INTERNATIONAL CIVIL AVIATION ORGANIZATION

REPORT OF THE ELEVENTH MEETING OF THE REGIONAL AIRSPACE SAFETY MONITORING ADVISORY GROUP (RASMAG/11)

BANGKOK, THAILAND, 8 – 12 JUNE 2009

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

Adopted by the RASMAG
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HISTORY OF THE MEETING

1. Introduction

1.1 The Eleventh Meeting of the Regional Airspace Safety Monitoring Advisory Group (RASMAG/11) was held in Bangkok, Thailand from 8 to 12 June 2009 at the Kotaite Wing of the ICAO Asia/Pacific Office.

2. Attendance

2.1 The meeting was attended by 38 participants from Australia, China, India, Japan, New Zealand, Republic of Korea, Singapore, Thailand, United States and IFALPA. A list of participants is at **Appendix A** to this report.

3. Officers & Regional Office

3.1. Mr. Robert Butcher, Operational Analysis Manager, Safety and Environment Group, Airservices Australia, chaired the meeting.

3.2. Mr. Andrew Tiede, Regional Officer ATM, Asia and Pacific Office, was the Secretary for the meeting.

4. Opening of the Meeting

4.1 The meeting was opened by Mr. Andrew Tiede on behalf of Mr. Mokhtar A. Awan, Regional Director of the Asia/Pacific Regional Office. In welcoming all participants to the Regional Office, he highlighted that this was an important feeder meeting to the September APANPIRG meeting and urged delegates to take advantage of the opportunity to finalize a number of items that were presently in work. Mr. Tiede updated the meeting in relation to the very successful outcomes of the RVSM Scrutiny Group in the Western Pacific/South China Sea area, noting that RVSM operations were now satisfying the regional target level of safety (TLS) and showing an improving trend. This was directly attributable to work of the States and organizations participating in the Scrutiny Group and was highly commendable.

4.2 Mr. Butcher welcomed participants to the meeting and commented that he was pleased to see the large number of State participants who were present given the current circumstances in the aviation industry. He particularly welcomed new representatives from Australia, India, Republic of Korea and the United States. He noted that there were some important items that needed to be progressed on the work program at this meeting including the EMA Handbook and the Long Term Height Monitoring impact statement being prepared for APANPIRG. Mr. Butcher asked all participants for their support in completing these tasks and was confident that the meeting would again provide important outcomes for the Region.

5. Documentation and Working Language

5.1 The working language of the meeting as well as all documentation was in English.

5.2 Twenty-five (25) Working Papers, five (5) Information Papers and one (1) Flimsy were considered by the meeting. A list of papers is included at **Appendix B** to this Report.

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REPORT ON AGENDA ITEMS

Agenda Item 1: Adoption of Agenda

1.1 The following agenda was adopted by the meeting:

Agenda Item 1: Adoption of Agenda

Agenda Item 2: Review outcomes of related meetings

Agenda Item 3: Reports from Asia/Pacific RMAs and EMAs

Agenda Item 4: Airspace safety monitoring documentation and regional guidance material

- EMA Handbook
- Regional Impact Strategy for RVSM long term height monitoring

Agenda Item 5: Airspace safety monitoring activities/requirements in the Asia/Pacific Region

Agenda Item 6: Review RVSM Safety Metric

Agenda Item 7: Review and update RASMAG Task List

Agenda Item 8: Any other business

Agenda Item 9: Date and venue of the next RASMAG Meeting

Agenda Item 2: Review outcomes of related meetings

Technical Meeting of Asia/Pacific RMAs

2.1 The first day of the RASMAG/11 meeting was conducted as a technical meeting for Asia/Pacific RMAs. The intent of this meeting was to give the RMAs a collective opportunity to focus discussions on technical issues, identify resolutions to these issues and standardize regional processes. As part of the meeting, some of the RMAs provided a brief overview of their activities since the last meeting and identified issues and problems that they were confronting.

2.2 The AAMA informed the meeting that it had been undertaking close coordination with Indonesia in order to enhance the cooperative effort towards ensuring data is available for the required safety risk assessments for RVSM to take place. The AAMA commented that there were still issues relating to the low level of large height deviation (LHD) reporting relative to the Jakarta and Ujung Pandang FIRs and also a number of data inconsistencies within the Indonesian aircraft approvals database. However, the AAMA stated that they were confident that these problems would be overcome in the near future given the high level of support being provided by the relevant State authorities. In relation to its responsibility for the Port Moresby FIR, the AAMA reported that it had some level of concern with regards to the effectiveness of LHD reporting within Papua New Guinea as no reports had been provided in the 12 months to April 2009. Notwithstanding, the meeting was informed that recent coordination between State authorities and the AAMA had provided positive indications that these issues will be resolved. Importantly the AAMA has now received updated information concerning Papua New Guinea RVSM approvals data.

2.3 The meeting was informed that the AAMA believed that there was still a lack of standardization with regards to how RMAs were assessing the duration of LHDs and proposed that this needed early resolution. The meeting agreed with this and suggested that the matter be continued offline between the RMA representatives. The next RMA technical meeting preceding the RASMAG/12 meeting would pursue this matter in accordance with Task List item 10/11.

2.4 The PARMO commented that since the last RASMAG meeting there had been significant coordination between PARMO and NAARMO on the one hand, and Eurocontrol on the other to progress aspects of the draft RMA Manual and ASE data. Specifically in relation to ASE data, the meeting was informed that the issues discussed related primarily to how each group was processing the data, how this could be standardized and what methods were employed to identify specific unusual data. Additionally PARMO stated that there was a desire from both groups to make their extensive ASE data available to other RMAs, particularly data on aircraft that have not met the approval criteria. Importantly, PARMO was keen to ensure that where subsequent follow up occurs in relation to an airframe the results of that follow up be advised to other RMAs in a timely fashion. The meeting was informed that PARMO was hopeful these coordination processes will be put in place in the near future.

2.5 The PARMO also provided information regarding the research being undertaken between the United States and Australia to demonstrate the ability to use ADS-B data for height monitoring. Additionally the meeting was informed that the AGHME site at Phoenix, Arizona has been completed and that work is currently being undertaken to assess the data provided by this unit so that it can be brought into full operation. The PARMO noted that the prime reason for the site in Phoenix is to provide monitoring for the large number of aircraft operating over routes between the United States and Mexico and to support a number of aircraft production facilities in the area. The meeting was informed that an additional AGHME site was being planned in the northern California/southern Oregon coast region. This site would assist with monitoring for aircraft operating on Pacific routes, as well as the western United States domestic routes.

2.6 Additionally the PARMO reported that they had been involved in discussions with the China RMA regarding the benefits of ground based monitoring. PARMO requested that any State providing data for scrutiny groups should ensure that the RVSM approval status information provided in aircraft flight plans is included with LHD data; and noted that Oakland and Tahiti FIRs will have AIDC implemented by early 2010.

2.7 MAAR informed the meeting that they have now obtained budget that will enable the purchase of an additional EGMU to support its height monitoring activities. Additionally MAAR raised a concern that in a similar way to the AAMA experience, they have found a number of inconsistencies with RVSM approvals database information supplied by some States which affected the integrity of the data. The types of errors showing up included specifically aircraft being flight planned as having an RVSM approval but not being recorded on the State approvals database, or being on the database but without any formal documentation being made available.

2.8 Discussion took place regarding the ability of an RMA such as MAAR, which has to coordinate with a large number of States, to effectively obtain information from State authorities that are less than cooperative. PARMO commented that they are having similar problems with some States as they are being ignored when they ask for additional information in relation to specific aircraft. The Secretary noted that this is a perennial problem for RMAs however States (i.e. not RMAs) are clearly responsible for compliance with Annex provisions – including Annex 6 and Annex 11 in regard to safety monitoring. RMAs are not able to assist those who do not participate. A proposal was put by the Chairman for a standard template letter from RASMAG that the RMAs could use to give weight to those requests which have proven difficult to resolve. Such a letter would specify that the request has been made on behalf of RASMAG which has specific empowerment from APANPIRG.

2.9 The meeting was informed that if a standard letter was developed, the Regional Office would have limited resource to assist with the sending of letters to States. MAAR suggested that possibly an additional request for States to provide an update of their approvals data every December along with their TSD may resolve the issue. China RMA reported that their situation is different to MAARs as they only monitor their own State FIRs and consequently they were not experiencing these problems. PARMO submitted that it is not easy to keep the data up to date but suggested that the RMAs could best be served by the State authorities sending an update on their approvals register once a month.

2.10 As a result of this discussion the meeting agreed that States would be asked for their current RVSM approvals data as an additional item for transmission to the RMAs with the annual traffic sample data (TSD), and that a standard letter template would be drafted for RMAs to use when required in support of specific enquiries to States. An item would be added to the Task List to ensure that RMAs prepared a suitable template letter for review by RASMAG/12 and the following Conclusion was drafted for consideration by APANPIRG/20:

Draft Conclusion RASMAG/11-1 – Provide Annual Update of RVSM Approvals to RMAs

That, in conjunction with the annual December traffic sample data submission required by Conclusion 16/4, the continuous update of RVSM Approvals data called for by Conclusion 19/15, and APANPIRG RMA requirements, States also provide an annual update of RVSM Approvals data.

2.11 JCAB informed the meeting that while they use the TSD from December in developing their reporting to RASMAG, and only have one FIR to monitor, they could use a monthly TSD for monthly reporting within Japan. Specifically JCAB informed the meeting that it has identified a number of aircraft in the Fukuoka FIR that are notifying RVSM approval however are not listed on the databases coordinated by other RMAs for States other than Japan. The meeting requested that JCAB make this information available to the relevant RMAs for follow up action with the States concerned.

2.12 Further discussion took place in relation to the use of a monthly TSD. A suggestion was made that where this data was available then RMAs should use that if they are reporting on a monthly basis. The Secretary commented that RASMAG has a responsibility to report to APANPIRG once a year and that it had already agreed to base this report on the 12 months to the end of April based on a TSD collected in December of the previous year. This would ensure that RMA reports for APANPIRG are standardized. New Zealand agreed that it was important to maintain that level of standardization and therefore supported the continued use of the December TSD and 12 months to April LHDs for RASMAG reports. PARMO commented that RASMAG should be selecting a stable period to establish occupancy values to enable a comparison of year on year samples to reduce variability. The meeting agreed to continue using the December TSD and LHD data for the 12-month period May – April for the purposes of reporting to RASMAG.

2.13 The technical meeting then focused its attention on reviewing the draft long term height monitoring impact statement. The basis of the review was the draft provided as Attachment 1 to WP/10 and after detailed discussion an amended version was developed and the outcomes are reported under Agenda Item 4.

2.14 The technical meeting noted that the presentation of LHDs adopted by the China RMA, as shown in **Table 1** below, comprised an effective and concise way of communicating a lot of information related to the LHD reports. Accordingly, the meeting agreed that all Asia/Pacific RMAs would adopt the table presentation below for future reporting of this type of information by RMAs to RASMAG.

LHD Category Code	LHD Category Description	No. of LHD Occurrences	LHD Duration (Min)	No. of flight levels transitioned without clearance
A	Flight crew failing to climb/descend the aircraft as cleared;	3	2.5	5
B	Flight crew climbing/descending without ATC clearance;	1	0	1
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-clearances etc);	1	0.17	0

Table 1: Methodology from China RMA adopted by APAC RMAs for LHD reporting

RMA Manual

2.15 The meeting recalled previous concerns regarding the delay in the finalisation of the RMA Manual and that it was expected that this would be resolved at the proposed ALL RMA meeting in Montreal in May 2009. As that meeting did not take place, the meeting sought clarification as to the current status of the Manual. The United States reported that work in developing a final draft had been undertaken by staff from NAARMO and PARMO and that the document had been submitted to the ICAO Secretariat for final editing. The Chairman informed the meeting that discussions between the Secretariat and himself during the SASP meeting that ended on 5 June identified that the Secretariat would be forwarding a final draft to all RMAs during the week that RASMAG was meeting. The intent was for RMAs to review the document and provide any final amendments to the Secretariat so that a final copy could be presented for endorsement to the now planned ALL RMA meeting to be held in either Montreal or Canberra, Australia later this year.

Amended wording for LHD submission form

2.16 The Secretariat drew the attention of the meeting to some input from the WPAC/SCS RSG in relation to the use of the ‘tick box’ question on the LHD reporting template - “*Were the Supervisors of the affected ACCs advised of this LHD occurrence*”. Concern had been expressed that this wording could be interpreted as an ATCO informing his supervisor within the same Centre, rather than between neighbouring ACC Supervisors as intended by RASMAG.

2.17 Following discussion, an amended wording was agreed by the meeting. RMAs would amend their LHD templates to read “*Were the Supervisors of the transferring and receiving ACCs advised of this LHD occurrence?*” An item was added to the Task List in this respect.

Deficiencies List

2.18 In reviewing the APANPIRG list of deficiencies in the ATM/AIS/SAR fields the meeting noted that Myanmar and Papua New Guinea (PNG) had previously been included on the list as a result of the non submission of safety data to RMAs. In the case of Myanmar, the difficulties had been resolved and the meeting agreed to recommend to APANPIRG that Myanmar be removed from the list. However, although the situation with PNG had improved data submission was still not full reliable, so PNG would be retained on the list. Additionally, data submission from Bangladesh and Lao PDR has been incomplete or absent so the meeting recommended to APANPIRG that these two States be added to the deficiencies list.

2.19 Participating in the discussion surrounding the relatively low number of States that were on the deficiencies list in relation to provision of safety data, IFALPA highlighted the steady improvements in this and other areas that were evident over the last few years. In IFALPA's view, many of these improvements had been deliberately and professionally driven by RASMAG. The beneficial safety outcomes in so many areas were a credit to RASMAG members and were appreciated by many pilots every day. IFALPA expressed their strong appreciation for the hard work, clear focus and excellent results consistently achieved by RASMAG.

Flight Levels Transitioned

2.20 The United States presented background material regarding the calculation of vertical collision risk for aircraft that may transition without authorization through flight levels as part of an LHD occurrence. The paper presented a mathematical means for calculating this aspect of operational vertical collision risk. Additionally, since the calculation is related to the exposure time during which an aircraft transitions through an unauthorized level, several results were considered depending on the vertical speed of an aircraft during climb or descent as it transitions the unauthorized flight level. In practice, it is seen that different conditions produce different vertical speeds, e.g., emergency descent, engine-out descent, normal climb/descent. So for the meeting's consideration, several speeds were evaluated and results presented.

2.21 The meeting thanked the United States for the detailed information, which would be studied by RMAs over the next few months. Further discussions would take place during the next meeting in relation to RMAs adopting a standardized approach in this respect.

Review of WPAC/SCS RSG/6

2.22 The Sixth Meeting of the Western Pacific/South China Sea RVSM Scrutiny Working Group (WPAC/SCS RSG/6) was held from 7 to 9 April 2009, to conduct the one year post implementation review of the revised flight level arrangements that had been implemented in the Western Pacific and South China Sea areas on 2 July 2008. This was a complex and widespread implementation that had affected a large number of different parties serving the 10 or so FIRs in this area. Outcomes from the ongoing work programme to reduce the number and duration of LHDs were also reviewed.

2.23 The meeting recalled that the Seventeenth meeting of the Asia/Pacific Air Navigation Planning and Implementation Regional Group (APANPIRG/17, August 2006) recognized that there were three very significant safety matters outstanding in relation to WPAC/SCS operations that needed to be urgently addressed:

1) the TLS for WPAC/SCS RVSM operations being exceeded;
2) concerns about the modified single alternate flight level orientation scheme; and
3) no updated horizontal safety assessment had been undertaken for the SCS.

2.24 In overall terms, it was apparent to WPAC/SCS RSG/6 that the specific terms of reference (TOR) established for RSG by APANPIRG to address urgent safety matters in the WPAC/SCS airspace had been substantially met and the RSG could therefore be considered for dissolution. The meeting agreed that the residual work items on the task list of the RSG –pertaining mainly to ATS route proposals − could be adequately handled by SEACG under their existing mandate. Further assistance was available from RASMAG and the ATM/AIS/SAR Sub-Group if necessary. Accordingly, the WPAC/SCS RSG/6 meeting agreed to the following Draft Conclusion for consideration by the ATM/AIS/SAR Sub-Group in June 2009:

Draft Conclusion RSG/1 - Dissolution of Western Pacific/South China Sea RVSM Scrutiny Working Group

That, having substantially completed the Terms of Reference established by APANPIRG,

a) the Western Pacific/South China Sea RVSM Scrutiny Working Group (WPAC/SCS RSG) be commended for the swift and effective outcomes in satisfactorily addressing RVSM safety performance in the WPAC/SCS area, and

b) the WPAC/SCS RSG be dissolved and any residual work items be allocated to the South East Asia ATS Coordination Group (SEACG) and/or the Regional Airspace Safety Monitoring Advisory Group (RASMAG) and ATM/AIS/SAR Sub Group as necessary.

2.25 The meeting commended the excellent outcomes that had been achieved by the participants of the WPAC/SCS RSG. In respect to the major concerns that had originally led APANPIRG to establish the WPAC/SCS RSG, the implementation of the revised flight level arrangements in July 2008 had resulted in greater harmonisation with the flight level arrangements in airspaces surrounding the WPAC/SCS area. Strategies implemented by States for the management of LHDs were having a significant beneficial effect which had resulted in very positive trends in safety performance that were expected to ensure the regional TLS continued to be met for the foreseeable future.

Review of PBN Task Force

2.26 The RASMAG/10 meeting (December 2008) reviewed the interim edition of the Regional PBN Plan adopted by APANPIRG/19 and proposed additional text for Section 9 - *Safety Assessment & Monitoring Requirements* to clarify that the responsibility for safety assessment and ongoing monitoring lies with the implementing States, not with RASMAG. States were encouraged to coordinate with RASMAG regarding the en-route safety assessment and monitoring requirements and methodologies. RASMAG/10 also proposed a number of editorial updates.

2.27 The PBN/TF/4 meeting (March 2009) reviewed the RASMAG proposals/ recommendations and, with the exception of the text of APANPIRG Conclusion 16/5 that had been included in the RASMAG submission, accepted the proposed changes. The PBN/TF also considered it necessary and appropriate to introduce further changes to some existing text so as to bring more clarity to the document and made a number of additional editorial adjustments to the plan.

Concerns raised by Hong Kong China

2.28 The Secretariat provided a copy of a working paper that had been submitted by Hong Kong China for the ATM/AIS/SAR Sub-Group meeting in late June. The paper commented that although the responsibility for safety assessment and ongoing monitoring lies with the implementing States, it should be noted that some States in the APAC Region neither have the level of technical expertise nor the resources to conduct PBN safety assessments. Implementation of en-route PBN initiatives in the region would very likely involve concerted efforts by multiple States. Given the scale and complexity of such regional airspace safety assessment, the process would necessarily rely heavily on the assistance provided by the regional RMAs/EMAs under the auspices of ICAO.

2.29 In particular, Hong Kong, China noted that States in the region do not generally have the experience and expertise in conducting terminal airspace safety assessments and apparently there is little assistance readily available to help those States. The situation needs to be addressed in order not to undermine the PBN implementation process in the APAC Region and Hong Kong, China recommended a discussion during the ATM/AIS/SAR Sub Group about the feasibility of ICAO providing assistance to States in conducting terminal airspace safety assessments.

2.30 The meeting shared many of the concerns raised by Hong Kong, China. The work programme for RASMAG was structured to primarily address vertical and horizontal safety monitoring in international airspaces. As such, PBN en-route implementations were already under the purview of RASMAG and significant effort had already been committed over the past two years to establishing horizontal monitoring capability and guidance by way of the EMA Handbook presently being finalized by RASMAG. Regrettably, RASMAG had been too busy to start to address the long standing data link monitoring requirements that were under their responsibility and recognized that these matters were long overdue. RASMAG's focus was presently on international airspace and, as terminal area matters were essentially all within the sovereign airspace of States, RASMAG had little capability or capacity to consider this area. This was reflected in the current composition of RASMAG, whose members had only limited terminal area expertise. As such, RASMAG was not in a position to be of any assistance with terminal area matters.

2.31 The meeting also recalled the laborious efforts undertaken by RASMAG a few years ago to establish fair and efficient mechanisms for the funding of regional airspace safety monitoring. Ultimately, these matters had proven too complex and agreement had been reached through APANPIRG that the parties presently providing vertical and data link monitoring services would continue to absorb the cost on behalf of the States being assisted. Since that time the demand for horizontal monitoring services to service PBN implementation had grown, however funding arrangements were not in place and horizontal monitoring capabilities were very limited regionally. In the opinion of the meeting, this was an important matter to be addressed in order to ensure adequate safety monitoring could urgently be made available to assist PBN implementation in both the en-route and terminal environments.

Outcomes from BBACG and SEACG

2.32 The meeting reviewed outcomes from the BBACG/20 (January 2009) and SEACG/16 (May 2009) meetings that were of significance to RASMAG. In particular, the meeting noted the formation of the Bay of Bengal Reduced Horizontal Separation Implementation Task Force (BOB-RHS/TF), with the scope of work commencing with a Phase 1 programme to implement widespread 50 NM longitudinal separation using CPDLC communications in the Bay of Bengal during 2009.

Safety Monitoring for Reduced Horizontal Separation in BOB

2.33 The BBACG/20 meeting learned that an important aspect of the implementation of reduced horizontal plane separations is the monitoring of occurrences of navigational errors in lateral and longitudinal navigation. Termed Gross Navigational Errors (GNEs), these must be identified and included in the collision risk models as part of the safety assessment and monitoring process.

2.34 Monitoring of lateral errors is often accomplished by radar controllers observing the lateral displacement from flight planned track as the aircraft enters radar coverage before coming into the coverage of ground based navigation aids at the end of an oceanic route segment.

2.35 Monitoring of longitudinal errors is accomplished by reporting occurrences where the observed longitudinal separation is either less or more than the expected longitudinal separation. This may be in situations where the separation standard is infringed, the expected time between two aircraft varies by 3 minutes or more (even if the applicable separation standard is not infringed) or when a pilot estimate varies by 3 minutes or more from that advised in a routine position report.

2.36 Accordingly, the BBACG/20 meeting recognized that implementation of a formal monitoring programme on a sub-regional basis for lateral and longitudinal navigation errors in the Bay of Bengal was necessary. It was also highlighted that EMA capability would be necessary in order to conduct the appropriate safety assessments to support the reduced longitudinal implementations proposed for the Bay of Bengal. BBACG/20 recognized that such EMA capability was not presently available for the Bay of Bengal.

Agenda Item 3: Reports from Asia/Pacific RMAs and EMAs

AAMA's RMA activities

Australian airspace

3.1 Australia presented the results of the safety assessments of the Brisbane and Melbourne FIRs undertaken by the Australian Airspace Monitoring Agency (AAMA). The meeting was informed that the assessment covered the 12-month period ending on 30 April 2009, using TSD for December 2008.

3.2 In completing the assessment, the AAMA assessed LHDs identified through the Airservices Australia Electronic Safety Incident Reporting (ESIR) system or provided by aircraft operators. The total number of minutes calculated for the period 1 May 2008 to 30 April 2009 was 341, drawn from 70 assessed non-NIL reports. The meeting noted that the calculated risk value had reduced in comparison to that reported to RASMAG at its last meeting. Australia informed the meeting that this was the result of not only high-duration incidents dropping out of the twelve month data sample, but also due to detailed review of specific operational errors and the measures put in place to reduce the likelihood of them being repeated.

3.3 The Australian report identified that the month of April 2009 recorded the lowest number and duration of risk bearing LHDs since May 2008. Additionally it showed that the number and duration of LHDs in terms of specific category remained relatively static over the last few months, although category L duration reduced by nearly 50% due to the accepted methodology whereby LHD occurrences more than 12 months old are no longer included in the data set.

3.4 The meeting was informed that the assessment for the Australian airspace resulted in an estimation of the total risk as 7.36×10^{-9} fatal accidents per flight hour, which does not satisfy the agreed TLS value of no more than 5.0×10^{-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, respectively. Australia commented that while the assessed risk value was still in excess of the TLS, it was pleasing to see that it was significantly lower than that last reported to RASMAG of 10.4×10^{-9} and the trend showed continued improvement. As a result, Australia was able to inform the meeting that a new assessment undertaken for the month of May 2009 showed the risk has continued to decline to $6.1 \times 10^{-9.}$

3.5 **Table 2** below summarizes the results of the airspace safety oversight in terms of the technical, operational, and total risks for the RVSM implementation in the Australian airspace.

Australian RVSM Airspace – estimated annual flying hours = 445,363.07 hours *(note: estimated hours based on December 2008 traffic sample data)*			
Source of Risk	**Lower Bound Risk Estimation**	**TLS**	**Remarks**
Technical Risk	0.026×10^{-9}	2.5×10^{-9}	Satisfies Technical TLS
Operational Risk	7.33×10^{-9}	-	-
Total Risk	**7.36×10^{-9}**	5.0×10^{-9}	**Does not satisfy Overall TLS**

Table 2: Risk Estimates for the RVSM Implementation in Australian Airspace

3.6 In addition, **Figure 1** below presents the trends of collision risk estimates for each month using the appropriate cumulative 12-month interval of LHD reports since 1 May 2008.

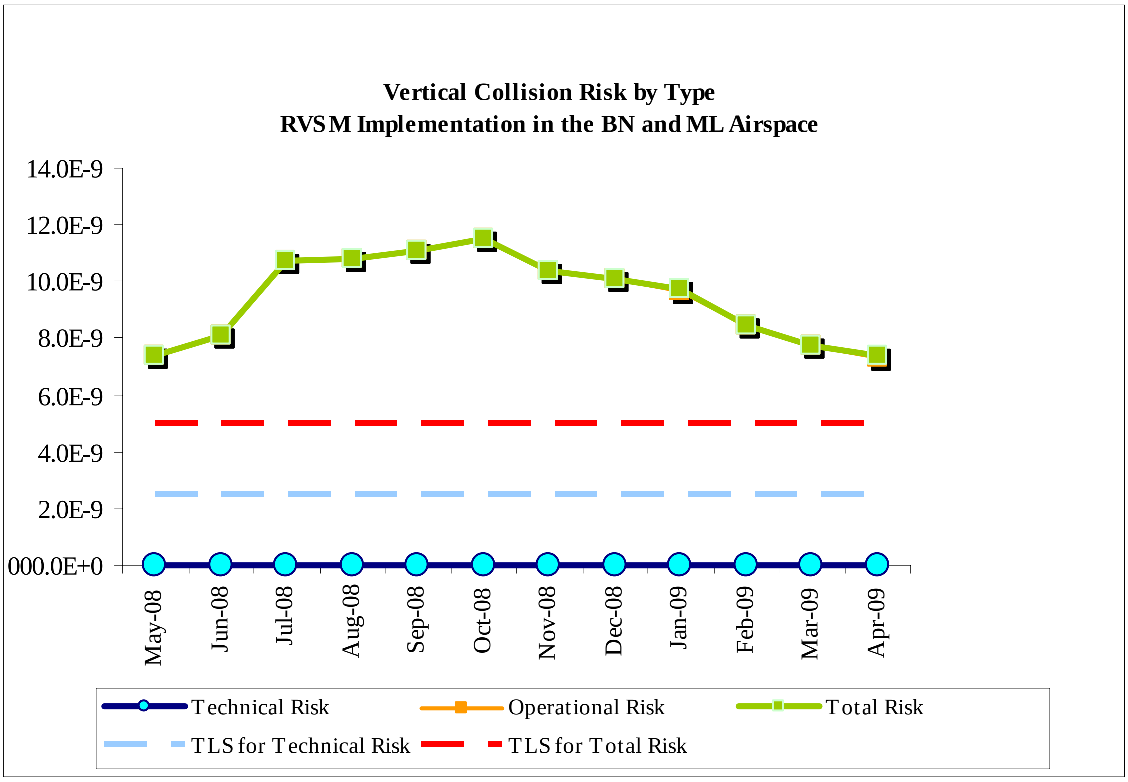

Figure 1: Trends of Risk Estimates for the Australian RVSM Airspace

3.7 The meeting was reminded that in its December 2008 report to RASMAG, Australia had highlighted that the AAMA had been able to establish a monthly risk value that provides a real-time picture of actual risk without the effect from historical high-time errors resident within the 12-month data sample. With this type of monthly assessment, the AAMA had been able to assess RVSM risk by showing individual LHD contribution to the calculated monthly risk as detailed in **Figure 2** below. The data shows that the monthly risk for April 2009 is significantly less than an average based on the 12 month total risk assessment and this has been the case since January 2009.

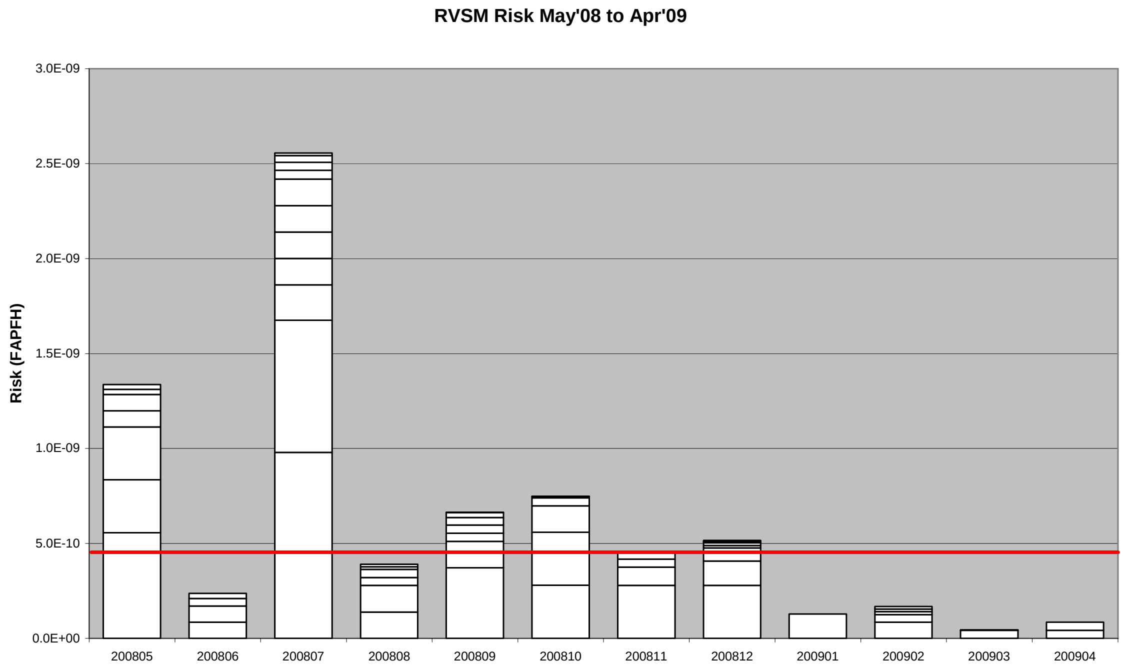

Figure 2: Monthly Risk Estimates for the Australian RVSM Airspace

3.8 The meeting noted the outcome for the Australian airspace in terms of estimated risk, particularly the continually decreasing trend since October 2008, and that the AAMA expects the risk to be below the TLS in the near future. In further discussing the report, the United States queried why the number of long duration LHDs appeared to have been reducing. Australia explained that specifically there had been a decrease in the number of coordination errors reported along the FIR boundaries where AIDC was not implemented. This had resulted from increasing cooperation among the States concerned to resolve these types of errors. Additionally the use of ADS-C and in some cases ADS-B had enabled errors to be identified and resolved in a more timely manner.

Indonesian Airspace

3.9 Australia presented the results of a safety assessment undertaken by the AAMA for the Jakarta and Ujung Pandang FIRs. Australia informed the meeting that the assessment covered the 12 month period ending on 30 April 2009, using traffic sample data for the month of December 2007 as the TSD for December 2008 was unavailable for use at the time the assessment was completed.

3.10 The meeting was informed that in undertaking the assessment, the AAMA had received a number of LHD reports from the Indonesian ANSPs and also from MAAR. Additionally the AAMA had access to a number of reports provided by Australia that included possible risk bearing LHDs relative to the Jakarta and Ujung Pandang FIRs. Assessment of these reports was made from the perspective of their impact within the Indonesian airspace. In determining the duration of some of these reports, the AAMA had been obliged to make some assumptions on likely scenarios and factors within the airspace. To date some of these assumptions have not been fully validated and therefore there is a small level of uncertainty regarding the final risk value determined for the airspace.

3.11 The meeting was informed that a total of 370.0 minutes duration was assigned to the 17 non-NIL LHDs identified which is a significant increase in assessed duration compared to that of 179 minutes last reported to RASMAG. The LHDs were summarized as follows:

- There was a noticeable spike for December 2008 due to 7 non-NIL LHDs with significant time duration. Six of these reports were Category E Coordination errors. One was a Category L report. Of concern to the AAMA is the significant variability in the reporting of LHDs, specifically operational errors. Currently the AAMA believes that a high level of under-reporting exists which it is working with the Indonesian DGCA and ANSPs to correct.

- Overall three L category LHDs were identified with a cumulative total duration of 75 minutes. All of the LHDs concerned Australian registered aircraft operating from Bali into the Australian FIRs, and were the result of the Bali Briefing Office erroneously amending the flight plans of the aircraft to show an RVSM approval when the aircraft were not approved. Discussions between the AAMA and the relevant ANSP have identified an assumption by the Briefing Office that as RVSM airspace in Indonesian FIRs is exclusive airspace, the aircraft must all be approved to flight plan within it. As the flight plans for all three flights had been amended to show a 'W' for RVSM approval, the AAMA assessed that Indonesian ATC must therefore have processed the aircraft as being approved when this was not the case.

- Twelve Category E – ATC coordination error reports were identified in the 12 month data sample, with six of these being reported by the ANSPs in December 2008 and all having significant duration. Five of these LHDs resulted in a total of 242 minutes where aircraft were operating at the wrong level prior to the error being identified by ATC. The highest duration report was of 61 minutes duration and the lowest 30 minutes. All of these five reports related to coordination errors between Jakarta and Makassar ACCs. One additional report of this category of LHD was for 3 minutes duration and involved incorrect coordination provided from the Colombo FIR.

3.12 The meeting was informed that the assessment for the Indonesian airspace resulted in an estimation of the total risk as 7.60×10^{-9} fatal accidents per flight hour, which does not satisfy the agreed TLS value of no more than 5.0×10^{-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, respectively.

3.13 **Table 3** below summarizes the results of the airspace safety oversight in terms of the technical, operational, and total risks for the RVSM implementation in the Indonesian airspace.

Indonesian RVSM Airspace – estimated annual flying hours = 2 707 849.49 hours *(note: estimated hours based on December 2007 traffic sample data)*			
Source of Risk	**Lower Bound Risk Estimation**	**TLS**	**Remarks**
Technical Risk	0.0264×10^{-9}	2.5×10^{-9}	Satisfies Technical TLS
Operational Risk	7.57×10^{-9}	-	-
Total Risk	$\mathbf{7.60 \times 10^{-9}}$	5.0×10^{-9}	**Does Not Satisfy Overall TLS**

Table 3: Risk Estimates for the RVSM Implementation in Indonesian Airspace

3.14 In addition, **Figure 3** below presents the trends of collision risk estimates for each month using the appropriate cumulative 12-month interval of LHD reports since 1 May 2008.

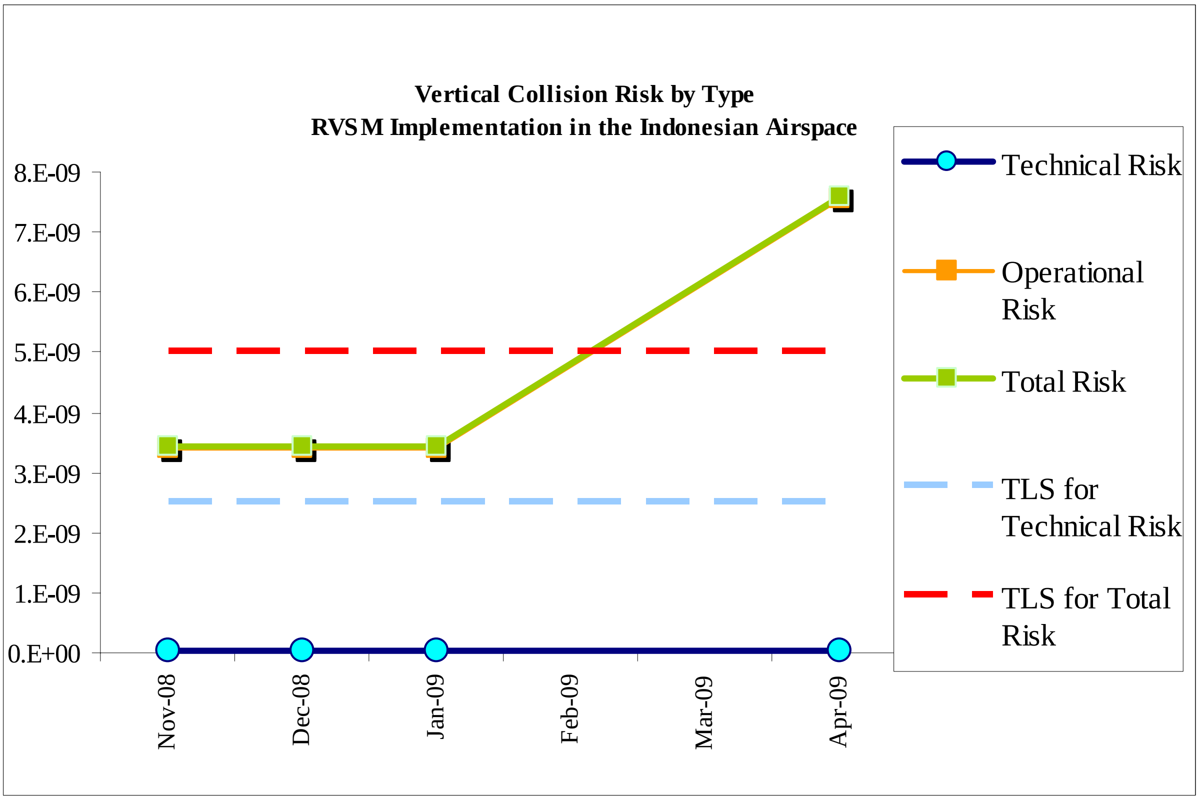

Figure 3: Trends of Risk Estimates for the Indonesian RVSM Airspace

3.15 The meeting thanked Australia and particularly the AAMA for its continuing efforts in to assess the Indonesian airspace and for its close coordination with Indonesian authorities to enhance the data required for the RMA to undertake its activities. The meeting noted the increasing risk for the airspace and hoped that controls would be implemented to effectively reduce the types of operational errors identified.

China RMA's activities

3.16 The China RMA briefed the meeting on the outcomes of the most recent safety estimate for the Chinese sovereign airspace. The TSD of December 2008 and the continuous LHD reports in the sovereign Chinese airspace between 1 May 2008 and 30 April 2009 were used to produce the updated risk estimates below. Each monthly estimate was weighted by the factors proportionate to the total number of flight hours in the procedural and radar components of the Chinese RVSM airspace.

3.17 The large height deviation reports are separated by categories based on the details provided for each deviation. **Table 4** below summarizes the number of LHD occurrences by cause of the deviation

LHD Category Code	LHD Category Description	No. of LHD Occurrences	LHD Duration (Min)	No. of flight levels transitioned without clearance
A	Flight crew failing to climb/descend the aircraft as cleared;	3	2.5	5
B	Flight crew climbing/descending without ATC clearance;	1	0	1
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-clearances etc);	1	0.17	0
D	ATC system loop error; (e.g. ATC issues incorrect clearance or flight crew misunderstands clearance message);	4	0.62	5
E	Coordination errors in the ATC-to-ATC transfer of 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);	2	1.33	0
G	Aircraft contingency event leading to sudden inability to maintain assigned flight level (e.g. pressurization failure, engine failure);	1	3	0
H	Airborne equipment failure leading to unintentional or undetected change of flight level (e.g. altimetry errors);	2	8	0
I	Turbulence or other weather related causes;	10	3.78	8
J	TCAS resolution advisory; flight crew correctly following the resolution advisory;	3	0.337	3
M	Other o Deviation due to display error of ATC automatic system	1	0.033	1
Total		28	19.77	23

Table 4: Summary of LHD Causes in sovereign Chinese airspace

3.18 Accordingly, the LHD occurrences in the China RVSM airspace are summarized as follows:

- Compared to the last 6 monthly assessment, the number of LHD occurrence decreased from 29 to 28 occurrences while total LHD duration increased from 16.0 to 19.77 minutes; and

- Durations of most of the large height deviation occurrences are less that 0.4 minutes, with maximum duration of 8 minutes.

3.19 **Table 5** below provides the results of the airspace safety oversight, as of April 2009, in terms of the technical, operational, and total risks for the RVSM implementation in the sovereign Chinese RVSM airspace.

Chinese sovereign RVSM Airspace – estimated annual flying hours = 1 990 071.8 hours *(note: estimated hours based on the December 2008 traffic sample data. Estimate represents the sum of total flying hours for Radar and Procedural control area)*			
Source of Risk	**Risk Estimation**	**TLS**	**Remarks**
Technical Risk	1.681×10^{-10}	2.5×10^{-9}	Satisfies Technical TLS
Operational Risk	1.819×10^{-9}	-	-
Total Risk	$\mathbf{1.987 \times 10^{-9}}$	$\mathbf{5.0 \times 10^{-9}}$	**Satisfies Overall TLS**

Table 5: Risk Estimates for RVSM implementation in Chinese RVSM airspace -April 2009

3.20 **Figure 4** below provides the vertical collision risk estimates by type (e.g. technical, operational, and total) for each month during the current reporting period based on recent Large Height Deviation reports.

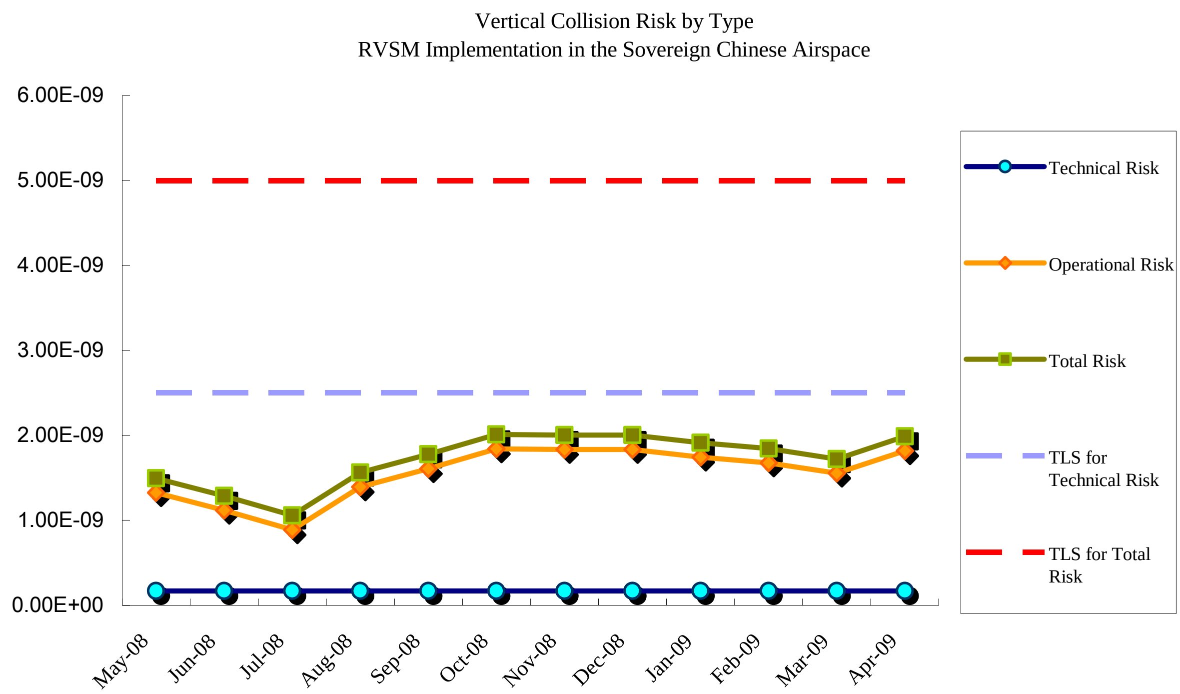

Figure 4: Trends of Risk Estimates for the RVSM Implementation in Sovereign Chinese Airspace

3.21 Therefore, the estimates of both technical and total risks from the available TSD and LHD reports satisfy the agreed TLS value of no more than 2.5×10^{-9} and 5.0×10^{-9} fatal accidents per flight hour. The meeting thanked the China RMA for the detailed report, noting the satisfactory value of the risk estimate in relation to the regional TLS.

JCAB's RMA activities

3.22 The Japan Civil Aviation Bureau RMA (JCAB RMA) presented the meeting with the result of the most recent RVSM airspace safety assessment for the Fukuoka FIR, which was derived from the December 2008 TSD and LHD reports for the period May 2008 to April 2009. The meeting noted that during the assessment period to April 2009, JCAB RMA received 55 LHD reports - of which 36 occurred within the Japanese airspace and were considered in the assessment. Of these 36 reports, 26 LHD occurrences were attributable to operational errors and 10 were attributable to technical errors, as shown in **Table 6** below.

<table>
<tr><th colspan="4">No. of LHD Occurrences / LHD Duration (min)</th></tr>
<tr><td rowspan="4">Total LHD reported (55)</td><td rowspan="3">Occurring within the Japanese airspace (36 / 117.1min)</td><td>Technical risk -(10 / 4.6min)</td><td>-</td></tr>
<tr><td rowspan="2">Operational risk (26 / 112.5min)</td><td>Coordination error in the ATC-unit-to-ATC-unit transfer of control responsibility (23 / 111.2min)</td></tr>
<tr><td>Other (3 / 1.3min)</td></tr>
<tr><td>Occurring outside of the Japanese airspace (19)</td><td colspan="2">-</td></tr>
</table>

Table 6: Summary of LHD Occurrences by categories (technical risk, operational risk, within/outside the Japanese airspace) – April 2009

3.23 **Table 7** below presents the estimates of vertical collision risk for the Japanese airspace.

Japanese RVSM Airspace – estimated annual flying hours = 915 968 hours *(note: estimated hours based on December 2008 traffic sample data)*			
Source of Risk	**Risk Estimation**	**TLS**	**Remarks**
Technical Risk	0.35×10^{-9}	2.5×10^{-9}	Satisfies Technical TLS
Operational Risk	22.83×10^{-9}	-	-
Total Risk	$\mathbf{23.18 \times 10^{-9}}$	$\mathbf{5.0 \times 10^{-9}}$	**Does Not Satisfy Overall TLS**

Table 7: Risk Estimates for the RVSM implementation in the Japanese airspace – April 2009

3.24 The meeting was informed that the assessment for the Japanese airspace resulted in an estimation of the total risk as 23.18×10^{-9} fatal accidents per flight hour, which does not satisfy the agreed TLS value of no more than 5.0×10^{-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, respectively. The sudden increase in the risk estimate is due to a single long duration (89 minutes) LHD occurrence, as explained below.

3.25 **Figure 5** below presents the trends of collision risk estimates by type (e.g. technical, operational, and total) for each month using the appropriate cumulative 12-month of LHD reports during reporting period.

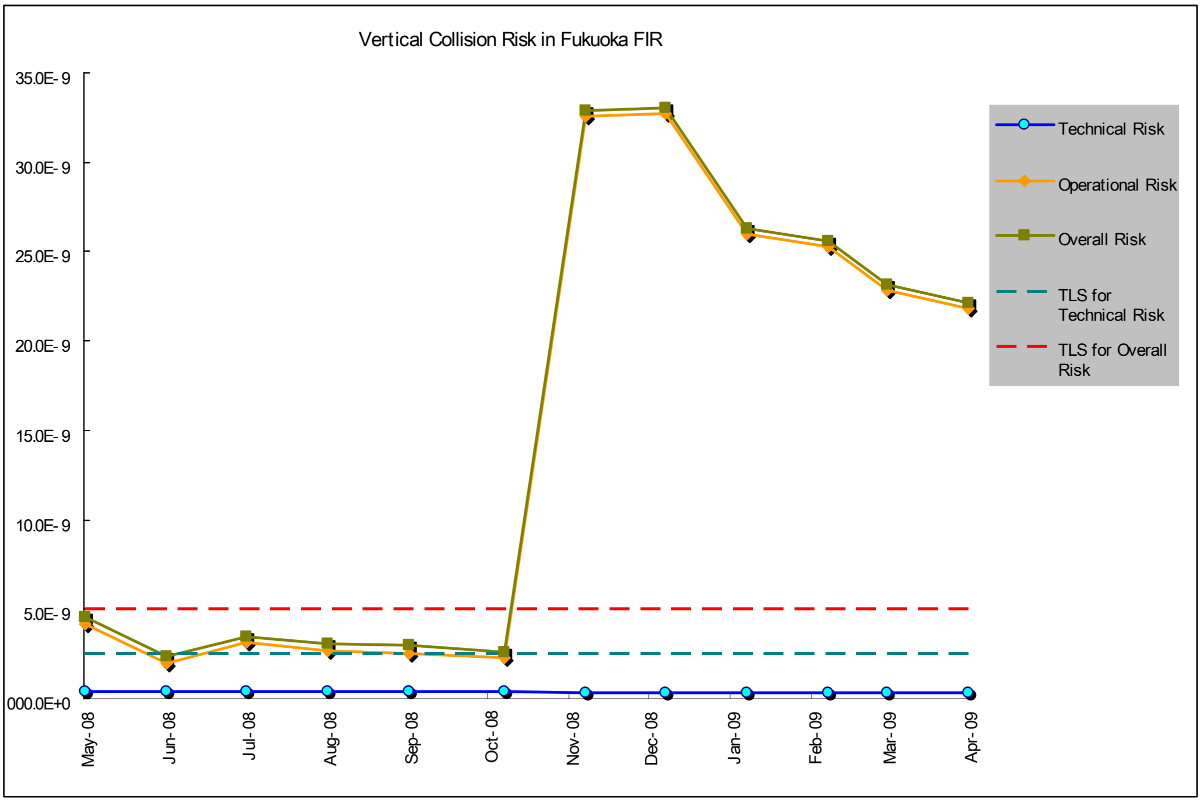

Figure 5: Trends of Risk Estimates for RVSM Implementation in Japanese airspace – April 2009

3.26 The meeting recalled the history of the risk estimates for the Fukuoka FIR, noting previous safety assessment results as follows:

RASMAG/7 (Jun 2007) = 8.61 x 10^{-9}
RASMAG/8 (Dec 2007) = 11.4 x 10^{-9}
RASMAG/9 (May 2008) = 11.4 x 10^{-9}
RASMAG/10 (Dec 2008) = 4.56 x 10^{-9}
RASMAG/11 (June 2009) = 23.18 x 10^{-9}

3.27 In reviewing the November 2008 LHD reports, the JCAB RMA noted that 4 reports had been received, for a total of 97 minutes of LHD duration, of which one report accounted for 89 minutes. It was this long duration LHD that had resulted in the sudden exceedance of the TLS, after a long period in which the JCAB had been actively implementing LHD mitigation measures that had resulted in the steady improvement in RVSM safety performance since RASMAG/9.

3.28 Analysis by JCAB RMA of the 89 minute LHD, which had occurred on 26 November 2008, attributed it to Category E – Coordination errors in the ATC to ATC transfer of control responsibility as a result of human factors issues. The LHD occurred in a complex scenario that resulted from the confluence of a number of contributory factors. Errors were initially made in data input to automated systems and a number of subsequent human factors errors occurred. As traffic was light, no traffic conflicts occurred.

3.29 The meeting thanked the JCAB RMA for the report and recognized that the single long duration LHD was responsible for the sudden exceedance of the TLS. The meeting commended the JCAB RMA for the frankness of their reporting and the comprehensive investigation undertaken to identify and resolve the factors underlying this long duration LHD occurrence.

3.30 The United States commented that JCAB had also recorded LHDs that do not have any risk within the Fukuoka FIR and that this is a good practice as it demonstrates the diligence of reporting and assessment. Australia reported that the AAMA also records LHDs with no risk and that it provides a good overall picture of the level and type of LHD reporting. The Secretary highlighted the commencement of the AIDC trial between Japan and Republic of Korea during May 2009 and that it would be interesting to assess what impact this has on the number of coordination errors.

MAAR's RMA activities

Bay of Bengal Airspace

3.31 The Monitoring Agency for the Asia Region (MAAR) provided a summary of airspace safety oversight for RVSM implementation in the Bay of Bengal (BOB) airspace**.** The RVSM safety oversight had been conducted based on a one-month traffic sample data (TSD) collected in December 2008 and the most recent rolling 12 months of Large Height Deviation (LHD) reports between May 2008 and April 2009 submitted by relevant States in the BOB Region. LHD data provided by the neighbouring RMAs is reviewed and used in the analysis where applicable.

3.32 The large height deviation reports are separated by categories based on the details provided for each deviation. **Table 8** below summarizes the number of LHD occurrences by cause of the deviation

LHD Category Code	**LHD Category Description**	**No. of LHD Occurrences**	**LHD Duration (Min)**
D	ATC system loop error; (e.g. ATC issues incorrect clearance or flight crew misunderstands clearance message)	3	3
E	Coordination errors in the ATC-to-ATC transfer of 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)	5	54
I	Turbulence or other weather related causes	1	0
M	Others	7	6
	Total	**16**	**63**

Table 8: Summary of LHD Causes in the BOB RVSM Airspace – April 2009

3.33 MAAR advised that annual flight hours, calculated based on the December 2008 TSD, were 1,131,465 hours for the BOB airspace and that LHD occurrences in the BOB RVSM airspace could be summarized as follows:

- Compared to the last 6 monthly assessment, the number of LHD occurrences has increased from 10 to 16 occurrences while total LHD duration reduced from 76 to 63 minutes

- Average duration of large height deviation occurrence is 3.9 minutes with maximum of 38 minutes

- The overall large height deviation duration was driven by a significant event in June 2008, which accounted for 38 minutes i.e. more than 60%

- Overall, there are very few large height deviation reports submitted by States in this region

- Significant portion of large height deviation occurrence (5 of 16 occurrences) as well as duration (54 of 63 minutes) is attributable to coordination errors in the ATC-to-ATC transfer of control responsibility as a result of human factors issues (Category E)

3.34 **Table 9** below summarizes the results of the airspace safety oversight as of May 2008 in terms of the technical, operational, and total risks for the RVSM implementation in the BOB airspace.

Bay of Bengal RVSM Airspace – estimated annual flying hours = 1 131 465 hours *(note: estimated hours based on December 2008 traffic sample data)*			
Source of Risk	**Risk Estimation**	**TLS**	**Remarks**
Technical Risk	0.59 x 10^{-9}	2.5 x 10^{-9}	Satisfies Technical TLS
Operational Risk	1.40 x 10^{-9}	-	-
Total Risk	**1.99 x 10^{-9}**	**5.0 x 10^{-9}**	**Satisfies Overall TLS**

Table 9: Risk Estimates for the RVSM Implementation in BOB Airspace – April 2009

3.35 In addition, **Figure 6** below presents the graphical trends of collision risk estimates for each month using the appropriate cumulative 12-months of LHD reports since May 2008.

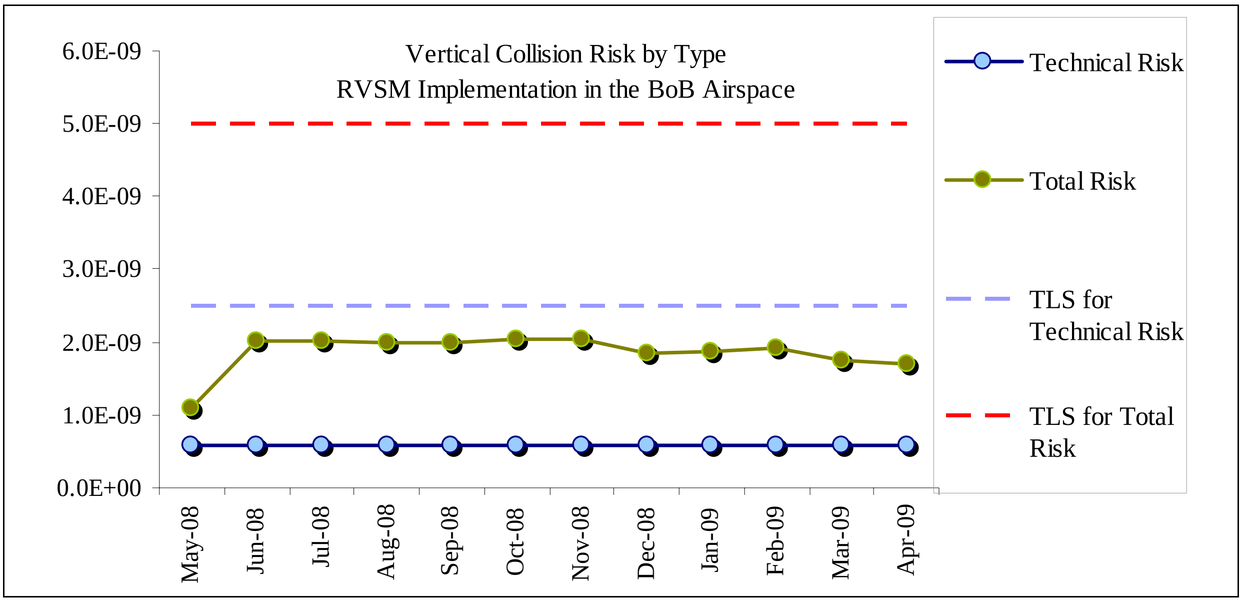

Figure 6: Trends of Risk Estimates for the RVSM Implementation in BOB Airspace – April 2009

3.36 Based on these collision risk estimates, both technical and total risks for the Bay of Bengal area based on the available TSD and LHD reports, 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 due to the loss of a correctly established vertical separation standard of 1,000 ft and to all causes, respectively.

3.37 However, MAAR continued to report that, based on available data from States and RMAs, it could be inferred that Bay of Bengal States may not entirely comprehend the significance and meaning of Large Height Deviation occurrences. The meeting strongly recommended that Bay of Bengal States review the definition and reporting requirements for Large Height Deviations and faithfully provide relevant information to MAAR in order to facilitate a statistically reliable safety assessment for this area.

Western Pacific/South China Sea Airspace

3.38 MAAR also provided a summary of airspace safety oversight for RVSM implementation in the Western Pacific/ South China Sea (WPAC/SCS) area. The RVSM safety oversight had been conducted based on a one-month traffic sample data (TSD) collected in December 2008 and the most recent rolling 12 months of Large Height Deviation (LHD) reports between May 2008 and April 2009 submitted by relevant States in the WPAC/SCS region. LHD data from neighbouring RMAs is also reviewed and used in the analysis where applicable.

3.39 The large height deviation reports are separated by categories based on the details provided for each deviation. **Table 10** below summarizes the number of LHD occurrences by cause of the deviation

LHD Category Code	**LHD Category Description**	**No. of LHD Occurrences**	**LHD Duration (Min)**
B	Flight crew climbing/descending without ATC clearance	1	1
D	ATC system loop error; (e.g. ATC issues incorrect clearance or flight crew misunderstands clearance message)	2	4
E	Coordination errors in the ATC-to-ATC transfer of 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)	67	119
I	Turbulence or other weather related causes	3	3
J	TCAS resolution advisory; flight crew correctly following the resolution Advisory	1	0
M	Other	4	5
Total		**78**	**132**

Table 10: Summary of LHD Causes in the WPAC/SCS RVSM Airspace

3.40 The meeting was informed that annual flight hours, calculated based on the December 2008 TSD, were 917 128 hours for the WPAC/SCS airspace and that LHD occurrences in the WPAC/SCS RVSM airspace could be summarized as follows:

- Compared to the previous 6 monthly assessment, the total LHD duration decreased from 194 minutes to 132 minutes while the number of LHD occurrences reduced from 84 to 78 occurrences

- Average duration of large height deviation occurrence improved from 2.31 minutes to 1.69 minutes

- Significant portion of large height deviation occurrence (67 of 78 occurrences) as well as duration (119 of 132 minutes) is attributable to coordination errors in the ATC-to-ATC transfer of control responsibility as a result of human factors issues (Category E)

3.41 **Table 11** below summarizes the results of the airspace safety oversight, as of April 2009, in terms of the technical, operational, and total risks for the RVSM implementation in the WPAC/SCS airspace.

Western Pacific/South China Sea RVSM Airspace – estimated annual flying hours = 917 128 hours *(note: estimated hours based on December 2008 traffic sample data)*			
Source of Risk	**Risk Estimation**	**TLS**	**Remarks**
Technical Risk	0.77×10^{-9}	2.5×10^{-9}	Satisfies Technical TLS
Operational Risk	3.57×10^{-9}	-	-
Total Risk	$\mathbf{4.34 \times 10^{-9}}$	$\mathbf{5.0 \times 10^{-9}}$	**Satisfies Overall TLS**

Table 11: Risk Estimates for the RVSM Implementation in WPAC/SCS Airspace – April 2009

3.42 In addition, **Figure 7** below presents the trends of collision risk estimates for each month using the appropriate cumulative 12-month of LHD reports since May 2008.

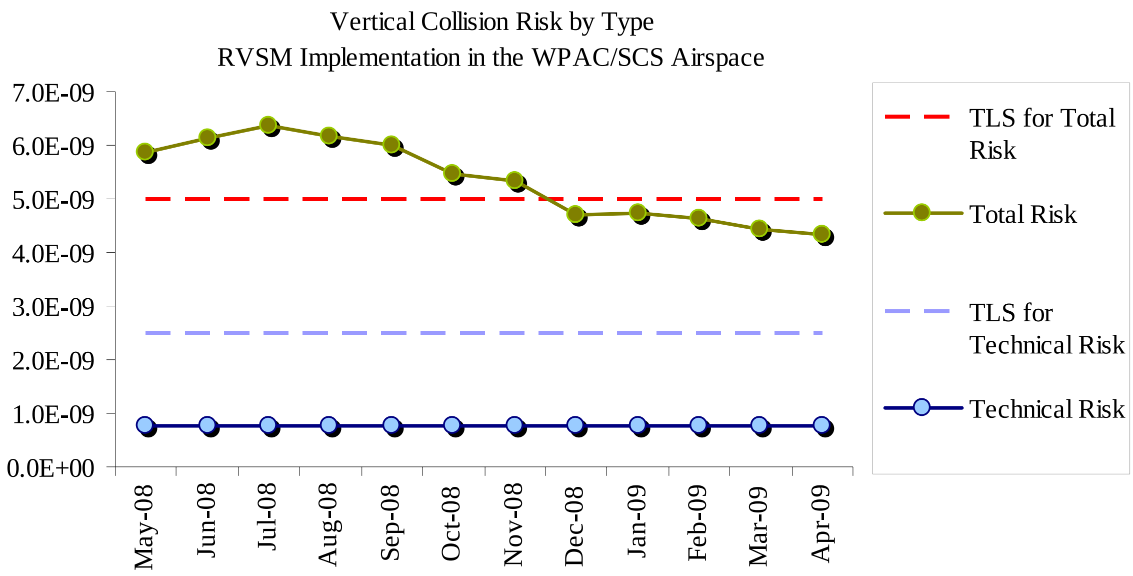

Figure 7: Trends of Risk Estimates for RVSM Implementation in WPAC/SCS Airspace – April 2009

3.43 Based on these collision risk estimates, both technical and total risks for the Bay of Bengal area based on the available TSD and LHD reports, satisfy the agreed TLS value of no more than 2.5×10^{-9} and 5.0×10^{-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, respectively. However, the number of large height deviations related to coordination errors in the ATC-to-ATC transfer of control responsibility as a result of human factors issues remains excessive.

3.44 The meeting noted that the safety assessment confirmed the beneficial trend that had been evident to the WPAC/SCS RSG/6 meeting in April continued to improve, demonstrating that the changes that had been implemented by the WPAC RSG were still taking effect. The meeting considered that this supported the proposal by the WPAC/SCS RSG that the Scrutiny Group be dissolved and residual items be managed by related groups including RASMAG.

3.45 The meeting recognized that in conducting the very intensive work programme that was necessary to address the urgent safety issues, the WPAC/SCS RSG was very reliant upon the vertical safety risk assessments conducted by MAAR in order to objectively demonstrate the improvements in vertical safety performance over time. This required significantly increased attention to detail by MAAR, in order that they could continually collate data received from States, conduct deeper analysis to identify problems and suggest possible mitigations, and undertake the more frequent reporting necessary to properly serve the WPAC/SCS RSG. The workload and responsibility on MAAR was also increased in studying the amended flight level arrangements eventually proposed by the WPAC/SCS RSG. The analysis by MAAR was an important component that supported the safety case for the implementation of revised flight level arrangements throughout the WPAC/SCS area in early July 2008. Accordingly, the meeting highly commended MAAR for their very professional efforts in this regard.

PARMO's RMA activities

3.46 The Pacific Approvals Registry and Monitoring Organization (PARMO) provided an update to the meeting including a summary of large height deviation reports, results of traffic data analysis, and an estimate of vertical risk for the airspaces under their responsibility. The report covers the reporting period from 1 May 2008 through 30 April 2009. The meeting noted that there were forty three reported large height deviations occurring within the Pacific and a portion of North East Asia RVSM airspace during the assessment period.

3.47 Two of these reports were large height deviations that contributed to technical risk. The cause of one deviation was reported to be turbulence or other weather-related causes. The cause of the other deviation was an incorrect setting on the altimeter that led to a deviation from assigned flight level by 400 feet.

3.48 Reports of thirty-three large height deviations contributing to operational risk were provided to the PARMO with twenty three of these events reported for Pacific airspace and ten for a portion of North East Asia airspace.

3.49 Twenty-five of the thirty three events that contribute to operational risk were related to air traffic control, fifteen of which occurred in the Pacific airspace and ten in the portion of North East Asia airspace. The cause of eighteen of the twenty-five events were related to errors in coordination of control between ATC facilities, either due to a lack of coordination or an error in the coordination from one ATC to the next. Eight events related to coordination errors occurred in Pacific airspace, and ten events related to coordination errors occurred in North East Asia airspace. All but one of these eighteen events were related to human factors issues.

3.50 Five events related to air traffic control were ATC loop errors, these errors occurred in Pacific airspace. One of these events led to an LHD duration of 60 minutes. Another event related to air traffic control occurred because the controller misunderstood communication from the crew (via satellite phone), understanding it to be the transitioning ATC relaying a request from the aircraft.

3.51 The coordination errors occur either due to a lack of coordination or an error in the coordination from one ATC to the next. These errors are by far the most common type of errors in both the Pacific and North East Asian airspaces.

Pacific Airspace

3.52 In reviewing the outcomes of the Pacific airspace, the meeting noted that the flying hours in the Pacific areas for which PARMO holds responsibility are estimated to be 840 000 hours per year (excluding Fukuoka FIR flying hours which have now been included with the Fukuoka estimations). The technical risk was estimated to be 0.060 x 10^{-9} fatal accidents per flight hour. The operational risk estimate is 4.584 x 10^{-9} fatal accidents per flight hour. The estimate of the overall vertical collision risk was 4.645 x 10^{-9} fatal accidents per flight hour, a dramatic increase over the last reporting period and attributable to a 60 minute duration LHD during March 2009 in the Central Pacific. Despite this long duration LHD, the risk estimates satisfy the regionally agreed TLS value of 5.0 x 10^{-9} fatal accidents per flight hour. The estimate utilizes the most recent 12 months of large height deviation reporting and recently updated collision risk parameters based on the December 2008 traffic samples collected and is shown in **Table 12** below.

Pacific RVSM Airspace – estimated annual flying hours = 840 000 hours *(note: estimated hours based on December 2008 traffic sample data)*			
Source of Risk	**Risk Estimation**	**TLS**	**Remarks**
Technical Risk	0.060 x 10^{-9}	2.5 x 10^{-9}	Satisfies Technical TLS
Operational Risk	4.584 x 10^{-9}	-	
Total Risk	**4.645 x 10^{-9}**	**5.0 x 10^{-9}**	**Satisfies Overall TLS**

Table 12: Vertical Collision Risk Estimates for Pacific Airspace – April 2009

3.53 **Figure 8** below provides a graphical representation of the updated risk estimates for Pacific RVSM airspace based on the recent 12 months of large height deviations.

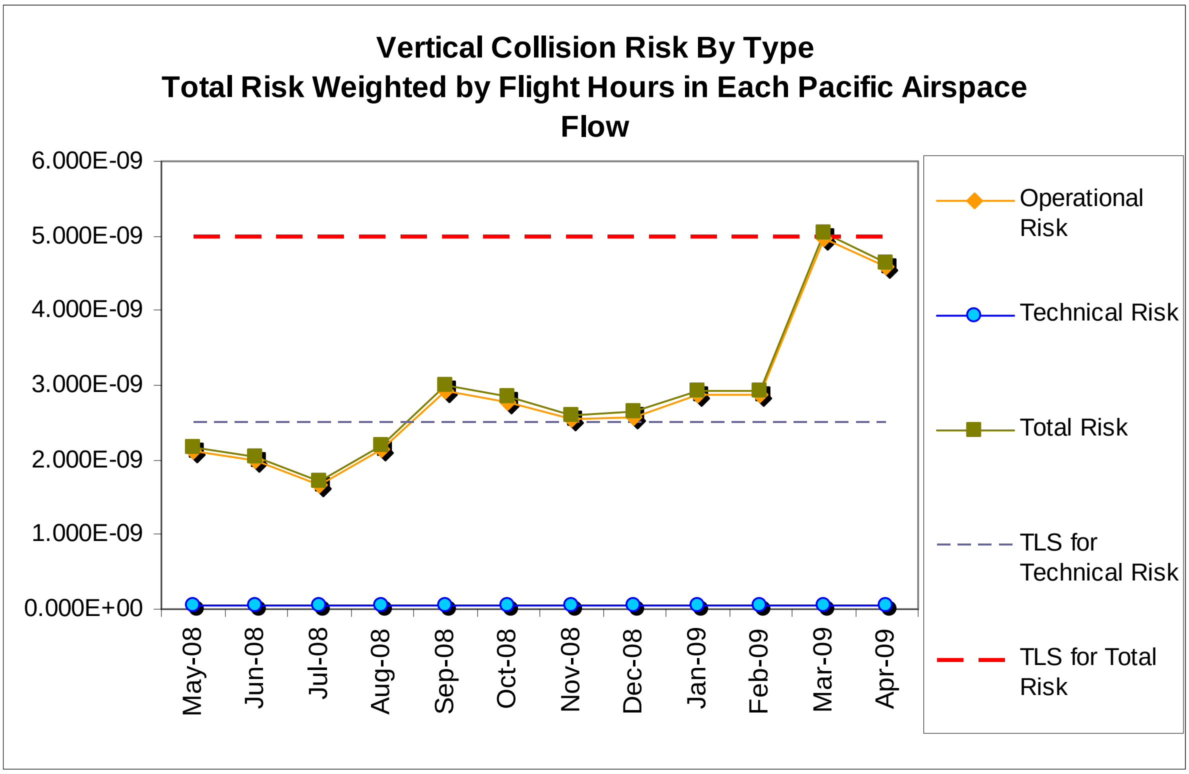

Figure 8: Vertical Collision Risk for Pacific RVSM Airspace – April 2009

North East Asia Airspace

3.54 In the North East Asia airspace the technical risk is estimated to be 0.177.x 10^{-9} fatal accidents per flight hour. The operational risk estimate is 3.105 x 10^{-9} fatal accidents per flight hour. The estimate of the overall vertical collision risk is 3.282 x 10^{-9} fatal accidents per flight hour. This estimate satisfies the regionally agreed TLS value of 5.0 x 10^{-9} fatal accidents per flight hour. In terms of LHD categorization, 100% of LHDs result from errors in ATC unit-to-ATC Unit coordination. This estimate utilizes the most recent 12 months of large height deviation reporting and recently updated collision risk parameters based on the December 2008 traffic samples collected and is shown in **Table 13** below.

Portion of NE Asia RVSM Airspace – estimated annual flying hours = 112 000 hours *(note: estimated hours based on December 2008 traffic sample data)*			
Source of Risk	**Risk Estimation**	**TLS**	**Remarks**
Technical Risk	0.177 x 10^{-9}	2.5 x 10^{-9}	Satisfies Technical TLS
Operational Risk	3.105 x 10^{-9}	-	
Total Risk	**3.282 x 10^{-9}**	**5.0 x 10^{-9}**	**Satisfies Overall TLS**

Table 13: Vertical Collision Risk Estimates for North East Asia Airspace – April 2009

3.55 **Figure 9** below provides a graphical representation of the updated risk estimates for North East Asia RVSM airspace based on the recent 12 months reports of large height deviations.

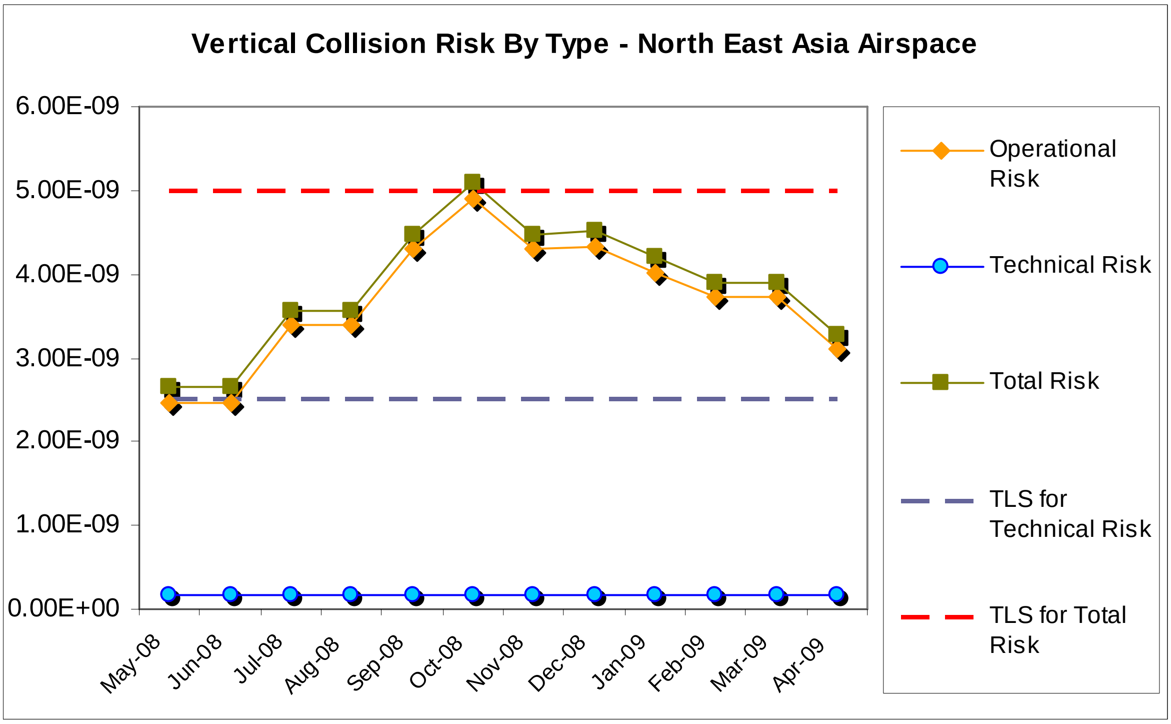

Figure 9: Vertical Collision Risk for North East Asia RVSM Airspace – April 2009

3.56 The meeting thanked the PARMO for the reports provided and for their continuing good work in undertaking RMA activities in Asia/Pacific. In discussing the reports, Australia noted that PARMO assessed a block clearance event as a category M LHD whereas the AAMA assesses such reports as either category A or B. Some discussion took place as to whether it is possible to standardize how these types of incidents are categorized. The meeting agreed that setting a common category for these types of reports would be difficult given the differing environments and incident scenarios, but encouraged using detailed information from the reports to select a category and only use the "M- Other" category as a last resort.

RVSM Non - Approved Operators Using RVSM Airspace

3.57 APANPIRG/19 expressed serious concern in relation to flights that were apparently using RVSM airspace when they did not have the State approvals to do so. In agreeing that this issue ultimately required regulatory intervention, the meeting requested RASMAG to continue its investigations in this regard with the objective of providing a more comprehensive briefing to APANPIRG/20 (2009) in relation to this issue**.**

3.58 In this respect, the United States presented the outcomes of a study by the PARMO of the approval status of aircraft contained in a traffic sample data (TSD) for December 2008 received from all of the FIR's under PARMO responsibility in the Pacific and North East Asia airspace. PARMO found a small number of operators that were not shown as approved when compared to the combined list of RVSM approvals for the period. PARMO recognized that even though the current approvals database was consulted, there are some time lags in showing the approval status from States, meaning that an operator may be approved and flying RVSM but the approval paperwork has not yet been processed and the database updated.

3.59 Therefore, the relevant state authorities have been contacted by PARMO for all 28 of the operator/aircraft type combinations observed (22 commercial operators/aircraft types and 6 aircraft operated under the registration number) during the period to confirm their RVSM approval status. At present, no responses have been received from those authorities and therefore the results are pending. Accordingly, a report was not able to be prepared for APNPIRG 20 and regional RMAs would continue to study the problem and provide feedback to the next meeting, for consolidation and submission to APANPIRG. An item was added to the Task list in this respect.

3.60 The meeting thanked the PARMO for their diligent efforts in leading this matter. The meeting also provided an opportunity to share information on approval status between RMAs and a number of RMAs were able to provide some direct feedback on the identified aircraft during the meeting.

Report from SEASMA

3.61 The South East Asia Safety Monitoring Agency (SEASMA) presented details of their most recent examination of operations on the six major air traffic service routes in South China Sea airspace, conducted in order to determine compliance with Asia and Pacific Region safety goals for the established lateral and longitudinal separation standards. The examination covered the period May 2008 through April 2009 and used analysis techniques developed in conformance with internationally applied collision risk methodology. The risk assessment employed data collected from the ongoing navigational error monitoring programme to analyze navigational performance on the routes and took into account the 2 July 2008 reduction in the lateral and longitudinal separation minima applied to two of the routes, L642 and M771.

3.62 **Table 14** below presents the total traffic counts reported by month transiting all South China Sea monitoring fixes.

Monitoring Month	Total Monthly Traffic Count Reported Over Monitored Fixes	Cumulative 12-Month Count of Traffic Reported Over Monitored Fixes Through Monitoring Month
May 2008	8123	81591
June 2008	7743	83239
July 2008	8423	85383
August 2008	7568	86638
September 2008	7293	87800
October 2008	7673	89029
November 2008	6576	89457
December 2008	6665	89597
January 2009	7244	90880
February 2009	6380	89434
March 2009	7016	88438
April 2009	6603	87307

Table 14: Monthly Count of Monitored Flights Operating on South China Sea RNAV Routes

3.63 SEASMA highlighted that there were two common methods usable for horizontal safety assessments generically termed a sequential sampling method and a direct estimation method, respectively. Both methods adequately demonstrate the safety performance but result in differing graphical presentations, as shown in **Figures 10 and 11** below.

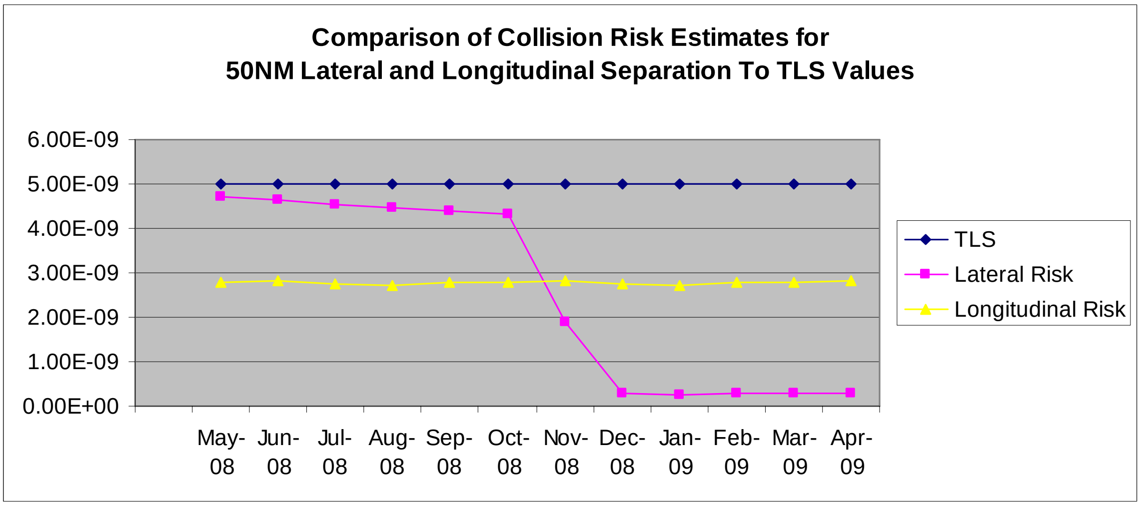

Figure 10: Direct Estimation Method **-** Assessment of Compliance with Lateral and Longitudinal TLS Values Based on Navigational Performance Observed During South China Monitoring Program

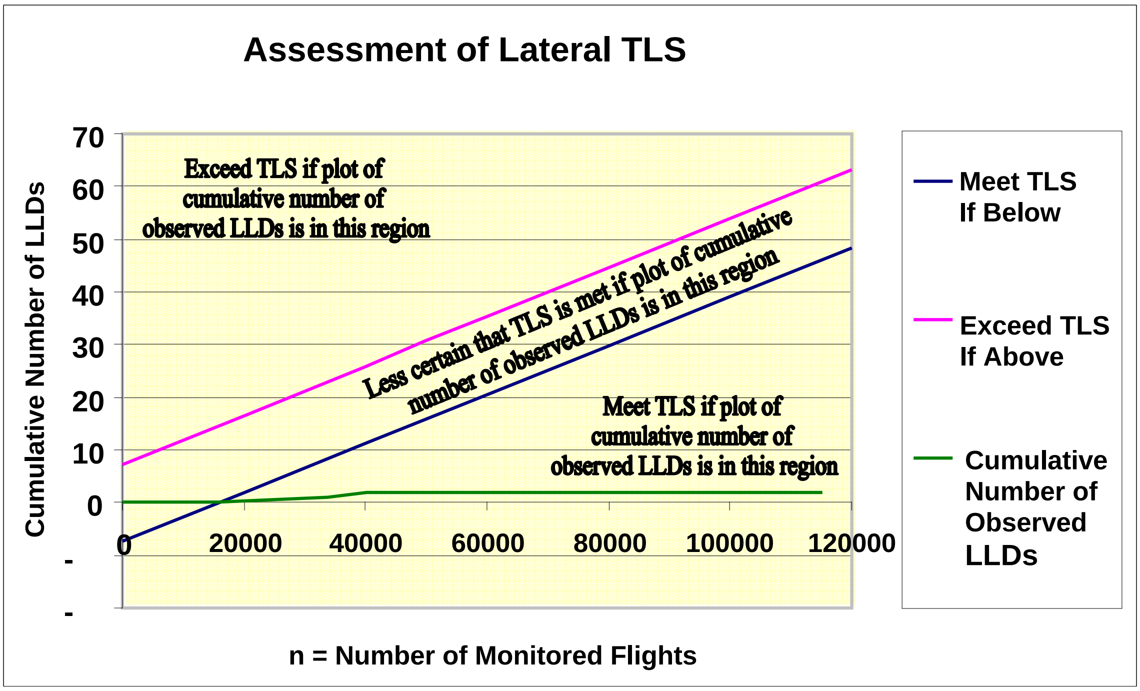

Figure 11: Sequential Sampling Method – Assessment of Compliance with Lateral TLS Based on Cumulative Number of LLDs Observed During South China Monitoring Programme

3.64 After detailed discussion comparing the advantages and disadvantages of the respective methods, the meeting selected the direct assessment method as depicted in **Figure 10** above as the standard presentation for the Asia/Pacific region. The meeting thanked SEASMA for the detailed briefings in this regard and looked forward to further presentations from SEASMA in the direct estimate format.

3.65 Importantly, the meeting noted that both lateral and longitudinal performance on the South China Sea RNAV six-route system are compliant with the regional TLS. The safety assessment also concludes that applying the existing reduced lateral and longitudinal minima used on L642 and M771 to the other four South China Sea routes would also meet established TLS values.

Agenda Item 4: Airspace safety monitoring documentation and regional guidance material

EMA Handbook

4.1 Singapore informed the meeting that subsequent to the work undertaken by RASMAG/10 in developing a mature draft of the EMA Handbook, Singapore had reviewed the document and had drafted some proposed amendments for RASMAG's consideration. The meeting thanked Singapore for the work they had undertaken in developing the amendments, and then reviewed the document in some detail.

4.2 In discussing aspects of the document, the United States queried the effectiveness of collecting PBN approvals data and whether it is a State responsibility to do this. The meeting was informed that there is not a well defined process in this regard and this could generate significant work for a State. Australia supported this view commenting that it saw issues in the timeliness of implementation of PBN in States which means any data of approvals may be disjointed. Importantly implementing PBN was not like RVSM as in the latter all States were required to meet a common approvals and readiness requirement by a certain time, whereas for PBN there does not appear to be the same level of agreed common implementation time frames between States.

4.3 The Secretary agreed with these views and suggested that possibly RASMAG could decide not to progress the EMA approvals data base aspect in the short term. The United States commented that in principle it would appear the meeting did agree with the spirit of the development of the EMA Manual but there would be problems with this particular approvals data base element. The meeting was requested to consider progressing the material as currently drafted and to highlight in its report the issues in regards to obtaining the approvals information. New Zealand stated that as PBN becomes more widely implemented a State will be able to provide approvals information more readily to the EMA and that there is nothing to stop an EMA starting that process now even if it has relatively few data records. Further discussion agreed that possibly changes to the text to reflect in the short term there may not be many approvals to populate an EMA's data base. The meeting agreed to leave the material in the draft but to soften the words to account for the concerns raised and that development of a data base by an EMA is a future activity as States develop PBN approval processes.

4.4 A small drafting group was then established to continue reviewing the document and to develop the new text in relation to the establishment of an approvals data base. This work resulted in a new draft version of the Manual which is detailed at **Appendix C** to this report. The meeting agreed that further review would take place following this meeting, to be completed in sufficient time for the Manual to be presented to APANPIRG for adoption, and that a small review group of RASMAG members will be established by the Secretary to complete this work. The following Conclusion was drafted for consideration by APANPIRG/20:

Draft Conclusion RASMAG/11-2 – Adopt En-route Monitoring Agency Handbook

That, the *Asia/Pacific En-route Monitoring Agency (EMA) Handbook*, as shown in Appendix C to the RASMAG/11 Report, be adopted and circulated as regional guidance material.

Regional Impact Strategy for RVSM Long Term Height Monitoring

4.5 APANPIRG/18 (September 2007) had recognized that the 2010 implementation of Annex 6 global long term monitoring requirements for airframes used in RVSM operations would have significant impacts in the way regional monitoring was managed, including the need for widespread regional height monitoring infrastructure capability to be made available. Under the terms of Conclusion 18/4, APANPIRG tasked Asia/Pacific RMAs in conjunction with RASMAG to prepare a regional impact statement summarizing the estimated consequences for the Region, including consideration of the numbers of airframes required to be monitored and ground infrastructure required.

4.6 Extensive work was conducted by the meeting in preparing such an impact statement, a copy of which is shown at **Appendix D.** The meeting accepted this version as an advanced draft and recognized that much of the work had also been done by RMAs in calculating the numbers of airframes to be monitored by each RMA. The meeting agreed that the current draft would be presented to the ATM/AIS/SAR Sub group in late June for comment. Additionally, a small drafting group comprising RMA representatives, IFALPA and the Secretariat would continue to finalize the draft with the objective of presenting a final version to APANPIRG in September for adoption. RMAs would each take responsibility for filling in the respective appendices with details of the monitoring burden of each RMA. A deadline of 31 July 2009 was established in order to provide time for the Secretariat to compile and circulate a final version and an item was added to the Task List in this regard. The following Conclusion was drafted for consideration by APANPIRG/20:

Draft Conclusion RASMAG/11-3 − RVSM Monitoring Impact Statement

That, the *Asia/Pacific Regional Impact Statement – RVSM Global Long Term Height Monitoring Requirements effective from November 2010,* as shown in Appendix D to the RASMAG/11 Report, be adopted and circulated as regional guidance material.

4.7 In discussing the tables of the monitoring burden developed by RMAs, the meeting considered where RMAs should be placing approvals data and monitoring results for access by other RMAs. The meeting was reminded that all RMAs had access to the FAA managed KSN website that was developed specifically for the global RMAs, and that RASMAG RMAs should use this as a central data warehouse for approvals data. While to date the RMAs agreed they had not been taking full advantage of the website, the meeting agreed that for standardization purposes RMAs will use the KSN for sharing approvals data and recognized the value for using the KSN for height monitoring and ASE data once a format/template is agreed.

RASMAG List of Competent Airspace Safety Monitoring Organizations

4.8 The meeting updated the *"RASMAG List of Competent Airspace Safety Monitoring Organizations"* (shown at **Appendix E**) for use by States requiring airspace safety monitoring services.

Agenda Item 5: Airspace safety monitoring activities/requirements in the Asia/Pacific Region

Asia/Pacific RVSM Minimum Monitoring Requirements (MMRs)

5.1 The China RMA highlighted to RASMAG/10 that they had been observing increased presence of aircraft type ERJ190 (EMB190) in their data. This type was a sophisticated 100+ seat twin jet manufactured by Embraer of Brazil, approximately similar to the B737/A320. RASMAG/10 agreed that there was a need to undertake further study in order to clarify which MMR monitoring category was applicable to this aircraft type.

5.2 The United States presented the results of a study examining the ASE performance of the Embraer E170 and E190 aircraft types. Using information made available from the aircraft manufacturer, empirical data made available from the European RMA and empirical data made available from the North American Approvals Registry and Monitoring Organization, the study compared the various data against RVSM performance requirements. First, the manufacturer presented materials that showed that both the E170 and E190 aircraft types were designed and built with similar characteristics so that the expected ASE performance would be the same.

5.3 Next ASE empirical data were obtained from the European RMA and were examined to ascertain whether the recommendation of the manufacturer was valid. Those summary results showed good agreement when comparing performance via mean and standard deviation estimates. With the North American RMA data, a more extensive analysis was accomplished. In agreement with the results obtained using European data, the ASE performance showed good statistical consistency and compatible results.

5.4 The meeting agreed that there is sufficient statistical evidence that both the E170/175 aircraft and the E190/195 aircraft have ASE performance data that can be combined into one group for the purpose of measuring height keeping performance. Further, a sufficiently large sample of data has been collected to render a stable set of estimates for the group and the estimates for mean and standard deviation for the group are well within ASE performance requirements. Accordingly, the meeting agreed to include the group [E170, E190] incorporating the E170/175 and E190/195 in Category 1 of the Asia/Pacific MMRs.

5.5 When considering the monitoring category for the Airbus 380 (A388), the meeting recognized that because the aircraft was new in service, very little monitoring data was available. This situation would improve quickly as the A388 was now regularly in Europe and would be monitored by the HMU facilities there. Although it was expected that this data would result in the A388 and derivatives being considered as a group for monitoring purposes, the absence of data did not yet enable this decision to be made. Accordingly, the A388 was included in the Category 2 of the Asia/Pacific MMRs and would be reviewed as data became available. A copy of the updated Asia Pacific MMRs has been included as **Appendix F.**

China RMA support to DPRK RVSM implementation

5.6 The meeting recalled the intention of the Democratic People's Republic of Korea (DPRK) to implement RVSM in the Pyongyang FIR during 2009. Subsequently, in coordination with the Regional Office DPRK had adopted the October 2009 AIRAC as the target date for implementation and the implementation would be based on Annex 2 metric flight level arrangements.

5.7 China updated the meeting, confirming their willingness to assist DPRK with implementation of RVSM, including provision by China RMA of safety assessment and monitoring services for the 2009 implementation. A key event in the cooperative program would be an examination of the readiness and safety assessments conducted by China RMA and a technical training as to the roles and functions of an RMA and safety assessments. Representatives from General Administration of Civil Aviation (GACA) of DPR Korea spent the week of 20 April meeting with counterparts from the Air Traffic Management Bureau (ATMB) of the Civil Aviation Administration of China to have a China-DPRK Coordination meeting for the RVSM implementation in Pyongyang FIR. Review of the readiness and safety assessments and technical training as to the roles and functions of an RMA and safety assessments was conducted by the China RMA with the directors from ATC and AIS Division of GACA.

5.8 Prior to their arrival in Beijing, the GACA team sent to China RMA a December 2008 traffic sample covering Pyongyang FIR operations within the general altitude band planned for RVSM application, the large height deviation (LHD) reports from 1 Sep 2007 to 28 Feb 2009, the RVSM approval data for DPRK's domestic airlines effective as April 2009 and the structure of airspace in Pyongyang FIR.

5.9 China and DPRK agreed that they would sign an updated ATS operational Letter of Agreement (LOA) in Pyongyang later this year. Two groups, each of up to ten air traffic controllers from DPR Korea will travel to China and receive RVSM training in August and September this year, in preparation for the October 2009 implementation.

5.10 The China RMA has completed a comprehensive pre-implementation safety assessment for the RVSM implementation in the Pyongyang FIR (**Appendix G** refers). The safety assessment demonstrates that, based on the collected TSD and State RVSM approval data China RMA received, more than 98.88% of the aircraft operations in Pyongyang FIR where RVSM is to be implemented have been conducted by RVSM airworthiness approved aircraft and 98.88% by fully RVSM approved operators and aircraft.

5.11 Based on the collected TSD and LHD reports, the technical risk estimate is 5.62×10^{-10}, and the overall risk is 1.66×10^{-9}. Both of them were found to satisfy the agreed TLS value of no more than 2.5×10^{-9} and 5.0×10^{-9} fatal accidents per flight hour due to the loss of a correctly established vertical separation standard of 300m (1,000ft) and to all causes, respectively. In addition, the report also defines the risk estimate for ATS route B467 which is the busiest route in Pyongyang FIR. It is found that technical risk is 7.40×10^{-10} and the overall risk is 2.29×10^{-9} fatal accidents per flight hour, which also satisfy the regional TLS.

5.12 The meeting highly commended the China RMA for the diligent and professional support for the DPRK implementation. With the excellent assistance from China, the work programme was proceeding smoothly and planning was well in hand to meet the October implementation date. The pre-implementation safety assessment was in the format and of the standard required by RASMAG and demonstrated the strong expectation that the regional target level of safety would be met during implementation.

Pyongyang FIR to China RMA

5.13 The meeting recalled that the MAAR was presently assigned responsibility for the Pyongyang FIR. Agreement had been reached during RASMAG/10 that the China RMA would undertake the pre-implementation safety assessment with assistance from MAAR and this work was advanced.

5.14 In relation to the future RMA responsibility for the Pyongyang FIR the meeting learned that DPRK had made a request to China that the China RMA take over all future RMA responsibility. The China RMA and MAAR were in agreement that the Pyongyang FIR should transfer to the China RMA and the meeting was pleased to endorse these arrangements. Accordingly, amendments were made to the RASMAG List of Competent Agencies and China would include this information in a summary paper to either the ATM/AIS/SAR Sub Group for APANPIRG meetings later this year. The meeting expressed its gratitude to the China RMA for their very proactive role in these matters.

China RMA – Progress in LTHM Arrangements

5.15 The China RMA has continued efforts to provide height keeping performance monitoring to the Chinese domestic airlines using Enhanced GPS monitoring units (EGMU) and has also started researching the feasibility of installing ground-based height monitoring capability. During a one-week training in January 2009, FAA specialists gave a comprehensive introduction about ground-based monitoring techniques, including guidance and requirements for RVSM Altimetry System Error (ASE) monitoring, aircraft sampling requirements/suggestions for monitoring systems, review of existing operational ground-based monitoring systems, and a detailed description about important aspects of Aircraft Geometric Height Measurement Element (AGHME) design.

5.16 In addressing the monitoring burden under their responsibility the China RMA has provided aircraft height keeping performance monitoring service to up to 11 different domestic operators, with a total of twenty five airframes being monitored. However, this is behind the schedule the China RMA established last year and arises because it takes a much longer time than anticipated to educate airspace users as to the roles and functions of an RMA and coordinate with the domestic operators about the importance and necessity of long term monitoring. In May this year, the CAAC published a new regulation to smooth and clarify the work flow and responsibilities concerning RVSM data collection and aircraft height keeping performance monitoring and this is expected to benefit the progress of long term monitoring in the airspace of China.

Changes to Traffic Sample Data requirements

5.17 Singapore presented WP/11 in which they identified various data elements that would be of assistance to an EMA if they were provided in the annual TSD provided by States. The meeting was informed that as an EMA needs to take necessary action to determine the likely cause of horizontal-plane deviations and to verify the approval status of the relevant operator, a check would need to be made of PBN approval records. As a result Singapore suggested that the availability of aircraft registration information in the annual TSD would facilitate the EMA in airspace monitoring functions. Additionally, Singapore commented that experience in developing the safety assessment for the South China Sea implementation of 50/50 separation revealed that the inclusion of Mach Numbers in the TSD both at the entry and exit fixes will facilitate longitudinal risk assessment.

5.18 The meeting was also informed that the type of horizontal plane separation applicable depends on the airspace in consideration and the PBN Approval Type of aircraft operating within that airspace. To facilitate an EMA in airspace monitoring, the aircraft PBN approval type(s) should also be included in the TSD. Singapore commented that another advantage of having the PBN approval types in the TSD is that it will provide advance information on the percentage of aircraft capable of higher navigation performance. This would assist in assessing fleet readiness when considering upgrade of PBN operation in that airspace.

5.19 The meeting thanked Singapore for the paper and discussed each of the proposed inclusions in the TSD in detail. In relation to the proposal to include aircraft registration, the meeting agreed that this should be requested as part of the TSD. The Chairman pointed out that RASMAG/10 had decided to include PBN approval in the TSD and that a new template was to be developed. The United States queried the process for obtaining this data suggesting it might be difficult for some States to comply, however Singapore believed this would be possible by sourcing directly from airlines. The Secretary reminded the meeting that the new ICAO flight plan format would make collection of PBN approvals data much more efficient. The United States commented that States should be encouraged to make the PBN approval information available in the TSD if possible to do so, however the United States would be unable to comply at the present time. The Chairman proposed that States should be asked to provide the information in the TSD if possible to source it from flight plans and that the report of the meeting should recognize that the new flight plan will make provision of the information more efficient.

5.20 With regard to the proposal to include Mach number in the TSD, the Secretary clarified that was being proposed was for the Mach number at the point of entry and exit be collected and as such the meeting should not underestimate the magnitude of the task. The Chairman suggested that this would pose difficulties for States in practical terms, particular those States without automated flight data processing systems. The United States supported this and commented that it was unlikely that they could provide that information for a number of years. In considering this issue further, the meeting agreed that this particular proposal would not be proceeded with.

5.21 The meeting agreed that to obtain the aircraft registration and PBN approval data, the TSD template should be amended to include two extra columns. A small drafting group was formed to complete this task and the new template is included at **Appendix H** for reference by Asia/Pacific RMAs and an item was included in the Task List.

Consideration of Regional PBN Approvals Data Base

5.22 Singapore informed the meeting that the draft EMA Handbook describes the need to establish and maintain a database of operational approvals specific to the horizontal-plane separation applied in the EMA's area of responsibility. They noted however that currently there is no common PBN Approvals database available to EMAs and considered that having a common PBN approvals database would prevent duplication and make data retrieval and verification easier. Hence Singapore proposed the establishment of a Regional data base that the SEASMA would manage on behalf of the EMAs.

5.23 There was significant discussion regarding the proposal from Singapore with the United States querying in the case of aircraft with multiple approvals, which approval would be reported? Additionally the United States commented that providing data on that State's commercial fleet should be relatively easy to accomplish, however the General Aviation fleet was a more difficult aspect to resolve. As a result the United States was not in a position to provide the information for a Regional data base for the time being. Australia agreed with this view, suggesting that the proposal may need further consideration by States to identify processes to enable efficient provision of the information, noting that the proposal for a Regional data base was something that RASMAG should work towards in the longer term. The meeting agreed not to pursue the Regional data base at the present time but for States to be requested to consider the proposal and how to best provide data for inclusion when it is established.

Japan – Progress towards EMA capability

5.24 As well as providing RMA services for the Fukuoka FIR, JCAB continues initiatives towards implementing horizontal monitoring capabilities. Japan's intention is to establish an EMA in accordance with the process described in EMA Handbook presently being prepared by RASMAG and is awaiting the adoption of the Handbook by APANPIRG. As a result of the delays in finalising the Handbook, Japan has rescheduled planning for EMA and expects to establish EMA capabilities in late 2009.

5.25 In the meantime, JCAB has established a database of aircraft approved by the State authorities for PBN operations and preparation of procedures for the collection of LLE (Large Longitudinal Error) has commenced. Additionally, Japan has already conducted safety assessments for the implementation of RNP-10 based lateral and longitudinal separation reduction (50 NM/50 NM) using ADS/CPDLC in the oceanic airspace on June 2006, and RNP-4 based longitudinal separation reduction (30 NM) using ADS/CPDLC in the oceanic airspace of the Fukuoka FIR on August 2008. JCAB also extended their appreciation to SEASMA for accepting a visit by JCAB in March 2009 to discuss EMA activities and procedures for horizontal plane safety assessment.

5.26 Japan introduced the Japanese Electronic Navigation Research Institute (ENRI: http://www.enri.go.jp/eng/index_e.htm), which has been participating in ICAO Separation and Airspace Safety Panel (SASP), is the co-author of the safety assessments conducted by JCAB. ENRI is responsible for research and development in the field of electronic navigation in Japan and their research activities cover the basic technologies of avionics such as electronic navigation, air traffic control and satellite navigation. Studies on the Safety Assessment Methodology of Airspace is one of the ENRI activities, recent outcomes are available at (http://www.enri.go.jp/eng/research/kenkyu/airspace_01.htm).

Agenda Item 6: Regional RVSM Safety Metric

Regional Safety Performance Objective and Metric

6.1 The meeting recalled that, as the ICAO planning objective is to achieve a performance based global air traffic management (ATM) system through the implementation of air navigation systems and procedures in a progressive, cost-effective and cooperative manner, APANPIRG had adopted Conclusion 19/1 calling for a regional performance framework to be established.

6.2 Accordingly, the meeting prepared a safety related Asia Pacific Regional Performance Objective and associated performance framework form (see **Appendix I**) that was applicable to the activities of RASMAG, adopting the following draft Conclusion for consideration by APANPIRG:

Draft Conclusion RASMAG/11-3 – Asia Pacific Regional Performance Objective - Airspace Safety Monitoring

That, the Asia Pacific Regional Performance Objective and associated performance framework form on airspace safety monitoring as contained in **Appendix I** to the RASMAG/11 Report be adopted in the current work programme for APANPIRG and its Sub Groups.

6.3 Noting the importance of measurable outcomes and metrics to the performance based approach, as described in the Global ATM Operational Concept and the Manual on Performance of the Global Air Navigation System, the meeting recognised that a suitable metric was necessary to measure aspects of regional airspace safety performance. Accordingly, the meeting adopted the following draft Conclusion for consideration by APANPIRG:

Draft Conclusion RASMAG/11-4 − Safety Metric

That, the following metric be adopted as an air navigation system indicator for the Asia and Pacific region:

> **Safety-1**: Percentage of RMA sub-regions meeting the regional Target Level of Safety (TLS) for RVSM operations, referenced as of end April each year.

Agenda Item 7: Review and update RASMAG Task List

7.1 The meeting agreed that the updated task list included as **Appendix J** accurately reflected the work programme of RASMAG.

Agenda Item 8: Any other business

Japan and the Republic of Korea - AIDC Operational Trial

8.1 Japan informed the meeting that Japan and the Republic of Korea had been preparing for the implementation of the AIDC operation for a few years. Effective from 1500 UTC on 13 May 2009, Fukuoka/Naha/Tokyo ACC and Incheon ACC commenced operational trials of AIDC.

8.2 A phased implementation process was adopted, as follows:

- Phase 1:From 13 May to 19 May 2009 1500 – 1800 UTC daily (Night time 3 hours)
- Phase 2:From 20 May to 03 June 2009 1100 – 1900 UTC daily (Night time 8 hours)
- Phase 3:From 04 June to 09 June 2009 0000 – 0800 UTC daily (Day time 8 hours)
- Phase 4:From 1500UTC 15 June 2009 to TBD 24 hours daily

8.3 Japan was of the view that AIDC operation would reduce the controllers' workload and transfer errors, increasing safety and capability. Japan and Republic of Korea would review the results of the operational trial and take steps towards a permanent implementation.

8.4 The use of AIDC had long been advocated by RASMAG as a way of reducing ATC Unit-to-ATC Unit coordination errors and the meeting congratulated both States on this implementation. RASMAG looked forward to the reporting from Japan in relation to the 'before' and 'after' instances of LHD and was hopeful that data from this implementation would demonstrate a marked reduction in ATC coordination errors and resultant LHDs.

United States - Operational Trial of ADS- B In-Trail Procedures

8.5 The United States provided an in-depth update on planning by the FAA to conduct an operational trial of ADS-B In-Trail Procedures (ITP) in the South Pacific. For ADS-B ITP, the maneuvering aircraft obtains the flight identification on proximate ADS-B equipped non-maneuvering aircraft using ADS-B IN technologies. Based on the ADS-B data from the non-maneuvering or reference aircraft, a pilot can make an ITP altitude change request to ATC. The controller, who maintains separation responsibility at all times can then approve the manoeuvre. The planned trial will be undertaken with United Airlines B747 aircraft and will be closely monitored and supervised by the FAA. One safety activity will be to identify any additional hazards that were not identified in the safety work in the lead up to the trial itself.

8.6 One of the more significant ADS-B ITP developmental activities has been the work that was undertaken by the ICAO Separation and Airspace Safety Panel (SASP) beginning at the tenth meeting of the SASP Working Group of the Whole (WG/WHL/10) held in Australia in November 2006. The SASP agreed that there was a need to develop procedures and material for inclusion in Doc 4444 PANS-ATM in addition to work being undertaken concurrently to establish the separation minima by collision risk modeling. To this end, the longitudinal subgroup of SASP has developed a PANS-ATM amendment with the intent that these provisions will set the requirements for the implementation of ADS-B ITP by Regions or States.

8.7 The mathematicians' subgroup of SASP supported this work by conducting collision risk modeling of the procedure. The results of this work can be found in the final draft of the recently completed ADS-B ITP Circular approved by SASP. This circular will be promulgated shortly and contains the proposed PANS-ATM amendment, an overview of all the work done to date including a list of appropriate supporting working papers and some examples of proposed Control Pilot Data Link Communications (CPDLC) message sets.

8.8 Additional supporting ADS-B ITP activity is being undertaken by the RTCA/European Organization for Civil Aviation Equipment (EUROCAE)-sponsored Requirements Focus Group (RFG). The RFG was established to perform coordinated requirements determination and interoperability for early implementation of ADS-B/ASAS applications. ADS-B ITP was one of the early applications the RFG chose to focus on.

8.9 During 2008 both RTCA and EUROCAE approved and published safety, performance and interoperability requirements documents for ITP. The documents are the DO-3122 and ED-1593, respectively and contain an Operational and Service Environment Description (OSED), an Operational Safety Assessment (OSA), an Operational Performance Assessment (OPA) and a collision risk model for ADS-B ITP. It is important to note that the RFG's terminology for ADS-B ITP is Air Traffic Situational Awareness – In-Trial Procedures (ATSA-ITP). The DO-312 or ED-159 provide more details of the procedure and the standards developed by RTCA and EUROCAE.

8.10 The meeting, led by IFALPA, probed operational issues, safety, and harmonization. Specific issues raised were as follows:

> *Has there been any work done in sharing this development with the Next Gen/Sesar projects*?
>
> The United States commented that the ITP has been the lead test case in this regard. The CRISTAL effort in Europe has worked off the same documentation from RTCA/Eurocae. The goal was to have the same standards globally so that any future projects would align to those standards. Aircraft system manufacturers have stated they want the system requirements to be standardized globally so that they will be the same as envisaged for future self-spacing applications.

In relation to the climb requirements for the procedure, wind can be quite critical and models are used to enable crews to make those decisions. The wind can change significantly over short vertical distances and therefore there are decisions to be made as whether to climb or descend at specified times or not. Has the modeling account for wind changes?

The United States commented that this is believed to be the first separation standard where wind models have been specifically taken into account and so to resolve some of these issues the standard introduces a Mach check.

Was temperature change also taken into account in the modeling because of its correlation with Mach?

The United States noted that it has been included in the modelling.

In terms of ADS-in, IFALPA commented that this has been on their 'wish list' for a significant time and they are very supportive to see it being implemented on the flight deck.

In terms of the other passive aircraft being uninvolved in the procedure and hence possibly unaware of the climbing aircraft, IFALPA suggested that pilots should be aware of the standard that is being used. There could be some concern among crews if they see an aircraft climbing up through its level in relatively close proximity and less than normally applied standard separation.

The United States agreed that possibly there may be a need to provide advice to passive aircraft and that this would be reviewed for the trial.

There was discussion that reduction in use of contingency fuel is a major expected outcome, however IFALPA noted that most flight plans will include optimum climbs and altitudes and that the normal flight plan fuel is based on achieving these and certain performance. Therefore IFALPA suggested that possibly the stated goal should actually be to ensure that the normal planned fuel can be achieved without the need to change the contingency fuel requirements.

The United States commented that they agreed noting that the intent is for the overlying contingency ('Captain add' fuel) to be better managed. There is no intent to change the legally required fuel for contingency.

In relation to application of the procedure in a mixed capability environment, would a non-participating aircraft without ADS-B-IN be given less priority for flight levels or be moved to accommodate an ITP participating aircraft?

The United States commented that non-participating aircraft should not be penalized, however at some point in time, preference for performance based navigation will possibly set new prioritization rules in airspace.

8.11 Strong support for the concept was expressed by the meeting and the FAA was encouraged to proceed with the operational trial. Although noting that the safety responsibilities were being borne by bodies other than RASMAG, including SASP, RTCA and EUROCAE, the RASMAG would appreciate being kept informed of the progress of the trial and any safety issues arising.

United States - Development of ADS- C In-Trail Procedures

8.12 In a similar vein, the United States updated the meeting about FAA planning for an operational trial of Automatic Dependent Surveillance–Contract (ADS-C) In-Trail Procedures (ITP) in the Pacific. An overview was provided of initiatives to assess the use of ADS-C to allow for a reduction below RNP 4 based 30 NM longitudinal separation for properly equipped aircraft (RNP-4, CPDLC, ADS-C, GNSS) that will climbed/descend through blocking traffic. The current target longitudinal standard being assessed is 16 nautical miles and distance measurement will be carried out by requesting near simultaneous periodic ADS-C reports.

8.13 The United States reported that throughout the procedure, responsibility for ensuring required separation remains with the air traffic controller. Controller procedures have already been developed; however, at this time they are somewhat cumbersome in that they require several manual inputs by the controllers. If the demonstrations prove successful, it is the intent of the FAA to automate the controller procedures

8.14 The FAA has prepared a safety model which is currently being internally reviewed. A safety hazard analysis has been completed and all identified risks were in the 'Low' category. The FAA will continue to apply best SMS practices throughout the demonstrations to identify any previously unforeseen hazards. The FAA will also collect metrics as to what actual benefits are observed. As part of the analysis of the benefits of this procedure, a business case was conducted to assess benefits for both the service provider and the user. The results of the business case indicated that all parties would benefit through economic and environmental benefits.

8.15 The meeting also expressed strong support for the ADS-C initiative and requested that RASMAG be kept fully informed of the progress of the trial and any further developments.

ISPACG CRA Data Link Analysis

8.16 New Zealand reminded the meeting that one of the tasks of the RASMAG is "to review the safety monitoring programmes in the Asia and Pacific Regions for implementation and operation of aircraft separation applications using data link".

8.17 This type of monitoring work is undertaken by the Central Reporting Agencies (CRAs) of the Asia Pacific Region. However, to date, very little formal reporting has been made available to the RASMAG. In this respect the CRA of the Informal South Pacific ATS Coordinating Group, the ISPACG CRA, has now published a collection of data link monitoring data summaries on its website at http://www.ispacg-cra.com/performance.asp

8.18 The information is presented by aircraft type and by operator (all data is de-identified), and provides a useful overview of data link performance in the South Pacific. These data include:

- CPDLC Performance
- Actual Communications Technical Performance (ACTP)
- Actual Communications Performance (ACP)
- Flight Crew Response
- ADS-C Performance

Agenda Item 9: Date and venue of the next RASMAG meeting

9.1 The meeting again acknowledged the value of the RMA technical meeting being the first day of each RASMAG meeting, specifically as this enabled Asia/Pacific RMAs to deal with a range of issues on a face-to-face basis. The meeting agreed that RASMAG/12 would retain this format. With regards to the scheduling of the next meeting, it was agreed that RASMAG/12 would be held from 14-18 December 2009, at the Regional Office premises.

9.2 The Secretariat would make appropriate arrangements and issue meeting invitations in due course that noted that the first day was set aside for the combined RMAs technical meeting.

10. Closing of the meeting

10.1 The Chairman, Mr. Butcher, thanked the meeting participants for their significant work during a busy meeting program. He noted that the meeting had managed to finalize a number of significant tasks including the EMA Handbook, the Long Term Height Monitoring Impact Statement and agreement on a suitable safety performance metric for the Region. He acknowledged the excellent work undertaken by the RMAs and that of the SEASMA and commented that it was pleasing to see that nearly all the monitored airspaces were meeting the TLS or had trends showing declining risk values.

List of Participants

	Name	Title/Organization	TEL/FAX/E-MAIL
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LIST OF INFORMATION AND WORKING PAPERS

WORKING PAPERS

NUMBER	AGENDA	TITLE	PRESENTED BY
WP/1	1	Provisional Agenda	Secretariat
WP/2	5	Safety Assessment of RVSM within the Australian Flight Information Regions *(Restricted)*	Australia
WP/3	2	The Sixth Meeting of the Western Pacific/South China Sea RVSM Scrutiny Group	Secretariat
WP/4	5	Performance-Based Approach Identification of Regional Performance Objective and Measurement	Secretariat
WP/5	3	Progress of Long Term Height Monitoring of China RVSM Airspace *(Restricted)*	China RMA
WP/6	3	Safety Monitoring Report from China Regional Monitoring Agency, May 2008 – April 2009 *(Restricted)*	China RMA
WP/7	7	Review of RASMAG Task List	Secretariat
WP/8	2	Outcomes from recent BBACG and SEACG Meetings	Secretariat
WP/9	4	Review of RASMAG List of Competent Airspace Safety Monitoring Organizations	Secretariat
WP/10	4	Draft Regional Impact Strategy for RVSM LTHM	Asia/Pacific RMAs & Secretariat
WP/11	5	Inclusion of Aircraft Registration, Mach Number and Performance Based Navigation Approvals in Traffic Sample Data (TSD)	Singapore
WP/12	5	Setting Up of a Regional PBN Approval Database	Singapore
WP/13	4	Proposed Changes to Draft EMA Handbook	Singapore
WP/14	8	Potential for Automatic Dependent Surveillance – Broadcast (ADS-B) In-Trail Procedures (ITP) Operational Flight Evaluation	United States
WP/15	3	Safety Monitoring Report from the Pacific Approvals Registry and Monitoring Organization May 2008 – April 2009 *(Restricted)*	PARMO
WP/16	4	The Pacific Approvals Registry and Monitoring Organization (PARMO) Assessment of the Monitoring Responsibility Associated with the Long-Term Height Monitoring Requirements	PARMO
WP/17	3	Assessment of Non-State-Approved Operators Using Pacific RVSM Airspace	PARMO
WP/18	8	Status of the Development and Implementation ADS-C-In-Trail Procedures	United States

NUMBER	AGENDA	TITLE	PRESENTED BY
WP/19	4	Regional Impact on the Effects of Global Long Term Height Monitoring Requirements	MAAR
WP/20	3	Summary of the Airspace Safety Review for the RVSM Operation in Asia Region *(Restricted)*	MAAR
WP/21	3	Safety Assessment of RVSM within the Indonesian Flight Information Regions *(Restricted)*	Australia
WP/22	3	Safety Assessment of RVSM within the Fukuoka Flight Information Region *(Restricted)*	Japan
WP/23	5	Reschedule of Establishment of Enroute Monitoring Agency (EMA) by Japan	Japan
WP/24	5	Summary of Altimetry System Error Data Estimated for Aircraft Type ERJ190	United States
WP/25	3	Report from the South East Asia Safety Monitoring Agency May 2008 – April 2009	Singapore

INFORMATION PAPERS

NUMBER	AGENDA	TITLE	PRESENTED BY
IP/1	-	List of Working Papers (WPs) and Information Papers (IPs)	Secretariat
IP/2	2	PBN/TF/4 Review of RASMAG Proposals on Interim Edition of Regional PBN Implementation Plan	Secretariat
IP/3	3	Treatment of Flight Levels Crossed in the Assessment of Vertical Collision Risk	United States
IP/4	5	Outcome of China RMA Review of Readiness and Safety Assessments conducted in support of Implementation for the Reduced Vertical Separation in Pyongyang Flight Information Region *(Restricted)*	China RMA
IP/5	5	Datalink Performance Monitoring Results	New Zealand

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NUMBER	AGENDA	TITLE	PRESENTED BY
1	2	Outcomes from RASMAG 10 PBN Safety Assessment & Monitoring Requirements	Secretariat

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REGIONAL AIRSPACE SAFETY MONITORING ADVISORY GROUP

ASIA/PACIFIC

EN-ROUTE MONITORING AGENCY (EMA)

HANDBOOK

VERSION 1.3

FOREWORD

The Regional Airspace Safety Monitoring Advisory Group (RASMAG) was established during 2004 by the Asia Pacific Air Navigation Planning and Implementation Regional Group (APANPIRG) to achieve a regional approach for coordination and harmonization of airspace safety monitoring activities, and to provide assistance to States in this respect. The RASMAG noted that requirements for monitoring aircraft height-keeping performance and the safety of reduced vertical separation minimum (RVSM) operations had been more comprehensively developed than had requirements for monitoring other air traffic management (ATM) services, such as reduced horizontal separation based on performance based navigation (PBN), or for monitoring of air traffic services (ATS) data link systems. For RVSM, a handbook with detailed guidance on the requirements for establishing and operating Regional Monitoring Agencies (RMA) had been developed by the ICAO Separation and Airspace Safety Panel (SASP), with the intent that the handbook be applied globally. There was no comparable global document under development by ICAO for the continued safe use of a horizontal-plane separation minimum where PBN is applied.

ICAO provisions require that the implementation of specified reduced separation minima, e.g. 50-NM lateral separation based on PBN RNAV 10, 50-NM longitudinal separation based on PBN RNAV 10 and Direct Pilot Controller Communication (DCPC), and 30 NM lateral and longitudinal separation based on Automatic Dependent Surveillance (ADS), Controller Pilot Data Link Communication (CPDLC) and PBN RNP 4, must first meet safety management system requirements and undergo a safety assessment based on collision risk modelling to confirm that the regionally established target level of safety (TLS) has been met for the airspace. Additionally, periodic safety reviews must be performed in order to permit continued operations. To date, the performance of safety assessments and continued monitoring for reduced horizontal separation minima had been carried out by a few specialized teams made up of technical experts and contractors supporting States within the region.

Under Decision 16/1, APANPIRG had adopted the term Safety Monitoring Agency (SMA) to mean an organization approved by regional agreement to provide airspace safety monitoring and implementation services for international airspace in the Asia/Pacific region for implementation and operation of reduced horizontal separation. Reference to the term SMA was subsequently amended by RASMAG and adopted by APANPIRG (Decision 20/XX) to En-route Monitoring Agency (EMA). The RASMAG agreed that there was a need to develop a handbook aimed at standardizing the principles and practices of such EMAs, in order to ensure the continued safe application of reduced horizontal separation standards in international airspace. Inclusion of the previously independent RNP and RNAV concepts under ICAO's global PBN concept has led to uncertainty amongst States regarding the monitoring requirements for new separation minima implementations where these minima are based on PBN approvals. In anticipation of more widespread use of the PBN RNAV 10 and RNP 4 navigation specifications within the international airspace of the Asia/Pacific Region, this handbook is being provided to identify the monitoring requirements and related EMA duties and responsibilities associated with those navigation specifications and the reduced separation minima which may be implemented based upon compliance with them. It should be noted that, with the exception of 50-NM lateral separation, introduction of the reduced horizontal minima necessitates satisfaction of explicit communications and surveillance requirements as well as the navigation performance requirements.

It is intended that this handbook will introduce a common set of principles and practices for monitoring in connection with reduced horizontal-plane separation minima based on the application of PBN. The handbook will also help to promote an interchange of information among Asia/Pacific States in support of achieving common operational monitoring procedures and of pooling data resulting from application of those procedures. Accordingly, APANPIRG has adopted the EMA Handbook under the terms of Conclusion 20/XX as Asia Pacific regional guidance material.

The Handbook is presented in two parts. Part 1 defines an EMA, describes its functions by means of a list of duties and responsibilities, and identifies the process by which an organization receives credentials as an EMA. Part 2 provides specific guidance to assist an EMA in carrying out the duties and responsibilities presented in Part 1.

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Includes appendices

1) **SCS implementation safety assessment**
2) **SCS Know your airspace analysis**
3) ***Reformat all the forms in the appendices***

LIST OF ABBREVIATIONS AND ACRONYMS

ADS	Automatic dependent surveillance
ANSP	Air navigation service provider
APANPIRG	Asia Pacific Air Navigation Planning and Implementation Regional Group
ATC	Air traffic control
ATM	Air traffic management
ATS	Air traffic services
CPDLC	Controller pilot data link communication
CRM	Collision risk model
EMA	En-route Monitoring Agency
FIR	Flight Information Region
FTP	File transfer protocol
ICAO	International Civil Aviation Organization
LLD	Large lateral deviation
LLE	Large longitudinal error
MASPS	Minimum aviation system performance standard
NM	Nautical miles
PBN	Performance-based navigation
RASMAG	Regional Airspace Safety Monitoring Advisory Group of APANPIRG
RMA	Regional Monitoring Agency
RNAV	Area navigation
RNP	Required navigation performance
RVSM	Reduced vertical separation minimum
SASP	Separation and Airspace Safety Panel
SSR	Secondary surveillance radar
STC	Supplemental Type Certificate
TLS	Target level of safety

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EXPLANATION OF TERMS

Collision risk.
The expected number of mid-air collisions in a prescribed volume of airspace for a specific number of flight hours due to loss of planned separation. (*Note: One collision is considered to produce two accidents.)*

Core (lateral) navigational performance.
That portion of overall navigational performance which accounts for the bulk of observed lateral errors and which can be characterized by a single statistical distribution, usually symmetric about the mean lateral error with the frequency of increasing-magnitude errors decaying at least exponentially.

Exclusionary PBN airspace.
Airspace in which flight cannot be planned by civil aircraft which do not hold a valid PBN approval from the appropriate State authority.

Horizontal separation.
The spacing provided between aircraft in the horizontal plane to avoid collision.

Large lateral deviation (LLD).
Any deviation of 15 NM or more to the left or right of the current flight-plan track.

Large longitudinal error (LLE).
Any unexpected change in longitudinal separation between an aircraft pair, or for an individual aircraft the difference between an estimate for a given fix and the actual time of arrival over that fix, as applicable, in accordance with the criteria set out below:

Type of Error	Category of Error	Criterion for Reporting
Longitudinal deviation	Aircraft-pair (Time-based separation applied)	Infringement of longitudinal separation standard based on routine position reports
Longitudinal deviation	Aircraft-pair (Time-based separation applied)	Expected time between two aircraft varies by 3 minutes or more based on routine position reports
Longitudinal deviation	Individual-aircraft (Time-based separation applied)	Pilot estimate varies by 3 minutes or more from that advised in a routine position report
Longitudinal deviation	Aircraft-pair (Distance-based separation applied)	Infringement of longitudinal separation standard, based on ADS, radar measurement or special request for RNAV position report
Longitudinal deviation	Aircraft-pair (Distance-based separation applied)	Expected distance between an aircraft pair varies by 10NM or more, even if separation standard is not infringed, based on ADS, radar measurement or special request for RNAV position report

Occupancy.
A parameter of the collision risk model which is twice the count of aircraft proximate pairs in a single dimension divided by the total number of aircraft flying the candidate paths in the same time interval.

Operational Approval.
An approval granted to an operator by the State authority after being satisfied that the operator meets specific aircraft and operational requirements.

Operational risk.
The risk of collision due to operational errors and in-flight contingencies.

Overall risk.
The risk of collision due to all causes, which includes the technical risk and the operational risk.

Passing frequency.
The frequency of events in which the centers of mass of two aircraft are at least as close together as the metallic length of a typical aircraft when traveling in the opposite or same direction on adjacent routes separated by the planned lateral separation at the same flight level.

Target level of safety (TLS).
A generic term representing the level of risk which is considered acceptable in particular circumstances.

Technical Risk
The risk of collision associated with aircraft navigation performance.

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Part 1

1 Description of a En-route Monitoring Agency, Its Functions and Establishment

1.1 Description

1.1.1 An En-route Monitoring Agency (EMA) is an organization providing airspace safety assessment and monitoring services to support the introduction and continued safe use of en-route horizontal-plane separation minima. An EMA comprises a group of specialists who carry out specific functions to provide these services. These functions are shown in the following set of EMA duties and responsibilities.

1.2 EMA Duties and Responsibilities

1.2.1 The duties and responsibilities of an EMA are:

1.2.1.1 to establish and maintain a database of operational approvals specific to the horizontal-plane separation applied in the EMA's area of responsibility;

1.2.1.2 to coordinate monitoring of horizontal-plane navigational performance and the identification of large horizontal-plane deviations;

1.2.1.3 to receive reports of large horizontal-plane deviations identified during monitoring; to take the necessary action with the relevant State authority and operator to determine the likely cause of the horizontal-plane deviation and to verify the approval status of the relevant operator;

1.2.1.4 to analyze data to detect horizontal-plane deviation trends and, hence, to take action as in the previous item;

1.2.1.5 to undertake data collections as required by RASMAG to:

a) investigate the navigational performance of the aircraft in the core of the distribution of lateral deviations;

b) establish or add to a database on the lateral navigational performance of:

- the aircraft population
- aircraft types or categories
- individual airframes;

c) examine the forecast accuracy of aircraft-provided times at future required reporting points

1.2.1.6 to archive results of navigational performance monitoring and to conduct scheduled risk assessments in light of agreed regional safety goals;

1.2.1.7 to contribute to a regional database of monitoring results;

1.2.1.8 to initiate necessary remedial actions and coordinate with specialist groups as necessary in the light of monitoring results;

1.2.1.9 to monitor the level of risk as a consequence of operational errors and in-flight contingencies as follows:

a) determine, wherever possible, the root cause of each deviation together with its size and duration;

b) calculate the frequency of occurrence;

c) assess the overall risk in the system against the overall safety objectives; and

d) initiate remedial action as required;

1.2.1.10 to initiate checks of the approval status of aircraft operating in the relevant airspace where horizontal-plane separation is applied, identify non-approved operators and aircraft using the airspace and notify the appropriate State of Registry/State of the Operator accordingly; and

1.2.1.11 to submit reports as required to APANPIRG through RASMAG.

1.3 Process for Establishing an EMA

1.3.1 An organization proposing to offer EMA services must be approved by the RASMAG.

1.3.2 In order to effectively carry out the duties and responsibilities of an EMA, an organization must be able to demonstrate an acceptable level of competence. Competence may be demonstrated by:

a) previous monitoring experience; or

b) participation in ICAO technical panels or other bodies which develop horizontal separation requirements or criteria for establishing separation minima based on PBN; or

c) establishment of a formal relationship with an organization qualified under (a) or (b).

1.3.3 Once competence has been demonstrated, the EMA should receive a formal approval by RASMAG.

1.3.4 Appendix A lists the RASMAG EMAs and the FIRs for which they are responsible.

Part 2

2. Guidance on the Responsibilities and Standardised Practices of En-route Monitoring Agencies

2.1 Purpose of this part

2.1.1 The purpose of this part of the Handbook is to document experience gained by organizations supporting the introduction of reduced horizontal-plane separation minima within the Asia and Pacific Region, and elsewhere, in order to assist an EMA in fulfilling its responsibilities. Where necessary to ensure standardized practices among EMAs, detailed guidance is elaborated further in appendices.

2.2 Establishment and Maintenance of a Database of PBN and Other Necessary Approvals

2.2.1 The experience gained through the introduction of RVSM within Asia/Pacific has shown that the concept of utilising monitoring agencies is essential to ensure safety in the region. They have a significant role to play in all aspects of the safety monitoring process. One of the functions of an EMA is to establish a database of operators and aircraft or aircraft types approved by their respective State authorities for PBN operations and, if necessary, for use of data link in the region for which the EMA has responsibility. This information is of vital importance in effectively assessing the risk in the airspace.

2.2.2 Aviation is a global industry; many operators may be approved for PBN and data link operations and their approvals registered with an EMA operating in a region where reduced horizontal separation has been implemented. Thus, there is considerable opportunity for information sharing among EMAs. While a region or sub-region introducing reduced horizontal-plane separation may need its own EMA to act as a focal point for the collection and collation of approvals for aircraft operating solely in that region, it may not need to maintain a complete database of all approved aircraft in the world. It will, however, be required to establish links with other EMAs in order to determine the PBN and/or data link status of aircraft, so that an assessment of the technical risk can be made.

2.2.3 To avoid duplication by States in registering approvals with EMAs, the concept of a designated EMA for the processing of approval data has been established. Under the designated EMA concept, all States are associated with a specified EMA for the reporting of PBN and data link approvals. Appendix B provides a listing of States and the respective designated EMA for PBN and data link approvals. EMAs may contact any State to address safety matters without regard to the designated EMA for approvals.

2.2.4 It is important to note that, in general, the aircraft operating in airspace where implementation of PBN-based separation is planned can be grouped into two categories. Some aircraft operate solely within the airspace targeted for introduction of reduced separation standards (and therefore may not have PBN and other required approval status), and others operate both within that airspace and other portions of airspace requiring PBN and other approvals. It is the responsibility of the EMA supporting introduction of reduced separation to gather State approvals data for the former category of aircraft from authorities responsible for issuing those approvals. To do so requires the EMA to establish a communication link with each such State authority and to provide a precise description of the approvals information required. Appendix C provides typical forms, with a brief description of their use, that an EMA might supply to a State authority to obtain information on aircraft PBN or data link approval status.

2.2.5 Where possible, the EMA should collect State approvals information for the latter category of aircraft – those already operating in other airspace where reduced horizontal-plane separation minima are applied – from other EMAs. This collection will be facilitated if each EMA maintains, in a similar electronic form, a database of State PBN and data link approvals.

2.2.6 Appendix D contains the minimum database content required and the format in which it should be maintained by an EMA. Appendix D also contains a description of the data to be shared by EMAs and the procedures for sharing.

2.3 Monitoring of Horizontal-Plane Navigation Performance

2.3.1 An EMA must be prepared to collect the information necessary to monitor horizontal-plane navigational performance as part of the risk assessment. It must institute procedures to monitor core navigational performance and to collect information descriptive of large deviations and operational errors in the horizontal plane.

Monitoring Core Navigational Performance

2.3.2 The EMA will investigate the navigational performance of the aircraft in the core of the distribution of lateral deviations by comparing aircraft reported position information with non-aircraft generated position information such as radar data. The EMA analysis of core navigation performance contributes to the determination of lateral overlap probability used in conducting a safety assessment. An EMA must enlist the cooperation of States and air navigation service providers (ANSPs) in monitoring horizontal-plane core navigational performance through the use of secondary surveillance radar or other appropriate surveillance systems. States and ANSPs have the responsibility to cooperate with the EMA and supply any requested data that will contribute to the evaluation of core navigational performance.

Monitoring the Occurrence of Large Lateral Deviations and Large Longitudinal Errors

2.3.3 Experience has shown that LLDs and LLEs have had significant influence on the outcome of safety assessments before and after implementation of PBN-based separation in a portion of airspace. Accordingly, a principal duty of an EMA is to ensure the existence of a program to collect this information, assess the occurrences and initiate remedial action to correct systemic problems. Section 2.6 provides guidance to an EMA for initiating such remedial actions as may be necessary to resolve systemic problems uncovered by this program. One way to ensure the existence of such a program is to develop letters of agreement between States.

2.3.4 A program to assess the occurrence of LLDs and LLEs will usually include a regional Scrutiny Group to support the EMA monitoring function. A Scrutiny Group is comprised of operational and technical subject matter experts that support the evaluation and classification of LLDs and LLEs. Scrutiny Group guidance is contained in Appendix XX.

2.3.5 Within the airspace for which it is responsible, each ANSP will need to establish the means to detect and report the occurrence of large horizontal-plane deviations. Experience has shown that the primary sources for reports of large horizontal-plane deviations are the ATC units providing air traffic control services in the airspace where reduced separation is or will be applied. The surveillance information available to these units – in the form of voice or ADS reports and, where available, surveillance radar or ADS-B returns – provides the basis for identifying large horizontal-plane deviations. A program for identifying large horizontal-plane deviations should be established and ATC units should report such events monthly. A suggested form for these monthly reports is shown in Appendix E. These reports should contain, as a minimum, the following information:

a) Reporting unit

b) Location of deviation, either as latitude/longitude or ATC fix

c) Date and time of large horizontal-plane deviation

d) Sub-portion of airspace, such as established route system, if applicable

e) Flight identification and aircraft type

f) Actual flight level or altitude

g) Horizontal separation being applied

h) Size of deviation

i) Duration of large deviation

j) Cause of deviation

k) Any other traffic in potential conflict during deviation

l) Crew comments when notified of deviation

m) Remarks from ATC unit making report

2.3.6 Other sources for reports of large horizontal-plane deviations should also be explored. An EMA is encouraged to determine if operators within the airspace for which it is responsible are willing to share pertinent summary information from internal safety oversight databases. In addition, an EMA should enquire about access to State databases of safety incident reports which may be pertinent to the airspace. An EMA should also examine voluntary reporting safety databases, where these are available, as possible sources of large horizontal-plane deviations incidents in the airspace for which it is responsible.

2.3.7 While an EMA will be the recipient and archivist for reports of large horizontal-plane deviations, it is important to note that an EMA alone cannot be expected to conduct all activities associated with a comprehensive program to detect and report large horizontal-plane deviations. Rather, an EMA should enlist the support of RASMAG, the ICAO regional office, appropriate implementation task forces, or any other entity that can assist in the establishment of such a program.

2.4 Conducting Safety Assessments and Reporting Results

Safety Assessment

2.4.1 A safety assessment conducted by an EMA consists of estimating the risk of collision associated with the horizontal-plane separation standard and comparing this risk to the established TLS. Examples of CRMs used in the development of separation minima are included in Appendix H of this document and in the ICAO Doc 9689 *Manual of Airspace Planning Methodology for the Determination of Separation Minima*. An EMA will need to acquire an in-depth knowledge of the use of the airspace within which the horizontal-plane separation has been implemented. Experience has shown that such knowledge can be gained through acquisition of charts and other material describing the airspace, and through periodic collection of samples of traffic movements within the airspace.

2.4.2 RASMAG will determine the safety reporting requirements for the EMA.

Establishing the Competence Necessary to Conduct a Safety Assessment

2.4.3 Conducting a safety assessment is a complex task requiring specialized skills which are not practiced widely. As a result, prior to receiving RASMAG approval to operate as an EMA, the organization will need to demonstrate the necessary competence to complete the required tasks.

2.4.4 Ideally, an EMA will have the internal competence to conduct a safety assessment. However, recognizing that personnel with the required skills may not be available internally, an EMA may find it necessary to augment its staff, either through arrangements with another EMA or with an external (i.e. non EMA) organization possessing the necessary competence.

2.4.5 If it is necessary to use an external organization to conduct a safety assessment, an EMA must have the competence to judge that such an assessment is done properly. This competence could be acquired through an arrangement with an EMA which has conducted safety assessments.

2.4.6 An EMA will need to take into account that a safety assessment must reflect the factors which influence collision risk within the airspace where the reduced horizontal-plane separation will be applied. Thus, an EMA will need to establish a method to collect and organize pertinent data and other information descriptive of these airspace factors. As will be noted below, some data sources from other airspace where reduced horizontal-plane separation has been implemented may assist an EMA in conducting a safety assessment. However, an EMA may not use the safety assessment results from another portion of airspace as the sole justification for concluding that the TLS will be met in the airspace where the EMA has safety assessment responsibility.

<u>Assembling a sample of traffic movements from the airspace</u>

2.4.7 Samples of traffic movement data should be collected for the entire airspace where reduced horizontal-plane separation will be implemented. As a result, ANSPs providing services within the airspace are required to cooperate in providing this data.

2.4.8 In planning the timing and duration of a traffic movement data sample, an EMA should take into account the importance of capturing any periods of heavy traffic flow which might result from seasonal or other factors. The duration of any traffic sample should be at least 30 days, with a longer sample period left to the judgment of an EMA. (Note: by agreement, traffic sample data within the Asia-Pacific Region is collected by all States for the month of December each year for purposes of RVSM monitoring. EMAs may wish to arrange for the augmentation of this sample to enable them to carry out their monitoring activity.)

2.4.9 The following information should be collected for each flight in the sample:

a) date of flight

b) flight identification or aircraft call sign, in standard ICAO format

c) aircraft type conducting the flight, as listed in the applicable edition of ICAO Doc 8643, Aircraft Type Designators

d) aircraft registration mark, if available

e) origin aerodrome, as listed in the applicable edition of ICAO Doc 7910, Location Indicators

f) destination aerodrome, as listed in the applicable edition of ICAO Doc 7910, Location Indicators

g) entry point (fix or latitude/longitude) into the airspace

h) time at entry point

i) flight level (and assigned Mach number if available) at entry point

j) exit point from the airspace

k) time at exit point

l) flight level (and assigned Mach number if available) at exit point

m) additional fix/time/flight-level combinations that the EMA judges are necessary to capture the traffic movement characteristics of the airspace

2.4.10 Where possible, in coordinating collection of the sample, an EMA should specify that information be provided in electronic form (for example, in a spreadsheet). Appendix F contains a sample specification for collection of traffic movement data in electronic form, where the entries in the first column may be used as column headings on a spreadsheet template.

2.4.11 Acceptable sources for the information required in a traffic movement sample could include one or more of the following: ATC observations, ATC automation system data, automated air traffic management system data and secondary surveillance radar (SSR) reports.

Data Link Performance Monitoring

2.4.12 Applications specific to communication systems required for PBN-based operations such as data link introduce operational and technical risk into the system. Therefore end-to-end safety performance monitoring of air-ground and ground-air data link communication services should be ongoing, in accordance with the information contained in the *Guidance Material for End-to-End Safety and Performance Monitoring of Air Traffic Service (ATS) Data Link Systems in the Asia/Pacific Region*, issued by the ICAO Asia and Pacific Office, Bangkok. .- In the assessment of risk levels, an EMA may find it necessary to use datalink performance data by Central Reporting Agencies (CRAs).

2.4.13 The following communication and surveillance performance elements could be considered for evaluation in a CRA analysis :

a. Position reporting methods and usage
b. Flight plans and data link capabilities
c. ADS downlink message traffic
d. ADS downlink transit times
e. ADS uplink message traffic
f. ADS uplink transit and response times
g. Anomalies identified in ADS data
h. Uplink messages with no response
i. CPDLC uplink and downlink message traffic, including response times
j. Communication service provider outages and the effect on data link performance

Agreed Process for Determining Whether the TLS is satisfied as the Result of a Safety Assessment

2.4.13 "Technical risk" is the term used to describe the risk of collision associated with aircraft navigation performance. Some of the factors which contribute to technical risk are:

a) errors in aircraft navigation systems; and

b) aircraft equipment failures resulting in unmitigated deviation from the cleared flight path, including those where not following the required procedures further increases the risk.

2.4.14 "Operational risk" is the term used to describe the risk of collision due to operational errors and in-flight contingencies. The term "operational error" is used to describe any horizontal deviation of an aircraft from the correct flight path as a result of incorrect action by ATC or the flight crew. Examples of such actions are:

a) a flight crew misunderstanding an ATC clearance, resulting in the aircraft operating on a flight path other than that issued in the clearance;

b) ATC issuing a clearance which places an aircraft on a flight path where the required separation from other aircraft cannot be maintained;

c) a coordination failure between ATC units in the transfer of control responsibility for an aircraft, resulting in either no notification of the transfer or in transfer at an unexpected transfer point;

d) weather deviation (Note: these deviations may be instances where the aircraft captain initiates the manoeuvre using operational authority but without advising ATC, and are not necessarily deemed as being incorrect action).

2.4.15 The TLS which must be satisfied is established by regional agreement and documented in the Regional Supplementary Procedures (Doc 7030). The generic Asia/Pacific TLS is presently established, for each dimension (lateral, longitudinal and vertical), as 5×10^{-9} fatal accidents per flight hour due to loss of planned separation; however, specific TLS values may be determined by ICAO for application of a particular separation minimum.

2.5 Monitoring Operator Compliance with State Approval Requirements

2.5.1 The overall intent of post-implementation EMA activities is to support continued safe use of the reduced horizontal-plane separation. One important post-implementation activity is monitoring operator compliance with State approval requirements by carrying out periodic checks of the approval status of operators and aircraft using airspace where PBN-based separation is applied. This is vital if reduced separation is applied on an exclusionary basis, that is, if State PBN and data link approval is a prerequisite for use of the airspace.

2.5.2 An EMA will require two sources of information to monitor operator compliance with State approval requirements: a listing of the operators, and the type and registration marks of aircraft conducting operations in the airspace; and the database of State PBN and data link approvals.

2.5.3 Ideally, this compliance monitoring should be done for the entire airspace on a daily basis. Difficulties in accessing traffic movement information may make such daily monitoring impossible. As a minimum, an EMA should conduct compliance monitoring of the complete airspace for at least a 30-day period annually.

2.5.4 When conducting compliance monitoring, the filed PBN or data link approval status shown on the flight plan of each aircraft movement should be compared to the database of State PBN and data link approvals. When a flight plan shows a PBN or data link approval not confirmed in the database, the appropriate State authority should be contacted for clarification of the discrepancy. An EMA should use a letter similar in form to that shown in Appendix G for the official notification.

2.5.5 An EMA should keep in mind that the State authority has the responsibility to take any action should an operator be found to have filed an incorrect declaration of State PBN or data link approval.

2.6 Remedial Actions

2.6.1 Remedial actions are those measures taken to remove causes of systemic problems associated with factors affecting safe use of the PBN-based separation. Remedial actions may be necessary to remove the causes of problems such as the following:

a) failure of an aircraft to comply with PBN or data link requirements

b) aircraft operating practices resulting in large horizontal-plane deviations

c) operational errors.

2.6.2 Monitoring results should be periodically reviewed by the EMA and the associated Regional Scrutiny Group in order to determine if there is evidence of any recurring problems or adverse trends.

2.6.3 As a minimum, an EMA and the associated Regional Scrutiny Group should conduct an annual review of reports of large horizontal-plane deviations with a view toward uncovering systemic problems and initiating remedial action. Should such a problem be discovered, an EMA should report its findings to the body overseeing horizontal-plane separation implementation, or to the RASMAG. An EMA should include in its report the details of large horizontal-plane deviations suggesting the root cause of the problem.

2.7 Review of Operational Concept

2.7.1 Experience has shown that the operational concept for the application of the horizontal-plane separation adopted by bodies overseeing horizontal-plane separation implementations can affect substantially the collision risk in airspace.

2.7.2 An EMA should review carefully the operational concept agreed by the body overseeing horizontal-plane separation implementation with a view to identifying any features of airspace use which may influence risk. An EMA should inform the oversight body of any aspects of the operational concept which it considers important in this respect.

LIST OF APPENDICES

APPENDIX A -

Flight Information Regions and Responsible En-route Monitoring Agency

FIR	Responsible EMA
Anchorage Oceanic	PARMO
Auckland Oceanic	
Bangkok	
Brisbane	AAMA
Calcutta	
Chennai	
Colombo	
Delhi	
Dhaka	
Fukuoka	
Hanoi	
Ho Chi Minh	SEASMA
Hong Kong	SEASMA
Honiara	
Inchon	
Jakarta	
Kabul	
Karachi	
Kathmandu	
Kota Kinabalu	SEASMA
Kuala Lumpur	SEASMA
Lahore	
Male	
Manila	SEASMA
Melbourne	AAMA
Mumbai	
Nadi	
Nauru	
Oakland Oceanic	PARMO
Phnom Penh	
Port Moresby	
Sanya	SEASMA
Singapore	SEASMA
Tahiti	
Taibei	
Ujung Pandang	
Ulaan Baatar	
Vientiane	
Yangon	

APPENDIX B -

States and Designated EMA for the reporting of PBN and Data Link Approvals

The following table provides a listing of States and the respective designated EMA for the reporting of PBN and data link approvals. Each designated EMA should advise the relevant States of its requirements with respect to reporting of PBN and data link approvals.

ICAO Contracting State	Designated EMA for PBN and Data Link Approvals
Afghanistan	
Australia	AAMA
Bangladesh	
Bhutan	
Brunei Darussalam	
Cambodia	
China	SEASMA
Cook Islands	
Democratic People’s Republic of Korea	
Fiji	
India	
Indonesia	
Japan	
Kiribati	
Lao People’s Democratic Republic	
Malaysia	SEASMA
Maldives	
Marshall Islands	
Micronesia (Federated States of)	
Mongolia	
Myanmar	
Nauru	
Nepal	
New Zealand	
Pakistan	
Palau	
Papua New Guinea	
Philippines	SEASMA
Republic of Korea	
Samoa	
Singapore	SEASMA
Solomon Islands	
Sri Lanka	
Thailand	
Tonga	
United States	PARMO
Vanuatu	
Viet Nam	SEASMA

APPENDIX C -

EMA Forms For Use in Obtaining Records of PBN and Data Link Approvals From a State Authority

There are 4 EMA forms for the collection of essential information relating to PBN and data link approvals:

EMA A1 – Point of Contact Details for Matters Relating to PBN or Data Link Approvals
EMA A2 – Record of PBN or Data Link Approval
EMA A3 – Withdrawal of PBN or Data Link Approval

1. Please read these notes before attempting to complete forms EMA A1, A2, A3 and A4.

2. It is important for the EMAs to have an accurate record of a point of contact for any queries that might arise from the monitoring of horizontal-plane separation. Recipients are therefore requested to include a completed EMA A1 with their first reply to the EMA. Thereafter, there is no further requirement unless there has been a change to the information requested on the form.

3. Form EMA A2 must be completed for each operator/aircraft granted a PBN or data link approval.

4. Form EMA A3 must be completed and submitted immediately whenever a State of Registry has cause to withdraw an operator/aircraft PBN or data link approval.

5. Note: the fields in the forms should be completed as indicated below. The numbers refer to the superscript numbers on forms EMA A2 and EMA A3.

   (1) Enter the 2-letter ICAO identifier as contained in ICAO Doc 7910. In the case of there being more than one identifier designated for the State, use the letter identifier that appears first.
   (2) Enter the operator's 3 letter ICAO identifier as contained in ICAO Doc 8585. For International General Aviation, enter "IGA". For military aircraft, enter "MIL". If none, place an X in this field and enter the name of the operator/owner in the Remarks row.
   (3) Enter the ICAO designator as contained in ICAO Doc 8643, e.g., for Airbus A320-211, enter A320; for Boeing B747-438 enter B744.
   (4) Enter series of aircraft type or manufacturer's customer designation, e.g., for Airbus A320-211, enter 211; for Boeing B747-438, enter 400 or 438.
   (5) Enter ICAO allocated Aircraft Mode S address code in hexadecimal format.
   (6) Enter the type of PBN Approval, e.g. RNP 2, RNP 4, RNAV 10, Data Link in each boxes provided.
   (7) Enter date in dd/mm/yy format, e.g. for 26 October 2007 enter 26/10/07.
   (8) Use a separate sheet of paper if insufficient space available.
   (9) Enter or Select Operator Type. E.g. Civil or Military.

EMA A1

POINT OF CONTACT DETAILS
FOR MATTERS RELATING TO PBN OR DATA LINK APPROVALS

This form should be completed and returned to the address below on the first reply to the EMA or when there is a change to any of the details requested on the form. ***PLEASE USE BLOCK CAPITALS THROUGHOUT.***

NAME OF STATE AUTHORITY OR ORGANISATION			
STATE OF REGISTRY			
STATE OF REGISTRY (ICAO 2 letter identifier)			

If there is more than one identifier for the State, please use the first that appears in the list.

ADDRESS DETAILS	
STREET	
CITY	
STATE/PROVINCE	
ZIP/POSTAL CODE	
COUNTRY/REGION	

CONTACT PERSON	
TITLE	
FIRST NAME	
MIDDLE NAME	
LAST NAME	
JOB TITLE	
EMAIL	

PHONE DETAILS			
COUNTRY CODE		AREA CODE	
DIRECT LINE		FAX NUMBER	

Please Tick One: ☐ Initial Reply ☐ Change of details

When complete, please return to:

EMA Address

Telephone:
Fax:
E-Mail

EMA A2
RECORD OF PBN APPROVAL

When a State of Registry approves or amends the approval of an operator/aircraft for PBN, details of that approval must be recorded and sent to the appropriate EMA without delay.

Please refer to the accompanying notes before providing the information requested below.
PLEASE USE BLOCK CAPITALS.

State of Registry[1]:	
State of Operator[1]:	
Operator Identifier[2]:	
Name of Operator:	
Operator Type[9]:	* CIVIL / * MILITARY (* DELETE AS APPROPRIATE)
Registration Date[7]:	
Aircraft Type[3]:	
Aircraft Series[4]:	
Manufacturers Serial Number:	
Registration Mark:	
Mode S Address Code (Hex)[5]:	
Number of Navigation System:	
Make/Model of Long Range Navigation System:	

PBN Approval Type[6]:				
PBN Time Limit:				
Date of Approval[7]:				
Date of Expiry[7]:				
Approval Authority (CAA):				
Approving CAA Official:				
Region for PBN Approval:				
State of PBN Approval[1]:				

Status of Previous PBN Approval: ☐ Please tick if any, describe approval

Remarks[8]:

When complete, please return to the following address.

EMA Address

Telephone:
Fax:
Email:

(1) Enter the 2-letter ICAO identifier as contained in ICAO Doc 7910. In the case of there being more than one identifier designated for the State, use the letter identifier that appears first.
(2) Enter the operator's 3 letter ICAO identifier as contained in ICAO Doc 8585. For International General Aviation, enter "IGA". For military aircraft, enter "MIL". If none, place an X in this field and enter the name of the operator/owner in the Remarks row.
(3) Enter the ICAO designator as contained in ICAO Doc 8643, e.g., for Airbus A320-211, enter A320; for Boeing B747-438 enter B744.
(4) Enter series of aircraft type or manufacturer's customer designation, e.g., for Airbus A320-211, enter 211; for Boeing B747-438, enter 400 or 438.
(5) Enter ICAO allocated Aircraft Mode S address code in hexadecimal format.
(6) Enter the type of PBN Approval, e.g. RNP 2, RNP 4, RNAV 10, Data Link in each boxes provided.
(7) Enter date in dd/mm/yy format, e.g. for 26 October 2007 enter 26/10/07.
(8) Use a separate sheet of paper if insufficient space available.
(9) Enter or Select Operator Type. E.g. Civil or Military.

EMA A3
WITHDRAWAL OF PBN OR DATALINK APPROVAL

When a State of Registry has cause to withdraw the PBN or data link approval of an operator/aircraft, the details requested below must be sent to the EMA without delay.

Please refer to the accompanying notes before providing the information requested. **PLEASE USE BLOCK CAPITALS**.

State of Registry[1]												
Operator Identifier[2]												
State of Operator[1]												
Aircraft Type[3]												
Aircraft Series[4]												
Manufacturers Serial Number												
Registration Mark												
Mode S Address Code (Hex)[5]												

Approval Withdrawn (PBN or DL)[6]				
Date of Withdrawal[7]				
PBN Withdrawn CAA Official				

Reason for Withdrawal	

When complete, please return to the following address.

EMA Address

Telephone:
Fax:
Email:

[1] Enter the 2-letter ICAO identifier as contained in ICAO Doc 7910. In the case of there being more than one identifier designated for the State, use the letter identifier that appears first.
[2] Enter the operator's 3 letter ICAO identifier as contained in ICAO Doc 8585. For International General Aviation, enter "IGA". For military aircraft, enter "MIL". If none, place an X in this field and enter the name of the operator/owner in the Remarks row.
[3] Enter the ICAO designator as contained in ICAO Doc 8643, e.g., for Airbus A320-211, enter A320; for Boeing B747-438 enter B744.
[4] Enter series of aircraft type or manufacturer's customer designation, e.g., for Airbus A320-211, enter 211; for Boeing B747-438, enter 400 or 438.
[5] Enter ICAO allocated Aircraft Mode S address code in hexadecimal format.
[6] Enter the type of PBN Approval, e.g. RNP 2, RNP 4, RNAV 10, Data Link in each boxes provided.
[7] Enter date in dd/mm/yy format, e.g. for 26 October 2007 enter 26/10/07.
[8] Use a separate sheet of paper if insufficient space available.
[9] Enter or Select Operator Type. E.g. Civil or Military.

APPENDIX D -

Minimal Informational Content For Each State PBN Or Data Link Approval To Be Maintained In Electronic Form By An EMA

Aircraft PBN and Data Link Approvals Data

To properly maintain and track PBN and data link approval information some basic aircraft identification information is required (e.g., manufacturer, type, serial number, etc.) as well as details specific to an aircraft's PBN and data link approval status. Table 1 lists the minimum data fields to be collected by an EMA for an individual aircraft. Table 1a describes the approvals database record format.

Table 1. Aircraft PBN and Data Link Approvals Data

Field	Description
Registration mark	Aircraft's current registration mark
Mode S Address Code (Hex)	Aircraft's current Mode S code 6 hexadecimal digits
Manufacturer Serial number	Aircraft Serial Number as given by manufacturer
Aircraft type	Aircraft Type as defined by ICAO document 8643
Aircraft Series	Aircraft generic series as described by the aircraft manufacturer (e.g., 747-100, series = 100)
State of Registry	State to which the aircraft is currently registered as defined in ICAO document 7910
Registration date	Date registration was active for current operator
Operator Identifier	ICAO code for the current Operator as defined in ICAO document 8585
Operator name	Name of the current Operator
State of Operator	State of the current Operator as defined in ICAO document 7910
Operator Type	Aircraft is civil or military
PBN approval type	PBN approval – eg RNP 4, RNAV 2, RNP 1
Region for PBN approval	Name of region where the PBN approval is applicable Note: Only required if PBN Approval is issued for a specific region
State of PBN approval	State granting PBN approval as defined in ICAO document 9613
Date PBN approved	Date of PBN Approval
Date of PBN expiry	Date of Expiry for PBN Approval
Date of Data Link approval	Date of Data Link Approval
Remarks	Open comments
Date of withdrawal of PBN approval	Date of withdrawal of the aircraft's PBN approval (if applicable)
Info by Authority	Yes or no indication "Was the information provided to the EMA by a State Authority?"

* not necessarily a separate field. Can be a field on its own, or it is indicated in the operator ICAO code as MIL when the military has an ICAO code designator.

Table 1a. Approvals Database Record Format

Field	Description	Type	Width	Valid Range
State of Registry	State of Registry	Alphabetic	2	AA-ZZ
Operator	Operator	Alphabetic	3	AAA-ZZZ
State of Operator	State of Operator	Alphabetic	2	AA-ZZ
AC Type	Aircraft Type	Alphanumeric	4	e.g. MD11
AC Mark/Series	Aircraft Mark / Series	Alphanumeric	6	
Serial Number	Manufacturer's Serial/Construction Number	Alphanumeric	12	
AC registration mark	Aircraft registration mark	Alphanumeric	10	
Mode S	Aircraft Mode "S" address (Hexadecimal)	Alphanumeric	6	000001-FFFFFF
PBN approval type	PBN approval type	Alphanumeric	6	e.g RNP4
Approval date	Date PBN approval issued (dd/mm/yyyy)	Date	10	e.g. 31/12/1999
Date of expiry	Date of expiry of PBN approval (if any) (dd/mm/yyyy)	Date	10	e.g. 31/12/1999
DL approval date	Date Data Link approval issued (dd/mm/yyyy)	Date	10	e.g. 31/12/1999
Remarks	National remarks	Alphanumeric	60	ASCII text

Aircraft Re-Registration/Operating Status Change Data

Aircraft frequently change registration information. Re-registration and change of operating status information is required to properly maintain an accurate list of the current population. Table 2 lists the minimum data fields to be maintained by an EMA to manage aircraft re-registration/operating status change data.

Table 2. Aircraft Re-Registration/Operating Status Change Data

Field	Description
Reason for change	Reason for change. Aircraft was re-registered, destroyed, parked, etc.
Previous registration mark	Aircraft's previous registration mark.
Previous Mode S	Aircraft's previous Mode S code.
Previous operator name	Previous name of operator of the aircraft.
Previous operator ICAO Code	ICAO code for previous aircraft operator.
Previous State of Operator	ICAO code for the previous State of the operator
New State of Operator	ICAO code for the State of the current aircraft operator.
New registration mark	Aircraft's current registration mark.
New State of Registration	Aircraft's current State of Registry.
New operator name	Current name of operator of the aircraft.
New Operator ICAO Code	ICAO code for the current aircraft operator.
Aircraft ICAO Type designator	Aircraft Type as defined by ICAO document 8643
Aircraft series	Aircraft generic series as described by the aircraft manufacturer (e.g., 747-100, series = 100).
Serial number	Aircraft Serial Number as given by manufacturer
New Mode S	Aircraft's current Mode S code 6 hexadecimal digits.
Date change is effective	Date new registration/ change of status became effective.

Contact Data

An accurate and up to date list of contacts is essential for an EMA to do business. Table 3 lists the minimum content for organizational contacts and Table 4 lists the minimum content for individual points-of-contact.

Table 3. Organizational Contact Data

Field	Description
Type	Type of contact (e.g., Operator, Airworthiness Authority, Manufacturer)
State	State in which the company is located.
State ICAO	ICAO code for the State in which the company is located.
Company/Authority	Name of the company/authority as used by ICAO (e.g., Bombardier)
Fax No	Fax number for the company.
Telephone number	Telephone number for the company.
Address (1-4)	Address lines 1-4 filled as appropriate for the company.
Place	Place (city, etc.) in which the company is located.
Postal code	Postal code for the company.
Country	Country in which the company is located.
Remarks	Open comments
Modification date	Last Modification Date.
Web-site	Company Web HTTP Location.
e-mail	Company e-mail address.
Civ/mil	Civil or Military.

Table 4. Individual Point of Contact Data

Field	Description
Title contact	Mr., Mrs., Ms., etc.
Surname contact	Surname or family name of point of contact.
Name contact	Given name of point of contact.
Position contact	Work title of the point of contact.
Company/Authority	Name of the company/authority as used by ICAO (e.g., Bombardier)
Department	Department for the point of contact.
Address (1-4)	Address lines 1-4 filled as appropriate for the point of contact.
Place	Place (city, etc.) in which the point of contact is located.
Postal code	Postal code for the location of the point of contact.
State	State in which the point of contact is located.
Country	Country in which the point of contact is located.
E-mail	E-mail of the point of contact.
Telex	Telex number of the point of contact.
Fax No	Fax number of the point of contact.
Telephone no 1	First telephone number for the point of contact.
Telephone no 2	Second telephone number for the point of contact.

Data Exchange Between EMAs

The following sections describe how data is to be shared between EMAs as well as the minimum data set that should be passed from one EMA to another. This minimum sharing data set is a sub-set of the data defined in previous sections of Appendix D.

All EMAs receiving data have responsibility to help ensure data integrity. A receiving EMA must report back to the sending EMA any discrepancies or incorrect information found in the sent data.

Data Exchange Procedures

The standard mode of exchange shall be e-mail or FTP. Data shall be presented in Microsoft Excel or Microsoft Access.

EMAs must be aware that the data are current only to the date of the created file.

Table 5. EMA Data Exchange Procedures

Data Type	Data Subset	Frequency	When
PBN and Data Link Approvals	All	Monthly	First week in month
Aircraft Re-registration/status	New since last broadcast	Monthly	First week in month
Contact	All	Monthly	First week in month
Non-Compliant Aircraft	All	As Required.	Immediate

In addition to regular data exchanges, one-off queries shall be given to an EMA on request. This includes requests for data in addition to the minimum exchanged data set such as service bulletin information.

Exchange of Aircraft Approvals Data

An EMA shall exchange PBN and Data Link Approvals data with other EMAs.. The following table defines the fields required for sending a record to another EMA.

Table 6. Exchange of Aircraft Approvals Data

Field	Needed to Share
Registration mark	**Desirable**
Mode S	Desirable
Serial number	**Desirable**
Aircraft type	**Mandatory**
Aircraft Series	**Mandatory**
State of Registry	**Mandatory**
Registration date	Desirable
Operator Identifier	**Mandatory**
Operator name	Desirable
State of Operator	**Mandatory**
Civil or military indication (not a field on its own. It is indicated in the ICAO operator code as MIL except when the military has a code)	Desirable
PBN approval type	**Mandatory**
State of PBN Approval	**Mandatory**
Date PBN approved	**Mandatory**
Date of PBN approval expiry	**Mandatory**
Date Data Link approved	**Mandatory**
Remarks	No
Date of withdrawal of PBN approval	**Mandatory**
Info by Authority	**Mandatory**

Aircraft Re-Registration/Operating Status Change Data

An EMA shall share all re-registration information.

Table 7. Exchange of Aircraft Re-Registration/Operating Status Change Data

Field	Need to Share
Reason for change (ie. re-registered, destroyed, parked)	**Mandatory**
Previous registration mark	**Mandatory**
Previous Mode S	Desirable
Previous operator name	Desirable
Previous operator ICAO Code	**Mandatory**
Previous State of Operator	**Mandatory**
State of Operator	**Mandatory**
New registration mark	**Mandatory**
New State of Registration	**Mandatory**
New operator nName	Desirable
New operator code	Desirable
Aircraft ICAO Type designator	**Mandatory**
Aircraft series	**Mandatory**
Serial number	**Mandatory**
New Mode S	**Mandatory**
Date change is effective	Desirable

Exchange of Contact Data

Table 8. Exchange of Organizational Contact Data Fields

Field	Need to Share
Type	**Mandatory**
State	**Mandatory**
State ICAO	Desirable
Company/Authority	**Mandatory**
Fax No	Desirable
Telephone number	**Mandatory**
Address (1-4)	**Mandatory**
Place	**Mandatory**
Postal code	**Mandatory**
Country	**Mandatory**
e-mail	Desirable
civ/mil	Desirable

Table 9. Exchange of Individual Point of Contact Data Fields

Field	Need to Share
Title contact	Desirable
Surname contact	**Mandatory**
Name contact	Desirable
Position contact	Desirable
Company/Authority	**Mandatory**
Department	Desirable
Address (1-4)	**Mandatory**
Place	**Mandatory**
Postal code	**Mandatory**
Country	**Mandatory**
State	**Mandatory**
E-mail	Desirable
Fax No	Desirable
Telephone no 1	**Mandatory**
Telephone no 2	Desirable

Confirmed Non-Compliant Information

As part of its monitoring assessments an EMA may identify a non-compliant aircraft. This information should be made available to other EMAs.

When identifying a non-compliant aircraft an EMA should include

- Notifying EMA
- Date sent
- Field
- Registration mark
- Mode S
- Serial number
- ICAO Type Designator
- State of Registry
- Registration date
- Operator ICAO Code
- Operator name
- State of Operator
- Date(s) of non-compliance(s)
- Action started (y/n)
- Date non-compliance resolved

Fixed parameters -Reference Data Sources

The sources of some standard data formats used by an EMA are listed below.

- ICAO Doc. 7910 " Location Indicators"
- ICAO Document 8585 " Designators for Aircraft Operating Agencies, Aeronautical Authorities, and Services"
- ICAO Document 8643 " Aircraft Type Designators"
- IATA "Airline Coding Directory"

APPENDIX E-

Suggested Form for ATC Unit Monthly Report of Large Lateral Deviations or Large Longitudinal Errors

[EN-ROUTE MONITORING AGENCY NAME]

Report of Large Lateral Deviation or Large Longitudinal Error

Report to the (*En-route Monitoring Agency Name*) of a large lateral deviation (LLD) or a large longitudinal error (LLE), including those due to weather deviations and other contingency events, as defined below:

Type of Error	Category of Error	Criterion for Reporting
Lateral deviation	Individual-aircraft error	15NM or greater magnitude
Longitudinal deviation	Aircraft-pair (Time-based separation applied)	Infringement of longitudinal separation standard based on routine position reports
Longitudinal deviation	Aircraft-pair (Time-based separation applied)	Expected time between two aircraft varies by 3 minutes or more based on routine position reports
Longitudinal deviation	Individual-aircraft (Time-based separation applied)	Pilot estimate varies by 3 minutes or more from that advised in a routine position report
Longitudinal deviation	Aircraft-pair (Distance-based separation applied)	Infringement of longitudinal separation standard, based on ADS, radar measurement or special request for RNAV position report
Longitudinal deviation	Aircraft-pair (Distance-based separation applied)	Expected distance between an aircraft pair varies by 10NM or more, even if separation standard is not infringed, based on ADS, radar measurement or special request for RNAV position report

Name of ATC unit:____

Please complete Section I or II as appropriate

SECTION I:

There were no reports of LLDs or LLEs for the month of __________

SECTION II:

There was/were _____ report(s) of LLD

There was/were _____ report(s) of LLE

Details of the LLDs and LLEs are attached.

(Please use a separate form for each report of lateral deviation or longitudinal error).

SECTION III:

When complete please forward the report(s) to:

En-route Monitoring Agency Name
Postal address
Telephone:
Fax:
E-Mail:

NAVIGATION ERROR INVESTIGATION FORM

PART 1 - To be completed by responsible officer in the Service Provider (and aircraft owner/operator if need)		
ATC Unit Observing Error:		
Date/Time (UTC):		
Duration of Deviation:		
Type of Error: (tick one)	☐ LATERAL	☐ LONGITUDINAL
Details of Aircraft		
	First Aircraft	**Second Aircraft (when longitudinal deviation observed)**
Aircraft Identification:		
Name of owner/Operator:		
Aircraft Type:		
Departure Point:		
Destination:		
Route Segment:		
Cleared Track:		
Position where error was observed: (BRG/DIST from fixed point or LAT/LONG)		
Extent of deviation – magnitude and direction: (NM for lateral, min/NM for longitudinal)		
Flight Level:		
For All Errors		
Action taken by ATC:		
Crew Comments when notified of Deviation:		
Other Comments:		

**** (Please Attach ATS Flight Plan)**

NAVIGATION ERROR INVESTIGATION FORM

<table>
<tr><td colspan="4">PART 2 - Details of Aircraft, and Navigation and Communications Equipment Fit
(To be completed by aircraft owner/operator)</td></tr>
<tr><th>LRNS</th><th>Number of Systems
(0, 1, 2 etc.)</th><th>Make</th><th>Model</th></tr>
<tr><td>INS</td><td></td><td></td><td></td></tr>
<tr><td>IRS</td><td></td><td></td><td></td></tr>
<tr><td>GNSS</td><td></td><td></td><td></td></tr>
<tr><td>FMS</td><td></td><td></td><td></td></tr>
<tr><td>Others
(please Specify)</td><td></td><td></td><td></td></tr>
<tr><th>COMS</th><td colspan="3"></td></tr>
<tr><td>HF</td><td></td><td></td><td></td></tr>
<tr><td>VHF</td><td></td><td></td><td></td></tr>
<tr><td>SATCOM</td><td></td><td></td><td></td></tr>
<tr><td>CPDLC</td><td></td><td></td><td></td></tr>
<tr><td colspan="2">Which navigation system was coupled to the autopilot at the time of observation of the error?</td><td colspan="2"></td></tr>
<tr><td colspan="2">Which NAV MODE was selected at the time of observation of the error?</td><td colspan="2"></td></tr>
<tr><td colspan="2">Which comms system was in use at the time of observation of the error?</td><td colspan="2"></td></tr>
<tr><td colspan="2">Aircraft registration and model/series</td><td colspan="2"></td></tr>
<tr><td colspan="2">Was the aircraft operating according to PBN requirements?</td><td>☐ Yes</td><td>☐ No</td></tr>
</table>

NAVIGATION ERROR INVESTIGATION FORM

PART 3 – Detailed description of incident **(To be completed by owner/operator – use separate sheet if required)**
Please give your assessment of the actual track flown by the aircraft, and the cause of the deviation:
Corrective action proposed:

PART 4 – To be completed by owner/operator, only in the event of partial or total navigation equipment failure.

Navigation System Type	**INS**	**IRS/FMS**	**Others (Please specify)**
Indicate the number of units of each type which failed			
Indicate position at which failure(s) occurred			
Give an estimate of the duration of the equipment failure(s)			
At what time were ATC advised of the failure(s)?			

NAVIGATION ERROR INVESTIGATION FORM

PART 5 – To be completed by investigating agency		
Have all required data been supplied?	☐ Yes	☐ No
Is further investigation warranted?	☐ Yes	☐ No
Will this incident be the subject of a separate report?	☐ Yes	☐ No
General comments:		
Classification: (please circle) A B C D E F G H I		

CLASSIFICATION OF GROSS NAVIGATION ERRORS	
Deviation Code	**Cause of Deviation**
Operational Errors	
A	~~Aircraft not approved to PBN requirements~~ Flight crew deviate without ATC Clearance;
B	Flight crew 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.);
C	Flight crew waypoint insertion error, due to correct entry of incorrect position or incorrect entry of correct position;
D	ATC system loop error (e.g. ATC issues incorrect clearance, Flight crew misunderstands clearance message etc);
E	Coordination errors in the ATC-unit-to-ATC-unit transfer of control responsibility;
Deviation due to navigational errors	
~~D~~	~~Navigation errors, including equipment failure notified to ATC in time for action~~
~~E~~	~~Other navigation errors, including equipment failure notified to ATC too late for action~~
F	Navigation errors, including equipment failure of which notification was not received by ATC or notified too late for action;
~~G~~	~~Mode select error~~
Deviation due to Meteorological Condition	
G	Turbulence or other weather related causes (other than approved);
Others	
H	An aircraft without PBN approval;
I	Others (Please specify)

APPENDIX F –

Note: Align this template with the standardized Asia/Pacific RMA data collection template, include PBN Approval type in RMA template, include ATS route in EMA template

Sample Content and Format for Collection of Sample of Traffic Movements

The following table lists the information required for each flight in a sample of traffic movements.

INFORMATION FOR EACH FLIGHT IN THE SAMPLE

The information requested for a flight in the sample is listed in the following table with an indication as to whether the information is necessary or is optional:

FIELD	EXAMPLE	MANDATORY OR OPTIONAL
Date (dd/mm/yyyy)	08/05/2007 for 8 May 2007	MANDATORY
Aircraft call sign	XXX704	MANDATORY
Aircraft Type	B734	MANDATORY
Aircraft registration mark	VH-ABC	MANDATORY
Origin Aerodrome	WMKK	MANDATORY
Destination Aerodrome	RPLL	MANDATORY
PBN Approval type	RNP 4	OPTIONAL
Entry Fix into Airspace	MESOK	MANDATORY
Time at Entry Fix (UTC)	0225 or 02:25	MANDATORY
Flight Level at Entry Fix	330	MANDATORY
Assigned Mach number at Entry Fix	M0.77	OPTIONAL
Route after Entry Fix		OPTIONAL
Exit Fix from Airspace	NISOR	MANDATORY
Time at Exit Fix (UTC)	0401 or 04:01	MANDATORY
Flight Level at Exit Fix	330	MANDATORY
Assigned Mach number at Exit Fix	M0.77	OPTIONAL
Route after Exit Fix		OPTIONAL
First Fix Within the Airspace OR First Airway Within the Airspace	MESOK OR G582	OPTIONAL
Time at First Fix (UTC)	0225 or 02:25	OPTIONAL
Flight Level at First Fix	330	OPTIONAL
Second Fix Within the Airspace OR Second Airway Within the Airspace	MEVAS OR G577	
Time at Second Fix (UTC)	0250 or 02:50	OPTIONAL
Flight Level at Second Fix	330	OPTIONAL
(Continue with as many Fix/Time/Flight-Level entries as are required to describe the flight's movement within the airspace)		OPTIONAL

APPENDIX G -

Letter To State Authority Requesting Clarification Of The State PBN or Data Link Approval Status Of An Operator

When the PBN or data link approval status shown in filed flight plan is not confirmed in an EMA's database of State approvals, a letter similar to the following should be sent to the relevant State authority.

<STATE AUTHORITY ADDRESS>

1. The (*EMA name*) has been established by the ICAO Asia/Pacific Regional Airspace Safety Monitoring Advisory Group (RASMAG) to support safe implementation and use of the horizontal-plane separation in (*airspace where the EMA has responsibility*), in accordance with guidance published by the International Civil Aviation Organization.

2. Among the other activities, the (*EMA name*) conducts a comparison of the State PBN and data link approval status, provided by an operator to an air traffic control unit, to the record of State PBN and data link approval available to us. This comparison is considered vital to ensuring the continued safe use of horizontal-plane separation.

3. This letter is to advise you that an operator which we believe is on your State registry provided notice of State PBN or data link approval which is not confirmed by our records. The details of the occurrence are as follows:

Date:
Operator name:
Aircraft flight identification:
Aircraft type:
Registration mark:
Filed PBN Approval type:
Filed Data Link Approval Status:
ATC unit receiving notification:

4 We request that you advise this office of the PBN and data link approval status of this operator. In the event that you have not granted a PBN or data link approval to this operator, we request that you advise this office of any action which you propose to take.

Sincerely,

(*EMA official*)

APPENDIX H -

Description of Models Used to Estimate Risk

(to be developed)

INTERNATIONAL CIVIL AVIATION ORGANIZATION
ASIA AND PACIFIC OFFICE

DRAFT

ASIA/PACIFIC REGIONAL IMPACT STATEMENT −

RVSM GLOBAL LONG TERM HEIGHT MONITORING REQUIREMENTS EFFECTIVE FROM NOVEMBER 2010

Version 1.6– June 2009

Issued by the ICAO Asia/Pacific Regional Office, Bangkok

TABLE OF CONTENTS

FOREWORD

Since the initial operational implementation of Reduced Vertical Separation Minimum (RVSM) in the North Atlantic in 1998, widespread implementation of RVSM has taken place globally. In the Asia/Pacific Region, implementation commenced as a result of the output of the Third Asia/Pacific Regional Air Navigation Meeting (RAN/3, Bangkok, Thailand 19 April – 7 May 1993) which called for an ICAO RVSM Task Force to progress RVSM implementation in the Pacific. The Ninth meeting of the Asia/Pacific Air Navigation Planning and Implementation Regional Group (APANPIRG 9, August 1998) established the Asia/Pacific RVSM Implementation Task Force (RVSM/TF) under the terms of Decision 9/4 and simultaneously adopted Conclusion 9/3 requiring actions to establish an RVSM implementation schedule for the Asia region, in addition to the programme for the Pacific region.

Under the capable stewardship of the RVSM/TF, Asia/Pacific RVSM implementations went forward smoothly commencing with the Pacific area in 2000 and followed by the Western Pacific and South China Sea area during 2002, the Bay of Bengal area in 2003, Japan and the Republic of Korea during 2005 and throughout the airspace of China in 2007. RVSM implementations in the two remaining Asia/Pacific FIRs, Pyongyang and Ulaan Baatar, are scheduled for 2009 and 2012, respectively.

Recognising the significance of the step from a 2000 ft vertical separation minimum to a 1000 ft vertical separation minimum, intensive monitoring arrangements were put in place to ensure the continued safety of RVSM operations. Such monitoring considers RVSM safety performance in terms of two components. Technical risk relates to the technical performance of equipment, including altimetry systems. Operational risk relates to human performance error and, in simple terms, considers errors made by pilots and air traffic controllers.

To be approved for operation in RVSM airspace, States must ensure that aircraft comply with technical requirements that enable the actual height cleared by air traffic services to be accurately maintained. The RVSM monitoring programmes around the world have collected extensive height keeping data to determine the stability of Altimetry System Error (ASE) in airframes used for RVSM operations. The results show that altimetry systems drift is worse than anticipated. Accordingly, provisions have recently been included in Annex 6 – *Operation of Aircraft* that take effect from 2010 and require the global long term monitoring of altimetry systems used for RVSM operations.

APANPIRG/20 (September 2009) has adopted this Asia/Pacific Regional Impact Statement, prepared by the Regional Airspace Safety Monitoring Advisory Group (RASMAG), under the terms of Conclusion 20/XX to provide general guidance to States. Additionally, specific guidance is provided to assist in identifying the ground-based monitoring infrastructure necessary for the regional RVSM monitoring programme, in order that States are better informed when making collaborative decisions about investments in regional infrastructure.

1. Introduction

1.1 At the broadest level, Annex 11 – *Air Traffic Services* requires States to establish a safety programme in order to achieve an acceptable level of safety in the provision of Air Traffic Services (ATS). More specific requirements exist for the implementation of safety management systems by Air Navigation Services Providers (ANSPs) that identify hazards, ensure remedial action and provide for the continuous monitoring and regular assessment of the safety level achieved.

1.2 In the specific case of the implementation and ongoing operation of reduced vertical separation minimum (RVSM), Annex 11 requires that for all airspace where a RVSM of 300 m (1 000 ft) is applied between FL 290 and FL 410 inclusive, a programme shall be instituted, on a regional basis, for monitoring the height-keeping performance of aircraft operating at these levels, in order to ensure that the implementation and continued application of this vertical separation minimum meets the safety objectives. The coverage of the height-monitoring facilities provided under this programme shall be adequate to permit monitoring of the relevant aircraft types of all operators that operate in RVSM airspace. Arrangements shall be put in place, through interregional agreement, for the sharing between regions of data from RVSM monitoring programmes.

1.3 The increasing complexity of requirements and the necessary State interactions led the Fourteenth meeting of the Asia/Pacific Air Navigation Planning and Implementation Regional Group (APANPIRG/14, August 2003) to establish the Regional Airspace Safety Monitoring Advisory Group (RASMAG) to provide oversight of airspace safety monitoring requirements, including the monitoring of the height keeping performance of the airframes used in RVSM operations, thereby providing a regional basis for RVSM monitoring in Asia/Pacific. In further addressing its responsibilities in this regard, APANPIRG adopted a Target Level of Safety (TLS) for en-route airspace in the Asia/Pacific region of 5×10^{-9} fatal accidents per flight hour in each dimension i.e. vertical, lateral and longitudinal. APANPIRG also continues to encourage cooperative arrangements between States to undertake airspace safety assessments and to provide airspace safety monitoring for the introduction of airspace changes and reduction in aircraft separation minima (vertical and horizontal), as well as for ongoing operations.

2. The need for RVSM Monitoring

2.1 Aircraft use a barometric altimeter to determine height and follow common pressure levels (flight levels) using a QNH of 1013 in RVSM airspace. The errors in the aircraft altimetry sensing systems are not apparent during routine operations as the altimeter displays to the aircrew and air traffic systems a level that includes these altimetry system errors (ASE). As such, the presentation to the pilot is often different to the actual height of the aircraft. During routine calibration the aircraft systems are maintained on the ground while at rest, so the dynamic nature of ASE is not seen. Aircraft altimetry systems also employ parts that:

- wear over time (such as the pitot-static probe and portions of internal plumbing); and/or
- are subject to damage (such as skin flexing/deformation during operations); and/or
- are effected by modification of airframes (such as the incorrect application of paint or mounting of accessories in the vicinity of the static pressure port).

2.2 All these activities are capable of producing significant error in true height. Other factors seen in normal operations of high-speed flight such as aerodynamic loading, and exposure to ranges of temperature, moisture and contaminants, are also capable of producing significant variation in the sensed pressure. These errors can vary over the population of operational aircraft of the same type and within each aircraft this error can change with time in service.

2.3 **Figure 1** below details the variations observed in true altitude over the last five years for a single airframe. Note the increased rate of deterioration in the last 10 months of the sample period. **Figure 2** shows the variation in ASE over a fleet of 15 airframes of the same type at about the same period of time

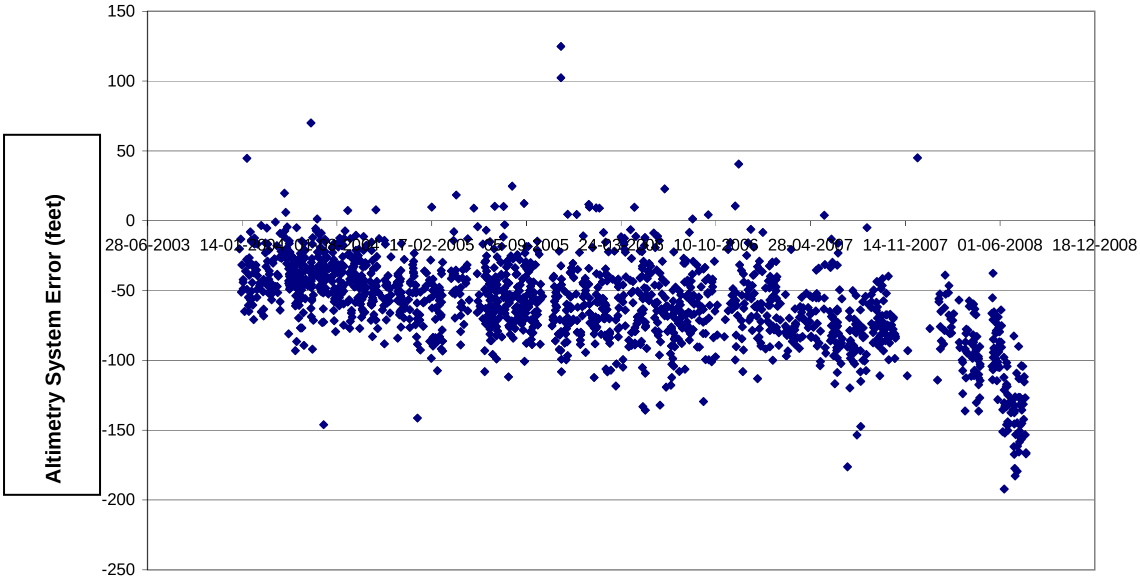


Figure 1: Example of single airframe Altimetry System Error degradation over 5 years

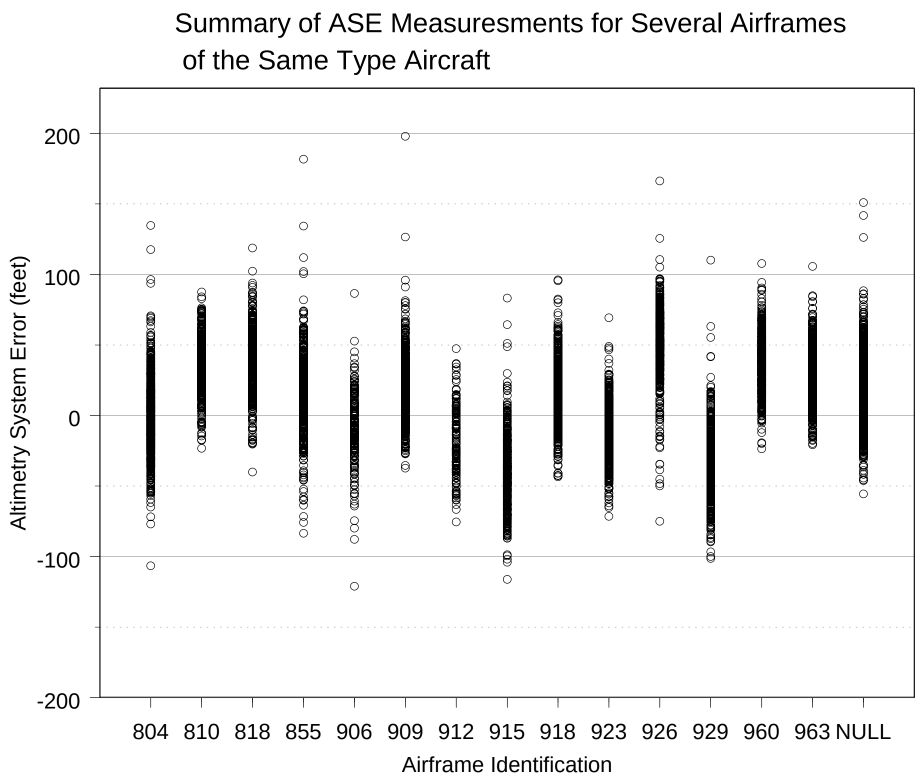


Figure 2: Variation of ASE over 15 airframes of same type at a similar point on time.

2.4 Safe RVSM operations demand high accuracy of the altimetry systems and RMAs have evidence that ASE can vary within a population of the same type at any point in time and by individual aircraft over any period of time. To ensure that only high accuracy altimetry systems are in operation, the ICAO Annex 6 monitoring requirements need to be in place by 2010 however it clearly makes for safer operations to implement the long term height monitoring capability without delay.

Include additional text here that explains the rationale for the Annex 6 sample requirements and periodicity etc. The objective is so that when Operators demand an explanation from RMAs as to why they have to be monitored, RMAs are properly equipped to answer.

3. Asia/Pacific RVSM Monitoring arrangements

3.1 Assessment of the safety performance of RVSM airspace is undertaken by specialist assessment bodies known as Regional Monitoring Agencies (RMAs), which are specifically established to undertake the on-going monitoring of RVSM operations in order to meet ICAO Standards. For the APAC Region, APANPIRG-endorsed RMA services are provided by:

- The Australian Airspace Monitoring Agency (AAMA), operated by Airservices Australia.
- The China RMA, operated by the Air Traffic Management Bureau (ATMB) of the Civil Aviation Administration of China (CAAC).
- The JCAB RMA, operated by the Japan Civil Aviation Bureau.
- The Monitoring Agency for the Asia Region (MAAR), operated by Aeronautical Radio of Thailand (AEROTHAI).
- The Pacific Approvals Registry and Monitoring Organization (PARMO), operated by the United States Federal Aviation Administration.

3.2 The Flight Information Regions (FIRs) for which each RMA takes responsibility have been described in the RASMAG *"List of Competent Airspace Safety Monitoring Organizations"*–a copy of which is included as Appendix A.

4. Long term RVSM height monitoring requirements

4.1 The ICAO Separation and Airspace Safety Panel (SASP) has identified that height-keeping performance monitoring results for RVSM approved aircraft had, in some cases, demonstrated long-term adverse trends in altimetry system error (ASE) stability. The likely results of this trend, if not reversed, would be aircraft becoming non-compliant with RVSM requirements. Accordingly, to ensure that adverse trends in ASE stability were detected, it was recognised that globally applicable RVSM long-term height monitoring requirements would be necessary.

4.2 As a result of proposals made by the SASP, during 2007 the ICAO Air Navigation Commission (ANC) agreed to amendments to Annex 6 – *Operation of Aircraft* that detail global RVSM long-term monitoring requirements that become effective in November 2010. These requirements state as follows:

> *7.2.7 The State of the Operator that has issued an RVSM approval to an operator shall establish a requirement which ensures that two aeroplanes of each aircraft type grouping of the operator have their height keeping performance monitored, at least once every two years or within intervals of 1 000 flight hours per aeroplane, whichever period is longer. If an operator aircraft type grouping consists of a single aeroplane, monitoring of that aeroplane shall be accomplished within the specified period.*

4.3 As a result of the adoption of the Annex 6 requirements above, during May 2009 the SASP proposed a revision to Annex 11 that clarifies the regional component of RVSM monitoring. This proposal is currently under review by the ICAO Secretariat and the ANC, and states as follows:

> *3.3.4.1 For all airspace where a reduced vertical separation minimum of 300 m (1 000 ft) is applied between FL 290 and FL 410 inclusive, a programme shall be instituted, on a regional basis, for monitoring the height-keeping performance of aircraft operating at these levels, in order to ensure that the ~~implementation and~~ continued application of this vertical separation minimum meets the regional safety objectives. ~~The coverage of the regional height-monitoring facilities provided under this programme shall be adequate to permit monitoring of all the relevant aircraft types and all of operators that operate in RVSM airspace.~~ The scope of regional monitoring programmes shall be adequate to conduct analyses of aircraft group performance and evaluate the stability of altimetry system error.*
>
> *~~Note. -- The number of separate monitoring programmes should be restricted to the minimum necessary to effectively provide the required services for the region.~~*
>
> *3.3.4.2 Arrangements shall be put in place, through inter-regional agreement, for the sharing between regions of data from monitoring programmes.*

4.4 The RASMAG has considered the new requirements for long-term height monitoring in some detail, noting that the provisions will take effect from November 2010 in about a years time. During 2008 RASMAG circulated 6 Long Term Height Monitoring Actions (Appendix B refers) for the attention of Asia/Pacific States and airspace users. Additionally, in relation to the Annex 6 and Annex 11 requirements, RASMAG has agreed that the RVSM **Minimum** Monitoring Requirements (MMRs, see Appendix C for summary of Asia/Pacific MMRs) that had previously been adopted for use by RMAs in the Asia/Pacific Region should continue in use for the time being. In taking this decision, RASMAG recognised that monitoring was a significant burden to operators and should be kept to the minimum necessary. RASMAG therefore agreed to continuously review monitoring results with the objective of migrating to the Annex 6 provisions as the basis for regional MMRs providing that regional safety requirements were not compromised.

4.5 APANPIRG/18 recognized that the 2010 implementation of Annex 6 global long-term monitoring requirements for airframes used in RVSM operations would have significant impacts in the way regional monitoring was managed, including the need for widespread regional height monitoring infrastructure capability to be made available. Under the terms of Conclusion 18/4, APANPIRG tasked Asia/Pacific RMAs in conjunction with RASMAG to prepare this regional impact statement summarizing the estimated consequences for the Region, including consideration of the numbers of airframes required to be monitored and ground monitoring infrastructure required.

5. Monitoring of Airframes

5.1 The implementation of long-term height monitoring requirements will place significant additional responsibilities on operators, State approval authorities and RMAs alike. Within the Asia/Pacific Region, the RMAs in conjunction with RASMAG have presently standardised on a set of RVSM MMRs that do not specifically prescribe on-going monitoring requirements after the initial monitoring of operator fleet or single aircraft type operations when an RVSM operational approval is sought by the operator. However, the Annex 6 provisions concern on-going monitoring specifically and, as a result, the current Asia/Pacific MMRs will need to be reviewed to align, to the extent possible, with the monitoring periodicity requirements in Annex 6.

5.2 For the purposes of this assessment in determining the monitoring requirement after November 2010, the Asia/Pacific RMAs have provided approximate numbers of airframes based on the criteria set in the Annex 6 amendment. As a result the total number of airframes to be monitored over the 2 year period ending November 2012 is expected to be about **XXXXX.** A detailed breakdown of this analysis is provided in Appendix D. It should be noted that the number of airframes to be monitored is likely to increase over the medium term as older, non-RVSM capable aircraft are replaced with more modern types with full RVSM capability.

6. Ground-Based Monitoring Infrastructure

6.1 The implementation of long-term height monitoring will require significant changes in the monitoring infrastructure to ensure the requirements of Annex 6 are met. Currently within the Asia/Pacific Region, airframe monitoring is undertaken by means of either a ground-based system or a portable unit temporarily mounted in the aircraft.

6.2 In the case of ground-based systems, monitoring is undertaken by aircraft flying in proximity to the Height Monitoring Units (HMUs) in Europe or in North America (where they are known as Aircraft Geometric Height Measurement Elements -AGHMEs) to estimate aircraft ASE. Three HMUs are managed by Eurocontrol, one by the North Atlantic Central Monitoring Agency (NAT CMA), and six AGHMEs by the Pacific Approvals Registry and Monitoring Agency (PARMO) - four in the United States and two in Canada. Ground-based monitoring by these systems is effective for aircraft operated internationally to those continents, and for new aircraft from the major manufacturers.

6.3 In practice, ground-based monitoring can only occur when an aircraft overflies – in level flight - a ground-based monitoring unit or transits the local airspace specifically associated with the unit. This is not convenient in all cases as operators may have to vary flight patterns to overfly a HMU. Therefore ground-based monitoring units should ideally be located at points that are routinely overflown by aircraft engaged in normal scheduled operations, rather than at locations that require aircraft to divert from normal flight paths in order to overfly the ground monitoring unit. At present, there are no operational ground-based monitoring facilities in the Asia/Pacific region.

6.4 The portable GPS Monitoring Unit (GMU) is a carry-on system installed in an aircraft for a single flight. Its main advantage is the ability to monitor an individual aircraft during normal operations without the need to fly over a ground-based monitoring system in a particular portion of airspace. Data files from a GMU must be post-processed to extract aircraft geometric height which must then be combined with other information in order to produce height keeping performance data. GMUs are used by the US FAA, AEROTHAI, ATMB of CAAC and one or two other approved service providers in conjunction with the FAA Technical Center. GMU monitoring is coordinated by RMAs or State approval authorities; it is widely used and effective. However, it can be costly and inconvenient to operators: there are charges for the use of the unit, and its installation and subsequent removal may involve time out of service for the aircraft.

6.5 In recent times the SASP has been progressing work to prove the acceptability of the geometric height data available in ADS-B messages as a cost effective means of monitoring ASE stability. Significant trials undertaken by the FAA in the United States have produced good results and in particular, the Australian Airspace Monitoring Agency (AAMA) operating through Airservices Australia is keen to progress this work given its wide-coverage ADS-B surveillance network and the cost effectiveness of such a system. However, using ADS-B data alone to monitor aircraft ASE will not provide a complete sample of the airspace population unless a mandated ADS-B fitment requirement exists in a particular Region or State. In Australia, for example, such a mandate will become effective in 2013 for all civil aircraft operating above Flight Level 280, but this is not yet the case in most areas of the Asia/Pacific region.

6.6 The advantage of ground-based monitoring systems (HMUs, AGHME or ADS-B) is that they provide large volumes of data and information about the aircraft population and permit repeated measurements on individual airframes, which is highly beneficial in detecting trends in ASE performance. The location of the ground-based monitoring system is very important, as it determines the number of aircraft for which ASE estimates will be produced and further consideration of this issue will need to be undertaken by RASMAG in conjunction with APANPIRG and Asia/Pacific States.

6.7 The advantage of a portable airborne system (GMU) is that it provides the ability to target specific portions of the airspace population to meet immediate needs, however GMU monitoring does not provide the continuous data streams necessary to determine aircraft group performance and ASE stability. Therefore although GMU monitoring addresses the basic MMR, it should be considered only as supplementary to ground-based monitoring.

6.8 Importantly, it should be recognised that the Asia/Pacific States have a large number of aircraft that confine their operations to single State or Regional environments and therefore would rarely be able to benefit from post-initial approval monitoring by the ground-based units in Europe and North America. This is particularly relevant in the cases of Australia, China, and India which have large domestic fleets that are not used for international operations. Of the **XXXXX** airframes expected to be monitored regionally over the 2 year period ending November 2012, it is estimated that less than **YY%** will have access to the European, Canadian or United States ground-based monitoring installations during scheduled services.

6.9 Accordingly, a complete monitoring programme for the Asia/Pacific region should make provision for a combination of ground-based monitoring systems such as the HMU, AGHME and/or, in the future, ADS-B as well as airborne systems such as the GMU. However, recognising the cost of installing, operating and maintaining such systems, regional investment should be kept at the absolute minimum necessary to meet the operational requirements. Since the use of ADS-B systems for height monitoring is still under development and it will be some time before ABS-B is usable as a monitoring alternative, currently proven ground-based monitoring systems will need to be deployed in the Asia/Pacific region as the initial response to the long-term monitoring requirements. Deployment of these systems needs to be closely coordinated with APANPIRG, RASMAG and the Asia/Pacific RMAs to ensure effective monitoring within the Region whilst avoiding unnecessary investment in dedicated monitoring infrastructure.

7. Impacts on the Asia/Pacific Region

Objectives of height monitoring

7.1 In considering the impact of the Annex 6 and proposed Annex 11 provisions on the Asia/Pacific region, an understanding of the objectives to be achieved by height monitoring is necessary. At the broadest level, the monitoring programme must ensure that the continued operational application of RVSM meets the established safety requirements.

7.2 In order to achieve this primary objective, three subsidiary objectives must be met for the performance monitoring of RVSM. The first is to ensure compliance with a basic RVSM Minimum Monitoring Requirement. The MMR serves as a check that operators initially made changes and continue to maintain aircraft in accordance with manufacturer's recommendations for airworthiness. For this purpose, only a sample of observations from each of the operators' fleets is required and the Annex 6 provisions require the observations to be taken at no less than a two year interval.

7.3 The second objective is to conduct analyses of aircraft group performance, where a group consists of airframes meeting common parameters including essentially identical design, static system source is nominally the same, avionics units are nominally the same etc, as defined in Chapter 4 of the *Manual on Implementation of a 300 m (1000 ft) Vertical Separation Minimum between FL290 and FL410 Inclusive (Doc 9574).* In achieving this objective, a much larger data sample adequate to determine ASE performance is required. Accordingly, enough ASE monitoring data should be captured to be able to assess <u>every</u> monitoring group against RVSM performance requirements routinely throughout the two-year period.

7.4 The final objective requires that in order to fulfil the system performance monitoring required by Chapter 6 of the *Manual on Implementation of a 300 m (1000 ft) Vertical Separation Minimum between FL290 and FL410 Inclusive (Doc 9574)*, as recognised in the amended Annex 11 provisions presently under consideration, the monitoring process should also aim to provide evidence of ASE stability. Sufficient ASE performance data must be available to show that, for the bulk of airframes circulating in the RVSM environment, ASE performance does not vary substantially from the beginning to the end of the two-year period. Such data is obtained from repeated samples on individual airframes throughout the two-year period.

Portable and ground-based monitoring

7.5 In terms of meeting the basic MMR, monitoring completed using a portable GMU is acceptable. However, in relation to assessing aircraft group performance and ASE stability, large volumes of data are necessary, including frequent monitoring of the same airframes over a period of time in order to determine typical group performance and identify any long-term adverse trends in ASE stability. Such large volumes of data are only obtainable from a ground-based monitoring installation that is regularly overflown by the relevant airframes. Accordingly, a regional monitoring infrastructure that provides the ability to meet the basic MMR requirements as well as the group performance and ASE stability monitoring requirements is necessary. This involves a mixture of portable GMU and ground-based monitoring capability used in a continuous and well coordinated manner.

Current Asia/Pacific monitoring capabilities

7.6 At present, there are no ground-based monitoring installations operating in the Asia/Pacific region. Such facilities are available in some other areas of the world visited regularly by aircraft based in the Asia/Pacific region, and some monitoring results are available to be shared between global RMAs.

7.7 Limited portable GMU monitoring capability is available via Asia/Pacific RMAs - as described in paragraph 6.4 above.

Appropriate ground-based monitoring locations

7.8 Clearly, in a region of the size of the Asia/Pacific it is not at all feasible to provide 100% monitoring capabilities in all areas. However, a review of the major international traffic flows (see Appendix E) suggests that appropriate locations for installation of ground-based monitoring systems could include Australia/New Zealand, south-east Asia, north-east Asia, China and India/Pakistan. The availability of ground-based monitoring capabilities in these five areas would adequately serve the majority of international traffic flows, whilst also catering for the disposition and monitoring of the larger domestic fleet operations in Australia, China and India. Adoption of such a ground-based infrastructure could mean that existing regional portable GMU capability is adequate. However, the absence of suitable ground-based infrastructure means that investment in GMU capabilities will be necessary.

7.9 In relation to a ground-based unit in northeast Asia, Japan is already advanced with planning to install three ground-based height monitoring units (HMUs) in the Japanese airspace (i.e. Fukuoka FIR). The first HMU is targeted to commence operations in the second quarter of 2011, the second and the third HMUs will come on stream in the second quarter of 2012.

Coordination arrangements

7.10 In an effort to minimise duplications of effort whilst still ensuring compliance with monitoring provisions, effective coordination between RMAs globally, and between RMAs and the States they are serving, is essential. Each Asia/Pacific RMA should examine monitoring results accumulated by all other authorized global RMAs, regardless of region, in order to utilize monitoring results from other regions to avoid duplication and reduce the actual monitoring burden faced by each RMA and operator.

7.11 APANPIRG has already recognised the importance of coordination between RMAs and States, with APANPIRG/19 (September 2008) promulgating the following Conclusion:

Conclusion 19/15 – Enhanced communications between States and RVSM RMAs

That, noting the Annex 6 provisions for the global long term monitoring of airframes used in RVSM operations and the critical role of Asia/Pacific RVSM Regional Monitoring Agencies (RMAs) in monitoring the safety of RVSM operations, the Regional Office draw the attention of States to the Long Term Height Monitoring Actions promulgated by RASMAG. In particular, States are encouraged to immediately strengthen relationships with their respective RMAs to ensure that information in relation to RVSM approval status is continuously available to RMAs.

7.12 Despite Conclusion 19/15, Asia/Pacific RMAs continue to experience difficulties in receiving timely and accurate information (including routine large height deviation [LHD] reporting) from States. In order to enable RMAs to assist States to fulfil their monitoring obligations, it is necessary that States:

a) continuously update RMA databases of operators and aircraft holding State RVSM approvals;

b) enable the expeditious forwarding of all LHD and related reports to RMAs, and

c) ensure availability of current details for State RVSM Point of Contact (POC) officials.

7.13 In the event that adequate compliance with coordination arrangements is not achieved, RASMAG will encourage APANPIRG to place non compliant States on the APANPIRG List of Deficiencies in the ATM/AIS/SAR Fields.

8. Conclusions

8.1 The Annex 6 requirements for RVSM long-term height monitoring that take effect from November 2010 will have a significant impact on the way in which such monitoring will be undertaken in the Asia/Pacific region. The RASMAG, in conjunction with the Asia/Pacific RMAs, has determined a probable monitoring burden of **XXXXX** airframes region-wide in the 2 years ending November 2012 and the existing Asia/Pacific RVSM Minimum Monitoring Requirements will need to be reviewed against the amended ICAO documentation.

8.2 Three primary objectives need to be achieved in terms of RVSM height monitoring:

a) Compliance with a basic Minimum Monitoring Requirement (MMR - e.g. two aircraft per type, per operator, per two years),

b) Conduct of analyses of aircraft group performance, and

c) Evaluation of the stability of altimetry system error.

8.3 Achievement of the first objective is via sampling of relatively few airframes at relatively long intervals. Achievement of the other two objectives requires large volumes of data obtained via repeated sampling of airframes over extended periods of time using ground-based monitoring equipment.

8.4 Additional monitoring infrastructure will need to be deployed in the Asia/Pacific Region. A range of proven monitoring systems is currently available, including ground-based fixed installation HMUs and AGHMEs and portable airborne GMUs. A mix of ground-based and portable GMU capability will be required. Although the use of ADS-B for height monitoring purposes is currently under development with trials to date showing encouraging results, it is expected to be some time before ADS-B provides a practical monitoring capability.

8.5 Monitoring conducted using portable GMU equipment achieves a single monitoring result on each occasion that is suitable for compliance with basic MMRs, however the large volumes of data necessary for evaluation of the group performance of aircraft and stability of altimetry systems can only be obtained by frequent monitoring using ground-based monitoring installations.

8.6 Ground-based monitoring can only occur when an aircraft overflies – in level flight - a ground-based monitoring unit or transits the local airspace specifically associated with the unit. Therefore ground-based monitoring units should ideally be located at points that are routinely overflown by aircraft engaged in normal scheduled operations, rather than at locations that require aircraft to divert from normal flight paths in order to overfly the ground monitoring unit.

8.7 States retain responsibility for compliance with Annex provisions, including those relating to RVSM height monitoring. However, an extensive system of APANPIRG approved RMAs has been established in the Asia/Pacific region to assist States in this regard, provided States make the necessary data continuously available to RMAs and comply with relevant RMA requirements. Coordination arrangements have been implemented between global RMAs to enable sharing of global monitoring data.

8.8 However, within the Asia/Pacific Region, present coordination activities by States with their respective RMAs are not adequate. States will be required to comply with related APANPIRG Conclusions, including Conclusion 19/15 and immediately strengthen relationships with their respective RMAs to ensure that information in relation to RVSM approval status is continuously available to RMAs. Should voluntary compliance not be effective, RASMAG will encourage APANPIRG to place non compliant States on the APANPIRG List of Deficiencies in the ATM/AIS/SAR Fields.

8.9 A review of the major international traffic flows suggests that appropriate locations for installation of ground-based monitoring systems could include Australia/New Zealand, south-east Asia, north-east Asia, China and India/Pakistan. The availability of ground-based monitoring capabilities in these five areas would adequately serve the majority of international traffic flows, whilst also catering for the disposition and monitoring of the larger domestic fleet operations in Australia, China and India. Adoption of such a ground-based infrastructure could mean that existing regional portable GMU capability is adequate. However, the absence of suitable ground-based infrastructure means that investment in GMU capabilities will be necessary.

8.10 Japan has already indicated its intention to deploy three HMUs situated within the airspace of Japan, with the first HMU targeted to become operational in 2011.

8.11 APANPIRG, in close coordination with RASMAG and Asia/Pacific RMAs will need to be involved in recommending the types and appropriate locations of monitoring systems to most effectively monitor the Asia/Pacific aircraft population with the least infrastructure investment.

APPENDIX A

APANPIRG Asia/Pacific Airspace Safety Monitoring

RASMAG LIST OF COMPETENT AIRSPACE SAFETY MONITORING ORGANIZATIONS

The Regional Airspace Safety Monitoring Advisory Group of APANPIRG (RASMAG) is required by its terms of reference to recommend and facilitate the implementation of airspace safety monitoring and performance assessment services and to review and recommend on the competency and compatibility of airspace monitoring organizations. In order to assist in addressing these requirements, RASMAG updates and distributes the following list of competent airspace safety monitoring organizations for use by States requiring airspace safety monitoring services. In the context of the list, abbreviations have meanings as follows:

- RMA – Regional Monitoring Agency – safety assessment and monitoring in the vertical plane (i.e. RVSM);
- EMA – En-route Monitoring Agency – safety assessment and monitoring in the horizontal plane (i.e. RHSM, RNAV10, RNP4);
- CRA – Central Reporting Agency – technical performance of data link systems (i.e. ADS/CPDLC); and
- FIT – FANS 1/A Interoperability/Implementation Team – parent body to a CRA.

(last updated 12 June 2009)

Organisation *(including contact officer)*	State	Competency	Status	Airspace assessed (FIRs)
Australian Airspace Monitoring Agency (AAMA) - **Airservices Australia** Mr Robert Butcher, Operational Analysis Manager, Safety and Environment Group, email robert.butcher@airservicesaustralia.com	Australia	APANPIRG RMA	Current	Brisbane, Honiara, Jakarta, Melbourne, Nauru, Port Moresby and Ujung Pandang FIRs.
		EMA	Current	Brisbane, Melbourne FIRs.

Organisation *(including contact officer)*	State	Competency	Status	Airspace assessed (FIRs)
China RMA - **Air Traffic Management Bureau, (ATMB) of Civil Aviation Administration of China (CAAC)** Mr. Tang Jinxiang, Engineer of Safety and Monitoring Technical Group, ATMB e-mail: tangjx@adcc.com.cn	China	APANPIRG RMA	Current	Beijing, Guangzhou, Kunming, Lanzhou, Shanghai, Shenyang, Urumqi and Wuhan FIRs and Sector 01 (airspace over Hainan Island) of the Sanya FIR, Pyongyang.
JCAB RMA - **Japan Civil Aviation Bureau** Mr. Kazunaga Suzuki, Special Assistant to the Director, Flight Procedures and Airspace Program Office email suzuki-k22z@mlit.go.jp	Japan	APANPIRG RMA	Current	Fukuoka FIR
		EMA	Available fourth quarter – 2009	Fukuoka FIR
Monitoring Agency for the Asia Region (MAAR) – Aeronautical Radio of Thailand LTD Mr. Nuttakajorn Yanpirat, Executive Officer, Systems Engineering,Aeronautical Radio of Thailand Ltd. email: nuttakajorn.ya@aerothai.co.th	Thailand	APANPIRG RMA	Current	Bangkok, Kolkatta, Chennai, Colombo, Delhi, Dhaka, Hanoi, Ho Chi Minh, Hong Kong, Karachi, Kathmandu, Kota Kinabalu, Kuala Lumpur, Lahore, Male, Manila, Mumbai, Phnom Penh, Sanya FIR, Singapore, Taibei, Ulaan Bataar, Vientiane, Yangon FIRs

Organisation *(including contact officer)*	State	Competency	Status	Airspace assessed (FIRs)
Pacific Approvals Registry and Monitoring Organization (PARMO) – Federal Aviation Administration (US FAA) Mr. Dale Livingston, Manager, Separation Standards Analysis Team, FAA email: dale.livingston@faa.gov	USA	APANPIRG RMA	Current	Anchorage Oceanic, Auckland Oceanic, Incheon, Nadi, Oakland Oceanic, Tahiti FIRs
		EMA	Current	Anchorage Oceanic, Oakland Oceanic
South East Asia Safety Monitoring Agency (SEASMA) - **Civil Aviation Authority of Singapore (CAAS)** Mr. Kuah Kong Beng, Chief Air Traffic Control Officer email: KUAH_Kong_Beng@caas.gov.sg	Singapore	EMA for South China Sea	Current	Hong Kong, Ho Chi Minh, Kota Kinabalu, Kuala Lumpur, Manila, Sanya and Singapore FIRs
FIT - SEA ICAO Regional Office email icao_apac@bangkok.icao.int & **CRA Japan** Mr. Mitsuo Hayasaka, Deputy Director, Air Traffic Control Association Japan, email:hayasaka@atcaj.or.jp	ICAO Regional Office & CRA Japan	FIT & CRA	Current	South China Sea FIRs

Organisation *(including contact officer)*	State	Competency	Status	Airspace assessed (FIRs)
IPACG/FIT Mr. Takahiro Morishima, JCAB Co-Chair email: morishima-t2zg@mlit.go.jp & Mr. Reed Sladen, FAA Co-Chair email reed.b.sladen@faa.gov	Japan & USA	FIT & CRA	Current	North & Central Pacific (Oceanic airspace within Fukuoka FIR, and Anchorage & Oakland FIRs)
CRA Japan Mr. Masahisa Hayashi, Deputy Director, Air Traffic Control Association Japan, email:hayashi@atcaj.or.jp	Japan	CRA	Current	Fukuoka FIR for IPACG/FIT Ho Chi Minh, Manila, Singapore FIRs for FIT-SEA
FIT - BOB ICAO Regional Office email icao_apac@bangkok.icao.int & Mr. Bradley Cornell, Boeing Engineering email Bradley.D.Cornell@Boeing.Com	ICAO Regional Office & Boeing USA	FIT & CRA	Current	Bay of Bengal FIRs, Ujung Pandang and Jakarta FIRs, provides assistance to the members of the Arabian Sea/Indian Ocean ATS Coordination Group (ASIOACG)
ISPACG/FIT Mr. Bradley Cornell, Boeing Engineering email Bradley.D.Cornell@Boeing.Com	Boeing USA	FIT & CRA	Current	South Pacific FIRs and members of the Informal South Pacific ATS Coordination Group (ISPACG)

APPENDIX B

RASMAG Long Term RVSM Height Monitoring Actions – Asia/Pacific Region

APANPIRG/18 (September, 2007) was of the opinion that work should be undertaken as soon as possible in order to assess the consequences for the Asia/Pacific Region of the implementation of ICAO global long term RVSM height monitoring requirements from 2010 and, under the terms of Conclusion 18/4, requested Asia/Pacific Regional Monitoring Agencies (RMAs) in conjunction with the APANPIRG Regional Airspace Safety Monitoring Advisory Group (RASMAG) to prepare a regional impact statement summarizing the estimated consequences for the Region, including consideration of the numbers of airframes required to be monitored.

In order to progress these matters in a timely fashion, RASMAG/8 (December, 2007) formulated six Long Term Height Monitoring (LTHM) Actions for promulgation, as outlined below. More details in respect to each LHTM Action can be found in the RASMAG/8 report, available from the website of the ICAO Asia/Pacific Office at http://www.bangkok.icao.int/ under the “Meetings” menu.

LTHM Action 1: Based on the final draft of the RMA Manual which was expected to be available from June 2008, Asia/Pacific RMAs in conjunction with RASMAG prepare and widely promulgate an information circular detailing, as a minimum, the roles and responsibilities of an RMA, the height monitoring process and equipment required, and the reasons and quantum of the global long term height monitoring requirements.

LTHM Action 2: To maintain effective delivery of existing RMA services and facilitate planning specifically designed to prepare for application of global long-term RVSM height monitoring requirements from 2010, each Asia/Pacific RMA should, as a matter of priority, bring to the attention of State regulators the difficulties being experienced by RMAs in receiving timely and accurate information (including routine large height deviation [LHD] reporting) from States. Asia/Pacific RMAs should seek assistance from States in implementing robust processes to:

a) continuously update RMA databases of operators and aircraft holding State RVSM approvals;

b) enable the expeditious forwarding of all LHD and related reports to RMAs, and

c) ensure availability of current details for State RVSM Point of Contact (POC) officials.

LTHM Action 3: Whilst recognizing that responsibility for compliance with Annex 6 height monitoring provisions remains the responsibility of States, as soon as practicable each Asia/Pacific RMA, in conjunction with State regulatory authorities and airspace user organizations, should develop a methodology for reviewing the RMA database of RVSM approvals in order to develop and promulgate a list of the minimum height monitoring which must be accomplished by each operator to which the RMA provides services. In preparing this list, account should be taken of special circumstances pertaining to infrequent airspace users recognizing that some operators may be required to complete minimum monitoring requirements which are a function of the proposed 1,000-flying-hour limit rather than the two-year limit.

<u>LTHM Action 4:</u> After determining the potential monitoring burden posed by the operators to which it provides service, each Asia/Pacific RMA should examine monitoring results accumulated by all other authorized global RMAs, regardless of region, in order to utilize monitoring results from other regions to avoid duplication and reduce the actual monitoring burden the RMA faces.

<u>LTHM Action 5:</u> Each Asia/Pacific Region RMA should, in light of its anticipated height monitoring burden, propose recommendations through RASMAG to APANPIRG useful in determining the regional ground-based and GPS-based Monitoring System (GMS) height monitoring infrastructure necessary to enable its affiliated operators to meet the global long-term RVSM monitoring requirements applicable from November 2010.

<u>LTHM Action 6:</u> Asia/Pacific RMAs collaboratively investigate the technical feasibility of using the aircraft geometric height produced by ADS-B and Multilateration surveillance systems to support monitoring of aircraft height keeping performance.

APPENDIX C

SUMMARY OF ASIA/PACIFIC RVSM MINIMUM MONITORING REQUIREMENTS (MMRs):

1. UPDATE OF MONITORING REQUIREMENTS TABLE AND WEBSITE. As significant data is obtained, monitoring requirements for specific aircraft types may change. When the table is updated, a letter will be distributed to States and operators. The updated table will be posted on the websites of the APAC Regional Monitoring Agencies (RMAs) on behalf of the International Civil Aviation Organization (ICAO) Asia-Pacific Regional Planning Group (APANPIRG).

2. INITIAL MONITORING. All operators that operate or intend to operate in airspace where RVSM is applied are required to participate in the RVSM monitoring programme. The attached table of monitoring requirements establishes requirements for initial monitoring associated with the RVSM approval process. In their application to the appropriate State authority for RVSM approval, operators must include a plan that demonstrates the process that will be used to meet the applicable initial monitoring requirements.

3. AIRCRAFT STATUS FOR MONITORING. Aircraft engineering work that is required for the aircraft to receive RVSM airworthiness approval must be completed prior to the aircraft being monitored. Any exception to this rule shall be coordinated with the State authority.

4. APPLICABILITY OF MONITORING FROM OTHER REGIONS. Monitoring data obtained in conjunction with RVSM monitoring programmes from other regions can be used to meet Asia/Pacific monitoring requirements. Asia/Pacific RMAs have access to monitoring data from other regions and will coordinate with States and operators to inform them on the status of individual operator monitoring requirements.

5. MONITORING PRIOR TO THE ISSUE OF RVSM OPERATIONAL APPROVAL IS NOT A REQUIREMENT. Operators should submit monitoring plans to the responsible civil aviation authority that show how they intend to meet the requirements specified in the attached table. Monitoring will be carried out in accordance with this table.

6. AIRCRAFT GROUPS NOT LISTED IN THE TABLE. Contact the RMA responsible for the State of registration for clarification if an aircraft group is not listed in the Minimum Monitoring Requirements table or for clarification of other monitoring related issues. An aircraft group not listed in the table below will probably be subject to Category 2 monitoring requirements.

7. TABLE OF MONITORING GROUPS. A table of monitoring groups is provided as an appendix to this Minimum Monitoring Requirements document. The table shows the aircraft types and series that are grouped together for operator monitoring purposes.

8. TRAILING CONE DATA. Altimetry System Error estimations developed using Trailing Cone data collected during RVSM certification flights can be used to fulfill monitoring requirements. It must be documented that aircraft RVSM systems were in the approved RVSM configuration for the flight.

9. MONITORING OF AIRFRAMES THAT ARE RVSM COMPLIANT ON DELIVERY. If an operator adds new RVSM compliant airframes of a type for which it already has RVSM operational approval and has completed monitoring requirements for the type in accordance with the attached table, the new airframes are not required to be monitored. If an operator adds new RVSM compliant airframes of an aircraft type for which it has NOT previously received RVSM operational approval, then the operator should complete monitoring in accordance with the attached tables.

10. FOLLOW-ON MONITORING. Monitoring is an on-going program that will continue indefinitely after the RVSM approval process. A follow-on sampling program for additional operator aircraft will be coordinated by the Asia-Pacific Regional Airspace Safety Monitoring Advisory Group (RASMAG).

MONITORING IS REQUIRED IN ACCORDANCE WITH THIS TABLE, HOWEVER, IT IS NOT REQUIRED TO BE COMPLETED PRIOR TO OPERATIONAL APPROVAL

MONITORING CATEGORY		AIRCRAFT TYPE	MINIMUM OPERATOR MONITORING FOR EACH AIRCRAFT GROUP
1	Group approved <u>and</u> monitoring data indicates performance in accordance with RVSM standards. **<u>Group Definition:</u>** aircraft have been manufactured to a nominally identical design and build and for RVSM airworthiness approval fall into a group established in an RVSM certification document (e.g., Service Bulletin, Supplemental Type Certificate, Type Certificate Data Sheet).	[A30B, A306], [A312 (GE), A313 (GE)], [A312 (PW), A313 (PW)], A318, [A319, A320, A321], [A332, A333], [A342, A343], A344, A345, A346 B712, [B721, B722], [B733, B734, B735], B737(Cargo), [B736, B737/BBJ, B738/BBJ, B739], [B741, B742, B743], B74S, B744 (5" Probe), B744 (10" Probe), B752, B753, [B762, B763], B764, B772, B773 CL60(600/601), CL60(604), C560, [CRJ1, CRJ2], CRJ7, DC10, [E135, E145], [E170, E190], F100, GLF4, GLF5, LJ60 L101, MD10, MD11, MD80 (All series), MD90	Two airframes from each fleet* of an operator to be monitored as soon as possible but **not later than 6 months after the issue of RVSM operational approval** ** Note. For the purposes of monitoring, aircraft within brackets* [ ] *may be considered as belonging to the same monitoring group. For example, an operator with six A332 and four A333 aircraft may monitor one A332 and one A333* ***or*** *two A332 aircraft* ***o****r two A333 aircraft.*
2	Group approved but insufficient monitoring data collected to move aircraft to Monitoring Category 1. Group definition applies.	Other group aircraft other than those listed in Category 1 including: A124, A388, ASTR, B703, B731, B732, BE20, BE40, C500, C25A, C25B, C525, C550**, C56X, C650, C750, CRJ9, [DC86, DC87], DC93, DC95, F2TH, [FA50 FA50EX], F70, [F900, F900EX], FA20, FA10, GLF2(II), GLF(IIB), GLF3, GALX, GLEX, H25B(700), H25B(800), H25C, IL62, IL76, IL86, IL96, J328, L29(2), L29(731), LJ31, [LJ35, LJ36], LJ45, LJ55, SBR1, T134, T154, T204, P180, PRM1,YK42	60% of airframes from each fleet of an operator (round up if fractional), as soon as possible but **not later than 6 months after the issue of RVSM operational approval.** (*Note: If 60 percent of the fleet yields a fractional number, round up to the next whole aircraft (e.g., for a fleet of 2 aircraft, 0.6 x 2 = 1.2; therefore, 2 aircraft must be monitored). ** Refer to aircraft group table for detail on C550 monitoring
3	Non-Group **<u>Non-group Definition:</u>** aircraft that do not fall under the group definition <u>and</u> for RVSM airworthiness approval are presented as an individual airframe.	Non-group approved aircraft	100% of aircraft shall be monitored as soon as possible but **not later than** **6 months after the issue of RVSM operational approval.**

Estimated RVSM Monitoring Burden For Asia/Pacific Region As a Result of Long Term Height Monitoring Requirements of Annex 6 - Period from Nov 2010 to Nov 2012

(Data estimated by Asia/Pacific RVSM Regional Monitoring Agencies RMAs)

AAMA – Australian Airspace Monitoring Agency (Airservices Australia)

Responsible State	Operator	MMR Category (1,2 or 3)	Aircraft Monitoring Group (e.g. [A34,A343])	Total Aircraft Type Count	Resultant Monitoring Burden
Australia		1			
Total					
Indonesia					
Total					
Papua New Guinea					
Total					
Grand Total					

China RMA – Air Traffic Management Bureau (ATMB)

of Civil Aviation Administration of China (CAAC)

Responsible State	Operator	MMR Category (1,2 or 3)	Aircraft Monitoring Group (e.g. [A34,A343])	Total Aircraft Type Count	Resultant Monitoring Burden (# airframes)
China		1			
Total					
DPRK					
Total					
Grand Total					

JCAB RMA - Japan Civil Aviation Bureau

Responsible State	Operator	MMR Category (1,2 or 3)	Aircraft Monitoring Group (e.g. [A34,A343])	Total Aircraft Type Count	Resultant Monitoring Burden (# airframes)
Japan		1			
Total					
Grand Total					

MAAR – Monitoring Agency for the Asia Region (AEROTHAI)

Responsible State	Operator	MMR Category (1,2 or 3)	Aircraft Monitoring Group (e.g. [A34,A343])	Total Aircraft Type Count	Resultant Monitoring Burden (# airframes)
(include names of MAAR States here)		1			
Total					
(include names of MAAR States here)					
Total					
(include names of MAAR States here)					
Total					
(include names of MAAR States here)					
Total					
Grand Total					

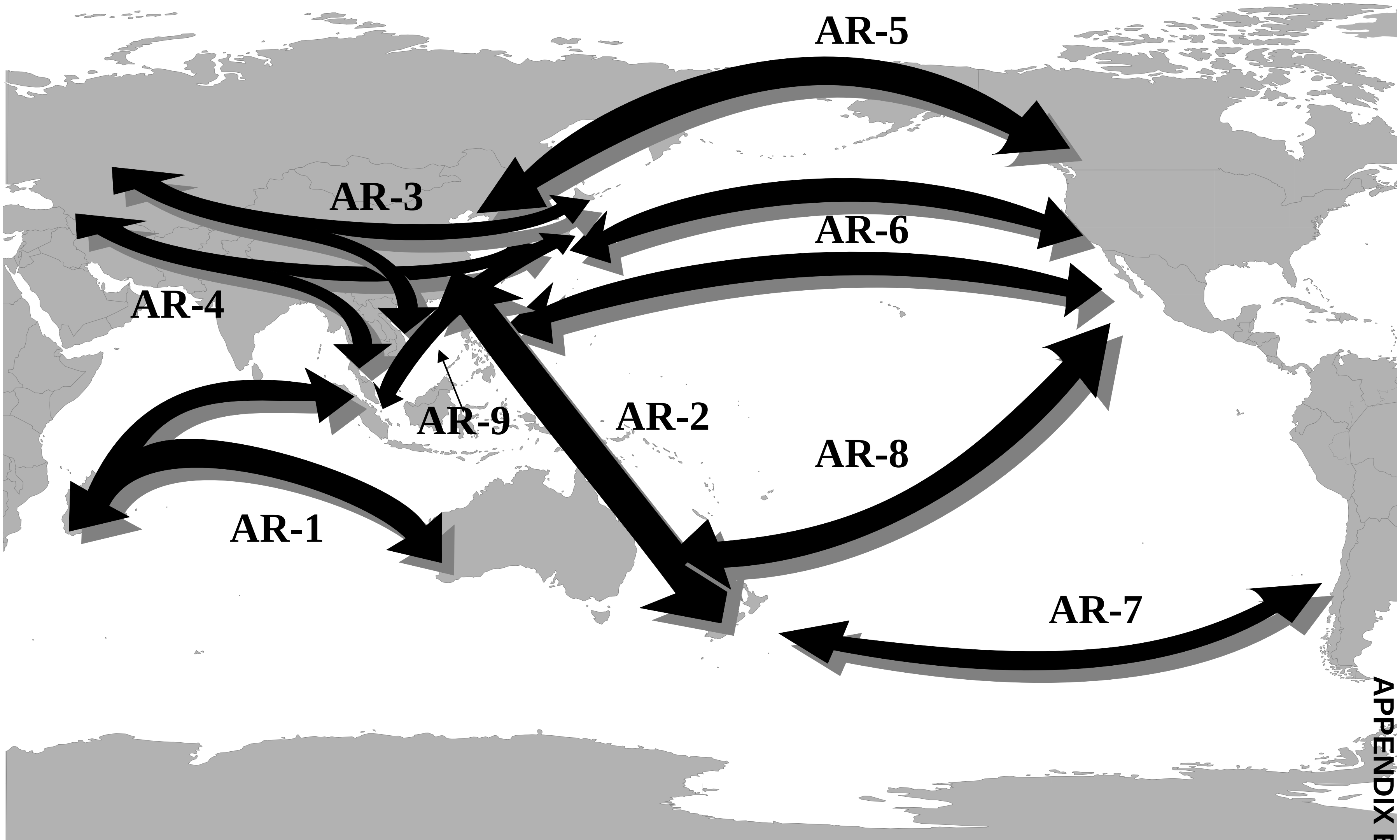
PARMO- Pacific Approvals Registry and Monitoring Organization (USA FAA)

Responsible State	Operator	MMR Category (1,2 or 3)	Aircraft Monitoring Group (e.g. [A34,A343])	Total Aircraft Type Count	Resultant Monitoring Burden (# airframes)
Fiji		1			
Total					
New Zealand					
Total					
Tahiti					
Total					
United States					
Total					
Grand Total					

Overall Asia/Pacific – Estimated Total Monitoring Burden

Asia Pacific Regional Total	

APAC MAJOR TRAFFIC FLOWS



APPENDIX E

APANPIRG Asia/Pacific Airspace Safety Monitoring

RASMAG LIST OF COMPETENT AIRSPACE SAFETY MONITORING ORGANIZATIONS

The Regional Airspace Safety Monitoring Advisory Group of APANPIRG (RASMAG) is required by its terms of reference to recommend and facilitate the implementation of airspace safety monitoring and performance assessment services and to review and recommend on the competency and compatibility of airspace monitoring organizations. In order to assist in addressing these requirements, RASMAG updates and distributes the following list of competent airspace safety monitoring organizations for use by States requiring airspace safety monitoring services. In the context of the list, abbreviations have meanings as follows:

- RMA – Regional Monitoring Agency – safety assessment and monitoring in the vertical plane (i.e. RVSM);
- EMA – En-route Monitoring Agency – safety assessment and monitoring in the horizontal plane (i.e. RHSM, RNAV10, RNP4);
- CRA – Central Reporting Agency – technical performance of data link systems (i.e. ADS/CPDLC); and
- FIT – FANS 1/A Interoperability/Implementation Team – parent body to a CRA.

(last updated 12 June 2009)

Organisation *(including contact officer)*	State	Competency	Status	Airspace assessed (FIRs)
Australian Airspace Monitoring Agency (AAMA) - Airservices Australia Mr Robert Butcher, Operational Analysis Manager, Safety and Environment Group email: robert.butcher@airservicesaustralia.com	Australia	APANPIRG RMA	Current	Brisbane, Honiara, Jakarta, Melbourne, Nauru, Port Moresby and Ujung Pandang FIRs.
		EMA	Current	Brisbane, Melbourne FIRs.

Organisation *(including contact officer)*	State	Competency	Status	Airspace assessed (FIRs)
China RMA - Air Traffic Management Bureau, (ATMB) of Civil Aviation Administration of China (CAAC) Mr. Tang Jinxiang, Engineer of Safety and Monitoring Technical Group, ATMB email: tangjx@adcc.com.cn	China	APANPIRG RMA	Current	Beijing, Guangzhou, Kunming, Lanzhou, Shanghai, Shenyang, Urumqi and Wuhan FIRs and Sector 01 (airspace over Hainan Island) of the Sanya FIR, Pyongyang.
JCAB RMA - Japan Civil Aviation Bureau Mr. Kazunaga Suzuki, Special Assistant to the Director, Flight Procedures and Airspace Program Office, email: suzuki-k22z@mlit.go.jp	Japan	APANPIRG RMA	Current	Fukuoka FIR
		EMA	Available fourth quarter – 2009	Fukuoka FIR
Monitoring Agency for the Asia Region (MAAR) – Aeronautical Radio of Thailand LTD Mr. Nuttakajorn Yanpirat, Executive Officer, Systems Engineering,Aeronautical Radio of Thailand Ltd. email: nuttakajorn.ya@aerothai.co.th	Thailand	APANPIRG RMA	Current	Bangkok, Kolkatta, Chennai, Colombo, Delhi, Dhaka, Hanoi, Ho Chi Minh, Hong Kong, Karachi, Kathmandu, Kota Kinabalu, Kuala Lumpur, Lahore, Male, Manila, Mumbai, Phnom Penh, Sanya FIR, Singapore, Taibei, Ulaan Bataar, Vientiane, Yangon FIRs

Organisation *(including contact officer)*	State	Competency	Status	Airspace assessed (FIRs)
Pacific Approvals Registry and Monitoring Organization (PARMO) – Federal Aviation Administration (US FAA) Mr. Dale Livingston, Manager, Separation Standards Analysis Team, FAA, email: dale.livingston@faa.gov	USA	APANPIRG RMA	Current	Anchorage Oceanic, Auckland Oceanic, Incheon, Nadi, Oakland Oceanic, Tahiti FIRs
		EMA	Current	Anchorage Oceanic, Oakland Oceanic
South East Asia Safety Monitoring Agency (SEASMA) - Civil Aviation Authority of Singapore (CAAS) Mr. Kuah Kong Beng, Chief Air Traffic Control Officer, email: KUAH_Kong_Beng@caas.gov.sg	Singapore	EMA for South China Sea	Current	Hong Kong, Ho Chi Minh, Kota Kinabalu, Kuala Lumpur, Manila, Sanya and Singapore FIRs
FIT - SEA (ICAO Regional Office email icao_apac@bangkok.icao.int & **CRA Japan** Mr. Mitsuo Hayasaka, Deputy Director, Air Traffic Control Association Japan, email:hayasaka@atcaj.or.jp	ICAO Regional Office & CRA Japan	FIT & CRA	Current	South China Sea FIRs

Organisation *(including contact officer)*	State	Competency	Status	Airspace assessed (FIRs)
IPACG/FIT Mr. Takahiro Morishima, JCAB Co-Chair, email: morishima-t2zg@mlit.go.jp & Mr. Reed Sladen, FAA Co-Chair, email: reed.b.sladen@faa.gov	Japan & USA	FIT & CRA	Current	North & Central Pacific (Oceanic airspace within Fukuoka FIR, and Anchorage & Oakland FIRs)
CRA Japan Mr. Mitsuo Hayasaka, Deputy Director, Air Traffic Control Association Japan, email: hayasaka@atcaj.or.jp	Japan	CRA	Current	Fukuoka FIR for IPACG/FIT Ho Chi Minh, Manila, Singapore FIRs for FIT-SEA
FIT - BOB ICAO Regional Office email icao_apac@bangkok.icao.int & Mr. Bradley Cornell, Boeing Engineering, email: Bradley.D.Cornell@Boeing.Com	ICAO Regional Office & Boeing USA	FIT & CRA	Current	Bay of Bengal FIRs, Ujung Pandang and Jakarta FIRs, provides assistance to the members of the Arabian Sea/Indian Ocean ATS Coordination Group (ASIOACG)
ISPACG/FIT Mr. Bradley Cornell, Boeing Engineering, email: Bradley.D.Cornell@Boeing.Com	Boeing USA	FIT & CRA	Current	South Pacific FIRs and members of the Informal South Pacific ATS Coordination Group (ISPACG)

ASIA PACIFIC RVSM MINIMUM MONITORING REQUIREMENTS

(MMRs)

(Last reviewed RASMAG/11, June 2009)

1. UPDATE OF MONITORING REQUIREMENTS TABLE AND WEBSITE. As significant data is obtained, monitoring requirements for specific aircraft types may change. When the table is updated, a letter will be distributed to States and operators. The updated table will be posted on the websites of the APAC Regional Monitoring Agencies (RMAs) on behalf of the International Civil Aviation Organization (ICAO) Asia-Pacific Regional Planning Group (APANPIRG).

2. INITIAL MONITORING. All operators that operate or intend to operate in airspace where RVSM is applied are required to participate in the RVSM monitoring programme. The attached table of monitoring requirements establishes requirements for initial monitoring associated with the RVSM approval process. In their application to the appropriate State authority for RVSM approval, operators must include a plan that demonstrates the process that will be used to meet the applicable initial monitoring requirements.

3. AIRCRAFT STATUS FOR MONITORING. Aircraft engineering work that is required for the aircraft to receive RVSM airworthiness approval must be completed prior to the aircraft being monitored. Any exception to this rule shall be coordinated with the State authority.

4. APPLICABILITY OF MONITORING FROM OTHER REGIONS. Monitoring data obtained in conjunction with RVSM monitoring programmes from other regions can be used to meet Asia/Pacific monitoring requirements. Asia/Pacific RMAs have access to monitoring data from other regions and will coordinate with States and operators to inform them on the status of individual operator monitoring requirements.

5. MONITORING PRIOR TO THE ISSUE OF RVSM OPERATIONAL APPROVAL IS NOT A REQUIREMENT. Operators should submit monitoring plans to the responsible civil aviation authority that show how they intend to meet the requirements specified in the attached table. Monitoring will be carried out in accordance with this table.

6. AIRCRAFT GROUPS NOT LISTED IN THE TABLE. Contact the RMA responsible for the State of registration for clarification if an aircraft group is not listed in the Minimum Monitoring Requirements table or for clarification of other monitoring related issues. An aircraft group not listed in the table below will probably be subject to Category 2 monitoring requirements.

7. TABLE OF MONITORING GROUPS. A table of monitoring groups is provided as an appendix to this Minimum Monitoring Requirements document. The table shows the aircraft types and series that are grouped together for operator monitoring purposes.

8. TRAILING CONE DATA. Altimetry System Error estimations developed using Trailing Cone data collected during RVSM certification flights can be used to fulfill monitoring requirements. It must be documented that aircraft RVSM systems were in the approved RVSM configuration for the flight.

9. MONITORING OF AIRFRAMES THAT ARE RVSM COMPLIANT ON DELIVERY. If an operator adds new RVSM compliant airframes of a type for which it already has RVSM operational approval and has completed monitoring requirements for the type in accordance with the attached table, the new airframes are not required to be monitored. If an operator adds new RVSM compliant airframes of an aircraft type for which it has NOT previously received RVSM operational approval, then the operator should complete monitoring in accordance with the attached tables.

10. FOLLOW-ON MONITORING. Monitoring is an on-going program that will continue indefinitely after the RVSM approval process. A follow-on sampling program for additional operator aircraft will be coordinated by the Asia-Pacific Regional Airspace Safety Monitoring Advisory Group (RASMAG).

EFFECTIVE AS OF: 12 June 2009

MONITORING IS REQUIRED IN ACCORDANCE WITH THIS TABLE, HOWEVER, IT IS NOT REQUIRED TO BE COMPLETED PRIOR TO OPERATIONAL APPROVAL			
MONITORING CATEGORY		**AIRCRAFT TYPE**	**MINIMUM OPERATOR MONITORING FOR EACH AIRCRAFT GROUP**
1	Group approved <u>and</u> monitoring data indicates performance in accordance with RVSM standards. **<u>Group Definition:</u>** aircraft have been manufactured to a nominally identical design and build and for RVSM airworthiness approval fall into a group established in an RVSM certification document (e.g., Service Bulletin, Supplemental Type Certificate, Type Certificate Data Sheet).	[A30B, A306], [A312 (GE), A313 (GE)], [A312 (PW), A313 (PW)], A318, [A319, A320, A321], [A332, A333], [A342, A343], A344, A345, A346 B712, [B721, B722], [B733, B734, B735], B737(Cargo), [B736, B737/BBJ, B738/BBJ, B739], [B741, B742, B743], B74S, B744 (5” Probe), B744 (10” Probe), B752, B753, [B762, B763], B764, B772, B773 CL60(600/601), CL60(604), C560, [CRJ1, CRJ2], CRJ7, DC10, [E135, E145], [E170, E190], F100, GLF4, GLF5, LJ60 L101, MD10, MD11, MD80 (All series), MD90	Two airframes from each fleet* of an operator to be monitored as soon as possible but **not later than 6 months after the issue of RVSM operational approval** ** Note. For the purposes of monitoring, aircraft within brackets [ ] may be considered as belonging to the same monitoring group. For example, an operator with six A332 and four A333 aircraft may monitor one A332 and one A333* ***or*** *two A332 aircraft* ***or*** *two A333 aircraft.*
2	Group approved but insufficient monitoring data collected to move aircraft to Monitoring Category 1. Group definition applies.	Other group aircraft other than those listed in Category 1 including: A124, A388, ASTR, B703, B731, B732, BE20, BE40, C500, C25A, C25B, C525, C550**, C56X, C650, C750, CRJ9, [DC86, DC87], DC93, DC95, F2TH, [FA50 FA50EX], F70, [F900, F900EX], FA20, FA10, GLF2(II), GLF(IIB), GLF3, GALX, GLEX, H25B(700), H25B(800), H25C, IL62, IL76, IL86, IL96, J328, L29(2), L29(731), LJ31, [LJ35, LJ36], LJ45, LJ55, SBR1, T134, T154, T204, P180, PRM1,YK42	60% of airframes from each fleet of an operator (round up if fractional), as soon as possible but **not later than 6 months after the issue of RVSM operational approval.** (*Note: If 60 percent of the fleet yields a fractional number, round up to the next whole aircraft (e.g., for a fleet of 2 aircraft, 0.6 x 2 = 1.2; therefore, 2 aircraft must be monitored). ** Refer to aircraft group table for detail on C550 monitoring
3	Non-Group **<u>Non-group Definition:</u>** aircraft that do not fall under the group definition <u>and</u> for RVSM airworthiness approval are presented as an individual airframe.	Non-group approved aircraft	100% of aircraft shall be monitored as soon as possible but **not later than 6 months after the issue of RVSM operational approval.**

MONITORING GROUPS FOR AIRCRAFT CERTIFIED UNDER GROUP APPROVAL REQUIREMENTS

Monitoring Group	ICAO Desig-nator	A/C Type	A/C Series
A124	A124	AN-124 RUSLAN	ALL SERIES
A300	A306 A30B	A300 A300	600, 600F, 600R, 620, 620R, 620RF B2-100, B2-200, B4-100, B4-100F, B4-120, B4-200, B4-200F, B4-220, C4-200
A310-GE	A310	A310	200, 200F,300, 300F
A310-PW	A310	A310	220, 220F,320
A318	A318	A318	ALL SERIES
A320	A319 A320 A321	A319 A320 A321	CJ , 110, 130 110, 210, 230 110, 130, 210, 230
A330	A332, A333	A330	200, 220, 240, 300, 320, 340
A340	A342, A343,	A340	210, 310
A345	A345	A340	540
A346	A346	A340	640
A3ST	A3ST	A300	600R ST BELUGA
AN72	AN72	AN-74, AN-72	ALL SERIES
ASTR	ASTR	1125 ASTRA	ALL SERIES
ASTR-SPX	ASTR	ASTR SPX	ALL SERIES
AVRO	RJ1H, RJ70, RJ85	AVRO	RJ70, RJ85, RJ100
B712	B712	B717	200
B727	B721 B722	B727	100, 100C, 100F,100QF, 200, 200F
B732	B732	B737	200, 200C
B737 (Classic)	B733 B734 B735	B737	300, 400, 500
B737 New Generation (NG)	B736 B737 B738 B739	B737 B737 B737 B737	600 700, 700BBJ 800 900
B737 (Cargo)	B737	B737	700C
B747Classic (CL)	B741 B742 B743	B747	100, 100B, 100F, 200B, 200C, 200F, 200SF, 300
B74S	B74S	B747	SR, SP
B744-5	B744	B747	400, 400D, 400F (With 5 inch Probes)
B744-10	B744	B747	400, 400D, 400F (With 10 inch Probes)
B752	B752	B757	200, 200PF

Monitoring Group	ICAO Desig-nator	A/C Type	A/C Series
B753	B753	B757	300
B767	B762 B763	B767	200, 200EM, 200ER, 200ERM, 300, 300ER, 300ERF
B764	B764	B767	400ER
B772	B772	B777	200, 200ER, 300, 300ER
B773	B773	B777	300, 300ER
BE40	BE40	BEECHJET 400A	ALL SERIES
BE20	BE20	BEECH 200 –KINGAIR	ALL SERIES
C500	C500	500 CITATION, 500 CITATION I, 501 CITATION I SINGLE PILOT	ALL SERIES
C525	C525	525 CITATIONJET, 525 CITATIONJET I	ALL SERIES
C525-II	C25A	525A CITATIONJET II	ALL SERIES
C525 CJ3	C25B	CITATIONJET III	ALL SERIES
C550-552	C550	552 CITATION II	ALL SERIES
C550-B	C550	550 CITATION BRAVO	ALL SERIES
C550-II	C550	550 CITATION II, 551 CITATION II SINGLE PILOT	ALL SERIES
C550-SII	C550	S550 CITATION SUPER II	ALL SERIES
C560	C560	560 CITATION V, 560 CITATION V ULTRA, 560 CITATION V ULTRA ENCORE	ALL SERIES
C56X	C56X	560 CITATION EXCEL	ALL SERIES
C650	C650	650 CITATION III , 650 CITATION VI , 650 CITATION VII	ALL SERIES
C750	C750	750 CITATION X	ALL SERIES
CARJ	CRJ1, CRJ2	REGIONALJET	100, 200, 200ER, 200LR
CRJ-700	CRJ7	REGIONALJET	700
CRJ-900	CRJ9	REGIONALJET	900
CL600	CL60	CL-600 CL-601	CL-600-1A11 CL-600-2A12, CL-600-2B16
CL604	CL60	CL-604	CL-600-2B16
BD100	CL30	CHALLENGER 300	ALL SERIES
BD700	GL5T	GLOBAL 5000	ALL SERIES
CONC	CONC	CONCORDE	ALL SERIES
DC10	DC10	DC-10	10, 10F, 15, 30, 30F, 40, 40F
DC86-7	DC86, DC87	DC-8	62, 62F, 72, 72F
DC93	DC93	DC-9	30, 30F
DC95	DC95	DC-9	SERIES 51

Monitoring Group	ICAO Desig-nator	A/C Type	A/C Series
E135-145	E135, E145	EMB-135, EMB-145	ALL SERIES
E170, E190	E170, E190	EMBRAER 170, 175, 190, 195	ALL SERIES
F100	F100	FOKKER 100	ALL SERIES
F2TH	F2TH	FALCON 2000	ALL SERIES
F70	F70	FOKKER 70	ALL SERIES
F900	F900	FALCON 900, FALCON 900EX	ALL SERIES
FA10	FA10	FALCON 10	ALL SERIES
FA20	FA20	FALCON 20 FALCON 200	ALL SERIES
FA50	FA50	FALCON 50, FALCON 50EX	ALL SERIES
GALX	GALX	1126 GALAXY	ALL SERIES
GLEX	GLEX	BD-700 GLOBAL EXPRESS	ALL SERIES
GLF2	GLF2	GULFSTREAM II (G-1159),	ALL SERIES
GLF2B	GLF2	GULFSTREAM IIB (G-1159B)	ALL SERIES
GLF3	GLF3	GULFSTREAM III (G-1159A)	ALL SERIES
GLF4	GLF4	GULFSTREAM IV (G-1159C)	ALL SERIES
GLF5	GLF5	GULFSTREAM V (G-1159D)	ALL SERIES
H25B-700	H25B	BAE 125 / HS125	700B
H25B-800	H25B	BAE 125 / HAWKER 800XP, BAE 125 / HAWKER 800, BAE 125 / HS125	ALL SERIES/A, B/800
H25C	H25C	BAE 125 / HAWKER 1000	A , B
IL86	IL86	IL-86	NO SERIES
IL96	IL96	IL-96	M , T, 300
J328	J328	328JET	ALL SERIES
L101	L101	L-1011 TRISTAR	1 (385-1), 40 (385-1), 50 (385-1), 100, 150 (385-1-14), 200, 250 (385-1-15), 500 (385-3)
L29B-2	L29B	L-1329 JETSTAR 2	ALL SERIES
L29B-731	L29B	L-1329 JETSTAR 731	ALL SERIES
LJ31	LJ31	LEARJET 31	NO SERIES, A
LJ35/6	LJ35 LJ36	LEARJET 35 LEARJET 36	NO SERIES, A
LJ40	LJ40	LEARJET 40	ALL SERIES
LJ45	LJ45	LEARJET 45	ALL SERIES
LJ55	LJ55	LEARJET 55	NO SERIES B, C
LJ60	LJ60	LEARJET 60	ALL SERIES

Monitoring Group	ICAO Desig-nator	A/C Type	A/C Series
MD10	MD10	MD-10	ALL SERIES
MD11	MD11	MD-11	COMBI, ER, FREIGHTER, PASSENGER
MD80	MD81, MD82, MD83, MD87, MD88	MD-80	81, 82, 83, 87, 88
MD90	MD90	MD-90	30, 30ER
P180	P180	P-180 AVANTI	ALL SERIES
PRM1	PRM1	PREMIER 1	ALL SERIES
T134	T134	TU-134	A, B
T154	T154	TU-154	A , B, M, S
T204	T204, T224, T234	TU-204, TU-224, TU-234	100, 100C, 120RR, 200, C
YK42	YK42	YAK-42	ALL SERIES

AIRSPACE SAFETY ASSESSMENT FOR THE RVSM IMPLEMENTATION IN THE AIRSPACE OF DEMOCRATIC PEOPLE'S REPUBLIC OF KOREA

Submitted to:

ICAO Asia/Pacific Regional Office
ICAO Regional Airspace Safety Monitoring Advisory Group

China Regional Monitoring Agency (China RMA)
June 2009

PRELIMINARY SAFETY ASSESSMENT OF THE AIRSPACE OF DEMOCRATIC PEOPLE'S REPUBLIC OF KOREA

TABLE OF CONTENTS

PRELIMINARY SAFETY ASSESSMENT OF THE AIRSPACE OF DEMOCRATIC PEOPLE'S REPUBLIC OF KOREA

EXECUTIVE SUMMARY

This report provides the summary of the preliminary readiness and safety assessments, supporting the Go/No-Go decision for the planned RVSM implementation in the airspace of Democratic People's Republic of Korea in October, 2009. For the completion of the safety assessment, this report presents a comprehensive traffic analysis of the collected traffic sample data (TSD). In this regard, flight operation statistics, traffic flow characteristics, operator and aircraft profiles, and flight level utilization are given.

The report demonstrates that, based on the collected TSD and State RVSM approval data China RMA received, more than 98.88% of the aircraft operations in Pyongyang FIR where RVSM is to be implemented have been conducted by RVSM airworthiness approved aircraft and 94.6% by full RVSM approved operators and aircraft.

In regard to the risk estimation for the Pyongyang FIR, the large height deviation (LHD) occurrences between 1 Sep 2007 to 28 Feb 2009 were collected, but they were all nil reports. Based on the collected TSD and LHD reports, the technical is 5.62×10^{-10}, and the overall risk is 1.66×10^{-9}. Both of them were found to satisfy the agreed TLS value of no more than 2.5×10^{-9} and 5.0×10^{-9} fatal accidents per flight hour due to the loss of a correctly established vertical separation standard of 300m (1,000ft) and to all causes, respectively.

In addition, the report also demonstrates the risk estimate for route B467 which is the busiest route in Pyongyang FIR. It is found that technical risk is 7.40×10^{-10} and the overall risk is 2.29×10^{-9} fatal accidents per flight hour.

PRELIMINARY SAFETY ASSESSMENT OF THE AIRSPACE OF DEMOCRATIC PEOPLE'S REPUBLIC OF KOREA

1. INTRODUCTION

This report provides the summary of preliminary readiness and safety assessment for the RVSM implementation in the airspace of Democratic People's Republic of Korea. The content of the report includes:

- ✈ Background,
- ✈ Summary of Know Your Airspace (KYA) analyses,
- ✈ Result of RVSM readiness assessment,
- ✈ Summary of Large Height Deviation (LHD) occurrences, and
- ✈ Results of RVSM risk assessment

2. BACKGROUND

Democratic People's Republic of Korea (DPRK) plans to implement RVSM between 8,900 meters (29,100 feet) and 12,500 meters (41,100 feet), inclusive, in sovereign airspace in October, 2009. According to ICAO *Manual on the implementation of a 300 m (1,000 ft) Vertical Separation Minimum Between FL290 and FL410 Inclusive, ICAO Doc 9574*, a preliminary safety assessment of airspace where RVSM is to be implemented is required.

During the China-DPRK Coordination Meeting on the RVSM Implementation in Pyongyang FIR held in Beijing from 20 to 24 April 2009, the meeting reviewed the monitoring and safety assessment required as part of the RVSM implementation process and the task list. Considering the long-term friendly neighboring relationship between China and DPRK, and the capability and commitment that China RMA has demonstrated in the progress of RVSM implementation in the sovereign Chinese airspace, DPRK is willing to take ICAO’s suggestion to let China RMA hold the RMA responsibility for Pyongyang FIR and provide RMA services, which include RVSM approval registration and aircraft height keeping performance monitoring for DPRK’s operators, and long-term safety assessment of DPRK’s RVSM airspace.

China Regional Monitoring Agency (China RMA) is assisting DPRK to do the readiness and safety assessment and provide necessary support and service in the preparation of RVSM implementation in Pyongyang FIR under the coordination of ICAO Asia Pacific Office.

Prior to the safety assessment, specialists from DPRK sent to China RMA a December 2008 traffic sample covering all DPRK’s airspace operations within the general altitude band planned for RVSM application, together with the Large Height Deviation (LHD) Reports from 1 Sep 2007 to 28 Feb 2009 and RVSM approval dataset for DPRK’s domestic airlines. The traffic sample data (TSD) consists of 895 flights and LHD reports are all nil reports. Both of the TSD and LHD were examined preliminarily by the China RMA during several days before the actual start of the review of the readiness and safety assessments.

PRELIMINARY SAFETY ASSESSMENT OF THE AIRSPACE OF DEMOCRATIC PEOPLE'S REPUBLIC OF KOREA

Based on the data collected, China RMA has endeavored to assess the readiness and safety of RVSM implementation in Pyongyang FIR, utilizing the internationally accepted collision risk methodology. The final readiness and safety assessments have been reviewed constructively and checked independently by the PARMO and MAAR. This report which presents the outcome of the assessments is expected to support the Go/No-Go decision for the RVSM implementation in Pyongyang FIR.

In addition, China RMA agreed to conduct the safety analyses required for the 90-day post implementation review of the RVSM implementation in the Pyongyang FIR.

2.1 FIRs Implementing RVSM

The geographical area included in the readiness and safety assessment is DPRK's airspace operations within the general altitude band planned for RVSM application. The FIR and Area Control Centers (ACC) included in this airspace are summarized in **Table 1**.

FIR	ACC
Pyongyang	Pyongyang ACC

Table 1: FIR and ACC in DPRK's Airspace Implementing RVSM

2.2 Data Inquiry for the RVSM Readiness and Safety Assessments of Pyongyang FIR

The readiness and safety assessments for the RVSM implementation in Pyongyang FIR are conducted based on:

- 1-month traffic sample data (TSD) collected in December 2008,
- State RVSM approval records of operators and aircraft using RVSM airspace, and
- Monthly Large Height Deviation (LHD) reports collected from 1 Sep 2007 to 28 Feb 2009.

Both TSD and LHD reports are significant pieces of information for estimating risks from technical and operational errors, which would facilitate the completion of the safety assessment for Pyongyang FIR where RVSM is to be implemented.

3. KNOW YOUR AIRSPACE ANALYSES

3.1 Airspace Structure

Figure 1 presents the en-route structure of the airspace of Pyongyang FIR. It can be found from Figure 1 that most of the crossing routes are in the mainland region of DPRK, which is in the west of Pyongyang FIR. But based on the Traffic Sample Data, it is found that approximately 85 percent of all flights occurred on route B467 which is in the east of Pyongyang FIR. More detail analysis will be given in section 6.3.

Figure 1: Airspace En-route Structure of DPRK Pyongyang FIR

There are four neighboring FIRs lying on the boundary of the Pyongyang FIR. Their names, the status that whether the RVSM is implemented within the boundary FIRs and whether the flight levels within those boundary FIRs are provided in feet or meters are demonstrated as follows:

1) Vladivostok FIR of Russian Federation: CVSM 500 meter
2) Fukuoka FIR of Japan: RVSM feet
3) Incheon FIR of Korea: RVSM feet
4) Shenyang FIR of China: RVSM meters

The flight level allocation systems in Pyongyang FIR before and after RVSM implementation are demonstrated in Appendix A

3.2 Traffic Sampling

The Traffic Data Sampling of Pyongyang FIR for December 2008 had been collected. It includes the information requested for an individual traffic movement, or flight.

3.3 Received Traffic Data

Table 2 contains a summary of the traffic data collected from 1 to 31 December 2008 for use in the analysis.

FIR Name	FIR Code	Data Collected in ACC	Collecting Method	Status	Remarks
Pyongyang	ZKKP	Pyongyang	Manual	Received	Data completed

Table 2: Summary of Traffic Data of December 2008 in DPRK Airspace (Pyongyang FIR)

The results of the KYA analysis of the DPRK collected TSD received from DPRK are presented in the following contents:

- Flight operation statistics
- Traffic flow characteristics
- Operator and aircraft profiles, and
- Flight level utilization.

3.4 Flight Operation Statistics

The provisional flight operational statistic in the planned RVSM airspace in Pyongyang FIR includes:

- Number of flights by ten days of Pyongyang FIR (**Table 3**)
- Number of flights per day in DPRK airspace (**Figure 2**)

FIR	Number of Flights			Total Number
	12/01-12/10	12/11-12/20	12/21-12/31	
Pyongyang	253	279	363	895

Table 3: Number of Flights in Pyongyang FIR Airspace of DPRK from the Collected TSD

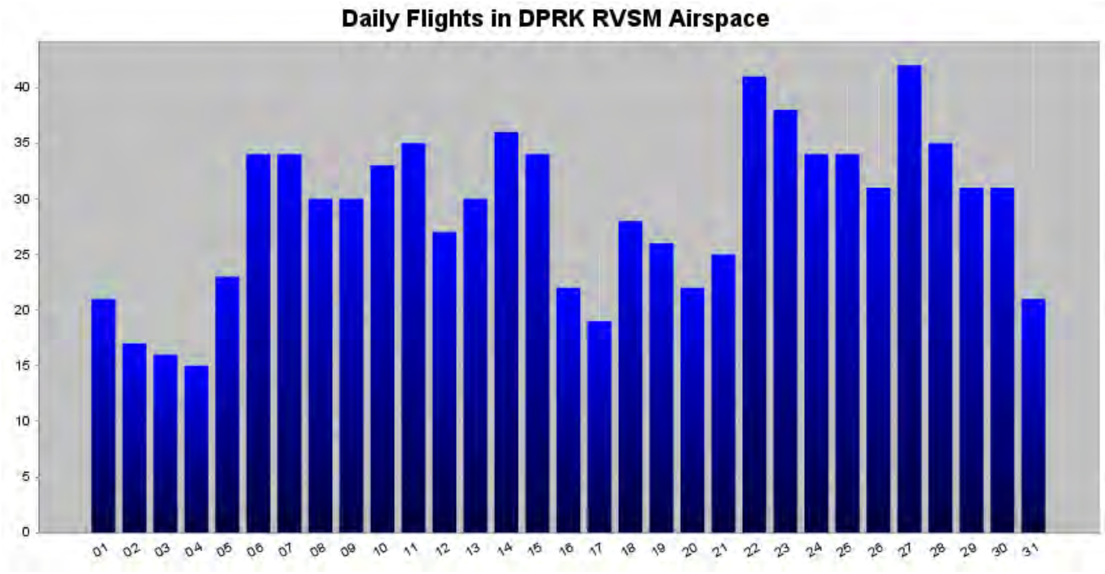


Figure 2: Number of Flights per Day in DPRK Airspace (Pyongyang FIR)

3.5 Traffic Flow Characteristics

The analyzed characteristics of traffic flow in the planned RVSM airspace in DPRK include:

- Top-15 city pairs (**Figure 3**)

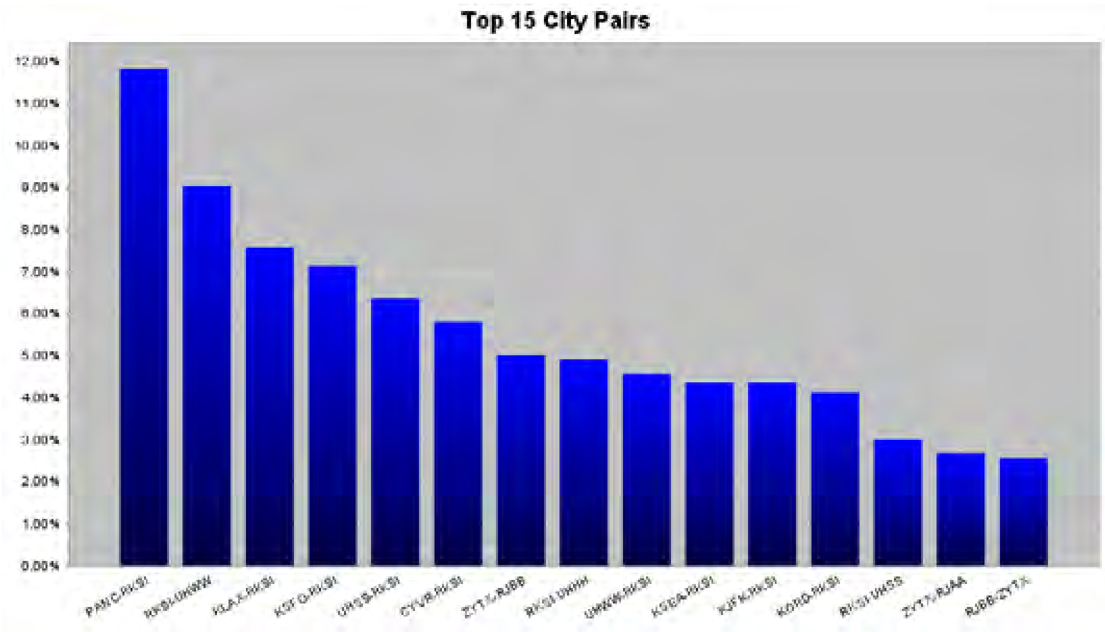


Figure 3: Top-15 City Pairs (the Y-Axis means the Percent of Total Traffics)

3.6 Operator and Aircraft Profiles

The information regarding the airspace users for the planned RVSM airspace in DPRK includes:

- Top-15 operators (**Figure 4**)

- Top-15 aircraft types (**Figure 5**)

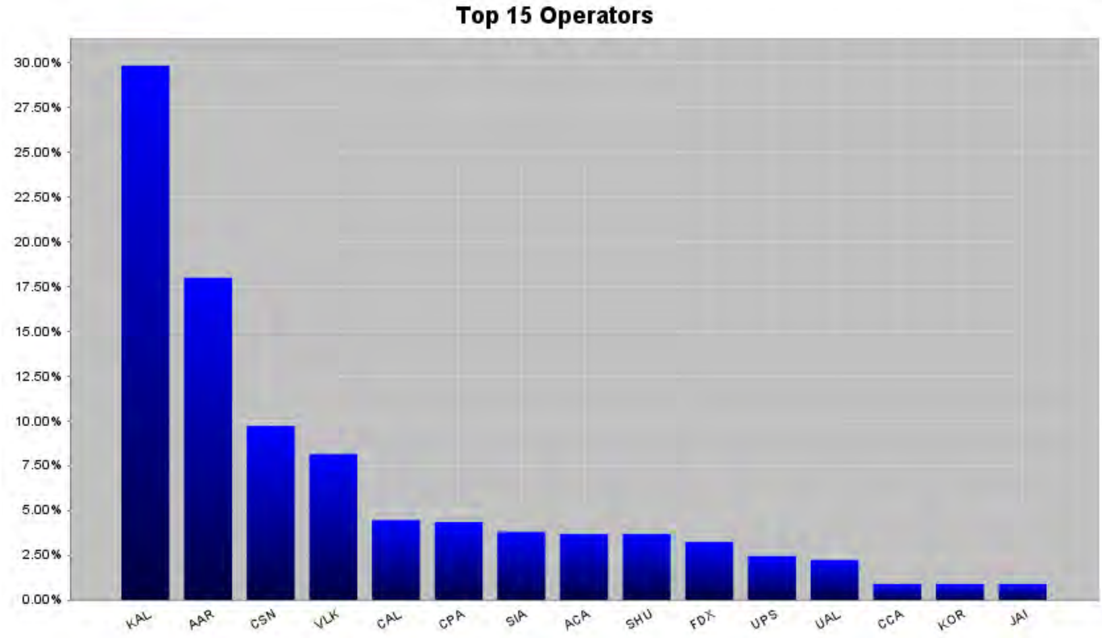


Figure 4: Top-15 Active Operators in the Planned RVSM Airspace of DPRK

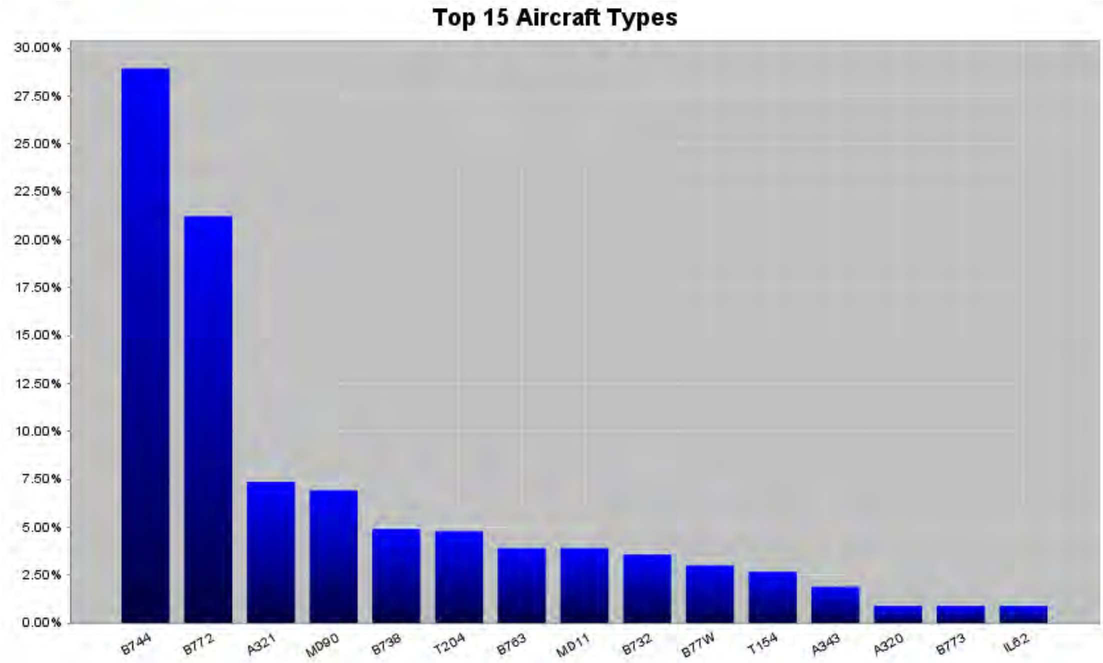


Figure 5: Top-15 Aircraft Types Operated in the Planned RVSM Airspace of DPRK

It is important to note that the top-15 operators and aircraft types represent more than 96 percent and more than 95 percent of the operations observed in the TSD respectively. Note that the all the flights presented in the TSD were conducted Commercial Operators, not including flights conducted by State aircraft or International General Aviation (IGA).

3.7 Flight Level Utilization

Figure 6 presents the utilization of flight levels (FL) in the current non-RVSM airspace of DPRK. Note that, for the RVSM implementation in DPRK airspace, the Single Alternate Flight Level Orientation Scheme (FLOS) will be applied full band between 8,900 and 12,500 meters, as same as the FLOS of the sovereign Chinese RVSM airspace.

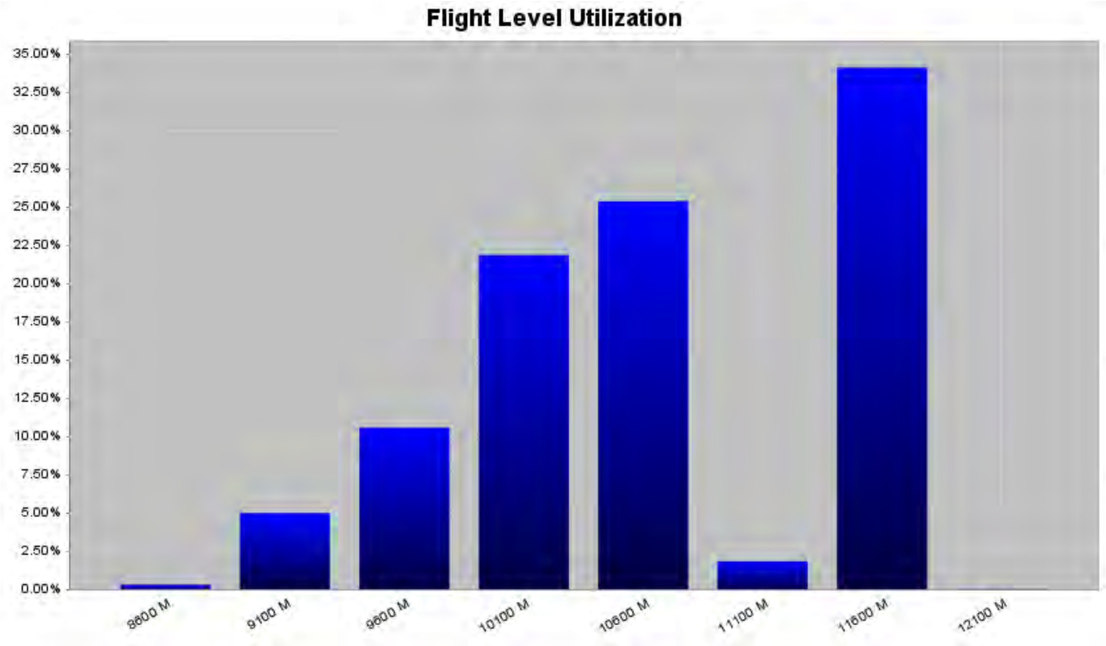


Figure 6: Flight Level Utilization in the Planned RVSM Airspace of DPRK

It can be found that there is an obvious drop of traffic on flight level 11100M. According to the explanation of General Administration of Civil Aviation (GACA), DPRK, this is because that the amount of northbound traffic flying over Pyongyang FIR is relatively lower and most of them are distributed on flight level 10100M.

4. RVSM READINESS ASSESSMENT

This section provides the results of the readiness assessment using the traffic sample data from 1st to 31st December 2008 within Pyongyang FIR. The criterion China RMA adopted in this readiness assessment for Pyongyang FIR as a prerequisite for the RVSM implementations is that **90** percent of operations between 8,900 and 12,500 meters (inclusive) in the collected traffic sample would be conducted by operators and aircraft with RVSM approval after the implementation of RVSM.

As one of its major responsibilities, the China RMA maintains a database of China RVSM approvals that have been granted by the Civil Aviation Administration of China (CAAC) to the Chinese domestic operators. For the preparation of readiness assessment for Pyongyang FIR, China RMA received the latest version of RVSM approval dataset for DPRK's domestic airlines effective as March 27, 2009. The China RMA also updated the database of RVSM approvals with the assistance from the global RMA community.

The collected one-month TSD from Pyongyang FIR were compared to the global RVSM approval dataset, including:

- Australian Airspace Monitoring Agency (AAMA),
- AFI RMA,
- China RMA,
- Canada,
- Caribbean and South American Monitoring Agency (CARSAMMA),
- DPRK,
- Eurocontrol RMA,
- France,
- Japan Civil Aviation Bureau (JCAB) RMA,
- Middle East Monitoring Agency (MID RMA),
- Monitoring Agency for Asia Region (MAAR),
- North America Approval and Registry Monitoring Organization (NAARMO),
- North Atlantic Central Monitoring Agency (NATCMA),
- Pacific Approval and Registry Monitoring Organization (PARMO),
- Russian Federation RVSM approvals for operators of Sakhalin Airlines and Vladivostok Air, and
- US MASPS

Note that the time of update for the RVSM approval files is demonstrated in **Appendix C**.

Approval Category	**Number of Operations in Traffic Sample**	**Percent Of Total Sample**
RVSM Airworthiness Approved Only	885	98.88%
RVSM Airworthiness Unapproved	10	1.12%
RVSM Operational-approved	885	98.88%
Non RVSM Operational-approved	10	1.12%
Total	895	100%

Table 4: Summary of the Readiness of Operators and Aircraft Types Operating in the airspace of Pyongyang FIR where RVSM is to be implemented

The detailed information regarding the result of readiness assessment is provided in the **Appendix D**.

Based on the results of the readiness assessment, it was found that 99.1% of the flights are foreign flights that fly over the airspace of Pyongyang FIR. It was possible to use the registration number to identify, by type, the number of flights conducted for each operator with approvals for the sample period.

Based on the given RVSM approval dataset, both of the percentage of operations that were conducted by RVSM Airworthiness approved and RVSM Operational-approved are 98.88% as shown in Table 4, both higher than the implementation goal of 90% for Asia Pacific Region.

5. LARGE HEIGHT DEVIATION OCCURRENCES

This section provides the summary of the large height deviation (LHD) occurrences associated with the RVSM implementation in the Pyongyang FIR. The historical data are used to estimate risk due to operational errors, which is a very important part in the preliminary safety assessment. All the historical records for the information of LHD were collected from 1 Sep 2007 to 28 Feb 2009, and were all nil reports.

The reason to explain the nil reports is that the responsible area of Pyongyang FIR is fully under radar control and the average daily traffic flow is relatively small.

To make a more conservative estimate for the operational risk, China RMA took the advice from PARMO to use the rate of LHD occurrences from airspace with similar characteristics. By 'similar characteristics', it means that an area composed of non-procedural airspace (since Pyongyang FIR has complete radar coverage) and similar operator/aircraft types.

China RMA took into account the difference in the traffic volume between Pyongyang and the other airspace which China RMA had data. By comparing the air traffic control status and operator/aircraft types, China RMA found that the airspace of Shenyang FIR (not including Harbin ACC which is under procedural control) is more similar to Pyongyang, and ‘scaled’ the total duration of LHD from Shenyang FIR airspace to match the traffic volume observed in DPRK airspace for the pre-implementation safety assessment. By 'Scaling’, it means that the duration of LHD in Shenyang FIR airspace is converted to its counterpart in Pyongyang FIR airspace according to the proportion of the total flight hours in both TSD.

The annual flight hours of DPR Korea TSD is 5252.8, the annual flight hours of Shenyang FIR (not including Harbin ACC) is 67112.6. The number of LHD occurrences, associated LHD durations (in minutes) by month in Shenyang FIR (not including Harbin ACC) airspace is as follows:

Month-Year	No. of LHD Occurrences	(Operational) LHD Duration (Minutes)
October 2008	2	0.367

So the number of LHD occurrences, associated LHD durations (in minutes) by month in DPR Korea is:

Month-Year	No. of LHD Occurrences	(Operational) LHD Duration (Minutes)
October 2008	2	0.00138

These data are used to estimate the operational risk for DPR Korea.

6. RISK ASSESSMENT AND SAFETY OVERSIGHT

The purpose of this section is to conduct the preliminary risk assessment and to present safety oversight for the RVSM implementation over DPRK airspace (Pyongyang FIR), planned for October, 2009. Accordingly, the internationally accepted collision risk methodology is applied.

As envisioned by the Review of the ICAO General Concept of Separation Panel (RGCSP), introduction of RVSM would be safe if:

- Collision risk due to all causes does not exceed 5 fatal accidents per 10^9 flying hours;
- Collision risk due to aircraft height-keeping systems does not exceed 2.5 fatal accidents per 10^9 flying hours.

The traffic sample data (TSD) of December 2008 and the continuous LHD nil reports associated with the DPRK airspace (since September 2007) are used to produce the risk estimates presented in this report.

For the safety assessment of the RVSM implementation in the DPRK airspace, the risk estimation is conducted based on the single alternate flight level orientation scheme (FLOS) applied on the ATS routes structure in Pyongyang FIR.

6.1 Estimate of the CRM Parameters

Table 5 summarizes the value and source material for estimating values for each of the empirical parameters of the internationally accepted Collision Risk Model (CRM), which is used to conduct the risk assessment and the safety oversight for the RVSM implementation in DPRK airspace (Pyongyang FIR).

Parameter Symbol	Parameter Definition	Parameter Value	Source for Value
S_x	Longitudinal separation standard for a region, or Length of longitudinal window used to calculate occupancy	80 NM	Standard value used in overall airspace

Parameter Symbol	Parameter Definition	Parameter Value	Source for Value
S_h	Planned Horizontal Separation	80 NM	Standard value used in overall airspace
$P_z(0)$	Probability of vertical overlap (with planned vertical separation equal to zero)	0.5380	Conservative value used in NAT, Pacific, Western Pacific/South China Sea RVSM safety assessments
$P_z(S_z)$	Prob. that 2 aircraft nominally separated by the vertical separation minimum S_z are in vertical overlap.	2.46×10^{-8}	
$P_y(0)$	Probability of Lateral Overlap	0.0835	Value used in NAT and average aircraft wingspan
$P_h(\theta)$	Probability of Horizontal Overlap	6.88×10^{-7}	Value used in the Western Pacific/South China Sea safety assessment
$\left\|\overline{\dot{h}(\theta)}\right\|$	Average relative horizontal speed during overlap for aircraft pairs on routes with crossing angle θ (let θ=45°)	367.4 knots	Value used in Western Pacific/South China Sea safety assessment (corresponds to an average aircraft speed of 480 knots)
$\left\|\overline{\dot{y}}\right\|$	Average absolute relative cross track speed for an aircraft pair nominally on the same track	4 knots	Value specified in ICAO Doc. 9574
$\left\|\overline{\dot{z}}\right\|$	Average absolute relative vertical speed of an aircraft pair that has lost all vertical separation	1.5 knots	Value used in NAT RVSM safety assessment

Table 5: Empirical Parameters in the CRM

Because the percentage of GPS-equipped aircraft in DPRK airspace is not available, so we used empirical value for Probability of Lateral Overlap $P_y(0)$ and average absolute relative cross track speed $\left|\overline{\dot{y}}\right|$ in the safety assessment. For the Probability of vertical overlap $P_z(0)$ and $P_z(S_z)$, we also used the empirical value. The reason is that the histogram of Assigned Altitude Deviation is also not available, so we can not recalculate $P_z(0)$ and $P_z(S_z)$ for DPRK and the empirical value be used in the assessment. But because there is not any LHD report from the DPRK airspace and the tail distribution of P_z is not significant. So the following estimated is conservative.

Table 6 summarizes the values for estimating parameters in the CRM, which we estimated on the basis of TSD collected in DPRK.

Parameter Symbol	Parameter Value	Parameter Definition
T	5252.8	Annual flight hours
E_z(same)	0	Same-direction vertical occupancies
E_z(opposite)	0.0419	Opposite-direction vertical occupancies
Crossing pairs	2736	Annual estimate of crossing pairs in crossing route
$\overline{\lvert\Delta V\rvert}$		Average relative along-track speed between aircraft on same direction routes
$\overline{\lvert V\rvert}$	465.852	Average absolute aircraft ground speed
λ_x	0.03162	Average aircraft length
λ_y	0.02794	Average aircraft wingspan
λ_z	0.00861	Average aircraft height
λ_h	0.03162	Diameter of the disk representing the shape of an aircraft in the horizontal plane

Table 6: Estimate of the Parameters based on the collected TSD in DPRK Airspace

It can be seen from **Table 6** that because of there were not any same direction vertical occupancies occurred in DPRK planned RVSM airspace, the E_z(same) equals zero and the $\overline{\lvert\Delta V\rvert}$ is not be estimated.

6.2 Safety Oversight for the RVSM implementation in DPRK Airspace

This section summarizes the results of the safety assessment for the DPRK airspace. **Table 7** provides the estimates of technical, operational, and total risks for the RVSM implementation in the DPRK airspace. Because there is not any LHD events in DPRK planned RVSM airspace, the Operational Risk value is zero.

Source of Risk	Lower Bound Risk Estimation	TLS	Remarks
Technical Risk	5.62×10^{-10}	2.5×10^{-9}	Below Technical TLS
Operational Risk	1.10×10^{-9}	-	-
Total Risk	1.66×10^{-9}	5.0×10^{-9}	Below Overall TLS

Table 7: Risk Estimate for the RVSM Implementation in DPRK Airspace

Figure 7 presents the trends of collision risk estimates for each month using the appropriate 18-month interval of LHD nil reports since September 2007.

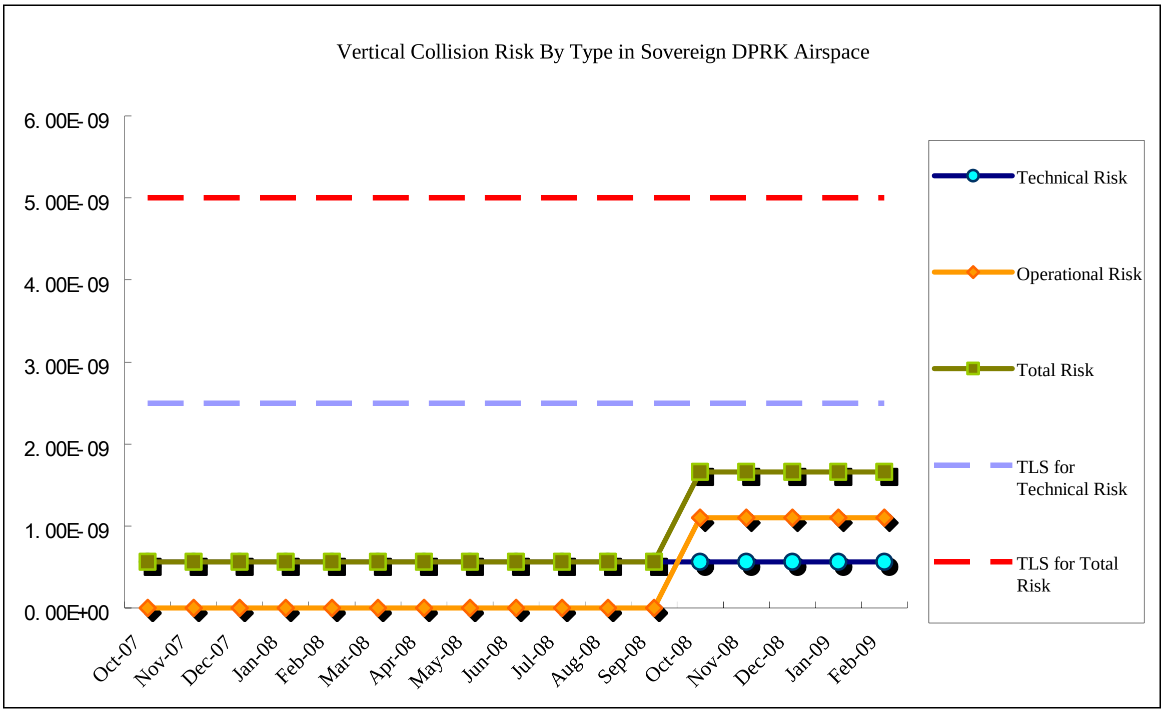


Figure 7: 18-month of Risk Estimate for the RVSM Implementation in DPRK Airspace

Based on the collision risk estimates from the received TSD and LHD nil reports, the technical risk for the RVSM implementation in DPRK airspace is 5.62×10^{-10} fatal accidents per flight hour. The total risk attributed to all causes is also 1.66×10^{-9}. Therefore, the estimates of both technical and total risks from the available TSD and 'borrowed' LHD satisfy the agreed TLS value of no more than 2.5×10^{-9} and 5.0×10^{-9} fatal accidents per flight hour due to the loss of a correctly established vertical separation standard of 300m and to all causes, respectively.

6.3 Additional Observations

In section 3.1, it is said that in DPRK, approximately 85 percent of all flights occurred on the route B467 in the east of Pyongyang FIR. China RMA extracted the traffic movement data of B467 from the collected TSD data, and estimated the Collision Risk for B467 airspace. **Table 8** presents the parameters of B467 route airspace.

Parameter Symbol	Parameter Value	Parameter Definition
T	4998.6	Annual flight hours
E_z(opposite)	0.0574	Opposite-direction vertical occupancies
Crossing pairs	2736	Annual estimate of crossing pairs in crossing route
$\overline{\lvert V \rvert}$	465.852	Average absolute aircraft ground speed

Table 8: Estimate of the Parameters based on the collected TSD in B467 Route Airspace

Table 9 provides the estimate of technical, operational, and total risks for the RVSM implementation in the B467 Route airspace.

Source of Risk	Lower Bound Risk Estimation	TLS	Remarks
Technical Risk	7.40×10^{-10}	2.5×10^{-9}	Below Technical TLS
Operational Risk	1.55×10^{-9}	-	-
Total Risk	2.29×10^{-9}	5.0×10^{-9}	Below Overall TLS

Table 9: Risk Estimate for the RVSM Implementation in B467 Route Airspace

Figure 8 presents the trends of collision risk estimates for B467 Route Airspace.

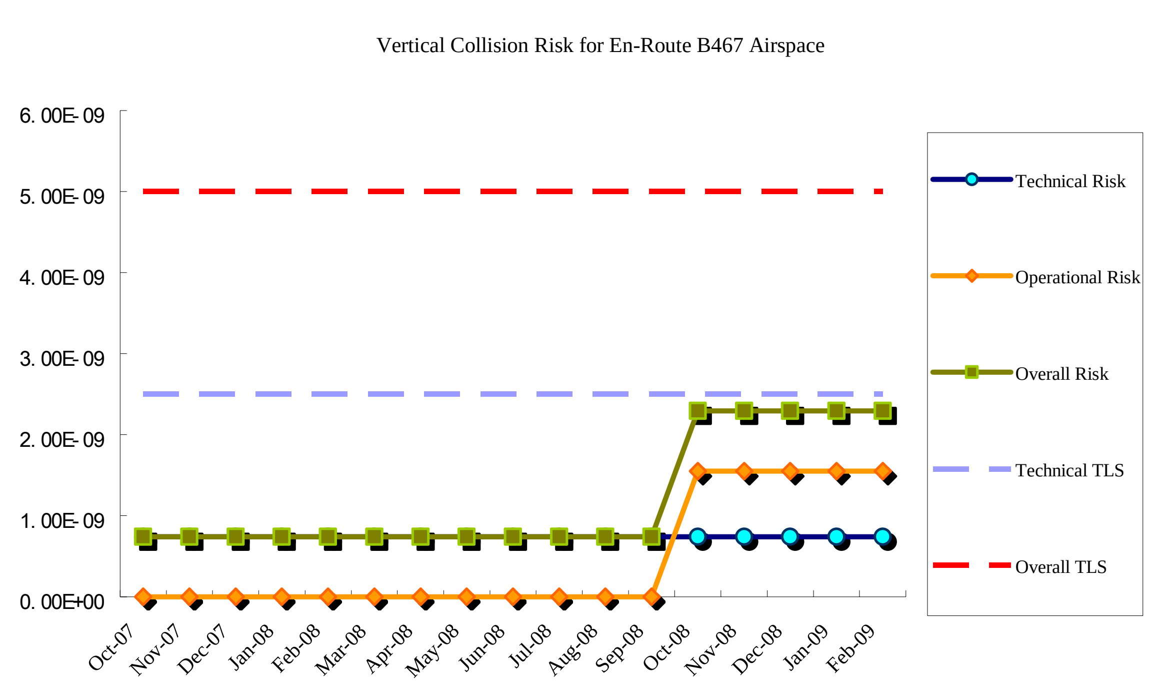


Figure 8: Risk Estimate for the RVSM Implementation in B467 Route Airspace

Based on the collision risk estimate from the extracted TSD and 'borrowed' LHD, the technical risk for the B467 route airspace is 7.40×10^{-10} fatal accidents per flight hour and the total risk is 2.29×10^{-9}. Both technical and overall risks are much below the TLS respectively.

By comparing the parameters and the result between B467 route airspace and the entire airspace of DPRK, it can be found that the annual estimate of crossing pairs in crossing route and the average absolute aircraft ground speed, $|\overline{V}|$, are same between B467 route airspace and the entire airspace of DPRK. In our opinion it is because of all occupancies (include opposite direction and crossing traffic) are occurred in B467 route airspace. The annual flight hours for DPRK airspace is bigger than B467 route airspace, and the Ez(opposite) of B467 route is larger than that of the entire airspace. It is because of there are some flights conducted in other routes, so the collision risk estimate for the entire airspace of Pyongyang FIR is relatively lower than that of the B467 route.

During the China-DPRK Coordination Meeting, China RMA suggested that DPRK establish the mechanism of collecting LHD events and submit reports to China RMA on a monthly basis to provide necessary data for the long-term safety assessment.

PRELIMINARY SAFETY ASSESSMENT OF THE AIRSPACE OF DEMOCRATIC PEOPLE'S REPUBLIC OF KOREA

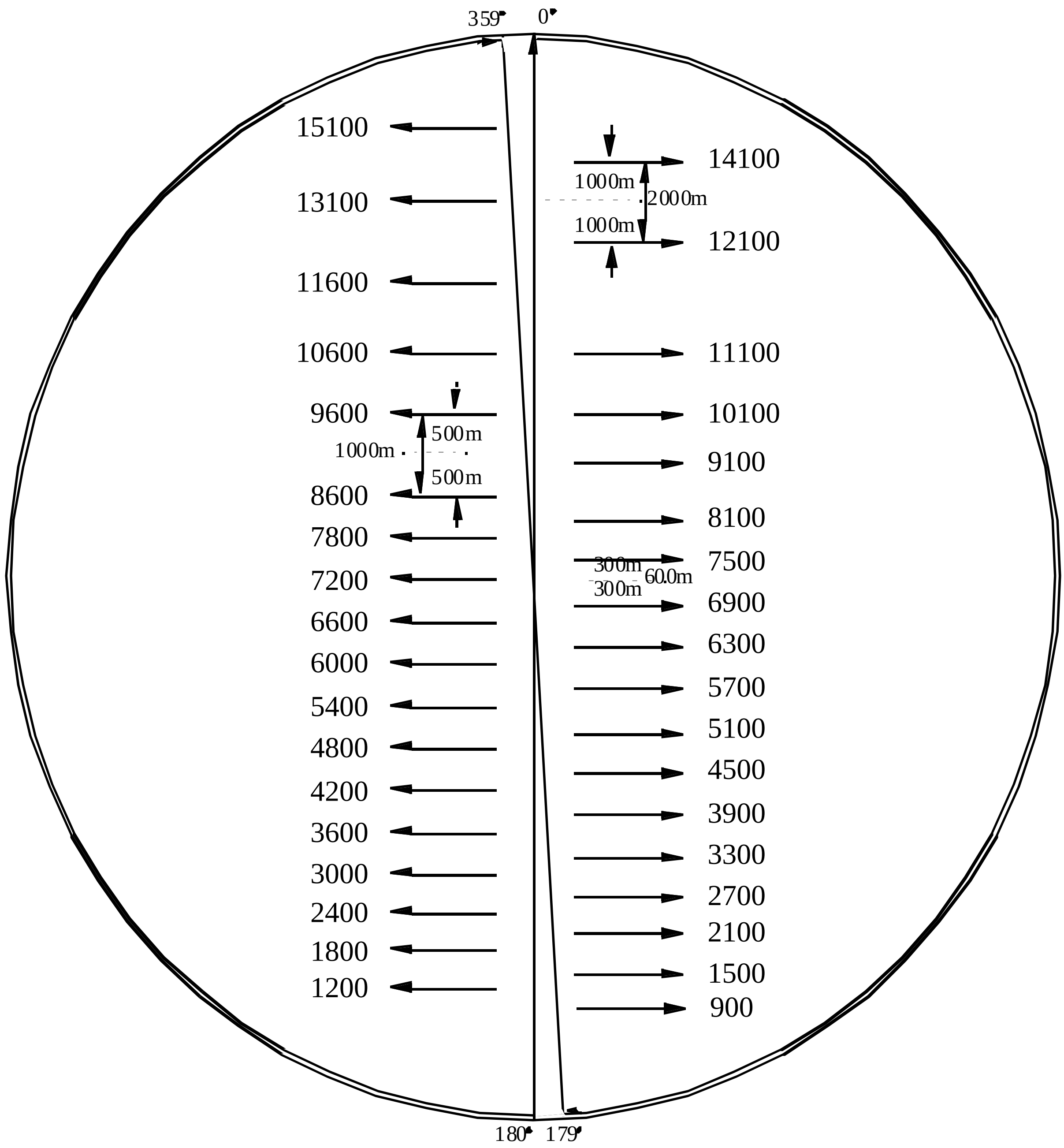
REFERENCES

1. *Manual on Implementation of a 300 m (1,000 ft) Vertical Separation Minimum Between FL 290 and FL 410 Inclusive*, International Civil Aviation Organization, Doc 9574, Montreal, March 1992.

2. *Review of the General Concept of Separation Panel*, Sixth Meeting, Montreal, 28 November – 15 December 1988, ICAO Doc 9536, RGCSP/6, Volumes 1 and 2.

3. *Review of the General Concept of Separation Panel*, Seventh Meeting, Montreal, 30 October – 20 November 1990, ICAO Doc 9572, RGCSP/7.

APPENDIX A

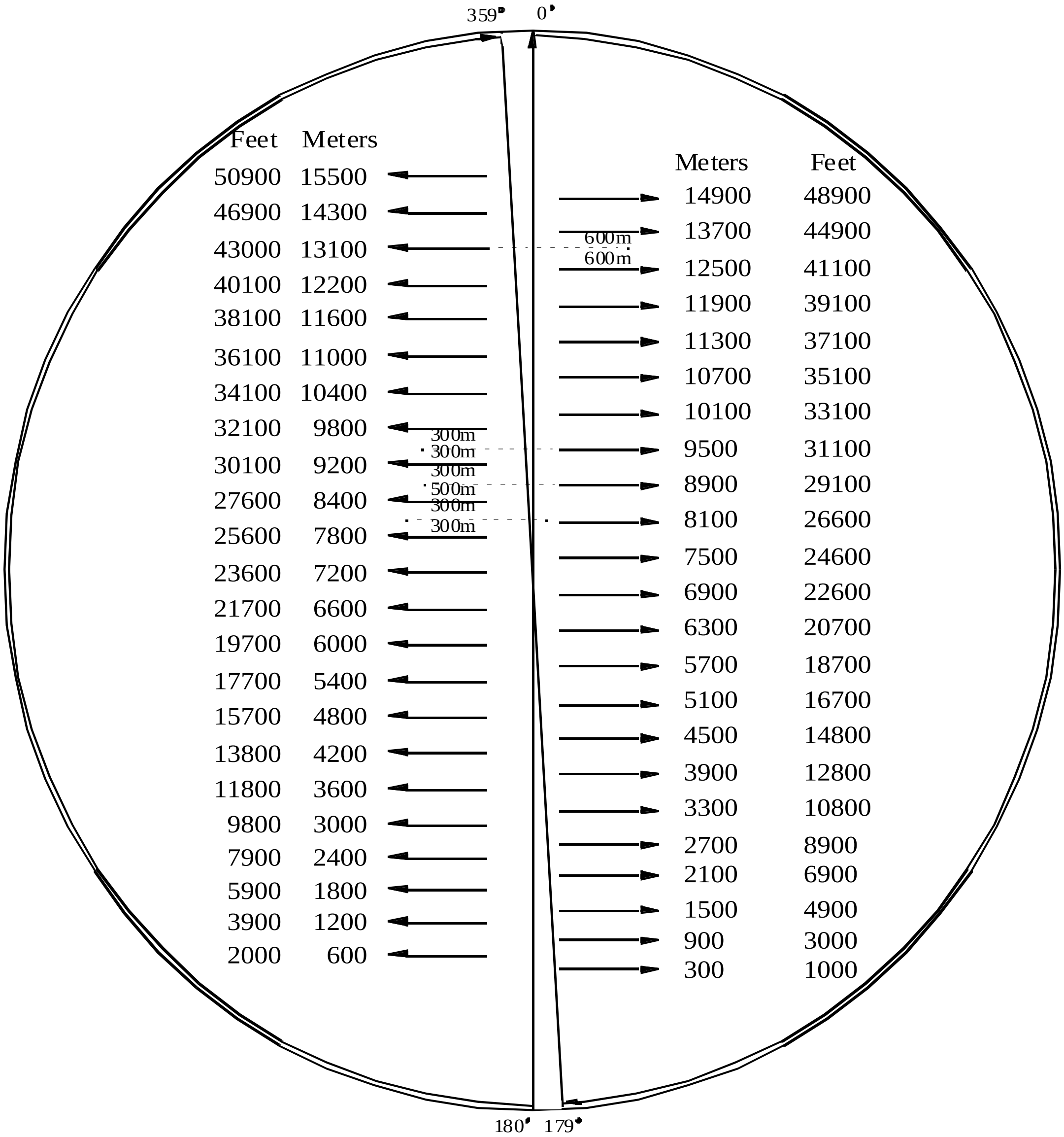


Current flight level allocation system in Pyongyang FIR

Current flight level allocation system

TABLE OF SEMI-CIRCULAR FLIGHT LEVEL SYSTEM			
000 - 179 FLIGHT LEVELS (ODD)		**180 - 359 FLIGHT LEVELS (EVEN)**	
METRES	FEET	METRES	FEET
900	2950	1 200	3 900
1 500	4 900	1 800	5 900
2 100	6 900	2 400	7 900
2 700	8 900	3 000	9 800
3 300	10 800	3 600	11 800
3 900	12 800	4 200	13 800
4 500	14 800	4 800	15 700
5 100	16 700	5 400	17 700
5 700	18 700	6 000	19 700
6 300	20 700	6 600	21 700
6 900	22 600	7 200	23 600
7 500	24 600	7 800	25 600
8 100	26 600		
9 100	29 900	8 600	28 200
10 100	33 100	9 600	31 500
11 100	36 400	10 600	34 800
12 100	39 700	11 600	38 100
14100	46300	13100	43 000
16100	52800	15100	49 5000

Diagram of Flight Levels Allocation



RVSM flight level allocation system to be introduced in Pyongyang FIR

RVSM flight level allocation system

000°- 179° Odd		**180°- 359° Even**	
m	feet	m	feet
300	1000	600	2 000
900	3 000	1 200	3 900
1 500	4 900	1 800	5 900
2 100	6 900	2 400	7 900
2 700	8 900	3 000	9 800
3 300	10 800	3 600	11 800
3 900	12 800	4 200	13 800
4 500	14 800	4 800	15 700
5 100	16 700	5 400	17 700
5 700	18 700	6 000	19 700
6 300	20 700	6 600	21 700
6 900	22 600	7 200	23 600
7 500	24 600	7 800	25 600
8 100	26 600	8 400	27 600
8 900	29 100	9 200	30 100
9 500	31 100	9 800	32 100
10 100	33 100	10 400	34 100
10 700	35 100	11 000	36 100
11 300	37 100	11 600	38 100
11 900	39 100	12 200	40 100
12 500	41 100	13 100	43 000
13 700	44 900	14 300	46 900
14 900	48 900	15 500	50 900
etc.	etc.	etc.	etc.

APPENDIX B

1. ICAO 3-Letter Operator Code for the operators that conducted flights in the airspace of Pyongyang FIR

	Operator Code	Operator Name	State of Registry
1.	AAR	Asiana Airlines, Inc.	Republic of Korea
2.	ACA	Air Canada	Canada
3.	AFR	Air France	France
4.	AZA	ALITALIA	Italy
5.	CAL	China Airlines	Taiwan
6.	CCA	Air China International Corporation	China
7.	CPA	Cathay Pacific Airways Ltd.	Hong Kong
8.	CSN	China Southern Airlines	China
9.	DAL	Delta Airlines, INC	United States of America
10.	DLH	Deutsche Lufthansa, A.G.	Germany
11.	FDX	Federal Express Corporation (FedEx)	United States of America
12.	JAI	Jet Airway	India
13.	KAL	Korean Air	Republic of Korea
14.	KLM	KLM Royal Dutch Airlines	Netherlands
15.	KOR	Air Koryo	DPRK
16.	PAC	United States Polar Air Cargo, Inc.(Long Each, Ca)	United States of America
17.	SHU	Sakhalin Airlines	Russian Federation
18.	SIA	Singapore Airlines Limited	Singapore
19.	SYL	Air Company Yakutia	Russian Federation
20.	UAL	United States United Airlines INC.	United States of America
21.	UPS	United States, United Parcel Service Company	United States of America
22.	VLK	Vladivostok Air	Russian Federation

APPENDIX C

Global RVSM Approval Dataset Used In the Readiness Assessment

Field	*Approval (alphabetical)*	*Date of updated*
1.	Australian Airspace Monitoring Agency (AAMA)	2009-04-07
2.	AFI RMA	2009-04-07
3.	China RMA	2009-04-16
4.	Canada	2009-05-22
5.	Caribbean and South American Monitoring Agency (CARSAMMA)	2009-04-07
6.	Eurocontrol RMA	2008-10-20
7.	DPRK	2009-03-27
8.	France	2007-01-22
9.	Japan Civil Aviation Bureau (JCAB) RMA	2009-04-07
10.	Middle East Monitoring Agency (MID RMA)	2006-09-10
11.	Monitoring Agency for Asia Region (MAAR)	2009-04-07
12.	North America Approval and Registry Monitoring Organization (NAARMO)	2009-04-07
13.	North Atlantic Central Monitoring Agency (NATCMA)	2009-02-11
14.	Pacific Approval and Registry Monitoring Organization (PARMO)	2009-04-07
15.	Russian Federation RVSM approvals for operators of Sakhalin Airlines and Vladivostok Air	2009-05-09
16.	US MASPS	2009-05-15

The Table Format of Readiness Assessment for Pyongyang FIR

Field	*Column Name*	*Comments*
1.	OPR	3-LETTER OPERATOR CODE
2.	AIRCRAFT_TYPE	ICAO AIRCRAFT TYPE DESIGNATOR
3.	FLIGHTS	NUMBER OF FLIGHTS
4.	PER	FLIGHTS DEVIDED BY TOTAL NUMBER OF FLIGHTS
5.	PER_CUM	CUMULATIVE PECENTAGE OF PER
6.	AW	NUMBER OF AIRWORTHINESS (AW) APPROVED FLIGHTS
7.	AW_PER	PERCENTAGE OF AW
8.	AWPER_CUM	CUMULATIVE PECENTAGE OF AW
9.	FULL	NUMBER OF FULL APPROVED FLIGTS
10.	FULL_PER	PERCENTAGE OF FULL APPROVED FLIGTS
11.	FULLPER_CUM	CUMULATIVE PECENTAGE OF FULL APPROVED FLIGTS

APPENDIX D

Readiness Assessment for Pyongyang FIR

OPERATOR	TYPE	FLIGHTS	PER(%)	PER_CUM(%)	AW	AW_PER(%)	AWPER_CUM(%)	FULL	FULL_PER(%)	FULLPER_CUM(%)
KAL	B744	114	12.73743017	12.73743017	114	12.73743017	12.73743017	114	12.73743017	12.73743017
KAL	B772	104	11.62011173	24.3575419	104	11.62011173	24.3575419	104	11.62011173	24.3575419
AAR	B744	63	7.039106145	31.39664804	63	7.039106145	31.39664804	63	7.039106145	31.39664804
CSN	MD90	62	6.927374302	38.32402235	62	6.927374302	38.32402235	62	6.927374302	38.32402235
AAR	A321	46	5.139664804	43.46368715	46	5.139664804	43.46368715	46	5.139664804	43.46368715
AAR	B772	45	5.027932961	48.49162011	45	5.027932961	48.49162011	45	5.027932961	48.49162011
KAL	B738	44	4.916201117	53.40782123	44	4.916201117	53.40782123	44	4.916201117	53.40782123
VLK	T204	43	4.804469274	58.2122905	43	4.804469274	58.2122905	43	4.804469274	58.2122905
SHU	B732	32	3.575418994	61.7877095	32	3.575418994	61.7877095	32	3.575418994	61.7877095
ACA	B763	29	3.240223464	65.02793296	27	3.016759777	64.80446927	27	3.016759777	64.80446927
CAL	B744	29	3.240223464	68.26815642	29	3.240223464	68.04469274	29	3.240223464	68.04469274
FDX	MD11	29	3.240223464	71.50837989	29	3.240223464	71.2849162	29	3.240223464	71.2849162
CPA	B744	27	3.016759777	74.52513966	27	3.016759777	74.30167598	27	3.016759777	74.30167598
VLK	T154	22	2.458100559	76.98324022	21	2.346368715	76.64804469	21	2.346368715	76.64804469
CSN	A321	20	2.234636872	79.21787709	20	2.234636872	78.88268156	20	2.234636872	78.88268156
SIA	B77W	18	2.011173184	81.22905028	18	2.011173184	80.89385475	18	2.011173184	80.89385475
UAL	B772	14	1.56424581	82.79329609	14	1.56424581	82.45810056	14	1.56424581	82.45810056
UPS	B744	13	1.452513966	84.24581006	13	1.452513966	83.91061453	13	1.452513966	83.91061453
CAL	A343	11	1.229050279	85.47486034	11	1.229050279	85.1396648	11	1.229050279	85.1396648

PRELIMINARY SAFETY ASSESSMENT OF THE AIRSPACE OF DEMOCRATIC PEOPLE'S REPUBLIC OF KOREA

OPERATOR	TYPE	FLIGHTS	PER(%)	PER_CUM(%)	AW	AW_PER(%)	AWPER_CUM(%)	FULL	FULL_PER(%)	FULLPER_CUM(%)
SIA	B772	11	1.229050279	86.70391061	11	1.229050279	86.36871508	11	1.229050279	86.36871508
CCA	B737	8	0.893854749	87.59776536	8	0.893854749	87.26256983	8	0.893854749	87.26256983
KOR	IL62	8	0.893854749	88.49162011	8	0.893854749	88.15642458	8	0.893854749	88.15642458
JAI	B773	8	0.893854749	89.38547486	8	0.893854749	89.05027933	8	0.893854749	89.05027933
VLK	A320	8	0.893854749	90.27932961	8	0.893854749	89.94413408	8	0.893854749	89.94413408
AZA	B772	6	0.670391061	90.94972067	6	0.670391061	90.61452514	6	0.670391061	90.61452514
CPA	B77W	6	0.670391061	91.62011173	6	0.670391061	91.2849162	6	0.670391061	91.2849162
UPS	MD11	6	0.670391061	92.29050279	4	0.446927374	91.73184358	4	0.446927374	91.73184358
UAL	B744	6	0.670391061	92.96089385	6	0.670391061	92.40223464	6	0.670391061	92.40223464
DAL	B772	5	0.558659218	93.51955307	5	0.558659218	92.96089385	5	0.558659218	92.96089385
CPA	A343	4	0.446927374	93.96648045	4	0.446927374	93.40782123	4	0.446927374	93.40782123
KAL	B747	4	0.446927374	94.41340782	4	0.446927374	93.8547486	4	0.446927374	93.8547486
UPS	B763	4	0.446927374	94.8603352	4	0.446927374	94.30167598	4	0.446927374	94.30167598
CSN	A306	4	0.446927374	95.30726257	4	0.446927374	94.74860335	4	0.446927374	94.74860335
AAR	B747	3	0.335195531	95.6424581	3	0.335195531	95.08379888	3	0.335195531	95.08379888
SIA	B744	3	0.335195531	95.97765363	3	0.335195531	95.41899441	3	0.335195531	95.41899441
SHU	AN12	3	0.335195531	96.31284916	0	0	95.41899441	0	0	95.41899441
PAC	B744	3	0.335195531	96.64804469	3	0.335195531	95.75418994	3	0.335195531	95.75418994
ACA	B77L	3	0.335195531	96.98324022	3	0.335195531	96.08938547	3	0.335195531	96.08938547
AFR	B772	3	0.335195531	97.31843575	3	0.335195531	96.42458101	3	0.335195531	96.42458101
AAR	B763	2	0.223463687	97.54189944	2	0.223463687	96.64804469	2	0.223463687	96.64804469
AAR	B774	2	0.223463687	97.76536313	2	0.223463687	96.87150838	2	0.223463687	96.87150838
AFR	B77W	2	0.223463687	97.98882682	2	0.223463687	97.09497207	2	0.223463687	97.09497207
DLH	A343	2	0.223463687	98.2122905	2	0.223463687	97.31843575	2	0.223463687	97.31843575

PRELIMINARY SAFETY ASSESSMENT OF THE AIRSPACE OF DEMOCRATIC PEOPLE'S REPUBLIC OF KOREA

OPERATOR	TYPE	FLIGHTS	PER(%)	PER_CUM(%)	AW	AW_PER(%)	AWPER_CUM(%)	FULL	FULL_PER(%)	FULLPER_CUM(%)
DLH	A346	2	0.223463687	98.43575419	2	0.223463687	97.54189944	2	0.223463687	97.54189944
ACA	B77W	1	0.111731844	98.54748603	1	0.111731844	97.65363128	1	0.111731844	97.65363128
SYL	T154	1	0.111731844	98.65921788	1	0.111731844	97.76536313	1	0.111731844	97.76536313
SXA	LJ24	1	0.111731844	98.77094972	0	0	97.76536313	0	0	97.76536313
SUM	IL76	1	0.111731844	98.88268156	1	0.111731844	97.87709497	1	0.111731844	97.87709497
SIA	T154	1	0.111731844	98.99441341	0	0	97.87709497	0	0	97.87709497
SIA	B777	1	0.111731844	99.10614525	1	0.111731844	97.98882682	1	0.111731844	97.98882682
KLM	B772	1	0.111731844	99.21787709	1	0.111731844	98.10055866	1	0.111731844	98.10055866
CPA	B777	1	0.111731844	99.32960894	1	0.111731844	98.2122905	1	0.111731844	98.2122905
CPA	B770W	1	0.111731844	99.44134078	1	0.111731844	98.32402235	1	0.111731844	98.32402235
FR2	B772	1	0.111731844	99.55307263	1	0.111731844	98.43575419	1	0.111731844	98.43575419
KLM	B744	1	0.111731844	99.66480447	1	0.111731844	98.54748603	1	0.111731844	98.54748603
KAL	B745	1	0.111731844	99.77653631	1	0.111731844	98.65921788	1	0.111731844	98.65921788
CSN	MD91	1	0.111731844	99.88826816	1	0.111731844	98.77094972	1	0.111731844	98.77094972
AFR	B744	1	0.111731844	100	1	0.111731844	**98.88268156**	1	0.111731844	**98.88268156**
TOTAL		895			885			885		

DATE	CALL SIGN	AIRCRAFT REGISTRATION	PBN APPROVAL TYPE[1]	AIRCRAFT TYPE	ORIGIN AERODROME	DESTINATION AERODROME	ENTRY FIX	TIME (UTC) AT ENTRY FIX	FL AT ENTRY FIX	ROUTE AFTER ENTRY FIX	EXIT FIX	TIME (UTC) AT EXIT FIX	FL AT EXIT FIX	ROUTE BEFORE EXIT FIX	FIX 1	TIME (UTC) AT FIX 1	FL AT FIX 1	ROUTE AFTER FIX 1	FIX 2	TIME (UTC) AT FIX 2	FL AT FIX 2	ROUTE AFTER FIX 2	FIX N	TIME (UTC) AT FIX N	FL AT FIX N	ROUTE AFTER FIX N	Complete these "FIX/TIME/FL/ROUTE" fields for every flight level and route changes

ASIA/PACIFIC REGION

PERFORMANCE FRAMEWORK FORM
(REGIONAL)

<table>
<tr><td colspan="5">REGIONAL PERFORMANCE OBJECTIVE: APAC – ATM 1
AIRSPACE SAFETY MONITORING TO ACHIEVE REGIONAL TLS</td></tr>
<tr><td colspan="5">Benefits</td></tr>
<tr><td>Safety</td><td colspan="4">• Improved safety management,
• Compliance with regional Target Level of Safety (TLS)</td></tr>
<tr><td colspan="5">Strategy
Short term/medium term (2009-2015)</td></tr>
<tr><td>ATM OC COMPONENTS</td><td>TASKS</td><td>TIME FRAME</td><td>RESPONSIBILITY</td><td>STATUS</td></tr>
<tr><td rowspan="2">AOM
(Airspace Organization and Management)</td><td>• Facilitate cooperative arrangements between States to undertake airspace safety assessments

• Review airspace safety monitoring that supports reduction in vertical and horizontal aircraft separation standards</td><td>2009-2015</td><td>RASMAG</td><td>In progress</td></tr>
<tr><td>• Assist States to achieve established Target Levels of Safety (TLS)</td><td>2009-2015</td><td>RASMAG
WPAC/SCS RSG
RNP/SEA-TF
BOB RHS/TF
RNP/TF</td><td>In progress</td></tr>
<tr><td>GPIs</td><td colspan="4">GPI/2 Reduced vertical separation minima, GPI/5 Performance based navigation, GPI/7 Dynamic and Flexible ATS route management</td></tr>
<tr><td>References</td><td colspan="4">• Asia/Pacific Guidance Material for ADS/CPDLC/AIDC Ground Systems Procurement and Implementation;
• Guidance Material for End-to-End Safety and Performance Monitoring of Air Traffic Service (ATS) Data Link Systems in the Asia/Pacific Region
• Asia/Pacific En-route Monitoring Agency (EMA) Handbook
• Regional Monitoring Agency (RMA) Manual
• Global Operational Data Link Document (GOLD).</td></tr>
</table>

RASMAG — TASK LIST

(last updated 12 June 2009)

ACTION ITEM	DESCRIPTION	TIME FRAME	RESPONSIBLE PARTY	STATUS	REMARKS
8/6	Take action to implement LTHM Actions 1-6 as described in RASMAG/8 report In particular, ensure arrangements for regional cooperation between RMAs	RASMAG/12	Asia/Pacific RMAs ~~including China RMA~~	Open	RASMAG LTHM Actions promulgated by State Letter AP018/8 of 31 January 2008. RASMAG/9 informed no progress made due to priority workloads for all RMAs and Regional Office. RASMAG/10 informed of actions taken so far, update RASMAG/11 about progress
~~9/3~~	~~Include estimate of annual hours flown and standardise reporting across RMAs graphs, and bar graphs using WP/18 from AAMA to RASMAG/9 as the basis~~	~~RASMAG/10~~	~~All Asia/Pacific RMAs including China RMA.~~	~~Open~~ ~~Completed~~	~~This information available from some RMAs during RASMAG/10, others will comply by RASMAG/11~~ ~~RASMAG/11 report demonstrates compliance by all RMAs~~
9/4	Japan to attempt to capture and analyse data in relation to implementation of AIDC with Republic of Korea during 2009 Attempt to show Category E LHD performance before and after implementation of AIDC	RASMAG/12	JCAB RMA	Open	AIDC trials commenced May 2009, implementation scheduled June 2009, JCAB RMA will update RASMAG/12
~~10/1~~	~~Standardise annual December TSD data collection template across all RMAs for regional application. Noting intention to expand use of December TSD to EMA and general planning and implementation, ensure collection of "En-route PBN Approvals Status" (e.g. RNP 4) and ATS route parameters.~~	~~RASMAG/11~~	~~Asia/Pacific RMAs, EMAs~~	~~Open~~ ~~Completed~~	~~Lead RMA is PARMO. RMAs to work by correspondence, present final template to RASMAG/11 for adoption~~ ~~RASMAG/11 adopted standardised temp[late with new columns for aircraft registration and en-route PBn capability~~

ACTION ITEM	DESCRIPTION	TIME FRAME	RESPONSIBLE PARTY	STATUS	REMARKS
10/2	Undertake studies to quantify the magnitude of the problem of RVSM non-approved flights operating in RVSM airspace. Identify solutions.	RASMAG/12	Asia/Pacific RMAs,	Open	Lead RMA is PARMO. RMAs to work by correspondence, present adequate information to RASMAG/11 to compile briefing for APANPIRG PARMO provided update report to RASMAG/11, further development required before reporting to APANPIRG
10/3	Recognising delays in RMA manual, Annex 6 monitoring requirements not implemented until Nov 2010, encourage APANPIRG to adopt MAAR MMRs as recommended by RASMAG.	RASMAG/12	RASMAG, Regional Office	Open	RASMAG/10 prepared draft APANPIRG Conclusion for consideration by APANPIRG in September 2009. RASMAG/11 updated MMRs to include E170, E190 & A388.
~~10/4~~	~~Noting intention of DPR Korea to implement RVSM by mid 2009, relay offer from China RMA to lead technical assistance to DPR Korea, notify willingness of RASMAG, MAAR and Regional Office to assist China RMA in supporting DPR Korea~~	~~RASMAG/11~~	~~Regional Office~~	~~Open~~ ~~Completed~~	~~Regional Office to write to DPR Korea, notify outcomes to ATMB China~~ ~~State Letter Ref.: T 3/10.1.7 — AP-ATM002521 January 2009~~
~~10/5~~	~~Prepare up to date Table for inclusion in Regional Monitoring Impact Statement that accurately reflects the Asia/Pacific FIRs and the RMA responsible for each FIR~~	~~RASMAG/11~~	~~Asia/Pacific RMAs~~	~~Open~~ ~~Closed~~	~~Lead RMA is AAMA. RMAs to work by correspondence, present final version to RASMAG/11 for inclusion in impact statement~~ ~~RMA manual is proceeding, this update will be include in Manual, including Pyongyang FIR from MAAR to China RMA~~

ACTION ITEM	DESCRIPTION	TIME FRAME	RESPONSIBLE PARTY	STATUS	REMARKS
~~10/6~~	~~Review monitoring requirements for Embraer family of twin jets including EMB 170 and EMB 190 with objective of including these types appropriately in regional MMRs~~	~~RASMAG/11~~	~~Asia/Pacific RMAs~~	~~Open~~ ~~Completed~~	~~RASMAG/11 updated MMRs to include E170, E190 & A388.~~
10/7	Prepare Taxonomy of RMA related terms with objective of clarifying and standardising reporting of LHD by States and limiting under reporting. Consider inclusion of taxonomy as appendix to Regional Monitoring Impact Statement	RASMAG/12	Asia/Pacific RMAs	Open	Lead RMA is AAMA. RMAs to work by correspondence, present final version to RASMAG/11 for inclusion in impact statement
10/8	Prepare final version of EMA Handbook for recommendation by RASMAG/11 to APANPIRG for adoption as regional guidance material	RASMAG/12	Small drafting Group (~~S~~EMAHRT members)	Open	Present final version to RASMAG/11 for Recommendation RASMAG/11 adopted advanced draft and continued small drafting group to prepare a submission to APANIRG/20 in September 2009.
10/9	Write advanced draft of Regional Impact Statement for long term height monitoring as required by APANPIRG Conclusion 18/4	RASMAG/12	Small drafting Group (Mr Butcher, Mr Tang Jinxiang, Mr Yanpirat, Mr Oseto, Ms Falk, Mr Farmer and RASMAG Secretary)	Open	Present advanced version to RASMAG/11 as basis for APANPIRG briefing RASMAG/11 adopted advanced draft and continued small drafting group to prepare a submission to APANIRG/20 in September 2009. RMAs to populate monitoring burden tables and send to Regional Office by 31 July.

ACTION ITEM	DESCRIPTION	TIME FRAME	RESPONSIBLE PARTY	STATUS	REMARKS
10/11	Standardise methodology of assessing duration of LHDs in application of the CRM	RASMAG/12	Asia/Pacific RMAs	Open	Lead RMA is AAMA. RMAs to work by correspondence, present updated information to RASMAG/11. PARMO presented information to RASMAG/11 on durations for crossing flight levels, further study and update to RASMAg/12
11/1	RMAs agreed to amend wording on LHD submission template to read to read *"Were the Supervisors of the transferring and receiving ACCs advised of this LHD occurrence?"*	RASMAG/12	Asia/Pacific RMAs	Open	
11/2	Prepare RASMAG template letter for use by RMAs in resolving difficulties with States. Such a letter would specify that the request has been made on behalf of RASMAG which has specific empowerment from APANPIRG. RASMAG/11 paragraph 2.8 refers	RASMAG/12	Asia/Pacific RMAs, Secretariat	Open	
11/3	Include aircraft identification and en-route PBN approval type in RMA TSD templates to encourage inclusion of this data in Annual December TSD	RASMAG/12	Asia/Pacific RMAs	Open	

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