International Civil Aviation Organization

Twenty-Ninth Meeting of the Regional Airspace Safety Monitoring Advisory Group (RASMAG/29)

Bangkok, Thailand, 19 – 22 August 2024

Agenda Item 2: Review Outcomes of Related Meetings

OUTCOMES OF RASMAG-MAWG AND RMACG MEETINGS

(Presented by the Chairperson)
(Prepared by MAAR)

SUMMARY

This paper presents a brief summary from the 11th Meeting of the Monitoring Agencies Working Group (MAWG/11) from 29 January to 1 February 2024 and the 19th Meeting of Regional Monitoring Agencies Coordination Group (RMACG/19) from 11 - 14 June 2024.

1. INTRODUCTION

1.1 The Eleventh Meeting of the Regional Airspace Safety Monitoring Advisory Group Monitoring Agencies Working Group (RASMAG/MAWG/11) Meeting was held from 29 January to 1 February 2024 in Bangkok, Thailand. Eighteen (18) participants attended the meetings from Australia, China, Japan, Singapore, Thailand, the United States, and ICAO Regional Officer from the Bangkok Office. Thirteen (13) working papers (WPs), Nine (9) information papers (IPs), and Five (5) Flimsies (FLs) were reviewed by the meeting.

1.2 The Nineteenth RMA Coordination Group Meeting (RMACG/19) was held at the headquarters of the International Civil Aviation Organization (ICAO) in Montreal, Canada from 11 to 14 June 2024 and hybrid format. Fifteen (15) participants representing seven (7) Regional Monitoring Agencies attended the meeting in person, while another twenty-one (21) participants from eight (8) RMAs contributed virtually. Twenty (20) working papers (WPs), twenty-four (24) information papers (IPs), and five (5) Flimsies (FLs) were reviewed by the meeting.

1.3 The topics of discussion and collaboration, will also be discussed by the RASMAG, include:

a) RVSM and PBCS approval, including the monitoring of Non-RVSM approved aircraft;

b) RVSM Minimum Monitoring Requirements (MMR);

c) Height Keeping Performance Monitoring (HKPM) activities and Altimetry System Error;

d) RVSM safety monitoring, including methodology, result analysis, and the LHD hot spots; and

e) PBCS oversight, including methodology, result analysis, and implementation status & plan.

1.4 Specific topics from MAWG/11 and RMACG/19 meetings which should be highlighted for the RASMAG/29 meeting are detailed in the discussion section of this WP.

2. DISCUSSION

RVSM Minimum Monitoring Requirements (MMR)

2.1 The RVSM Minimum Monitoring Requirements (MMR) Version 2024 was reviewed and adopted by the RMACG meeting, which can be found in the **Attachment 1 (WP/16 from RMACG/19)**. The official release version 2024 will be distributed to States once available. The changes to the new version of MMR are as follow:

New entrants to the Civilian MMR

a) Gulfstream Model GVIII-G700 (G700), ICAO code GA7C, manufacturer serial number beginning with 87001, is added as a new Monitoring Group GLF8 in Category 2.

Changes to existing Monitoring Groups in the Civilian MMR

b) The ICAO type for GL5T is changed to BD700 (BD-700-1A11) and the ICAO type for GLEX is BD700 (BD-700-1A10).

c) The certification of the Boeing 737-MAX7 (or B37M), as well as the certification of the Boeing 777X (or B779), are both delayed. For the time being the B37M Monitoring Group and the B779 Monitoring Group are both removed from the MMR.

d) After Embraer investigated the noncompliant performance of the E135-145 Monitoring Group, this Monitoring Group is split into three new Monitoring Groups as shown below:

   i) The new E135-145 Monitoring Group contains only the EMB-135, EMB-140, and EMB-145 aircraft types.

   ii) The new E135BJ1 Monitoring Group contains all EMB-135BJ (E35L) aircraft, except for those specified in the new E135BJ2 Monitoring Group.

   iii) The new E135BJ2 Monitoring Group contains EMB-135BJ (E35L) aircraft with serial number 586, 1144, 1193, 1219, 1220, 1223 thru 1227, 1229 and on; and any other E35L aircraft that incorporates Service Bulletin SB145LEG-34-0039.

Changes of Category in the Civilian MMR

e) NAARMO presented data and rationale to support moving the B38M Monitoring Group and the B39M Monitoring Group from Monitoring Category 2 to 1 of the MMR. These two groups have had more than two years of stable performance in Category 2, and both group and individual aircraft performance satisfy RVSM requirements. Additionally, because the Boeing 737-MAX8-200 [current Monitoring Group B8200] is a variant of the Boeing 737-MAX8 [current Monitoring Group B38M], it was proposed to merge the B8200 into the B38M Monitoring Group. Data presented by the NAARMO demonstrated that ASE performance among airframes in the B39M, B38M, and B8200 Monitoring Groups is stable and within RVSM requirements, the ASE mean and SD. Individual airframe performance is good as well. The RMACG meeting agreed to the proposed changes.

f) EUR RMA identified several Monitoring Groups demonstrating compliance with group performance requirements, as well as long term ASE stability. These Monitoring Groups had more than 50 individual airframes monitored and/or a minimum of 1,000 height monitoring results in the last two years. EUR RMA therefore proposed and the RMACG meeting agreed that the following Monitoring Groups in Category 2 are

changed to Category 1: A20N, A339, A350, B78X, BCS1, C25C, C550-B, CRJ10, E290, E295, E545-550, F2TH, GL7T, GLF6, GLF7, LJ35-36, PC24 and TBM.

New entrants to the Military MMR

g) Grob D-500 EGRETT II is added to the Military MMR as a Category 3, experimental aircraft. The ICAO Code is EGRT. This addition to the MMR was proposed by the EUR RMA.

h) Beechcraft 350 Super King Air is added to the Military MMR. These are modified versions of civilian aircraft with additions to the fuselage for military use. Due to these modifications these aircraft are Category 3, non-group. For consistency with the civilian type, the name of these will be BE30 in the Military MMR. The ICAO Code is B350. This addition to the MMR was proposed by NAARMO.

PBCS Format for Approval File

2.2 The NAT CMA presented PBCS Format for Approval File to the RMACG meeting and requested an update to the RVSM approval information exchange format as published in ICAO Doc 9937 to include RCP and RSP approval information. Currently, during the routine task of compiling the RVSM approvals snapshots, the NAT CMA must alter and reposition the RCP and RSP fields to create one standardized combined snapshot.

2.3 The RMACG meeting reviewed and endorsed the date formats included in all fields of the RVSM approval file, it was suggested that the following date format: yyyy/mm/dd would be more efficient in terms of database programming. This format also supported ease of sorting data chronologically.

2.4 All RMAs need to include RCP and RSP fields on the RVSM approvals snapshot and modify the format of all the date fields by 30 September 2024. However, this change does not affect the F2 Form or how States submit approval data to the RMAs.

Procedure of Submitting LHD Report from Operator

2.5 During the MAWG meeting, JASMA presented the procedures and the cases in which aircraft operators directly submitted a Large Height Deviation (LHD) report directly to the JASMA with the LHD reporting form as published in Japan's AIP. JASMA inquired at the meeting of the procedures for how RMAs/States/Administrations obtained an LHD report from aircraft operators.

2.6 The meeting explored various sources of safety data reporting systems and the existing data sharing mechanism whereby the monitoring agencies could possibly obtain LHD occurrence reports from flight crews. It was mentioned that the member States had the obligation to submit LHD occurrence data to the RMAs even though it was usually delegated to ANSPs. The meeting also discussed the possibility to propose an action at RASMAG/29 for the ICAO to conduct a survey asking if the member States had a reporting mechanism in place and were aware of the requirement to submit LHD occurrence information including those reported by air operators. After consultation with ICAO, ICAO and the Chair would initiate contact with RASG-APAC to explore appropriate ways to address this issue.

Sub-Category of Large Height Deviation (LHD) Category E

2.7 The MAWG meeting discussed the sub-categories of LHD Category E through illustrative examples with the aim to align the descriptions, improve the consistency, and harmonize the safety analysis for Asia Pacific States and monitoring agencies. The standardization of the sub-categories with descriptive examples was supported by the meeting and decided to have further study and discussion among the monitoring agencies as a side meeting during RASMAG/29.

Management Process of Hot Spots for RASMAG

2.8 In relation to the RASMAG Action Item 26/5 inviting the MAWG to consider drafting a formalized process of identifying, monitoring, and removing hot spots for the Asia Pacific region, the MAWG meeting reviewed comments and feedback from MAAR, China RMA, JASMA, and PARMO regarding their trials of the process since 2022. The meeting agreed that the process as detailed in **Attachment 2 (Attachment to WP/06 from RASMAG/MAWG/11**) was ready and would be presented to the RASMAG/29 meeting for endorsement and its application by APAC RMAs and EMAs.

2.9 MAAR also informed the MAWG meeting of a request raised during the RASMAG/28 meeting to list the involved FIRs for each hot spot by alphabet. This proposal was to remove the speculation of involvement from the order of FIRs. The meeting agreed to rearrange the FIRs in the List of LHD Hot Spots in an alphabetical order.

Subdivision of Hot Spot

2.10 The MAWG meeting agreed with JASMA's proposal to allow the splitting of a hot spot into smaller areas depending on the FIR interfaces, the contributing factors, implementation of mitigation measures, etc. The meeting decided to split Hot Spot B and Hot Spot D into smaller areas at the interface level. Therefore, the safety assessment report would refer to the new codes, as follows:

B1 for Incheon and Shanghai FIR boundary;

B2 for the area with four intersection points of A593, Y590, Y711, and Y722;

B3 for Fukuoka and Incheon FIR boundary;

D1 for Fukuoka and Manila FIR boundary;

D2 for Manila and Taibei FIR boundary;

D3 for Hong Kong and Manila FIR boundary;

D4 for Manila and Sanya FIR boundary;

D5 for Ho Chi Minh and Manila FIR boundary;

D6 for Manila and Singapore FIR boundary;

D7 for Kota Kinabalu and Manila FIR boundary;

D8 for Manila and Ujung Pandang FIR boundary;

D9 for Manila and Oakland FIR boundary.

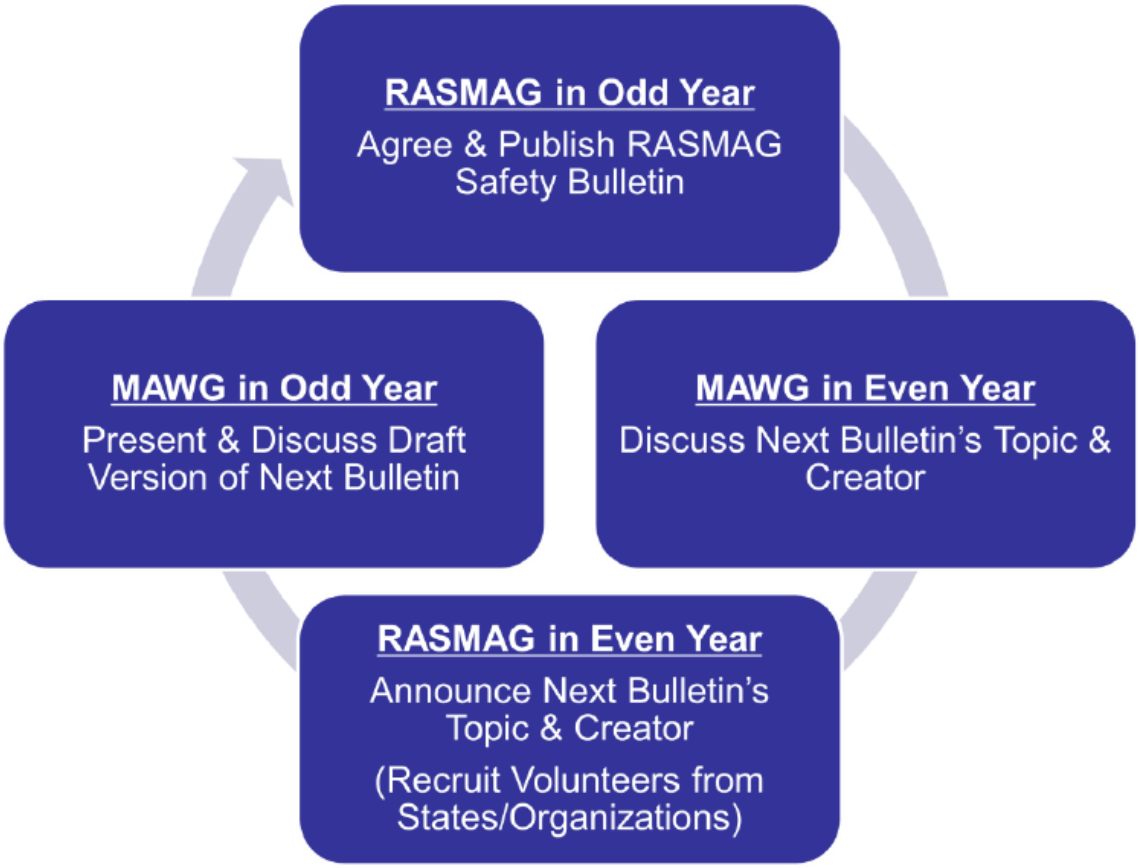
2.11 ICAO requested to document the process of Hot Spot Subdivision into the Management Process of Hot Spots for RASMAG.

2.12 Once the meeting of RASMAG/29 adopts the application of the Hot Spot Management Process as previously proposed in paragraph 2.8, the GUIDANCE MATERIAL FOR THE CONTINUED SAFETY MONITORING OF THE ASIA-PACIFIC RVSM AIRSPACE, version 2.0 is

accordingly updated to version 3.0 (**Attachment 3**) for consideration by the meeting. Additionally, the arrangement of the FIRs in the List of LHD Hot Spots in an alphabetical order (paragraph 2.9) and the subdivision of Hot Spot (paragraph 2.10) are also included in version 3.0.

RASMAG Safety Bulletin

2.13 JASMA presented the proposal for the framework of the Safety Bulletin issued by RASMAG to ensure the publication of the bulletin every two years. The proposed framework of RASMAG Safety Bulletin for agreement by RASMAG is depicted below.



2.14 JASMA proposed Team Resource Management (TRM) as the next topic and also volunteered to lead. The Chair thanked JASMA for volunteering and follow-up on the RASMAG Safety Bulletin. The MAWG/11 meeting agreed with TRM as the next topic.

3. ACTION BY THE MEETING

3.1 The meeting is invited to:

a) note the information contained in this paper;

b) communicate changes to the new RVSM MMR version 2024 (paragraph 2.1) as detailed in **Attachment 1 (WP/16 from RMACG/19)** with aircraft operators;

c) consider adoption and application of the Hot Spot Management Process for RASMAG (paragraph 2.8) as detailed in **Attachment 2 (Attachment to WP/06 from RASMAG/MAWG/11**);

d) consider adoption and application of the GUIDANCE MATERIAL FOR THE CONTINUED SAFETY MONITORING OF THE ASIA-PACIFIC RVSM AIRSPACE version 3.0 (paragraph 2.12) as detailed in **Attachment 3**;

e) agree to the proposed framework of RASMAG Safety Bulletin (paragraph 2.13);

f) contribute ideas and contents under the topic of Team Resource Management (TRM) for the next RASMAG Safety Bulletin (paragraph 2.14); and

g) discuss any relevant matters as appropriate.

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International Civil Aviation Organization

WORKING PAPER

REGIONAL MONITORING AGENCIES COORDINATION GROUP

NINETEENTH MEETING (RMACG/19)

(Montreal, Canada 11 - 14 June 2024)

Agenda Item 3: Reduced Vertical Separation Minimum (RVSM) Monitoring Groups and Minimum-Monitoring Requirements (MMR)
3.1 MMR maintenance management

RVSM Minimum Monitoring Requirements Update

(Presented by NAARMO - Prepared by Brian Livings)

SUMMARY

The 2023 RVSM Minimum Monitoring Requirements (MMR) Chart was reviewed by NAARMO and EUR RMA, who prepared a list of recommended amendments to the MMR for 2024. The MMR table is presented in Attachment A.

1. INTRODUCTION

1.1. The Regional Monitoring Agency (RMA) Manual (ICAO Doc. 9937; 1st ed. 2010) prescribes on-going quality control checks of operator fleets, also known as Long-term Height Monitoring (LTHM) requirements. The instrument which best describes these requirements is the MMR chart, which does appear in the RMA Manual but is also revised when necessary, during the RMA Coordination Group meeting.

1.2. The MMR continues to be maintained outside of the RMA Manual, so that any developments such as new aircraft, new avionics, and new insights into improvement or failure in achieving the goals in the MMR can be addressed without engaging the requisite cost and slowness of a publishing cycle for the Manual. All RMAs have access to the MMR via a Knowledge Sharing Network (KSN) available only to RMAs.

2. DISCUSSION

2.1. New entrants to the Civilian MMR

a) Gulfstream Model GVIII-G700 (G700), ICAO code GA7C, manufacturer serial number beginning with 87001, are added as a new Monitoring Group GLF8. This addition to the MMR is requested by EUR RMA and NAARMO.

2.2. Changes to existing Monitoring Groups in the Civilian MMR

a) Additional defining criteria for existing Monitoring Groups: Some NAARMO processes refer to aircraft in the GL5T Monitoring Group and the GLEX Monitoring Group using their manufacturer's type code instead of the ICAO code. The code for GL5T is BD700 (BD-700-1A11) and the code for GLEX is BD700 (BD-700-1A10). For clarity these codes should be added as additional defining criteria for the GL5T and GLEX.

b) Existing Monitoring Groups to be removed: The certification of the Boeing 737-MAX7 (or B37M), as well as the certification of the Boeing 777X (or B779), are both delayed. For the time being the B37M Monitoring Group and the B779 Monitoring Group can both be removed from the current MMR.

c) Existing Monitoring Group to be changed: Embraer investigated the noncompliant performance of the E135-145 Monitoring Group. It is proposed to split this Monitoring Group into three new Monitoring Groups as shown below. For more information please see WP03.

i. The new E135-145 Monitoring Group will contain only the EMB-135, EMB-140, and EMB-145 aircraft types.

ii. The new E135BJ1 Monitoring Group will contain all EMB-135BJ (E35L) aircraft, except for those specified in the new E135BJ2 Monitoring Group.

iii. The E135BJ2 Monitoring Group will contain EMB-135BJ (E35L) aircraft with serial number 586, 1144, 1193, 1219, 1220, 1223 thru 1227, 1229 and on; and any other E35L aircraft that incorporates Service Bulletin SB145LEG-34-0039.

2.3. Existing Monitoring Groups investigated to determine if it is appropriate to change their current monitoring category. It is accepted practice to place new aircraft types, or variants, in Category 2 until sufficient data is available to confirm overall group compliance as well as long term ASE stability. This period is generally accepted to be a minimum of two years. It is also possible to demote aircraft groups from Category 1 to Category 2, however this should only be considered if there are clearly identified generic performance problems, with sufficient representative monitoring data to confirm non-compliance with group performance requirements. In these circumstances a formal investigation should first be initiated with the appropriate certification authority as well as the airframe manufacturer.

a) At the present time there are no aircraft in Category 1 which are being considered for moving to Category 2.

b) Boeing requested that the B38M Monitoring Group be changed from Category 2 to Category 1 of the MMR. Along with the category change, it is also proposed that the 737-MAX8-200 (B8200 Monitoring Group), as a variant of the 737-MAX8, can be merged into the B38M Monitoring Group. Additionally, Boeing requested that the B39M Monitoring Group also be changed from Category 2 to Category 1. NAARMO conducted an investigation of

monitoring data from several RMAs to support these proposals. For more information please see WP04.

c) EUR RMA identified several Monitoring Groups demonstrating compliance with group performance requirements, as well as long term ASE stability. These Monitoring Groups have more than 50 individual airframes monitored and/or a minimum of 1,000 height monitoring results in the last two years. EUR RMA therefore proposes that the following Category 2 Monitoring Groups be changed to Category 1: A20N, A339, A350, B78X, BCS1, C25C, C550-B, CRJ10, E290, E295, E545-550, F2TH, GL7T, GLF6, GLF7, LJ35-36, PC24 and TBM.

2.4. New entrants to the Military MMR

a) Grob D-500 EGRETT II to be added to the Military MMR as a Category 3, experimental aircraft. The ICAO Code is EGRT. This addition to the MMR was proposed by the EUR RMA.

b) Beechcraft 350 Super King Air to be added to the Military MMR. These are modified versions of civilian aircraft with additions to the fuselage for military use. Due to these modifications these aircraft are Category 3, non-group. For consistency with the civilian type, the name of these will be BE30 in the Military MMR. The ICAO Code is B350. This addition to the MMR was proposed by NAARMO.

3. ACTION BY THE MEETING

3.1. The Meeting is invited to:

(a) note and review the contents of this working paper;

(b) review Appendix A, the MMR, for any clarifications needed for RMACG endorsement;

(c) agree that FAA and EUROCONTROL continue their work on the MMR;

(d) agree that all RMAs participate in the annual MMR review session at the RMACG;

(e) ask RMAs to contribute monitoring data to the annual review; and

(f) discuss any other relevant MMR matters as appropriate.

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Appendix A

RVSM MONITORING GROUPS AND MINIMUM MONITORING REQUIREMENTS

AS OF: 14 June 2024

Version: 2024.1

1. UPDATE OF MONITORING REQUIREMENTS TABLE AND WEBSITE. As significant data is obtained, monitoring requirements for specific aircraft types may change. When Table 1 below, is updated, a letter will be distributed by the Regional Monitoring Agencies (RMAs) to the States concerned. The updated table will be posted on the RMA website being maintained by the International Civil Aviation Organization (ICAO). The secure website address is: http://portal.icao.int

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 program. Table 1 establishes requirements for initial monitoring associated with the RVSM approval process. In their application to the appropriate State authority for RVSM approval, operators must show a plan for meeting 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 will be coordinated with the State authority.

4. APPLICABILITY OF MONITORING FROM OTHER REGIONS. Monitoring data obtained in conjunction with RVSM monitoring programs from other regions can be used to meet regional monitoring requirements. The RMAs, which are responsible for administering the monitoring program, 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 and the RMA that show how they intend to meet the requirements specified in Table1. Monitoring will be carried out in accordance with this table.

6. AIRCRAFT GROUPS NOT LISTED IN TABLE 1. Contact the RMA for clarification if an aircraft group is not listed in Table 1 or for clarification of other monitoring related issues. An aircraft group not listed in Table 1 will probably be subject to Category 2 monitoring requirements.

7. TABLE OF MONITORING GROUPS. Table 2 shows the aircraft types and series that are grouped together for operator monitoring purposes.

8. TABLE OF NON-GROUP AIRCRAFT: Table 3 shows the aircraft types and series that are Non-Group aircraft (i.e., Not certified under group approval requirements) for monitoring purposes.

9. 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, however, that aircraft RVSM systems were in the approved RVSM configuration for the flight.

10. 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 table.

11. FOLLOW-ON MONITORING. Monitoring is an on-going program that will continue after the RVSM approval process. Long term minimum monitoring requirements are established in the Annex 6 to the Convention on

International Civil Aviation. On a regional basis, a programme shall be instituted for monitoring the height-keeping performance of aircraft operating in RVSM airspace in order to ensure that continued application of this vertical separation minimum meets regional safety objectives.

Table 1: MONITORING REQUIREMENTS TABLE (Civilian)

MONITORING IS REQUIRED IN ACCORDANCE WITH THIS TABLE

MONITORING PRIOR TO THE ISSUE OF RVSM APPROVAL IS **NOT** A REQUIREMENT

CATEGORY		GROUP DESCRIPTOR	MINIMUM MONITORING REQUIREMENTS
1	GROUP APPROVED: DATA INDICATES COMPLIANCE WITH THE RVSM MASPS	A124, A20N, A30B, A306, A310-GE, A310-PW, A318, A320, A330, A339, A340, A345, A346, A350, A380, A3ST, AVRO, B38M, B39M, B712, B727, B737C, B737CL, B737NX, B747CL, B74S, B744-5, B744-10, B748, B752, B753, B764, B767, B772, B773, B787, B78X, BCS1, BD100, BE40, C25A, C25B, C25C, C510, C525, C550-B, C560, C56X, C650, C680, C750, CARJ, CL600, CL604, CL605, CRJ7, CRJ9, CRJ10, DC10, E135-145, E135BJ1, E135BJ2, E170-190, E290, E295, E545-550, E50P, E55P, F100, F2TH, F900, FA7X, GALX, GLEX, GL5T, GL7T, GLF4, GLF5, GLF6, GLF7, H25B-800, J328, LJ35-36, LJ40, LJ45, LJ60, MD10, MD11, MD80, MD90, PC12, PC24, PRM1, T154, TBM	Operators of aircraft types contained in this category shall have a minimum of 2 airframes monitored every 2 years or 1,000 flight hours, whichever is longer calculated from the date of the last successful height monitoring. Operators with fleets consisting of aircraft from more than one Monitoring Group shall meet this requirement for each group in the fleet. In the event that an operator has a single airframe from a Group, then that aircraft shall be monitored every 2 years or 1,000 flight hours, whichever is longer calculated from the date of the last successful height monitoring.
2	GROUP APPROVED: INSUFFICIENT DATA ON APPROVED AIRCRAFT	Other group aircraft other than those listed above including: A148, A158, A20N, A321XLR, A337, A339, A350, AC90, AC95, AJ27, AN72, ASTR, ASTR-SPX, B701, B703, B731, B732, B37M, B38M, B39M, B744-LCF, B779, B78X, B8200, BCS1, BE20, BE30, C25C, C441, C500, C550-B, C550-II, C550-SII, C700, C919, CRJ10, D328, DC85, DC86-87, DC91, DC93, DC94, DC95, EPIC, E120, E45X, EA50, E290, E295, E545-550, F2TH, F70, FA10, FA20, FA50, G150, G280, GL7T, GLF2, GLF8, GLF2B, GLF3, GLF6, GLF7, H25B-700, H25B-750, H25C, HA4T, HDJT, IL62, IL76, IL86, IL96, L101, L29B-2, L29B-731, LJ23, LJ24, LJ25, LJ28, LJ31, LJ35-36, LJ55, MC21, MU30, PA46, P180, P180-II, PAY4, PC24, SB20, SBR1, SBR2, SF50, SU95, T134, T204, T334, TBM, WW24, YK42	Operators of aircraft types contained in this category shall have a minimum of 60% of airframes monitored every 2 years or 1,000 flight hours, whichever is longer calculated from the date of the last successful height monitoring, (the number of airframes to be monitored shall be rounded up to the nearest whole integer). Operators with fleets consisting of aircraft from more than one Monitoring Group shall meet this requirement for each Group in the fleet.
3	NON-GROUP	Aircraft types for which no generic compliance method exists: A225, AN12, AN26, B190, B462, B463, B74S-SOFIA, BA11, BE9L, FA6X, GSPN, H25A, L29A, PAY3, R721, R722, SJ30, STAR	Operators of aircraft types contained in this category shall have 100% of airframes monitored every 2 years or 1,000 flight hours, whichever is longer calculated from the date of the last successful height monitoring.

Table 2: MONITORING GROUPS FOR AIRCRAFT CERTIFIED UNDER GROUP APPROVAL REQUIREMENTS

Monitoring Group	A/C ICAO	Manufacturer Type	Additional Defining Criteria
A124	A124	AN-124 RUSLAN	
A148	A148	AN-148	
A158	A158	AN-158	
A30B	A30B	A300	
A306	A306	A300	
A310-GE	A310	A310	Series: 200, 200F, 300, 300F
A310-PW	A310	A310	Series: 220, 220F, 320, 320F
A318	A318	A318	
A320	A319	A319	
	A320	A320	
	A321	A321	
A321XLR	A21N	A321XLR	
	A21N	A321neo XLR	
A20N	A19N	A319neo	
	A20N	A320neo	
	A21N	A321neo	
	A21N	A321LR	
A330	A332	A330	
	A333	A330	
A337	A337	AIRBUS BELUGA XL (A330-743L)	
A339	A339	A330-900neo	
	A338	A330-800neo	
A340	A342	A340	
	A343	A340	
A345	A345	A340	

Monitoring Group	A/C ICAO	Manufacturer Type	Additional Defining Criteria
A346	A346	A340	
A350	A359 A359 A35K	A350-900 A350-900 ULR A350-1000	
A380	A388	A380	
A3ST	A3ST	A300	600R ST BELUGA
AC90	AC90	COMMANDER 690 COMMANDER 840 COMMANDER 900	
AC95	AC95	AERO COMMANDER 695	
AJ27	AJ27	ARJ21-700	
AN72	AN72 AN74	ANTONOV AN-72 ANTONOV AN-74	
ASTR	ASTR	1125 ASTRA	S/n 1-78, except 73
ASTR-SPX	ASTR	1125 ASTR SPX, G100	S/n 73, 79-145 S/n > 145
AVRO	RJ1H RJ70 RJ85	RJ100 Avroliner RJ70 Avroliner RJ85 Avroliner	
B37M	B37M	Boeing 737 MAX 7	
B38M	B38M B38M	Boeing 737 MAX 8 B737-MAX8-200	
B39M	B39M	Boeing 737 MAX 9	
B701	B701	B707	
B703	B703	B707	Series 320, 320B, 320C
B712	B712	B717	

Monitoring Group	A/C ICAO	Manufacturer Type	Additional Defining Criteria
B727	B721	B727	
	B722	B727	
B731	B731	B737	
B732	B732	B737	
B737CL	B733	B737-300	
	B734	B737-400	
	B735	B737-500	
B737NX	B736	B737-600	
	B737	B737-700	B737-700 including the BBJ
	B738	B737-800	B737-800 including the BBJ2
	B739	B737-900	
	B739	B737-900ER	
B737C	B737	B737-700	Series: 700C
B747CL	B741	B747-100	
	B742	B747-200	
	B743	B747-300	
B74S	B74S	B747SP	
	B74R	B747SR	
B744-5	B744	B747-400	5 inch Probes up to s/n 25350
	B74D		
B744-10	B744	B747-400	10 inch Probes from s/n 25351
	B74D		
B744-LCF	BLCF	B747-400	
B748	B748	B747-8	
B752	B752	B757-200	
B753	B753	B757-300	
B767	B762	B767-200	
	B763	B767-300	

Monitoring Group	A/C ICAO	Manufacturer Type	Additional Defining Criteria
B764	B764	B767-400	
B772	B772	B777-200	
	B772	B777-200ER	
	B77L	B777-F	
	B77L	B777-200LR	
B773	B773	B777-300	
	B77W	B777-300ER	
B779	B779	B777-9	
B787	B788	B787-8	
	B789	B787-9	
B78X	B78X	B787-10	
B8200	B38M	B737-8200	Not including the standard B737-MAX8 which is in the B38M Monitoring Group above
		B737-MAX8-200	
		B737-MAX200	
BCS1	BCS1	BOMBARDIER CS100	
	BCS1	AIRBUS A220-100	
	BCS3	BOMBARDIER CS300	
	BCS3	AIRBUS A220-300	
BD100	CL30	CHALLENGER 300	
	CL35	CHALLENGER 350	Begins at s/n 20501
BE20	BE20	200 KINGAIR	
BE30	BE30	B300 SUPER KINGAIR	
	B350	B300 SUPER KINGAIR 350	
BE40	BE40	BEECHJET 400	
		BEECHJET 400A	
		BEECHJET 400XP	
		HAWKER 400XP	
C441	C441	CONQUEST II	

Monitoring Group	A/C ICAO	Manufacturer Type	Additional Defining Criteria
C500	C500	500 CITATION	
	C500	500 CITATION I	
	C501	501 CITATION I SINGLE PILOT	
C510	C510	MUSTANG	
C525	C525	525 CITATIONJET	
		525 CITATIONJET 1	
		525 CITATIONJET PLUS	
	C25M	C525-M2	S/n 800 and on
C25A	C25A	525A CITATIONJET II	
C25B	C25B	CITATIONJET III	
		525B CITATIONJET III	
C25C	C25C	525C CITATIONJET IV	
C550-B	C55B	550 CITATION BRAVO	S/n 550-0801 and on
C550-II	C550	550 CITATION II	S/n 550-0001 to 550-0800
	C551	551 CITATION II SINGLE PILOT	
C550-SII	C550	S550 CITATION SUPER II	S/n starts with “S”
C560	C560	560 CITATION V	
		560 CITATION V ULTRA	
		560 CITATION V ENCORE	
		560 CITATION V ENCORE PLUS	
C56X	C56X	560 CITATION EXCEL	
		560 CITATION XLS	
		560 CITATION XLS PLUS	
C650	C650	650 CITATION III	
		650 CITATION VI	
		650 CITATION VII	
C680	C680	680 CITATION SOVEREIGN	
	C68A	680-A LATITUDE	“A” in s/n

Monitoring Group	A/C ICAO	Manufacturer Type	Additional Defining Criteria
C700	C700	700 CITATION LONGITUDE	
C750	C750	750 CITATION X	
C919	C919	COMAC C919	
CARJ	CRJ1	CRJ-100	
	CRJ2	CRJ-200	
	CRJ2	CRJ-440	
	CRJ2	CHALLENGER 800	
	CRJ2	CHALLENGER 850	
CRJ7	CRJ7	CRJ-700	
	CRJ7	CRJ-550	
CRJ9	CRJ9	CRJ-705	
	CRJ9	CRJ-900	
CRJ10	CRJX	CRJ-1000	
CL600	CL60	CL-600	S/n < 5000
		CL-601	
CL604	CL60	CL-604	S/n 5000-5700
		CL-601-3A	S/n 5001-5134
		CL-601-3R	S/n 5135-5300
CL605	CL60	CL-605	S/n > 5700
	CL60	CL-650	
DC10	DC10	DC-10	
D328	D328	328 TURBOPROP	
DC85	DC85	DC-8	
DC86-87	DC86	DC-8	
	DC87	DC-8	
DC91	DC91	DC-9	
DC93	DC93	DC-9	
DC94	DC94	DC-9	

Monitoring Group	A/C ICAO	Manufacturer Type	Additional Defining Criteria
DC95	DC95	DC-9	
EPIC	EPIC	Epic E1000	
E120	E120	EMB-120 Brasilia	
E135-145	E135 E135 E145	EMB-135 EMB-140 EMB-145	Does not contain any EMB-135BJ (E35L) aircraft
E135BJ1	E35L	EMB-135BJ Legacy 600/650	All EMB-135BJ aircraft, except those in E135BJ2
E135BJ2	E35L	EMB-135BJ Legacy 600/650	EMB-135BJ aircraft with S/n 586, 1144, 1193, 1219, 1220, 1223 thru 1227, 1229 and on; Any other EMB-135BJ that incorporates Service Bulletin SB145LEG-34-0039.
E45X	E45X	EMB-145 XR	
E170-190	E170 E170 E75S E75L E190 E190	E170 E175 E170-200 short wing E175 long wing E190 E195	
E290	E290	E190-E2	
E295	E295 E295	E195-E2 E190-400	
E50P	E50P	PHENOM 100	
E545-550	E545 E545 E550 E550	EMB-545 LEGACY 450 EMB-545 PRAETOR 500 EMB-550 LEGACY 500 EMB-550 PRAETOR 600	
E55P	E55P	PHENOM 300	

Monitoring Group	A/C ICAO	Manufacturer Type	Additional Defining Criteria
EA50	EA50	ECLIPSE	
F100	F100	FOKKER 100	
F2TH	F2TH	FALCON 2000 FALCON 2000-EX FALCON 2000LX FALCON 2000-LXS FALCON 2000-S	
F70	F70	FOKKER 70	
F900	F900	FALCON 900 FALCON 900DX FALCON 900EX FALCON 900LX	
FA10	FA10	FALCON 10	
FA20	FA20	FALCON 20 FALCON 200	
FA50	FA50	FALCON 50 FALCON 50EX	
FA7X	FA7X FA8X	FALCON 7X FALCON 8X	
G150	G150	G150	
G280	G250 G280	G250 G280	
GALX	GALX	1126 GALAXY G200	
GLEX	GLEX	GLOBAL EXPRESS CLASSIC GLEX GLOBAL XRS GLOBAL 6000 GLOBAL 6500	BD700 (BD-700-1A10) S/n > 9158 S/n > 9431, and 9313 and 9381 S/n > 60001

Monitoring Group	A/C ICAO	Manufacturer Type	Additional Defining Criteria
GL5T	GL5T	GLOBAL 5000	BD700 (BD-700-1A11)
		GLOBAL 5000-GVFD	S/n > 9434, and 9386 and 9401
		GLOBAL 5500	S/n > 60001
GL7T	GL7T	GLOBAL 7500	
GLF2	GLF2	GULFSTREAM II (G-1159)	
GLF2B	GLF2	GULFSTREAM IIB (G-1159B)	
GLF3	GLF3	GULFSTREAM III (G-1159A)	
GLF4	GLF4	GULFSTREAM IV (G-1159C)	
		G300	
		G350	
		G400	
		G450	
GLF5	GLF5	GULFSTREAM V (G-1159D)	
		G500	
		G550	
GLF6	GLF6	G650	
GLF7	GA5C	G500 GVII	
	GA6C	G600 GVII	
GLF8	GA7C	G700 GVIII	Begins at s/n 87001
H25B-700	H25B	BAE 125 / HS125	Series: 700A, 700B
H25B-750	H25B	HAWKER 750	
H25B-800	H25B	BAE 125 / HS125	Series: 800A, 800B
		HAWKER 800XP	
		HAWKER 800XPI	
		HAWKER 800	
		HAWKER 850XP	
		HAWKER 900XP	
		HAWKER 950XP	

Monitoring Group	A/C ICAO	Manufacturer Type	Additional Defining Criteria
H25C	H25C	HAWKER 1000	
HA4T	HA4T	HAWKER 4000	
HDJT	HDJT	HONDAJET HA-420	
IL62	IL62	ILYUSHIN-62	
IL76	IL76	ILYUSHIN-76	
IL86	IL86	ILYUSHIN-86	
IL96	IL96	ILYUSHIN-96	
J328	J328	328JET	
L101	L101	L-1011 TRISTAR	
L29B-2	L29B	L-1329 JETSTAR II	
L29B-731	L29B	L-1329 JETSTAR 731	
LJ23	LJ23	LEARJET 23	
LJ24	LJ24	LEARJET 24	
LJ25	LJ25	LEARJET 25	
LJ28	LJ28	LEARJET 28 LEARJET 29	
LJ31	LJ31	LEARJET 31	
LJ35-36	LJ35	LEARJET 35, 35A LEARJET 36, 36A	
LJ40	LJ40 LJ70	LEARJET 40 LEARJET 70	Begins at s/n 2001 Begins at s/n 2134
LJ45	LJ45 LJ75	LEARJET 45 LEARJET 75	 Begins at s/n 456
LJ55	LJ55	LEARJET 55	
LJ60	LJ60	LEARJET 60	
MC21	MC21	IRKUT MC21-300	
MD10	MD10	MD-10	
MD11	MD11	MD-11	

Monitoring Group	A/C ICAO	Manufacturer Type	Additional Defining Criteria
MD80	MD81	MD-80	
	MD82	MD-80	
	MD83	MD-80	
	MD87	MD-80	
	MD88	MD-80	
MD90	MD90	MD-90	
MU30	MU30	MU-300 DIAMOND	1A
PA46	PA46	PA46-500TP	
		PA46-600TP	
P180	P180	P-180 AVANTI	S/n < 1105 but not 1002
P180-II	P180	P-180 AVANTI II	S/n > 1104 and also 1002
	P180	P-180 AVANTI EVO	
PAY4	PAY4	PA-42 Cheyenne 400	Series: 1000 CHEYENNE
PC12	PC12	Pilatus PC-12	
PC24	PC24	Pilatus PC-24	
PRM1	PRM1	PREMIER 1	
SB20	SB20	SAAB 2000	
SBR1	SBR1	SABRELINER 40	
		SABRELINER 60	
		SABRELINER 65	
SBR2	SBR2	SABRELINER 80	
SF50	SF50	CIRRUS SF50	RVSM-capable s/n 8, 89, and 94 or above
SU95	SU95	SUKHOI SUPERJET 100-95	
T134	T134	TU-134	
T154	T154	TU-154	

Monitoring Group	A/C ICAO	Manufacturer Type	Additional Defining Criteria
T204	T204	TU-204 TU-214 TU-224 TU-234	
T334	T334	TU-334	
TBM	TBM7 TBM8 TBM9	TBM-700 TBM-850 TBM-900	 TBM8 with winglets, begins at s/n 1000
WW24	WW24	1124 WESTWIND	
YK42	YK42	Yakovlev YAK-42 Yakovlev YAK-40	

Table 3: Non-GROUP AIRCRAFT (i.e., Not certified under group approval requirements) (Civilian)

Non-Group Descriptor	A/C ICAO	Manufacturer Type	Additional Defining Criteria
A225	A225	ANTONOV AN-225	Non-Group
AN12	AN12	ANTONOV AN-12	Non-Group
AN26	AN26	ANTONOV AN-26	Non-Group
B190	B190	BEECH 1900	Non-Group
B462	B462	BAe-146-200	Non-Group
B463	B463	BAe-146-300	Non-Group
B74S-SOFIA	B74S	NASA B74SP with Sofia telescope	Non-Group: N747NA (s/n 21441)
BA11	BA11	BAC-111	Non-Group
BE9L	BE9L	Beechcraft King Air C90GT Beechcraft King Air C90GTI King Air Model 90 except F90 and F90-1	Non-Group

Non-Group Descriptor	A/C ICAO	Manufacturer Type	Additional Defining Criteria
FA6X	FA6X	Falcon 6X	Non-Group
GSPN	GSPN	GROB G-180 SPn Utility Jet	Non-Group
H25A	H25A	HS125-400, -600	Non-Group
L29A	L29A	L-1329 JETSTAR 6/8	Non-Group
PAY3	PAY3	PIPER Cheyenne 3	Non-Group
R721	R721	B-727-100: Re-engined	Non-Group
R722	R722	B-727-200: Re-engined	Non-Group
SJ30	SJ30	SWEARINGEN SJ-30	Non-Group
STAR	STAR	BEECH 2000 STARSHIP	Non-Group

Table 1: MONITORING REQUIREMENTS TABLE (Military)

MONITORING IS REQUIRED IN ACCORDANCE WITH THIS TABLE

MONITORING PRIOR TO THE ISSUE OF RVSM APPROVAL IS **NOT** A REQUIREMENT

CATEGORY		GROUP DESCRIPTOR	MINIMUM MONITORING REQUIREMENTS
1	GROUP APPROVED: DATA INDICATES COMPLIANCE WITH THE RVSM MASPS	C17, C130, KC135	Operators of aircraft types contained in this category shall have a minimum of 2 airframes monitored every 2 years or 1,000 flight hours, whichever is longer calculated from the date of the last successful height monitoring. Operators with fleets consisting of aircraft from more than one Monitoring Group shall meet this requirement for each group in the fleet. In the event that an operator has a single airframe from a Group, then that aircraft shall be monitored every 2 years or 1,000 flight hours, whichever is longer calculated from the date of the last successful height monitoring.
2	GROUP APPROVED: INSUFFICIENT DATA ON APPROVED AIRCRAFT	Other group aircraft other than those listed above including: A178, A400, C5, C550-552, E3, F18, KC2, KC46, KC39, P1, P8	Operators of aircraft types contained in this category shall have a minimum of 60% of airframes monitored every 2 years or 1,000 flight hours, whichever is longer calculated from the date of the last successful height monitoring, (the number of airframes to be monitored shall be rounded up to the nearest whole integer). Operators with fleets consisting of aircraft from more than one Monitoring Group shall meet this requirement for each Group in the fleet.
3	NON-GROUP	**Aircraft types for which no generic compliance method exists:** GLF5-AEW, GLEX-ASTOR **Aircraft types for which the compliance method is not known:** A30B-M, A310-M, A332-M, ASTR-M, B737-AWACS, BE30, C12, C21, C32, C35, C37, C40, C550-B-M, C9, CL60-M, E135-M, E4, E6, E8, E530, EGRT, FA10-M, FA20-M, FA50-M, GLF3-M, GLF4-M, IL76-M, KC10, KC-390, KC46, P180-M, R135, VC25	Operators of aircraft types contained in this category shall have 100% of airframes monitored every 2 years or 1,000 flight hours., whichever is longer calculated from the date of the last successful height monitoring.

Table 2: MONITORING GROUPS FOR AIRCRAFT CERTIFIED UNDER GROUP APPROVAL REQUIREMENTS (Military)

Monitoring Group	A/C ICAO	Manufacturer Type	Additional Defining Criteria
A178	A178	Antonov A178	
A30B-M	A30B	A300	B2-100 (Zero-G)
A310-M	A310	A310	MRT, MRTT
A332-M	A332	KC30-A KC45-A Voyager KC2, KC3	MRTT
A400	A400	A400M	
ASTR-M	ASTR	1125 ASTRA	NAV&COM
C12	BE20	C-12	
C130	C130	C-130 Hercules	Series: H only
	C30J	C-130J Hercules	
C17	C17	C-17 Globemaster III	
C21	LJ35	C-21	
C32	B752	C-32	Series: A, B
C40	B737	C-40 Clipper	
C5	C5	C5 Galaxy	
C550-552	C550	552 CITATION II (USN)	
C550-B-M	C550	550 CITATION BRAVO	
C550-M	C550	550 CITATION II	
C35	C560	560 CITATION V UC-35	
C37	GLF5	C-37 TP102D	Series: A, B Series: C
CL60-M	CL60	CL604	MPA
E135-M	E135	EMB-135	MRT

Monitoring Group	A/C ICAO	Manufacturer Type	Additional Defining Criteria
E3	E3TF E3CF	E-3 Sentry	
E4	B742	E-4	
E6	E6	E-6 Mercury	
B737-AWACS	E7A	B737	B737 AEW&C
E8	B703	E-8 J-Stars	
E530	E530	TEXTRON AIRLAND SCORPION	
FA10-M	FA10	FALCON 10	MRT
FA20-M	FA20	FALCON 20	EW/ELINT, MRT, EXP
FA50-M	FA50	FALCON 50	MPA/SAR
F18H	F18H	McDonnell-Douglas F/A 18 F/A-18 Hornet	
GLF3-M	GLF3	C-20	Series: A, B, C, D, E
GLF4-M	GLF4	C-20 S102B TP102	Series: F, G, H
IL76-M	IL76	IL-76	MRT, T
KC2	KC2	KAWASAKI KC2 C-2 RC-2 XC-2	
KC10	DC10	KC-10 Extender KDC-10 DC-10	
KC46	KC46	Boeing KC46 Boeing KC-46 Pegasus Boeing KC46A or B767-2C	
KC135	B703	KC-135 Stratotanker	

Monitoring Group	A/C ICAO	Manufacturer Type	Additional Defining Criteria
	K35E K35R	KC-135 Stratotanker C-135 Stratotanker	
KC39	KC39	Embraer KC390	
P1	P1	Kawasaki P-1	
P180-M	P180	P-180 AVANTI	
P8	P8	B738-ERX	BOEING P8 POSEIDON
R135	R135	RC-135	
VC25	B742	VC-25	

Abbreviations:

EW/ELINT	Electronic Warfare/Electronic Intelligence
EXP	Experimental
MPA	Maritime Patrol Aircraft
MRT	Multi Role Transporter
MRTT	Multi Role Transporter and Tanker
SAR	Search and Rescue
T	Transporter

Table 3: Non-GROUP AIRCRAFT (i.e., Not certified under group approval requirements) (Military)

Non-Group Descriptor	A/C ICAO	Manufacturer Type	Additional Defining Criteria
GLEX-ASTOR	GLEX	Raytheon Sentinel aka RAF's ASTOR (Airborne Stand-Off Radar)	Non-Group
GLF5-AEW	GLF5	GULFSTREAM G550	Non-Group : AEW

Abbreviations: AEW Airborne Early Warning

— END —

RASMAG MAWG/11−WP/06
29/01/2024 - 01/02/2024

The 11th Meeting of the Regional Airspace Safety Monitoring Advisory Group (RASMAG) Monitoring Agency Working Group (MAWG/11)

Bangkok, Thailand, 29 January – 1 February 2024

Agenda Item 4: EMA/RMA Safety Monitoring

MANAGEMENT PROCESS OF HOT SPOTS FOR RASMAG

(Presented by MAAR)

SUMMARY

This paper relates to RASMAG Action Item 26/5, inviting the MAWG to consider drafting a formalized process of identifying, monitoring, and removing hot spots for Asia Pacific region. The draft of hot spot management process is referred to as the attachment to this paper. The comments and feedback from MAAR, China RMA, JASMA, and PARMO regarding their trials of the process are summarized for further discussion during the plenary. The meeting is invited to consider the next step for the hot spot management of Asia Pacific region.

1. INTRODUCTION

1.1 With reference to RASMAG Action Item 26/5, the RASMAG/26 meeting held in 2020 invited the MAWG to consider drafting a formalized process of identifying, monitoring, and removing hot spots for Asia Pacific region.

1.2 In February 2022, MAAR presented the management process of LHD, LLE, and LLE hot spots to the MAWG/9 meeting as WP/07 (**Attachment 1**). The drafted management process contained three (3) parts: identifying, monitoring, and removing hot spots. The identification process relied on an RMA to judge if there was any cluster of LHDs, LLDs, and LLEs before testing them against the determining criteria of a hot spot. The hot spot determining criteria considered the number of occurrences, the risk estimates, or the TLS. The MAWG agreed that the process would be conducted as a trial before making a decision.

2. DISCUSSION

2.1 In 2022, MAAR presented the hot spot management process as WP/07 to the RASMAG/27 together with the trial results. The results were consistent with the current list of LHD hot spots and also contained new areas of concerns requiring attention from the member States and the RASMAG.

2.2 China RMA trialed the process to identify hot spots in Chinese airspace and presented their analysis in WP/12 to the RASMAG/27 in 2022. China RMA stated that the identification of clusters was the key to locate hot spots while setting a very specific standard for pinpointing a cluster was a challenge. The process could be improved as the RMAs accumulated their experience utilizing the method together with expertise of operational issues under their areas of responsibility.

2.3 JASMA presented their trial results in WP/14 for RASMAG/27 in 2022 and WP/10 for RASMAG/28 in 2023. JASMA stated that the procedure was beneficial for RMAs and EMAs to manage hot spots even though some detailed consideration and discussion, such as definition and standard of identifying a cluster or fluctuation of traffic volume, would be needed. It was also noted

that JASMA was ready to move forward conducting the procedure as an ordinary and standard procedure.

2.4 PARMO provided the results from the application of the hot spot identification process to the CEP Traffic Flow, Hot Spot N, as Flimsy 2 for RASMAG/28 in 2023. The results confirm the decision to continue monitoring Hot Spot N.

3. ACTION BY THE MEETING

3.1 The meeting is invited to:

a) consider the next step for the hot spot management process for proposal to the RASMAG. It can be that:

i) the trial should be continued to gather more experience and insight;

ii) more work should be conducted to standardize the definition of a cluster;

iii) the process should be endorsed as it is for its application by APAC RMAs and EMAs, and the MAWG should continue to improve the process as required; or

iv) the process cannot be harmonized for application to whole region due to different localities and RASMAG Action Item 26/5 should be proposed to be closed.

b) discuss any relevant matters as appropriate.

…….

The 9th Meeting of the Regional Airspace Safety Monitoring Advisory Group (RASMAG) Monitoring Agency Working Group (MAWG/9)

Video Teleconference, 14 – 18 February 2022

Agenda Item 4: EMA/RMA Safety Monitoring

MANAGEMENT PROCESS OF HOT SPOTS FOR RASMAG

(Presented by MAAR)

SUMMARY

The process of identifying, monitoring and removing Large Height Deviation (LHD) hot spots had been developed informally over several years to gear RASMAG's focus towards areas that should require special attention. To fulfill RASMAG Action Item 26/5, this paper proposes a process of identifying, monitoring and removing LHD hot spots for Asia Pacific (APAC) RMAs and EMAs to review and adjust before presenting to the RASMAG.

1. INTRODUCTION

1.1 The objectives of the Regional Airspace Safety Monitoring Advisory Group (RASMAG) are to:

- facilitate the safe implementation of reduced separation minima and CNS/ATM applications within the Asia and Pacific Regions in regard to airspace safety monitoring; and
- assist States to achieve the established levels of airspace safety for international airspace within the Asia and Pacific Regions.

1.2 To meet these objectives, the RASMAG has been reviewing airspace safety performance in the Asia and Pacific (APAC) Regions at the regional level and within international airspace. **Table 1** shows the vertical overall risk estimates of APAC airspaces from 2013 to 2020, as an example of safety monitoring activities. The red highlight indicates that the particular vertical overall risk estimate exceeds the target level of safety of 5 x 10^{-9} FAPFH.

Airspace	Vertical Overall Risk Estimates ($10^{-9}FAPFH$)							
	2013	2014	2015	2016	2017	2018	2019	2020
China	1.51	5.5	3.27	4.661	27.95	1.18	1.37	7.11
Incheon	0.6	4.13	6.43	5.3	0.12	4.06	1.07	0.23
Indonesia	3.82	2.18	1.1	4.12	7.2	2.94	10.2	0
Japan	3.66	7.17	22.11	9.16	9.63	10.61	11.57	11.57
Pacific	8.05	3.86	4.3	2.12	5.74	26.46	31.41	22.04
Pyongyang	1.58	0.21	0	0.444	0	1.62	3.02	1.04
SA/IO	13.47	18.73	32.27	27.75	62.39	56.06	36.78	15.67
SEA	5.22	4.14	5.73	9.44	9.38	5.07	3.59	1.82
SW Pacific	3.43	3.01	5.22	2.8	2.1	4.84	1.37	0.017

Table 1 The vertical overall risk estimates of APAC airspaces from 2013 to 2020.

1.3 The types of operational errors that are used for RASMAG's monitoring activities are Large Height Deviations (LHDs), Large Lateral Deviations (LLDs) and Large Longitudinal Errors

(LLEs). These are indicative of operational risks inherent in the APAC airspace. They became visible with the mature reporting culture of service providers and States. In 2015, the RASMAG/20 meeting decided to identify and prioritize high risk areas as LHD, LLD and LLE hot spots. These hot spots together with the analysis were reported to the APANPIRG so that specific actions could be initiated to reduce risk to an acceptable level. The EMAs, RMAs, States, and ATC units were also urged to take actions to establish scrutiny groups or alternate means to address the hot spots and present action plans and details of progress to the RASMAG.

1.4 **Table 2** presents the hot spots in APAC that have been identified since 2015.

Hot Spot	Involved FIRs	Responsible RMA(s) or EMA(s)	Identified Year	Status
A1	Kolkata/Chennai/Dhaka – Yangon	MAAR	2015	Cat. E LHDs reducing
A2	Chennai – Kuala Lumpur	MAAR	2015	Cat. E LHDs reducing
B	Incheon (AKARA Corridor)	PARMO, China RMA and JASMA	2015	Cat. E LHDs
C	Hong Kong – Guangzhou/Sanya	China RMA and MAAR	2015	Removed in 2020
D	Manila – all adjacent FIRs	MAAR, JASMA, PARMO and AAMA	2015	Cat. E LHDs reducing Cat. F LHDs emerging
E	Lahore – Urumqi	China RMA and MAAR	2015	Removed in 2020
F	Mogadishu – Mumbai	MAAR	2016	Cat. E LHDs
G	Sana'a/Muscat – Mumbai	MAAR	2016	Cat. E LHDs (Sanaa improved)
H	Guangzhou – Wuhan	China RMA	2015	Removed in 2020
I	Karachi – Kabul	MAAR	2018	Removed in 2020
J	Jakarta – Singapore/Kota Kinabalu	AAMA and MAAR	2018	Cat. E LHDs reducing
K	Jakarta – Ujung Pandang	AAMA	2018	Removed in 2020
L	Fukuoka – Khabarovsk	JASMA	2018	Removed in 2020
M	Colombo - Melbourne	AAMA and MAAR	2019	Potential non-hot spot
N	Oakland USA – Hawaii CEP	PARMO	2019	Cat. E LHDs increasing

Table 2 List of LHD hot spots that had been identified since 2015

1.5 Hot Spot A1 to E as detailed in **Table 2** were the first 6 hot spots identified during the RASMAG/20 meeting in 2015. The responsible RMAs and EMAs were also identified to assist States and ANSPs of the involved FIRs to address the issues of specific hot spots. Up to present, a total of 15 hot spots were identified as A1 to N. Out of 15 hot spots, 6 hot spots were already resolved and marked as 'Removed' in the status column. The removal of a hot spot was usually proposed by the responsible RMA or EMA, then the RASMAG meeting agreed with the proposal after reviewing the safety analysis which showed that the risk was reduced to an acceptable level of safety for at least 2 consecutive years.

1.6 Now that the RASMAG maintains the list of LHD, LLD, and LLE hot spots as a focus of the meeting, the EMAs, RMAs, States, and ATC units are expected to present action plans and details of progress during the annual meeting.

1.7 The monitoring of operational risks as LHD, LLD, and LLE hot spots has evolved over recent years but the process has never been formally documented for RASMAG participants. During the RASMAG/26 meeting in 2020, the Chair, hence, invited the MAWG to consider drafting a formalized process of identifying, monitoring and removing hot spots for consideration by RASMAG.

2. DISCUSSION

2.1 Rather than relying on a single determining criterion, the current practices conducted by RASMAG make use of multiple criteria such as the geographical distribution of occurrences, the number of occurrences and the risk estimate of those occurrences. When the operational risk of a hot spot has been successfully reduced with substantial evidences for at least 2 years, the hot spot would be proposed to the RASMAG for its removal from the hot spot list.

2.2 In an attempt to formalize the management process of LHD, LLE, and LLE hot spots in APAC, the following steps are proposed.

Identifying an LHD/LLD/LLE hot spot

2.3 Cluster Identification - the monitoring agency will explore, perhaps by plotting a map, if any occurrences are reported in close proximity (i.e. an area where the traffic flows are controlled by multiple ATS units, an area along the FIR/sector boundaries between adjacent ATS units, or an area with a specific traffic route system). This step requires a subjective judgement by the responsible monitoring agency. The identified clusters of occurrences will be determined if they fit criteria of being hot spots in the next step. The RASMAG meeting can also identify such a cluster and request the monitoring agency to investigate if it fits the hot spot criteria.

2.4 Hot Spot Criteria - the cluster of occurrences will be identified as an LHD, LLD or LLE hot spot if it fits **at least one** of the following criteria:

a. The number of occurrences - the number of all occurrences in the cluster takes up a “relatively big portion” of the total number of occurrence reports of that specific region.

To be a “relatively big portion” in number,

$$\text{the number of occurrences in the cluster} \geq \frac{the\ total\ number\ of\ occurrences\ in\ the\ region}{n+1}$$

where ‘n’ is the number of clusters in the region.

b. The risk estimate - the sum of operational risk estimates of all occurrences in the cluster takes up a “relatively big portion” of the region’s operational risk estimate.

To be a “relatively big portion” in risk,

$$\text{the sum of operational risk of the cluster} \geq \frac{the\ region's\ operational\ risk\ estimate}{n+1}$$

where ‘n’ is the number of clusters in the region.

c. Exceeding the TLS - the sum of operational risk estimate of all occurrences in the cluster reaches or exceeds the overall TLS of 5×10^{-9} FAPFH.

2.5 There are some circumstances where LHDs, LLDs and LLEs are scattered throughout the region and, hence, a hot spot cannot be identified even though the overall TLS is exceeded. It can be

caused by a few occurrences with high operational risk. No patterns or commonalities can be found. These cases should be individually addressed, not as hot spots.

2.6 After LHD, LLD or LLE hot spots are identified, the responsible monitoring agency will report details to the RASMAG meeting for consideration. With concurrence from the RASMAG, the monitoring process of these hot spots will start.

Monitoring an LHD/LLD/LLE hot spot

2.7 The list of LHD, LLD or LLE hot spots in APAC is maintained by RASMAG with details of the involved FIRs, the 'lead' monitoring agency, the year of identification, and the current status.

2.8 During the annual RASMAG meeting, working papers or information papers are expected from the relevant States and administrations to update the meeting on the actions being taken to address each hot spot.

2.9 The 'lead' monitoring agencies are also expected to have the hot spots analysed in their safety assessment reports for the annual RASMAG meeting.

2.10 After its annual meeting, the RASMAG will report updates to the APANPIRG in a consolidated manner and, if required, request for further actions.

Removing an LHD/LLD/LLE hot spot

2.11 To remove an LHD, LLD, or LLE hot spot from the list maintained by the RASMAG, proof of mitigation and/or prevention measures should be presented to the RASMAG meeting and the implementation results should reflect the effectiveness of risk controls in terms of reduction in the number of occurrences and operational risk of the hot spot.

2.12 The risk assessment report from the responsible monitoring agency should demonstrate that the hot spot no longer satisfies any of the criteria listed in 2.4 for at least 2 consecutive years. With approval from the RASMAG meeting, the hot spot will be labelled as 'potential non-hot spot' after the first year and 'removed' after the second year. However, the RASMAG may decide to continue monitoring certain hot spots (retaining the 'potential non-hot spot' status) even if they no longer satisfy the criteria for at least 2 consecutive years when other circumstantial factors could have temporarily reduced the number of occurrences and the risk.

2.13 When a hot spot is marked as 'removed', the specific monitoring process for that particular hot spot will stop; the hot spot will be monitored under regular process.

2.14 For record control purposes, the hot spot details will not be removed from the list but the status will reflect its being non-hot spots. However, the same hot spot record maybe reused if the operational errors of the same issues re-emerge in the same area.

2.15 Once finalized by the MAWG meeting, MAAR will present the draft process to the next RASMAG.

Trial #1: hot spot identification and criteria with existing hot spots

2.16 To demonstrate the proposed steps and the criteria of hot spot identification as detailed in paragraph 2.3 - 2.5, MAAR conducts a trial by applying the proposed steps and criteria to MAAR's areas of responsibility. Specifically, data from the South Asia Indian Ocean (SA/IO) region and South East Asia (SEA) region is analyzed against the proposed criteria to see how well the results correlate with the previously identified hot spots A1 (Kolkata/Chennai/Dhaka – Yangon), A2 (Chennai – Kuala Lumpur), D (Manila – all adjacent FIRs), F (Mogadishu – Mumbai), G (Sana'a/Muscat – Mumbai) and I (Karachi – Kabul).

2.17 Cluster Identification - the geographical plots of LHDs in SA/IO and SEA regions between 2013 - 2020 are explored. The LHDs clusters are identified for each region and year as depicted in blue ovals in **Figure 1 - Figure 16**.

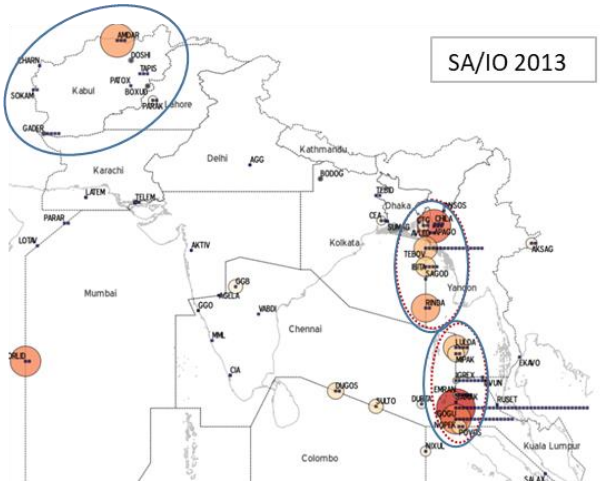


Figure 1 SA/IO 2013 LHD clusters (blue ovals)

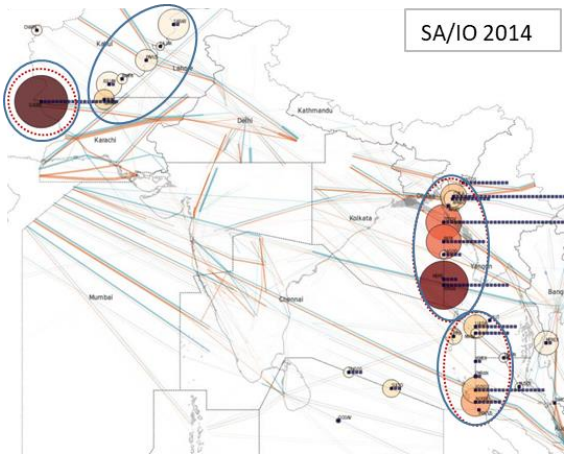


Figure 2 SA/IO 2014 LHD clusters (blue ovals)

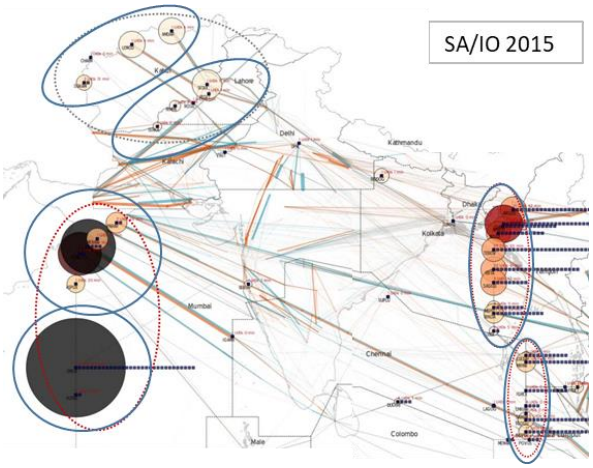


Figure 3 SA/IO 2015 LHD clusters (blue ovals)

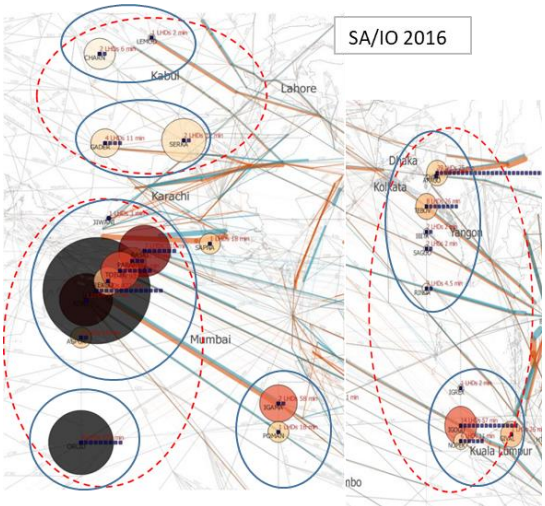


Figure 4 SA/IO 2016 LHD clusters (blue ovals)

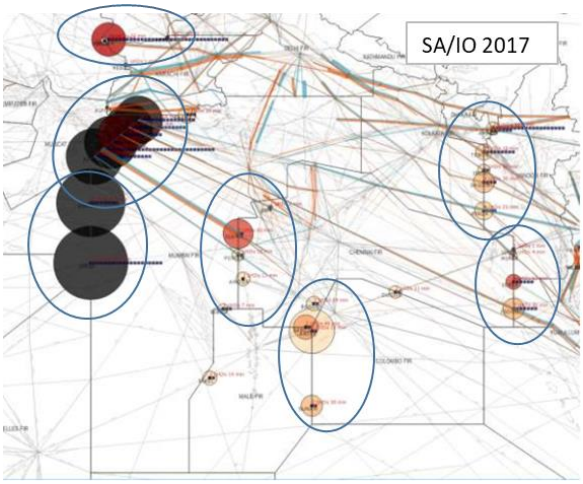


Figure 5 SA/IO 2017 LHD clusters (blue ovals)

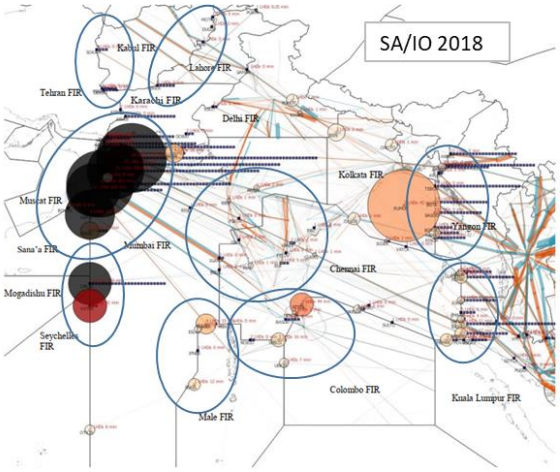


Figure 6 SA/IO 2018 LHD clusters (blue ovals)

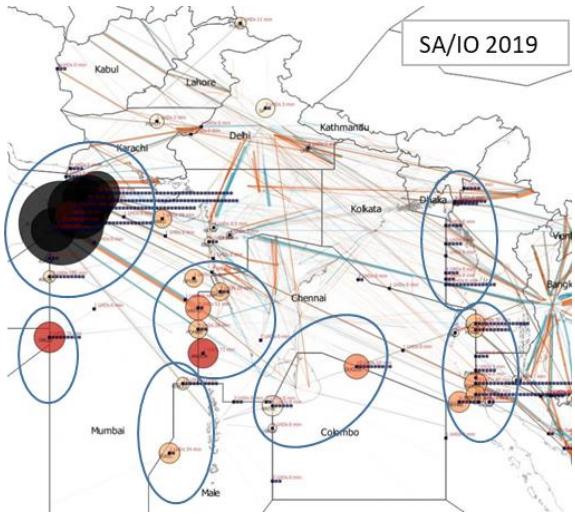


Figure 7 SA/IO 2019 LHD clusters (blue ovals)

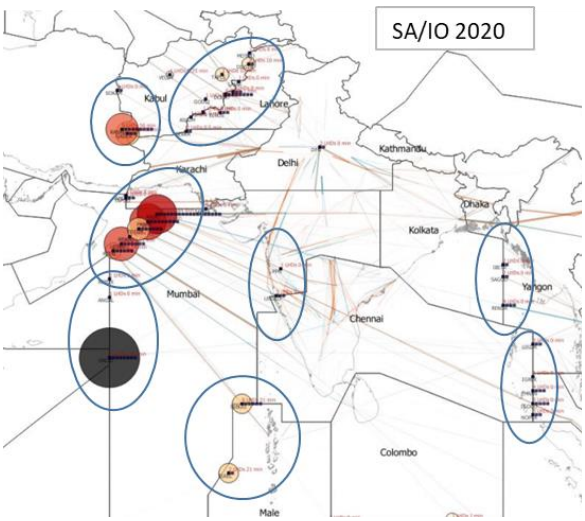


Figure 8 SA/IO 2020 LHD clusters (blue ovals)

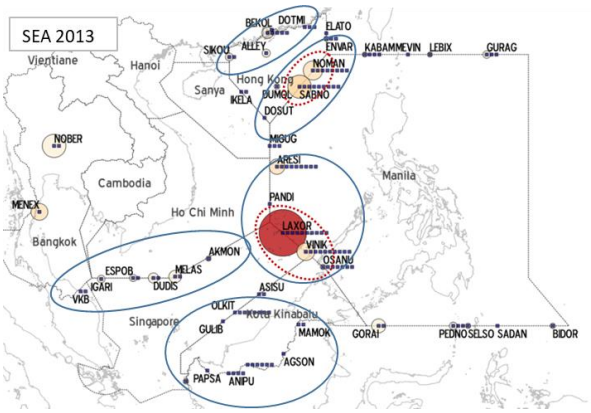


Figure 9 SEA 2013 LHD clusters (blue ovals)

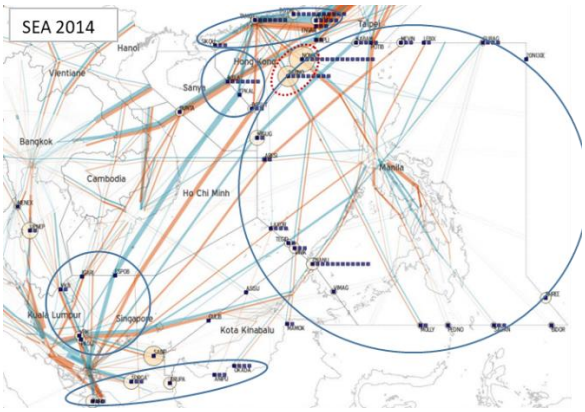


Figure 10 SEA 2014 LHD clusters (blue ovals)

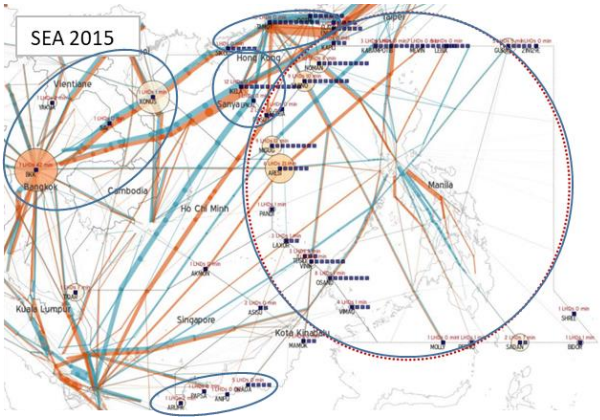


Figure 11 SEA 2015 LHD clusters (blue ovals)

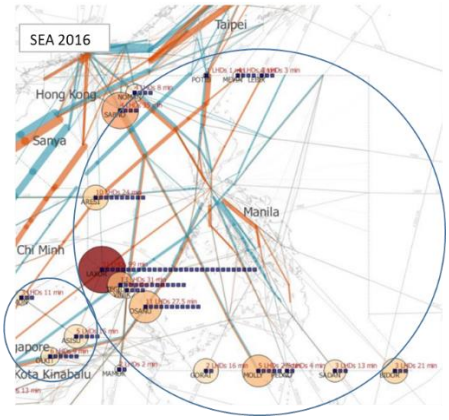


Figure 12 SEA 2016 LHD clusters (blue ovals)

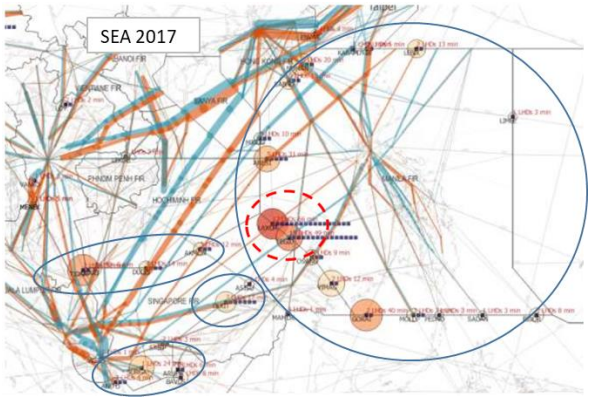


Figure 13 SEA 2017 LHD clusters (blue ovals)

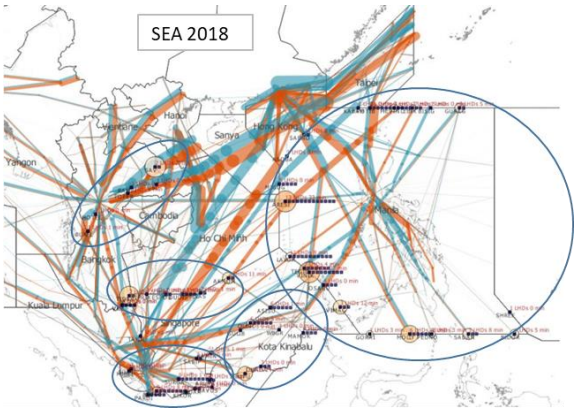


Figure 14 SEA 2018 LHD clusters (blue ovals)

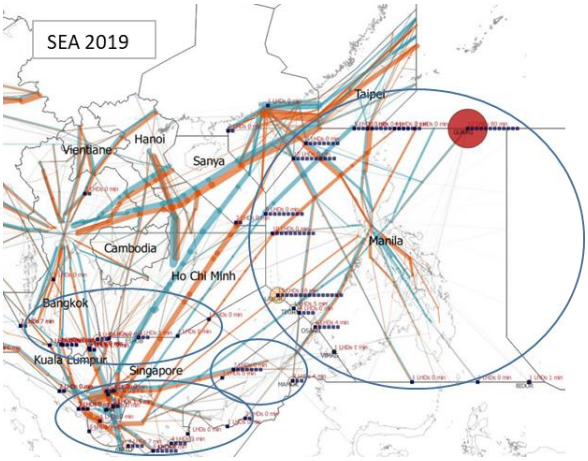


Figure 15 SEA 2019 LHD clusters (blue ovals)

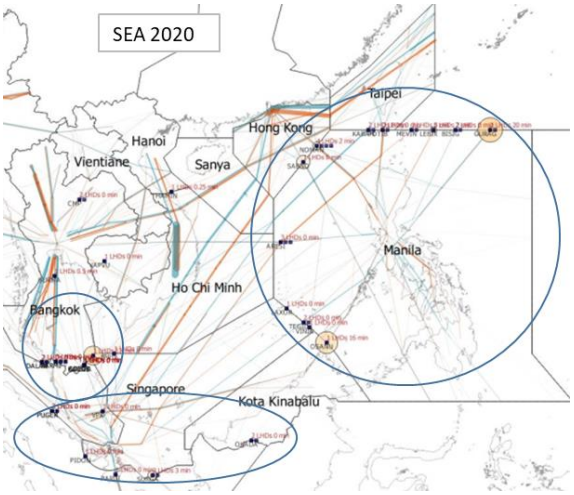


Figure 16 SEA 2020 LHD clusters (blue ovals)

2.18 The first row of **Table 3** and **Table 4** shows the number of identified LHD clusters between 2013 and 2020 for SA/IO and SEA region, respectively.

SA/IO Region	2013	2014	2015	2016	2017	2018	2019	2020
SA/IO Number of Clusters	3	4	6	7	7	9	7	8
SA/IO Number of LHDs	162	224	380	758	924	666	434	152
SA/IO Risk (x10^{-9} FAPFH)	12.82	17.78	31.44	26.88	61.25	55.13	35.99	15.19
Criteria: Number	40.50	44.80	54.29	94.75	115.50	66.60	54.25	16.89
Criteria: Risk (x10^{-9} FAPFH)	3.21	3.56	4.49	3.36	7.66	5.51	4.50	1.69
Criteria: TLS (x10^{-9} FAPFH)	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00

Table 3 LHD profiles of SA/IO region between 2013 - 2020 and the hot spot criteria

SAE Region	2013	2014	2015	2016	2017	2018	2019	2020
SEA Number of Clusters	5	5	5	2	4	5	4	3
SEA Number of LHDs	133	144	166	363	400	176	145	39
SEA Risk (x10^{-9} FAPFH)	4.41	2.98	4.25	8.25	7.96	3.92	2.09	1.42
Criteria: Number	22.17	24.00	27.67	121.00	80.00	29.33	29.00	9.75
Criteria: Risk (x10^{-9} FAPFH)	0.74	0.50	0.71	2.75	1.59	0.65	0.42	0.36
Criteria: TLS (x10^{-9} FAPFH)	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00

Table 4 LHD profiles of SEA region between 2013 - 2020 and the hot spot criteria

2.19 Hot Spot Criteria - There are 3 criteria to check if the identified clusters can be considered as hot spots. The first criteria, the number of occurrences of a cluster, is calculated by the formula in 2.4 (a) and shown in the fourth rows, labelled as 'Criteria: Number', of **Table 3 and Table 4**. The second criteria, the risk estimate of a cluster, is calculated by the formula in 2.4 (b) and shown in the fifth rows, labelled as 'Criteria: Risk', of **Table 3 and Table 4**. The third criteria, exceeding TLS, is compared against the constant value of 5 x10^{-9} and shown in the sixth rows, labelled as 'Criteria: TLS', of **Table 3 and Table 4**.

2.20 **Table 5** shows the number of LHDs and the risk of the previously identified hot spots as well as the results of checking against the criteria. A 'Negative' result means that the cluster does not satisfy that particular criterion. Conversely, a 'Positive' result means that the cluster satisfies that particular criterion and can be identified as a hot spot. The results from applying the process are detailed in **Table 5,** indicating that:

- Hot Spot A1 fits the hot spot criteria from 2014 to 2019;
- Hot Spot A2 fits the hot spot criteria from 2015 to 2019;
- Hot Spot D fits the hot spot criteria from 2013 to 2020;
- Hot Spot F fits the hot spot criteria in 2015, 2017, 2018 and 2020;
- Hot Spot G fits the hot spot criteria from 2015 to 2020; and
- Hot Spot I fits the hot spot criteria in 2017 and 2020. (This hot spot might be marked as 'removed' from being a hot spot in 2019 from applying this process.)

Hot Spot A1 (SA/IO)	2013	2014	2015	2016	2017	2018	2019	2020
Number of LHDs	-	134	195	246	165	168	59	8
Check Criteria: Number	-	Positive	Positive	Positive	Positive	Positive	Positive	Negative
Risk	-		6.81	1.07	2.04	0.6	0.31	0
Check Criteria: Risk	-	Negative	Positive	Negative	Negative	Negative	Negative	Negative
Check Criteria: TLS	-	Negative	Positive	Negative	Negative	Negative	Negative	Negative

Hot Spot A2 (SA/IO)	2013	2014	2015	2016	2017	2018	2019	2020
Number of LHDs	-	44	115	280	200	107	104	16
Check Criteria: Number	-	Negative	Positive	Positive	Positive	Positive	Positive	Negative
Risk	-		0.85	2.07	0.93	0.72	1.6	0
Check Criteria: Risk	-	Negative	Negative	Negative	Negative	Negative	Negative	Negative
Check Criteria: TLS	-	Negative	Negative	Negative	Negative	Negative	Negative	Negative

Hot Spot D (SEA)	2013	2014	2015	2016	2017	2018	2019	2020
Number of LHDs	75	73	60	254	156	148	99	24
Check Criteria: Number	Positive	Positive	Positive	Positive	Positive	Positive	Positive	Positive
Risk	-	-	3.8	5.87	5.17	2.72	1.74	1.05
Check Criteria: Risk	-	-	Positive	Positive	Positive	Positive	Positive	Positive
Check Criteria: TLS	-	-	Negative	Positive	Positive	Negative	Negative	Negative

Hot Spot F (SA/IO)	2013	2014	2015	2016	2017	2018	2019	2020
Number of LHDs	2	0	31	9	21	24	9	8
Check Criteria: Number	Negative	Negative	Negative	Negative	Negative	Negative	Negative	Negative
Risk	-	-	11.57	3.11	7.28	5.13	0.74	4.8
Check Criteria: Risk	-	-	Positive	Negative	Negative	Negative	Negative	Positive
Check Criteria: TLS	-	-	Positive	Negative	Positive	Positive	Negative	Negative

Hot Spot G (SA/IO)	2013	2014	2015	2016	2017	2018	2019	2020
Number of LHDs	3	0	16	114	85	170	157	50
Check Criteria: Number	Negative	Negative	Negative	Positive	Negative	Positive	Positive	Positive
Risk	-	-	6.09	14.6	39.07	32.66	24.91	6.37
Check Criteria: Risk	-	-	Positive	Positive	Positive	Positive	Positive	Positive
Check Criteria: TLS	-	-	Positive	Positive	Positive	Positive	Positive	Positive

Hot Spot I (SA/IO)	2013	2014	2015	2016	2017	2018	2019	2020
Number of LHDs	-	20	9	9	123	10	0	12
Check Criteria: Number	-	Negative	Negative	Negative	Positive	Negative	Negative	Negative
Risk	-	-	-	-	1.57	0	0	2.11
Check Criteria: Risk	-	-	-	-	Negative	Negative	Negative	Positive
Check Criteria: TLS	-	-	-	-	Negative	Negative	Negative	Negative

Table 5 The results of checking against the hot spot criteria for LHD Hot Spots A1, A2, D, F, G and I

Trial #2: hot spot identification and criteria (clusters at the interface level)

2.21 It can be observed that **Table 5** only focuses on the already identified hot spots as listed in **Table 2**. On one hand, the proposed process seems to agree with what the RASMAG is doing. On the other hand, the number and the shape of clusters in trial #1 can be biased. And there can be other hot spots being overlooked. Another trial is conducted as an example for the SEA region between 2019 and 2020.

2.22 As shown in **Figure 17** and **Figure 18**, the LHD clusters are re-identified at the FIR interface levels without considering the already identified hot spots. The number of clusters in SEA region increases from 4 to 8 in 2019 and from 3 to 5 in 2020.

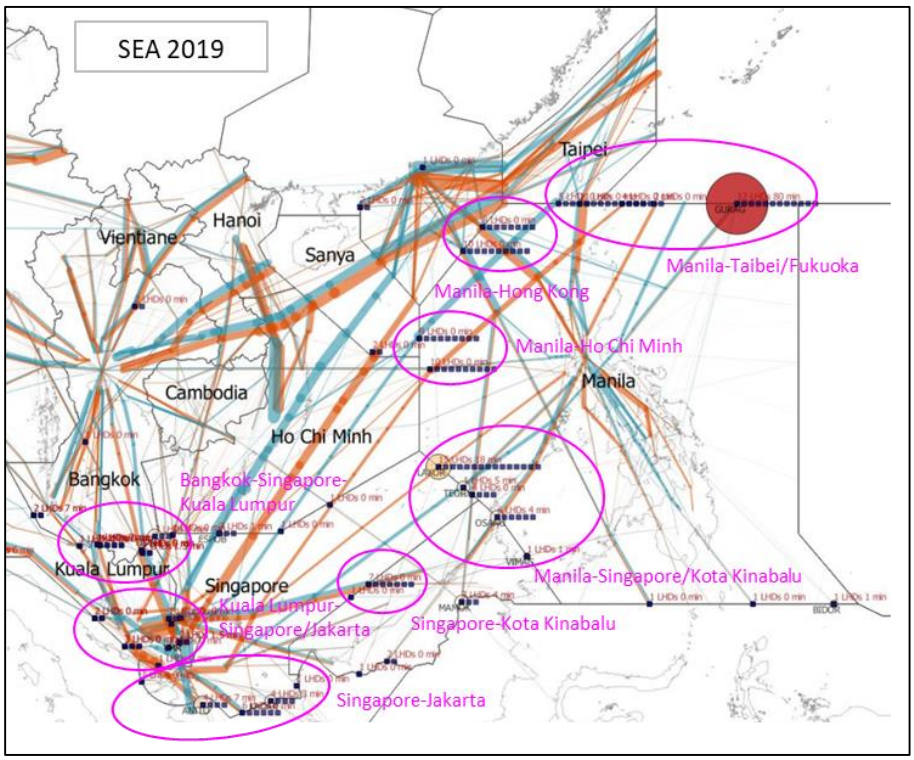


Figure 17 SEA 2019 LHD clusters (magenta ovals), re-identified at interface level

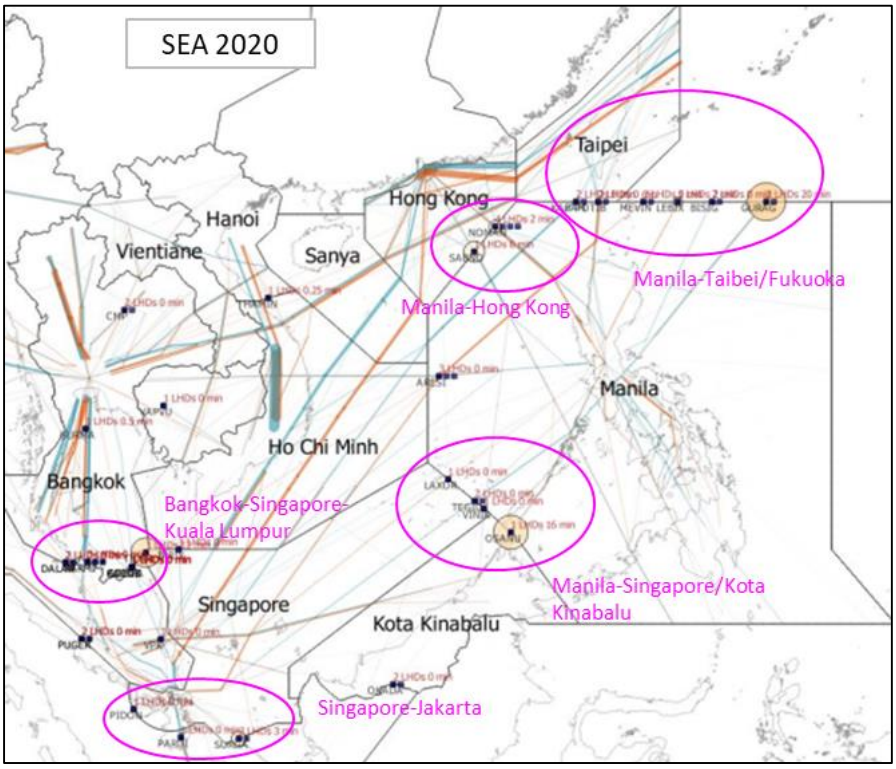


Figure 18 SEA 2020 LHD clusters (magenta ovals), re-identified at interface level

2.23 **Table 6** shows the LHD profile of SEA region between 2019 and 2020 with the updated clusters and criteria.

SAE Region	2019	2020
SEA Number of Clusters	8	5
SEA Number of LHDs	145	39
SEA Risk (x10^{-9} FAPFH)	2.09	1.42
Criteria: Number	16.11	6.50
Criteria: Risk (x10^{-9} FAPFH)	0.23	0.24
Criteria: TLS (x10^{-9} FAPFH)	5.00	5.00

Table 6 LHD profile of SEA region in 2019 - 2020, updated with new clusters and criteria

2.24 **Table 7** and **Table 8** show the number of LHD and risk of each clusters which are re-identified at the interface level. The risk criteria are also re-calculated. The results from applying the process indicates that:

- the northern and eastern interfaces of Manila FIR satisfy the hot spot criteria in 2019 and 2020;
- the Bangkok-Singapore/Kuala Lumpur interface satisfy the hot spot criteria in 2019 and 2020;
- all other interfaces among Singapore, Jakarta, Kuala Lumpur and Kota Kinabalu do not satisfy the hot spot criteria in 2019 and 2020.

2019 Clusters (SEA)	Manila-Singapore/ Kota Kinabalu	Manila-Taibei/ Fukuoka	Manila-Hong Kong	Manila-Ho Chi Minh	*Singapore-Jakarta*	Bangkok-Singapore/ Kuala Lumpur	*Kuala Lumpur-Singapore/ Jakarta*	*Singapore-Kota Kinabalu*
Number of LHDs	28	31	17	20	14	13	12	9
Check Criteria: Number	Positive	Positive	Positive	Positive	Negative	Negative	Negative	Negative
Risk	0.36	1.36	0	0	0.17	0.32	0	0.02
Check Criteria: Risk	Positive	Positive	Negative	Negative	Negative	Positive	Negative	Negative
Check Criteria: TLS	Negative	Negative	Negative	Negative	Negative	Negative	Negative	Negative

Table 7 The results of checking against the hot spot criteria for 2019 LHD clusters in SEA region

2020 Clusters (SEA)	Manila-Singapore/ Kota Kinabalu	Manila-Taibei/Fukuoka	Manila-Hong Kong	*Singapore-Jakarta*	Bangkok-Singapore/ Kuala Lumpur
Number of LHDs	5	8	5	4	9
Check Criteria: Number	Negative	Positive	Negative	Negative	Positive
Risk	0.37	0.49	0.19	0.07	0.28
Check Criteria: Risk	Positive	Positive	Negative	Negative	Positive
Check Criteria: TLS	Negative	Negative	Negative	Negative	Negative

Table 8 The results of checking against the hot spot criteria for 2020 LHD clusters in SEA region

2.25 The results of the second trial demonstrate that the criteria remain effective for Hot Spot D (Manila FIR interfaces) even when all other clusters at the interfaces among Singapore, Jakarta, Kuala Lumpur and Kota Kinabalu (in *italics*) are excluded. Interestingly, the process also identifies a new LHD hot spot at the Bangkok-Singapore/Kuala Lumpur interface in both years.

3. ACTION BY THE MEETING

3.1 The meeting is invited to:

a) review the proposed process of LHD/LLD/LLE hot spot management in paragraph 2.3 - 2.14; and

b) discuss other relevant matters as appropriate.

— END —

GUIDANCE MATERIAL FOR THE CONTINUED SAFETY MONITORING OF THE ASIA-PACIFIC RVSM AIRSPACE

Version 3.0

August 2024

FOREWORD

Guidance Material for the Continued Safety Monitoring of the Asia-Pacific RVSM Airspace is published by the Asia and Pacific Office of ICAO, on behalf of the Asia/Pacific Air Navigation Planning and Implementation Regional Group (APANPIRG).

The purpose of this document is to describe the post-implementation safety monitoring activities for RVSM airspace, including the respective roles and responsibilities of States and Regional Monitoring Agencies (RMAs). It also signifies the importance of a collaborative approach to ensure the continued safe operation of RVSM in the Asia/Pacific Air Navigation Region.

The Guidance material will be updated from time to time by the Regional Airspace Safety Monitoring Advisory Group (RASMAG) and amendments will be issued accordingly.

AMENDMENT HISTORY

Version	Effective Date	Description	Section Affected
1.0	July 2019	First version approved by RASMAG/24	All
2.0	August 2023	Reformat document template and make minor editorial changes	All
		Update Appendix B – APANPIRG CONCLUSIONS AND DECISIONS (up to the 33th meeting of APANPIRG) and insert references to the conclusions and decisions in the document	All and Appendix B
		Add new content	3.37, 6.11 - 6.13, 6.15, Appendix C - G
		Rephrase the background and scope of the document	1.4, 1.10, 1.11
		Rephrase to the RMA responsibilities and duties	2.14, 2.24, 2.26, 4.2
		Remove LHD as a cause to withdraw an RVSM approval	3.18
		Rephrase the implementation of a two-year limit for an RVSM approval and remove the recommendation	3.23
		Rephrase to make LTHM as a requirement, rather than a recommendation	5.9
		Rephrase the tolerable ASE performance requirements	5.13
		- Remove the need for States to classify LHDs into categories - Add date and time to the list of minimum information for LHD reporting	6.10

3.0	August 2024	Add new content under section “Management Process of Hot Spots”	6.16 - 6.30

TABLE OF CONTENTS

LIST OF DEFINITIONS

The following definitions are provided in order to clarify certain specialised terms used in this document.

Accredited States	Those States within an RVSM region which are collectively responsible for coordination, through a single Regional Monitoring Agency, for the implementation of APANPIRG RVSM safety policy, decisions, exchange of RVSM approvals, large height deviations, long term height-keeping monitoring data and other RVSM related information.
Accredited RMA	An RMA, established by APANPIRG, to which a State is accredited for the coordination of RVSM related issues.
Altimetry System Error (ASE)	The difference between the altitude indicated by the altimeter display assuming a correct altimeter barometric setting and the pressure altitude corresponding to the undisturbed ambient pressure.
Assigned Altitude Deviation (AAD)	The difference between the transponder Mode C altitude and the assigned altitude/flight level.
Automatic Altitude Control System	Any system which is designed to automatically control the aircraft to a referenced pressure altitude.
General Air Traffic (GAT)	Flights conducted in accordance with the rules and provisions of ICAO.
Collision Risk	The expected number of mid-air aircraft accidents 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.)
Height-Keeping Capability	Aircraft height-keeping performance which can be expected under nominal environmental operating conditions with proper aircraft operating practices and maintenance.
Height-Keeping Performance	The observed performance of an aircraft with respect to adherence to cleared flight level.
Hexadecimal Number Format	A representation of a 4-bit binary number (0 - 15 in decimal) by use of numbers 0 to 9 and letters A to F
Large Height Deviation	A vertical deviation of 300 ft or more from an ATC assigned or coordinated altitude. The deviation may be the result of human error, equipment malfunction or environmental factors such as turbulence, and should be reported in accordance with Appendix C – LHD/LLE/LLD TAXONOMY.
Operational Air Traffic (OAT)	Flights which do not comply with the provisions stated for GAT and which rules and procedures have been specified by appropriate authorities.
Reduced Vertical Separation Minimum (RVSM)	A vertical separation minimum of 300 m (1 000 ft) which is applied between FL 290 and FL 410 inclusive, on the basis of regional air navigation agreements and in accordance with conditions specified therein.

RVSM Approval	The approval that is issued by the appropriate authority of the State in which the Operator is based or the State in which the aircraft is registered.
State Aircraft	Aircraft used in Military, Customs, and Police services shall be deemed to be State Aircraft (Reference - ICAO Convention on International Civil Aviation, Article 3 (b)).
Static Source Error	The difference between the pressure sensed by the static system at the static port and the undisturbed ambient pressure.
Static Source Error Correction (SSEC)	A correction which may be applied to compensate for the static source error associated with an aircraft.
Target Level of Safety (TLS)	A generic term representing the level of risk which is considered acceptable in particular circumstances.
Vertical Separation	Vertical separation is the spacing provided between aircraft in the vertical plane to avoid collision.

LIST OF ABBREVIATIONS

The acronyms listed hereunder have been chosen from those which are specifically related to activities of the APANPIRG and/or are most frequently found in this report in order to assist in its reading.

AAD	Assigned Altitude Deviation
ADS-B	Automatic Dependent Surveillance - Broadcast
AHMS	ADS-B Height Monitoring System
AMC	Acceptable Means of Compliance
AOC	Air Operator's Certificate
APANPIRG	Asia/Pacific Air Navigation Planning and Implementation Regional Group
ASE	Altimetry System Error
ATC	Air Traffic Control
ATM	Air Traffic Management
ATS	Air Traffic Services
CFL	Cleared Flight Level
CRM	Collision Risk Model
FIR	Flight Information Region
FL	Flight Level
GAT	General Air Traffic
GMU	GPS Monitoring Unit
GPS	Global Positioning System
HMU	Height Monitoring Unit
ICAO	International Civil Aviation Organisation
IGA	International General Aviation
LHD	Large Height Deviation
LTHM	Long Term Height Monitoring
MASPS	Minimum Aircraft System Performance Specification
MEL	Minimum Equipment List
NSA	National Supervisory Authorities
OAT	Operational Air Traffic
PANS	Procedures for Air Navigation Services
RMA	Regional Monitoring Agency
RPG	Regional Planning Group
RVSM	Reduced Vertical Separation Minimum of 300 m (1000 ft) between FL 290 and FL 410 inclusive
SSE	Static Source Error
SSEC	Static Source Error Correction
SSR	Secondary Surveillance Radar

STC	Supplementary Type Certificate
TC	Type Certificate
TCAS	Traffic Collision and Avoidance System
TLS	Target Level of Safety
TVE	Total Vertical Error
VSM	Vertical Separation Minimum

1. INTRODUCTION

Background

1.1 The implementation of a Reduced Vertical Separation Minimum between FL 290 and FL 410 in the Asia and Pacific Air Navigation Region provided the benefits of additional en-route capacity and improved fuel efficiency for aircraft operators. Such a major transformation of the separation minimum required extensive safety analysis of the inherent increase in the risk of mid-air collision, which resulted in the definition of more stringent aircraft altitude keeping performance requirements. A monitoring programme was also initiated to ensure that both the technical and operational safety issues of the new separation standard were appropriately identified and addressed prior to implementation.

1.2 The new aircraft performance requirements were incorporated into a number of global standards and Acceptable Means of Compliance (AMC). These are generically termed Minimum Aircraft System Performance Specifications (MASPS). The MASPS include the minimum build standard and equipment configuration of an aircraft, the accuracy of the altimetry system over the full operational flight envelope and the continued airworthiness procedures necessary to ensure that the performance is maintained. Operators which demonstrated both technical compliance and the application of appropriate operational procedures obtained an approval to operate within RVSM airspace with 1,000 ft. vertical separation.

1.3 The pre-implementation safety programme required monitoring of aircraft technical height keeping performance, verification of aircraft/operator RVSM approval status and the undertaking of a collision risk assessment to ensure that an internationally agreed Target Level of Safety (TLS) was satisfied.

1.4 Analysis of the data provided by the pre-implementation monitoring programme indicated that the risk level was acceptable, assuming that only approved aircraft would operate within the airspace and that aircraft altimetry system performance would remain stable over time.

1.5 In 2002, ICAO took the decision that in all regions in which RVSM had been implemented, it would be necessary for the Regional Planning Groups (RPG) to initiate programmes for the continuous monitoring of aircraft height keeping performance to ensure that risk levels remained below the TLS. In addition, these programmes would include monitoring the compliance of operator/aircraft approval requirements.

1.6 In the Asia and Pacific Region, the Regional Airspace Safety Monitoring Advisory Group (RASMAG) was established 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 where necessary provide assistance to States to acquit their responsibilities.

1.7 To support the work of the RASMAG, five regional monitoring agencies (RMAs) have been established and endorsed by APANPIRG. The RMAs conduct airspace monitoring and safety oversight activities on behalf of States accredited to their respective regions in accordance with the procedures and processes detailed in ICAO Doc 9937 *Operating Procedures and Practices for Regional Monitoring Agencies in Relation to the Use of a 300 m (1 000 ft) Vertical Separation Minimum Between FL 290 and FL 410 Inclusive.*

1.8 This responsibility includes monitoring operators/aircraft with regards to height keeping performance and approval status, and long term fleet monitoring requirements. The responsibility of the RMA is limited to monitoring operator compliance with the various technical and operational requirements and reporting any non-compliance or safety issue to the State exercising operational authority over that operator. It remains the responsibility of individual States to ensure that any appropriate remedial action is taken.

1.9 Common Terms of Reference (ToR) for all RMAs are approved by RASMAG and are reproduced in Appendix A – TERMS OF REFERENCE OF ASIA PACIFIC MONITORING AGENCIES.

Scope and Purpose of the Document

1.10 This document provides operational guidance and practices concerning RVSM safety monitoring program in the Asia/Pacific Air Navigation Region based on the ICAO's requirements in the ICAO Annex 6, Annex 11, Doc 9574, Doc 9937 and other related manuals.

1.11 The document describes the regional framework established by RASMAG and interaction between stakeholders which is required to support the safe operation of RVSM and demonstrate compliance with regulatory requirements.

1.12 The specific purpose of this guidance material is therefore to:

a) Encapsulate the regulatory requirements contained in Annex 6 and 11 to the Convention on International Civil Aviation and to describe a practical safety monitoring framework in order to meet the particular demands of the Asia/Pacific RVSM airspace;

b) Describe the principal roles and interfaces of the APANPIRG, accredited member State and the RMA to provide an effective framework for all safety monitoring and oversight activities;

c) Describe the data exchange and coordination requirements between the RMA and State National Supervisory Authorities as well as recommended working practices; and

d) Provide recommendations for appropriate action in the event of operator non-compliance with RVSM approval or performance requirements.

1.13 To facilitate comprehension this document often refers to the operations and role of the Asia Pacific RMAs in the definite singular article (The RMA). However, it must be emphasised that there are more than one active RMA in the region although some modes of operation differ.

2. RVSM REGULATORY REQUIREMENTS AND MONITORING ACTIVITIES

2.1 There are a number of documents which relate to requirements, guidance and best practices for the safe continuous operation of RVSM. Some of these documents are in effect regulatory requirements which govern all contracting States to the Convention on International Civil Aviation (unless States have notified ICAO of any differences). These are the Annexes to the Convention on International Civil Aviation and are defined as International Standards and Recommended Practices (SARPs). Other documents relate to procedures, the application of which is governed by the Annexes. Finally, there is guidance material including the Acceptable Means of Compliance related to aircraft MASPS, the application of RVSM and the operating procedures for an RMA.

2.2 The major documents which impact the application of RVSM and the responsibilities related to technical aircraft performance, safety oversight and compliance monitoring are described below in **Table 1**.

Document	Description	Type
ICAO Annex 11	High level requirements for the establishment of regional monitoring agencies in all regions in which RVSM has been implemented	SARPs
ICAO Annex 6 (Part 1 and 2)	The operation of Aircraft	SARPs
ICAO Annex 8	Airworthiness of Aircraft	SARPs
ICAO Doc 4444	Procedures for Air Navigation Services – Air Traffic Management	Procedures (governed by ICAO Annexes)
ICAO Doc 7030	Regional Supplementary Procedures	Regional Procedures (governed by ICAO Annexes)
ICAO Doc 9574	Implementation of a Reduced Vertical Separation Minimum	ICAO Guidance material
ICAO Doc 9937	Operating procedures for Regional Monitoring Agencies	ICAO Guidance material

Table 1: Documents Related to Regulatory Requirements and Safety Oversight Activities within RVSM Airspace

2.3 Of the documents listed above in **Table 1**, ICAO Annex 6 and ICAO Doc 7030 contain the most relevant information related the material contained in this document. The following sections expand on the specific RVSM requirements contained in these two documents.

2.4 Please note that the referencing paragraph numbers are omitted on purpose for maintainability of this document.

ICAO Annex 6

2.5 Annex 6 to the Convention on International Civil Aviation defines requirements for the operation of aircraft. Part 1 relates to commercial operators and part 2 to operators of IGA aircraft.

2.6 Prior to granting an RVSM approval a State is required to confirm that the aeroplane satisfies minimum equipment and height keeping performance requirements. The State must also be satisfied that the operator has instituted appropriate continued airworthiness and flight crew procedures and practices. Following the granting of an approval the State is responsible for ensuring that the aircraft continues to meet

height keeping performance requirements, that all operators participate in regional or global monitoring programmes and that only approved aircraft operate within the airspace.

2.7 A summary of the responsibilities of individual State Authorities defined in ICAO Annex 6 are reproduced below in **Table 2**.

Annex 6 Part 1	**Annex 6 Part 2**
Aeroplane equipment requirements	
Aeroplane shall be approved by State of Operator	Aeroplane shall be approved by State of Registry
Aeroplane vertical navigation performance requirements	
Pre-approval aeroplane/operator requirements	
State (of Operator) responsibility to ensure provisions for receiving reports from accredited RMA and implementing measures to correct the performance of aircraft not compliant with height keeping requirements	State (of Registry) responsibility to ensure provisions for receiving reports from accredited RMA and implementing measures to correct the performance of aircraft not compliant with height keeping requirements
State of Operator that has issued an RVSM approval to an operator shall ensure that the operator complies with biennial fleet monitoring targets.	State of Registry that has issued an RVSM approval to an operator shall ensure that the operator complies with biennial fleet monitoring targets.
All States that are responsible for airspace where RVSM has been implemented, or which have issued RVSM approvals shall establish provisions and procedures to ensure that appropriate action will be taken with operators of non-approved aircraft. (**These provisions and procedures need to address both the situation where the aircraft is operating without approval in the airspace of the State and the situation where an operator for which the State has regulatory oversight responsibility is found to be operating without the required approval in the airspace of another State.)**	
The aeroplane shall be sufficiently provided with navigation equipment to ensure that, in the event of the failure of one item of equipment at any stage of the flight, the remaining equipment will enable the aeroplane to navigate in accordance with [aeroplane equipment requirements]	

Table 2: Summary of Requirements for the Approval and Operation of Aircraft in RVSM Airspace

2.8 States should ensure that appropriate processes and procedures are in place to take appropriate action with operators who fail to comply with the regulatory requirements, or operate aircraft which no longer comply with the conditions under which an RVSM approval was issued. Such action may include withdrawal of an RVSM approval on a temporary or permanent basis.

ICAO Doc 7030

2.9 Regional requirements are contained in ICAO Regional Supplementary Procedures, ICAO Doc 7030. The principal supplementary procedures related to RVSM are summarized below in **Table 3**.

Doc 7030 Supplementary Procedures Summary

General

- Within the RVSM airspace, the vertical separation minimum shall be 300 m (1 000 ft).
- Operators intending to conduct flights within the airspace where RVSM is applied shall require an RVSM approval either from the State of Registry or the State of the Operator. The State of Registry or the State of the Operator, as appropriate, should verify that the height-keeping performance capability of approved aircraft meets the requirements specified in Annex 6, Parts I and II.
- Within the RVSM airspace, aircraft that have not received RVSM State approval may be cleared to operate in accordance with policy and procedures established by the State provided that 600 m (2 000 ft) vertical separation is applied.
- ATC clearance into RVSM airspace shall not be issued to formation flights of civil aircraft.
- If the receiving unit has not received a flight plan, the sending unit shall verbally inform the receiving unit whether or not the aircraft is RVSM-approved.
- Monitoring of flight operations in the RVSM airspace shall be conducted to assess the continuing compliance of aircraft with the height-keeping performance requirements.

In-Flight Contingency

An in-flight contingency affecting flight in RVSM airspace pertains to unforeseen circumstances that directly impact on the ability of one or more aircraft to operate in accordance with the vertical navigation performance requirements of RVSM airspace. Such in-flight contingencies can result from degradation of aircraft equipment associated with height-keeping or from turbulent atmospheric conditions.

- When a single aircraft is experiencing an in-flight contingency that impacts on RVSM operations, the associated coordination message(s) shall be supplemented verbally by a description of the cause of the contingency.
- The pilot shall inform ATC as soon as possible of any circumstances where the vertical navigation performance requirements for RVSM airspace cannot be maintained. In such cases, the pilot shall obtain a revised ATC clearance prior to initiating any deviation from the cleared route and/or flight level, whenever possible. When a revised ATC clearance cannot be obtained prior to such a deviation, the pilot shall obtain a revised clearance as soon as possible thereafter.
- When informed by the pilot of an RVSM-approved aircraft operating in RVSM airspace that the aircraft's equipment no longer meets the RVSM requirements, ATC shall consider the aircraft as non-RVSM-approved.
- ATC shall take action immediately to provide a minimum vertical separation of 600 m (2 000 ft) or an appropriate horizontal separation from all other aircraft concerned that are operating in RVSM airspace. An aircraft rendered non-RVSM-approved shall normally be cleared out of the RVSM airspace by ATC when it is possible to do so.
- Pilots shall inform ATC, as soon as practicable, of any restoration of the proper functioning of equipment required to meet the RVSM requirements.
- The first ACC to become aware of a change in an aircraft's RVSM status shall coordinate with adjacent ACCs, as appropriate.
- When an aircraft operating in RVSM airspace encounters severe turbulence due to weather or wake vortex that the pilot believes will impact the aircraft's capability to maintain its cleared flight level, the pilot shall inform ATC. ATC shall establish either an appropriate horizontal separation or an increased minimum vertical separation.

• ATC shall, to the extent possible, accommodate pilot requests for flight level and/or route changes and shall pass on traffic information as required. • When a meteorological forecast is predicting severe turbulence, ATC shall determine whether RVSM should be suspended and, if so, for how long and for which specific flight level(s) and/or area. • ATC shall solicit reports from other aircraft to determine whether RVSM should be suspended entirely or within a specific flight level band and/or area. • The ACC suspending RVSM shall coordinate such suspension(s) with, and any required adjustments to, sector capabilities with adjacent ACCs, as appropriate, to ensure an orderly progression to the transfer of traffic. • In cases where RVSM will be suspended, the ACC suspending RVSM shall coordinate with adjacent ACCs with regard to the flight levels appropriate for the transfer of traffic, unless a contingency flight level allocation scheme has been determined by letter of agreement. The ACC suspending RVSM shall also coordinate applicable sector capabilities with adjacent ACCs as appropriate.

Table 3: Summary of Regional Supplementary Procedures related to RVSM

2.10 A summary of the responsibilities of States defined in Annex 8 Airworthiness of Aircraft are presented in **Table 4**: Summary of Requirements for the Aircraft RVSM airworthiness.

Annex 8, part II
The State establishes that continuing aircraft airworthiness determined through the periodical inspection at appropriate time interval having regard to lapse of time and type of service or, alternatively, by means of a system of inspection that will produce at least an equivalent result.
Any failure to maintain an aircraft in an airworthy condition as defined by the appropriate airworthiness requirements render the aircraft ineligible for operation
The State, where aircraft was registered, issues airworthiness certificate or updates ones certificate in accordance with [requirements associated with a Certificate of Airworthiness] The State, where aircraft was registered, establishes requirements, that the aircraft is suitable for the flights operating, in compliance with the technical maintenance requirement in accordance with Annex 6.

Table 4: Summary of Requirements for the Aircraft RVSM airworthiness

2.11 States should be aware that the requirements described above are applicable to all aircraft, including commercial, general aviation, military and other State designated aircraft, intending to operate under GAT rules with a 1,000 ft. vertical separation minimum in RVSM airspace. Non-approved State designated aircraft may request a clearance in RVSM airspace with a 2,000 ft. vertical separation minimum; however, operators must declare non-RVSM on flight plans.

Regional Monitoring Agencies

2.12 A Regional Monitoring Agency is established by an ICAO Regional Planning Group to oversee the safety of operations in RVSM airspace. There are no formal regulatory requirements defining the responsibilities of an RMA. Instead, the RMA operates under Terms of Reference (ToR) agreed with the PIRG for implementation of monitoring functions to the required quality standard.

2.13 RMAs are expected to operate in accordance with the precepts of ICAO Doc. 9574 - *Manual on Implementation of a 1,000 ft. Vertical Separation Minimum between FL 290 and FL 410 Inclusive*. Guidance

on the operation and procedures of an RMA are included in ICAO Doc. 9937 - *Operating Procedures and Practices for Regional Monitoring Agencies in Relation to the use of a 1,000 ft. Vertical Separation Minimum between FL 290 and FL 410 Inclusive*.

2.14 The ICAO Doc 9574 states that there is a need for system performance monitoring for the operational use of RVSM. The principal responsibility of an RMA is to support the continued safe use of RVSM within a designated airspace, including verifying aircraft/operator RVSM approval status, monitoring aircraft height keeping performance, verifying the operator's compliance with the long-term monitoring requirements and providing annual airspace safety assessment. The RMA monitors aircraft/operator compliance within the precepts of ICAO Annex 6, reporting non-compliance and any associated safety issues to the States which retain the responsibility for ensuring that appropriate remedial action is taken. To perform this function, it is essential that the States provide practical support to the RMA, particularly with regards to coordinating RVSM approval data exchanges and providing operational incident reports for inclusion in the annual safety assessment.

2.15 RMAs prepare RVSM annual safety reports which are presented to RASMAG. Completed reports usually include:

a) A quantitative assessment of the risk of mid-air collision attributable to the implementation of RVSM. This assessment includes both, technical risk attributable to aircraft technical height keeping performance, and total risk due to all causes including technical and human/operational errors;

b) A review of the major contributing factors which result in Large Height Deviations, with the purpose of reducing the number of risk bearing incidents;

c) Any other safety related issues associated with the implementation or continued use of RVSM;

d) Recommended measures to decrease risk with particular emphasis on improving aircraft height-keeping performance;

e) Recommended measures to improve the safe operation of RVSM airspace; and

f) Implementation of all applicable conclusions and decisions agreed by APANPIRG. Report non-compliance with APANPIRG conclusions and decisions by individual States, operators and service providers.

Monitoring Compliance with Requirements

2.16 This section provides an overview of the activities which the RMA and accredited States are required to conduct to provide an effective safety oversight and compliance monitoring infrastructure for Asia/Pacific RVSM airspace. It describes the high-level functions of the monitoring programme and how these relate to the various responsibilities which are defined in the ICAO Annexes and global and regional procedures documents. Specific procedural detail for each of these functions is provided in the subsequent sections.

2.17 The major functional objectives of the monitoring programme are to, conduct technical aircraft height keeping performance monitoring, verify the approval status of aircraft and operators flying in RVSM airspace and conduct airspace safety assessments. For each of these functions to be conducted effectively it is important that the Regional Monitoring Agency and accredited States operate in close cooperation, with each organisation fulfilling its obligations as determined by APANPIRG.

RVSM Approvals

2.18 Under the provisions of Annex 6 and the regional supplementary procedures all operators and aircraft intending to operate in RVSM airspace with a 1,000 ft. vertical separation are required to be approved by the State exercising operational authority over that aircraft and/or operator. Operators indicate that they hold a valid approval by filing a 'W' in item 10 of the ICAO flight plan. States are required to take appropriate action in the event that a non-approved operator/aircraft is found to be operating within RVSM airspace.

2.19 The practical task of monitoring aircraft/operator approval status is devolved to the RMA. For the RMA to perform this function effectively it is important that a complete inventory of aircraft approved to operate in RVSM airspace is maintained. The RMA maintains a central database of RVSM approved aircraft populated with records provided by individual States and other RMAs.

2.20 The RMA cross checks the central records of RVSM approvals against flight plans. A request for approval status of any unreported aircraft for which a 'W' has been inserted into the flight plan is sent to the appropriate State for confirmation of approval status. If the State confirms the approval, then the record is added to the responsible RMAs database and no further action is required. In the event that the aircraft is not approved the State is required to take appropriate action, which may be to exclude the operator from operating in RVSM airspace until a valid approval has been issued.

2.21 To ensure an effective service and to minimise workload for both the RMA and individual authorities, States should ensure that the list of RVSM approvals for which it is responsible is kept up to date and communicated regularly to the RMA. States should also ensure that they have introduced procedures for receiving reports of possible non-approved aircraft from the RMA and conducting follow up investigations to verify the true status of the aircraft reported. In addition to transmitting new approvals to the RMA it is equally important that the RMA is informed when approvals are withdrawn or when aircraft are de- or re-registered. It has been demonstrated that the most effective mechanism is for each State to maintain a single centralised database of RVSM approvals which should be communicated to the RMA on a regular basis.

Aircraft Technical Height Monitoring Programme

2.22 Under the provisions of Annex 11 each RVSM region is required to maintain a technical height keeping performance monitoring programme. The specific requirements of the monitoring programme are defined in Annex 6 and RVSM guidance material and include; verification of individual aircraft altimetry system performance, verification of generic aircraft MASPS, operator compliance with fleet monitoring targets and finally to provide technical performance data for annual airspace safety assessments.

2.23 The RMA conducts technical height keeping performance monitoring which involves comparing measured aircraft geometric height data against actual geometric pressure altitude derived from meteorological data, provided by accredited meteorological international organisations. The monitoring systems in use include individual on-board GPS Monitoring Unit (GMU), ground-based multilateration Height Monitoring Unit (HMU), and ADS-B Height Monitoring System (AHMS).

2.24 The RMA is responsible for submitting reports of individual aircraft which do not comply with performance requirements to the appropriate State authorities for remedial action. The RMA also submits reports of operators which do not meet biennial fleet monitoring targets, upon receipt of which States are also required to take appropriate action. In the event that the RMA identifies that a specific aircraft type may not comply with the RVSM performance requirements then the technical height keeping performance monitoring information is forwarded to the appropriate authority/State which issued the original aircraft airworthiness approval or the RMA of that State. The original airworthiness authority/State will then investigate and resolve any non-compliance with the aircraft manufacturer.

2.25 Data from the technical aircraft height keeping performance monitoring programme also contributes to the annual safety assessment, providing core data which is extrapolated for all RVSM airspace to provide a technical collision risk assessment which must satisfy a Target Level of Safety of 2.5×10^{-9} collisions per flight hour.

Operational Risk Events

2.26 One of the main responsibility of an RMA is to verify that the target level of safety will continue to be met upon implementation of RVSM and provide safety assessment report to ICAO. The assessment consists of two elements which are the technical risk (as described above) and the risk due to operational issues such as aircraft altitude deviations and other risk bearing incidents such as incorrect coordination, communication errors and TCAS events.

2.27 The operational risk assessment relies on States to provide reports of operational incidents reinforced with specific event information when requested by the RMA.

RMA/State Interfaces

2.28 For the RVSM safety oversight and monitoring compliance programme to remain effective it is essential that the interfaces between the RMA and each accredited State are adequately defined and maintained. Each State should ensure that appropriate contact information is provided to the RMA. It is considered to be most effective for each State to provide a single contact point for communicating with the RMA for all RVSM matters. This contact is required to transmit all RVSM approval information to the RMA, receive and process; reports of non-approved aircraft; reports of technically non-compliant aircraft; reports of operators which are not compliant with fleet monitoring targets, and to submit operational event reports for inclusion in the annual RVSM safety assessment.

2.29 States should ensure that staff required to interface with the RMA are adequately trained and instructed in the various responsibilities required. In the event that individuals change work roles or leave the organisation it is essential that a complete handover to a replacement is completed so that there is no detrimental effect on the overall quality of service. In the event that it is not feasible to maintain single points of contact then it is necessary to ensure that the RMA is notified of all contacts and their respective responsibilities.

2.30 The operational framework including the accepted procedures to accomplish the monitoring programme objectives are discussed in more detail in the following sections.

3. RVSM APPROVAL PROCESSES

3.1 This section provides guidance and recommendations for the issuance and management of aircraft RVSM approvals by a State, and the coordination of that data with the RMA to which the State is accredited. It also describes the policies of the RMA with regard to compliance with approval requirements and how the information is shared with other RVSM regions.

3.2 A brief description of the constituent parts of the RVSM approval is provided below. In the following sections focus is given to the issues which particularly relate to maintenance of the approval, the conditions under which an approval may be considered to be valid and compliance monitoring in the post implementation environment.

3.3 There are a minimum of three constituent parts of an RVSM approval which are:

- Airworthiness Approval (MASPS): Confirmation that the build of an aircraft satisfies minimum equipment and height keeping performance requirements and that an appropriate maintenance programme has been developed by the manufacturer to maintain performance;

- Continued Airworthiness: Confirmation that the operator of an aircraft has instituted an appropriate continued airworthiness programme which should be based on the procedures developed by the manufacturer; and

- Operational Approval: Confirmation that the operator of an aircraft has instituted appropriate flight crew procedures for operations in RVSM airspace.

3.4 Detailed guidance material describing the recognised processes for the approval of the build of an aircraft is contained in ICAO Doc. 9574, FAA AC 91-85 and EASA AMC CS-ACNS, Annex I to ED Decision 2013/031/R. Additional material applicable to this document is provided in the next section.

3.5 The airworthiness approval is valid for all individual airframes produced to the same build standard and is normally issued by a single airworthiness authority. It is not considered necessary for subsequent approval authorities to re-confirm the airworthiness approval unless the aircraft has been modified or constructed to a Supplementary Type Certificate (STC) or equivalent build standard not covered by the original approval.

3.6 Unlike the Airworthiness Approval, the Continued Airworthiness and Operational Approval need to be issued by each individual approval authority, which must verify that the operator has instituted appropriate continued airworthiness procedures and that flight crews have been trained in RVSM operational procedures. The operational approval indicating valid areas of operation should be stated on the operator's AOC or in the pilot's flight manual. Once the approval authority is satisfied that all requirements have been met the State is required to notify the RMA that the aircraft in question meets all criteria for operations in RVSM airspace and is approved.

3.7 The airworthiness approval normally remains valid for the operational lifetime of an airframe, provided that the aircraft has been maintained in accordance with the manufacturers continued airworthiness procedures and that the aircraft is not subject to any modification which may require re-evaluation of the build standard. The continued airworthiness and operational approvals are operator specific and may not be transferred upon re-registration. Under certain circumstances it may be necessary to withdraw or re-issue an operational approval if the conditions under which the original approval was issued are no longer valid.

3.8 By issuing an approval to operate in RVSM airspace, a State is declaring that all contributing approval requirements are met including airworthiness approval, continued airworthiness and operational approval.

3.9 In the event that, following a report issued by the RMA, an aircraft is found to be operating in RVSM airspace with a 'W' designator, the State should make immediate contact with the operator concerned and where necessary issue instructions to cease flights in RVSM airspace. A review should be held into the circumstances under which the operator was operating without approval and appropriate action taken.

RVSM airworthiness approval

3.10 The aircraft airworthiness approval is normally granted by a single airworthiness authority and applies to a particular build standard which is defined by a specific Type Certificate (TC), Supplementary TC (STC), Service Bulleting (SB) or TC amendment. To obtain the approval, the manufacturer is required to submit an RVSM approval data package which is then evaluated in detail by the airworthiness authority prior to issuing the approval.

3.11 As a minimum the RVSM approval data package consists of the following:

a) The applicable build standard to which the data package applies;

b) A definition of the applicable flight envelopes;

c) Data showing compliance with the RVSM performance criteria;

d) The procedure to be used to ensure that all aircraft submitted for airworthiness approval comply with RVSM criteria. These procedures include the references of applicable Service Bulletins and the applicable approved aircraft flight manual amendment or supplement; and

e) The maintenance instructions that ensure continued airworthiness for RVSM approval.

3.12 RVSM performance data should include both measured and analytical data indicating the Static Source Error characteristics of the aircraft build standard and the corrections which must be applied to demonstrate the required performance.

3.13 Once a State (normally the State of manufacture or in the case of the EU, EASA) has issued an RVSM airworthiness approval for a specific build standard, it is not normally necessary for States issuing operational approvals for aircraft constructed to that same build standard to repeat the process. However, States issuing approvals to operators should verify that the build standard of an aircraft put forward for approval is the same as that referenced on the original RVSM airworthiness approval. This is particularly important when an aircraft is modified or built to an STC issued at a later date to that of the original airworthiness approval.

3.14 Particular attention should be given to aircraft built for special purpose roles, such as military applications, photographic or civilian survey missions. Procurement authorities are recommended to explicitly indicate whether an aircraft derivative is required to operate in an RVSM environment, with reduced separation minima, on the appropriate procurement specification and that such an individual RVSM solution is required to be demonstrated by submission of an RVSM approval data package.

3.15 In the event that an aircraft undergoes any structural or equipment modifications post airworthiness approval issue, then the original airworthiness approval may no longer be valid. States responsible for approving the modification must issue a new airworthiness approval based on a data package produced specifically for the modification. Revised aircraft performance data will need to be submitted to verify RVSM criteria compliance.

3.16 An aircraft which is constructed to a build standard with a generic RVSM airworthiness approval, and which exhibits common RVSM performance characteristics, is termed an RVSM Group certified aircraft. Any aircraft which is built or modified to a unique build standard with its own individual RVSM airworthiness approval, is termed an RVSM Non-Group aircraft. States must ensure that a full RVSM performance and analysis process is conducted on all individual Non-Group aircraft prior to issuing an RVSM approval. RMAs maintain a list of all recognised RVSM group definitions and can provide guidance on specific cases.

Validity of an RVSM operational approval

3.17 As the RVSM Operational Approval issued by a State includes verification of the operator's continued airworthiness and flight crew procedures, the approval cannot be transferred between operators. In the event that an operator changes its technical support structure (i.e. changes maintenance supplier) then it may be necessary to re-issue the approval.

3.18 Under certain circumstances it may be necessary to withdraw an RVSM approval from an operator. Such circumstances may include operator non-compliance with performance or fleet monitoring target requirements, or any other reason determined appropriate by the approval authority. Withdrawal of approval may apply to individual airframes or a complete fleet. Rarely, it may be necessary for the original airworthiness authority to withdraw approval for a complete build standard.

3.19 In accordance with Annex 8 to the Convention on International Civil Aviation, the State Authority should ensure a periodic inspection to demonstrate that the RVSM airworthiness remains valid, and that the aircraft and operator remain in compliance with the established requirements. As part of the height keeping performance monitoring programme, the RMA conducts trend analysis and can assist in monitoring the efficacy of an operator's RVSM continuous airworthiness procedures. If RVSM continuous airworthiness procedures are determined to be inadequate, the RVSM approval may be considered to be invalid.

3.20 In accordance with the requirements of Annex 6, any aircraft that operates with reduced separation minima in RVSM airspace must hold a valid RVSM approval. Similarly, any aircraft which is non-compliant with Altimetry System Error requirements (due to inadequate RVSM continuous airworthiness procedures) can be considered to be non-compliant with general airworthiness requirements defined in Annex 8. Under the precepts of this requirement, any non-compliance renders the aircraft ineligible for operation.

3.21 State authorities should also consider the RVSM approval status of any aircraft/operator under the following circumstances:

a) The conditions under which an initial approval was issued have changed. For example, the construction or equipment configuration of the aircraft has been changed such that the original RVSM data approval package is no longer valid;

b) The operator is not in compliance with the long-term monitoring requirements, and so cannot demonstrate the effectiveness of continued airworthiness procedures.

3.22 In such circumstances as those described above, the State should satisfy itself that corrective action has been taken before the aircraft is permitted to continue operations in RVSM airspace. Such action may include submission of a new RVSM approval data package, but in all cases should include height monitoring in accordance with a plan agreed between the State and operator and coordinated with the RMA. Such a monitoring programme should demonstrate compliance with all airworthiness requirements within a reasonable time frame which should not exceed 6 months. Failure to comply with an agreed monitoring plan should result in the removal of the RVSM type approval for the operator (i.e. removal of approval for all airframes of the type for which the operator is non-compliant with monitoring targets).

3.23 There is no harmonized requirement to limit the duration of an RVSM approval. Some States have implemented a two-year limit to ensure that operators comply with all height monitoring requirements before a renewal is issued. However, States which do not issue an approval with such a limitation should ensure that they have initiated procedures to ensure that operators continue to comply with all height monitoring requirements. An operator with an expired approval shall be treated identically to an operator flying with no approval and reported for non-compliance with Asia/Pacific flight rules. It was agreed as APANPIRG Conclusion 27/31 – Reduced Vertical Separation Minimum (RVSM) Approval Expiry - that States should:

a) in case they intend to allow RVSM approvals to expire, review their RVSM approvals data sharing procedures to take into account their ability to update RVSM approvals to Regional Monitoring Agencies (RMAs) before they expire; and
b) in case they do not allow RVSM approvals to expire, notify the RMA to remove all existing expiration dates (if any), and ensure that any future withdrawals of RVSM approvals are sent to the RMA.

3.24 In the event that an aircraft is re-registered then the approval issued to the original operator shall be automatically cancelled. Aircraft which are dry-leased, i.e. leased to a third party operator (lessee) who provides their own crew, shall not be operated on an approval issued to the owner/operator (lessor).

3.25 Any aircraft/operator found to be operating as RVSM approved, without an approval being issued by the State exercising operational authority, with an expired approval, or with an approval issued to another operator or registration shall be reported as non-approved to the State exercising operational authority and any other States in whose airspace the aircraft may be operating. It remains the responsibility of individual States to ensure that appropriate action is taken with operators of non-approved aircraft. It was agreed as APANPIRG Conclusion 28/12 – Management of Non-RVSM Aircraft - that, due to the continuing problem of non-Reduced Vertical Separation Minimum (RVSM) aircraft operating inappropriately within the RVSM Stratum on a long-term basis:

a) Asia/Pacific States should respond in a timely manner to Regional Monitoring Agency (RMA) recommendations; and
b) Asia/Pacific States and Administrations should enact policies, legislation (including appropriate enforcement actions), and procedures to ensure such non-approved aircraft are identified and refused entry into the RVSM stratum unless specifically exempted, or they have Air Traffic Control (ATC) approval, and
c) ICAO should survey Asia/Pacific States and Administrations to determine whether such policies, legislation and procedures to exclude non-RVSM aircraft have been implement; and
d) RMAs should treat aircraft with an unverified RVSM approval status by its State of Approval for more than one month, starting from the first RMA notification, as a non-RVSM approved aircraft and that information provided to relevant State authorities for appropriate action; and
e) RMAs should be empowered by APANPIRG to have direct communication with concerned ministries/authorities if required in the event of inadequate action by the State.

RVSM approvals - RMA

3.26 Aircraft approval status verification is delegated to the accredited RMA. The RMA maintains a database of aircraft which is populated with approval records submitted by State representatives and RMAs from other RVSM regions.

3.27 The RMA conducts regular audits of flight plans, comparing the registrations of aircraft from flight plans in which RVSM approval has been indicated, to records contained in the RMA database of approvals. The RMA will submit a request to the appropriate State authority if an aircraft which is not listed in the database is found to be operating as RVSM approved. If the aircraft is subsequently confirmed as holding a valid approval, then its details are added to the database. If the aircraft is not approved then it remains the

responsibility of the State to take appropriate action, which may be to instruct the operator to cease flying in RVSM airspace until a valid approval has been issued.

3.28 The RMA functions as a monitoring and reporting agency only. The RMA is not responsible for verifying that any conditions applicable to an RVSM approval issued by a State are met; however, the RMA may require clarification if an aircraft is not recognised as an RVSM type. In addition, the RMA is not responsible for verifying that the operator is compliant with any operational limitation defined on the AOC or flight manual, or that the aircraft is being flown by the operator or crew to whom the approval has been issued.

3.29 It is the responsibility of individual States to implement processes and procedures to verify that aircraft construction, equipment, performance, maintenance instructions and crew training all comply with the RVSM regulatory requirements. The RMA cannot be involved in the internal approval process. Specifically, height monitoring data cannot be used in lieu of certified and calibrated SSE measurement systems, operated under controlled conditions, to provide engineering substantiation of aircraft height keeping performance.

3.30 Non-approved aircraft present potential safety threats in RVSM airspace and so need to be identified and appropriate action taken in an expeditious manner. To improve the effectiveness of the RMA and to avoid unnecessary investigations, it is important that States support the RMA by ensuring that the records of RVSM approvals are correct and up to date. Errors in the database result in unnecessary workload for both the RMA and State authority.

3.31 States can report individual aircraft approvals to the RMA using form F2 available on each RMA's website.

3.32 An RVSM approval shall be considered valid indefinitely unless a State issues a specific expiry date or until the State informs the RMA that an approval is no longer valid (i.e. the aircraft has been re-registered, placed in indefinite storage, scrapped, or the approval is withdrawn for any other reason). The RMA will not accept a transfer of an RVSM approval between operators. Upon a change of operator, the RMA will remove the approval confirmation until a new approval is issued. The RMA will not accept RVSM approvals directly from operators.

3.33 In addition to conducting audits of flight plans within its own accredited area of responsibility, an RMA may be requested to confirm the approval status of an aircraft operating in another RVSM region. The RMA will forward all such requests to the appropriate State authority.

3.34 Aircraft which are confirmed as non-approved will be reported as such to the States where they were operating. This information will also be available to States within the region.

3.35 To maintain an accurate database of approvals, the RMA will periodically request a State to participate in an audit of the full list, or inventory, of approvals for which the State is responsible. (APANPIRG Conclusion 20/22 − Provide Annual Update of RVSM Approvals to RMAs).

3.36 A structured approach to approvals management and efficient State/RMA coordination procedures is important to ensure the effectiveness of the safety oversight programme. Any breakdown in coordination may result in increased workload and distraction from addressing priority safety issues and may be referenced in the annual RASMAG Report presented by the RASMAG to APANPIRG.

3.37 In the event that a State does not provide safety related data to approved regional safety monitoring agencies, including RMAs, in accordance with the requirements of safety monitoring, then the RMA shall propose to the RASMAG to subsequently propose the State to be included in the APANPIRG ATM and Airspace Safety Deficiencies List (APANPIRG Conclusion 16/6 – Non Provision of safety related data by States).

RVSM approvals - States

3.38 In accordance with the precepts of ICAO Annex 6, States are the principal authorities, tasked with ensuring that all aircraft under their operational authority, intending to operate in RVSM airspace, are approved. States are required to ensure that aircraft/operators continue to comply with performance and fleet monitoring target requirements. States are also required to take appropriate action with operators of non-approved aircraft found to be operating within their sovereign airspace.

3.39 States should ensure that a list of personnel authorised to issue notifications of RVSM approvals to the RMA are supplied beforehand. States can submit relevant contact information using form F1 available on each RMA's website.

3.40 To minimise workload and to avoid aircraft being incorrectly identified as non-approved, it is important that States have processes and procedures in place to enable the easy verification of the status of any aircraft for which they exercise operational authority. It is recommended that each State implement a centralised database of approvals which can be periodically cross checked with the RMA database.

3.41 States must ensure that they have implemented processes and procedures to respond to requests for approval status confirmation received from the RMA and that appropriate action is taken with operators of any aircraft which are found to be operating without approval. Expeditious responses to RMA requests are necessary to avoid aircraft being incorrectly labelled as non-approved.

3.42 States should ensure that RVSM approvals are issued prior to operators commencing flights in RVSM airspace. This applies to delivery and ferry flights as well as normal operations. To minimise workload and avoid unnecessary investigative actions, States should ensure that new approval records together with any changes to existing records are forwarded to the RMA with minimum delay. States should pay particular attention to ensure that the RMA is notified when an aircraft is re-registered, removed from service, changes operator or any other situation which may affect the RVSM approval status. Regular cross checks between the RMA and States are necessary to maintain the currency of the region's approvals and to minimise unnecessary workload.

3.43 It is recommended that in the event that an operator is found to be flying in RVSM airspace without approval then they should be instructed to cease filing flight plans with 'W' in item 10 with immediate effect. Furthermore, the State should investigate the circumstances under which the operator was conducting such flights and either, implement procedural changes where necessary, or take appropriate action in the event of wilful action on the part of the operator.

3.44 States should also consider the approval status of any aircraft/operator which does not comply with performance or fleet monitoring target requirements, as reported by the RMA. States which issue expiry dates should ensure that aircraft/operators are fully compliant with all requirements before any approval extension is issued. It is important that States ensure that they have instituted procedures to ensure appropriate action is taken with operators of aircraft with approvals due for expiration. An aircraft with an expired approval shall be considered as non-approved.

3.45 Upon receipt of any report involving a failure to adhere to RVSM in-flight crew procedures, the State should ensure the investigation of the circumstances of the incident. Where appropriate the State should ensure that remedial training has been implemented to avoid future repetitions and, depending on the severity or frequency of incidents, should consider withdrawal of the operator's RVSM approval.

3.46 In addition to taking appropriate action with any non-compliant aircraft/operator, it may be necessary for a State to implement a review of its own internal approval processes which may have inadvertently contributed to any aircraft/operator non-compliance. Such situations may include:

- Issuing an approval based on an invalid RVSM approval data package (for example when an aircraft is constructed to an STC when the data package is only valid for aircraft constructed to the original TC);

- Inadequate, inappropriate or overdue response upon receipt of a non-compliance by the accredited RMA;

- Lack of operator familiarity with RVSM flight crew procedures or approval requirements; and

- Inadequate configuration management control of RVSM approval information including data coordination with the accredited RMA.

RVSM approvals – Flight planning

3.47 All operators of RVSM approved aircraft indicate that a particular aircraft is RVSM approved by filing a 'W' in item 10 of the ICAO flight plan (including State approved aircraft). Any filing of the 'W' by a non-approved aircraft is in contravention of ICAO Doc. 7030.

3.48 State aircraft which are not RVSM approved may be permitted to operate in RVSM airspace with a 2,000 ft. vertical separation minimum; however, they must not file a 'W' in the flight plan and must indicate STS/NONRVSM in item 18 of the flight plan. Only military, customs and police may file flight plans as State aircraft. Formation flights are not permitted in RVSM airspace even if the individual aircraft themselves are RVSM approved. It was agreed as APANPIRG Conclusion 25/26 – Flights in RVSM Airspace by non-approved State Aircraft – that, Asia/Pacific States be urged to ensure close cooperation between civilian and military authorities, so that all RVSM operational requirements are clearly understood and complied with by State aircraft. It was also agreed as APANPIRG Conclusion 32/6 – RVSM Approvals Data and Filing of RVSM Indicator in Flight Plans of State Aircraft – that, States are urged to liaise with their State aircraft operators to not file 'W' in item 10 of the ICAO flight plan of aircraft that are not approved for RVSM.

3.49 Civilian non-approved aircraft will normally not be provided with an ATC clearance into RVSM airspace with the exception of designated airspaces in the Asia/Pacific region where non-approved civilian aircraft are permitted to operate. States are required by the precepts of ICAO Annex 6 to take appropriate action with aircraft/operators found to be operating in RVSM airspace without approval. It was agreed as APANPIRG Conclusion 24/26 – Repetitive Non-RVSM Approved Aircraft Operating as RVSM Approved Flights – that, Asia/Pacific States should, except where a specific non-RVSM operation is authorised, deny entry to operate within RVSM airspace for aircraft that have been confirmed as non-RVSM approved over a significant length of time, or by intensive checking. Operators should ensure that flight plan dispatchers have accurate information regarding the RVSM approval status of all aircraft within a fleet so that incorrect approval status is not entered into the flight plan.

RMA action of non-approved and non-compliant aircraft

3.50 Under the precepts of ICAO Annex 6 a State is required to take appropriate actions in the event that an aircraft for which it exercises operational authority is found to be operating in RVSM airspace without approval. In addition, a State is also required to take appropriate action against any non-approved aircraft, irrespective of the State of origin, which may be operating within the airspace of the State concerned. The monitoring of this second requirement is problematic for many States as there is no reference document or system which can be easily accessed to confirm the approval status of all aircraft operating within their airspace.

3.51 Specific action which any State may take with regard to an aircraft requesting an RVSM clearance, remains the responsibility of the individual State concerned. However, it should be emphasised that Asia/Pacific States should, except where a specific non-RVSM operation is authorised, deny entry to operate

within RVSM airspace for aircraft that have been confirmed as non-RVSM approved over a significant length of time (APANPIRG Conclusion 24/26 – Repetitive Non-RVSM Approved Aircraft Operating as RVSM Approved Flights).

4. RMA/STATE COORDINATION

RMA contacts

4.1 An RMA is established to support States to demonstrate compliance with ongoing safety oversight and airspace monitoring requirements in RVSM airspace. The five RMAs in the Asia/Pacific Air Navigation region represent 39 States. As the RMA is responsible for managing RVSM approvals (both civil and military), addressing RVSM airworthiness issues and processing operational event reports for risk assessment, it is often necessary for a State to provide multiple contacts to the RMA. Therefore, the RMA may be required to maintain connections with a number of individual points of contact within its area of accreditation. The RMA must also maintain communication with all other RMAs which represent the different RVSM regions around the world as well as aircraft manufacturers and regulatory bodies.

4.2 The data communication traffic for the RMA is relatively high so it is important that the RMA is aware of the credentials and responsibility/authority of any individual with which it communicates; particularly as some data exchanges involve sensitive and confidential information. In general, the RMA directly communicates with the designated States. Except by prior arrangement, the RMA may directly communicate with operators in the responsible RVSM region. The RMA does not accept direct communications from operators or States from other RVSM regions, requesting that all such communications be directed through the host RMA, who can often provide the appropriate information without reference to other RMAs.

4.3 Each RMA provides a generic e-mail address to which all information and requests for data and assistance should first be directed. The RMA will review each message and redirect to a specialist if necessary. All messages to the RMA will be acknowledged and if appropriate a dialogue will be initiated either through the generic e-mail address or by a specialist in the area of discussion.

4.4 The web addresses for the Asia/Pacific RMAs are:

- AAMA: http://www.airservicesaustralia.com/services/aama/
- China RMA: http://www.chinarma.cn/
- JASMA: http://www.jasma.jp/
- MAAR: https://www.aerothai.co.th/maar/index.php
- PARMO: https://www.faa.gov/air_traffic/separation_standards/parmo/

4.5 The RMAs are not operational ATC units and therefore are normally manned during regular working hours only.

State contacts

4.6 To provide a coordinated and effective safety oversight and monitoring programme for RVSM in Asia/Pacific it is important that each State delegates specific units and/or individuals to interface directly with the RMA to which it is accredited. States should ensure that official points of contact are clearly identified and reported to the RMA. States should ensure that authorised points of contact are notified to the RMA for the following areas:

a) Exchanging RVSM approval information with the RMA on a regular basis;

b) Managing requests for approval status confirmation received from the RMA and taking appropriate action with operators of non-approved aircraft;

c) Managing reports received from the RMA of aberrant and non-compliant aircraft Altimetry System Error and other airworthiness issues;

d) Addressing operator non-compliance with fleet monitoring targets received from the RMA;

e) Collating and distributing operational incident reports in RVSM airspace;

f) Providing flight plan traffic sample data of December every year to support the annual RVSM safety assessment (as defined in ICAO Doc. 9937 and agreed in APAPIRG Conclusion 16/4 – Traffic Sample Data Collection).

4.7 It is desirable to minimise the number of contacts from each State with which the RMA has to coordinate actions; however, in the majority of cases it is accepted that two or more points of contact may be required to ensure appropriate expertise is available for each of the functions described above.

4.8 To avoid misunderstanding and the delay in verifying credentials following communications from unknown contacts, States should submit all authorised points of contact to their accredited RMA using F1 form available on each RMA's website.

4.9 It is important that each State ensures that responsibilities are transferred and new RMA F1 forms are issued in the event of staff leaving or changing position so that continuity of service with the RMA is maintained.

Inappropriate State Actions

4.10 Effective oversight and resolution of safety issues in RVSM airspace can only be achieved if the RMA and its accredited States function together to ensure that RVSM data is accurate and that appropriate follow up actions are taken in an expeditious manner. It is particularly important that States ensure that appropriate remedial action is taken as quickly as possible in the event that the RMA submits a report requiring State action. (APANPIRG Conclusion 22/10 – RVSM Approvals, item c and Conclusion 23/15 – Long-Term Non-RVSM Approved Aircraft, item b)

4.11 In the event that a State does not take action which is considered appropriate with any non-approved or non-compliant aircraft/operator, then the RMA shall propose to the RASMAG to subsequently propose the State to be included in the APANPIRG ATM and Airspace Safety Deficiencies List.

5. TECHNICAL HEIGHT KEEPING PERFORMANCE AND MONITORING

5.1 A major part of the RVSM safety oversight programme involves monitoring aircraft technical height keeping performance, or more specifically, aircraft Altimetry System Error (ASE). ASE is the difference between the altitude indicated by the altimeter display, assuming a correct altimeter barometric setting, and the pressure altitude corresponding to the undisturbed ambient pressure; or described more simply as the difference between the actual altitude of the aircraft and the indicated altitude of the aircraft. Any aircraft flying at an incorrect level presents a threat to air safety; however, ASE is particularly dangerous as the effect is frequently invisible to pilots, ground controllers and aircraft collision avoidance systems such as TCAS.

5.2 A major contributor to ASE is the Static Source Error (SSE), which is the error introduced, when attempting to measure the ambient air pressure, caused by the physical presence of the aircraft itself. The SSE characteristic is a variable influenced by a number of parameters including, airframe design and configuration, speed, altitude, weight and attitude of the aircraft. The SSE characteristic of an airframe is modelled at the design phase with corrections applied in the aircraft's avionics system which are intended to remove its effects. However, the SSE characteristic can change over time due to a number of factors including, degradation of sensor components, physical damage to sensor probes or static ports, blockages of the pressure system, or aircraft modifications. In the event that the SSE characteristic changes then the corrections applied in the avionics may no longer be valid, resulting in increased ASE. Validated continuous airworthiness programmes are essential to ensure any changes to SSE are detected and corrected.

5.3 The purpose of the height monitoring programme is to verify that the initial Static Source Error Corrections (SSEC) remains valid, that the continuous airworthiness programmes are adequate and that operators have implemented such programmes correctly. Biennial minimum monitoring targets for all operators of RVSM approved aircraft are defined in ICAO Annex 6 to ensure correct application of continuous airworthiness programmes; however increased quantities of monitoring are required when a new RVSM type or variant is developed until such time as the initial and long term ASE characteristic of the design has been confirmed. The actual monitoring target for any operator of an RVSM approved aircraft is therefore determined by the type of aircraft. The monitoring requirements for all RVSM approved aircraft, variants and derivations are defined in a table revised annually by the ICAO RMA Coordination Group (RMACG). Copies of the latest MMR can be obtained from the RMA to which a State is accredited.

5.4 The accurate measurement of ASE requires the use of precise and calibrated specialist equipment operated under controlled conditions, and is an expensive process which is normally only performed at the initial airworthiness stage. It is not feasible to expect all operators of RVSM approved aircraft to undergo repeated flight checks under these controlled conditions to demonstrate continued compliance with ASE performance requirements. A number of alternative systems have been developed which provide accurate estimates of aircraft ASE under most conditions. The major advantage of these systems is that they can operate with little or no active participation on the part of the operator and are transparent to the crew. A brief description of techniques employed by RMAs to estimate aircraft ASE characteristics is provided in the following section.

Height Monitoring Systems

5.5 There are three independent height monitoring systems currently in use. These are:

- GPS Monitoring Unit (GMU). This is a portable carry on device used to estimate the ASE of a single flight for one aircraft. The advantage is that the aircraft can be monitored almost anywhere that it is scheduled to operate; however, the operating and processing costs for the operator are high as they rely on dedicated resources;

- Height Monitoring Unit (HMU). An HMU is a fixed ground based system which with one central and four outer receiving stations. The HMU measures geometric height of an aircraft

using the multilateration principle. Multilateration obtains three-dimensional positions calculated from the time difference of arrival (TDOA) of signals at each receiving stations from the transponder of an aircraft in flight. At least four receiving stations are required, and the fifth improves omni-directional coverage, accuracy and system redundancy. The coverage of an HMU is approximately 30 – 50 NM in radius; and,

- ADS-B Height Monitoring Systems (AHMS). An Automatic dependent surveillance-broadcast (ADS-B) Height Monitoring System (AHMS) is a height monitoring system that utilizes data from an existing ADS-B network. It uses geometric height data available from ADS-B equipped aircraft in order to calculate the ASE. The coverage of an AHMS depends on the coverage of the ADS-B network it obtains data from.

5.6 There are advantages and disadvantages to all the monitoring systems; however, they all operate on the same fundamental principle, which is the comparison of the true height of an aircraft against the height of the pressure level which corresponds to the indicated altitude of the aircraft. The implementation of such a system is however quite complex. For GMUs, the height of the aircraft is provided by the GPS receiver of the on-board GMU. For an AHMS, the height of the aircraft is obtained from the aircraft's GPS receivers. An HMU, on the other hand, relies on the estimation of the aircraft height using multilateration techniques. The determination of the height of the pressure level which corresponds to the indicated altitude of the aircraft is challenging as the pressure levels move up and down depending on the specific meteorological conditions and vary in magnitude over both time and position. Various methods of modelling the continually changing height of the pressure level have been implemented; however, they all rely on an initial set of values obtained from various Numerical Weather Prediction models (NWP) provided by national and international meteorological organisations.

5.7 It is important to ensure that the monitoring data is correlated to the correct aircraft. Height monitoring systems only receive the aircraft ICAO 24-bit aircraft identifier. It is necessary to compare the 24-bit aircraft address to the address provided by the State in the RVSM approval data. If the transmitted address is different from the one recorded by the RMA then the monitoring result will not be correlated to the correct aircraft.

Operator Long Term Height Monitoring Programme

5.8 All operators of RVSM approved aircraft are required to participate in the RVSM height monitoring programme. The principal purposes of the long term height monitoring programme are to verify long term ASE stability and the efficacy of an operator's continued airworthiness programme.

5.9 All operators of RVSM approved aircraft in the Asia/Pacific Air Navigation Region are required to comply with the Long Term Height Monitoring (LTHM) requirements defined in the current version of the MMR. Data from any of the recognised RVSM monitoring programmes may be used to satisfy an operator's monitoring target. The monitoring target varies dependent on the total amount and quality of monitoring data available, the period over which time such data was obtained and the quality of the performance data. For aircraft designs which have been monitored, with statistically representative data samples demonstrating stable performance, for in excess of two years, the requirement is for all operators to have a minimum of two aircraft monitored every two years or 1,000 flight hours, whichever the greater. For aircraft designs which have received a generic RVSM airworthiness approval within the last two years, operators are required to have 60% of their fleets monitored every two years or 1,000 flight hours, whichever the greater. Finally, if an aircraft is modified or built to a unique design and presented for RVSM airworthiness approval on an individual basis then that aircraft is required to be monitored every two years or 1,000 flight hours, whichever the greater.

5.10 States should ensure that all operators of RVSM approved aircraft under their operational authority comply with the minimum fleet monitoring targets. States should ensure that operators, including those with a single aircraft or small fleets, have implemented plans to demonstrate compliance with LTHM

requirements and that the targets are met in the time frame required (APANPIRG Conclusion 27/32 – Reduced Vertical Separation Minimum (RVSM) Monitoring of Small Fleets). States should take appropriate action with any operator which fails to comply with the LTHM requirements. Such appropriate action includes temporary revocation or suspension of an approval, complete withdrawal of approval and refusing an extension in the event that an approval has expired.

5.11 The RMAs conduct regular assessments of operator compliance with monitoring targets, the results of which are forwarded to the various State authorities which have the responsibility for determining what further action should be taken. Operators are encouraged to contact the RMA to check availability and flight requirements for the various height monitoring programmes prior to conducting any dedicated monitoring flights.

ASE Performance Investigations

5.12 ASE data acquired from the height monitoring programmes is used in three ways by the RMA. The total data sample provides the input to the technical collision risk assessment conducted annually by the RMA and presented to RASMAG and the APANPIRG. Data is also grouped by aircraft type and individual airframe to assess generic and discrete airframe ASE performance.

5.13 The ICAO Annexes and the various MASPS documents define the maximum tolerable ASE performance requirements for both RVSM groups (i.e. the total population of aircraft built to a common compliance standard), and individual airframes, in order to comply with the technical safety limits. The principal requirements are described below:

- The absolute value of mean ASE of any RVSM group shall not exceed 80 ft.;
- The sum of the absolute value of mean ASE and 3 standard deviations of ASE of any RVSM group shall not exceed 245 ft.; and
- The ASE of any individual airframe shall not exceed 245 ft. in magnitude.

5.14 The RMA collects the measurement results and conducts regular analysis of both group and individual airframe performance. In the event that the group performance results, taking into account the size of the available data sample, indicate non-compliance with one or both of the requirements defined above then it requests a more detailed investigation by the Authority responsible for issuing the original airworthiness certificate. The resolution of any generic RVSM group investigation may be time consuming and expensive. Actions to resolve a generic performance investigation may include design changes, re-calculation of SSEC or amendments to continuous airworthiness procedures. Although removal of a generic RVSM airworthiness approval remains the ultimate sanction of any authority, the implications for both the manufacturer and existing operators would be extremely serious making this an unlikely scenario in all but the most extreme cases which impact safety separation standards.

5.15 More common than a group investigation is an investigation into the performance of an individual aircraft which exhibits non-compliant ASE performance due to damage or degradation of a component within the static pressure system. In addition to reporting an aircraft which is not compliant with the absolute ASE limit, the RMA monitors performance which is not consistent with the core distribution of aircraft and which may be in the early stages of deterioration towards becoming non-compliant. Such performance is termed aberrant.

5.16 Any aircraft which exhibits performance which is not compliant with the ASE performance requirements defined above is subject to a mandatory report submitted to the appropriate State authority for immediate action. An RMA may recommend a State or operator to investigate the performance of an aircraft which is aberrant if the typical performance is over a pre-set limit (typically 200 ft.) or if the ASE characteristic

indicates a significant trend towards non-compliance. States are urged to formulate a course of actions in regards to an aircraft reported as being non-compliant.

5.17 Although the RMA may institute an investigation into a non-compliant or aberrant aircraft, it remains the responsibility of the appropriate State authority to ensure that the case is investigated and resolved to its own satisfaction. The RMA can provide assistance and guidance, either directly advising the operator or as consultant to the State. Upon confirmation that remedial action has been completed the RMA will liaise with the State to decide if the investigation can be closed. Additional monitoring should be conducted to ensure any remedial action has been successful. The problems most commonly associated with poor ASE performance include the following:

- Humidity, leaks or corrosion in static pressure lines;
- Damage, blockage corrosion to static vents, pitot heads or probes;
- Air flow disturbance in area of static sensors due to paint damage, contamination or other physical changes;
- Airframe skin waviness effects;
- Angle of Attack vanes stiff or out of tolerance;
- TAT units out of tolerance;
- Air Data Computers out of tolerance;
- Damage to pressure transducers;
- Invalid SSEC; and
- Invalid MASPS compliance.

5.18 Any aircraft which fails to meet the technical vertical navigation performance requirements, particularly with regards to Altimetry System Error, represents a risk to maintaining vertical separation between aircraft. Following the receipt of a report of large ASE the State authority should be expected to take action proportional to the magnitude and characteristic of the non-compliance.

- An individual non-compliant ASE result considered to be inconsistent with typical performance for that airframe and which has subsequently returned to normal levels. The State should investigate the circumstances of the problem and if necessary implement changes to operational and continuous airworthiness procedures. Dependent on the severity of the problem the operator may be permitted to continue operations in RVSM airspace during the investigation.
- An individual or multiple non-compliant ASE results considered to be representative of typical performance for that airframe. The State should withdraw the RVSM approval until an investigation into the problem is completed and the operator can demonstrate that the non-compliance has been resolved. In the event that non-compliance is due to aircraft modification, equipment change, etc., then it may be necessary to re-evaluate the entire RVSM approval data package for the aircraft concerned, prior to issuing a new approval.

- A generic RVSM group fails to comply with group performance requirements. The State which issued the original airworthiness approval for the type should actively investigate the circumstances and if necessary withdraw the type approval until resolved.

6. ALTITUDE DEVIATION AND OTHER OPERATIONAL REPORTS

6.1 A key safety objective of the Asia/Pacific RVSM monitoring programme is the estimation of collision risk due to technical and operational reasons. The collision risk estimation process is complex and not within the scope of this document. The key parameters for the collision risk assessment are deviations from assigned (or planned/expected) flight levels, including both the magnitude and the duration of events, and the aircraft dimensions.

6.2 The technical risk assessment is conducted using monitoring data which is considered to be generic and so can be extrapolated for the entire population of aircraft throughout the region. The required magnitude and duration parameters are embedded in the data itself and the aircraft dimensions available once the monitoring result is correlated to a known registration.

6.3 The calculation of the operational risk is similar in concept; however, the data can only be supplied from operational units and is dependent on the specific operational environment and air situation at the time of the event. Each operational risk event is unique in nature and therefore it is not possible to extrapolate the parameters derived from one event to other areas of the region. To enable the RMA to provide a reasonable estimate of risk due to operational factors, it is important that all accredited States institute processes to collect operational incident reports and forward the relevant information to the RMA for inclusion in the risk assessment process.

6.4 The following sections describe the information which is required by the RMA to conduct the collision risk estimate and the definitions of events which should be reported.

Description of Operational Events

6.5 Altitude deviations and sudden unplanned alterations to ATC clearances inherently carry a greater risk in areas in which a reduced vertical separation minimum has been implemented. It is therefore important that an assessment is periodically conducted to ensure that collision risk estimates satisfy pre-defined Target Levels of Safety (TLS).

6.6 The RMA conducts operational environment collision risk estimates using data provided by accredited member States. An event is reportable to the RMA when either an aircraft makes a deviation from a cleared level between FL 280 and FL 420 (cleared or actual) or an ATC clearance results in a risk bearing situation, such as loss of separation or TCAS initiated deviation.

6.7 The range of factors which may result in a reportable event include the following:

- Pilot not following an ATC clearance resulting in flight at unassigned flight level;
- Unexpected rate of climb/descent resulting in exceeding or not achieving cleared flight level;
- Pilot not following established contingency procedures for emergency descent;
- Technical failure in the altimetry or automatic altitude control system of an aircraft;
- Turbulence or other weather-related phenomena;
- Response to airborne collision avoidance system resolution advisory;
- An error in issuing an ATC clearance which results in flight at incorrect level or which impairs separation minima;

- Coordination errors between adjacent ATC units in the transfer of control responsibility for an aircraft resulting in flight at an incorrect or unexpected flight level; and

- Communication loop errors, (undetected or garbled read back/feedback errors).

6.8 The important parameters which must be available if the report is to be used for the quantifiable risk assessment include the magnitude of deviation and duration. It is possible that a single event will have multiple phases each with its own set of parameters. As much information as possible should be provided on the report to assist in the estimation of the required parameters and nature of the event.

Reporting of Operational Events

6.9 A number of methodologies are available for estimating the collision risk parameters due to operational events. These may include follow up investigations to determine the nature of any deviation, and/or the receipt and analysis of dedicated operational incident reports, or large Height Deviations. In both methodologies it is essential that individual States provide the operational event reports to the accredited RMA.

6.10 When States submit operational incident reports, it is important to ensure that the following minimum information is provided:

- High level description of event;

- Aircraft type and identity;

- Date, time and location of occurrence;

- Magnitude of vertical error or deviation (for each phase of event if applicable), which may also be reported as expected flight level, and actual or observed flight level; and

- Duration of deviation (for each phase of event if applicable).

6.11 States may refer to Appendix C – LHD/LLE/LLD TAXONOMY for the description and examples of LHDs to be reported and Appendix D – LHD FAQs for the frequently asked questions about LHD reporting. The RMA can provide copies of preformatted forms for the purposes of reporting operational incidents. Please note that each individual RMA may arrange a different mechanism for the reporting such as an e-mail submission or an online system. In some RVSM regions special arrangements may be made for the submission of RVSM operational incident reports through other safety oversight programmes.

6.12 Cross-boundary LHDs can be categorized as category E "coordination errors in the ATC-to-ATC transfer of control responsibility as a result of human factors issues" and involve two ATS units. To ensure that there is coordination between the two involving ATS units to uncover the cause and prevent future occurrences, the cross-boundary LHD coordination procedure is recommended for every LHD occurrence that involves another ATS unit, as illustrated in Appendix E – Cross-Boundary LHD Coordination Procedure. If the LHD point of contact from another State is unknown, the RMA may be able to assist State to obtain such information.

6.13 Due to the continuing prevalence of LHDs, States are encouraged to conduct further investigation and provide in-depth analyses of LHDs, especially those induced by their responsible ATS units. Appendix F – LHD Analysis Form (Form A) is recommended as a template for sharing the analysis results and Appendix G – LHD Preventative/Mitigation Measures Form (Form B) for sharing mitigation measures planned or taken to minimize LHDs with the RASMAG and the responsible RMA. The purpose is not to apportion blame on any organizations but to understand the underlying root causes in order to develop safety mitigations to prevent reoccurrences.

Risk Estimation of Operational Events

6.14 The RMA is responsible for reviewing all operational incident reports and compiling the parameters for the collision risk analysis. If a report does not include the minimum information required, then the report may not be included in the assessment. In the event that some information is missing the RMA may, based on previous reports and experience, include an estimate for a parameter so that the report may contribute to the risk assessment. If appropriate the RMA may also send a request to the operator directly or through another RMA to clarify the contributory causes of a large height deviation. On the basis of internal investigation, the operator should reply to the RMA's request and provide information regarding the cause of any large height deviation. The RMA will clearly distinguish between parameters which have been submitted on reports and those which are estimates based on the evidence available.

6.15 The common guidance for the Asia Pacific RMAs on how to treat TCAS RA-related reports (agreed at the RASMAG MAWG/9 meeting in 2022) is as follows:

a. If there is an operational error leading to the RA that fits the definition of an LHD, then the RMA should treat that error as a separate LHD. The category of this LHD should correspond to the nature of that operational error.

b. For all vertical deviations as a result of the TCAS RA itself that have a magnitude of 300 feet or more,

   i. if the flight crew correctly follow the RA, the deviations should be recorded as Category J LHDs and treated as technical errors

   ii. if the flight crew incorrectly follow the RA, the deviations should be recorded as Category K LHDs and treated as operational errors.

c. For all non-deviations resulting from the flight crew disregarding the TCAS RA, they should be recorded as Category K LHDs and treated as operational errors.

Management Process of Hot Spots

6.16 The types of operational errors that are used for RASMAG's monitoring activities are Large Height Deviations (LHDs), Large Lateral Deviations (LLDs) and Large Longitudinal Errors (LLEs). These are indicative of operational risks inherent in the APAC airspace. They become visible with the mature reporting culture of service providers and States. In 2015, the RASMAG/20 meeting decided to identify and prioritize high risk areas as LHD, LLD and LLE hot spots. The list of hot spots together with the analysis is reported to the APANPIRG annually so that specific actions could be initiated to reduce risk to an acceptable level. The EMAs, RMAs, States, and ATC units are also urged to take actions to establish scrutiny groups or alternate means to address the hot spots and present action plans and details of progress to the RASMAG.

6.17 In 2024, the meeting of RASMAG/24 adopted the management process of LHD, LLE, and LLD hot spots for Asia Pacific Region. The process consists of three (3) parts: identifying, monitoring, and removing a hot spot.

<u>Identifying an LHD/LLD/LLE hot spot</u>

6.18 Cluster Identification - the monitoring agency will explore, perhaps by plotting a map, if any occurrences are reported in close proximity (i.e. an area where the traffic flows are controlled by multiple ATS units, an area along the FIR/sector boundaries between adjacent ATS units, or an area with a specific traffic route system). This step requires a subjective judgement by the responsible monitoring agency. The identified clusters of occurrences will be determined if they fit criteria of being hot spots in the next step. The RASMAG

meeting can also identify such a cluster and request the monitoring agency to investigate if it fits the hot spot criteria.

6.19 Hot Spot Criteria - the cluster of occurrences will be identified as an LHD, LLD or LLE hot spot if it fits **at least one** of the following criteria:

a. The number of occurrences - the number of all occurrences in the cluster takes up a "relatively big portion" of the total number of occurrence reports of that specific region.

To be a "relatively big portion" in number,

$$\text{the number of occurrences in the cluster} \geq \frac{\textit{the total number of occurrences in the region}}{n+1}$$

where 'n' is the number of clusters in the region.

b. The risk estimate - the sum of operational risk estimates of all occurrences in the cluster takes up a "relatively big portion" of the region's operational risk estimate.

To be a "relatively big portion" in risk,

$$\text{the sum of operational risk of the cluster} \geq \frac{\textit{the region's operational risk estimate}}{n+1}$$

where 'n' is the number of clusters in the region.

c. Exceeding the TLS - the sum of operational risk estimate of all occurrences in the cluster reaches or exceeds the overall TLS of 5 x 10^{-9} FAPFH.

6.20 There are some circumstances where LHDs, LLDs and LLEs are scattered throughout the region and, hence, a hot spot cannot be identified even though the overall TLS is exceeded. It can be caused by a few occurrences with high operational risk. No patterns or commonalities can be found. These cases should be individually addressed, not as hot spots.

6.21 After LHD, LLD or LLE hot spots are identified, the responsible monitoring agency will report details to the RASMAG meeting for consideration. With concurrence from the RASMAG, the monitoring process of these hot spots will start.

Monitoring an LHD/LLD/LLE hot spot

6.22 The list of LHD, LLD or LLE hot spots in APAC is maintained by RASMAG with details of the involved FIRs, the 'lead' monitoring agency, the year of identification, and the current status. The naming of a hot spot should be arranged by FIRs in an alphabetical order to prevent the speculation of involvement from the order of FIRs.

6.23 During the annual RASMAG meeting, working papers or information papers are expected from the relevant States and administrations to update the meeting on the actions being taken to address each hot spot.

6.24 The 'lead' monitoring agencies are also expected to have the hot spots analysed in their safety assessment reports for the annual RASMAG meeting.

6.25 After its annual meeting, the RASMAG will report the current list of LHD, LLD or LLE hot spots in APAC together with progress updates to the APANPIRG in a consolidated manner and, if required, request for further actions.

6.26 If the environmental condition of an existing hot spot changes (e.g., the route structure or traffic pattern is changed, and the mitigation measures are completed and demonstrated the risk reduction in one part of the hot spot), that hot spot can be split into smaller areas depending on the FIR interfaces, the contributing factors, implementation of mitigation measures, etc. To split a hot spot, the same process as detailed in this section is applied by considering if the split clusters satisfy any of the hot spot criteria.

Removing an LHD/LLD/LLE hot spot

6.27 To remove an LHD, LLD, or LLE hot spot from the list maintained by the RASMAG, proof of mitigation and/or prevention measures should be presented to the RASMAG meeting and the implementation results should reflect the effectiveness of risk controls in terms of reduction in the number of occurrences and operational risk of the hot spot.

6.28 The risk assessment report from the responsible monitoring agency should demonstrate that the hot spot no longer satisfies any of the criteria listed in 2.4 for at least 2 consecutive years. With approval from the RASMAG meeting, the hot spot will be labelled as ‘potential non-hot spot’ after the first year and ‘removed’ after the second year. However, the RASMAG may decide to continue monitoring certain hot spots (retaining the ‘potential non-hot spot’ status) even if they no longer satisfy the criteria for at least 2 consecutive years when other circumstantial factors could have temporarily reduced the number of occurrences and the risk.

6.29 When a hot spot is marked as ‘removed’, the specific monitoring process for that particular hot spot will stop; the hot spot will be monitored under regular process.

6.30 For record control purposes, the hot spot details will not be removed from the list but the status will reflect its being non-hot spots. However, the same hot spot record maybe reused if the operational errors of the same issues re-emerge in the same area.

APPENDIX A – TERMS OF REFERENCE OF ASIA PACIFIC MONITORING AGENCIES

Regional Monitoring Agencies
Operating in the International Civil Aviation Organization (ICAO) Asia and Pacific Region (APAC)

Terms of Reference

Monitoring Agencies operating in the ICAO Asia Pacific Region support satisfaction of safety requirements as specified in Annex 11 to the Convention on International Civil Aviation, *Rules of the Air*, and fulfill the functions as specified by ICAO Doc 9937, *Operating Procedures and Practices for Regional Monitoring Agencies in Relation to the Use of a 300 m (1 000 ft) Vertical Separation Minimum Between FL 290 and FL 410 Inclusive* and ICAO Doc 10063, *Manual on Monitoring the Application of Performance-based Horizontal Separation Minima.*

Monitoring agencies also support the objectives of the RASMAG:

a) facilitate the safe implementation of reduced separation minima and CNS/ATM applications within the Asia and Pacific Regions in regard to airspace safety monitoring; and

b) assist States to achieve the established levels of airspace safety for international airspace within the Asia and Pacific Regions.

There are two types of monitoring agencies operating in the Asia Pacific region.

(a) Regional monitoring agencies (RMAs) monitor and assess operations applicable to Reduced Vertical Separation Minimum (RVSM).

(b) En-route monitoring agencies (EMAs) monitor and assess operations applicable to reduced horizontal plane separation minima.

Asia Pacific monitoring agencies shall support the use of RVSM and performance-based horizontal plane separation minima in Asia Pacific airspace, which shall consist of airspace as defined by RASMAG.

Asia Pacific monitoring agencies shall perform the following functions:

1. Establish a database to maintain information necessary for verification of operator/aircraft compliance with requirements associated with application of RVSM and performance-based horizontal plane separation minima.
2. Initiate checks of operator/aircraft compliance with RVSM and performance-based horizontal plane separation minima as filed in a flight plan and operating in the relevant airspace, identify operators and aircraft not meeting the requirements and using the relevant airspace, and notify the appropriate State of Registry/State of the Operator accordingly;
3. Facilitate the transfer of information necessary for verification of operator/aircraft compliance with requirements associated with application of RVSM and performance-based horizontal plane separation minima to and from other monitoring agencies;
4. Receive and assess reports of large deviations/errors and
    a. determine, wherever possible, the root cause of each vertical/lateral deviation or longitudinal error together with its size and/or duration
    b. take the necessary action with the relevant State and operator to determine the likely cause of the deviation

    Guidance for determining large deviations in the vertical and horizontal planes is included in ICAO Docs 9937 and 10063 respectively
5. Assess compliance of operators and aircraft operating in the Asia Pacific Region with RVSM height-keeping performance requirements*;

6. Investigate the height-keeping performance of the aircraft in the core of the distribution*;
7. Establish and/or maintain a database of operational performance data, including vertical, lateral navigation and/or communication and/or surveillance performance for:
    a. all flight operations;
    b. operators/aircraft types; and
    c. individual airframes;
8. Determine the appropriate method to monitor longitudinal risk**;
9. Analyse data collected on a predictive and proactive basis to detect deviation/error trends in the horizontal and vertical planes and, hence, to take action as specified in ICAO Doc 9937 and ICAO Doc 10063;
10. Conduct periodic risk assessments:
    a. assess the overall risk (technical combined with operational and in-flight contingencies) in the system against the overall safety objectives; and
    b. proactively identify aberrant changes in operational performance from the agreed regional safety goal;
11. Initiate necessary remedial actions as necessary and coordinate with RASMAG as necessary in light of monitoring results; and
12. Submit reports as required to the RASMAG.

* *Applicable to RMAs only*

** *Applicable to EMAs only*

APPENDIX B – APANPIRG CONCLUSIONS AND DECISIONS

APANPIRG Conclusions and Decision (Up to the 33th APANPIRG in 2022)

Conclusion 16/3 – Large Height Deviations – Western Pacific/South China Sea area	That, in noting the prevalence of RVSM large height deviation occurrences in the Western Pacific/South China Sea area, the Regional Office draw the attention of all States concerned to identify and put in place remedial actions to mitigate such significant errors on an urgent basis.
Conclusion 16/4 – Traffic Sample Data Collection	That, States be advised by the Regional Office that December every year had been adopted for the routine collection of 30 days of traffic sample data to satisfy airspace safety monitoring requirements.
Conclusion 16/5 – No implementation of reduced separation unless compliant with Annex 11	That, recognizing that some States had not adequately complied with safety management provisions, the Regional Office advise States of the Asia/Pacific Region that further regional implementation of reduced separation minima should only proceed in circumstances where implementing States can demonstrate an ability to comply with Annex 11, Chapter 2, safety management provisions for the continuous monitoring and regular assessment of the safety level achieved.
Conclusion 16/6 – Non Provision of safety related data by States	That the Regional Office advise that States not providing safety related data to approved regional safety monitoring agencies, including RMAs, in accordance with the requirements of safety monitoring agencies will be included in the APANPIRG List of Deficiencies in the ATM/AIS/SAR fields.
Conclusion 18/3 – Prevalence of LHDs from ATC Unit-to-ATC Unit coordination errors	That, in noting the continued prevalence of RVSM Large Height Deviation (LHD) occurrences resulting from ATC Unit-to-ATC Unit coordination errors, as reported by RMAs assessing RVSM operations within Asia Pacific Region, the Regional Office: a) draws to the attention of States that investigations into LHD should concentrate in this area, and b) highlights the APANPIRG recommendation that States work towards the implementation of compatible AIDC capabilities based on the Asia/Pacific AIDC ICD between ATC units as soon as possible.
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.

Decisions 20/21 – Expand use of safety monitoring data	That the arrangements for annual month of December traffic sample data by all States to satisfy airspace safety monitoring analysis called for by APANPIRG Conclusion 16/4 be expanded to enable this data to also be available for airspace planning and implementation purposes. This will apply only where such data is not otherwise available to regional or State implementing bodies and only with specific written authority of the ICAO Asia/Pacific Regional Office on each occasion.
Conclusion 20/22 − Provide Annual Update of RVSM Approvals to RMAs	That, in addition to the continuous update of RVSM Approvals data called for by Conclusion 19/15 and APANPIRG RMA requirements, States provide an update of RVSM Approvals data in conjunction with the annual December traffic sample data submission required by Conclusion 16/4.
Conclusion 22/10 – RVSM Approvals	That, the States are urged to: a) ensure that they provide point of contact details and complete RVSM approval data to the appropriate RMA in a timely manner; and b) encourage their ANSP to provide details to their RMA, on a monthly basis, of all flight plans filed showing RVSM approval; and c) take appropriate action regarding non-compliant aircraft, on the basis of the data provided by their RMA.
Conclusion 23/15 – Long-Term Non-RVSM Approved Aircraft	That, States are urged in a timely manner to: a) update Regional Monitoring Agency data on RVSM approved aircraft; and b) respond to, and take action regarding RMA queries on long-term data indicating that aircraft were not approved.
Conclusion 23/16 – Safety Monitoring Data Provision	That, recognising the importance of data collection for safety monitoring purposes, States be urged to: a) provide data as requested by Regional and En-Route Monitoring Agencies (RMA/EMA) in accordance with the RMA Manual (Doc 9937) and EMA Manual (either through a formal agreement or an informal understanding as appropriate); and b) provide available ADS-B data for height-keeping monitoring to RMAs when requested.
Conclusion 24/26 – Repetitive Non-RVSM Approved Aircraft Operating as RVSM Approved Flights	That, Asia/Pacific States should, except where a specific non-RVSM operation is authorised, deny entry to operate within RVSM airspace for aircraft that have been confirmed as non-RVSM approved over a significant length of time, or by intensive checking.

Conclusion 24/27 – Prioritization of AIDC Implementation to Address LHDs	Considering that ATS Inter-facility Data Communications (AIDC) is an important means of minimizing Large Height Deviations (LHD), Asia/Pacific States should support the expedition of AIDC through collaborative projects at the following significant LHD interface areas: a) Indonesia: between Jakarta and Chennai/Ujung Pandang/Brisbane/Melbourne FIRs; b) India: between Chennai and Kuala Lumpur FIRs; c) Philippines: between Manila and Fukuoka/Taibei/Hong Kong/Ho Chi Minh/ Singapore/Kota Kinabalu/ Ujung Pandang FIRs; and d) China: between – i. Urumqi and Lahore FIRs; and ii. Beijing and Ulaan Baatar FIRs.
Conclusion 25/25 – Submission of FPLs as Traffic Sample Data (TSD)	That, Asia/Pacific States that do not have an automated TSD generation capability be urged to consult with the appropriate Regional Monitoring Agency (RMA) and if agreed, submit their raw Flight Plan (FPL) messages to the appropriate RMA, instead of conventional TSDs.
Conclusion 25/26 – Flights in RVSM Airspace by non-approved State Aircraft	That, Asia/Pacific States be urged to ensure close cooperation between civilian and military authorities, so that all RVSM operational requirements are clearly understood and complied with by State aircraft.

Conclusion 26/28 - Asia/Pacific LHD Hot Spot Action Plans	That, the following Regional Monitoring Agencies (RMAs), States and ATC units should take urgent action to establish a scrutiny group or an alternate means to address the following Large Height Deviation (LHD) hot spot areas and present Action Plans and details of progress made to the ICAO Regional Office, prior to 01 January 2016: a) MAAR, India, Myanmar and Malaysia – Kolkata/Chennai FIRs interface with Yangon/Kuala Lumpur FIRs; b) PARMO, China RMA, JASMA, MAAR, China, Japan, Republic of Korea and Taibei Area Control Centre (ACC) – Incheon FIR AKARA Corridor interface with Shanghai/Fukuoka/Taibei FIRs; c) China RMA, MAAR, China and Hong Kong China – Hong Kong FIR interface with Guangzhou/Sanya FIRs; d) MAAR, AAMA, JASMA, Hong Kong China, Indonesia, Japan and the Philippines – Manila FIR interface with Fukuoka/Hong Kong China/ Singapore/Ujung Pandang FIRs; and e) China RMA, MAAR, China and Pakistan – Urumqi FIR interface with Lahore FIR. *Note 1*: the RMAs in bold were expected to take the lead in organising the scrutiny groups or alternative means to address the issues. *Note 2*: BOBASIO (Bay of Bengal Arabian Sea Indian Ocean) in agreement with MAAR has been identified as a scrutiny group for BOBASIO States in respect of the BOBLHD Hot spot Action Plan.
Conclusion 27/29 – Use of Available ADS-B Data for Aircraft Height Monitoring	That, ADS-B data obtained by a Regional Monitoring Agency (RMA) for use in aircraft height-keeping monitoring by means of an ADS-B Height Monitoring System (AHMS), can be sourced from aircraft not subject to an ADS-B related operational approval.
Conclusion 27/30 – Large Height Deviation Guidance Material	That, Asia/Pacific States should utilise the Large Height Deviation (LHD) Guidance Material on LHD taxonomy, reporting form(s), cross-boundary LHD reporting flow, and LHD Point of Contacts (POC) posted on Asia/Pacific Regional Monitoring Agency (RMA) websites.
Conclusion 27/31 – Reduced Vertical Separation Minimum (RVSM) Approval Expiry	That, Asia/Pacific States should: a) in case they intend to allow RVSM approvals to expire, review their RVSM approvals data sharing procedures to take into account their ability to update RVSM approvals to Regional Monitoring Agencies (RMAs) before they expire; and b) in case they do not allow RVSM approvals to expire, notify the RMA to remove all existing expiration dates (if any), and ensure that any future withdrawals of RVSM approvals are sent to the RMA.

Conclusion 27/32 – Reduced Vertical Separation Minimum (RVSM) Monitoring of Small Fleets	That, Asia/Pacific States should have processes to ensure that single aircraft operators or operators with small fleets are appropriately monitored in terms of Annex 6 requirements, including: a) the provision of guidance material so operators are aware of their responsibilities; and b) regulatory procedures being in place to ensure a State meets its obligation under Annex 6 that RVSM approved aircraft are monitored systematically.
Conclusion 28/12 – Management of Non-RVSM Aircraft	That, due to the continuing problem of non-Reduced Vertical Separation Minimum (RVSM) aircraft operating inappropriately within the RVSM Stratum on a long-term basis: a) Asia/Pacific States should respond in a timely manner to Regional Monitoring Agency (RMA) recommendations; and b) Asia/Pacific States and Administrations should enact policies, legislation (including appropriate enforcement actions), and procedures to ensure such non-approved aircraft are identified and refused entry into the RVSM stratum unless specifically exempted, or they have Air Traffic Control (ATC) approval, and c) ICAO should survey Asia/Pacific States and Administrations to determine whether such policies, legislation and procedures to exclude non-RVSM aircraft have been implement; and d) RMAs should treat aircraft with an unverified RVSM approval status by its State of Approval for more than one month, starting from the first RMA notification, as a non-RVSM approved aircraft and that information provided to relevant State authorities for appropriate action; and e) RMAs should be empowered by APANPIRG to have direct communication with concerned ministries/authorities if required in the event of inadequate action by the State.

Conclusion 29/28 – Empowerment to adopt Conclusions and Decisions on purely technical/operational matters by APANPIRG's Sub Groups	That, the empowerment to APANPIRG Sub Groups to adopt Conclusions and Decisions on technical/operational matters has been working effectively and considering its benefit for effectiveness of APANPIRG work: 1) APANPIRG Subgroup should adopt Conclusions/Decisions related to: a) any amendment to TOR, including an extension of time of Working Group/Taskforce formed under relevant Subgroup; and b) all technical and operational aspects of Subgroup's work within its TOR. 2) APANPIRG Subgroup should formulate Draft Conclusions/ Draft Decisions and submit to APANPIRG for adoption: a) any amendment to TOR, including an extension of time of Working Group/Taskforce formed under TOR approved by the APANPIRG; b) APANPIRG Air Navigation Deficiencies[1]; and c) report on slow progress by States in implementation aspects. 3) ICAO Secretariat would indicate clearly in the report of the Sub-group meeting on how the cross Sub-group Conclusions/Decisions to be coordinated and endorsed; and 4) As per empowerment principle, APANPIRG Subgroups or Taskforce/Working Groups are empowered to make Conclusions/Decisions related to regional guidance material for publication in ICAO APAC website. [1] *Note: In case States provide satisfactory evidence to the APAC Office for the resolution of the deficiencies, the APAC Office in consultation with the Chair of respective Sub Group and subsequent approval from Chairman of APANPIRG may take action to remove the deficiency from APANPIRG open deficiency list.*

Conclusion 31/11 – Alphanumeric Call Sign Initiative	Noting: 1) the extreme safety risks associated with pilot-ATC miscommunication and the number of Category D (ATC Loop Error) Large Height Deviations (LHDs); 2) APANPIRG Conclusion 27/15. ATMSG Conclusions 5-5 and 5-6 regarding the Asia Pacific Alpha Numeric Call-Sign (ANCS) call sign project; and 3) alphanumeric call signs were a well-established call sign confusion mitigation, that: leading Air Navigation Service Providers (ANSPs) and aerodrome operators, in coordination with CANSO and ACI, were urged to consider a trial to identify and overcome any barriers for the implementation of alphanumeric call signs, with a view to developing a project for the Asia/Pacific (APAC) Region.
Conclusion 32/6 – RVSM Approvals Data and Filing of RVSM Indicator in Flight Plans of State Aircraft	That, States are urged to: 1. liaise with their State aircraft operators to not file ‘W’ in item 10 of the ICAO flight plan of aircraft that are not approved for RVSM; and 2. respond to a survey on RMA and State responsibility on the matter of RVSM approvals of State aircraft.

APPENDIX C – LHD/LLE/LLD TAXONOMY

Note: The LLE/LLD Taxonomy are not part of RVSM monitoring but are provided in this document for ease of reference. It is last revised by MAWG/6 in 2022 and presented in 2023 at RASMAG/28.

LHD Category Code	LHD Category Description
A	Flight crew failing to climb/descend the aircraft as cleared
B	Flight crew climbing/descending without ATC Clearance
C	Incorrect flight level provided due to incorrect operation or interpretation of airborne equipment (e.g. incorrect operation of fully functional FMS, incorrect transcription of ATC clearance or re-clearance in FMS, flight plan followed rather than ATC clearance, original clearance followed instead of re-clearance etc.)
D	ATC system loop error (e.g. ATC issues incorrect flight level clearance or flight crew misunderstands flight level clearance message.)
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 of flight level)
F	Coordination errors in the ATC-to-ATC transfer of control responsibility as a result of equipment outage or technical issues (e.g. late or non-existent coordination of flight level)
G	Aircraft contingency event leading to sudden inability to maintain assigned flight level (e.g. pressurization failure, engine failure)
H	Airborne equipment failure leading to unintentional or undetected change of flight level (e.g. altimetry errors)
I	Turbulence or other weather related causes leading to unintentional or undetected change of flight level
J	TCAS resolution advisory, flight crew correctly climb or descend following the resolution advisory
K	TCAS resolution advisory, flight crew incorrectly climb or descend following the resolution advisory
L	An aircraft being provided with RVSM separation is not RVSM approved (e.g. flight plan indicating RVSM approval but aircraft not approved, ATC misinterpretation of flight plan)
M	Others

LHD Taxonomy with Examples

(The examples are added for MAAR's safety communication)

LHD Category Code	LHD Category Description
A	Flight crew failing to climb/descend the aircraft as cleared Example: Aircraft A was at FL300 and assigned FL360. A CLAM alert was seen as the aircraft passed FL364. The Mode C level reached FL365 before descending back to FL360.
B	Flight crew climbing/descending without ATC Clearance
C	Incorrect flight level provided due to incorrect operation or interpretation of airborne equipment (e.g. incorrect operation of fully functional FMS, incorrect transcription of ATC clearance or re-clearance in FMS, flight plan followed rather than ATC clearance, original clearance followed instead of re-clearance etc.) Example: The aircraft was maintaining a flight level below the assigned altitude. The altimeters had not been reset at transition. The FL assigned was 350. The aircraft was maintaining FL346 for in excess of 4 minutes.
D	ATC system loop error (e.g. ATC issues incorrect flight level clearance or flight crew misunderstands flight level clearance message.) Example: All communications between ATC and aircraft are by HF third party voice relay. Aircraft 1 was maintaining FL360 and requested FL380. A clearance to FL370 was issued, with an expectation for higher levels at a later point. A clearance was then issued to Aircraft 2 to climb to FL390, this was correctly read back by the HF operator, but was issued to Aircraft 1. The error was detected when Aircraft 1 reported maintaining FL390.
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 of flight level) Example 1: Sector A coordinated Aircraft 1 to Sector B at FL380. The aircraft was actually at FL400. Example 2: The Sector A controller received coordination on Aircraft 1 for Waypoint X at FL370 from Sector B. At 0504 Aircraft 1 was at Waypoint X at FL350 requesting FL370.
F	Coordination errors in the ATC-to-ATC transfer of control responsibility as a result of equipment outage or technical issues (e.g. late or non-existent coordination of flight level)

	Example: Controller in FIR A attempted to send AIDC message to coordinate transfer of aircraft at FL320. Messaging was unsuccessful to contact adjacent FIR by telephone fail. Aircraft contacted adjacent FIR without coordination being completed.
G	Aircraft contingency event leading to sudden inability to maintain assigned flight level (e.g. pressurization failure, engine failure) Example: Aircraft 1 descended from FL400 to FL300 with a pressurization issue.
H	Airborne equipment failure leading to unintentional or undetected change of flight level (e.g. altimetry errors) Example: Aircraft 1 cruising at FL380. ATC receives alert indicating aircraft climbing through FL383. Flight crew advises attempting to regain cleared level with autopilot and navigation system failure.
I	Turbulence or other weather related causes leading to unintentional or undetected change of flight level Example: During the cruise at FL400, the aircraft encountered severe turbulence, resulting the aircraft descending 1,000 ft. without a clearance.
J	TCAS resolution advisory, flight crew correctly climb or descend following the resolution advisory Example: Aircraft 1 was cruising at FL350. Flight crew received "Traffic Alert" from TCAS and almost immediately after an "RA Climb" instruction. Flight crew responded and climbed Aircraft 1 to approx FL353 to comply with TCAS instruction. TCAS display indicated that opposite direction Aircraft 2 descended to approx FL345 and passed below Aircraft 1.
K	TCAS resolution advisory, flight crew incorrectly climb or descend following the resolution advisory
L	An aircraft being provided with RVSM separation is not RVSM approved (e.g. flight plan indicating RVSM approval but aircraft not approved, ATC misinterpretation of flight plan) Example 1: Original flight plan details submitted by FIR A for outbound leg showed Aircraft 1 as negative RVSM. Subsequent flight plan submitted by FIR B showed Aircraft 1 as RVSM approved. FIR A controller checked with aircraft shortly after entering FIR A and pilot confirmed negative RVSM.

	Example 2: Aircraft 2 cruising FL310 was handed off to the Sector X controller who noticed the label of Aircraft 2 indicated RVSM approval. The Sector X controller had controlled the aircraft the day before. It was then a non-RVSM aircraft. The controller queried the status of Aircraft 2 with the pilot who advised the aircraft was negative RVSM.
M	Others

APPENDIX D – LHD FAQS

General

Q: What is an LHD?

A: An RVSM Large Height Deviation (LHD) is defined as any vertical deviation of 300 feet (90 m.) or more from the flight level expected to be occupied by the flight. The deviation may be the result of any operational error or technical condition affecting the flight and includes any operational error that causes the aircraft to be at a location (position and/or time) that is unexpected by the controller.

In other words, an LHD occurs when a controller expects an aircraft to be at one location, but the aircraft is actually at another location.

Q: Why States are required to submit LHD report?

A: ICAO Doc9574 RVSM Implementation Manual (section 5.4) specifies that ATC authorities are responsible to report LHD for any reason to their responsible RMA for collision risk assessment.

Q: How does an LHD contribute to mid-air collision risk?

A: An aircraft occupies space unexpected by a controller. Not knowing that the space is occupied, the controller may clear another aircraft to that location, which may cause a mid-air collision.

Q: What is the benefit of LHD reporting while it may be perceived as additional workload by some units?

A: Reporting safety significant occurrences is a key process of a good safety management system since it enables an organization to have the necessary information to be able to manage the associated risk. LHDs are considered 'hazards' in the RVSM airspace as they could potentially lead to a catastrophic outcome - a mid-air collision. Do not fall into a trap where we get too comfortable with the risk just because nothing has not happened yet.

To report to the RMA or not

Q: Some states impose flow restrictions by issuing NOTAMs or AFTN service message. If the incoming traffic violates the flow restriction but complies with separation agreed in the LOA, should this incident be reported as an LHD?

A: No. This operational error may be reported internally, but does not need to be reported as an LHD to the RMA.

Q: A controller does not receive a transfer or the appropriate revision of the transfer of an aircraft from the transferring unit, but surveillance system enables the accepting controller to determine the location of the incoming aircraft well before the Transfer-of-Control (TOC) point, allowing the accepting controller to call the transferring controller back to confirm the aircraft's intent. Should this incident be reported?

A: Yes. Although such occurrences typically do not contribute to the quantitative estimate of risk, these occurrences should still be reported as LHDs to the responsible RMA. Even though the individual event has been mitigated, those errors were still made by the transferring ACC unit. With our online LHD reporting system, such an occurrence will be notified to the transferring ACC unit's POC. If such occurrences are not reported, then the transferring ACC unit would not have known about these transfer errors. States are strongly encouraged to collaborate with their neighboring ACC to prevent such occurrences in the future.

Q: The transferred SSR code does not match the incoming traffic. The controller sees the incoming traffic, but cannot identify it. Should this be reported?

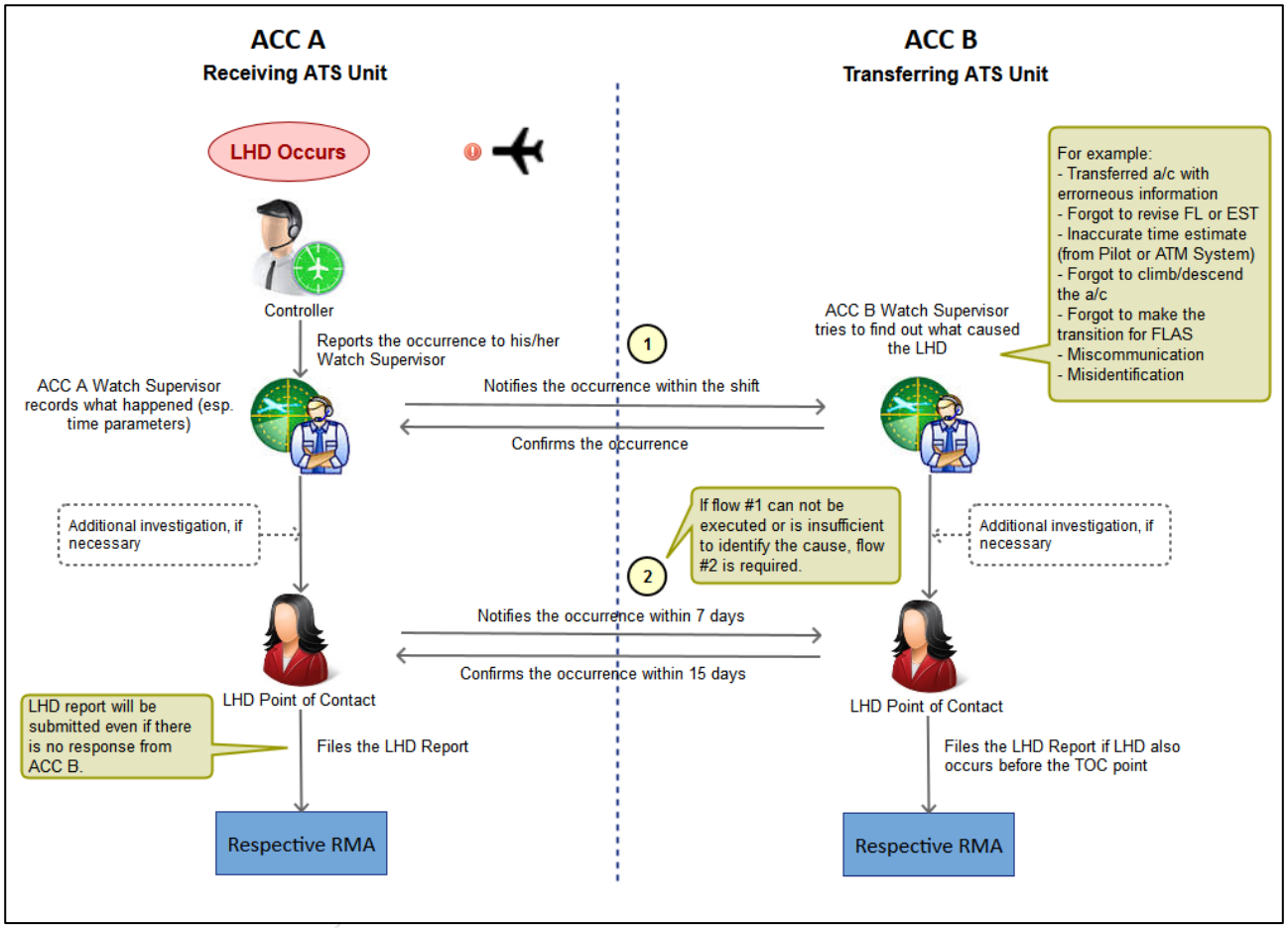
A: Yes. The RMA will analyze this type of occurrence case by case.

Q: The traffic doesn't arrive at the transferred time. The controller calls the transferring unit to get an updated transferred time. Should this occurrence be reported?

A: Yes, but it should be reported to your designated Enroute Monitoring Agency (EMA). If the time difference is big, such an occurrence would be an LHD; the EMA will relay the report to the RMA.

APPENDIX E – CROSS-BOUNDARY LHD COORDINATION PROCEDURE

Cross-boundary LHDs are mostly, but not limited to, Category E "coordination errors in the ATC-to-ATC transfer of control responsibility as a result of human factors issues". Category E LHDs constitute about 90% of all LHD occurrences and usually most of the risk in RVSM. To ensure that there is coordination between the two involving ATS units to uncover the cause and prevent future occurrences, the following additional coordination procedure is recommended for every LHD occurrence that involves another ATS unit.



APPENDIX F – LHD ANALYSIS FORM (FORM A)

Due to the continuing prevalence of LHDs, States are encouraged to conduct further investigation and provide in-depth analyses of LHDs, especially those induced by their responsible ATS units. The purpose is not to apportion blame on any organizations but to understand the underlying root causes in order to develop safety mitigations to prevent reoccurrence. In case of significant occurrences (such as long duration LHDs), States are encouraged to provide an analysis for each occurrence. For other occurrences, States can provide analysis of a group of similar occurrences.

1. Organization: **2. Date of Analysis**:

3. If it is a single occurrence - Please provide occurrence date, call sign*, and location:

4. If it is a group of occurrences – Please describe the nature of occurrences:

5. Details of the analysis: Please provide detailed description of the followings

Description of Occurrence(s)	
Contributing Factors and Mitigations - **Contributing factors/causes**: Please describe ***all*** factors leading to such occurrence(s) - **Mitigations/controls/barriers**: Please describe any measure which could be used to prevent/detect LHD occurrence(s), or reduce their duration. Also, please describe existing barriers which could be improved.	
Procedures/LOAs – which could be non-existent, inappropriate, not strictly adhered to, or needed review	
Contributing factors/causes	**Mitigations/controls/barriers**
Human Factor Issues – ex. fatigue, workload, competency, English proficiency, teamwork, situational awareness	
Contributing factors/causes	**Mitigations/controls/barriers**
Systems/Equipment – ex. equipment failures, unserviceability, usability, reliability, poor design	
Contributing factors/causes	**Mitigations/controls/barriers**
Other Factors – ex. training, staffing, clearly defined roles and responsibilities, workplace condition, weather	
Contributing factors/causes	**Mitigations/controls/barriers**

APPENDIX G – LHD PREVENTATIVE/MITIGATION MEASURES FORM (FORM B)

Due to the continuing prevalence of LHDs, States are urged to provide a list of measures planned or taken to minimize LHDs (including detection of LHD occurrences and actions taken to reduce LHD duration). Please list all actions planned or taken by your organization, including comments on their effectiveness.

1. Organization:

2. Date of analysis:

3. Hotspot/Area (example: eastern boundary of FIR A):

4. Please provide detailed description of the followings:

No.	Preventive/mitigation measures planned/taken	Target/actual effective date	Progresses/difficulties	Comments on effectiveness of mitigations
1				
2				
3				
4				
5				
6				

5. Is there anything the RMA/RASMAG/ICAO can assist with related to LHDs?