



**Twenty First Meeting of the Africa-Indian Ocean Planning and Implementation Regional Group
(APIRG/21)
(Nairobi, Kenya, 9 – 11 October 2017)**

Agenda Item 4: RVSM Airspace Safety

AFI RVSM COLLISION RISK ASSESSMENT (CRA) NO 10

(Presented by the AFI Regional Monitoring Agency)

SUMMARY

This Working Paper Discusses the 7th Post Implementation RVSM CRA in the AFI Region. Two of the AFI RVSM Safety Policy objectives are addressed, i.e. an assessment of the Technical Vertical Collision Risk and the Total Vertical Collision Risk. There is a progressive deterioration tendency in the Total Vertical Collision Risk observed from CRA 7 assessed for the year 2012. State authorities will hereby be informed of the AFI RVSM system risk and requested to act on improving overall performance with special reference to the ATM element.

REFERENCE(S):

- ICAO Doc 9574; ICAO Doc 9937; AFI RVSM Safety Policy
- AFI RVSM CRA 10, ICAO Cir 331

Related ICAO Strategic Objective(s): A B & E

1. INTRODUCTION

1.1 The AFI Regional Monitoring Agency (ARMA), monitoring the AFI RVSM system, is required by the provisions of ICAO Document 9937, Operating Procedures and Practices for Regional Monitoring Agencies in Relation to the Use of a 300 m (1000 ft) Vertical Separation Minimum Between FL 290 and FL 410 Inclusive, to provide APIRG with an annual overview relating to RVSM system risk within the AFI Region based on the annual quantitative RVSM Collision Risk Assessment.

1.2 The meeting should recall that AFI CRA's are, inter alia, compiled by making use of the monthly RVSM safety assessment traffic data which is collected by all accredited State/FIR Area Control Centre's and submitted to the ARMA to monitor RVSM system safety and risk. Further to this Unsatisfactory Condition Reports (UCR) deposited into the central depository database managed by the ICAO TAG are reviewed and where applicable processed into the CRA. RVSM Large Height Deviations reported directly or indirectly to ARMA are also prepared and worked into the assessment.

1.3 CRA 10 presents the 7th post-implementation CRA for RVSM in the AFI Region. The assessment addresses two of the AFI RVSM Safety Policy objectives, i.e. an assessment of the Technical Vertical Collision Risk evaluated against the agreed to Target Level of Safety (TLS) of 2.5×10^{-9} fatal

accidents per flight hour, and an assessment of the Total Vertical Collision Risk evaluated against a TLS of 5×10^{-9} fatal accidents per flight hour. The aforementioned are the Global norm as adopted by APIRG.

1.4 CRA 11 for 2016 is currently under construction and will be presented at APIRG 22.

1.5 The meeting should recall that an overview of CRA 8 was presented at APIRG 20. Due to the time period between APIRG 20 and APIRG 21 an overview of CRA 9 was discussed at the most recent TAG meeting where various RVSM National Program Manager's and representatives were in attendance.

2. DISCUSSION

2.1 Collision Risk Assessment 10 (CRA 10) provides an assessment incorporating all applicable aspects of the RVSM system elements which are monitored. The final result is presented as the Total Vertical Collision Risk estimate which should be noted by the meeting and evaluated against the AFI Target Level of Safety (TLS) 5×10^{-9} fatal accidents per flight hour. The final result will be illustrated on a tendency graph for easy reference.

2.2 The estimate of the Technical Vertical Collision Risk was once again calculated to be below the agreed to AFI Technical Vertical TLS of 2.5×10^{-9} fatal accidents per flight hour which is a positive indication however the estimate of the agreed to Total Vertical Collision Risk does not meet the Total Vertical Collision Risk TLS of 5×10^{-9} fatal accidents per flight hour. The Total Vertical Collision Risk estimate should be viewed with concern and will require attention.

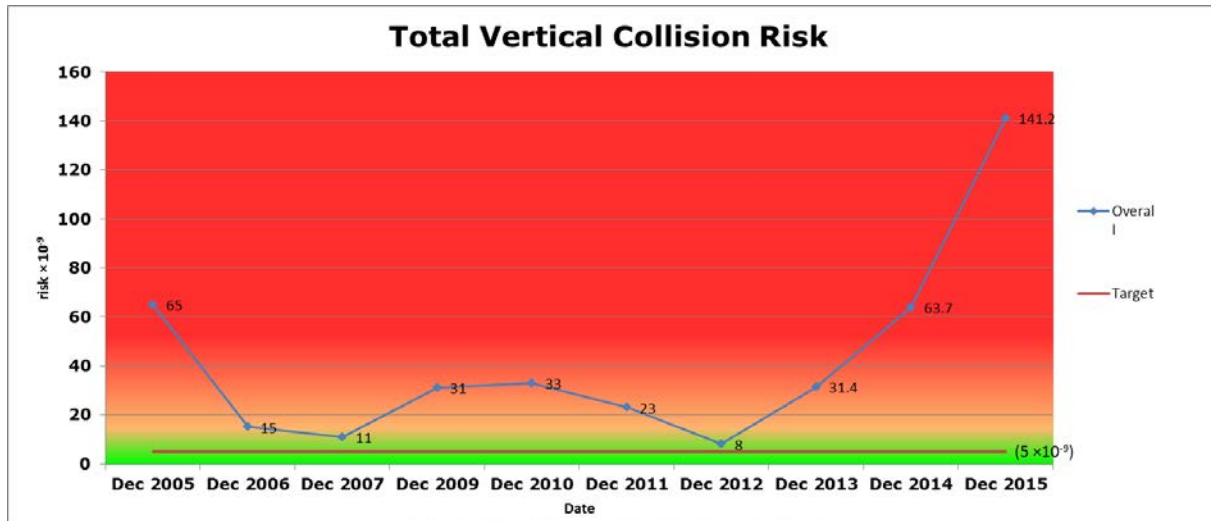
2.3 The calculated estimate of the Technical Vertical Collision Risk as mentioned in paragraph 2.2 is well below the Technical Target Level of safety by a factor of 13 and has moved only very slightly upwards towards the TLS 2.5×10^{-9} . The accuracy of GNSS navigation requires the risk mitigation effects of Strategic Lateral Offset Procedure (SLOP) which would make this estimate even better hence the urgency for the completion of the documented implementation of SLOP in FIR's where applicable. Currently 50% of FIR's have implemented SLOP as per APIRG Conclusion 17/43. Recall that SLOP has not been worked into this CRA as implementation has not been completed. The Technical Vertical Collision risk estimate is encouraging and will be monitored for any degradation.

2.4 The CRA 10 estimate of the Total Vertical Collision Risk was calculated as 141.2×10^{-9} fatal accidents per flight hour. This result measured against the AFI Total Vertical Collision Risk TLS is 28.2 times greater than the AFI TLS. The estimate is approximately two times larger than the estimate for CRA 9. The increase in the CRA 10 estimate of the total vertical collision risk is attributed to the combined effect of increases in the probability of vertical overlap due to RVSM Large Height Deviations (LHD) and in the passing frequency. The increase in the estimate of the probability of vertical overlap resulted from a doubling of the number of improper flight level crossings and increases by approximately fifty per cent in the proportions of flight time spent at an incorrect opposite-direction and same-direction flight level. The majority of the events appear to be as a result of imperfect real time Air Traffic Management. For easy reference two bar graphs will be displayed in a short power point presentation at the meeting.

2.5 The CRA 11 safety event raw data currently being processed, approximately 42 events, provides a similar scenario that attributes approximately 32 safety events to imperfect real time Air Traffic Management. There remains a lot of work on CRA 11 before facts can be presented.

2.6 Together with the information in paragraph 2.4 there was a mid-air collision within the period of assessment that occurred on 5 September 2015. Information on the large height deviation of one of the two aircraft involved in the collision was included in the estimation of the risk due to flying at an incorrect opposite-direction flight level. Prior to this event there was another similar event with the same aircraft. The duration of flight time at the incorrect level significantly contributed to the estimated

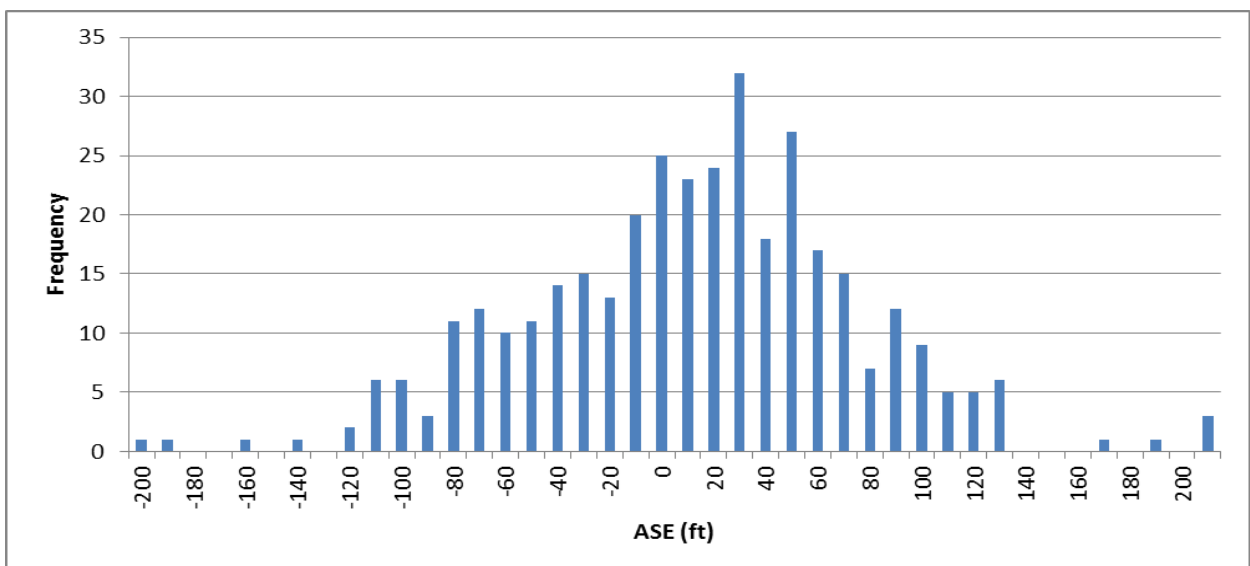
Total Vertical Collision Risk in AFI RVSM airspace. The risk presented by the aircraft lost in the mid-air event might be conservative.



2.7 The precision of lateral navigation is an important factor with regard to vertical collision risk. It has been assumed that 85% of the flying time in AFI RVSM airspace would be made with GNSS navigation and the remaining 15% with VOR/DME navigation. This assumption is the same as for CRA 9. The risk mitigating effect of SLOP has not been incorporated therefore the benefits or lost. If SLOP was quantified and included into the CRA the estimated Total Vertical Collision Risk would have been significantly reduced.

2.8 The full implementation and use of SLOP within AFI RVSM airspace, APIRG Conclusion 17/43, should be encouraged, where applicable, to counteract the adverse effect of the very accurate GNSS navigation on vertical collision risk. ICAO Circular 331 has relevance and State authorities should address accordingly. Together with this Clear Air Turbulence and descending wake turbulence from heavy aircraft appears to be on the increase which could be mitigated by SLOP.

2.9 Important to the meeting is the continued long term height monitoring of target aircraft within an operators fleet of aircraft. Unfortunately only 38% of the monitoring burden has been achieved. With the available information represented by the 38% monitored aircraft it can be assumed that altimetry stability as presented in the histogram below has been achieved.



2.10 The immediate processing of RVSM UCR's and undivided RVSM vigilance whilst providing an ATM service and operating in RVSM airspace cannot be over emphasized in order to arrest and bring the Total Vertical Collision Risk back towards the agreed to AFI TLS. Greater emphasis and focus is required on coordination failures and breakdown of separation at crossing points which is creating an environment for greater RVSM risk. Improved real time ATM will contribute significantly to reducing safety events and risk. This should be targeted to reduce risk with well-considered remedial action.

2.11 The root causes that contribute towards the high Total Vertical Risk estimate not meeting the Target Level of Safety remain as follows:

2.11.1 Generically Human Factors largely attributed to imperfect real time ATM and to a minor degree flight deck originated risk or a combination of both.

2.11.2 The lack of or improper coordination between ATC sectors and FIRs continues to escalate thus causing Safety Events leading to UCR's.

2.11.3 The lack of or non-adherence to procedures.

2.12 The CRA is in general an indication of the successes, failures, errors and remedial actions required. Further remedial action debate and implementation towards eliminating coordination failures and the breakdown of separation at ATS route crossing points will be imperative to reducing the risk. It appears that both the afore-mentioned are largely embedded in imperfect real time ATM. This debate, possibly in a workshop format, should take place as soon as practically possible during specific RVSM dedicated time with AFI RVSM experts from applicable disciplines tasked to find practical solutions to reduce the RVSM risk.

2.13 Continuous undivided RVSM vigilance should be embedded in all RVSM system elements.

3. ACTION BY THE MEETING

3.1 The meeting is invited to:

- (a) Take note and review the contents of this working paper;
- (b) Urge all State Civil Aviation Authorities to diligently manage all the RVSM system elements towards reducing the Total Vertical Collision Risk.
- (c) Support the complete implementation of SLOP as per APIRG Conclusion 17/43.
- (d) Request ICAO to arrange RVSM implementation workshops to find practical solutions to significantly reduce RVSM risk.

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