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**International Civil Aviation Organization
UNDP/ICAO Regional Project RLA/98/003
Transition to the CNS/ATM Systems in the CAR and SAM Regions**

**Sixth Meeting/workshop of Air Traffic Management (ATM) Authorities and
Planners for RVSM, RNAV routes and RNP implementation in the CAR and SAM Regions**

(San José, Costa Rica, 29 September-3 October 2003)

Agenda Item 2: Action Plan for RNP Implementation in the CAR/SAM Regions

**a) Review of the Action Plan for RNP 10 Pre-Operational Implementation in
parallel routes UL 780 and UL 302 in the Santiago de Chile-Lima segment**

Safety Assessment

(Presented by CARSAMMA)

Summary

This working paper presents a summary of the results of the safety assessment process internationally accepted for the Required Navigation Performance 10 (RNP 10) implementation in the airspace of the Santiago de Chile-Lima corridor of Routes UL 302 and UL 780. It provides risk collision and parameter estimated values and reflects the effects in the estimated risk of the current routes structure in the Santiago-Lima corridor. It also presents the estimated risk taking into account an increase in air traffic movement up to 2012 for different growth rates. This working paper concludes that the risk estimate associated with RNP 10 application in January 2004 in the Santiago de Chile-Lima corridor is lower than the safety level required.

1. Introduction

1.1 During the AP/ATM/4 Meeting, January 2003, safety assessment was established associated with RNP 10 application in the airspace of the Santiago de Chile-Lima corridor of routes UL 302 and UL 780, planned for January 2004.

1.2 During the AP/ATM/5 Meeting, June 2003, the need to provide an in advance report of the RNP 10 Implementation safety assessment in the Santiago de Chile-Lima corridor was established. This safety assessment was jointly provided by the CAR/SAM Regional Monitoring Agency (CARSAMMA) and the Safety and Airspace Monitoring Working Group (SAM /WG) of the RVSM Task Force

(RVSM/TF). The safety assessment presented in this working paper indicates that the risk level attributable for any reason for the planned RNP 10 implementation does not exceed the Target Level of Safety.

1.3 The purpose of this working paper is to provide a comprehensive explanation of the safety assessment for the Santiago de Chile-Lima corridor for the consideration of the Task Force.

1.4 The International Civil Aviation Organization developed the *Manual on Airspace Planning Methodology for the Determination of Separation Minima*, Doc. 9689. During its meetings, the Review of the General Concept of Separation Panel (RGCSPP) adopted a TLS value of 5 fatal accidents per 10^9 flying hours due to any reason, as well as the safety goal to go together with the global RNP introduction.

1.5 Therefore, as foreseen by the RGCSPP, introduction of RNP will be safe if the collision risk due to any reason does not exceed 5 fatal accidents per 10^9 flying hours.

2. Discussion

2.1 The risk assessment used in this analysis is based on the Reich Collision Risk Model (CRM). The results are applicable to the present situation. A projection for air traffic increase from 2,4% in the 2002-2012 period has also been performed. The estimated risk is compared with the Target Level of Safety (TLS) of 5×10^{-9} accidents per flying hour.

2.2 The studies have considered that every aircraft and crew that fly in the Santiago de Chile-Lima corridor have RNP 10 operation approval.

2.3 A sample of data collected in one month for the period from 1 to 31 December 2002 was reviewed, representing about 1142 flights, from which some of the parameters used in the collision risk model were determined, such as: medium size of the aircraft operating in the airspace considered; medium relative speeds and lateral occupation. For the calculation of the lateral occupation rate a spacing of 80 NM was used, taking into account that the longitudinal separation applied to the route is 10 minutes based in the Mach Number Technique (MNT).

2.4 The data collected shows the inexistence of lateral deviations, what does not mean they do not exist in practice, as per experiences obtained with other airspaces. In this way, lateral superposition probability, $P_y(S_y)$, was calculated based in an analytic model. In the model considered, two different types of deviations were taken into account: the normal and the gross ones. The analysis has given the following value $P_y(S_y) = 7,0795 \times 10^{-8}$.

2.5 Vertical superposition probability, $P_z(0)$, was calculated from the vertical deviations obtained from a monitoring programme carried out by the NAT region, due to the inexistence of information on such deviations. The result obtained was $P_z(0) = 0,504$.

2.6 As there was no data available for any of the two components, typical or atypical, for the Santiago de Chile-Lima corridor, the data and models of the NAT region were used.

2.7 The typical performance data AAD consisted of Mode C data, collected for aircraft flying between FL 290 and FL 410, inclusive, East to the Canada coast within their radar coverage.

2.8 For the atypical performance AAC, the great altitude deviations were used, atypical, obtained in 1997 from the “NAT MNPS” airspace. Afterwards, a “Double Double Exponential” model was obtained as the best model for the airspace data considered.

2.9 The vertical relative speed was adjusted with parameters used in other regions.

2.10 The estimated occupation, 0.028, reflects traffic distribution along the day. The data related to the times passing by the check points of the position were obtained by extrapolation of the values obtained in the sample collected, taking into account that some of the constant points of the analyzed segments did not have time information.

3. Results and Conclusions

3.1 The value found for the collision risk for the actual traffic in the Santiago de Chile-Lima corridor of routes UL 780 and UL 302 is $7,3350 \times 10^{-10}$.

3.2 The collision risk has been estimated for traffic growth rates of 2, 4% and 6% for the 2002-2012 period.

3.3 As shown in Figure 1, the collision risk values are under the limit of 5×10^{-9} , assumed as Target Level of Safety (TLS).

3.4 In the CARSAMMA and the ICAO SAM Office web page the complete report of the RNP 10 Implementation Safety Assessment in the Santiago de Chile-Lima segment of routes UL 302 and UL 780 is published.

4. Suggested Action

4.1 The Meeting is invited to take note of the information contained in this working paper regarding RNP 10 Implementation.

4.2 That the States involved continue RNP 10 Implementation in the analyzed segments of routes UL 302 and UL 780, with the amendments to the relevant documents.

4.3 Lateral deviations should be obtained and informed to CARSAMMA, according to the procedures of the deviations monitoring programmes. Every deviation higher than 10NM should be informed, using the appropriate forms.

4.4 Vertical deviations higher than 300 ft should be informed to CARSAMMA, according to the appropriate forms.

4.5 Data regarding aircraft RNP and RVSM approval status of each State involved should also be informed.

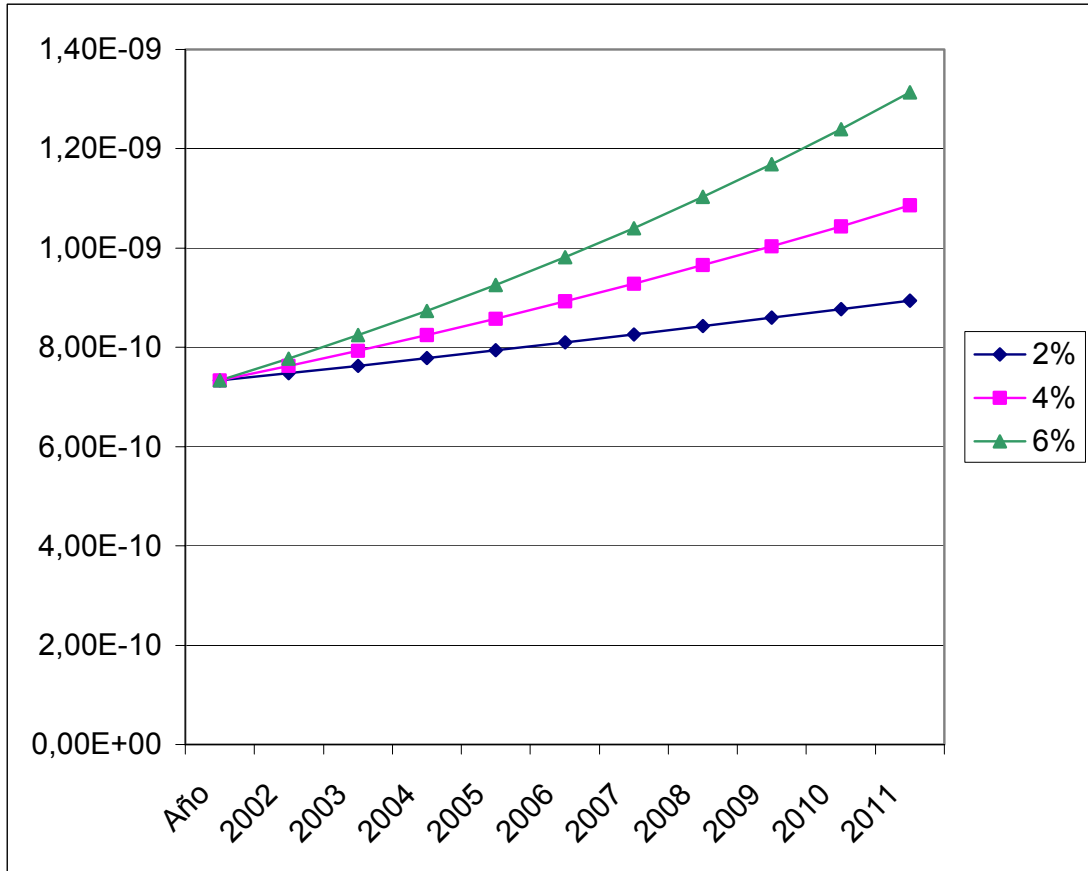


Figure 1. Collision Risk with Annual Growth Rates of 2, 4% and 6%.