RASMAG/19−IP06
27-30/5/2014

International Civil Aviation Organization

The Nineteenth Meeting of the Regional Airspace Safety Monitoring Advisory Group (RASMAG/19)

Pattaya, Thailand, 27-30 May 2014

Agenda Item 2: Review Outcomes of Related Meetings

REPORT OF THE FIRST MEETING OF RASMAG MONITORING AGENCIES WORKING GROUP (MAWG/1)

(Presented by Australia)

SUMMARY

The First Meeting of the Regional Airspace Safety Monitoring Advisory Group Monitoring Agencies Working Group (RASMAG/MAWG/1) was held from 2-6 December2013 at Honolulu, Hawaii. The meeting was hosted by the Pacific Aircraft Registry and Monitoring Organisation (PARMO). This paper presents a summary of the main discussion points and work items progressed.

1. INTRODUCTION

1.1 To ensure adequate opportunity for close coordination between the monitoring agencies in Asia/Pacific, RASMAG supported the convening of the Monitoring Agencies Working Group, to be hosted by a monitoring agency once each year.

1.2 The First Meeting of the Regional Airspace Safety Monitoring Advisory Group Monitoring Agencies Working Group (RASMAG/MAWG/1) was held from 2-6 December 2013 at Honolulu, Hawaii. The meeting was hosted by the Pacific Aircraft Registry and Monitoring Organisation (PARMO).

2. DISCUSSION

2.1 During the MAWG/1 meeting, representatives from all Asia/Pac RMAs and EMAs discussed a range of work items and issues aimed at resolving specific safety and process issues directly related to the work of these groups. The full report of the meeting is provided at **Attachment A**.

2.2 Work undertaken at the MAWG/1 included:

a) a detailed review of horizontal collision risk methodologies with agreement that the EMAs would work to standardize on the Hsu model;

b) a review of progress on work being undertaken within the ICAO Separation and Airspace Safety Panel (SASP) to globalise the Asia/Pacific Enroute Monitoring Agency Manual;

c) undertaking a detailed review of altimetry system error results from ADS-B monitoring systems, and from AGHME and HMU in the United States and Japan;

d) discussing the impact of strategic lateral offset procedures (SLOP) and their impact on the risk in RVSM airspace;

e) reviewing identified operations by non-approved aircraft as RVSM-approved and developed a clear process by which RMAs would identify and attempt to resolve these issues;

f) updating the latest safety assessment reports provided by monitoring agencies;

g) agreeing on a standardized and revised reporting template for monitoring agencies;

3. ACTION BY THE MEETING

3.1 The meeting is invited to note the items highlighted in this paper and the information contained in **Attachment A**.

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INTERNATIONAL CIVIL AVIATION ORGANIZATION

REPORT OF THE
1st MEETING OF THE
REGONAL AIRSPACE SAFETY MONITORING ADVISORY GROUP MONITORING AGENCY WORKING GROUP (RASMAG/MAWG/1)

HONOLULU, HAWAII, USA, 2 – 6 DECEMBER 2013

The views expressed in this Report should be taken as those of the Meeting and not the Organization

Approved by the Meeting
and published by the ICAO Asia and Pacific Office, Bangkok

CONTENTS

APPENDICES TO THE REPORT

ATTACHMENTS TO THE REPORT

INTRODUCTION

Meetings

1.1 The First Meeting of the Regional Airspace Safety Monitoring Advisory Group Monitoring Agencies Working Group (RASMAG/MAWG/1) was held from 2-6 December2013 at Honolulu, Hawaii. The meeting was hosted by the Pacific Aircraft Registry and Monitoring Organisation (PARMO).

Attendance

2.1 Eighteen (18) participants attended the meetings from Australia, China, India, Japan, New Zealand, Singapore, Thailand, and the United States. The list of participants is at **Attachment 1** to this report.

Officer and Secretariat

3.1 Mr. Robert Butcher from the Australian Airspace Monitoring Agency (AAMA) chaired the meeting.

Opening of the Meeting

4.1 Mr Butcher welcomed participants to the meetings.

Documentation and Working Language

5.1 The working language of the meeting and the language for all documentation was English. 23 working papers (WPs) 6 information paper (IPs) and 1 Flimsy (FL) were presented. The list of papers and presentations is shown at **Attachment 2** to this report.

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REPORT ON AGENDA ITEMS

Agenda Item 1: Horizontal Collision Risk Model Review

1.1 A technical meeting was held for Asia/Pac Enroute Monitoring Agencies (EMAs) on Monday 2 December.

Review of longitudinal risk models used by EMAs (WP2)

1.2 The PARMO presented a brief summary of the longitudinal collision risk models used by Asia Pacific EMAs in the horizontal safety monitoring reports prepared for the RASMAG. The Asia Pacific EMAs currently utilize both the Reich time-based longitudinal model modified for distance-based separation and the generalized Hsu collision risk model. It was noted that the Rice form of the Hsu collision risk model is also utilized by one EMA.

1.3 During the presentation, the PARMO noted that empirical data obtained from the airspace can be used to assess several of the Hsu collision risk model parameters including the speed error distribution, observed navigation performance, components of the controller intervention buffer, or proportion of overdue reports. An example safety assessment completed for the planned implementation of the 50 NM longitudinal, 30 NM lateral, and 30 NM longitudinal separation minima in New York oceanic airspace was provided.

Hsu Collision Risk Model (Flimsy 1)

1.4 The AAMA presented Flimsy 1 on the Hsu CRM. The original Hsu model was extended by David Anderson and is still commonly used by the SASP for separation standard development. Dr Aldis explained how the Hsu model applies naturally to a pair of aircraft on intersecting tracks since it simulates the aircraft motion and the opportunity for horizontal overlap at each point in time.

1.5 The SASP Hsu CRM simplifies in the special case of a pair of same, identical track aircraft which is relevant to EMA airspace monitoring. Many different aircraft pairs can be simulated by repeated calls to the Hsu CRM. The time interval over which risk is estimated can be set to values which match particular RCP and RSP specifications, or it can be tailored to values estimated from airspace data collection.

1.6 It was argued in the presentation that the Hsu model is more flexible than the Reich model which is commonly used by EMAs. It allows consideration of the effect on risk of reporting time and of communications and surveillance performance. A C program of the SASP Hsu model was made available at the meeting. In its current form the program assumes a truncated Double Exponential (DE) aircraft speed distribution, and either Gaussian or DE aircraft position error distributions.

1.7 The meeting reviewed and discussed the material provided by PARMO and the AAMA, concluding that for some EMAs, using the proposed methodology may prove difficult. However the meeting stressed the need for standardisation of the model where possible, recognising that some EMAs would need time to assimilate the methodology into their modelling. To assist EMAs to use the Hsu model, PARMO and AAMA agreed to provide additional guidance directly to them. Additionally, PARMO will bring a proposal to RASMAG next year to amend the EMA Manual to include new guidance on the use of the Hsu model but ensuring that the current methodology is retained.

Action: *EMAs to review and work towards standardisation on Hsu model as presented by PARMO* *and the AAMA and identify compliance or implementation issues to RASMAG/19.*

Extension of periodic report interval on oceanic flight under longitudinal 30nm separation standard in Fukuoka FIR (WP/7)

1.8 JASMA presented WP/7 that highlighted that in the Fukuoka FIR, the 30 NM longitudinal separation standard was introduced in 2008 and that the periodic position report interval for RNP4 aircraft is set to 10 minutes based on the previous pre-implementation safety analysis. Although a shorter position report interval reduces the risk of collision, it increases the operational cost as airlines have to pay for more data transmission via satellite connection. The paper suggested therefore, that the position report interval should be as long as possible without infringing safety.

1.9 The paper provided significant detail on a post-implementation safety assessment that now clearly demonstrates that the position report time interval could be extended from 10 to 14 minutes in accordance with Doc 4444 requirements for 30 NM separation. Additionally the assessment indicated that this reporting interval would still meet the target level of safety even with future increased traffic levels.

1.10 The meeting discussed aspects of the modelling undertaken by JASMA in some detail and the MAWG had no concern with the intention to extend the reporting interval to 14 minutes to align with Doc 4444. JASMA plans to present the work to SASP. Discussion of the WP included comment that the accurate centreline tracking by GNSS aircraft needed to be modelled carefully because the risk is very sensitive to it. SASP/WG/WHL/23-WP/2 contains another recent approach to this point.

Agenda Item 2: Adoption of Agenda

2.1 The provisional agenda (WP1) was adopted by the meeting.

Agenda Item 3: Review Outcomes of Related Meetings

3.1 No papers were provided for this agenda item however, the meeting was provided an update on deliberations at the recent Separation and Airspace Safety Panel (SASP) meeting in New Delhi. The Chairman indicated that the SASP had continued its review of the proposed EMA Manual that had been presented by Ms Falk (PARMO) and Mr Butcher (AAMA). The SASP had proposed further amendments to the draft Manual in particular ensuring that it contained direct links to Annex 19 and Doc 9859 (Safety Management). Ms Falk and Mr Butcher were tasked to provide a new version 6 of the document to the next SASP meeting in May 2014.

3.2 The meeting was advised that the SASP Mathematicians Sub Group (MSG) had also commenced work to validate the revision of the RVSM collision risk model to account for the presence of non-approved aircraft in the airspace. This work is ongoing.

Agenda Item 4: ADS-B Height Monitoring

Distribution of altimetry system error results from the US ADS-B data (WP3)

4.1 The PARMO presented the Distribution of Altimetry System Error (ASE) results taken from a sample of the United States ADS-B data from January through August 2013. The paper provided a summary of the distribution of ASE results by States, by operators, and by aircraft types. Out of a total of over 13 million aircraft tracks the final number of usable segments for ASE calculation was 68%. A series of tables identified and classified the number of valid segments used for calculations. The paper also identified from each aircraft the link technology version use during the sample period.

4.2 The data showed that in several cases some aircraft were showing a combination of link technology version interchangeably for the sampled time period. Other RMAs have also observed this behaviour in some aircraft but the reason for this is unknown although several are suspected.

4.3 The meeting discussed the data provided by the PARMO and encouraged further data to be made available to RASMAG particularly ASE results. Comparative work could then be undertaken between RMAs. PARMO agreed to make this data available. Additionally the meeting discussed aspects of assumed geometric height reference for DO260B aircraft. PARMO understood that these aircraft were referencing height above ellipsoid however some doubt existed among other RMAs. The AAMA consulted with experts in Australia on the matter and they advised that the DO260B documentation states:

2.2.3.2.6.1.15 "Difference From Barometric Altitude" Subfield in Airborne Velocity Messages - Subtype=1

The "Difference From Barometric Altitude" subfield is a 7-bit ("ME" bits 50 – 56, Message bits 82 – 88) field that is used to report the difference between Geometric (GNSS or INS) Altitude Source data and Barometric Altitude when both types of Altitude Data are available and valid. The difference between barometric altitude and GNSS Height Above Ellipsoid (HAE) is preferred. However, GNSS Altitude (MSL) may be used when airborne position is being reported using TYPE Codes 11 through 18. If airborne position is being reported using TYPE Codes 9 or 10, only GNSS Height Above the Ellipsoid (HAE) may be used. For TYPE Codes 9 and 10, if GNSS Height Above the Ellipsoid (HAE) is not available, then the Difference from Barometric Altitude subfield **shall** be set to ALL ZEROs.

Note: *The basis for the barometric altitude difference (either GNSS HAE or Altitude MSL) must be used consistently for the reported difference.*

4.4 As a result the meeting concluded that it may not be true that DO260B aircraft only provide geometric height referencing the ellipsoid. PARMO agreed to research this issue further and advise RASMAG.

Action: *PARMO to research the issue related to the geometric height reference for DO260B aircraft and report to RASMAG/19.*

Progress update for the China RMA's evaluation of altimetry system error using ADS-B (WP10)

4.5 China RMA informed the meeting that since Sep. 2012, they have been trialling ADS-B Height Monitoring using the ADS-B data of Aviation Data Communication Corporation (ADCC). Up to August 2013, 4,739 aircraft with 1.2 billion (1,204,158,824) separate data points have been monitored by the China RMA. This provided 43.7 million (43,678,639) minutes of monitoring output.

4.6 The main monitoring outcomes reported by China RMA included:

- 1,428 aircraft registered in the China RMA (where the total number is 2,223);
- 3,097 aircraft registered in other RMAs;

- 214 aircraft were not included in the global approval database updated in Sep 12th, 2013;
- 2,154 aircraft (45.5%) used the MSL as a geoid reference;
- 619 aircraft (13.1%) used the HAE as a geoid reference;
- the geoid reference of 1,966 aircraft (41.5%) cannot be determined due to either the limited data volume or the single operation region of geoid;
- the geoid reference of 678 aircraft can be successfully determined (609 with MSL and 69 with HAE) successfully by the joint use of data from AAMA and MAAR.

4.7 The meeting thanked China RMA for the detailed paper noting that it is China's intention to provide ADS-B monitoring services in January 2014 although no mandate for ADS-B equipage had been established in China to date. Further discussion focused on how RMAs using ADS-B can share data effectively. The AAMA advised that they were still investigating hosting data sharing on their web site. Further advice in this regard will be made available at RASMAG.

ADS-B height monitoring by AAMA up to October 2013 (WP17)

4.8 The AAMA provided summary results for Altimetry System Error (ASE) for data collected from January 1, 2012 through to September 29, 2013. The main results reported were:

- 2,059 aircraft seen in the AAMA data;
- 1,987 aircraft were assessed as suitable to be monitored;
- 1,942 aircraft had ASE determined;
- 1,388 aircraft (67%) used the HAMSL as a geoid reference;
- 472 aircraft (23%) used the HAE as a geoid reference;
- the geoid reference of 140 aircraft (7%) cannot be determined;
- the geoid reference of 53 aircraft was variable.

4.9 The AAMA provided box plots and distributions of ASE for major aircraft types (Figure 2) as follows and reported that A380 aircraft demonstrated quite alarming degradation in performance over time with some aircraft degrading by 10 feet per month. These aircraft will require continued close monitoring. The AAMA also noted a degradation in performance for some B767 and B744 aircraft.

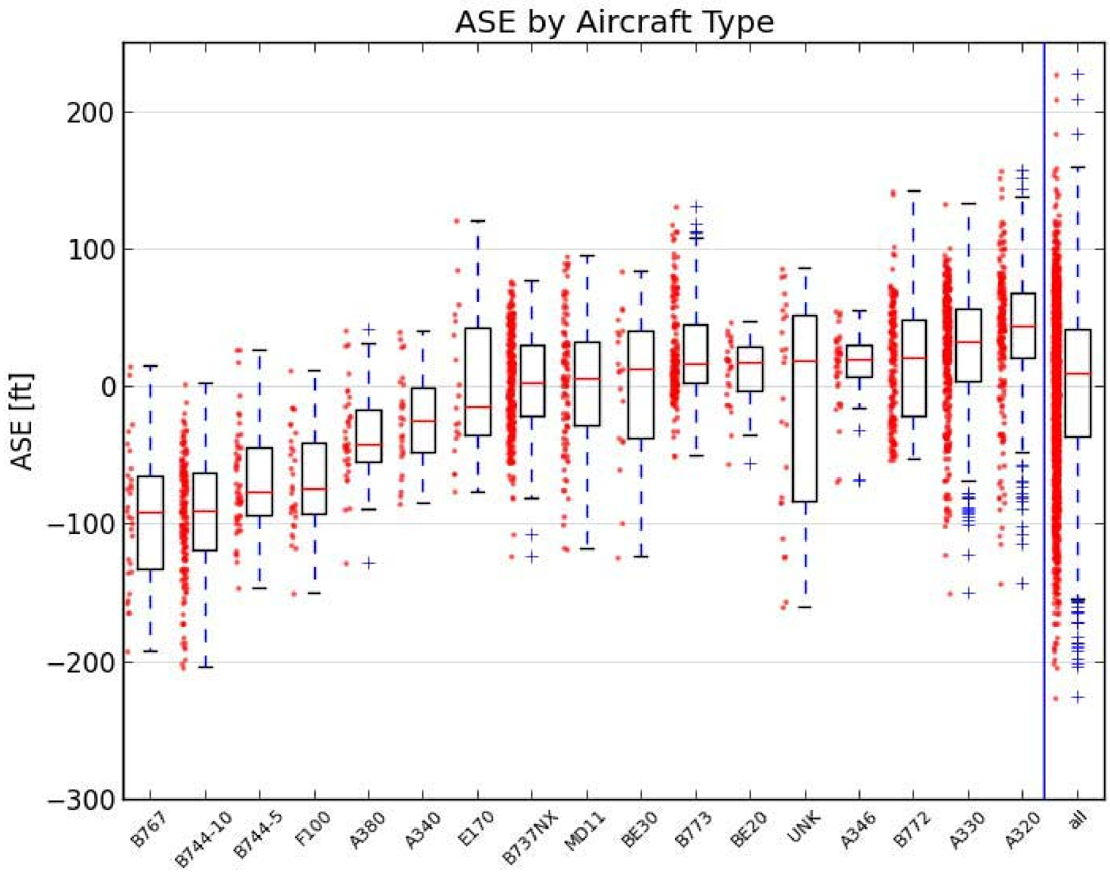


Figure 2 from WP17

4.10 The meeting thanked the AAMA for the detailed information regarding ASE assessments and encouraged further data to be made available at future meetings. The meeting discussed the aircraft reference point for calculated altitude information. The AAMA had been advised that specifically for large aircraft, this reference point is the lower point of the extended landing gear. The meeting recognised that this might account for the observed 30 foot (approx) variation in ADS-B ASE when compared to other monitoring systems. The AAMA agreed to research this issue and report back to RASMAG.

Action: *AAMA to undertake research into identifying the reference for aircraft altitude and report to RASMAG/19.*

<u>ADS-B height monitoring system data sharing activity (IP2)</u>

4.11 MAAR presented information on the progress of their ADS-B Height Monitoring System implementation highlighting the importance of ADS-B data sharing between the MAAR and States under its responsibility. The paper showed the positive outcomes achieved through ADS-B data sharing between States and their RMA, noting that it significantly expands the number of aircraft that can be effectively monitored in any sub-region. MAAR provided specific examples of this cooperative effort with CAA Singapore and CAA Taiwan.

<u>Height keeping performance monitoring process (IP4)</u>

4.12 JASMA presented information regarding the RVSM aircraft height keeping performance monitoring process used in Japan noting that JASMA uses a well defined process to assess monitored aircraft and to determine if their performance needs further review on a watch list. JASMA also indicated its intention to commence experimental use of ADS-B height monitoring.

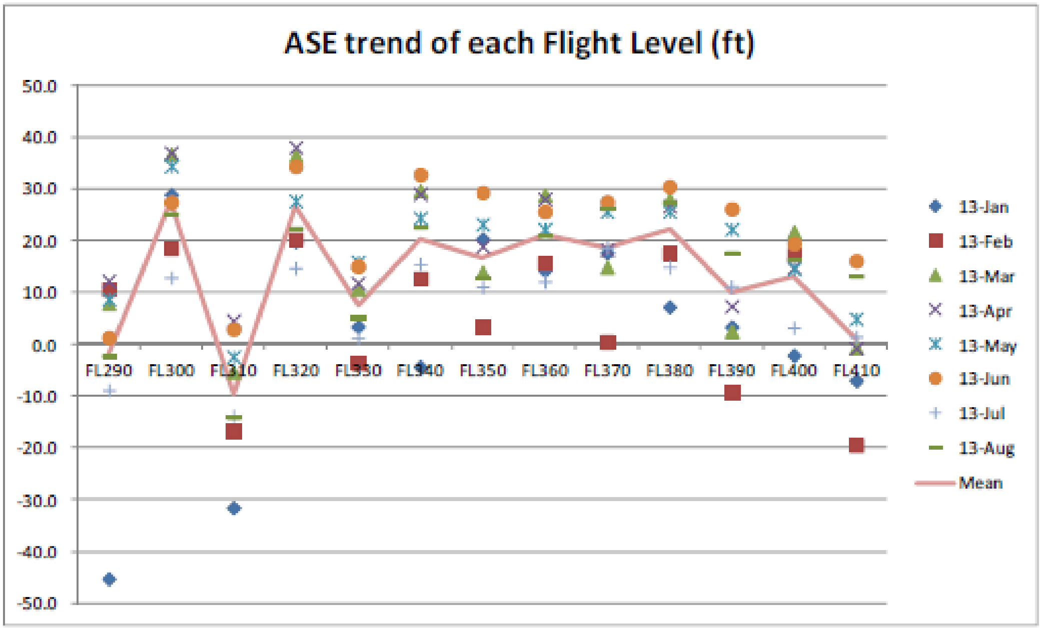
4.13 The meeting discussed the information noting that the data lent itself to a level of automation to enhance the process. Further discussion highlighted similarities between the mean ASEs identified by JASMA for some operator fleets and those identified by the AAMA in WP17. The meeting agreed that the RMAs should work to provide to the next RASMAG meeting, comparative ASE data sourced from the various monitoring systems in Asia/Pac. PARMO agreed to take the lead in coordinating this activity.

Action: *PARMO coordinate with other RMAs a paper for presentation to RASMAG/19 that provides comparative ASE data sourced from the various monitoring systems in Asia/Pac.*

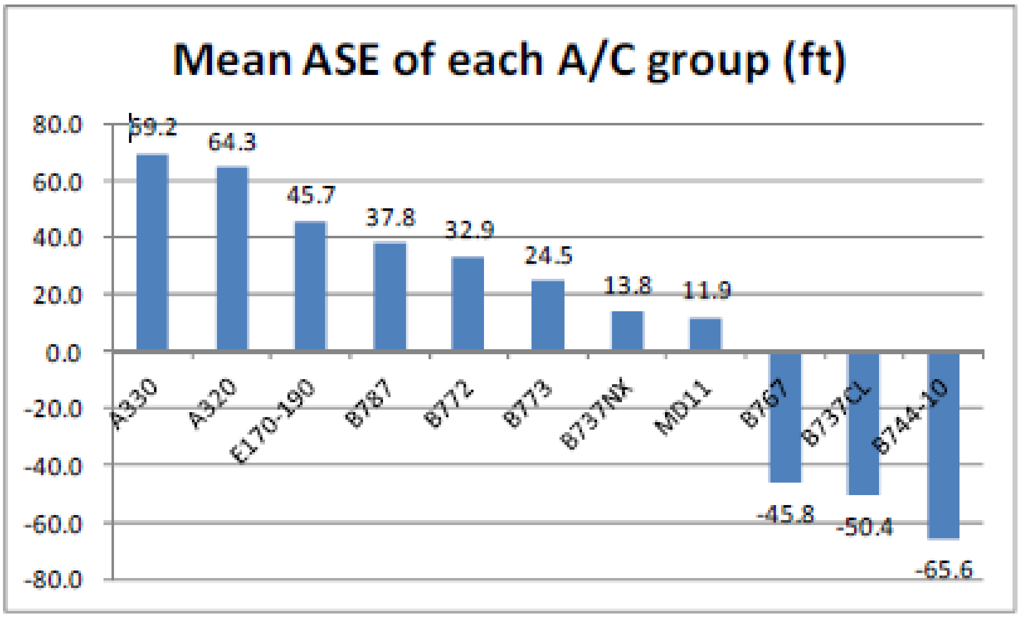
TVE and ASE trend of Setouchi HMU (IP5)

4.14 JASMA presented the monitoring results of major aircraft types in Japan, noting that a total of 228,808 monitoring data were obtained from Setouchi HMU for the period between January 16, 2013 and September 15, 2013. The average of mean TVE is 14.7 ft and the average of standard deviation of TVE is 62.4 during this period.

4.15 The paper provided a graph of ASE trends at RVSM flight levels (see below), highlighting that the ASE of January and February are smaller than the other months and some January measurement results have deviations significantly to the minus side. Additionally the paper provided data on mean ASE for each observed aircraft type group (Figure 3 of IP5).



(Figure 2 from IP5)



(Figure 3 of IP5)

4.16 The meeting thanked Japan for the interesting data noting that in Table 2 in IP5 (and in Figure 2 shown above) that the highest values are always during summer and the lowest in winter. No specific reason for this was identified and it was agreed that JASMA should research this in conjunction with available meteorological services staff in Japan and to report back to RASMAG.

Action: *JASMA in conjunction with meteorological services in Japan research the reasons for highest values of ASE trend during summer and lowest in winter. Report back to RASMAG/19.*

Agenda Item 5: EMA/RMA Safety Monitoring Reports for RASMAG

Enhancing the EMA and RMA safety monitoring reports summary (WP4)

5.1 The PARMO presented several items regarding the EMA and RMA safety monitoring reports prepared for the RASMAG. The PARMO encouraged the meeting to discuss ways in which the safety reports can be made more effective for the RASMAG and APANPIRG. One possibility is to consider producing consolidated risk estimates and trend analyses which may assist the RASMAG and APANPIRG in assessing the safety of the airspace. The group agreed that the RASMAG safety reports could be improved so as to direct the focus of the readers to areas in need of attention in the region. One suggestion was to provide a list highlighting the top three causes of observed operational errors, the top three “hot spots” in the region, and indicate that the region should always strive to obtain better reporting of LHDs, LLDs, and LLEs.

5.2 The PARMO also discussed the possibility for a RMA to inform airspace users on the current use of strategic lateral offset procedure (SLOP) in the airspace. This information may encourage more operators to employ SLOP as part of their regular procedures. The first step is to identify areas in the airspace where the use of SLOP may be used such as an existing parallel route system or routes consisting of alternating flight level allocations. The use of SLOP can be detected from ADS-C position reports; if such information is available a RMA may be able to identify operations operating on route centerline, 1 NM to the right of route centerline, or 2 NM to the right of route centerline. The PARMO presented a summary of the use of SLOP in portions of the Pacific airspace as an example.

5.3 The meeting acknowledged that this activity would enhance the safety of the airspace, as the use of SLOP consistent with the recommended practice can be shown to significantly reduce risk. A few RMAs indicated that identifying the use of SLOP would be problematic due to difficulties in obtaining the necessary data. Some questions were raised regarding the new micro-offset SLOP which will allow for 0.1 NM offsets from route centerline up to a maximum of 0.5 NM. However, the current number of aircraft capable of micro-offsets represents a relatively small proportion of the aircraft population.

Action: *Where possible, RMAs/EMAs provide analyses to the next RASMAG on SLOP use and any subsequent decrease in airspace risk as a result. This analysis should be included in the safety assessment reports to RASMAG.*

Proposed executive summary content for RVSM safety report (WP5)

5.4 MAAR pointed to the fact that a template has been developed to standardize the content and format of safety reports for all RMAs. The executive summary section of the safety reports aimed to provide significant findings from annual safety assessments conducted by the RMAs. Specifically the meeting was informed that it is important that the contents in the executive summary convey the information from the RMAs to its audiences most accurately and effectively so that the planning groups and/or States involved can devise corrective and/or preventive measures accordingly.

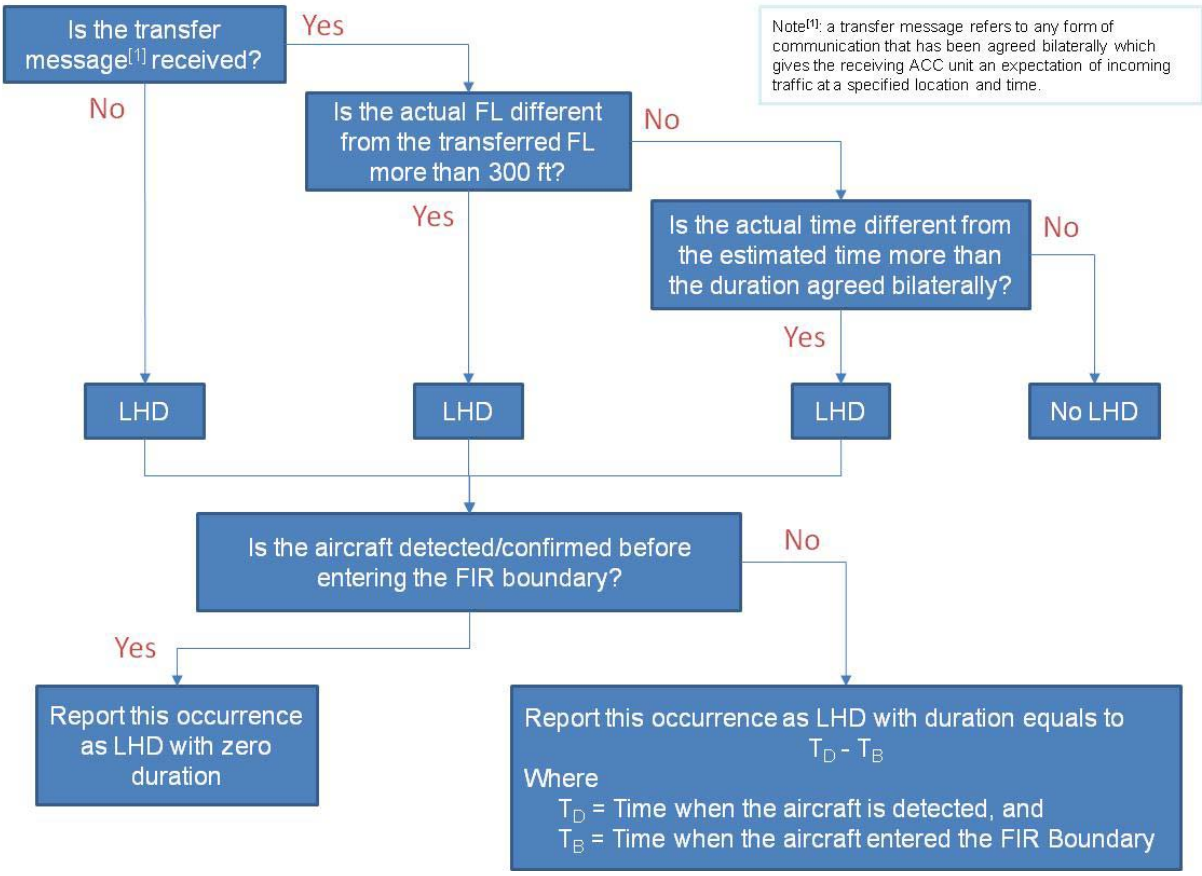
5.5 The paper proposed new content for the executive summary of RMA safety reports to RASMAG. These proposals were readily accepted by the meeting as a template for reporting to RASMAG and aspects were incorporated in a new reporting template drafted by the AAMA and detailed at Appendix A to this meeting report. The differences from the existing format in relation to the executive summary are:

- Operational risk associated with each category is shown instead of the number of Occurrence;
- A chart depicting 12-Month cumulative operational risk by LHD category is inserted to illustrate operational risk composition and trend;
- A map depicting operational risk values associated with their geographical locations where the corresponding LHDs occurred.

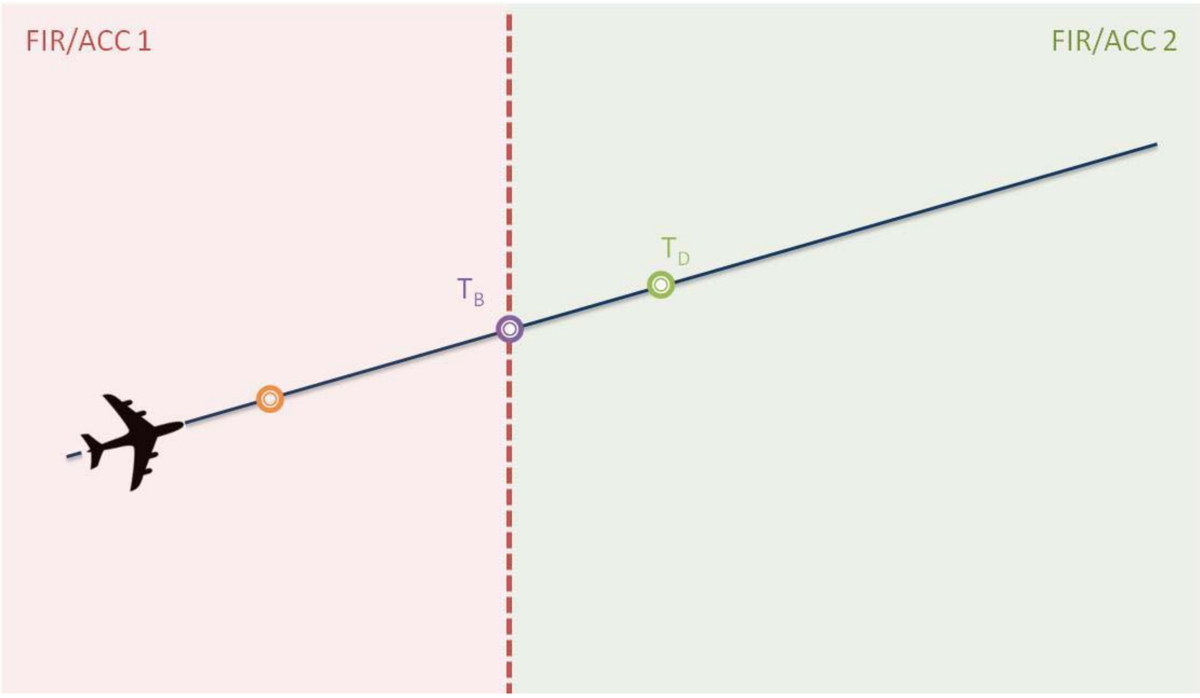
Category E Large Height Deviation illustration (WP6)

5.6 The meeting was informed by MAAR that in analyzing the FIRs' operational risk based on their LHD reports, some disparities have been observed in the number of LHD reports among States in the Region. To resolve any inconsistencies among States in LHD reporting procedures, the MAAR aimed to promote a common understanding of LHD reporting. Since the majority of LHD reports in the Region are Category E, the MAAR created an illustration that explains the nature of these types of operational errors.

5.7 The illustration is based on the nature of transfer messages, flight level difference, and time difference, as shown in the figures below. Figure 2 of WP6 shows the parameters used to compute the time duration for such LHDs.



(Figure 1 of WP6)



(Figure 2 of WP6)

5.8 The meeting congratulated MAAR on taking this initiative and endorsed the format and content of the illustrations except that the time of resolution should be used rather than the time of detection. The meeting proposed that MAAR develop these illustrations into a poster type format and present to RASMAG for endorsement and to identify a suitable means by which the information could be distributed to States and ANSPs. Other comments included the observation that since Category E commonly contributes most of the risk, it may be useful for RMAs to consider subcategories of Category E based on Figure 1 of WP6.

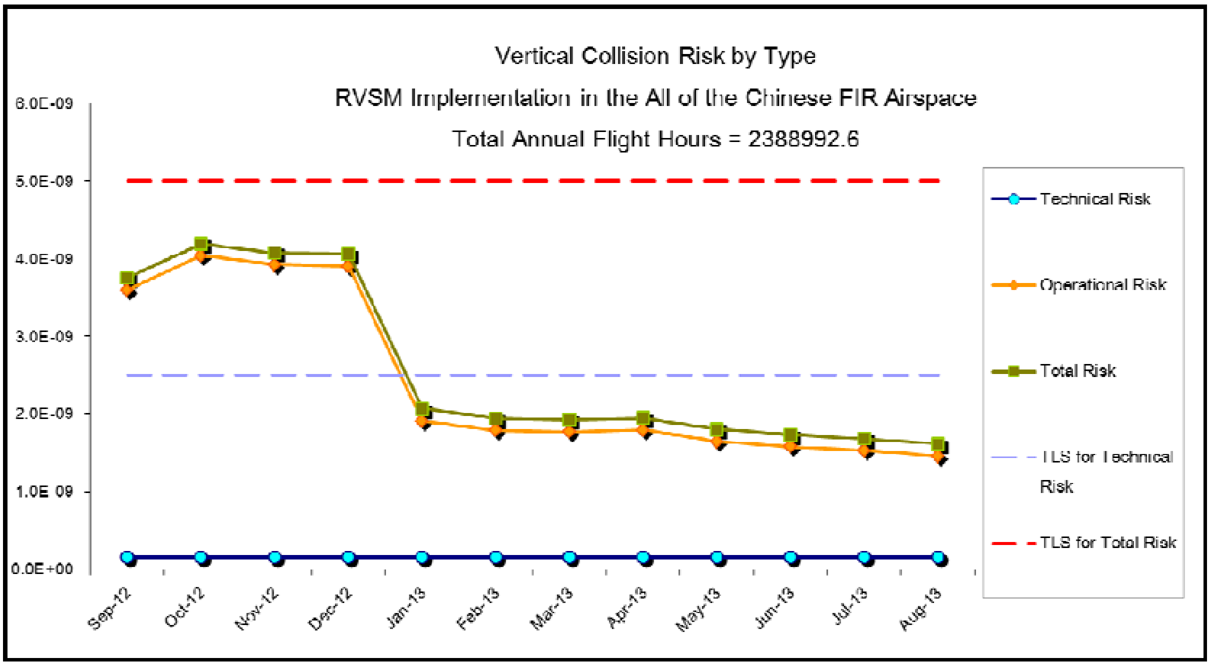
***Action:** MAAR develop the illustrations at paragraph 5.7 into a poster type format and present to RASMAG for distribution to States and ANSPs.*

China RMA Safety Report (WP9)

5.9 China presented the results of the airspace safety oversight for the RVSM operation in the airspace of Chinese FIRs and the Pyongyang FIR (Democratic Republic of Korea – DPRK) from 01 September 2012 until 31 August 2013. The estimates of technical and total risks for the airspace of Chinese FIRs satisfy the agreed TLS value of no more than 2.5 x 10^{-9} and 5.0 x 10^{-9} fatal accidents per flight hour, with an overall risk estimate of **1.62 x 10^{-9}**.

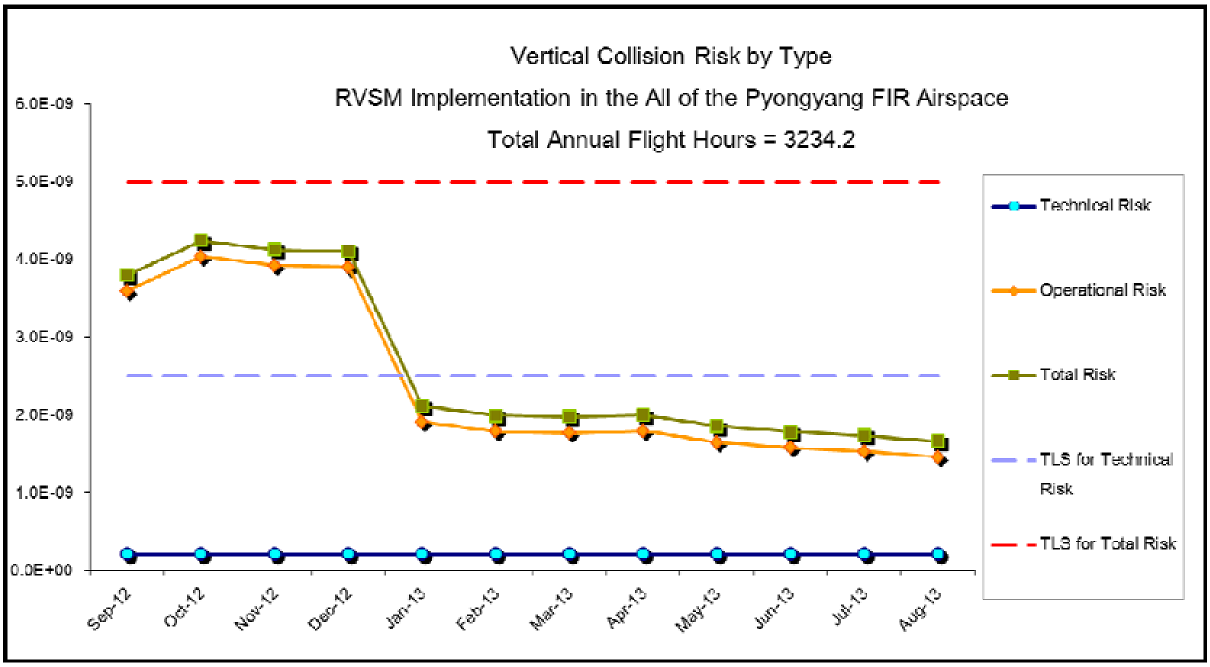
5.10 China RMA noted that a significant portion of LHDs (13 of 30) was attributable to Category E (ATC transfer of control coordination errors due to human factors) with most of these occurring in the Urumqi FIR.

5.11 The figure below presents collision risk estimate trends for the Chinese FIRs.



(**Figure 6 of WP9**: Airspace of Chinese FIRs RVSM Risk Estimate Trends)

5.12 The estimate of the overall vertical collision risk for the Pyongyang FIR was **1.67 x10^{-9}** fatal accidents per flight hour, which satisfied the globally agreed TLS value of 5 x 10^{-9} fatal accidents per flight hour. The figure below presents collision risk estimate trends for DPRK airspace.



(Figure 7 of Pyongyang section of WP9: DPRK Airspace RVSM Risk Estimate Trends)

5.13 China RMA reported that no Large Height Deviation had occurred during 2012 within the Pyongyang FIR. Considering the long-term nil LHD reports, to make a conservative estimate for the operational risk, China RMA used the operational risk value of Chinese FIRs, and the technical risk was calculated from the TSD data collected in December 2012.

5.14 The meeting acknowledged China RMA's efforts to resolve data issues with DPRK in terms of training in regard to RVSM and for the provision of data such as LHD and TSD. In response to a question from China RMA, the meeting discussed the identification and reporting of LHD hotspots. It was agreed that individual RMA/EMAs would still plot LHD/LLE/LLD as they do now, but identifying hotspot areas in their report to RASMAG. RASMAG would then collate that hotspot information and transfer it to an Asia/Pacific regional chart for reporting to APANPIRG.

Action: *RMAs/EMAs to provide additional information in report that identifies hotspot areas for LHD/LLE/LLD reports including the category of errors reported in the hotspot.*

<u>Restricting Non-RVSM Approved Aircraft in RVSM Airspace (WP11)</u>

5.15 This year, China RMA has identified a few suspected aircraft from the monthly flight plan check, and after confirmation with domestic regional CAAs and other RMAs, some are confirmed to be non-approved. The China RMA reported these confirmed non-approved aircraft information together with the flight data to the Air Traffic Management Bureau with a suggested course of action that ATC restrict these aircraft from operating in RVSM airspace as a reminder to the operators to take immediate actions for RVSM approval registration.

5.16 Importantly China RMA highlighted that the restriction of aircraft in this way needs a clear procedure including when withdrawal of the restriction is warranted when the aircraft is identified as having received RVSM approval.

5.17 The meeting reviewed the information from China RMA and discussed the processes that other RMAs are using to identify confirmed non-approved aircraft information to CAAs and ANSPs. The meeting observed that a number of RMAs were using similar processes to those implemented by China RMA. The meeting concluded that information regarding these procedures should be progressed through RASMAG for endorsement and then advice to States. The steps agreed in the process are:

i) Complete RVSM approvals cross-check of RMA approvals data and current flight plan information

ii) Identified Non-Approved aircraft/operators should be advised to relevant State authority and RMA to validate the approval status of the aircraft.

iii) Identified Non-Approved aircraft that are not confirmed by the relevant State authority and RMA as having an RVSM approval should be identified to ANSPs and other State authorities through the responsible RMA with a suggestion that clearances to operate in RVSM airspace should be withheld until confirmation that the aircraft has a correctly issued RVSM approval. That advice to be forthcoming from the responsible RMA.

Action: *Chairman to draft paper for RASMAG/19 to highlight the discussion and outcomes regarding non-approved ('rogue') operations and process agreed by RMAs to State authorities and ANSPs.*

Error Reports Received by PARMO (WP12)

5.18 The PARMO presented details on 25 error reports received between January and August 2013. It was indicated that the formal review and categorization of these events is planned for January 2014. A sub-category under the code A for reported LHDs was created to track events which involved flight crew incorrect adherence to ATC issued clearances to climb at a specified time. A question was raised as to how to categorize time error events. These are events in which the flight crew fails to notify ATC when the time over next position is expected to vary by 3 minutes or more than the previously provided estimate. The meeting agreed to the following re-wording of category F for LLEs:

Deviation Code	Cause of Deviation
Deviation due to navigational errors	
F	Navigation errors, including incorrect position estimate or equipment failure of which notification was not received by ATC or notified too late for action;

5.19 The PARMO will include this revised definition in the EMA Manual currently being worked through the SASP. In addition, the meeting determined that the category E for LHDs may need clarification to account for cases when the ATC transfer error involved a time error. The PARMO agreed to provide the next RASMAG meeting with a suggestion for the clarification to category E.

Action: *PARMO to review category E LHD definition to account for time error and provided proposed new wording to RASMAG/19.*

Assessment of Non-RVSM Approved Aircraft (WP13)

5.20 The AAMA provided the outcome of the August 2013 check to identify non-RVSM aircraft which were identified at least once in the previous 4 months and also at least 5 months previously. The assessment identified **105 individual airframes** in the data set, with airframes from India showing the highest number (22). Other Asia/Pacific States with significant numbers were Australia, Indonesia and the United States. In undertaking the comparison process, the AAMA was reliant on the quality of the data contained in the approvals databases provided by other RMAs. While the AAMA comparison identified a large number of airframes for some States of registry, it is recognised that delays in processing approval information between the State authorities and RMAs could be a factor.

5.21 The meeting noted a change in reporting criteria for Non-Approved aircraft used by the AAMA as follows:

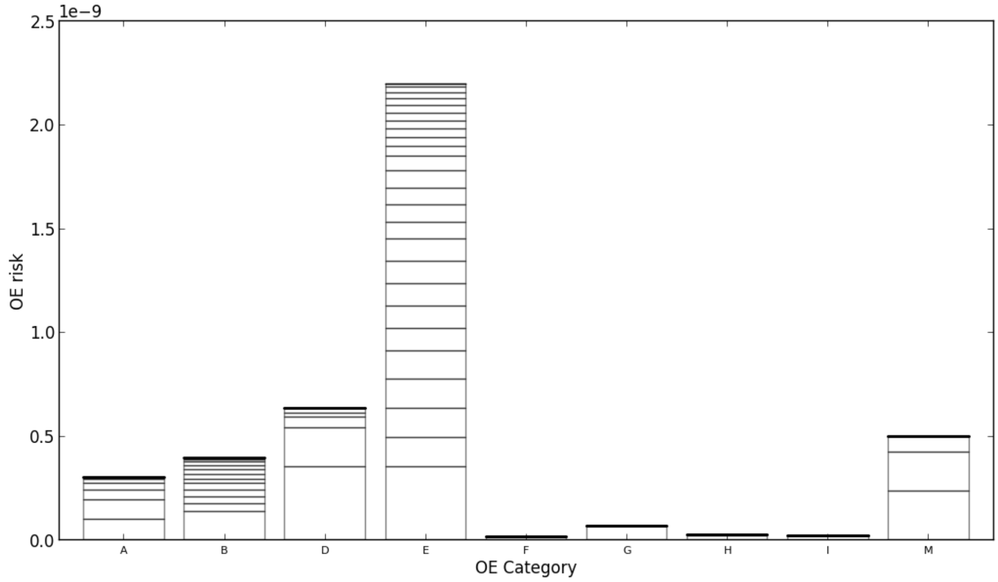
- a Rogue during the last 4 months (May 2013 to August 2013) and
- a Rogue at least 5 months ago (before May 2013) and
  not in a RMA RVSM Approvals file used for the August 2013 AAMA Rogues.

5.22 Discussions between the RMAs in regard to some of the data in the AAMA report managed to resolve some identified rogues and led to agreements by some RMAs to provide specific data in relation to some of the fleets identified to resolve their current status.

Contribution of Individual Operational Errors (WP14)

5.23 The AAMA presented WP/14 on individual LHD risk. The WP followed on from WP116 of the RMACG-8 (Canberra, April 2013) to show new plots of the RVSM risk due to each LHD category and from each attribution. Currently reported statistics such as the number of LHDs, number of minutes at wrong level, and number of wrong levels crossed are only indirect (and potentially misleading) measures of RVSM risk. If the risk contribution of each LHD is known then it is possible to better understand the causes of RVSM risk and to better target any risk reduction strategies.

5.24 The AAMA referred to individual risk plots from MAAR (presented at this meeting) which further illustrated what was possible. It was noted that risk hotspots could be quantified by this method and ranked. The risk due to different subcategories of the dominant category E LHDs could be explored. The meeting encouraged the AAMA and MAAR to incorporate individual risk plots in RVSM risk assessments and demonstrate their effectiveness at the next RASMAG meeting in 2014. Figure 3 of WP14 provides an example of one such plot showing individual risk grouped by LHD type.



(Figure 3 of WP14)

***Action:** AAMA and MAAR to incorporate individual risk plots in RVSM risk assessments and demonstrate their effectiveness at RASMAG/19.*

Accounting for Erroneous Use of RVSM Designators in the CRM (WP15)

5.25 The PARMO presented a methodology to account for the erroneous use of RVSM designators in the vertical collision risk assessment. A recent SASP working paper was provided that discussed potential approaches for a modification to the vertical technical risk. The paper suggests that the technical risk be divided into two components; one for risk arising from encounters between two RVSM-approved airplanes, and another for risk arising from encounters between a RVSM-approved airplane and a non-RVSM-approved airplane. For the example data in the WP, encounters between two non-RVSM-approved airplanes were so rare as to make a negligibly small contribution to the risk. RMAs would need to estimate the proportion of annual flying hours attributable to non-approved operations to verify that this held true in their own airspace. The PARMO provided an example of how a RMA can estimate components of technical risk using recent traffic sample data and airspace scrutiny results of non-approved operations.

5.26 The PARMO informed the group that the SASP MSG is tasked with characterizing the ASE of non-approved aircraft, in order to estimate vertical overlap probability for encounters between approved airplanes and non-approved airplanes. The SASP MSG suggested that there might be non-approved aircraft operating below FL290, whose ASE performance could be examined.

5.27 The meeting supported the principle of accounting for erroneous use of RVSM designators in the CRM and asked to be kept informed of progress within the SASP. The RMAs with ground-based monitoring systems were asked to investigate whether their ASE data might contain any data from non-approved airframes.

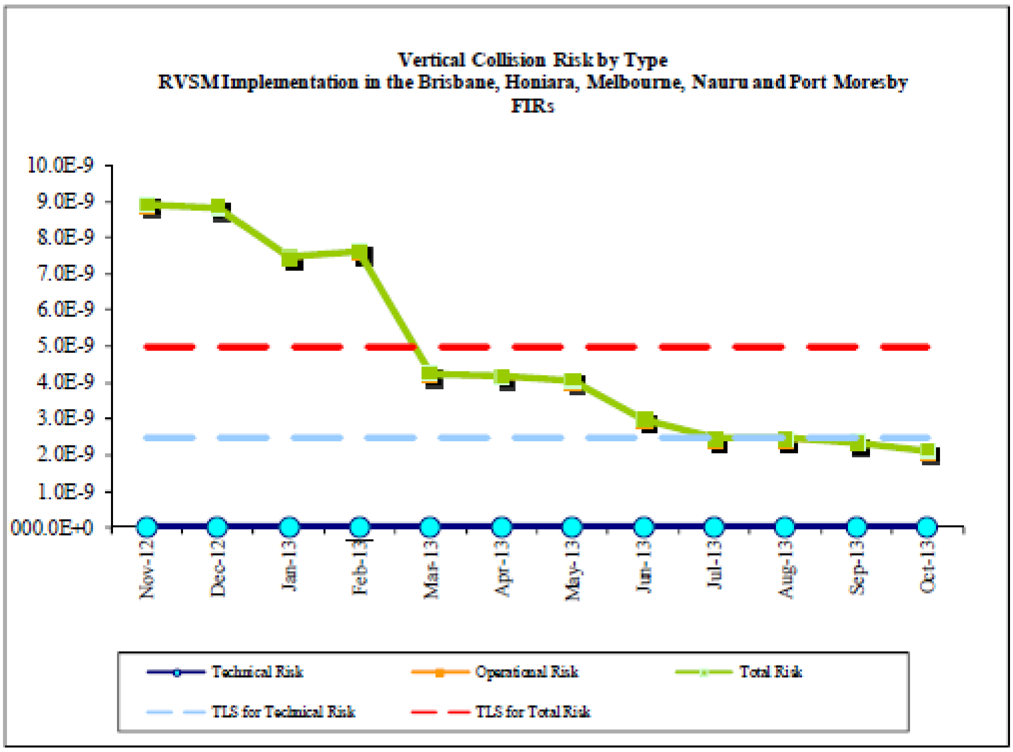
***Action:** RMAs to provide to the next RASMAG, ASE data from non-approved airframes.*

AAMA Safety Report (WP18)

5.28 The AAMA highlighted that for the period ending December 2012 the overall risk for the Australian, Nauru, Papua New Guinea (PNG) and Solomon Islands airspace, the overall risk estimation of **8.82 x 10^{-9}** did not meet the target level of safety (TLS). The meeting was informed that the risk for the period to end of October 2013 shows a decrease to 2.12 x 10^{-9} fapfh.

5.29 The AAMA also reports a monthly risk value in an attempt to provide real-time information on actual risk without reliance on historical high-time errors resident within the 12 month data sample. The monthly risk for October 2013 was assessed as 0.05 x 10^{-9} which is well below the average monthly risk based on an annual risk of 5.0 x 10^{-9}.

5.30 The figure below shows the collision risk estimate trends for Australian, Nauru, PNG and Solomon Islands Airspace.



(Figure 1 of WP18: Australian, Nauru, PNG and Solomon Islands Airspace Risk Estimate Trends)

5.31 The meeting acknowledged the significant improvement in the risk value for the Australian, Nauru, PNG and Solomon Islands airspace.

Summary of Error Reports Received by JASMA (WP19)

5.32 JASMA provided a summary of the Large Height Deviations (LHDs), Large Lateral Deviations (LLDs) and Large Longitudinal Errors (LLEs) reports received by that RMA/EMA for Fukuoka FIR between November 2012 and October 2013. The meeting was informed that the intent of providing this information was to share the details of the reported events with other Asia Pacific EMAs and RMAs to identify any Regional trends.

5.33 The data showed that:

- A total of 49 LHD and 4 LLD reports were received in the reporting period
- No LLEs were reported
- Category J (TCAS RA) reports were the highest number of LHDs followed by Category E
- LLD reports were categorised with single Category A, B, C and G reports

5.34 In further discussing the information, JASMA advised that the high number of TCAS reports reflected nuisance RAs, mainly the result of high climb or descent rates where separation was not infringed.

Template for Safety Assessment Reporting (WP20)

5.35 The AAMA informed the meeting that it had undertaken a review of the current 'standardized' format used by RMAs for reporting safety assessments and had identified room for editorial enhancements and inclusion of additional data and analysis to improve the assessment. The AAMA provided a revised template for the review of the meeting.

5.36 The meeting reviewed the template in some detail and acknowledged its enhancements over the previously used template. Additional enhancements to the template proposed by the meeting were for the new executive summary format proposed by MAAR in WP5; including an appendix based on the format used by PARMO that details the LHDs used in the assessment; inclusion of identification of LHD hotspots; and inclusion of a table showing States/FIRs that have provided or not provided LHD reports by month.

5.37 The AAMA amended the template to accommodate the proposed changes and the template is at Appendix A to this report.

Data Collection and State Responsibility Issues (WP21)

5.38 BOBASMA presented WP21 that identified issues involved in data collection and the responsibility of member States in reporting aircraft deviations and operational approvals to the EMAs. The paper also presented BOBASMA's view on consolidated reporting for Asia Pacific region and the need to optimize the use of existing monitoring capabilities of States.

5.39 In relation to the issue of data collection by EMAs, BOBASMA highlighted that despite its best efforts and while there has been formal monitoring program to monitor horizontal plane deviations in the Bay of Bengal Arabian Sea airspace since July 2010, there has been just one reported LLD. Additionally, while the webpage for BOBASMA was created in August 2011 for the member States to view the updates, download various templates and to upload required data not one State has requested password access to use this facility. In spite of repeated correspondence with the State authorities (for the collection of essential information in the BOBASIO airspace relating to en-route PBN and data link approval), member States fail to provide such information on a regular basis.

5.40 BOBASMA proposed that awareness of safety requirements could be enhanced by requiring States to conduct annual safety assessments and submit them to the respective monitoring agencies. This could be initiated in the short term by those States that have existing capabilities and which could be mandated to comply with this requirement. BOBASMA also commented that with its new ADS-B network and its internal capabilities in terms of safety assessment that it stood ready to accept additional responsibilities to support Regional safety activities.

5.41 The meeting thanked BOBASMA for bringing these issues to the attention of the MAWG. In relation to the data collection issues, it was agreed that States represented at RASMAG should provide papers to their respective DGCA on the specific issues identified by BOBASMA requesting that the DGCAs raise these matters at the next DGCA meeting in 2014. Additionally, these issues should be raised at RASMAG with the view to drafting a conclusion for APANPIRG to encourage States to respond more effectively. MAAR commented on the proposal for individual State safety assessments noting that it would be difficult for an RMA/EMA to assess these as the usual assessments undertaken in the region are conducted on traffic flows or sub-regionally. However it was agreed that States could still undertake a safety assessment as they see fit for their own purposes in ensuring safety.

5.42 In relation to BOBASMA taking on additional responsibilities in terms of supporting RMA activity, MAAR and BOBASMA agreed to meet for further discussions on processing of ADS-B data.

BOBASMA LHD Reporting to MAAR (WP22)

5.43 BOBASMA reported that in an effort to improve the reporting of LHD, LLE and LLDs, the Airports Authority of India facilitated a meeting between BOBASMA and the ATS Unit in charge of the twelve ACCs in New Delhi in May 2013. The meeting aimed to increase the awareness on the significance of airspace safety monitoring and reporting of observed aircraft deviation.

5.44 BOBASMA has received and forwarded to MAAR 36 LHD reports from the different Indian ACCs/OCCs for the period January to August 2013. The meeting noted that the majority of these were for Category E LHDs.

5.45 The meeting and specifically MAAR thanked BOBASMA for their efforts to improve the reporting culture within ATC units in India and encouraged them to continue with these efforts.

5.46 At the conclusion of this agenda item, the meeting considered how best to highlight to APANPIRG the safety issues identified from on-going assessments of operational and technical error reports. A proposal was put forward suggesting that RMAs and EMAs in their safety assessment reporting for the next RASMAG meeting, should identify 2 or 3 significant safety issues identified and possibly associated with hot spot areas. These safety issues will then be collated and reviewed by RASMAG for reporting as Asia/Pacific top airspace safety issues. The meeting agreed with this proposal.

***Action**: RMAs and EMAs to identify from analysis of operational and technical error reports, 2 or 3 significant safety issues as part of their RASMAG safety assessment reports.*

***Action:** RASMAG to collate and review safety issues identified by the RMAs and EMAs and report these to APANPIRG as Asia/Pacific top airspace safety issues.*

Agenda Item 6: Data Link Performance Monitoring

Observed Performance in Anchorage and Oakland Oceanic Airspace (WP8)

5.47 The PARMO presented observed data link performance for the Anchorage and Oakland Flight Information Regions (FIRs) which includes the overall aggregate performance, reported outage information, performance for specific systems, summary of overdue ADS-C reports, and performance by operator. The performance of the satellite data link communication systems is relevant to the work of the RASMAG and MAWG. Many of the reduced horizontal separations employed or planned in various parts of the Asia Pacific region, such as the 30-NM and 50-NM longitudinal separation, require performance-based communication and surveillance systems that utilize data link to support the reduced separation minima.

5.48 The meeting thanked PARMO for the detailed presentation and acknowledged the extensive analysis provided by the FAA in terms of assessing data link performance. The EMAs discussed various aspects of coding software to enable the enhanced analysis of data link messages, and to identify overdue reports. In discussing the GOLD performance targets, the meeting was reminded that the 99.9% target was set as an efficiency and workload measure but the 95% is the safety target which should be met.

5.49 With regards to the actions detailed in the paper, the meeting recalled APANPIRG conclusion 24/26 that encouraged States to support the assigned EMA with the provision of information regarding –

i. observed aircraft horizontal navigation performance; and
ii. observed non-compliant data-link performance of individual aircraft; and
iii. aircraft data-link approvals.

5.50 The meeting acknowledged that these elements formed an essential part of the work of an EMA and that they are already identified within the work of an EMA as specified in the draft global EMA Manual being progressed by the SASP. The meeting also discussed the need to include data link performance information in EMA reporting to RASMAG, concluding that EMAs should source data link performance data from Asia/Pacific FITs or other groups to validate the assumptions used for the implementation of separation, as part of ongoing safety assessments.

PBC&S and EMA Roles (WP16)

5.51 The PARMO presented the current status of the implementation of performance-based communication (PBC) and performance-based surveillance (PBS) and efforts to coordinate amendments to ICAO documents. This information will be useful to EMAs in identifying potential roles in overseeing PBC and PBS at the regional level. Based upon current information, it is anticipated that the global operational data link document (GOLD), satellite voice guidance material (SVGM) and PBCS Manual will become official ICAO documents by 4th quarter 2014. Further, it is intended for the relevant sections of Annex 6, Annex 11 and Doc 4444 to be amended to include provisions for PBCS by November 2016.

5.52 The potential roles to be fulfilled by an EMA in facilitating PBCS include: maintaining a database of RCP and RSP approvals, collecting aggregate performance analysis results from ANSPs/States to combine and produce regional performance analysis results, and performing scrutiny checks on filed RCP/RSP against RCP/RSP approvals.

5.53 The meeting thanked PARMO for the paper and reviewed the details provided on future update schedules to documents that will incorporate PBCS requirements. Discussion considered whether there were linkages in the new version of Doc 9689 to the proposed EMA Manual and PARMO agreed to research this issue and report back to RASMAG. The meeting also noted the roles that an EMA may need to undertake in relation to PBCS that included:

- Maintaining database of RCP and RSP approvals;
- Collecting aggregate performance analysis results from ANSPs/States to combine and produce regional performance analysis results; and
- Performing scrutiny checks on filed RCP/RSP against RCP/RSP approvals

PARMO advised that these elements are already included in the role description of an EMA in the new EMA Manual.

GOLD Performance Monitoring in Fukuoka FIR (IP/3)

5.54 JASMA provided information regarding a paper presented at the recent 38th meeting of the Informal Pacific ATC Coordinating Group and the 25th meeting of the FANS Interoperability Team (IPACG/38 and FIT/25). The paper presents the preliminary analysis based on the GOLD regarding FANS

1/A fleet performance in Fukuoka FIR.

5.55 The meeting was informed that observed data link performance showed that the 95 % criteria for RSP180 ADS-C and RCP240 ACTP, ACP and PORT are met for satellite, VHF and all media types combined. In addition, the performance at the levels specified by the 99.9% criteria is 99.0% or better for all performance measures. However, some of the operators are not achieving 99.0% for the 99.9% efficiency target. Most of the operators contributing 90% of the ADS-C downlink messages are meeting the 95% criteria for RSP180 ADS-C downlink latency and RCP240 ACTP and ACP.

5.56 The meeting thanked JASMA for making this valuable information available. Additionally the meeting endorsed JASMA's comment that it is important that information of this type is used to validate assumptions in the CRM for safety assessments.

Python Tools (IP/6)

5.57 The AAMA described a data link decoder and a set of flexible and extensible data link tools written in Python. This software is designed to support a range of performance monitoring, incident investigation and analysis activities. Python is a free and platform-independent computer programming language which has many high-level modules written to assist program development.

5.58 While data link performance monitoring was a prime consideration in undertaking this work, the data link software will also enable the AAMA (and the Operational Analysis unit of Airservices) to merge ADS-C data with ADS-B, radar and Flight Data Record information into accurate aircraft flight tracks. The exercise of writing the software has also enabled a deeper understanding of data link messaging within the team. This will enable future analysis tasks involving data link messages to be undertaken with confidence.

5.59 The meeting thanked the AAMA for the work undertaken in developing these tools and looked forward to a final version being available. The AAMA reiterated that it would be pleased to provide the tools to RMAs/EMAs as required.

Agenda Item 7: Any Other Business

Not Monitored – Approved or Not Approved (WP/23)

5.60 The AAMA posed a number of questions regarding how States and RMAs should treat aircraft that are not monitored in accordance with the requirements of Annex 6. Specifically the group of aircraft of most interest here are those of single aircraft fleets of a single aircraft type, typically small operators of general aviation type aircraft. The significant concern raised by the AAMA is that there does not seem to be any standardised closure of the monitoring loop for these types of operators and no agreed outcome as to whether the aircraft continues to be RVSM approved if monitoring is not undertaken in accordance with the Annex. To try to resolve this situation, the AAMA proposed that RVSM approvals should be issued for a limited time frame to ensure that monitoring is undertaken during an acceptable period to permit effective assessment that the MASPS requirements are still being met, and that RMAs should act to notify the relevant State regulator by means of a standardised letter, of the monitoring deficiencies observed.

5.61 The meeting thanked the AAMA from highlighting these important issues and acknowledged that it is a problem for other RMAs. China RMA explained that like the Australian case, RVSM approvals are not time limited and usually only expire on re-registration or de-registration of an aircraft. However they do encourage operators to get as many aircraft as possible monitored. With the implementation of ADS-B height monitoring, they believe they can achieve a growing proportion of monitoring for aircraft registered in China, but cannot guarantee that each individual aircraft will be monitored because of no mandate for ADS-B equipage in China. China

RMA agreed with the views expressed in the paper and believes there should be more pressure on the regulators to get aircraft monitored to ensure the safety of the airspace. Other RMAs including JASMA commented that States within their jurisdiction provided time limited approvals for aircraft and required operators to re-apply for these after typically a two to three year period.

5.62 MAAR agreed with the proposals from the AAMA which amounted to effectively 'raising the bar' on compliance with height monitoring requirements. They commented that possibly operators should be informed that they should not use the same two aircraft from a fleet to comply with height monitoring requirements, so that more airframes in the fleet can be monitored over time. MAAR suggested that encouraging compliance with the Annex 6 monitoring requirements was best achieved through APANPIRG. PARMO questioned that, noting the limitations on access to monitoring, how should the RMAs best reiterate the Annex 6 requirements to States and operators? The meeting concluded that this should be done through APANPIRG and ICAO rather than placing the onus on the RMAs. The meeting also agreed that the use of a standardized letter by RMAs to bring non-compliance with the Annex 6 provisions to the attention of a State regulator or operator was preferable.

Action: *RMAs to consider these issues further and to provide to RASMAG/19 data on aircraft/operators that have not met the Annex 6 monitoring requirements in regards to compliance with monitoring time frames. This information can then be developed into a draft conclusion for APANPIRG, encouraging States and operators to comply with the Annex provisions.*

Action: *The AAMA to draft a standard letter for RMAs to use to notify State regulators and operators of non-compliance with Annex 6 monitoring provisions.*

Agenda Item 8: Date and Venue of the Next RASMAG Meeting

8.1 The meeting noted that the next RASMAG meeting was tentatively planned to be held in early June 2014 at Bangkok, Thailand.

8.2 The meeting discussed possible venues for the next meeting of the MAWG. It was agreed to make a decision on this at the next RASMAG meeting. However for planning purposes, EMAs and RMAs should plan on a late November/early December time frame.

Closing of the Meeting

9.1 In closing, the Chairman thanked the meeting participants for their contributions to the work of the MAWG. Additionally the meeting expressed its sincere thanks to PARMO and the FAA for graciously hosting the meeting.

APPENDIX A to RASMAG/MAWG/1 Report

[Name of RMA] (XXXX)

[Insert RMA logo here if available]

Airspace Safety Review of RVSM in [name of airspace] Airspace [Month/Year] to [Month/Year]

\

Role	Name and Position	Signature and Date
Prepared By		
Reviewed By		

Executive Summary

For the period [starting day/month/year] to [end day/month/year] inclusive, the total risk [meets/does not meet] the agreed Target Level of Safety (TLS) value of 5.0 x 10^{-9}. **Table A** summarizes RVSM technical, operational and total risks. **Figure A** presents collision risk estimate trends.

[Insert names of State(s) or sub-region] RVSM Airspace – estimated annual flying hours = [number of hours] hours *(note: estimated hours based on December [year] traffic sample data)*			
Source of Risk	**Risk Estimation**	**TLS**	**Remarks**
RASMAG XX Total Risk (Previous RASMAG)	x.xx x 10^{-9}	5.0 x 10^{-9}	[Above/Below] TLS
Technical Risk	x.xx x 10^{-9}	2.5 x 10^{-9}	[Above/Below] Technical TLS
Operational Risk	x.xx x 10^{-9}		
Total Risk	**x.xx x 10^{-9}**	5.0 x 10^{-9}	**[Above/Below] TLS**

Table A: XX Airspace RVSM Risk Estimates

[Insert monthly risk trend graph here]

Figure A: RVSM Risk Estimate Trends

Table B presents a summary of 12-month cumulative operational risk associated with Large Height Deviation (LHD) reports by LHD category within **[Insert names of State(s) or sub-region]** for the reporting period.

Code	LHD Category Description	Operational Risk (x 10^{-9})
A	Flight crew fails to climb or descend the aircraft as cleared	X
B	Flight crew climbing or descending without ATC clearance	X
C	Incorrect operation or interpretation of airborne equipment	X
D	ATC system loop error	X
E	ATC transfer of control coordination errors due to human factors	X
F	ATC transfer of control coordination errors due to technical issues	X
G	Aircraft contingency leading to sudden inability to maintain level	X
H	Airborne equipment failure and unintentional or undetected level change	X
I	Turbulence or other weather related cause	X
J	TCAS resolution advisory and flight crew correctly responds	X
K	TCAS resolution advisory and flight crew incorrectly responds	X
L	An aircraft being provided with RVSM separation is not RVSM approved	X
M	Other	X
Total		X

Table B: 12-month cumulative operational risk associated with LHD reports by LHD category.

Figure B provides the 12-Month cumulative operational risk by LHD category cause within XX Airspace during the assessment period.

[Insert risk composition trend graph here]

Figure B: Operational risk composition and trend

AIRSPACE SAFETY REVIEW OF THE RVSM IMPLEMENTATION IN [INSERT STATE(S) OR SUB-REGION NAMES] AIRSPACE [MONTH/YEAR] TO [MONTH/YEAR]

Prepared by
[Name of RMA] (XXXX) – *[Month/Year]*
(An ICAO APANPIRG approved Regional Monitoring Agency)

1. Introduction

1.1 This report provides an airspace safety review of RVSM airspace risk in the [insert FIR names] Flight Information Regions (FIRs). The review is undertaken monthly using a twelve month data sample period.

2. Data Sources

2.1 **Traffic Sample Data (TSD).** A TSD covering four weeks of the month of [Month/Year] of aircraft operating in the [insert FIR names] FIRs was used as required by ICAO Regional agreement.

2.2 **Large Height Deviation (LHD).** A cumulative 12-month data set of LHD reports was used, covering [Month/Year] to [Month/Year]. **Table 1** indicates those FIRs which submitted LHD reports including nil returns. **Appendix A** provides details of LHD reports.

FIR Name	[AAA]	[BBB]	[CCC]	[DDD]	[EEE]
[month/year]	✓				
[month/year]	✓				
[month/year]	✓				
[month/year]	✓				
[month/year]	✓				
[month/year]	✓				
[month/year]	✓				
[month/year]	✓				
[month/year]	✓				
[month/year]	✓				
[month/year]	✓				
[month/year]	✓				

Table 1: Summary of LHD Reports submitted by FIRs

3. Summary of LHD Occurrences

3.1 **Table 2** and **Figure 2** summarise the number of LHD occurrences assessed and associated LHD duration (in minutes) or number of levels crossed by month from [starting day/month/year] to [end day/month/year] inclusive.

Month-Year	No. of Non-NIL LHD	LHD Duration (Min)	No. Levels Crossed
2013			
January			
February			
March			
April			
May			
June			
July			
August			
September			
October			
November			
December			
Total			

Table 2: Summary of Non-NIL LHD Occurrences and Duration

[Insert standard graph of LHD by month]

Figure 2: Summary of LHD Occurrences (by Month)

3.2 [Insert discussion/analysis on table 2 and Figure 2]

3.3 **Table 3** and **Figure 3** summarise the number of LHD occurrences, the associated LHD duration (in minutes) and number of flight levels crossed without clearance, by LHD category from [start day/month/year] to [end day/month/year] inclusive.

LHD Category Code	LHD Category Description	No. of LHD Occurrences	LHD Duration (Min)	No. levels crossed without clearance
A	Flight crew failing to climb/descend the aircraft as cleared	XX	XX	X
B	Flight crew climbing/descending without ATC Clearance			
C	Incorrect operation or interpretation of airborne equipment (e.g. incorrect operation of fully functional FMS, incorrect transcription of ATC clearance or re-clearance, flight plan followed rather than ATC clearance, original clearance followed instead of re-clearance etc)			

D	ATC system loop error; (e.g. ATC issues incorrect clearance or flight crew misunderstands clearance message)			
E	Coordination errors in the ATC to ATC transfer or control responsibility as a result of human factors issues (e.g. late or non-existent coordination, incorrect time estimate/actual, flight level, ATS route etc not in accordance with agreed parameters)			
F	Coordination errors in the ATC to ATC transfer or control responsibility as a result of equipment outage or technical issues			
G	Deviation due to aircraft contingency event leading to sudden inability to maintain assigned flight level (e.g. pressurization failure, engine failure)			
H	Deviation due to airborne equipment failure leading to unintentional or undetected change of flight level			
I	Deviation due to turbulence or other weather related cause			
J	Deviation due to TCAS resolution advisory, flight crew correctly following the resolution advisory			
K	Deviation due to TCAS resolution advisory, flight crew incorrectly following the resolution advisory			
L	An aircraft being provided with RVSM separation is not RVSM approved (e.g. flight plan indicating RVSM approval but aircraft not approved, ATC misinterpretation of flight plan)			
M	Other – this includes situations of flights operating (including climbing/descending) in airspace where flight crews are unable to establish normal air-ground communications with the responsible ATS unit.			
Total				

Table 3: Summary of LHD Occurrences and Duration by LHD Category

[Insert standard graph of LHD by causes]

Figure 3: Summary of LHD Causes

Table 4 and **Figure 4** presents a summary of 12-month cumulative operational risk associated with Large Height Deviation (LHD) reports by LHD category within **[Insert names of State(s) or sub-region]** for the reporting period.

Code	LHD Category Description	Operational Risk (x 10^{-9})
A	Flight crew fails to climb or descend the aircraft as cleared	X
B	Flight crew climbing or descending without ATC clearance	X
C	Incorrect operation or interpretation of airborne equipment	X
D	ATC system loop error	X
E	ATC transfer of control coordination errors due to human factors	X
F	ATC transfer of control coordination errors due to technical issues	X
G	Aircraft contingency leading to sudden inability to maintain level	X
H	Airborne equipment failure and unintentional or undetected level change	X
I	Turbulence or other weather related cause	X
J	TCAS resolution advisory and flight crew correctly responds	X
K	TCAS resolution advisory and flight crew incorrectly responds	X
L	An aircraft being provided with RVSM separation is not RVSM approved	X
M	Other	X
Total		X

Table 4: 12-month cumulative operational risk associated with LHD reports by LHD category.

[Insert graph of 12-Month cumulative operational risk by LHD category cause]

Figure 4: Operational risk composition and trend

3.4 [Insert discussion/analysis of LHDs including any obvious trends or significant reports of high risk and identification of significant hot spots]

4. Risk Assessment and Safety Oversight

4.1 **Collision Risk Model (CRM) Parameters.** The value of the parameters in the Collision Risk Model (CRM) used to estimate risk in the RVSM airspace, are summarized in **Table 5**.

Parameter	Description	Value
λ_x	Average aircraft length	
λ_y	Average aircraft wingspan	
λ_z	Average aircraft height	

$\overline{\lvert\Delta V\rvert}$	Average relative same-direction speed	
$\overline{\lvert V\rvert}$	Average aircraft speed	
$\overline{\lvert\dot{y}\rvert}$	Average relative cross-track speed	
$\overline{\lvert\dot{z}\rvert}$	Average relative vertical speed during loss of vertical separation	
$P_z(0)$	Probability two aircraft at the same nominal level are in vertical overlap	

Table 5: Estimates of the Parameters in the CRM

4.2 **Risk Estimation Results.** The results for the technical, operational, and total risk for the RVSM implementation are detailed in **Table 6**. The technical risk [meets/does not meet] the agreed TLS value of no more than 2.5 x 10^{-9} fatal accidents per flight hour due to the loss of a correctly established vertical separation standard of 1,000 ft and to all causes. **The operational and weighted total risk [meets/does not meet] the specified TLS value** for these components of 5.0 x 10^{-9}.

[Insert names of State(s) or sub-region] RVSM Airspace – estimated annual flying hours = [number of hours] hours *(note: estimated hours based on December [year] traffic sample data)*			
Source of Risk	**Risk Estimation**	**TLS**	**Remarks**
RASMAG XX Total Risk (Previous RASMAG)	x.xx x 10^{-9}	5.0 x 10^{-9}	[Above/Below] TLS
Technical Risk	x.xx x 10^{-9}	2.5 x 10^{-9}	[Above/Below] Technical TLS
Operational Risk	x.xx x 10^{-9}	-	-
Total Risk	**x.xx x 10^{-9}**	5.0 x 10^{-9}	**[Above/Below] TLS**

Table 6: XX Airspace **Risk Estimates**

4.3 **Figure 5** presents the trends of collision risk estimates for each month using the appropriate cumulative 12-month data set of LHD reports.

[Insert monthly risk trend graph here]

Figure 5: Trends of Risk Estimates for RVSM Airspace

4.4 A monthly LHD risk value is determined to provide real-time information on actual risk without reliance on historical high-time errors resident within the 12 month data sample. The data in **Figure 6** below shows the monthly risk for [month/year] as [x.xx] x 10^{-9} which is [above/below] the average monthly risk of the annual risk of 5.0 x 10^{-9} (red line in Figure 6 below).

[Insert Monthly LHD Risk Estimate graph here]

Figure 6: Monthly LHD Risk Estimates for the

[insert State(s)/Sub-region name] RVSM Airspace.
Red line is the average monthly value for an annual risk of 5.0 x 10^{-9}. Risk is measured in Fatal Accidents per Flight Hour (FAPFH).

5. [Insert title of other data/analysis as required]

5.1 [Insert discussion as required including chart of geographic location of risk bearing LHDs and hot spots within the 12 month data set………..]

6. Long Term Height-keeping Monitoring (LTHM)

To meet the ICAO Annex 6 LTHM requirements, the [name of RMA] undertakes a monitoring program. The current monitoring burden data for [insert names of State(s) or sub-region] is detailed in **Table 7** below.

State	Total RVSM Approved Airframes	Resultant Monitoring Burden	Total Airframes Remaining to be Monitored
XXXXX			

Table 7: LTHM Burden

Appendix A to AIRSPACE SAFETY REVIEW

Details of the Reported LHD Events

LHD date	Source	Assigned FL	Observed/ Reported FL	Duration at Incorrect FL	Cause	Category /Sub category
[day/month/year]	XXX	FLxxx	FLxxx	XX min		[LHD code]
[day/month/year]						
[day/month/year]						
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ATTACHMENT 1 - LIST OF ACTIONS

Action number	By Whom	By When	Action Required	Deliverable	Status
1/1	All EMAs	RASMAG/19	Review and work towards standardisation on Hsu model as presented by PARMO and the AAMA and identify compliance or implementation issues. RASMAG/19.	Info to RASMAG	Open
1/2	PARMO	RASMAG19	research the issue related to the geometric height reference for DO260B aircraft	Report	Open
1/3	AAMA	RASMAG/19	undertake research into identifying the reference for aircraft altitude	Report	Open
1/4	All RMAs	RASMAG/19	PARMO coordinate with other RMAs a paper for presentation to RASMAG/19 that provides comparative ASE data sourced from the various monitoring systems in Asia/Pac	Paper	Open
1/5	JASMA	RASMAG/19	In conjunction with meteorological services in Japan research the reasons for highest values of ASE trend during summer and lowest in winter	Report	Open
1/6	All RMAs/EMAs	RASMAG/19	Provide analyses to the next RASMAG on SLOP use and any subsequent decrease in airspace risk as a result. This analysis should be included in the safety assessment reports to RASMAG.	Report	Open
1/7	MAAR	RASMAG/19	Develop the illustrations at paragraph 5.7 of MAWG/1 report into a poster type format and present to RASMAG for distribution to States and ANSPs.	Formatted poster draft	Open
1/8	All RMAs/EMAs	RASMAG/19	Provide additional information in report that identifies hotspot areas for LHD/LLE/LLD reports including the category of errors reported in the hotspot.	Report	Open
1/9	Chairman	RASMAG/19	Draft paper for RASMAG/19 to highlight the discussion and outcomes regarding non-approved (‘rogue’) operations and process agreed by RMAs to State authorities and ANSPs	Paper	Open
1/10	PARMO	RASMAG/19	Review category E LHD definition to account for time error and provided proposed new wording	New definition	Open
1/11	AAMA/MAAR	RASMAG/19	Incorporate individual risk plots in RVSM risk assessments and demonstrate their effectiveness	Report/Paper	Open
1/12	All RMAs	RASMAG/19	ASE data from non-approved airframes	Report	Open

Action number	By Whom	By When	Action Required	Deliverable	Status
1/13	RMAs/EMAs	RASMAG/19	Identify from analysis of operational and technical error reports, 2 or 3 significant safety issues as part of their RASMAG safety assessment reports	Report inclusion	Open
1/14	RASMAG	RASMAG/19	RASMAG to collate and review safety issues identified by the RMAs and EMAs and report these to APANPIRG as Asia/Pacific top airspace safety issues	Report	Open
1/15	All RMAs	RASMAG/19	RMAs to consider these issues further and to provide to RASMAG/19 data on aircraft/operators that have not met the Annex 6 monitoring requirements in regards to compliance with monitoring time frames. This information can then be developed into a draft conclusion for APANPIRG, encouraging States and operators to comply with the Annex provisions	Data report	Open
1/16	AAMA	RASMAG/19	Draft a standard letter for RMAs to use to notify State regulators and operators of non-compliance with Annex 6 monitoring provisions	Standard letter	Open

ATTACHMENT 2 – LIST OF PARTICIPANTS

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ATTACHMENT 3- LIST OF PAPERS

Number	Agenda Item	Title	Prepared by
WP/1	2	AGENDA, TIMETABLE AND WORKING ARRANGEMENTS	Chairperson
WP/2	1	REVIEW OF LONGITUDINAL RISK MODELS USED BY EMAs (Attachment ZNY 50 30 30…)	PARMO
WP/3	4	DISTRIBUTION OF ALTIMETRY SYSTEM ERROR RESULTS FROM THE US ADS-B DATA	PARMO
WP/4	5	ENHANCING THE EMA AND RMA SAFETY MONITORING REPORTS SUMMARY	PARMO
WP/5	5	PROPOSED EXECUTIVE SUMMARY CONTENT FOR RVSM SAFETY REPORT (Attachment: Appendix A Safety Template)	MAAR
WP/6	5	CATEGORY E LARGE HEIGHT DEVIATION ILLUSTRATION	MAAR
WP/7	1	EXTENSION OF PERIODIC REPORT INTERVAL ON OCEANIC FLIGHT UNDER LONGITUDINAL 30NM SEPARATION STANDARD IN FUKUOKA FIR	JASMA
WP/8	6	OBSERVED DATA LINK PERFORMANCE IN ANCHORAGE AND OAKLAND OCEANIC AIRSPACE (Attachment: Data Link Performance Analysis in US FIRs)	PARMO
WP/9	5	SAFETY MONITORING REPORT FROM CHINA REGIONAL MONITORING AGENCY SEPTEMBER 2012 - AUGUST 2013 (Attachment: Executive Summary China RMA Assessment)	CHINA RMA
WP/10	4	PROGRESS UPDATE FOR THE CHINA RMA'S EVALUATION OF ALTIMETRY SYSTEM ERROR USING ADS-B	CHINA RMA
WP/11	5	RESTRICTIONS OF CONFIRMED NON-APPROVED AIRCRAFT INTO RVSM AIRSPACE	CHINA RMA
WP/12	5	SUMMARY OF ERROR REPORTS RECEIVED BY PARMO 2013	PARMO
WP/13	5	IDENTIFICATION OF NON-APPROVED AIRFRAMES OPERATING WITH RVSM APPROVAL STATUS	AAMA
WP/14	5	RVSM RISK REPORTS WHICH SHOW THE CONTRIBUTION OF INDIVIDUAL OPERATIONAL ERRORS	AAMA
WP/15	5	PROPOSED METHODOLOGY TO ACCOUNT FOR THE ERRONEOUS USE OF RVSM DESIGNATORS IN THE VERTICAL COLLISION RISK ASSESSMENT (ATTACHMENT IS NON	PARMO

		APPROVED RVSM REVISED)	
WP/16	6	PERFORMANCE BASED COMMUNICATION AND SURVEILLANCE AND EMA ROLES	PARMO
WP/17	4	ADS-B HEIGHT MONITORING BY AAMA UP TO OCTOBER 2013	AAMA
WP/18	5	AAMA RVSM SAFETY ASSESSMENT REPORT AUSTRALIAN, PAPUA NEW GUINEA, NAURU and SOLOMON ISLANDS (ATTACHMENT A)	AAMA
WP/19	5	SUMMARY OF ERROR REPORTS RECEIVED BY JASMA	JASMA
WP/20	5	PROPOSED TEMPLATE FOR SAFETY ASSESSMENT REPORTING BY ASIA/PAC RMAs (ATTACHMENT A and B)	AAMA
WP/21	5	ISSUES IN DATA COLLECTION AND RESPONSIBILITY OF MEMBER STATES	BOBASMA
WP/22	5	SUMMARY OF LHD REPORTS SENT TO MAAR 2013	BOBASMA
WP/23	7	NOT MONITORED – APPROVED OR NOT APPROVED?	AAMA
IP/1	2	LIST OF PAPERS BY AGENDA ITEM	Chairperson
IP/2	4	ADS-B HEIGHT MONITORING SYSTEM DATA SHARING ACTIVITY	MAAR
IP/3	6	GOLD PERFORMANCE MONITORING IN FUKUOKA FIR	JASMA
IP/4	4	RVSM AIRCRAFT HEIGHT KEEPING PERFORMANCE MONITORING PROCESS (Attachment: Appendix A, B, C & D)	JASMA
IP/5	4	TVE AND ASE TREND OF SETOUCHI HMU (Attachment: Appendix A)	JASMA
IP/6	6	PYTHON TOOLS FOR DATA LINK DECODING AND PERFORMANCE MONITORING	AAMA
Flimsy/1	1	ICAO SEPARATION AND AIRSPACE SAFETY PANEL HSU COLLISION RISK MODEL (Attachment zipped files)	AAMA