RAC I

NAT SPG/23

SUMMARY OF DISCUSSIONS AND CONCLUSIONS

OF THE

TWENTY-THIRD MEETING OF THE NAT SYSTEMS PLANNING GROUP

(Lisbon, 5 - 16 May 1986)

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INTRODUCTION

1. The Twenty-Third Meeting of the North Atlantic Systems Planning Group (NAT SPG) was held in Lisbon from 5 to 16 May 1986. The Meeting was chaired by Mr. V. Feehan, the Member for Ireland.

2. In addition to IAOPA, IATA and IFALPA, the Group had, as usual, also invited Denmark, Norway, Spain and the USSR to attend this Meeting. Both the Members for the Netherlands and IAOPA had not been able to attend. A list of participants is at page 3.

3. At its opening session, the Meeting was addressed by Mr. A. Viçoso, Deputy Director General of Civil Aviation, Portugal and Mr. J.C. Mendes, Director General for Air Navigation of ANA, the Public Corporation of Airports and Air Navigation of Portugal.

4. In order to progress its work efficiently, the Group established a number of sub-groups to deal with particular detailed aspects of some of the subjects considered during the Meeting. These were:

a) a sub-group charged with the scrutiny of navigational performance questions, of which Mr. J. Irving of the United Kingdom acted as Rapporteur;

b) a sub-group dealing with the review of matters related to NAT aeronautical telecommunications, of which Mr. H. Sweetman of the United Kingdom acted as Rapporteur;

c) a sub-group to consider the mathematical-statistical aspects of separation minima in the NAT Region, of which Mr. A. Busch of the USA acted as Rapporteur.

5. Mr. D. Oudin from the European Office of ICAO served as Secretary of the Meeting ans was responsible for the preparation of this Report. He was assisted by Mr. C. Eigl from ICAO Headquarters and Mr. A. Suban from the European Office of ICAO. Secretarial support was provided by Mrs. M. Daulnay and Mrs. N. Goldschmid from the European Office of ICAO.

6. The Group expressed its sincere thanks to the Government of Portugal and ANA for hosting the Meeting and for providing the extensive support that was necessary for the successful completion of NAT SPG/23.

LIST OF CONCLUSIONS

LIST OF PARTICIPANTS

CANADA

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Agenda Item 1: NAT air navigation system safety performance review

1.1 Introduction

1.1.1 Discussions under this Agenda Item were covered under the following headings:

a) the navigation performance accuracy achieved in the NAT Region during the period 1 March 1985 to 28 February 1986;

b) mathematical-statistical aspects and risk assessment methodology;

c) method of improving the observed standard of navigation performance in the NAT Region;

d) methods of improving the effectiveness of current monitoring procedures.

1.2 Navigation performance accuracy achieved in the NAT Region during the period 1 March 1985 to 28 February 1986

1.2.1 The Group completed a scrutiny of observed gross navigation errors in the NAT Region and found that a total of 74 (46)* errors were reported during the period under review. 25 (15)* of these errors occurred outside MNPS airspace and were classified as Table "C" errors. Of the remaining 49 (31)* errors, 14 (5)* were not eligible for inclusion in the risk analysis, as defined by NAT SPG/17, and were classified as Table "B" errors. A brief review of these Table "B" errors is given at paragraph 1.2.12. The remaining 35 (26)* errors which form the basis of the detailed scrutiny were classified as Table "A" errors. 6 (0)* of these errors lay in the 25-29NM error band, however, and as such were not considered in the risk assessment (see para 1.2.11).

Note: The classification of errors as Table "A", Table "B" and Table "C" errors refers to Tables A, B and C used by the Central Monitoring Agency to group errors into those eligible for scrutiny, not eligible for scrutiny and those that occurred outside MNPS airspace.

1.2.2 A breakdown of the 29 (26)* errors remaining is given in Attachment A to this Agenda Item. The format is in accordance with established procedures and, as in previous summaries, the number of errors which are permissible by the collision risk models have been shown. The increase of three errors total over those analysed during the previous monitoring year was offset by an increase of approximately 14% in the total observed MNPS traffic in the period under review.

*For purposes of comparison, corresponding figures for the last monitoring period (1984-85) are in brackets

1.2.3 The Group noted that there had been a slight improvement in the navigation performance in the NAT MNPS airspace during the period under review. The Eta errors ($\geqslant$ 30NM), and the Zeta errors (50-70NM) for "All MNPS" and "OTS" traffic, were all contained by the respective early warning error rates of 5.3×10^{-4} (Eta) and 1.3×10^{-4} (Zeta).

1.2.4 The predominant cause of navigation error was again "Waypoint Insertion Error". Of the 29 Table "A" errors scrutinised, 9 (31%) were the result of an insertion of incorrect waypoint data into the INS/ONS computer. As in the previous year, over half of these errors (5) were associated with differences between the flight planned route and that which was cleared by ATC. The Group felt that there might be justification for further breakdown of Waypoint Insertion Errors to identify the true nature of the error, for example:

Classification C1 - Equipment control error including inadvertent waypoint insertion error.

Classification C2 - Waypoint insertion error due to the correct entry of incorrect position.

The Group agreed, however, that regardless of the circumstances of this type of error it was clear that the operating procedures/cross checks, detailed in the NAT MNPS Operations Manual, were still not being applied by some crews.

1.2.5 The Group observed that three navigation errors were attributable to the auto-pilot being disconnected from the INS/ONS. Although not previously unknown, this cause of error had not occurred as frequently during any earlier monitoring year. The Group, therefore, briefly considered the merits of some form of audio or visual warning to the pilot when the cross track error detected by the INS/ONS exceeds a pre-set level.

1.2.6 Once again, a high percentage (28%) of the Table "A" errors were made by aircraft which were not approved for MNPS operations (14% of the Table "B" errors also come into this category, see para 1.2.12). In two instances, the lack of approval was due more to administrative problems at State/operator level than to a lack of navigation equipment carried on board the aircraft or to crew experience and the actual causes of the errors were waypoint insertion error, in one case and Omega problems, in the other. There were also two cases where the aircraft was re-cleared by ATC to change flight levels and hence to enter the MNPS airspace from above or below. The remaining four non-approved aircraft were operated by infrequent NAT users, namely two military, one delivery flight and one equipped with ADF only. In considering this class of error, the Group was informed that the Central Monitoring Agency was hampered by the lack of response of some States to requests for confirmation or otherwise of MNPS authorization of a given flight.

1.2.7 A noteable feature of this year's monitoring exercise was that six of the seven errors caused by the failure of the navigation equipment were attributable to Omega-equipped aircraft. This amounted to almost 21% of the total Table "A" errors and appeared abnormally high. However, a further three errors related to Omega failure were found in the 25 to 29NM classification and three more were contained in the "non-MNPS approved" category thus raising to 12 the number of errors due to Omega equipment failures. This represented 34% of the total of 35 Table "A" errors, and gave rise to concern in that this number of failures appeared disproportionately high given the relatively fewer numbers of aircraft equipped with Omega systems as compared to INS systems.

1.2.8 The geographic distribution of the majority of the Omega failures was found to be of interest. Four failures occurred in the vicinity of 50 degrees West in a three degree latitude band. Six failures occurred in the vicinity of twenty degrees West in a four degree latitude band. Of the six failures at twenty West, five were experienced between 52 and 53 degree North. The Group felt that from this superficial appraisal, further study was needed to determine, whether there was a geographically-related degradation of position finding at these locations or whether there was an adverse diurnal effect on the Omega equipment. It was disturbing to note that of the seven errors caused by equipment failure, only two were reported to ATC in sufficient time to allow corrective action to be taken.

1.2.9 The Group noted that there had been a marked reduction in the number of those Table "A" errors which were caused by some breakdown in the ATC System communications Loop. There was only one such error against four errors in 1984-85. This incident involved both a lateral and a vertical error. The active role of Gander OAC in monitoring the position given in forward estimates and thus preventing 13 possible "waypoint insertion errors" was noted with appreciation.

1.2.10 Once again there was a marked difference in the navigation error rate caused by different groups of operators. The following figures, crude as they may be in their breakdown, have been compiled to illustrate apparent trends although the civil operator groups have not been clearly defined:

1985/86 TRAFFIC DATA			
TYPE OF OPERATOR	PERCENTAGE OF MNPS TRAFFIC	PERCENTAGE/NUMBER TABLE "A" ERRORS	COMPARATIVE "ETA" ERROR RATES
FREQUENT CIVIL MNPS USERS	55 (63,250 FLTS)	27.6/8	$\underline{1.26} \times 10^{-4}$
OTHER CIVIL MNPS USERS	33 (37,950FLTS)	51.7/15	$\underline{3.95} \times 10^{-4}$
MILITARY	12 (13,800 FLTS)	20.6/6	$\underline{4.34} \times 10^{-4}$

1.2.11 Although the monitoring procedures require that all reported navigation errors of 25NM or more are investigated, only errors of 30NM or more are included in the risk analysis. The Group nevertheless felt that the six errors in the 25NM to 29NM band were worthy of mention as their scrutiny supported many of the points already noted with regard to the other errors, in particular:

a) three of the six aircraft experienced failure of, or problems with, Omega equipment;

b) two aircraft were not approved for MNPS operations;

c) one aircraft experienced a degree of failure of a triple INS fit.

1.2.12 In reviewing the 14 Table "B" errors, that is, those errors which occurred in the NAT MNPS airspace but which were not eligible for inclusion in the risk analysis, the Group was unable to provide an explanation for the wide variation in the numbers of these errors over previous years:

1982-83	-	17 errors
1983-84	-	20 errors
1984-85	-	5 errors
1985-86	-	14 errors.

The following table provides a breakdown of the Table "B" errors during the period under review. The 1984-85 figures are given in brackets.

ERROR CLASSIFICATION	NUMBER OF ERRORS	
A	(2)	2
B	(1)	5
C	(1)	5
D	(0)	0
E	(0)	0
F	(0)	1
UNCLASSIFIED	(1)	1
TOTAL	(5)	14

1.2.13 It was observed that there were two further instances of errors by non-approved operators and five cases of waypoint insertion error which confirmed the findings from the Table "A" errors. However, in contrast to the latter errors, the Table "B" breakdown revealed five errors due to ATC System Loop Error. These illustrated the broad scope of the "ATC System Loop":

a) One error resulted from a misunderstanding of the Oceanic entry point given in a re-clearance.

b) Two errors were made by the operator in recording the cleared route and both were included in the readback/forward estimate. In one instance the error was not identified by ATC, and in the other the error was detected but ATC was unable to contact the operator in time to prevent the error occurrence.

c) One error was due to a mistake by military planning staff when establishing an airspace reservation for a formation of aircraft.

d) One error occurred when an aircraft flew the correct route but reported an incorrect position.

This variety of error-causes clearly emphasized the need for greatest care by all agencies and elements involved in the ATC/communications loop.

1.2.14 The Group then briefly reviewed the Table "C" errors, i.e. those errors which occurred in the NAT Region but outside MNPS airspace. As noted in connexion with Table "B" errors, the 25 Table "C" errors reported during this monitoring year showed a marked increase over the previous period (15). However, viewed in the light of the 1983-84 figure of 38, and the 1982-83 total of 28, this increase was not particularly significant. Although the Table "C" errors by definition occurred outside MNPS airspace, all except four errors were subject to full follow-up action. Many of these errors were typical of those associated with aircraft carrying a reduced navigation capability e.g. short-range navigation equipment only. Eight errors were committed by aircraft operating above MNPS airspace of which six were at FL410. Four of the errors above MNPS airspace involved military aircraft, one of these was caused by a mis-plotted re-clearance and in three cases no explanation had yet been received. The remaining four errors confirmed the lessons from the Tables "A" and "B" errors. Two were caused by Omega failures and two by ATC System Loop Errors. It was believed useful if the Central Monitoring Agency were to attempt to ascertain whether those aircraft which made navigation errors above MNPS airspace were MNPS-approved. The Group commented on the fact that of the 25 Table "C" errors, 11 were made by military aircraft.

1.2.15 The Group noted that during the period under review there was only one reported incident of an erosion of longitudinal separation in excess of three minutes.

1.2.16 In considering the one recorded instance of a vertical separation error, the Group agreed that it would be of value if "vertical errors" could also be reported to the Central Monitoring Agency. It therefore included suitable material in the provisions regarding follow-up action on observed and reported deviations.

1.2.17 Pursuant to NAT SPG/22 Report, para 1.5.3, the Central Monitoring Agency, in co-operation with Iceland, had carried out a study of the observed navigation performance on the routes between Greenland - Iceland - Scotland. The Group was satisfied that the recorded error rate on these routes was comparable with that experienced within the entire MNPS airspace and no further action was necessary at this time.

1.3 Mathematical/Statistical aspects and risk assessment methodology

Occupancy

1.3.1 The Member for Canada provided data for 1985 on lateral occupancy in NAT MNPS airspace to the Group. It was found that same direction occupancy for the OTS was 0.92 and random traffic was 0.26 with an overall weighted average of 0.66. The opposite direction occupancy for the OTS was 0.002, random traffic was 0.005 with an overall weighted average of 0.003. It was noted that over the past three years there had been a steady increase in Eastbound occupancy while the Westbound occupancy had not shown the same increase. The overall traffic counts had been increasing in both directions. The suggested reason was that Eastbound flows of traffic were more compressed, probably resulting from wind effects while Westbound flows, also because of prevailing winds, were more diversified, resulting in fewer proximate pairs. The aircraft traffic count increased for an average of 13% per year over the last two years whilst average occupancy increased only 6% per year.

1.3.2 The Member for the United Kingdom also submitted data for 1985 on lateral occupancy. This indicated that same direction occupancy for the OTS was 0.84, random traffic was 0.16 with an overall weighted average of 0.57. The opposite direction occupancy for the OTS was 0.0032, random traffic was 0.0096 with an overall weighted average of 0.0058. As in the Canadian study, there was an indication of a steady increase in occupancy of the Eastbound flow but not of the Westbound flow.

1.3.3 The Group was not able to easily reconcile the differences between the occupancy estimates provided. It was believed that sampling differences alone might not have affected these estimates and the Group therefore requested its Members for Canada and the United Kingdom to jointly examine their procedures in an effort to determine whether differences in the measurement processes used might be systematically affecting the estimation process.

1.3.4 Given the results from Canada and the United Kingdom, it was decided to combine the two estimates by simple averaging, in order to arrive at overall system estimates. This process resulted in the following:

OCCUPANCY ESTIMATES FOR THE NAT		
	same direction	opposite direction
OTS	0.89	0.0026
Random	0.21	0.0073
Overall	0.62	0.0044
OTS occupancy ratio : 1.31		
Random occupancy ratio: 0.46		
MNPS occupancy ratio : 0.89		

Note: The occupancy ratio is obtained by dividing the measured occupancy in the OTS or Random portions of the NAT/MNPSA by the criterion value from the collision risk model parameterization. A ratio of less than 1.00 indicates the measured occupancy value was less than the criterion value and conversely a value of greater than 1.00 indicates the measured values were greater than the same criterion value.

1.3.5 The Member for the United Kingdom presented data on lateral deviations of aircraft observed at Shannon radar. For Eastbound traffic (2540 samples) the standard deviation was 3.3NM and for Westbound traffic (1312 samples) the standard deviation was 1.6NM. These results were found to be consistent with results presented in previous years and confirmed that the standard deviation requirement of the MNPS of 6.3NM was comfortably achieved.

1.3.6 The Group then reviewed data on large error navigational performance between 1 March 1985 and 28 February 1986 presented by the Member for the United Kingdom. The achieved error rate for errors 30NM or greater for the total MNPS airspace was 2.51×10^{-4} which compared to the MNPS eta requirement of 5.3×10^{-4} or less, thus indicating an all MNPS airspace error rate of less than one half the MNPS requirement. The data indicated that the error rates for the more critical errors between 50 to 70NM for the OTS were 1.20 for Model 1 and 0.89 for Model 2; for random traffic 0.99 for Model 1 and 0.99 for Model 2; and for the overall MNPS airspace 1.12 for Model 1 and 0.92 for Model 2. The MNPS criterion for this type of error is 1.3 (all numbers are times 10^{-4}). Thus the achieved large error ratios were: for OTS 0.92 Model 1 and 0.68 Model 2; for Random 0.76 Model 1 and 0.76 Model 2; and for MNPS airspace 0.84 Model 1 and 0.72 Model 2.

1.3.7 A presentation by the Member for the United States gave rise to discussion in three specific areas:

1) the combining of systems data to arrive at an estimate of MNPS airspace system safety;

2) an analysis of the past five years of lateral navigation performance data in the aggregate to confirm the distributional characteristics, the parameters of that distribution and the effect or result of these parameter estimates; and

3) an analysis of some of the difficulties in providing confidence interval estimates and using them for making decisions.

1.3.8 The analysis of a MNPS airspace risk ratio at NAT SPG/22 had weighted the OTS and random risk ratios according to the number of aircraft observations used in the respective zeta error calculations. It was now determined that a more precise procedure would be to weight the derived OTS and random risk ratios by the appropriate aircraft system flight times within each of the respective portions of the MNPS airspace. At this time, no appropriate data was available to do this weighting. Thus, for the time being, it was proposed that each individual risk ratio be weighted by the appropriate proportions of aircraft in the MNPS airspace within the OTS and within the random portion respectively. To arrive at an estimate of the partitioning of total MNPS airspace traffic into OTS and random elements the Group used information provided by its Member for Canada and data established by the NAT Traffic Forecasting Group. The latter material allowed a good estimate of the total NAT traffic after adjusting for traffic that would probably not be in MNPS airspace flying below or above it. The Canadian data allowed for a good estimate of OTS traffic, together with the estimate of OTS traffic from the gross error monitoring report by the United Kingdom. From this process, it was estimated that for 1985 the OTS/Random proportion was 50/50. Thus the final calculations were as follows:

	OCCUPANCY RATIO		ZETA RATIO	
OTS risk ratio	1.31 (1.27)	x	0.92 (0.69)	= 1.21 (0,88) Model 1
			0.68 (0.50)	= 0.89 (0.64) Model 2
Random risk ratio	0.46 (0.48)	x	0.76 (1.92)	= 0.35 (0.92) Model 1
			0.76 (1.92)	= 0.35 (0.92) Model 2
MNPSA (Model 1)	= 0.78 (0.90)			
(Model 2)	= 0.62 (0.75)			

(All numbers in brackets are NAT SPG/22 estimates for 1984 using that year's weighting scheme.)

1.3.9 These risk ratios indicate, being significantly less than 1.00, that the MNPSA relative risk was less than the target level of safety. The numbers in brackets indicate:

a) that the relative risk for 1985 was less than for 1984; and

b) that, although the relative occupancies did not change much, the reduction in errors between 50 to 70NM (zeta criterion) has had a noticeable effect on the system safety.

1.3.10 Two recommendations were forthcoming from this analysis:

a) data on relative track times for OTS and random would be necessary to improve this weighting process; and

b) because of the sensitivity of this methodology to small fluctuations in numbers of gross errors, it would be prudent to examine any current year performance in the light of the past year or two so as to detect any trends in the data that might not be evident in any one year's examination. This is especially true if any of the risk ratios are near or above 1.00.

1.3.11 An analysis using all the radar core samples and large error reports provided a total sample of 12,844 observations for core data and 455,160 observations from which the large error count had been obtained. This was the largest overall data sample ever examined for lateral navigation performance. This data confirmed that a double double exponential distribution was best fit for examining the probability of lateral overlap [Py (Sy = 60)] in the collision risk model. This reaffirmed the decision arrived at when establishing the MNPS methodology. The estimated parameters of this distribution were α = 0.0004, λ_1 = 2.55NM (SD = 3.61NM) and λ_2 = 39.3NM (SD = 55.6NM). All these parameters were less than what had been estimated at the time of the MNPS derivation. The convolution of this function produced an estimate of Py (Sy = 60) of less than one half of the original value. Thus, even though there was a preponderence of large errors between 50 and 70NM, there was every reason to believe that the probability of lateral overlap parameter in the collision risk model was being more than satisfied so as to maintain the system risk below the target level of safety.

1.3.12 The Member for the USA provided a general discussion of the difficulties inherent in developing tolerance limits for the parameters of the collision risk model for which a decision about overall system safety would be sensitive (i.e. zeta errors, occupancy and the target level of safety). Since a further discussion on these issues was necessary before any rigid statistical processes could be developed and/or recommended for adoption, it was necessary to undertake some considerable further work in this area. The Member for the USA agreed to continue his efforts and to report to the Group at its next Meeting.

Situation regarding the application by ATC of lateral and longitudinal separation in NAT MNPS airspace

1.3.13 In view of the results of the navigation error scrutiny and the mathematical-statistical assessment of the navigation performance situation the Group agreed that the application by ATC of the current MNPS separation criteria continued to be justified under present circumstances.

1.4 Methods of improving the observed standard of navigation performance in the NAT Region

1.4.1 Based on the findings during its review of the achieved navigation performance accuracy (para 1.2 above refers), the Group considered ways and means of improving the observed standard of navigation performance in the NAT Region.

1.4.2 The Group recalled the somewhat encouraging results of State letters circulated in previous years by the European Office of ICAO in order to enhance States' awareness of their responsibilities as licensing authorities for NAT MNPS operations. It was felt that a similar letter should again be circulated to all States likely to have aircraft on their registers that may operate through NAT MNPS airspace:

a) reminding States of their responsibility in accordance with the NAT SUPPs (Doc 7030) for the approval of NAT MNPS operations;

b) seeking information from States as to their MNPS authorization practices;

c) asking their co-operation in establishing the status of authorization of individual flights observed in NAT MNPS airspace;

d) inviting States to ensure widest possible publicity of the MNPS requirements of the NAT Region.

CONCLUSION 23/1 - ICAO STATE LETTER ON NAT MNPS OPERATIONS

That the European Office of ICAO issue a State letter addressed to all States likely to have aircraft on their registers that may operate in NAT MNPS airspace in order to:

a) remind States of their responsibility in accordance with the NAT SUPPs (Doc 7030) for the approval of NAT MNPS operations;

b) urge States to co-operate in establishing whether a specific flight was authorized to operate in NAT MNPS airspace;

c) ask States how authorization is granted to military and International General Aviation flights for NAT MNPS operation;

d) seek clarification from States regarding the NAT MNPS authorization of ferry flights where the certifying State of the pilot is different from that of the operator;

e) invite States to consider issuing a NOTAM Class II or an Aeronautical Information Circular describing the conditions for flight operations within NAT MNPS airspace;

f) invite States to consider the publication of articles in General Aviation magazines and "in-house" pilot bulletins outlining the concepts and obligations for pilots and operators in seeking MNPS authorization.

Note: Conclusion 23/3 also refers.

1.4.3 A sample text for a proposed NOTAM Class II or Aeronautical Information Circular mentioned in c) above is contained in Attachment B to Agenda Item 1. This text was derived from UK AIC No. 74/1985 of 5 December 1985.

1.4.4 In addition, the Group felt it advisable that aeronautical chart producing agencies (private, airlines, military and State) should be approached with a request to display a prominently highlighted notice on the front page of their North Atlantic navigation and orientation charts drawing the attention of users to the special demands of NAT MNPS airspace. A suitable sample text for that purpose is at Attachment C to Agenda Item 1. The Members of the Group agreed to take the necessary action with their respective administrations for such an approach and IATA agreed to advise its Member airlines accordingly.

CONCLUSION 23/2 - MNPS ANNOTATION OF NORTH ATLANTIC AIR NAVIGATION CHARTS

That the Members of the NAT SPG and IATA take necessary action to approach the aeronautical chart producing agencies with a request to display a prominently highlighted notice on the front page of their North Atlantic Navigation and Orientation charts drawing the attention of users to the special demands of NAT MNPS airspace.

1.4.5 With respect to the high incidence of navigation errors committed by aircraft equipped with Omega Navigation Systems (ONS), the Group felt that the attention of States, operators, user organizations and manufacturers of Omega equipment should be drawn to the concern of the NAT SPG at the relatively poor navigation performance achieved with such equipment in the NAT Region. It was agreed that this matter merited detailed study, with the assistance and cooperation of interested bodies, to determine the full extent of the problem in terms of error rate in the NAT Region and to identify the causes of these errors.

1.4.6 In the ensuing discussion, the Group sensed a degree of urgency in that matter and wished to explore all available avenues to make progress. It was agreed that the European Office of ICAO, when issuing its State letter on NAT MNPS operations (Conclusion 23/1 refers), should also advise States of the NAT SPG's concern over the observed high error-rate of ONS-equipped aircraft in the North Atlantic and of the need for a critical re-assessment of all NAT MNPS approvals involving Omega navigation systems. Any views that States might have on the subject, as well as information on the number of Omega-equipped aircraft currently approved by them for NAT MNPS operations, should be forwarded to the United Kingdom for consolidation into a working paper for the next Meeting of the NAT SPG.

1.4.7 In addition, the Group hoped that an approach to the International Omega Association at its next annual meeting (Québec City, August 1986) might draw the attention of Omega equipment manufacturers to the problem so that a useful response may be expected from the manufacturing side. The Member for the United Kingdom agreed to pursue this matter through the UK representative on the International Omega Association.

CONCLUSION 23/3 - INCREASED NAVIGATION ERROR RATE OF OMEGA EQUIPPED AIRCRAFT IN THE NAT REGION

That,

a) the European Office of ICAO, when writing to States in accordance with Conclusion 23/1:

   i) express the NAT SPG's concern at the observed high proportion of Omega equipped aircraft in the overall number of observed navigation errors in the NAT Region;

   ii) advise States of the need for a critical re-assessment of all NAT MNPS approvals involving Omega equipped aircraft;

   iii) request States to provide the number of Omega equipped aircraft on their register that are currently certified for NAT MNPS operations known to operate in that airspace and their frequency of operation;

   iv) solicit any comments that States may have on the subject;

b) the Member for the United Kingdom attempt to draw the attention of the International Omega Association to the problem of the observed increased navigation error rate of Omega equipped aircraft in the North Atlantic, in order to obtain a response from the ONS manufacturing segment of the industry.

1.4.8 With respect to the idea of providing an audio/visual warning to the pilot in cases when the on-board navigation equipment detects a cross track error in excess of a pre-set level, the Group appreciated the technical and economical difficulties involved in modifications to existing equipment. It nevertheless felt that future equipment might usefully be devised so as to provide this facility (para 1.2.5 above refers).

1.4.9 In further discussion, the Group expressed some concern at the wording of the US Federal Aviation Regulation 91.20, Appendix C, para 3, which affords ATC discretionary powers to allow non-MNPS approved aircraft into MNPS airspace when traffic conditions permit. It was stressed that this regulation was in conflict with the NAT MNPS concept and the related provisions of the ICAO Regional supplementary Procedures (Doc 7030) applicable in the NAT Region as well as ICAO world-wide provisions. The Group hoped that the USA would find it possible to correct this situation as soon as possible and requested its Member for the USA to look into the matter, as appropriate.

1.5 Methods of improving the effectiveness of current monitoring procedures

1.5.1 In addition to those elements of para 1.4 that were expected to have an incidence on an improvement of the effectiveness of current monitoring procedures in the NAT Region, notably the enhanced co-operation of States of registry regarding MNPS approvals (Conclusion 23/1 refers), the Group found it advisable to ask that:

a) whenever possible, NAT Provider States should report to the Central Monitoring Agency all incidents involving:

   i) an erosion of the longitudinal separation between aircraft within NAT MNPS airspace in excess of three minutes;

   ii) the operation of aircraft, within NAT MNPS airspace, with a radar observed or reported height deviation in excess of 300 feet from the assigned flight level;

b) whenever possible, NAT Provider States should advise the Central Monitoring Agency of instances where ATC had intervened to prevent ATS System Loop Errors or Waypoint Insertion Errors in the NAT MNPS airspace.

1.5.2 In addition, the Group considered a request from its Member for the USA that NAT Provider States might assist in determining the name of the pilot-in-command of any US Registered IGA aircraft with an observed gross navigation error. It was agreed that this could be achieved by the inclusion of the dispatch airfield as an addressee on the initial error signal which would include a request for submission of the relevant flight plan together with the name of the pilot-in-command to the FAA.

1.5.3 The Group agreed to incorporate the above modifications in the relevant sections of the Guidance and Information Material concerning Air Navigation in the NAT Region (Attachment D to Agenda Item 1 refers).

1.5.4 In reviewing material submitted by its Members for Canada, the United Kingdom and the USA on various spot checks to ascertain the approval status of MNPS operators, the Group noted that there was continued evidence of MNPS oerations by non-approved users, and also that many States did not respond to requests for information regarding approvals. It was agreed that, as in the past, the assistance of the European Office of ICAO should be sought as may be deemed necessary. The Group also agreed that Provider States in the NAT Region should be invited to continue to make similar random checks whenever possible.

CONCLUSION 23/4 - SPOT CHECKS ON MNPS APPROVAL OF AIRCRAFT OPERATIONS IN NAT MNPS AIRSPACE

That the NAT Provider States continue to carry out spot checks at irregular intervals on the MNPS approval of selected operators in NAT MNPS airspace.

1.5.5 The Group received information from its Member for Canada showing that 73% of the Westbound traffic passing through the North American radar observation window were on the OTS. The Group agreed that this figure should be reflected in the future OTS figures used on the monitoring graphs and tables used by the Central Monitoring Agency.

1.5.6 There was some discussion of the presentation of the monitoring graphs and tables by the Central Monitoring Agency and it was agreed that these should be amended in order to:

a) remove possible confusion/ambiguity between Table "A", "B", "C" errors and error classifications A, B, C;

b) provide separate tables for "Eta" and "Zeta" errors;

c) show 25NM-29NM errors in the "Not eligible for analysis" Table "B";

d) adjust the error classifications so that the over-riding "Non-MNPS Approved" classification does not conceal operational errors (Waypoint Insertion Error) and occasionally more accurate weighting of errors;

e) consider a possible sub-division of Waypoint Insertion Errors (para 1.2.4 refers).

1.5.7 The Group discussed, at some length the question of the provision of guidance material on the use of single flight management systems (FMS) in MNPS airspace. It was concluded that further study of this issue was necessary and the Group invited its Members to prepare papers for its next Meeting concerning:

a) the present policy as applied to MNPS approval for FMS equipped aircraft, including types of aircraft and details of the equipment carried;

b) future policy for request for MNPS approvals;

c) draft material for inclusion in the NAT Guidance and Information Material and the NAT MNPS Operations Manual.

IATA and IFALPA undertook to provide papers and the Member for the United Kingdom agreed to co-ordinate a paper to NAT SPG/24. The Group emphasized that no formal decision should be made for at least one year.

1.5.8 As in the past, the Group discussed the question whether or not ATC could play a more active part in determining whether aircraft about to enter NAT MNPS airspace were so approved by their State of Registry. The Member for Canada undertook to monitor all ICAO Flight Plans filed at Goose Bay by IGA aircraft for MNPS operations, to ensure there was an "X" in the Field 10 indicating MNPS approval. Non-approved aircraft would not be given ATC clearance to operate in MNPS airspace. The Group felt that other Provider States should be encouraged to take similar steps.

1.5.9 In furtherance of NAT SPG Conclusion 22/3, the Member for the United Kingdom had reviewed the radio-telephony phraseology used by ATC in connexion with conditional ATC clearances. It was found that the provisions contained in ICAO Doc 4444 (PANS-RAC) and Doc 9432 (Manual of Radiotelephony) were adequate and did not require modification. The Group agreed that no further action was necessary on this subject.

1.5.10 In concluding its deliberations on this Agenda Item, the Group noted with appreciation the part played by the US FAA and the US Department of Defence in improving the navigation performance by military aircraft in the latter part of the monitoring year, together with the reduction in the time needed to complete investigations of reported errors. The Group also appreciated the improvement in the navigation performance of the specific aircraft type which had been involved in high navigation error rates in previous monitoring periods (see NAT SPG/22-Report, para 1.2.8).

RESULTS OF THE 1985-1986 NAVIGATION ERROR SCRUTINY

(para 1.2 refers)

CLASSIFICATION (see Note 1)	≥30NM ETA ERRORS	ERROR			
		50-70NM (ZETA ERRORS)			
		TOTAL MNPS TRAFFIC (see Note 2)		OTS TRAFFIC	
		Model 1	Model 2	Model 1	Model 2
A	8	4	4	1	1
B	1	0	0	0	0
C	13	7	4.68	7	4.68
D	2	2	2	1	1
E	1	0	0	0	0
F	4	0	0	0	0
Not classified	0				
TOTAL	29	13	10.68	9	6.68
Total in last period	26	15	13.28	6	4.30
OBSERVED TRAFFIC		115 784		75 259	
last monitoring period traffic		101 837		66 194	
Permissable number of errors within MNPS requirements	61.36 (5.3×10^{-4})	15.05 (1.3×10^{-4})		9.78 (1.3×10^{-4})	
Permissable number of errors before action based on operational judgement is required	92.01 (7.95×10^{-4})	22.57 (1.95×10^{-4})		14.67 (1.95×10^{-4})	

Note 1: Classification of errors (NAT SPG/17, para 1.2.3)

Class	Cause
A	Aircraft not certified for operation in MNPS airspace.
B	ATC system loop error.
C	Equipment control error, including way-point insertion error.
D	Other navigation errors, including equipment failure notified to ATC in time for action.
E	Other navigation errors, including equipment failure notified to ATC too late for action.
F	Other navigation errors, including equipment failure of which notification was not received by ATC.

Note 2: Weighting Factors used in Model 2 (NAT SPG/17, page 1-B-1)

(i) ATC System Loop Errors which scrutiny establishes could only occur at exit from the oceanic airspace be factored as follows and treated as zeta (50 - 70NM) errors.

(i) those having an observed magnitude of:

50 - 70NM . . . . . Factor by 0.12
110 - 130NM . . . . . Factor by 0.31
170 - 190NM . . . . . Factor by 0.44

(ii) those having an equivalent* magnitude of:

60NM . . . . . Factor by 0.06
120NM . . . . . Factor by 0.16
180NM . . . . . Factor by 0.22

(ii) ATC System Loop Errors which scrutiny cannot establish as being of a type which could only occur at exit from the oceanic airspace, and Waypoint Insertion Errors, be factored as follows and treated as zeta (50 - 70NM) errors:

(i) those having an equivalent* magnitude of:

50 - 70NM . . . . . Factor by 0.46
110 - 130NM . . . . . Factor by 1.22
170 - 190NM . . . . . Factor by 1.75
230 - 250NM . . . . . Factor by 2.0

* "Equivalent" magnitude is the magnitude which scrutiny establishes that the error would have reached, had not the presence of radar enabled the error to be truncated.

Attachment B
to Agenda Item 1

SAMPLE TEXT FOR NOTAM CLASS II OR AIC

(Derived from UK AIC No. 74/1985 of 5 December 1985)

MINIMUM NAVIGATION PERFORMANCE SPECIFICATIONS IN THE NORTH ATLANTIC REGION

1. Minimum Navigation Peformance Specifications (MNPS) are applied to aircraft operating between Flight Levels 275 and 400 within the Shanwick, Gander, Reykjavik, New York (part of) and Santa Maria Oceanic Control Areas (OCAs) as shown in Appendix A. Details of the specifications are included in the relevant AIPs of the NAT Provider States. Continuous monitoring of the navigation accuracy of aircraft using MNPS airspace is carried out by the use of radars covering the exits from the airspace in order to confirm that the required navigation standard is being achieved.

2. On the basis of such monitoring it has been agreed by ICAO that the lateral separation minimum for aircraft operating in MNPS airspace shall be 60NM.

3. It is implicit in the concept of MNPS and essential to the application of the quoted lateral separation minimum, that ALL operations in MNPS airspace, without exception, achieve the highest standards of navigation performance accuracy. Thus any flight by a (...State...) registered aircraft within North Atlantic (NAT) MNPS airspace must be specifically approved by the (...Civil Aviation Authority...) for such operations in accordance with (...Article of the the Air Navigation Order or other applicable legal instrument...).

4. In order to assist operators and crews to achieve the required standard of navigation accuracy, two documents have been published:

a) ICAO Doc T13/5N - Guidance and Information Material concerning Air Navigation in the NAT Region. The material in this Document deals primarily with planning and management of operations in the NAT Region and is mainly addressed to States and Operators.

b) North Atlantic MNPS Airspace Operations Manual. This manual has been developed specifically for use by pilots intending to operate in MNPS airspace.

Copies of these documents are available to operators of (...State...) registered aircraft from (...Address of national administration...).

5. The inherent obligations placed upon crews and operators of (...State...) registered aircraft by the NAT MNPS airspace requirements can be summarised as follows:

a) The flight MUST have the prior approval of the (...Civil Aviation Authority...) for operations in NAT MNPS airspace.

b) The approved aircraft minimum navigation installation MUST be serviceable and MUST have been checked for accuracy prior to entry into MNPS airspace.

c) Whilst in MNPS airspace the approved operating procedures MUST be adhered to. Except in emergency, diversions from the ATC cleared track MUST NOT be made without prior approval of the controlling ATC unit.

d) If subsequent unserviceability reduces the navigational capability below the required minimum for MNPS operations after entry into MNPS airspace then the controlling ATC unit MUST be advised so as to allow for any necessary adjustments of separation from adjacent aircraft.

e) There MUST be a high standard of supervision, monitoring and cross checking of data inserted into automatic navigation systems to prevent large errors arising from erroneous waypoint entries.

f) There MUST be a high standard of co-ordination with ATC units to ensure that misunderstandings over the route to be flown do not occur.

6. Operators of (...State...) registered aircraft intending to fly in NAT MNPS airspace can obtain further information on the measures necessary to gain (...Civil Aviation Authority...) approval from the following:

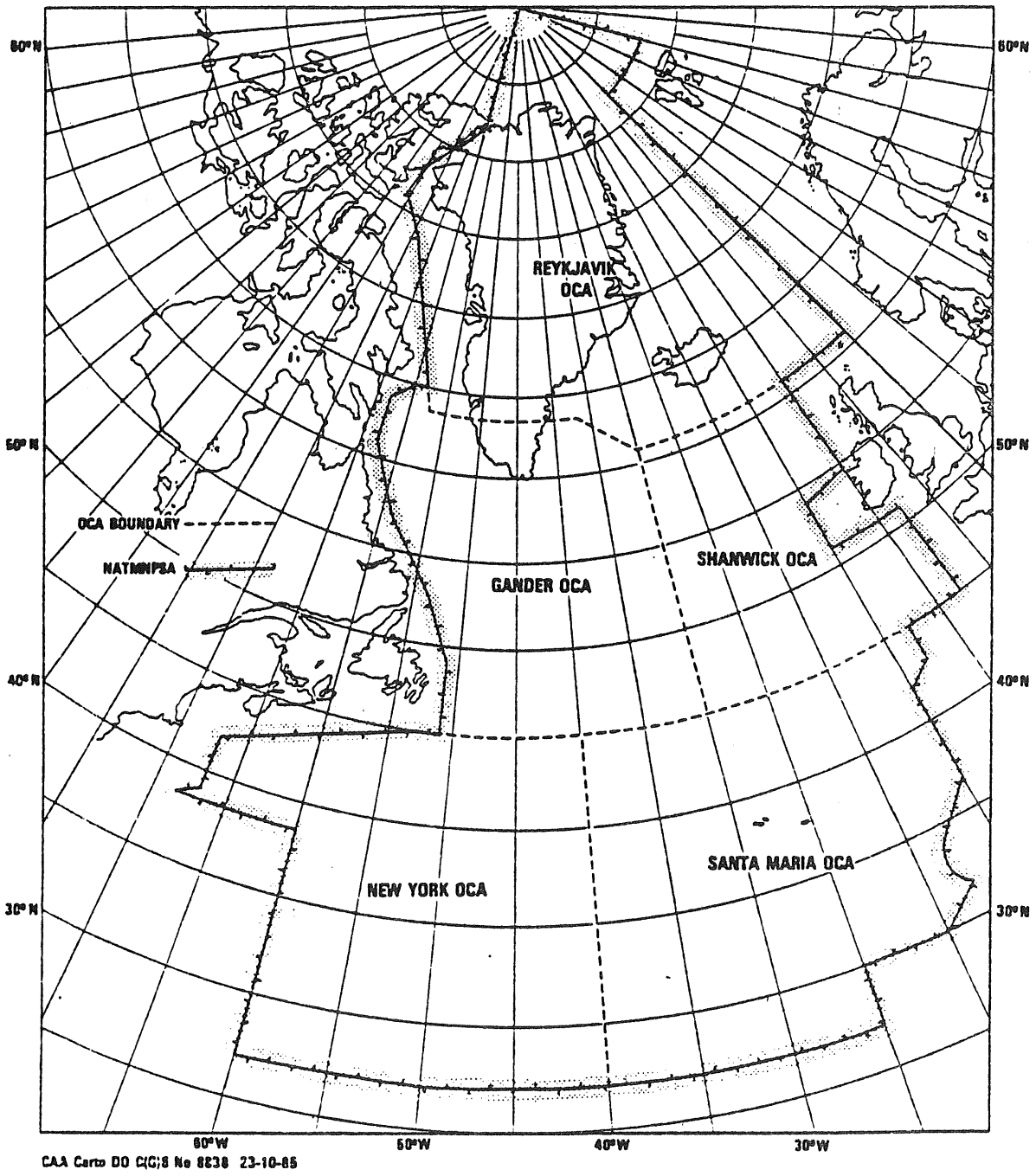
Equipment and Installation Approvals
(...appropriate address...)

Operating Standards Approval
(...appropriate address...)

ATC Aspects
(...appropriate address...)

This Circular is issued for information, guidance and necessary action.

NORTH ATLANTIC MINIMUM NAVIGATION PERFORMANCE SPECIFICATION AIRSPACE (NAT MNPSA) BETWEEN FL275 AND FL400



SAMPLE TEXT FOR MNPS NOTICE ON NAT AIR NAVIGATION CHARTS

ATTENTION

NORTH ATLANTIC MINIMUM NAVIGATION PERFORMANCE SPECIFICATIONS (NAT MNPS) AIRSPACE

Most of the North Atlantic Region, from the geographic North Pole to 27°N, and between FL275 and FL400 has been designated by ICAO as MNPS Airspace. No aircraft should enter this airspace unless it is MNPS equipped and the operation is specifically authorized by the State of Registry or State of the Operator, as appropriate.

MATERIAL TO REPLACE RELEVANT SECTION OF THE NAT GUIDANCE AND INFORMATION MATERIAL ON NAVIGATION PERFORMANCE MONITORING

(3-25)

Note: References to page numbers in brackets apply to the current Fourth Edition of Doc T13/5.N.

PROVISIONS REGARDING FOLLOW-UP ACTION ON OBSERVED AND REPORTED DEVIATIONS

Note: The following material was developed by the NAT SPG.

1. Notification by the observing authority

1.1 Taking into account that slightly different administrative arrangements within the States engaged in monitoring will exist, follow-up action on observed deviations from track by 25NM or more should, in general, be as follows:

1.1.1 For aircraft operating within MNPS airspace:

a) the observing ATC unit should, if at all possible, inform the pilot of the aircraft concerned of the observed error and also that an error report will be processed; any comment made by the pilot at the time of notification should be recorded;

b) all operators, including military, and other relevant Area Control Centres should be notified, either directly by the observing ATC unit or by any other agency designated by the States concerned, by the speediest means available (telephone, AFTN, telex, as appropriate) and with the least possible delay of the observed deviation (for the format of such message see page 3-27). This should be followed as soon as possible by a written confirmation (see pages 3-28 to 3-30). All notifications should be copied to the Central Monitoring Agency.

Note: When a US registered aircraft is involved which is not clearly identified as an air carrier or military operator, a copy of the initial error signal (see page 3-27) should be sent to the company/agency which submitted the ICAO Flight Plan, requesting the full flight plan details plus the name of the pilot-in-command to be sent to KRWAYA, Attention AFS220.

c) States of Registry of the operator concerned should receive a copy of the written confirmation (see page 3-30B), and, if so indicated to the monitoring authority, of the AFTN telex notification.

Note: Canada, Denmark, France, Iceland, Ireland, Norway, Portugal, Sweden, the UK and the USA have already stated this requirement. (Deviations involving SAS flights need only be addressed to Sweden).

1.1.2 For aircraft operating outside MNPS airspace:

a) the observing ATC unit should, if at all possible, inform the pilot of the aircraft concerned of the observed error and also that an error report may be processed; any comment made by the pilot at the time of notification should be recorded;

b) where the observed deviation from track is 25NM or more, but less than 50NM, the observing ATC unit, or other agency designated by the State, should notify the Central Monitoring Agency of the deviation with the least possible delay (AFTN, telex) using the message format shown on page 3-27. This should be followed as soon as possible by a written confirmation where this is deemed necessary. The Central Monitoring Agency will then advise the State of Registry (see page 3-33) if that particular State had indicated a requirement for notification of such errors or if the circumstances of the error require further investigation;

c) where the observed deviation from track is 50NM or more, but the procedure detailed in sub-paras 1.1.1 b) and c) will be followed.

1.2 Additional Reports to CMA:

Whenever possible, details of the following occurrences should be reported to the Central Monitoring Agency.

1.2.1 Any erosion of the longitudinal separation between aircraft, in the MNPS airspace, in excess of 3 minutes should be reported by AFTN or Telex in the format shown on page 1-28 (new page).

1.2.2 Altitude deviations in excess of 300 feet, being observed on radar (Mode 'C' SSR) or by scrutiny of pilot reports should be reported in the format shown on page 1-29 (new page).

1.2.3 Any occasion when, as a result of a cross-checking of forward position reports, ATC take action to prevent a gross navigation error should be reported in the format shown on page 1-30 (new page).

2. Further follow-up action by the operator and/or State of Registry

2.1 Subsequent follow-up action on observed deviations of 25NM or more, notified in accordance with the above provisions, should initially be conducted between the operator and a designated agency of the State having a responsibility for the ATC unit which observed the deviation on the understanding that:

a) the errors outlined in sub-para 1.1.2 b) (i.e. deviations $\geq$ 25NM but $<$ 50NM occurring outside the MNPS airspace) will not normally require further action. If an investigation is deemed necessary it will be conducted by the State of Registry;

b) monitoring States may, if they so wish, request the assistance of other States in monitoring activities;

c) the State of Registry of the operator concerned should be requested to conduct a further investigation if deemed necessary;

d) all correspondence should be copied to the Central Monitoring Agency;

e) the European Office of ICAO will assist in those cases where no response is obtained from either the operator concerned or the State of Registry.

(new page)

MESSAGE FORMAT FOR A REPORT TO THE CENTRAL MONITORING AGENCY OF AN EROSION OF LONGITUDINAL SEPARATION IN EXCESS OF 3 MINUTES

1. EROSION OF LONGITUDINAL SEPARATION REPORT

2. REPORTING AGENCY

3. DATE

4. FIRST AIRCRAFT IDENT AND OPERATOR

5. AIRCRAFT TYPE

6. MACH NO./POSITION/TIME/ALTITUDE

7. SECOND AIRCRAFT IDENT AND OPERATOR

8. SECOND AIRCRAFT TYPE

9. MACH NO./POSITION/TIME/ALTITUDE

10. CREW COMMENTS WHEN NOTIFIED (IF APPLICABLE)

11. REMARKS
