International Civil Aviation Organization

SAT/16-WP/14
04/05/2011

SIXTEENTH MEETING ON THE IMPROVEMENT OF AIR TRAFFIC SERVICES OVER THE SOUTH ATLANTIC

(Recife, Brasil, 4-6 May 2011)

Agenda Item 1.3: Air Traffic Management (ATM)

"RESULTS OF 2009 RVSM/RNP10 COLLISION RISK ASSESSMENT (EUR/SAM CORRIDOR) AND RECOMMENDED ACTIONS

(Presented by SATMA)

SUMMARY

This WP presents a resume and conclusions of the 2009 RVSM/RNP10 safety assessment in EURSAM corridor applying the collision risk model to available data, and proposal actions to be taken

1. BACKGROUND

SATMA, as monitoring Agency, was committed by SAT group to conduct studies and required Assessments to analyse the conditions for the Safety application of RVSM-and RNP10 in EUR/SAM Corridor. The EUR/SAM corridor became an RVSM-RNP10 area in January 2002 after an initial Safety Assessment.

This document includes the figures and results of collision risk assessment that has been made for the EUR/SAM Corridor, in the South Atlantic, for flight levels between FL290 and FL410. This study is a safety assessment in order to evaluate collision risk for the year 2009.

It became mandatory to perform and present periodically an **RVSM RNP-10 Post-implementation Analysis** about the situation in the EUR/SAM Corridor in order to ensure that critical parameters stay between safe figures and that required Target Level of Safety keeps bellow allowed figures.

2. AIRSPACE ASSUMPTIONS

Two quantitative risk assessments, based on suitable versions of the Reich Collision Risk Model, have been carried out. The first assessment concerns the lateral collision risk whilst the second one concerns the vertical collision risk. The vertical collision risk assessment has been split into two parts. The first part considers the risk due to technical causes, whilst the second one considers the risk due to all causes.

The scenario analyzed is the current route network, composed of four nearly parallel north south routes, (UN-741 UN-866 UN-873 UN-857) , being the two easternmost bidirectional and the other two, unidirectional. Traffic on the RANDOM route to the west of the current UN-741 and has not been considered in the analysis as it is assumed that its contribution would not change the results dramatically.

As far as crossing traffic is concerned, apart from the traffic on the published Routes that crosses the Corridor in SAL, Dakar and Recife (UR-976/UA-602, UL-435 and UL-695/UL-375), traffic that crosses the Corridor using non published routes that carry more than 50 aircraft per year, has also been considered.

Minimum lateral separation between routes is 110NM for routes UN-741/UN-866, 90NM for routes UN-866/UN-873 and 50NM for routes UN-873/UN-857. Routes UN-741 and UN-866 are unidirectional, with traffic in odd and even flight levels (Southbound traffic on route UN-741 and Northbound traffic on route UN-866).

On the other hand, routes UN-873 and UN-857 are bidirectional. The flight level allocation scheme in these last two routes is the following:

- Southbound flight levels: FL300, FL320, FL340, FL360, FL380 and FL400.
- Northbound flight levels: FL290, FL310, FL330, FL350, FL370, FL390 and FL410

The risk has been evaluated in 6 different locations along the Corridor and an estimation of the collision risk for the next 10 years has been calculated, assuming a traffic growth rate of 6% per year. The results obtained are very similar in all the locations and the risk associated to the Corridor is the largest of all the values obtained.

This study does not consider the reduction of the collision risk that would be obtained with the use of ADS.

3. DATA ASSUMPTIONS

The CRM program uses flight plan data obtained from Palestra (Aena's database), for the Canaries and traffic data from the samples provided by SAL, Dakar and Atlantic-Recife from 1st January 2009 to 31st December 2009.

Extrapolation of traffic data has been necessary in some cases in order to obtain the traffic distribution along the Corridor and on crossing routes.

Besides data from Palestra, traffic samples from SAL and Atlantic-Recife for the entire 2009 were also available for this assessment. On the other hand, Dakar provided traffic samples from seven month out of the year 2009 (1st January-31st March, 1st May-30th June and 1st September-31st October) .

Data provided by SAL, Dakar and Recife include information from all aircraft overflying the airspace on the four main routes of the Corridor. Regarding crossing routes, SAL provides traffic information from airways UR-976/UA-602 whereas Recife provides traffic data from UL-375/UL-695. Conversely, no crossing traffic information is provided by Dakar.

On the other hand, from the traffic information provided by Recife only southbound traffic with destination Brazil is included in the traffic samples from January to April.

Since data formats in which data from SAL, Dakar and Recife was provided were different from each other and different from the one used by Palestra, a transformation of formats was necessary to get all the data in the same format (the one used by Palestra). It is remarkable that in the data provided, sometimes there was not information of all the needed waypoints and, in some other cases, the information was incoherent. As a result, trajectories and information at required waypoints (i.e., time and FL) were assumed, considering the most logical routes and speeds for the extrapolation.

4. RESULTING FIGURES FOR CRM

For current traffic levels, the calculated lateral collision risk is 2.0704×10^{-9}, whilst the lateral collision risk estimated for 2019 with an annual traffic growth rate of 6% is 3.7078×10^{-9} and, in consequence, the system is considered to be laterally safe in the period under consideration.

As far as the technical vertical risk is concerned, the value of the collision risk for the current traffic levels is estimated to be 0.0094×10^{-9} and the technical vertical collision risk estimated for 2019 with an annual traffic growth rate of 6%, 0.0169×10^{-9} . Both values are below the TLS.

Regarding the vertical risk due to large height deviations, it has been calculated using the LHD reports sent by the four involved States. The contribution of these deviations to the total vertical risk in the Corridor is 1.0676×10^{-6} (2.1549×10^{-7} if the value 0.059 is taken for Py(0)), which greatly exceeds the TLS.

Nevertheless, it is important to remark that **all the deviations received related for the period were due to a coordination error**, and they are not related to RVSM operations. If these coordination errors were not taken into account, the total vertical risk would comply with the TLS, since it would be equal to the technical vertical risk. In any case, as the problem is clearly identified, the use of adequate corrective actions to reduce coordination errors in the Corridor will reduce the risk. These measures should be applied as soon as possible.

Locations	Lateral Collision Risk 2009	Lateral Collision Risk 2019
Canaries	$1.2214 \cdot 10^{-9}$	$2.1873 \cdot 10^{-9}$
SAL 1	$1.3332 \cdot 10^{-9}$	$2.3876 \cdot 10^{-9}$
SAL 2	$2.0704 \cdot 10^{-9}$	$3.7078 \cdot 10^{-9}$
Dakar 1	$1.6361 \cdot 10^{-9}$	$2.9300 \cdot 10^{-9}$
Dakar 2	$1.4924 \cdot 10^{-9}$	$2.6726 \cdot 10^{-9}$
Recife	$1.5517 \cdot 10^{-9}$	$2.7788 \cdot 10^{-9}$

Locations	Technical Vertical Collision Risk 2009	Technical Vertical Collision Risk 2019
Canaries	$0.0094 \cdot 10^{-9}$	$0.0169 \cdot 10^{-9}$
SAL 1	$0.0037 \cdot 10^{-9}$	$0.0066 \cdot 10^{-9}$
SAL 2	$0.0059 \cdot 10^{-9}$	$0.0105 \cdot 10^{-9}$
Dakar 1	$0.0065 \cdot 10^{-9}$	$0.0116 \cdot 10^{-9}$
Dakar 2	$0.0062 \cdot 10^{-9}$	$0.0111 \cdot 10^{-9}$
Recife	$0.0063 \cdot 10^{-9}$	$0.0112 \cdot 10^{-9}$

Locations	Total Vertical Collision Risk 2009	Total Vertical Collision Risk 2019
Canaries	$1.7728 \cdot 10^{-7}$	$3.1748 \cdot 10^{-7}$
SAL 1	$5.0382 \cdot 10^{-7}$	$9.0226 \cdot 10^{-7}$
SAL 2	$4.3219 \cdot 10^{-7}$	$7.7398 \cdot 10^{-7}$
Dakar 1	$1.0423 \cdot 10^{-6}$	$1.8666 \cdot 10^{-6}$
Dakar 2	$1.0676 \cdot 10^{-6}$	$1.9120 \cdot 10^{-6}$
Recife	$4.2489 \cdot 10^{-7}$	$7.6091 \cdot 10^{-7}$

5. DISCUSSION AND SATMA ACTIONS

When RVSM/RNP was to implement in 2002, same date than EUROPE, a mandatory initial Safety Assessment had to be performed following ICAO instructions/procedures for the implementation of RVSM/RNP in a specific Area. This initial study was developed, as in other Regions, based in estimations and experience about the behaviour of traffic in comparison with other similar Oceanic areas. If back to 2002 we have to remember that there were no agreed procedures to follow and monitor deviations as we have today.

Regrettably, since part of real data was available and introduced in the last studies, analysis and results has turned more negative and obtained figures, now with gained expertise, require to face a different situation with higher exigencies. It is obvious and inevitable to conclude that, perhaps, the initial estimations agreed in 2002 were no conservative enough.

The operational error is the point to be improved and since one of the most important conclusions reached is that all the deviations received in the analysed period were due to a coordination error and that there was not any traffic in conflict, we may consider to be in an advantaged position, far from the worst scene of random causes .We know the problem and the causes.

ICAO DOC 9937 "Operating Procedures and Practices for Regional Monitoring Agencies in Relation to the Use of a 300 m (1 000 ft) Vertical Separation Minimum Between", establishes in Chapter 1. 2 RMA FUNCTIONS point e) that the **Monitoring Agencies should initiate necessary remedial actions if RVSM requirements are not met.** In that sense, SATMA has presented several mitigations to prevent LHDs in the aim to reroute this situation:

SAT/15- WP/17 : **coordination procedures between adjacent ACC´s to prevent LHD´s**
"Implementation of additional ATC unit to unit coordination procedures to prevent LHD´s" .
a) Transferring ACC
In cases where the position of the aircraft is 10 minutes or less to the boundary with the receiving ACC, except imperative previous coordination and emergencies, the transferring ACC will never modify the cleared flight level and Mach number of the aircraft different from the ones communicated to the next ACC on the previous traffic estimate.
b) Receiving ACC
In cases where the position of the aircraft is 5 minutes or less from the boundary with the transferring ACC, except imperative previous coordination and emergencies, the receiving ACC will never modify the cleared flight level and Mach number of the aircraft different from the ones communicated by the transferring ACC on the previous traffic estimate
Agreed Conclusion SAT15/05: Common additional procedures to prevent LHDs, that
SAT/15 Meeting having expressed its concern about the LHDs due to operational errors in ATC unit to unit coordination **implores** ACCs to apply the coordination procedures for flight level changes near the common boundaries reflected on their respective LoAs.
SAT/15-WP/18 OLDI implementation
This paper presents OLDI links for Canary Islands
The Meeting is invited to analyze and discuss ways implement OLDI services to prevent collaterals miss coordination.
Agreed Conclusion SAT/15/16: Implementation of AIDC /OLDI in SAT
*That SAT States **be encouraged** to implement AIDC messages interchange where possible, as technical action to reduce human errors in coordination operations between neighboring ACCs*
SAT15/WP LHD monitoring Team
The paper propose the creation of LHD monitoring Team
Conclusion SAT14TF1/08: LHD Monitoring , That
a) The LHD focal point be identified and advised to SATMA by 1st July 2009
b) The LHD Monitoring Team will commence its activities by 1st July 2009
c) The LHD Monitoring Team review and endorse The Monitoring Terms Of Reference as contained in Appendix G
Conclusion SAT15/04: Operational Procedure
That Brazil, Cape Verde, Senegal and Spain will implement on AIRAC date 12
January 2011 the operational procedure based on ADS-C/CPDLC reflected in
Appendix F (Operational procedures to prevent LHD´s based on ADS-C CPDLC or only ADS-C)

2.1. Cases where both collateral ACC´s are ADS-C & CPDLC equipped

2.1.1.- The transferring ACC shall send to the aircraft the CPDLC message (UM160) NEXT DATA AUTHORITY (facility designator) at least 1 minute before doing the next step.

2.1.2.- from 15 to 45 minutes before the common boundary, the transferring ACC will initiate the connection transfer procedure sending a FN_CAD message that will instruct the aircraft system to initiate an AFN Log- on to the next ACC (still full connection with the transferring ACC)

2.1.3.- If 10 minutes before reaching the common boundary point the automatic Log- on with the receiving ACC has not been successful, the pilot shall start a manual Log- on

2.1.4.- Once the Log- on is accepted by the receiving ACC, the receiving controller will establish the CPDLC connection which will remain inactive until the CPDLC END SERVICE message is sent from the transferring ACC and received by the aircraft

2.1.5.- Immediately after the reception of the Log- on, the receiving ACC will establish, at least, a 15 minutes periodic contract and a way point change event contract. (Demand contracts will also be used if it is considered necessary)

2.1.6.- The transferring ACC will send the CPDLC END SERVICE message 5 minutes before the common boundary point

2.1.7.- The transferring ACC will not terminate the ADS- C connection before the aircraft has over flown the boundary point

2.2.- Case where the transferring ACC only ADS-C equipped and receiving ACC is ADS-C &CPDLC equipped

2.2.1.- from 15 to 45 minutes before the common boundary the transferring ACC shall initiate the connection transfer procedure sending a FN_CAD message that will instruct the aircraft system to initiate an AFN Log- on to the next ACC (still ADS-C connection with the transferring ACC)

2.2.2.- If 10 minutes before reaching the common boundary point the automatic Log- on with the receiving ACC has not been successful, the pilot shall start a manual Log- on

2.2.3.- Once the Log- on is accepted by the receiving ACC, the receiving controller can establish the CPDLC connection which will be active on the receiving ACC. The receiving ACC will never start the CPDLC message interchange (attend new requests or provide clearances) with the aircraft until reaching the common boundary point

2.2.4.- Immediately after the reception of the Log- on, the receiving ACC will establish, at least, a 15 minutes periodic contract and a waypoint change event contract. (Demand contracts will also be used if it is considered necessary)**.**

It can be noted that, from all mentioned above, only the proposal about the "creation of LHD monitoring team" was agreed by the plenary.
One of them is pending of information to be provided (ADS), and others just derived into mere advises for good intentions.
It is essential that ICAO/SAT group require from involved states mandatory actions, SATMA proposals or others, so the EURSAM Corridor can meet the TLS required from CRM model

6. REGIONAL MONITORING AGENCIES (RMAS) COORDINATION

All Regional Monitoring Agencies are aware about the fact that Operational Risk treatment in CRM model is specially penalized by LHD/LD occurrences. Although it is true that there is at endemic problem in the corridor (traffic coordination), it is also true that the same problem is present in other Regions. EURSAM Corridor is also affected, being an Oceanic Area, by conditions and reporting procedures that produce durable Deviations.

SATMA will attend to next RMA meeting (Montreal June 2011) to present EURSAM RVSM/RNP safety situation and to compare our Corridor with other similar structural Regions to look for solutions and coordinated actions with other Regional Monitoring agencies.

One the aims of this periodic RMAs meeting is to refine and discuss the application of the CRM model, overall in operational risk, and its application to Safety Assessments. Even other models are taken into account if they fit with main safety criteria. A summary report of this meeting and conclusions will be presented to SAT Group accordingly.

7. 2010 SAFETY ASSESMENT REPORT

2010 Safety Assessment will be presented once data from States regarding 2010 traffic is delivered to SATMA. In that sense it is important to remember that DATA models to send is included the document "DATA NEEDED FOR EUR/SAM MONITORING AND ASESSMENTS" published in SATMA website (www.satmasat.com) since SAT14. Also 2011 data should be delivered.

8. ACTION BY THE MEETING

The SAT/16 Meeting is invited to:

a) Take note of the information provided about results of Safety Assessment in EURSAM Corridor for 2009 (Full Study to be published in www.satmasat.com).
b) Encourage ICAO to collaborate SATMA to implement mandatory initiatives aimed to revert the situation concluded by 2009 Safety Assessment analysis following ICAO DOC 9937 "Operating Procedures and Practices for Regional Monitoring Agencies in Relation to the Use of a 300 m (1 000 ft) Vertical Separation Minimum Between", Chapter 1. 2 regarding **RMA FUNCTIONS** point e) **initiate necessary remedial actions if RVSM requirements are not met.**
c) SATMA to present a summary of EUR/SAM Corridor Safety Assessment and LHD summary in **next RMA meeting** (Montreal June 2011).
d) A summary report of affecting conclusions from RMA meeting will be presented by SATMA to SAT Group.
e) Apart from LHD/LD monthly report, States to deliver SATMA data regarding 2010/2011 traffic following, if possible, the DATA models of document "DATA NEEDED FOR EUR/SAM MONITORING AND ASESSMENTS" published in SATMA website (www.satmasat.com).

- END -