INTERNATIONAL CIVIL AVIATION ORGANIZATION

WESTERN AND CENTRAL AFRICA OFFICE

Twenty-Fourth Meeting on the Improvement of Air Traffic Services over the South Atlantic (SAT/24)
Luanda, Angola, 5-7 June 2019

Agenda Item 3.2: **Review of RMA report on Traffic Statistics, Safety procedures and Operating procedures.**

3.2.2 ARMA TRAFFIC STATISTICS

(Presented by the ARMA)

SUMMARY
This paper provides the review of the regional monitoring agencies report on traffic statistics, safety procedures and operational procedures, and document present the collision risk analysis report for the RVSM airspace in the year 2018 at the AFI, the Collision Risk Assessment (CRA) methodology was used for the airspace safety assessment as recommended by ICAO in space RVSM, and demonstrates that the safety criteria defined in ICAO Document 9574 continue to be satisfied in the RVSM airspace of the AFI FIRs.
REFERENCE(S): Manual on Implementation of a 300 m (1 000 ft) Vertical Separation Minimum Between FL 290 and FL 410 Inclusive, ICAO Doc 9574-AN/934, SECOND EDITION – 2002.
Related ICAO Strategic Objective(s): **Safety, Capacity & Efficiency**

1. INTRODUCTION:

1.1 The AFI FIR RVSM airspace was treated as an isolated system, with its own statistical parameters.

1.2 We analysed data from 325,092.08 flight hours related to the transit of aircraft using sections of AFI FIR airplanes between flight levels 290 to 410 which operate in the SAT Area

FIR/UIR	No of months processed	Flight time estimate for 2016 (hrs)
Accra	11	33,798.96
Asmara	-	
Beira	12	30,759.35
Cape Town	8	20,057.55
Dakar*	(3+12+12+0) * 12 / 48 = 6.8	67,053.77
Johannesburg	10	74,102.82
Johannesburg Oceanic	-	
Luanda	-	
N'Djamena	7	39,064.26
Niamey*	(11+12) * 12 / 24=11.5	52,483.15
Roberts	11	7,772.22
Total	**77.3**	**325,092.08**

2. DISCUSSION

2.1 The monitoring groups' probability densities density $f_i^{ASE}(a)$, $i = 1, \dots, n_{MG}$ are to be estimated on the basis of height monitoring data of RVSM approved aircraft. Height monitoring data can be collected by ground-based Height Monitoring Units (HMUs), Aircraft Geometric Height Monitoring Elements (AGHMEs), or by air portable GPS Monitoring Units (GMUs). Ground-based HMUs or AGMEs are not available in the AFI region. However, as the normal height-keeping performance of RVSM approved aircraft is not dependent on the region of operation, HMU data collected in other ICAO Regions may be used for the modelling of a monitoring group's ASE probability density $f_i^{ASE}(a)$. Notice that the overall ASE probability density defined by eq. (A.1) will vary from region to region due to differences in the weighting factors β_i resulting from the particular composition of each region's aircraft population.

2.2 For the current post-implementation CRA 12 2017, ASE probability densities $f_i^{ASE}(a)$, $i = 1, \dots, n_{MG}$, from the latest RVSM safety assessment for the EUR region have been used, based on height monitoring data for the period 1st January 2016 – 31 December 2017.

Monitoring Group	Flight time proportion		Monitoring Group	Flight time proportion
A124	0.001349		CL605	0.001132
A306	0.000284		CRJ10	0.000387
A30B	5.03E-05		CRJ7	0.001068
A310-GE	0.000564		CRJ9	0.002334
A310-M	0.000564		D328	1.77E-06
A318	0.000251		DC10	6.32E-05
A320	0.10707		DC85	5.21E-07
A330	0.134274		DC86-87	0.000136
A339	7.55E-06		DC93	1.04E-06
A340	0.051099		E120	1.05E-05
A345	0.000416		E135-145	0.02368
A346	0.018989		E170-190	0.025671
A350	0.008575		E50P	2.39E-05
A380	0.024699		E545-E550	1.91E-05
AC90	4.67E-06		E55P	4.7E-05
AN12	3.78E-05		EA50	1.64E-06
AN72	0.000107		F100	0.00022
ASTR	3.22E-05		F2TH	0.000995
ASTR-SPX	3.22E-05		F70	0.000441
AVRO	0.003488		F900	0.003903
B190	9.1E-06		FA10	0.000147
B703	6.14E-06		FA20	0.00022
B712	7.59E-06		FA50	0.000779
B727	0.001294		FA7X	0.00253
B732	0.000517		G150	2.24E-05
B737C	0.017252		G280	0.000139

B737CL	0.029971		GALX	7.76E-05
B737NX	0.208665		GL5T	0.000381
B744-10	0.015402		GLEX	0.002369
B744-5	0.015402		GLF2B	2.73E-05
B747CL	0.000122		GLF3	0.000203
B748	0.005724		GLF4	0.001451
B74S	7.02E-06		GLF5	0.001484
B752	0.001916		GLF6	0.00034
B753	9.54E-05		H25A	7.42E-05
B764	0.000275		H25B-700	0.000409
B767	0.031711		H25B-750	0.000409
B772	0.064181		H25B-800	0.000409
B773	0.106987		H25C	0.000289
B787	0.056104		HA4T	0.00012
BA11	1.22E-06		IL62	1.39E-05
BD100	0.000375		IL76	0.001183
BE20	0.000257		IL96	3.52E-05
BE30	0.00028		J328	0.001185
BE40	0.000308		L101	1.66E-05
C25A	1.5E-05		LJ23	9.77E-07
C25B	1E-05		LJ31	7.77E-05
C441	4.23E-06		LJ35-36	0.000398
C500	6.67E-05		LJ45	0.000594
C560	0.000463		LJ55	0.00017
C56X	0.000278		LJ60	0.000478
C650	0.000206		MD11	0.004327
C680	0.00031		MD80	0.000481
C750	4.09E-05		MD90	6.39E-07
CARJ	0.005226		P180	1.78E-05
CL600	0.001132		PC12	6.37E-05
CL604	0.001132			

2.3 An average cruising speed of 481.44 kts has also been calculated.

Table A.4 Average aircraft dimensions for AFI RVSM aircraft population

Aircraft Dimension	Value (ft)
Length	170.720
Width	158.44
Height	49.04

2.4 Passing Frequency

Ideally, the three different types of passing frequencies should be determined for each ACC in the AFI Region over a one-year period and be used as a basis to identify the three busiest adjacent ACCs. Thus, as a part of the AFI RVSM programme, States in the AFI Region have been requested by ICAO State letter to provide monthly traffic flow data to the African Regional Monitoring Agency ARMA (Refs. 15 and 16). The need for this and other monitoring data has been duly recognised and confirmed by the AFI RVSM programme in the conclusions of its successive Task Force meetings, see e.g. reference 17 – conclusions 13.1 and 13.2. Many, but not all, States have provided the monthly traffic flow data in one form or another. Prior to any data being available for the first pre-implementation collision risk assessment CRA 1, some operational judgement was applied to identify the three busiest adjacent ACCs by specifying the following four clusters of adjacent States as candidates for the ultimate passing frequency averaging:

- Algeria, Libya, Egypt;
- Central African Republic, Nigeria, Egypt;
- Nigeria, Chad, Cameroon; and
- South Africa, Botswana, Democratic Republic of Congo (DRC)/Angola.

2.5 Each of the four clusters provided a kind of east-west cross-section through the major north-south routes in the AFI Region with the associated FIR/UIRs being:

- IC-1: Algiers, Tripoli, Cairo;
- IC-2: Brazzaville/ N'Djamena, Kano, Cairo;
- IC-3: Kano, N'Djamena, Brazzaville; and
- IC-4: Johannesburg, Cape Town, Gaborone, Kinshasa/Luanda.

2.6 The above clusters have been used as a guideline for each of the pre-implementation CRAs, though it was recognised that data from each ACC is really needed to be able to perform the passing frequency estimation and averaging properly. It should also be remarked that Cairo FIR and Tripoli FIR have become part of the Middle East/Asia RVSM airspace (Ref. 18).

2.7 Another look at the ACCs covering the region's busiest traffic flows or highest passing frequencies has been based on the six Areas of Routing (ARs) to, from, and within Africa, defined by the Africa - Indian Ocean Planning and Implementation Group (APIRG), namely (see figure D-1 of reference 19):

- AR-1: Europe South Atlantic;
- AR-2: Atlantic Ocean;
- AR-3: Europe – Eastern Africa (including Oceanic Areas);
- AR-4: Europe – Southern Africa, including continental Southern Africa routes;
- AR-5: Continental Western Africa including coastal areas; and
- AR-6: Trans-Indian Ocean.

2.8 The three continental Areas of Routing AR-3, AR-4, and AR-5 are of relevance to the passing frequency assessment as prescribed by reference 2. The FIR/UIRs making up these three Areas of Routing are:

- AR-3: Addis Ababa, Asmara, Cairo, Dar Es Salaam, Entebbe, Khartoum, Mogadishu, Nairobi, and Tripoli;
- AR-4: Brazzaville, Cape Town, Gaborone, Harare, Johannesburg, Kano, Kinshasa, Luanda, Lusaka, N'Djamena, Niamey, Tripoli, and Windhoek; and

- AR-5: Accra, Brazzaville, Dakar, Kano, Niamey, N'Djamena, and Roberts.

2.9 In accordance with the cruising levels (at or above FL290) in use in (most of) the FIR/UIRs in the AFI Region under RVSM, a negligible number of same-direction passings between aircraft at adjacent flight levels should be expected, i.e. $n_x(same)$ in the collision risk model of eqs. (2.8) and (2.9). Some such same-direction passings, however, have been found in the traffic flow data provided in ARMA Form 4 and have been included in the computation of the equivalent opposite-direction passing frequency defined by eq. (2.8). Table 2.3 summarizes the opposite-direction and equivalent opposite-direction passing frequencies obtained from the ARMA Form 4 traffic flow data for the various FIR/UIRs. Notice that (useable) data for the passing frequency calculations.

2.10 The current CRA 12 2017 passing frequencies may be compared with the previous ones utilized in CRA 11 2016. As can be seen in table 2.3, the passing frequency increased or decreased with more than 50% for four FIRs/UIRs, namely Accra (-83%), Johannesburg (-89%), N'Djamena (-53%) and Niamey (-64%). It is not clear whether these changes are due to actual changes in traffic patterns or due to changes or limitations in the ARMA Form 4 traffic flow data. Although these changes are quit significant in some cases, the effect on the estimated passing frequency for the AFI Region is limited.

Triple of adjacent FIR/UIRs	Maximum average passing frequency	Initial Cluster or Area of Routing
Dakar — N'Djamena — Niamey	0.0870	IC-3, AR-4, AR-5
Kano — N'Djamena — Niamey	0.0860	IC-3, AR-4, AR-5
Dakar — Kano — Niamey	0.0854	IC-3, AR-4, AR-5

2.11 This value is approximately 40% smaller than the value of 0.1933 equivalent opposite-direction passings per flight hour utilised in the previous CRA 11 2016. It is unclear whether the change is due to changes in traffic patterns or due to limitations in the available data, or both. Nonetheless, it continues to be necessary to stress the importance of complete and representative data to avoid the risk of underestimating collision risk model parameters and thus of underestimating the real risk of collision between aircraft. In this context, reference should also be made to the unsatisfactory situation of a number of FIR/UIRs still not providing any data in ARMA Form 4 for the passing frequency estimation process.

3. Action by the meeting

3.1 The meeting is invited to:

a) take note of the contents of this paper;