Agenda Item 5: Collision risk assessment and LHD

e) Analysis on RMAs issues on data reporting quality and format

Data for Collision Risk Model in EUR /SAM

(Prepared by SATMA)

SUMMARY

This working paper presents some considerations regarding procedures to get the data to be treated in the Collision Risk Model.

1. Background

1.1 The reliability of the collision risk assessments greatly depends on the availability and accuracy of the used data. In the studies made up to now for the EUR/SAM Corridor, it has been made clear the lack of data, without which it is not possible to model the parameters of the collision risk model adequately.

1.2 Following that purpose, and even if some amendments should be introduced in it, the document "RMA DATA NEEDED FOR EUR/SAM MONITORING AND ASESSMENTS" (see **Appendix A**) delivered some time ago by SATMA, as a guide to be followed by EURSAM States, could be of interest.

2. Analysis

2.1 Since 2002 all EUR/SAM States has been sending both Traffic Data and LHD occurrences to SATMA as main information to perform CRM Model, in which Safety Assessment is based. It was agreed that between 1st and 5th of each month that information should be received by SATMA.

2.2 Though States use to be disciplined, it is true that there is lack of information due to some of the following three causes.

a. ATC/Pilots do not Report the occurrence of an LHD/LD. We deal -still- with a lack of **"reporting culture"** after the traffic has been serviced. Pilots are not involved in RVSM monitoring, as LHD Reports from Pilots is zero.

b. ACC do not send report LHD to SATMA. Very unusual.
c. ACC LHD Report is incomplete. Very usual. When an incomplete LHD is received by SATMA the investigation is hard to follow, as it occurred weeks or even a month ago.

2.3 To minimize this lack of information LHD delivery formats where modified and a NO REPORT DEVIATION flag was incorporated. See **Appendices B and C.**

2.4 On the other hand, new generation surveillance systems (ADS-C, ADS-B) are not evaluated by CRM Model. This implies that some agreement about LHD considerations should be reformulated, so TLS calculation is more in line with the truth concept of "deviation" as "unexpected flight level". LHD reported are sometimes no so unexpected thanks to surveillance monitoring.

3. Suggested actions

3.1 RMAs, States and SAT/SOG members revise the information provided to establish a common procedure for LHD Reporting and create an adequate BBDD for investigation and mitigation actions purposes.

APPENDIX A

RMA DATA NEEDED FOR EUR/SAM MONITORING AND ASESSMENTS

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1.- INTRODUCTION

The reliability of the collision risk assessments greatly depends on the availability and accuracy of the used data. In the studies made up to now for the EUR/SAM Corridor, it has been made clear the lack of data, without which it is not possible to model the parameters of the collision risk model adequately.

The data that should be provided is enumerated in this document, together with a brief explanation of their utility and the format to be used in each case.

The given templates are preferred. Nevertheless, any other template will be acceptable as long as the required information is provided.

2.- PROPOSAL FOR DATA COLLECTION

All the following data should be provided to SATMA (satma@enaire.es) for all the FIR/UIRS included in the EUR/SAM Corridor, i.e. FIR/UIR Recife (Atlantico), Dakar Oceanic UIR, SAL Oceanic UIR and Canarias UIR, unless otherwise stated in the next sections.

Of all the requested data, deviation reports and traffic samples are essential. Radar data would also be useful, although it is not indispensable.

2.1.- DEVIATION REPORTS

The main parameters of the lateral and the vertical collision risk models are the probabilities of lateral and vertical overlap, $P_y(S_y)$[1] and $P_z(S_z)$[2], respectively. Data needed for the computation of lateral and vertical overlap probabilities are the distributions of the lateral and vertical deviations of aircraft from their assigned flight paths.

In particular, in the lateral case, it is important to avoid underestimating the tail of the distribution, i.e. the probability of "large" or "gross" errors, as the lateral risk estimate is sensitive to that part of the distribution.

As far as the vertical case is concerned, the probability of vertical overlap is obtained from the probability density function of the Total Vertical Error (TVE), modelling separately its two components: Altimetry System Error (ASE) and Assigned Altitude Deviation (AAD)[3].

The total collision risk, due to all causes and not only the technical ones, can not be obtained if reports on large height keeping deviations are not provided. This information will be used to model the atypical AAD performance.

A fairly large data sample is needed to be able to model these distributions confidently. Therefore, it is recommended that data on large lateral and vertical deviations be provided every month in order to improve the estimation of overlap probabilities.

[1] $P_y(S_y)$ is the probability of lateral overlap of aircraft nominally flying on laterally adjacent paths at the same flight level.

[2] $P_z(S_z)$ is the probability of vertical overlap of aircraft nominally flying on adjacent flight levels of the same track.

[3] AAD: Difference between the displayed altitude and the assigned altitude. Its performance is divided into typical performance (deviation no greater than 300 ft) and atypical performance (deviation greater than 300ft).

At least those lateral deviations whose magnitude is equal or greater than 5NM and altitude deviations of 300ft or more should be reported.

If no deviations are detected, information should also be sent monthly indicating that no deviations were detected in the airspace in question during the given period of time.

See in Annex 1 the forms to be used.

2.2.- FLIGHT PROGRESS DATA

The primary data source will continue to be the flight progress data obtained from ENAIRE's database, Palestra, for the Canaries. This data is already available. Thus, this section is not applicable to the Canaries FIR/UIR.

It would be recommended that accurate flight progress data be made available from the rest of FIR/UIRs in order to cross-check Palestra's data, facilitating the verification of traffic flows, distribution and passing frequencies.

This information is also needed to compute the occupancy values due to crossing traffic, what will not be otherwise possible.

To achive this second objective, it is recommended that, minimum two to three months of daily traffic, covering the main traffic flow as well as the crossing traffic, becomes available from all FIR/UIRs. Traffic on the RANDOM route should also be provided.

The form to be used for these traffic samples can be found in Annex 2.

2.3.- RADAR DATA

It would also be useful to have a sample of radar data from the areas where radar coverage is available.

This information can be used to obtain information on lateral and vertical deviation events, in order to improve the estimation of overlap probabilities.

As far as the vertical component is concerned, the typical performance of AAD could be obtained from archive Mode C data.

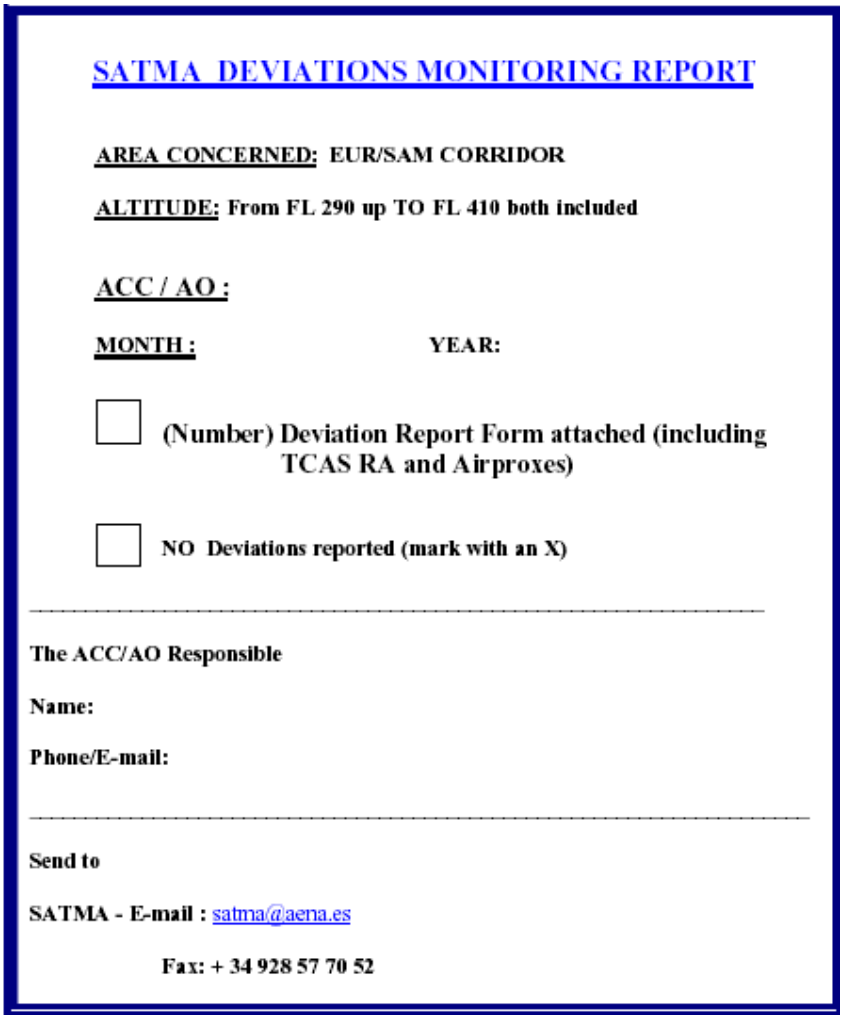
It can also be used to obtain the value of the average relative cross-track speed between aircraft that have lost lateral separation, $|\bar{\dot{y}}|$, from data on lateral deviations and speeds.

ANNEX 1

FORMS FOR DEVIATIONS

A1.1.- FORMS FOR DEVIATIONS

A report like the one shown in Figure 1 should be sent monthly, even if no deviations have been detected (for completeness).



SATMA DEVIATIONS MONITORING REPORT

AREA CONCERNED: EUR/SAM CORRIDOR

ALTITUDE: From FL 290 up TO FL 410 both included

ACC / AO :

MONTH : YEAR:

☐ (Number) Deviation Report Form attached (including TCAS RA and Airproxes)

☐ NO Deviations reported (mark with an X)

The ACC/AO Responsible

Name:

Phone/E-mail:

Send to

SATMA - E-mail : satma@aena.es

Fax: + 34 928 57 70 52

Figure 1
SATMA Deviations Monitoring Report

If any deviation (lateral or vertical) has been detected, a form like the one shown in Table 1 must be filled for each of them. It is basically the form already used by SATMA, but with some modifications, being the most important one the classification of vertical deviations.

NAVIGATION DEVIATION INVESTIGATION FORM				
Date/Time (UTC):			Reporting Unit:	
Type of Report: □ PILOT – Flight □ CONTROLLER – ATC Unit			Conflict Alert Systems:	
Type of Deviation: □ LATERAL □ Type (A to G) □ VERTICAL □ Type (1 to 7)			Causes: ☐ WEATHER ☐ OTHERS (Specify)	
DETAILS OF AIRCRAFT	First Aircraft		Second Aircraft (for vertical)	
Aircraft Identification:				
Name of Owner/Operator:				
Aircraft Type:				
Departure Point:				
Destination:				
Route Segment:				
Flight Level:	Cleared	Actual	Cleared	Actual
Cleared Track:				
Extent of deviation - magnitude and direction: (NM for lateral; feet for vertical)				
Amount of time at incorrect Flight Level/Track:				
Position where deviation was observed: (BRG/DIST from fixed point or LAT/LONG)				
WAS ATC Clearance obtained: ☐ YES ☐ NO	If ATC clearance NOT obtained WERE Contingency procedures Followed: ☐ YES ☐ NO			
Action Taken by ATC/Pilot:				
Crew comments, if any, when notified:				
Remarks:				

Table 1
Deviation report form

A1.2.- GUIDELINES FOR COMPLETION

A1.2.1.- General guidelines

- Use the deviation report form to report a lateral deviation or an altitude deviation of 300ft or more. Events above FL290 inclusive are requested.

- Complete the form as soon as practicable after the occurrence.

- The ATCO/Pilot shoud fill as many items as possible.

- Any other report templates are fully acceptable as long as mandatory items are included (see A1.2.3).

- The notification of any deviation (vertical or lateral) has to be classified, when possible, according to the types described in A1.2.2.

A1.2.2.- Causes of deviations

A1.2.2.1- Lateral deviations

The causes of lateral deviations can be classified into the following types:

- **A-**.Committed by aircraft not certified for operation in the RNP airspace.

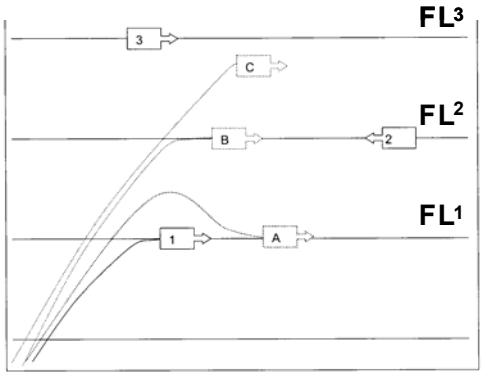
- **B-**.ATC system loop error.

- **C1-**.Equipment control error including inadvertent waypoint error.

- **C2-**.Waypoint insertion error due to the correct entry of incorrect position.
- **D-**. Other with failure notified to ATC in time for action.
- **E-**. Other with failure notified to ATC too late for action.
- **F-**. Other with failure notified/received by ATC.
- **G-**.Lateral deviations due to weather when unable to obtain prior ATC clearance.

A1.2.2.2- Vertical deviations

Figure 2 shows the three basic error categories.



Aircraft1: correct climbing path
Scenario A: aircraft 1 performs a level bust
Scenario B: aircraft 1 joins an incorrect level
Scenario C: aircraft 1 crosses an incorrect flight level

Figure 2
Illustration of the 3 basic error categories

Should a different scenario occur, please provide as many descriptive details as possible in the corresponding boxes to support its assessment.

The causes of the large height deviations can be classified into the following categories:

- **1.-** Pilot error (e.g; acting without a clearance, misunderstanding a clearance, flying to the wrong flight level, level bust).

- **2.-** ATC error (e.g. failing to take another aircraft into account when giving a clearance, judgement error, co-ordination with military ATC, planning/procedural failure, etc).

- **3.-** Pilot-ATC loop error (e.g. pilot gave in-correct read-back not picked up by ATC).

- **4.-** Aircraft equipment failure/ error (e.g. gross autopilot errors)

- **5.-** TCAS (e.g. RA, TA, nuisance warning).

- **6.-** Wake Turbulence.

- **7.-** Unknown

A1.2.3- Mandatory and optional fields

The mandatory fields are:

- Type of report: State whether deviation observed by ATC or reported by pilot.

- Date/Time (UTC)

- Type of deviation: lateral or vertical and subtype according to the classification in A1.2.2.

- Aircraft Identification: Callsign and/or registration number.

- Aircraft type: Use ICAO designators.

- Cleared flight level: FL[1] according to Figure 2.
- Actual flight level: Flight level to which the aircraft actually deviated.
- Cleared track
- Extent of deviation-magnitude and direction: NM for lateral and feet for vertical.
- Amount of time at incorrect Flight level/ Track.
- Position where deviation was observed: latitude and longitude or bearing and distance from fixed point.
- Was ATC clearance obtained?
- If ATC clearance NOT obtained, were contingency procedures followed?: If they were not, an explanation why have to be included in “Remarks”.

The optional fields are:

- Causes: Weather or others (specify)
- Conflict alert systems: Indicate if available and which ones
- Name of owner/operator
- Departure point
- Destination

- Action taken by ATC/Pilot

- Crew comments, if any, when notified

- Remarks: Add any cause or factors believed relevant to the occurrence. If it is possible, give a more precise explanation of the type of deviation.

ANNEX 2

FORM FOR TRAFFIC SAMPLE

A2.1.- FORM FOR TRAFFIC SAMPLE

The form for traffic samples is an EXCEL table that includes the items explained below. The format can be seen in Table 2.

EUR/SAM CORRIDOR POST IMPLEMENTATION SAFETY ASSESMENT FORM FOR TRAFFIC SAMPLE																		
FIR IDENTIFICATION:																		
DATE	**ROUTE**	**ACFT. CALL SIGN**	**ACFT TYPE**	**DEPART. AD**	**DEST. AD**	**PROGRESSION IN RVSM AIRSPACE (FIX. TIME and FLIGHT LEVEL)**												
						ENTRY FIX	**TIME AT ENTRY FIX**	**FL AT ENTRY FIX**	**FIX 1**	**TIME AT FIX 1**	**FL AT FIX 1**	**FIX 2**	**TIME AT FIX 2**	**FL AT FIX 2**	**CONTINUE AS NECESSARY**	**EXIT FIX**	**TIME AT EXIT FIX**	**FL AT EXIT FIX**

Table 2
Form for traffic sample

A2.2.- GUIDELINES FOR COMPLETION

- Use this form to report traffic samples, including flights on the main routes of the Corridor and crossing traffic.
- Fill one line for each flight. If any of the fields is unknown, fill that cell with three dashes, ---.
- The information that must be introduced in each column is the following one:

  - DATE: Day, month and year of occurrence (dd/mm/yy).
  - ROUTE: Route name.
  - ACFT. CALLSIGN: Aircraft callsign or registration number.
  - ACFT TYPE: Aircraft type. Use ICAO designators.
  - DEPART. AD: Departure aerodrome. Use ICAO designators.
  - DEST: AD: Destination aerodrome. Use ICAO designators.
  - ENTRY FIX: Entry fix to the FIR.
  - TIME AT ENTRY FIX: hh:mm:ss.
  - FL AT ENTRY FIX: Flight level at entry fix (FLXXX).
  - FIX 1:The first reporting point after the entry fix if it is different from exit fix.
  - TIME AT FIX1: hh:mm:ss.
  - FL AT FIX1: Flight level at fix1 (FLXXX).
  - FIX 2: The second reporting point after the entry fix if it is different from the exit fix.
  - TIME AT FIX2: hh:mm:ss.
  - FL AT FIX2: Flight level at fix2 (FLXXX).
  - CONTINUE AS NECESSARY: If there are more than two reporting points between the entry and exit fixes, three columns should be added for each of them, as in the case of fix 1 or 2. These columns must be completed with their names, time at the fix and flight level at fix.
  - EXIT FIX: The exit fix of the FIR.
  - TIME AT EXIT FIX: hh:mm:ss
  - FL AT EXIT FIX: Flight level at exit fix (FLXXX).

APPENDIX B- Coordination LHD (Investigation form)

LHD Date:	**Involved FIRs:**

ENTRY/EXIT FIX (LAT/LONG) POINT: **(FLIGHT NUMBER) CALL SIGN:**

Active Surveillance	**Radar** ☐ **ADS** ☐ **None** ☐

TIME		**LEVEL**	
1. TIME UTC	**2. ATC CONTACT TIME**	**3. COORDINATED FL**	**4. UNEXPECTED FL**
* ESTIMATED TIME FROM OVERFLYING ENTRY POINT TILL ATC CONTACT			

1. Real UTC time at ENTRY/EXIT Point
2. Time lapse between field 1 and Aircraft position/level notification
3. Last Estimated/Coordinated FL from Exit FIR to Entry FIR (Via Voice/OLDI)
4. Real FL at ENTRY point

** Only If fields 1 and 2 are not available*

Comments:

Crew comments (if any):

When complete please forward the report(s) to:

South Atlantic Monitoring Agency (SATMA) E-Mail: satma@enaire.es/aariasf@enaire.es

The information contained in this form is confidential and will be used for statistical safety analysis purposes only.

APPENDIX C

SATMA DEVIATIONS MONITORING REPORT

AREA CONCERNED: **EUR/SAM CORRIDOR**

ALTITUDE: **From FL 290 up TO FL 410 both included**

ACC / AO :

MONTH : **YEAR:**

☐ **(Number) Deviation Report Form attached (including TCAS RA and Airproxes)**

☐ **NO Deviations reported (mark with an X)**

The ACC/AO Responsible

Name:

Phone/E-mail:

Send to

SATMA - E-mail : satma@enaire.es