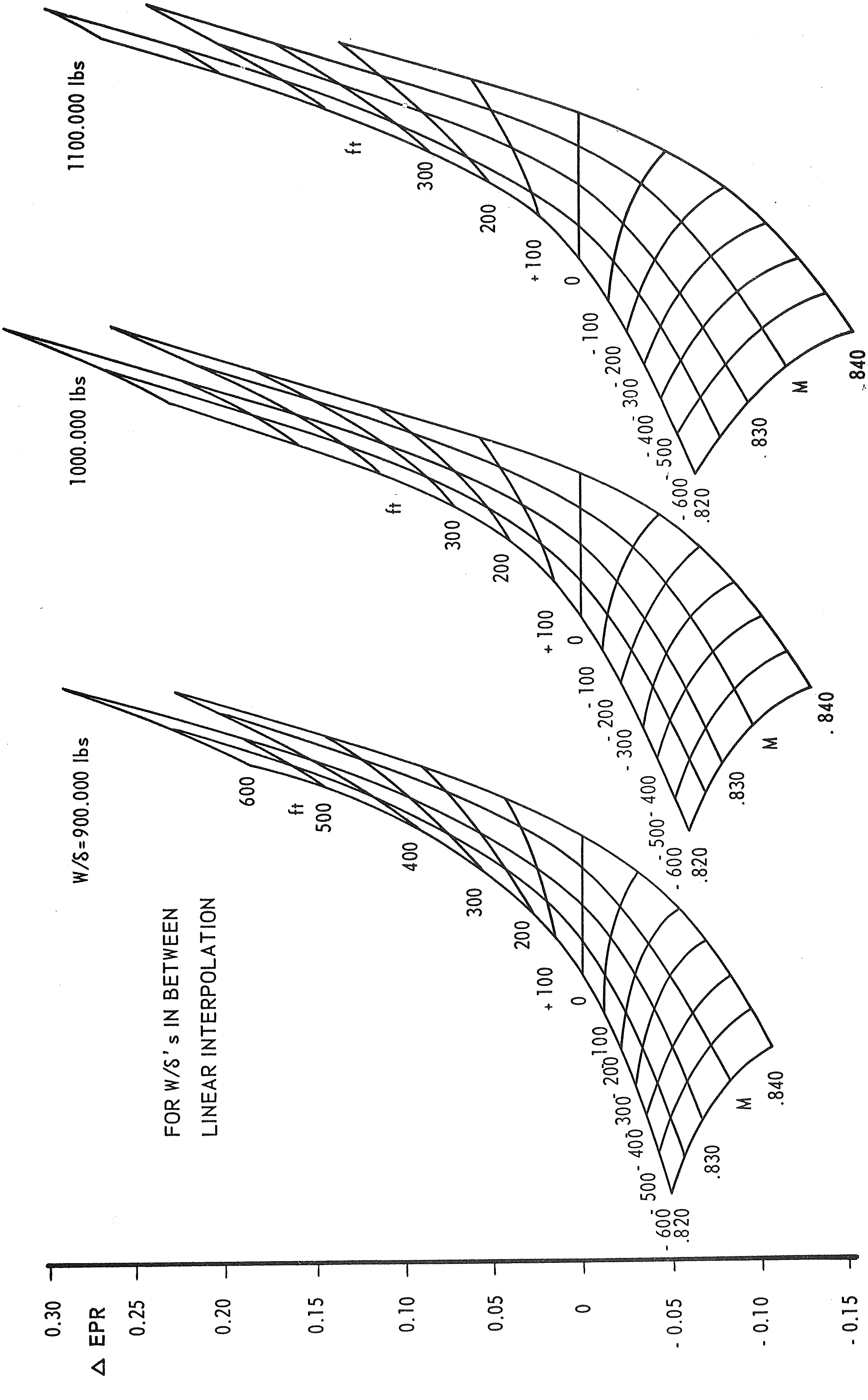

(W/δ) i
W/δ > (W/δ) i
W/δ < (W/δ) i
ENGINE PRESSURE RATIO
PA TRUE < PA i
PA TRUE > PA i
(EPR) 1
(EPR) CHART
(EPR) 2
PA TRUE > PA IND = 1
PA TRUE < PA IND = 2
MACH NUMBER
M T2
M i
M T1

Fig. 2 - B - 2

DC-8 4% LEADING EDGE EXT. JT 3D-3 ENGINES



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3. Summary of Agenda Item 3 : Review of the NAT Air Reporting Procedures

3.1 General

3.1.1 Two surveys covering the ATC and MET aspects of the NAT Air Reporting Procedures respectively were carried out in 1966 by the European Office of ICAO. Comments by States on these reviews revealed general dissatisfaction with the Air Reporting Procedures which had been developed at the Special NAT Regional Meeting (1965) and surveys of the air reports revealed that as much as 50% of the air reports made by pilots were not in accordance with the procedures. It was therefore believed that this matter required early attention and since the NAT Systems Planning Group contained representation from at least the major provider States in the NAT Region, the Group agreed to review this matter with the intention of preparing proposals for improvement of the Air Reporting Procedures which could be put to the NAT States for consideration.

3.1.2 When looking into the reasons for the present unsatisfactory situation, the Group found that, apart from a number of specific shortcomings which are treated below, there existed also a number of general difficulties which appeared to require improvement. One of these general shortcomings concerned ICAO Doc. 7030 which, especially as far as the NAT Region is concerned, serves as a basic reference document both to operators and ground services. The present lay-out of this document, whereby procedures of a number of Regions are sometimes consolidated into one single paragraph and the editorial lay-out of the document, which, to the uninitiated reader, presents considerable difficulties, was believed to be one of the reasons for the genereal difficulties experienced not only with air reporting, but also with other aspects of air navigation. It was therefore believed that a re-arrangement of this document, whereby Regional Supplementary Procedures applicable to the various air navigation services would be presented Region by Region, could considerably improve the present text.

3.1.3 A further source of difficulties was the lack of consolidated presentation of all applicable procedures concerning air reporting and associated services and facilities in the NAT Region. The fact that these procedures and information on facilities and services are now distributed throughout a number of national AIPs, some of which are not even arranged in accordance with the specifications of Annex 15, does not facilitate matters either. It was therefore agreed that an Information Circular should be prepared and should be published by all provider States in the NAT Region, and that this Circular should be up-dated from time to time as required. A draft of such an Information Circular is attached in Appendix A.

3.1.4 A third point was that experience by one country had shown that the provision of a suitable form, for pilots engaged in regular operations across the North Atlantic, showing in diagrammatic form the requirements for air reporting, could do much to improve adherence to established procedures.

3.1.5 A detailed review of the Air Reporting Procedures was conducted by the Group in two stages :

i) A review of the existing Air Reporting Procedures with a view to developing immediate improvements.

ii) A general review of air reporting in the NAT Region with a view to developing a long-range solution to this matter.

In the course of its discussions the Group found, however, that, apart from a number of technical developments in the communications field there appeared to exist very little possibility to make a distinctive difference between short-range and long-range improvements. It was felt that air reporting would have to develop along evolutionary lines which were dictated by developments in a number of air navigation fields. Therefore no distinct difference between these two aspects of the question has been made in this summary.

3.1.6 The Group noted that amongst both operators and ground services concerned there existed a general desire to reduce air reporting, not only with regard to the number of reports required to be made but also with respect to the contents of each of these reports. A realistic appraisal of the present situation in the ATS, MET and COM fields in the NAT Region revealed, however, that any such reduction could, at this time, only be applied to a selected part of the overall traffic operating in the Region. This means that special procedures would have to be developed to cover this possibility. This, in turn, however, increased the complexity of the procedures to the point where they became impracticable in actual application. It was therefore agreed that it would be essential in any proposal for a change to the present unsatisfactory procedures to strike a compromise between the sophistication of the procedure itself and the facility with which it could be applied. It was therefore agreed that the only basic difference in the procedures should be between aircraft operating outside the organized track system and those flying in this system.

3.2 ATS requirements for air reporting.

3.2.1 Contents of position reports.

3.2.1.1 It was agreed that all the elements contained in Section 1 of the air report were required from aircraft operating outside the organized track system. For aircraft operating in the organized track system it was pointed out that the item "next position and time over" was not absolutely essential with each position report. The Group agreed, however, that, in order to achieve uniformity of position reporting within the region, it would be better at this time to include this item in all position reports. The indication of the next position in a position report offers the possibility of detecting any possible misunderstandings between pilots and the ATC units concerned regarding the route to be flown.

3.2.1.2 Experience with the application of the Mach number technique had proved very satisfactory and it was therefore believed that the initial safe-guard requiring the reporting of the current Mach number with each position report was no longer necessary and should be eliminated from the Regional Supplementary Procedures. This presupposed, however, that the requirement for obtaining ATC approval before making any changes to the Mach numbers or the immediate notification of ATC, in cases of temporary changes to the Mach numbers, be strictly applied.

3.2.2 <u>Frequency of position reports</u>

3.2.2.1 The Group believed that, in theory, it would be possible to retain the procedure whereby a full position report was made only every 20° of longitude while abbreviated reports would be made at the intermediate points of 10° longitude. Practical experience had, however, shown that this was not satisfactory. The New York Oceanic ACC modified this procedure and imposed a requirement for full reports at every 10° of longitude due to crossing traffic. The Lisboa Oceanic ACC issued a NOTAM also requiring full reports at every 10° of longitude.

3.2.2.2 In addition, it was also noted that the PANS-RAC concerning alerting service (para. 2. in Part VI of Doc 4444) which are applicable in the NAT Region (para 6.2.1 in Part 2 of Doc 7030 refers) required that an "Operations normal" message had to be sent whenever the time between successive position reports exceeds one hour, which would be the case when 20° interval reporting was applied.

3.2.2.3 It was therefore agreed to return generally to the practice of requiring a position report from all aircraft at every 10° of longitude.

3.2.2.4 It was nevertheless believed useful to draw attention to the desirability of amending the PANS-RAC at the next suitable opportunity so that, within controlled airspace, position reports spaced at more than hourly intervals did not automatically require the transmission of an "Operations normal" message.

3.2.3 Operation on a fixed track system between Canada and the USA and the Bermudas and the CAR Region.

3.2.3.1 It was noted that a large proportion of NAT traffic operates on a fixed track system which has been established between Canada, the USA, Bermuda and the CAR Region. It therefore appeared necessary to develop appropriate SUPPS to cover these operations which are conducted differently from other NAT traffic as far as flight planning, designation of reporting points and reporting of position were concerned.

3.2.4 Designation of tracks in the organized track system.

3.2.4.1 Experience had shown that the use of a special designator (consisting of a letter) for each track established in the organized track system within the Gander and Shanwick FIRs helped to reduce loading on the ATC communication channels. In addition it also served to make aircraft entering the NAT Region aware of the fact that they were operating on the organized track system.

3.2.4.2 This would become even more significant if there was going to be a difference between the air-reporting of those aircraft operating on organized tracks and those outside the organized track system.

3.2.5 Revision of Pilots' Estimates

3.2.5.1 The provision in Annex 2, Chapter 3, para 3.5.2.2.1 c), whereby pilots are required to notify ATC of a revision of their estimate for the next designated reporting point whenever there is a difference of 3 minutes or more between it and a previous estimate was considered to be unrealistic in the NAT Region. In many cases such a revision had no significant effect on the progress of the flight and resulted, therefore, only in a superfluous communication. It was, therefore, agreed that in the NAT Region the difference in estimates requiring notification to ATC be increased to 5 minutes.

3.3 Requirement for Section 2 of the Air Report

3.3.1 A review of Section 2 of the air report revealed that the requirement, both by pilots and operators, for the provision of this section no longer existed since in the NAT Region, the operational conditions which had previously motivated its inclusion in the air report had largely disappeared. It was therefore agreed that this Section should, under normal conditions, no longer be transmitted on a routine basis. This should be drawn to the attention of pilots and operators concerned.

3.4 Meteorological aspects of air reporting

3.4.1 Contents of routine aircraft observations

3.4.1.1 The Group noted that the contents of aircraft observations received from NAT flights consisted mostly of temperature and wind only. Together with the occasional turbulence and cloud reports received, this was believed to be adequate and there seemed to be no need to suggest changes.

3.4.1.2 A reduction in message length could, however be effected if there were no need to identify spot winds, which are becoming the large majority of winds reported, by the term "SPOT". It was noted that this affects a world-wide procedure (PANS-RAC, App.1, Part 1, Item 9) and the Group therefore suggested that the possibility of reversing the present arrangement (i.e., so as not to label spot winds but to identify mean winds by the term "MEAN") should be reviewed at the next suitable opportunity.

3.4.2 Frequency of routine aircraft observations

3.4.2.1 The Group noted that the procedures developed by the Special NAT Meeting had been found much too complex and were consequently improperly implemented. This was confirmed by States' comments on an inquiry carried out by the European Office of ICAO prior to the Meeting. The Group agreed, therefore, that a completely new approach was needed to the MET reporting question.

3.4.2.2 Any new approach would have to take into consideration the following important points :

a) comparatively few reports are received from aircraft not operating on organized tracks, while there are too many from aircraft on organized tracks. This latter situation causes a considerable load on the communication channels without adding materially to the quality of the MET service;

b) the expected increase in flights during the coming years will provide an adequate number of reports from aircraft operating outside the track system, but will produce an excessive number of such reports from aircraft on the organized tracks.

3.4.2.3 It was therefore agreed that any exemption or designation procedures should apply only to aircraft operating on organized tracks and should be such as to stabilize the situation in respect of number of reports even when traffic increases. Furthermore, such procedures should, as much as possible, meet the requirement for simplicity laid down in the PANS-MET, 2.3.1.3 c).

3.4.2.4 In view of these considerations the Group developed a simple procedure according to which :

a) aircraft not operating on organized tracks would be required to make and report observations at each reporting point;

b) aircraft operating on organized tracks would neither report nor make observations unless they were designated to make and report observations at all reporting points. Such designations would be made at the rate of one aircraft per track approximately each hour. (The possibility of exempting aircraft only from reporting was considered, but there was considerable doubt as to the utility of such a measure in the NAT Region.)

3.4.2.5 The resulting sequence of aircraft observations, separated by 300-500 NM, was believed to provide sufficient data for operational and basic meteorological purposes (e.g., numerical forecasting), and to offer the important advantage of providing a series of mutually consistent observations from the same aircraft.

3.4.3 Special air reports and SIGMET information

3.4.3.1 Greater attention to the making and reporting of special air reports, often the basis of SIGMET information, was believed to be necessary. In this connection the Group was informed that the transmission of SIGMET information to large numbers of aircraft was causing a considerable workload to ATC and COM personnel apart from the increased loading on the NAT HF communication channels. Transmission by general call (SELCAL) did not appear to be a workable solution, nor utilization of existing NAT VOLMET broadcasts. It was, however, stated that there may be a possibility of including SIGMET information in VOLMET broadcasts when the latter were revised in 1969/70 and offered additional broadcast time. In this case it might be necessary to combine this with a directed transmission drawing the attention of aircraft to the particular VOLMET broadcast.

3.4.3.2 While pilots attribute importance to the provision of SIGMET information, it was agreed that there were certain points which deserved study in addition to the communication aspects. The question was raised whether existing SIGMET procedures took into account the real requirements of turbo-jet aircraft for en-route weather warnings; for example, icing and thunderstorm warnings may not be relevant to flights at their cruising levels. On the other hand, there may be a need for information from pilots on the accuracy or otherwise of SIGMET information received, so as to prevent the large scale dissemination of unnecessary data. Finally, there was also the question of the distance ahead for which SIGMET information was indeed a necessity.

3.4.3.3 It was therefore agreed that both the users and the ground services concerned should collect more definite data on this subject so that a detailed study could be made.

3.5 Communications aspects of Air Reporting

3.5.1 Procedural matters

3.5.1.1 When considering possibilities of alleviating the load imposed on the HF communication channels it was noted that it was normal to read back all ATC parts of messages. In the absence of any detailed information on the number of errors avoided or detected by this method, the Group was unable to decide on the abolishing of this practice. It was, however, suggested that statistics be kept on this so that an early decision could be taken.

3.5.1.2 Since SELCAL code information is now regularly available at the COM stations concerned in the NAT Region it is no longer deemed necessary for the pilot to specify his SELCAL code in the initial check-call.

3.5.2 Technical Matters

3.5.2.1 Statistics provided to the Group showed that the HF air-ground communication channels in the NAT Region were not, as a general rule, overloaded. It was, however, noted that the 2 Mc/s channels in Families B and C suffered heavy loads during peak hours. This resulted from the fact that the 2 Mc/s channel in Family A (2931 Kc/s) was no longer provided at Gander. It was therefore proposed that Canada should re-install this frequency at Gander. Canada agreed to study this proposal.

3.5.2.2 It was also noted that the extended range VHF GP channels provided are not always used to best advantage. In fact, many aircraft changed to, or remained on, HF communication when VHF contact would have been possible. It was therefore agreed that this point should be covered in the Draft Circular attached in Appendix A.

3.5.2.3 Finally it was agreed that, in view of the benefits derived from extended range VHF stations, States should be encouraged to maintain their programmes in this respect in order to improve the air-ground communication situation in the border areas of the NAT Region.

3.6 <u>Conclusion</u>

3.6.1 As a consequence of the above the Group agreed to prepare a proposal for amendment of those SUPPS in Doc 7030 affecting air reporting and other aspects mentioned in this summary. This proposal is attached in <u>Appendix B</u>.

3.6.2 In view of past experience and in order to be sure that this proposal was satisfactory before it was incorporated in Doc 7030, it was agreed that the provider States (Canada, Denmark, Iceland, Portugal, the UK and the USA) should implement its provisions on a trial basis, if possible by the AIRAC date in August, with at least 4 weeks advance notice by NOTAM.

3.6.3 If it is found that the proposal, possibly with amendments made in the light of experience, was successful (this to be determined at a meeting between the provider states concerned, to be held not earlier than 3 months after the beginning of the trial period) it would be formally submitted to ICAO in order to obtain the necessary amendment of Doc 7030. The Group noted with satisfaction that the UK was prepared to formally process the proposed amendment.

INFORMATION CIRCULAR

AIR REPORTING PROCEDURES - NAT RÈGION

1. Introduction

1.1 This information circular is issued to clarify the air reporting procedures applicable in the NAT Oceanic control areas south of latitude 70° N and to identify the communications facilities available to flights within these areas. Attention is also drawn to certain other procedures which, if applied effectively, will result in a more efficient use of the communications channels available.

2. Position Reporting (Part I of the AIREP)

2.1 In the Gander, Shanwick, New-York, Lisboa, Reykjavik and Sondrestrom oceanic control areas (south of latitude 70° N) a position report must be made at each designated reporting point.

2.2 This report shall contain the following :

i) Aircraft Identification

ii) Position and time

iii) Flight Level

iv) Next position and estimated time over.

3. Operational Control Information (Part II of the AIREP)

3.1 Since the information in this part of the AIREP is not required by ATS, it is strongly recommended that it should not be transmitted unless this is considered essential by the operator or pilot. It is believed that adoption of this recommendation will achieve an appreciable reduction in HF communication channel loading.

4. Meteorological Observations (Part III of the AIREP)

4.1 Meteorological information shall be transmitted with every position report except that when an aircraft is cleared on one of the organized tracks (e.g. "Track Bravo") it will only make and transmit these observations if it is instructed "SEND MET REPORTS" when receiving its oceanic clearance.

5. Use of Communications Channels

5.1 VHF General purpose facilities

5.1.1 To reduce the loading of HF channels maximum use should be made of the VHF general purpose facilities available within the NAT Region. The approximate coverage of the stations concerned is shown in the diagram at the Appendix A. Maximum use of VHF will contribute to the speed and efficiency of the communications service in the remaining area where only HF can be used.

5.2 SELCAL Checks

5.2.1 It is no longer considered necessary for the SELCAL code to be transmitted by the pilot when he is initiating a SELCAL check since this information should always be available at the ground station.

-NOTE

A diagram forming Appendix A should be produced indicating the VHF general purpose cover available in the land areas bordering the NAT Region. This diagram to incorporate examples of the Air Reporting procedures required on :

i) a northerly oceanic track between Europe and North America
ii) a southerly oceanic track between Europe and North America
iii) a Great Circle track between Ireland and Newfoundland
iv) a track aligned in a north-south direction for example between Iceland and the Azores.

Proposed amendment to the NAT Regional Supplementary Procedures

Doc 7030, Part 2 : Rules of the Air, Air Traffic Services and Search and Rescue

Para. 4.1.1.1 add a new sub-para 4) as follows :

"4) For flights operating along the fixed ATS route network between Canada, the USA, Bermuda and the CAR Region, the track shall be defined by appropriate reference to this route network."

Para. 4.1.1.3 amend to read : "Significant points other than those established in the fixed ATS route network between Canada, the USA, Bermuda and the CAR Region, shall be indicated by whole or half degrees of latitude and whole degrees of longitude, except that for flights operating north of 70° N the latitude shall be indicated in degrees and minutes."

Para. 4.5.1 amend to read : "An abbreviated clearance shall only be issued by ATS when clearing an aircraft to follow one of the organized tracks throughout its flight within the NAT control areas. In all other circumstances full details of the cleared track shall be specified in the clearance message."

Para 4.5.1.1 amend to read : "When an abbreviated clearance is issued it shall include :

i) cleared track specified by a code letter;
ii) cleared flight level;
iii) cleared Mach number;
iv) if the aircraft is designated to report meteorological information in flight, the phrase "SEND MET REPORTS" e.g., "Cleared track ALFA, FL 350, Mach. 82 SEND MET REPORTS"."

Para 4.5.1.1.1 amend to read : "On receipt of an abbreviated clearance the pilot shall read back full details of the track specified by the code letter and in addition the other contents of the clearance message."

Para 4.5.1.1.2 remains

Para 4.5.1.2 delete

Para 5.2.2 amend to read : "Unless otherwise required by ATS, position reports shall be made at the significant points listed in the flight plan. For flights operating along the fixed ATS route network between Canada, the USA, Bermuda and the CAR Region, position reports will be made over designated reporting points specified in the route network.

Para 5.2.5.2 Next Position and Time Over - amend to read : "Next position" shall normally be expressed as the significant point at which the aircraft is next required to report its position."

After Para 5.2.5.2 insert new para to read : "If the estimated time over the next significant point is found to be in error by 5 minutes or more a revised estimated time over shall be transmitted as soon as possible to the appropriate ATS unit."

Para 5.2.5.3.1 delete

Para 5.2.5.4 delete

Part 4 : Meteorology

Para 2.3.1 1) delete the supplementary procedure applicable to NAT only and replace by : "All aircraft flying in the Gander, Shanwick, New-York and Lisboa Oceanic FIRs between North America and Europe, in either direction, shall make and record routine meteorological observations * at each designated reporting point, except that aircraft cleared on an organized track in accordance with para 4.8 of Part 2 of these Regional Supplementary Procedures shall be required to make and record routine observations only when designated as MET reporting aircraft in accordance with 2.3.3 of Part 4 of these procedures (see below).

Para 2.3.1 1) Note denoted by asterisk to be retained, but "or" to be amended to read "of".

Para 2.3.1 1) Note denoted by ≠ at bottom of column 2 of page 4-1-4 to be deleted.

Para 2.3.3 delete the supplementary procedure applicable to NAT only and replace by : "All aircraft flying in the Gander, Shanwick, New-York and Lisboa Oceanic FIR between North America and Europe, in either direction, shall report routine meteorological observations * at each designated reporting point, except that aircraft cleared on an organized track in accordance with para 4.8 of Part 2 of these Regional Supplementary Procedures shall be required to report routine observations only when notified at the time of receiving Oceanic clearance that they are to "SEND MET REPORTS". "Such designation should apply to one aircraft per track at approximately hourly intervals.

REASONS FOR DRAFT AMENDMENTS TO REGIONAL SUPPLEMENTARY PROCEDURES

Part 2

Para 4.1.1.1 and 4.1.1.3 These amendments together with that made to para 5.2.2 are intended to cater for procedures applicable in the fixed ATS route network established between Canada, the USA, Bermuda and the CAR Region, which carries a large amount of international air traffic.

Para. 4.5.1 In relation to the organized track system it is proposed to adopt a system of abbreviated clearances to reduce loading on communication channels and to expedite the delivery of clearances to NAT flights.
It is considered desirable to delete the phrase "cleared via flight planned route" as experience has shown this to be prone to error and the method has therefore fallen into disuse.

Para 5.2.2 The intention of this amendment is to satisfy the ATS requirements of all NAT centres and to simplify the existing procedures which have proved too complex.

Para. 5.2.5.2 This is consequential to amendment of para. 5.2.2

New para. after 5.2.5.2 The 3 minute standard specified in Annex 2, Chapter 3, para. 3.5.2.2.1 c) is considered to be unrealistic with the NAT control areas where the navigational environment is less precise than in continental airspace.

Para. 5.2.5.3.1 Consequent upon deletion of abbreviated reports.

Para. 5.2.5.4 Satisfactory experience of the application of Mach number techniques has resulted in no further ATS requirement for this information. Further simplification of the Air Reporting Procedures can therefore be achieved.

<u>Part 4</u>

Para. 2.3.1 1) The existing procedures have proved to be too complex and ineffective in practice. It is considered that the proposed designation procedure operated by the appropriate ATC unit represents a much simpler procedure which does not require interpretation by flight crews in relation to direction and time of flight and which will contribute to a reduction in HF channel loading during periods of dense traffic.

The proposal represents an attempt to rationalize and distribute more effectively the provision of meteorological data across the North Atlantic Region. It preserves the level of meteorological reporting in areas where traffic is relatively light but where applied to flights within the organized track system will still ensure an adequate coverage of aircraft observations to satisfy the reasonable needs of the units providing meteorological services in the North Atlantic Region.

In detail, it is considered that the proposal recognizes the basic need for the provision of in-flight observation of upper atmosphere conditions in an area where surface based radio sonde stations are sparsely distributed. It provides necessary material to assist in the construction of upper air and significant weather charts, to assess the validity of forecast charts and furthermore supplies an essential means of up-dating forecasts. It is believed that application of the revised procedures will result in provision of a series of mutually consistent observations, from each aircraft, separated by a distance of between 300 and 500 NM along its track. This interval should be adequate for synoptic purposes and should facilitate detection of erroneous information.

It is recognized that some reduction in quantity will occur at peak periods within the organized track system. Nevertheless the number of "MET designated" aircraft should provide an acceptable network of observations from that part of the North Atlantic Region covered by the organized track system without involving a complicated exchange of data between ATS and Meteorological units concerned.

Para 2.3.1 — 1) Deletion of the note relating to aircraft registered in Australia is required as this stipulation does not apply in the proposal for amendment of the main paragraph.

Para 2.3.3 — Introduction of the revised procedure in para 2.3.1. 1) will remove the need for the provisions of this paragraph.

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4. Summary of Agenda Item 4 : Exchange of views on Criteria for Assessment of System Performances

4.1 General

4.1.1 The Group was guided by the Report of the special North Atlantic Meeting (Montreal, 1965) on Agenda Item 3b, and took particular note that "the intent was in fact to establish criteria which might assist in the assessment of the system as a whole, now in being or planned for use in the NAT Region, rather than for the assessment of the requirements of such a system and that the criteria intended to be developed for the assessment of system performance in term of capacity over the North Atlantic were not to be applied in practical day-to-day operations in the field of air traffic services. They are intended as a tool for application in any joint efforts to develop an optimum system for the NAT region and are therefore primarily an instrument for the development of future plans."

4.1.2 On the basis of Working Papers presented by Canada, IATA and the UK, the Group concluded that NAT provider States should be encouraged to pursue development of several alternative but complementary means of assessing system performance in an effort to gain sufficient experience to demonstrate the adequacy or faults of the proposals.

4.1.3 The Group encountered some difficulties in the apparent conflict between Special NAT agreement to "establish criteria which might assist in the assessment of the system as a whole... for use in the NAT Region" and the more limited geographical area of usual concern to the Group, i.e., the NAT Oceanic Control Areas. Meaningful assessment of the system as a whole must, inevitably, include consideration of problems encountered in the transitional areas between oceanic and continental airspace and, in some cases, problems encountered between airport terminal areas and the transitional areas. The Group recommended future expansion of the scope of system assessment activities by Administrations to include these areas.

4.1.4 The Group concluded that the Statistical Traffic model developed by the UK held special promise and warranted the collection of additional system performance data to demonstrate its effectiveness.

4.1.5 The criterion of effectiveness must be related to a meaningful scale of values. It should therefore be the average extra operating costs incurred in deviating from optimum flight plans in order to maintain safe separation. This can be used to guide airlines and traffic authorities on the investment which can be justified for the provision of adequate air space capacity.

4.2 <u>Description of the Statistical Traffic Model</u>

4.2.1 The model enables the assessment of overall cost penalty from the statistical distribution of the ATC deviations suffered by airlines. The effects of imperfect meteorological forecasting can be separately assessed from past records and distinguished from the strictly ATC penalty. The ATC deviations can be extracted from the flight records of the day, or they can be estimated from traffic models, as indeed they have to be for future circumstances. To convert deviations into fuel and time penalty it is desirable to consider conditions outside the strictly oceanic area.

4.2.2 In estimating overall cost the model takes account not only of the individual penalties in terms of fuel and time delay but also of the statistical spread of these and the effects on such items as fuel reserve uplift, payload capacity and schedule keeping. So far this model has been applied to a simplified picture of the North Atlantic traffic system in which all traffic is confined to one route. The Group proposes to extend this to a system more nearly like that currently in effect on the North Atlantic.

4.2.3 When the cost criterion is developed, a suitable form in which to express it is to describe the equivalent permissible spread of traffic corresponding to given levels of penalty; say the horizontal and vertical spread of the parallel track system required by the bulk (say 95%) of the busy hour traffic.

4.2.4 A secondary criterion suggested is that of the proportion of aircraft for which fuel penalty exceeds 15 mins of cruising fuel consumption and/or time penalty exceeds 15 mins. From the idealised model developed by the UK, we find that this criterion refers to the extreme tail of the distribution in that, even at the higher level of cost, only about 0.05% of aircraft exceed these limits. For operational use, the spread of tracks for 95% of traffic will be more practical, but of course some check should be made of the extent of these tails in practice.

4.3 Validation of the Model

4.3.1 In response to a request from the Group to supply airline operational data to validate the model, IATA expressed appreciation of the work which had been done by Administrations, and of their future plans. The airlines would be willing to assist in supplying data of the type specified, but experience had shown that this was difficult to do for two inter-related reasons. To be effective, a considerable amount of information relating to each flight must be supplied; and this was required during the peak traffic period when airlines could least afford the time. This latter point would be particularly significant during 1967 when airlines would be contributing to the supply of data on navigational capability.

4.3.2 It was therefore agreed that Administrations would obtain data in two ways :

a) From the information which it was already planned to obtain in connection with the navigational data-collection exercise : for example, during this exercise Oceanic centres are being required to retain flight data, weather maps used in plotting flight plan tracks, MTP's etc. and cleared Mach Nos., while during 22 days of airline post-flight analysis, airlines will record the time in the Oceanic area, the coordinates of the cleared track and perhaps some additional significant remarks. Some useful information may be derived from these two sources of data. This might be even more valuable if airlines were to add, on the reverse of the Form 1-D, the coordinates of the track filed in the flight plan, the coordinates of what would have been the most desirable Flight Path and Altitudes had the Organized Track Structure not existed, and relevant remarks.

b) From the airlines, in a more subjective way, and by correspondence :

Airlines would be requested to provide, sometime about October, information on the following :

i) The extent to which time penalties result in secondary penalties such as re-scheduling.

ii) The importance of time penalty as compared with fuel penalty.

iii) The incidence of excess fuel requirements being so great as to necessitate off-loading payload, or making en-route refuelling stops.

iv) Comments on individual cases of gross penalties being experienced.

v) Some information on the amount of fuel used in following undesirable flight profiles.

vi) The extent to which imperfect MET forecasts affect flight efficiency.

4.4 Conclusions

4.4.1 The Group concluded that the UK Statistical Traffic Model method of system assessment offered the promising potential of early application. However, the Model must be validated and refined utilizing the airline operational data referred to in para. 4.3.2. Once the model has been validated, it is unlikely that further airline data will be required to assess systems penalties for subsonic flights in the NAT Region.

4.4.2 The Traffic Model offers the opportunity to forecast systems penalties without the requirement to extract the deviation actually experienced from flight records.

4.4.3 The systems penalties may be expressed by States as a simple cost criterion for the planning of systems investment.

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5. Summary on Agenda Item 5 : Any other Business

5.1 General

5.1.1 The Group agreed that, under this item the following subjects, which had been submitted by members and by invited international organizations, should be reviewed :

i) Review of the work programme of the Group.
ii) Mathematical treatment of the data on longitudinal separation obtained during the data collection programme.
iii) Transition of air traffic between the NAT and the EUM Regions.
iv) Experimental VHF air-ground communications in the NAT Region via a synchronous satellite.
v) Activities of the NAT Traffic Forecasting Group.

5.1.2 It was further agreed that, with the exception of ii) and iii) above, these subjects should be reviewed by members of the Group only.

5.1.3 Two items which had also been suggested for consideration by the Group were not retained. They were :

i) Operations of the NAT ad-hoc ATC Coordination Team.
ii) Action on Recommendation 6 iii/6 of the Special NAT Meeting (1965).

5.1.4 With respect to i) it was suggested that Canada should write to the other States represented on the team giving its view on the report prepared following the team's first round of visits with a view to determining future activity. This was accepted by all members of the Group concerned with this subject.

5.1.5 As regards ii) above, it was felt that this matter, which concerned the provision of a NAT supplement to their AIPs, was not appropriate for consideration by the Group and it was therefore decided not to include this subject on the work programme.

5.2 Consideration of individual subjects

5.2.1 Review of the work programme of the Group

5.2.1.1 The Group reviewed the subjects for future consideration listed under Agenda Item 7 of the Summary of Discussions of its Second Meeting in order to up-date its work programme. At the same time it related work done during this meeting to the subjects listed therein. This review resulted in the following up-dated work programme of the Group :

i) Long Term Planning Programme;

ii) Impact of SST Operations on the NAT Air Navigation System;

iii) Developments in Satellite Communications;
Note : Para. 5.2.4 of the present summary refers.

iv) Improvement of Logical Methods for the Determination of Separation Minima;
Note : the summary on Item 2 refers.

v) Future Planning for NAT Aeronautical Fixed and Mobile Services;
Note : Some aspects of this subject are treated under Agenda Item 3 of this summary.

vi) Provision of Ocean Stable Platforms;

vii) Future Planning for NAT Meteorological Services;
Note : Some aspects of this subject are treated under Agenda Item 3 of this summary.

viii) Criteria for the Assessment of System Performance;
Note : Agenda Item 4 of this summary refers.

ix) Review of NAT Air Reporting Procedures;
Note : Agenda Item 3 of this summary refers.

x) Vertical Separation above Flight Level 290 in Specified Parts of the NAT Region;
Note : Agenda Item 2 of this summary refers.

xi) Longitudinal Separation in Specified Parts of the NAT Region;

Note : Para. 5.2.2 of this summary refers.

xii) Review of NAT ATC Procedures;

Note : Some aspects of this subject are treated under Agenda Item 3 of this summary.

xiii) Consideration of up-dated Traffic Forecasts;

Note : Para. 5.2.5 of this summary refers.

5.2.2 Mathematical treatment of the data on longitudinal separation to be obtained during the data collection programme

5.2.2.1 A brief exchange of views took place on the mathematical treatment of data on longitudinal separation obtained during the data collection programme, using as basis a Working Paper presented by the French Member of the Group.

5.2.2.2 The Group noted that data on the relative speeds of aircraft from coast to coast will be obtained through the data collection programme. It further noted that this data will be retained in the records (cf. Summary of Agenda Item 1, Appendix B, para. 2). It therefore agreed to postpone detailed discussions of the question of the mathematical treatment of this data to its next meeting.

5.2.3 Transition of air traffic between the NAT and EUM Regions

5.2.3.1 Recommendation 6 ii/1 of the SP/NAT Meeting 1965 (page 6 ii-8 of ICAO Doc 8499, SP/NAT (1965) required France, Ireland and the UK to review, as a matter of urgency, the ATS situation regarding air traffic in transit between the EUM and the NAT Regions in the area south of Ireland in the vicinity of 0800 W. The V EUM RAN Meeting, in its Recommendation 10/11 (page 10-10 of ICAO Doc 8588, EUM/V) took this up, stating that the problem "should be considered as a matter relevant to the appropriate continental airspaces".

5.2.3.2 Very little apparent progress has been made on this subject and the Group noted that this matter was one of considerable preoccupation by the operators concerned. It also noted that the effects of the present situation had a noticeable effect on the organization of the air traffic in the NAT Region. After having been informed of suggestions made by IATA for a possible resolution of the difficulties in this area, and having received information on the studies being made in the United Kingdom towards the elimination of the difficulties encountered as well as the very complex problems involved, the Group agreed that it was not qualified to deal with this matter in any detail. It was, however, of the opinion that it was entitled to stress the urgency of remedial action by the States concerned and it therefore requested them to give this matter their earliest attention in coordination with the operators and international organizations concerned.

5.2.4 Experimental VHF air-ground communications in the NAT Region via a synchronous satellite.

5.2.4.1 The US Member informed the Group that the USA intended, in early 1968, to place an experimental synchronous satellite in orbit at a position approximately over the equator and near 44° W, which would provide communications cover over the major part of the NAT Region. This satellite (whose designation was Applications Technology Satellite = ATS-C) was to be used to conduct experiments regarding a number of air navigation applications, including VHF air-ground communications.

5.2.4.2 As the satellite is planned to use frequency 135.6 Mc/s for this purpose, this has given rise to concern amongst NAT and EUM States regarding possible interference to ground stations to which this frequency had been assigned for normal aeronautical VHF air-ground communication purposes. Experience in the USA with a satellite now in stationary orbit over the Pacific Ocean had, however, shown that such interference was unlikely to occur either directly on the frequency used or on adjacent channels, except in those cases where ground stations concerned were using extremely low noise receivers together with high gain antennas, normally only provided at extended range stations.

5.2.4.3 In order not to cause serious penalties to this experimental programme, the US Member expressed the hope that :

i) no request for a change of the frequency used for the programme would be made;

ii) in the unlikely event that interference would occur, its extent would be measured and reported before a frequency change be effected at the ground station concerned;

iii) States in both NAT and EUM Regions would give full support to this programme in view of its importance for future developments regarding air-ground communications in the NAT Region.

5.2.4.4 The Group recognized that an experiment of this nature would be of value in gaining further knowledge concerning the potential benefits to future aeronautical developments in the NAT Region.

5.2.5 <u>Activities of the NAT Traffic Forecasting Group</u>

5.2.5.1 The US Member informed the Group that the Traffic Forecasting Group for the NAT Region had held its last meeting on 21-22 March 1967 in Washington. During this meeting the Forecasting Group had prepared the North Atlantic air traffic forecasts for the period 1966 to 1967 and had forwarded these to ICAO (these had been made available by the US Member to the Group).

5.2.5.2 The US Member also informed the Group that the Traffic Forecasting Group was considering a review of its methods for the establishment of the air traffic forecasts. This might, however, require clarification by the NAT Systems Planning Group of a number of factors now used by the traffic forecasters. It was, however, agreed that this clarification could be obtained through Canada, the UK and the USA, the three members of the NAT Systems Planning Group who composed the Traffic Forecasting Group.

5.2.5.3 Finally, the Group was informed by the US Member that preliminary plans were being developed in the USA to undertake a census of the actual traffic at some time in the near future in order to obtain the latest data on the traffic flow in the NAT Region. The members from Canada and the UK assured the US Member of their Administrations' willingness to cooperate in such a census.

5.2.5.4 As far as the availability of up-dated traffic forecasts was concerned, the Group expressed its continued requirement for this information and stressed again the need that this data be made available to all other NAT States since it represented one of the basic sources for any advanced planning in the NAT Region.

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6. Summary on Agenda Item 6 : Election of Chairman of the next meeting

6.1 Mr J.F. Sapin, the member from France was elected unanimously chairman of the next meeting on a proposal by the UK Member, Mr D.A. Blake, seconded by the US Member, Mr R.F. Huard.

7. Arrangements for the next Meeting of the Group

7.1 Date and site of the next meeting

7.1.1 After careful consideration of all factors involved, the Group agreed that its next meeting should be planned to be held sometime in April 1968 at the Paris Regional Office of ICAO.

7.2 Tentative agenda

7.2.1 In view of likely developments in the various fields so far reviewed by the Group, it agreed that, subject to confirmation at a later date, the tentative agenda for its next meeting should comprise the following items :

i) Review of the results of the data collection programme regarding navigational capability of aircraft in the NAT Region;

ii) Development of a method for the determination of longitudinal separation standards in the NAT Region;

iii) Review of the future work programme of the Group;

iv) Election of the Chairman of the next meeting.

7.3 Attendance

7.3.1 In view of the tentative agenda, the Group agreed that Portugal and Iceland as well as IANC, IATA and IFALPA should be invited to participate in the next meeting.

7.4 Meeting arrangements

7.4.1 The Group hoped that ICAO would find it possible to provide arrangements similar to those made for this meeting, for its next meeting.

7.5 Future handling of the problem of vertical separation in the NAT Region

7.5.1 As reflected in the summary on Agenda Item 2, and more specifically in para 2.2.12, the Group felt that at least one more meeting on the subject of vertical separation was required before it would be able to arrive at a definite position on this matter. Primarily in view of the need for further studies and experiments and also because of its work programme on other items, this meeting could however be held at the earliest time in late 1968.

7.5.2 It was therefore felt by the Group that it would not be useful for ICAO to plan a LIM/NAT Meeting on this subject before spring 1969 at the earliest.

LIST OF NAMES AND ADDRESSES OF THE MEMBERS OF THE NORTH ATLANTIC SYSTEMS PLANNING GROUP

Name	State	Address	Remarks
Mr. R.W. Dodd	CANADA	Chief, Air Traffic Control Division, Civil Aviation Branch, Department of Transport, 207, Queen Street, OTTAWA, Ontario.	
M. J-F. Sapin	FRANCE	Ingénieur en chef à la Navigation Aérienne, Secrétariat Général à l'Aviation Civile, 93, Bd du Montparnasse, 75 - PARIS 6. (Tel.: 548.58.80)	Chairman of 4. Meeting.
Mr. G.E. Enright	IRELAND	Officer-in-Charge, Aviation Radio Service, 34, Clarendon Street, DUBLIN 2, Eire. (Tel.: 774 836 direct or 48 888 Ext.346)	
Mr. J.G. ten Velden	KINGDOM OF THE NETHERLANDS	Dep. Chief Air Traffic, Control Bureau, Civil Aviation Department, Kanaalweg 3, THE HAGUE.	
Mr. D.A. Blake	UNITED KINGDOM	Deputy Director of Control (Plans) 3, Headquarters, National Air Traffic Control Services, The Adelphi, John Adam Street, LONDON, W.C.2.	
Mr. Robert F. Huard	UNITED STATES OF AMERICA	Principal Staff Officer, North Atlantic Systems Planning Staff, Office of International Aviation Affairs, Federal Aviation Agency, WASHINGTON D.C. 20553.	Coordinator of data collection programme.