International Civil Aviation Organization
CAR/SAM Regional Planning and Implementation Group (GREPECAS)
Third Meeting of the Programmes and Projects Review Committee (CRPP/3)
Mexico City, Mexico, 21 to 23 July 2015

Agenda Item 2: Air navigation activities at global, intra-regional and inter-regional level

2.3 Coordination with RASG-PA

Activities carried out by RASG-PA and PIRG-RASG cooperation mechanisms

(Presented by the Secretariat)

SUMMARY

The purpose of this working paper is to inform about the development of the GREPECAS-RASG-PA cooperation mechanism for the harmonisation and coordination of activities aimed at the drafting and execution of regional, sub-regional, and national implementation plans, with a view to optimising civil aviation safety and efficiency. Likewise, it presents an analysis of large height deviation (LHD) monitoring in the CAR/SAM Regions.

REFERENCES

- Doc 9750, Global Air Navigation Plan
- Global Aviation Safety Plan (GASP)
- Doc 9574, Manual on implementation of a 300m (1000ft) vertical separation minimum between FL290 and FL410 inclusive
- Manual-Guide on the Assessment of Large Height Deviations (LHDs)
- SAM/IG/12, 13,14, and 15 meeting reports
- GREPECAS/17 meeting report
- GTE/13 and GTE/14 meeting reports

ICAO strategic objectives	*A - Safety* *B - Air navigation capacity and efficiency* ***E** - Environmental protection*

1. Introduction

1.1 The Global Air Navigation Plan (GANP) and the Global Aviation Safety Plan (GASP) are implemented and kept valid through close coordination and coordination among all stakeholders. The CAR/SAM Regions conduct these activities through the CAR/SAM Regional Planning and Implementation Group (GREPECAS) and the Regional Aviation Safety Group – Pan America (RASG-PA).

1.2 These groups are responsible for promoting the drafting and execution of regional, sub-regional, and national implementation plans, thus ensuring the harmonisation and coordination of efforts aimed at enhancing safety and efficiency of civil aviation.

1.3 In order to harmonise and coordinate these activities, it is important to maintain the GREPECAS-RASG-PA cooperation mechanism and the interaction between these groups in order to advance efforts to enhance the safety and efficiency of operations, each within its area of responsibility and in accordance with ICAO strategic objectives.

2. Discussion

2.1 Within the context of GREPECAS responsibilities, the 300m (1000ft) vertical separation minimum between FL 290 and 410 (RVSM) was implemented in the CAR/SAM Regions in 2005.

2.2 As a result of this implementation and in order to analyse and assess safety in RVSM airspace, monitor large height deviations (LHD) and the RVSM approval status of aircraft, the CAR/SAM Regional Monitoring Agency (CARSAMMA) was created following the directives of ICAO for this type of agencies. To support the activities of this agency, the Scrutiny Task Force (GTE) was established, with the terms of reference approved by GREPECAS.

2.3 CARSAMMA and the GTE, in coordination with CAR/SAM States, have developed a methodology for the analysis and assessment of large height deviations (LHDs), in order to monitor system performance and enhance safety in CAR/SAM RVSM airspace.

2.4 CARSAMMA conducts an annual quantitative assessment, in which it calculates the risk value applying the Collision Risk Model (CRM) established in ICAO Doc 9574 (Manual on implementation of a 300m (1000ft) vertical separation minimum between FL290 and FL410 inclusive), using a target level of safety (TLS) of 5×10^{-9} mortal accidents per hour of flight as reference parameter.

2.5 Likewise, since 2011, the GTE has recognised that, in addition to the quantitative analysis, a qualitative risk analysis of LHDs should be carried out based on a safety management system (SMS) approach, since the CRM uses a mathematical formula to calculate the risk level without showing the details of the analysed events. The qualitative risk analysis of LHDs permits an individual assessment of the risk level of each event, the identification of potential hazards and, accordingly, the adoption and implementation, if applicable, of mitigation measures. This methodology also helps to identify trends and critical points of occurrence in the respective FIRs of CAR/SAM States and International Organisations.

2.6 In order to estimate the system risk, the CRM model requires many parameters that are derived from data sources provided to CARSAMMA. One such parameter required by the CRM model is the total annual number of hours flown at an incorrect level. Furthermore, for a precise estimation of risk, CARSAMMA requires monthly information on large height deviations (LHDs) generated by the area control centres (ACCs) responsible for each flight information region (FIR) in RVSM airspace. LHD records contain the necessary information to estimate the annual number of hours flown at an incorrect level in RVSM airspace.

2.7 During the analysis, the cause of the event is identified using the LHD code table contained in Attachment B to the Manual-Guide on the Assessment of Large Height Deviations (LHDs). After CARSAMMA has identified the cause (LHD code), the GTE conducts a scrutiny, analysing risks associated to each of the LHD codes identified, assessing the severity and probability of occurrence, using the methodology shown in the aforementioned Manual-Guide.

2.8 In summary, CARSAMMA, together with the GTE, analyses both the technical risk (influenced by the reliability and precision of aircraft avionics) and the operational risk (influenced by the human and technological components on the ground). These are the main factors for assessing safety in RVSM airspace.

Operational risk

2.9 The analysis of operational risk related to RVSM implementation in the CAR/SAM Regions reflects some operational characteristics of the CAR/SAM Regions that are not common in other airspaces.

2.10 The definition of errors according to their cause was based on the classification approved by GREPECAS/17 in 2014, which would be applied to 2013 LHDs.

Analysis of scenarios

2.11 CARSAMMA and the GTE have calculated the risk associated to all causes for 2013, based on 3 scenarios:

SCENARIO 1

2.12 Scenario 1 represents the technical and operational risks calculated based on the CRM for the CAR, SAM, and CAR/SAM Regions. In 2013, the total risk was 2.38 times greater than the target level of safety (TLS) of 5×10^{-9} mortal accidents per hour of flight agreed for the region. This means that additional mitigation measures must be taken by CAR and SAM States to reduce LHDs, taking into account that action taken so far has not been effective. **Table 1** below shows the results of the analysis.

Region	Technical risk	Operational risk	Total risk
CAR	$0.00539E^{-9}$	$13.60000E^{-9}$	**$13.6E^{-9}$**
SAM	$0.01010E^{-9}$	$11.20010E^{-9}$	**$11.2E^{-9}$**
CAR/SAM	$0.00910E^{-9}$	$11.78400E^{-9}$	**$11.9E^{-9}$**
TLS	**$2.5E^{-9}$**	-	**$5.0E^{-9}$**

Table 1 - Scenario 1

SCENARIO 2

2.13 Scenario 2 was used to show the significant prevalence of "E"-type errors in CARSAMMA calculations. If the aforementioned errors were not taken into account, total risk would drop to a practically insignificant value of about 1.5% of the maximum risk.

2.14 This result shows that maximum priority must be assigned to mitigating "E"-type errors. Likewise, the GTE expressed its concern about the lack of data on other types of error that surely occurred in the CAR/SAM Regions. **Table 2** below shows the results of the analysis.

Region	Technical risk	Operational risk	Total
CAR	0.00539E^{-9}	0.0595E^{-9}	**0.0649E^{-9}**
SAM	0.01010E^{-9}	0.0655E^{-9}	**0.0755E^{-9}**
CAR/SAM	0.00910E^{-9}	0.0643E^{-9}	**0.0734E^{-9}**
TLS	**2.5E^{-9}**	-	**5.0E^{-9}**

Table 2 - Scenario 2

SCENARIO 3

2.15 CARSAMMA calculated scenario 3 excluding LHDs in the South Atlantic, in order to quantify and assess their incidence in the total scenario.

2.16 The analysis of this scenario revealed that LHDs in the South Atlantic accounted for 25% of the total risk calculated for the CAR/SAM Regions, which is extremely high. **Table 3** below shows the results of the analysis, without taking into account the South Atlantic scenario.

Region	Technical risk	Operational risk	Total risk
CAR	0.00539E^{-9}	10.3000E^{-9}	**10.3000E^{-9}**
SAM	0.01010E^{-9}	8.5100E^{-9}	**8.5200E^{-9}**
CAR/SAM	0.00910E^{-9}	8.8800E^{-9}	**8.89004E^{-9}**
TLS	**2.5E^{-9}**	-	**5.0E^{-9}**

Table 3 - Scenario 3

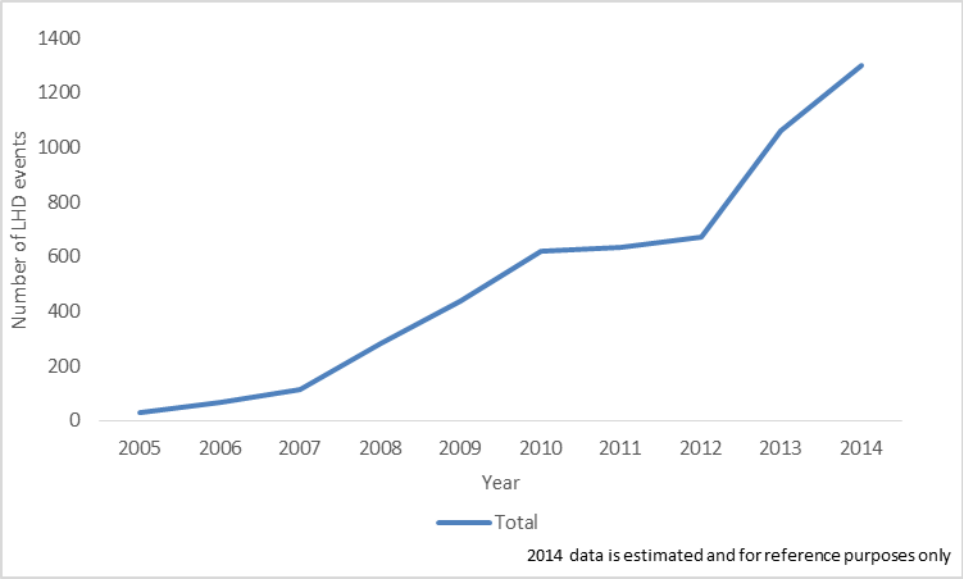
2.17 E-coded LHDs (*ATC coordination error)* were the most frequent in 2013, with 1,015 events, followed by codes C (9), L (6), B and I (5). The high number of E-coded events shows the need for better coordination between adjacent air traffic control units, which could be achieved through the implementation of technology, supervision, and training in controller-to-controller coordination.

2.18 The following map shows the geographical location of LHD critical risk points for the data set covering 12 consecutive months in 2013, in the CAR/SAM FIRs. **Graph A** seeks to provide a quick visual representation of the specific risk points related to RVSM operations.

Graph A *- CAR/SAM FIRs - RVSM areas of risk for LHDs*
January - December 2013

2.19 The black rectangle in the upper left corner of Graph A is the LHD with the highest risk value (VR=61) in the Central American FIR. The boundaries of the Guayaquil/Lima and Guayaquil/Bogotá FIRs continue to show a high number of LHDs, mostly E-coded errors (*coordination errors*). There are several quite representative LHDs identified in the current data set in the vicinity of the Atlántico/Montevideo/Ezeiza FIRs.

2.20 As may be noted, the main operational errors (LHDs) collected in the CAR/SAM Regions from January to December 2013 are related to ATC-to-ATC coordination loop errors and lack of coordination by the transferring ATC unit (1,015 E-type LHDs). The evolution of LHD occurrences from 2005 to 2014, for all types of errors, is shown in **Graph B** below. The number of LHDs shown for 2014 is an estimate, since the corresponding final scrutiny process has not been completed yet.



Graph B *– Evolution of large height deviations (LHDs)*

2.21 As may be seen in this graph, there was a constant increase in the number of LHD reports since the collection of LHD events started. This is due to increased awareness by users and service providers of the importance of LHDs, and to an improved reporting culture aimed at a better identification of coordination loop errors.

2.22 Taking into account the need for corrective action regardless of the results of the risk assessment in order to reduce and/or eliminate E-type errors that have a significant impact on safety in CAR/SAM RVSM airspace, GREPECAS formulated Conclusion 15/36 – *Measures to reduce operational errors in the ATC coordination loop between adjacent ACCs.*

2.23 As part of these measures, an attempt has been made to minimise the lack of effective coordination through the implementation of systems such as AIDC to reduce the possibility of LHDs, but the results of this implementation at regional level will only be assessed in 2016. Furthermore, ADC/CPDLC is being implemented to facilitate the coordination of flights in the South Atlantic.

3. Conclusions

3.1 After a period of 10 years of continuous analysis of RVSM airspace in the CAR/SAM Regions, it is concluded that the States, International organisations and the industry must pay special attention to all these aspects in order to ensure that:

- All aircraft operating in RVSM airspace are RVSM certified;
- The aircraft certification process is still valid;
- The target level of safety (TLS) of $5x10^{-9}$ mortal accidents per hour of flight is still met;
- Aircraft altimetry systems (ASE) continue to be stable;

- E-coded operational errors are eliminated or reduced to an acceptable level in order to minimise total risk of RVSM airspace, adopting and implementing mitigation measures to reduce collision risk due to operational errors or lack of coordination between ATC units, in order to meet the safety levels agreed in the CAR/SAM Regions; and

- Air traffic control procedures continue to be effective.

4. **Suggested action:**

4.1 The Meeting is invited to:

a) Take note of the information contained in this paper;

b) Approve the text shown in **Appendix A** to this working paper in order to inform RASG-PA about GREPECAS activities concerning LHDs and include the information in the sixth edition of the Annual Safety Report;

c) Recommend any other action it may deem appropriate.

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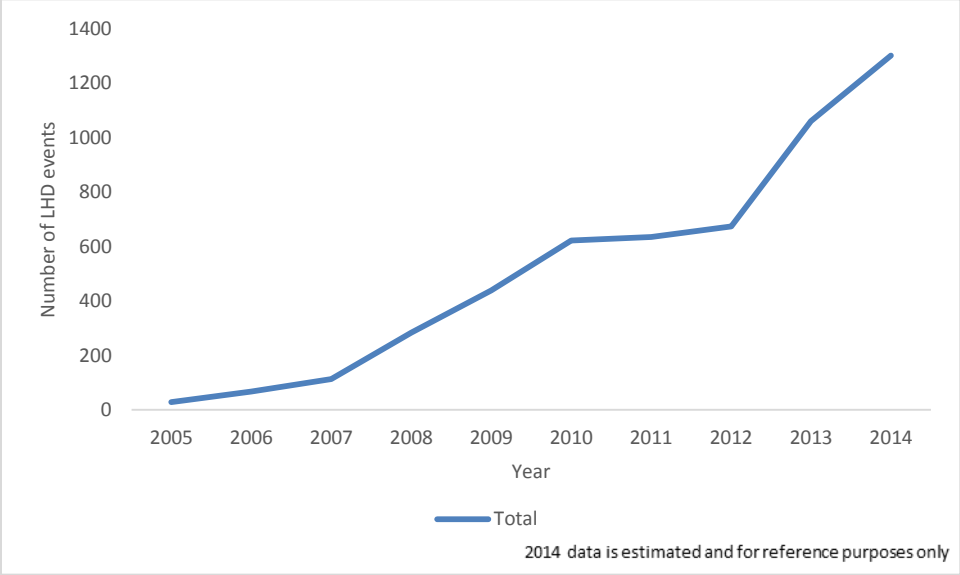
APPENDIX A

Text proposed to be put into consideration of RASG-PA for inclusion in the Sixth Edition of the Annual Safety Report.

- The CAR/SAM Regional Monitoring Agency (CARSAMMA), in coordination with the "Scrutiny Working Group" (GTE) of GREPECAS and the States of the CAR and SAM Regions developed a methodology for analyzing and evaluating of Large Height Deviations (LHD) for the oversight of system performance and to increase the level of safety in the RVSM space of the CAR and SAM Regions, by evaluating both technical risk (affected by reliability and accuracy of aircraft avionics) and operational risk (affected by human and technological elements on ground). In 2013, the total risk was **higher** than the TLS regionally agreed. Particularly, it was found a lack of effective coordination in the South Atlantic FIRs involved in controlling the traffic between Malvinas and Ascension Islands, **accounting for the 25% of the total risk** in CAR and SAM Regions.
- The distribution of LHD events, for the time period from 2005 to 2014 is presented in the following figure. Note 2014 data is estimated and only used as a reference.

a) LHD events distribution per year. 2005-2014. CAR and SAM Regions (CARSAMMA)



As shown in the previous figure, there was a significant increasing trend throughout the period. This do not actually means an increased level of risk, but further analysis should be conducted in order to determine if it could be related to an improved reporting culture, as a result of the long sensitization process of carried out in the region since the implementation of RVSM.