



International Civil Aviation Organization

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

Pattaya, Thailand, 27 – 30 May 2014

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

AAMA RVSM SAFETY ASSESSMENT REPORT

(Presented by Australia)

SUMMARY

This paper presents the results of safety assessments undertaken by the Australian Airspace Monitoring Agency (AAMA) for the twelve month period ending 31 December 2013. The assessments cover the Brisbane, Honiara, Jakarta, Melbourne, Nauru, Port Moresby and Ujung Pandang FIRs.

1. INTRODUCTION

1.1 This paper provides details of the airspace safety oversight assessment undertaken by the AAMA for the RVSM implementations in the Australian, Nauru, Papua New Guinea and Solomon Islands RVSM airspace as well as for the Indonesian airspace. The full reports are detailed in **Attachments A and B**.

2. DISCUSSION

2.1 The report shows that for the Australian, Nauru, Papua New Guinea and Solomon Islands airspace, the target level of safety (TLS) was met. This indicates a positive change from the last report to RASMAG/18 where the TLS was not being met in the airspace.

2.2 Since the completion of the assessments provided with this paper, the AAMA has completed further assessments for each month to the end of April 2014 for the Australian, Nauru, Papua New Guinea and Solomon Islands airspace. These assessments show that the assessed risk for that period remains below the TLS.

2.3 The AAMA reports a monthly risk value in an attempt to provide real-time information on actual risk without reliance on historical high-time errors resident within the 12 month data sample. Figure 1 below shows the monthly risk for December 2013 as 1.51×10^{-9} which is above the average monthly risk which gives an annual risk of 5.0×10^{-9} . The increased monthly risk was the result of a single Category D LHD that was the result of an incorrect read-back of a level assignment by an aircrew that was uncorrected by ATC. The duration of the occurrence was assessed as 10 minutes.

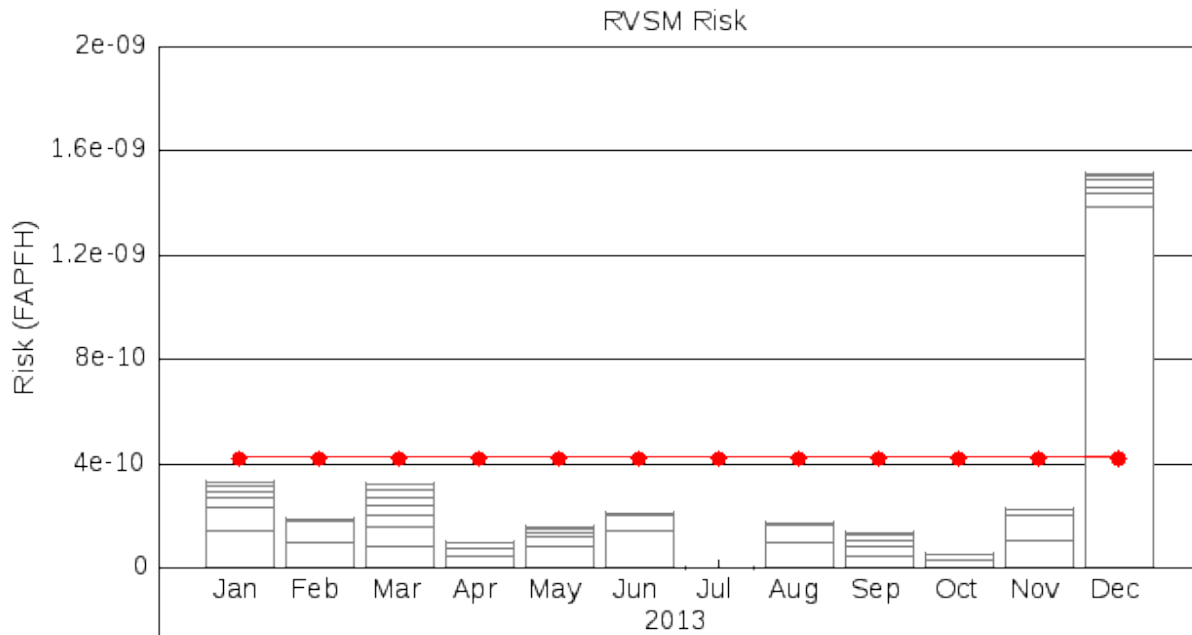


Figure 1: Monthly Assessed Risk

2.4 The assessment for the Indonesian Airspace shows the TLS continues to be met. Table 4 shows a high proportion of Category E LHD reports, and Figure 5 shows that many of these occurrences are located in a single geographic location at the boundary between the Jakarta and Ujung Pandang FIRs near ANY near Surabaya. The AAMA continues to monitor and highlight these occurrences to Indonesian authorities.

Executive Summary - Australian Nauru, Papua New Guinea and Solomon Islands airspace

2.5 **Table 1** summarizes Australian, Nauru, Papua New Guinea and Solomon Islands airspace RVSM technical, operational, and total risks. **Figure 2** presents collision risk estimate trends during the period from 1 January 2013 to 31 December 2013.

Australian, Nauru, Papua New Guinea and Solomon Islands Airspace – estimated annual flying hours = 599,990.50 hours <i>(note: estimated hours based on Dec 2011 traffic sample data)</i>			
Source of Risk	Risk Estimation	TLS	Remarks
<i>RASMAG 18 Total Risk</i>	8.82×10^{-9}	5.0×10^{-9}	<i>Above TLS</i>
Technical Risk	0.0255×10^{-9}	2.5×10^{-9}	Below Technical TLS
Operational Risk	3.40×10^{-9}	-	-
Total Risk	3.43×10^{-9}	5.0×10^{-9}	Below TLS

Table 1: Australian, Nauru, Papua New Guinea and Solomon Islands Airspace RVSM Risk Estimates

Figure 2: Australian, Nauru, Papua New Guinea and Solomon Islands Airspace RVSM Risk Estimate Trends

2.6 **Table 2** presents a summary of the LHD causes within Australian, Nauru, Papua New Guinea and Solomon Islands airspace from 1 January 2013 until 31 December 2013.

Code	LHD Category Description	No.
A	Flight crew fails to climb or descend the aircraft as cleared	12
B	Flight crew climbing or descending without ATC clearance	14
C	Incorrect operation or interpretation of airborne equipment	0
D	ATC system loop error	8
E	ATC transfer of control coordination errors due to human factors	23
F	ATC transfer of control coordination errors due to technical issues	0
G	Aircraft contingency leading to sudden inability to maintain level	1
H	Airborne equipment failure and unintentional or undetected level change	1
I	Turbulence or other weather related cause	1
J	TCAS resolution advisory and flight crew correctly responds	0
K	TCAS resolution advisory and flight crew incorrectly responds	0
L	An aircraft being provided with RVSM separation is not RVSM approved	0
M	Other	1
Total		61

Table 2: Summary of LHD Causes within Australian, Nauru, Papua New Guinea and Solomon Islands Airspace

2.7 **Figure 3** provides the geographic location of risk bearing LHD reports within Australian, Nauru, Papua New Guinea and Solomon Islands Airspace during the assessment period.

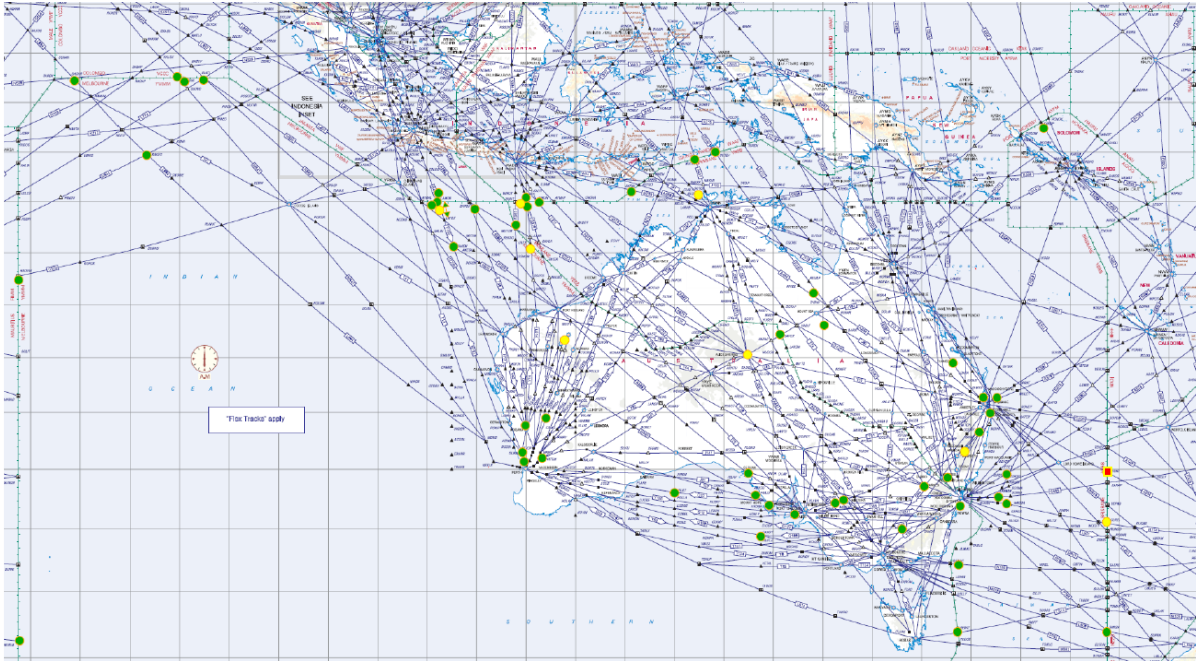


Figure 3: Australian, Nauru, Papua New Guinea and Solomon Islands Airspace – Risk Bearing LHD

Executive Summary- Indonesian airspace

2.8 **Table 3** summarizes Indonesian airspace RVSM technical, operational, and total risks. **Figure 4** presents collision risk estimate trends during the period from 1 January 2013 to 31 December 2013.

Indonesian Airspace – estimated annual flying hours = 761390 hours <i>(note: estimated hours based on Dec 2012 traffic sample data)</i>			
Source of Risk	Risk Estimation	TLS	Remarks
<i>RASMAG 18 Total Risk</i>	1.81×10^{-9}	5.0×10^{-9}	<i>Below TLS</i>
Technical Risk	0.134×10^{-9}	2.5×10^{-9}	Below Technical TLS
Operational Risk	3.68×10^{-9}	-	-
Total Risk	3.82×10^{-9}	5.0×10^{-9}	Below TLS

Table 3: Indonesian Airspace RVSM Risk Estimates

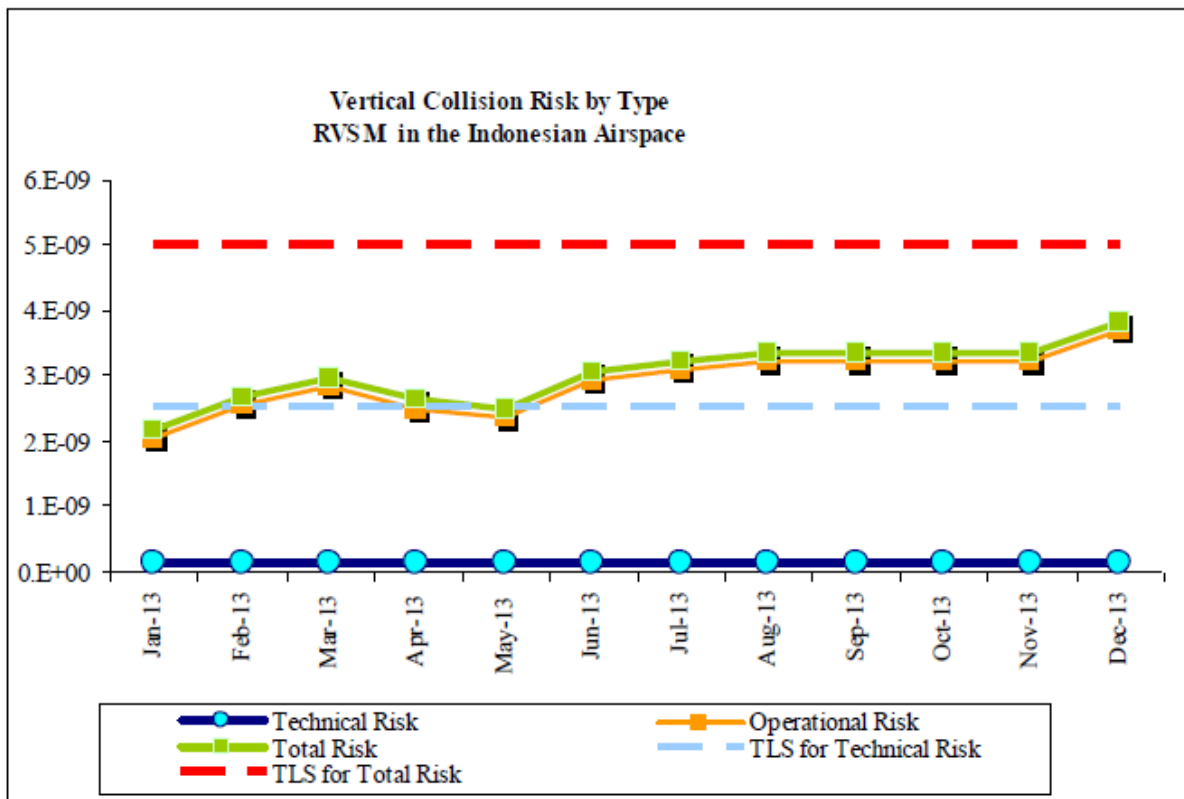


Figure 4: Indonesian Airspace RVSM Risk Estimate Trends

2.9 **Table 4** presents a summary of the LHD causes within Indonesian airspace from 1 January 2013 until 31 December 2013.

Code	LHD Category Description	No.
A	Flight crew fails to climb or descend the aircraft as cleared	8
B	Flight crew climbing or descending without ATC clearance	1
C	Incorrect operation or interpretation of airborne equipment	0
D	ATC system loop error	3
E	ATC transfer of control coordination errors due to human factors	30
F	ATC transfer of control coordination errors due to technical issues	0
G	Aircraft contingency leading to sudden inability to maintain level	0
H	Airborne equipment failure and unintentional or undetected level change	0
I	Turbulence or other weather related cause	0
J	TCAS resolution advisory and flight crew correctly responds	1
K	TCAS resolution advisory and flight crew incorrectly responds	0
L	An aircraft being provided with RVSM separation is not RVSM approved	0
M	Other	2
Total		45

Table 4: Summary of LHD Causes within Indonesian Airspace

2.10 **Figure 5** provides the geographic location of risk bearing LHD reports within Indonesian Airspace during the assessment period.

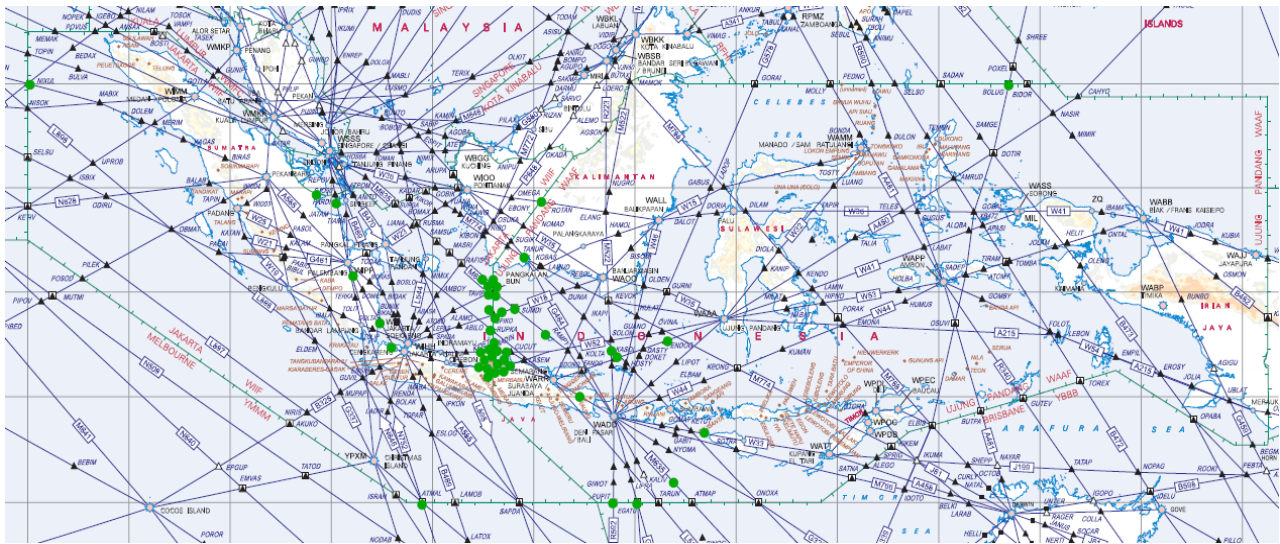


Figure 5: Indonesian Airspace – Risk Bearing LHD

3. ACTION BY THE MEETING

3.1 The meeting is invited to:

- a) note the information contained in this paper; and
- b) discuss the results of the airspace safety oversight presented in this working paper and the attached documentation..

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AUSTRALIAN AIRSPACE MONITORING AGENCY (AAMA)



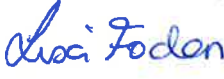


**Airspace Safety Review of RVSM
in
Indonesian Airspace
January to December 2013**

AUSTRALIAN AIRSPACE MONITORING AGENCY (AAMA)



**Airspace Safety Review of RVSM in
Australian, Nauru, Papua New Guinea and
Solomon Islands Airspace
January 2013 to December 2013**

Role	Name and Position	Signature and Date
Prepared By	Robert Butcher Operational Analysis Manager	 5/2/14
	& Dr Geoff Aldis Quantitative Modelling Specialist	 10/2/14
Reviewed By	Lisa Foden A/Team Leader, Safety Data and Analysis	 10/2/14

Executive Summary

For the period 1 January 2013 to 31 December 2013 inclusive, the total risk meets the agreed Target Level of Safety (TLS) value of 5.0×10^{-9} . **Table A** summarises RVSM technical, operational and total risks. **Figure A** presents collision risk estimate trends.

Australian, Nauru, Papua New Guinea and Solomon Islands RVSM Airspace – estimated annual flying hours = 599,990.50 hours (note: estimated hours based on December 2011 traffic sample data)			
Source of Risk	Risk Estimation	TLS	Remarks
Technical Risk	0.0255×10^{-9}	2.5×10^{-9}	Below Technical TLS
Operational Risk	3.40×10^{-9}	-	-
Total Risk	3.43×10^{-9}	5.0×10^{-9}	Below Overall TLS

Table A: Australian, Nauru, Papua New Guinea and Solomon Islands Airspace RVSM Risk Estimates

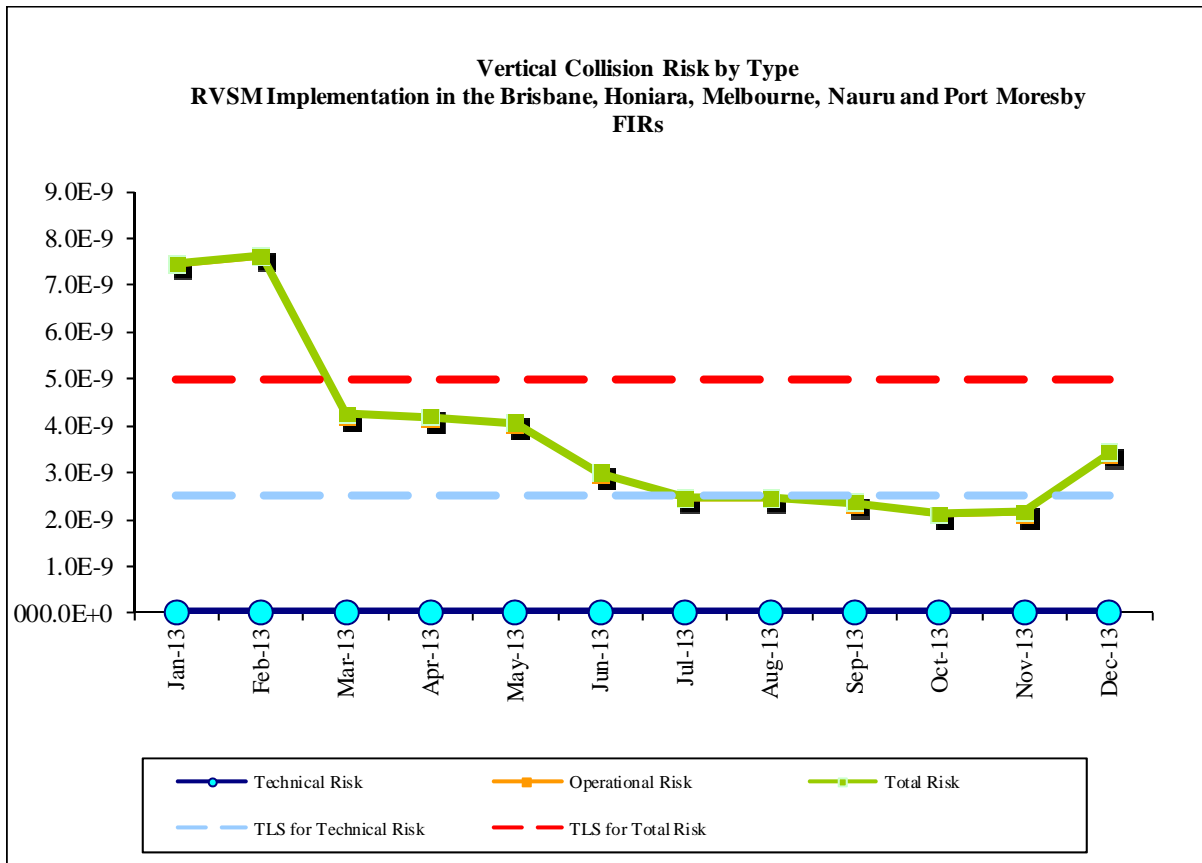


Figure A: RVSM Risk Estimate Trends

**AIRSPACE SAFETY REVIEW OF THE RVSM IMPLEMENTATION IN
AUSTRALIAN, NAURU, PAPUA NEW GUINEA AND SOLOMON ISLANDS
AIRSPACE
JANUARY 2013 TO DECEMBER 2013**

Prepared by
Australian Airspace Monitoring Agency (AAMA) – February 2014
(An ICAO APANPIRG approved Regional Monitoring Agency)

1. Introduction

1.1 This report provides an airspace safety review of RVSM airspace risk in the Brisbane, Honiara, Melbourne, Nauru and Port Moresby Flight Information Regions (FIRs). The review is undertaken monthly using a twelve month data sample period.

2. Data Sources

2.1 **Traffic Sample Data (TSD).** A TSD covering four weeks of the month of December 2011 of aircraft operating in the Brisbane, Honiara, Melbourne, Nauru and Port Moresby FIRs was used as required by ICAO Regional agreement.

2.2 **Large Height Deviation (LHD).** A cumulative 12-month data set of LHD reports was used, covering January 2013 to December 2013. **Table 1** indicates those FIRs which submitted LHD reports including nil returns. **Appendix A** provides details of LHD reports.

FIR Name	Brisbane	Honiara	Melbourne	Nauru	Port Moresby
January 2013	✓	✓	✓	✓	
February 2013	✓	✓	✓	✓	
March 2013	✓	✓	✓	✓	
April 2013	✓	✓	✓	✓	
May 2013	✓	✓	✓	✓	
June 2013	✓	✓	✓	✓	
July 2013	✓	✓	✓	✓	
August 2013	✓	✓	✓	✓	
September 2013	✓	✓	✓	✓	
October 2013	✓	✓	✓	✓	
November 2013	✓	✓	✓	✓	
December 2013	✓	✓	✓	✓	

Table 1: Summary of LHD Reports submitted by FIRs

3. Summary of LHD Occurrences

3.1 **Table 2** and **Figure 2** summarise the number of LHD occurrences assessed and associated LHD duration (in minutes) or number of levels crossed, by month from 1 January 2013 to 31 December 2013 inclusive.

Month-Year	No. of Non-NIL LHD	LHD Duration (Min)	No. Levels Crossed
2013			
January	6	6.0	2
February	3	14.0	1
March	7	11.5	3
April	5	32.0	3
May	9	7.5	5
June	3	2.0	4
July	1	3.0	0
August	4	5.5	0
September	7	1.0	5
October	2	2.0	1
November	5	7.0	2
December	9	20.0	8
Total	61	111.5	34

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

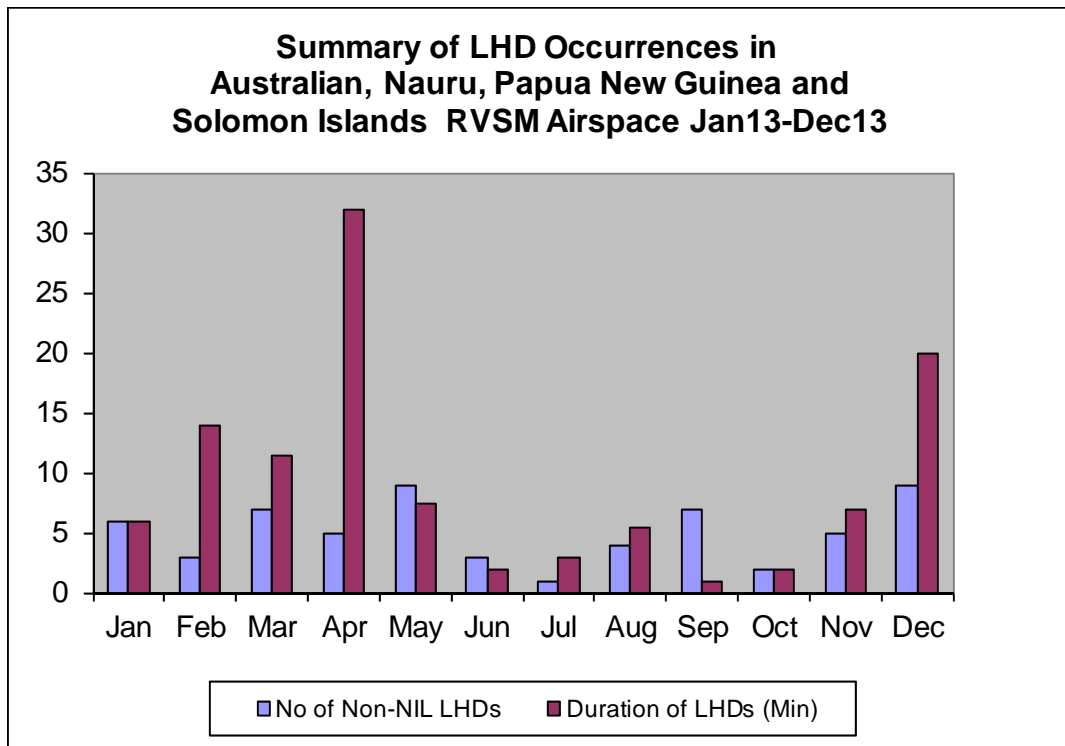


Figure 2: Summary of LHD Occurrences (by Month)

3.2 Nine non-Nil LHDs were reported for the month of December which is an increase from the previous month. The total assessed risk duration almost tripled compared to the previous month. (See Table 2 and Figure 2).

3.3 **Table 3** and **Figure 3** summarise the number of LHD occurrences, the associated LHD duration (in minutes) and number of flight levels crossed without clearance, by LHD category from 1 January 2013 to 31 December 2013 inclusive.

LHD Category Code	LHD Category Description	No. of LHD Occurrences	LHD Duration (Min)	No. levels crossed without clearance
A	Flight crew failing to climb/descend the aircraft as cleared	12	14	8
B	Flight crew climbing/descending without ATC Clearance	14	5	9
C	Incorrect operation or interpretation of airborne equipment (e.g. incorrect operation of fully functional FMS, incorrect transcription of ATC clearance or re-clearance, flight plan followed rather than ATC clearance, original clearance followed instead of re-clearance etc)	0	0	0
D	ATC system loop error; (e.g. ATC issues incorrect clearance or flight crew misunderstands clearance message)	8	12.5	5
E	Coordination errors in the ATC to ATC transfer or control responsibility as a result of human factors issues (e.g. late or non-existent coordination, incorrect time estimate/actual, flight level, ATS route etc not in accordance with agreed parameters)	23	78	4
F	Coordination errors in the ATC to ATC transfer or control responsibility as a result of equipment outage or technical issues	0	0	0
G	Deviation due to aircraft contingency event leading to sudden inability to maintain assigned flight level (e.g. pressurization failure, engine failure)	1	0	6
H	Deviation due to airborne equipment failure leading to unintentional or undetected change of flight level	1	0	1

I	Deviation due to turbulence or other weather related cause	1	0	1
J	Deviation due to TCAS resolution advisory, flight crew correctly following the resolution advisory	0	0	0
K	Deviation due to TCAS resolution advisory, flight crew incorrectly following the resolution advisory	0	0	0
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)	0	0	0
M	Other – this includes situations of flights operating (including climbing/descending) in airspace where flight crews are unable to establish normal air-ground communications with the responsible ATS unit.	1	2	0
Total		61	111.5	34

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

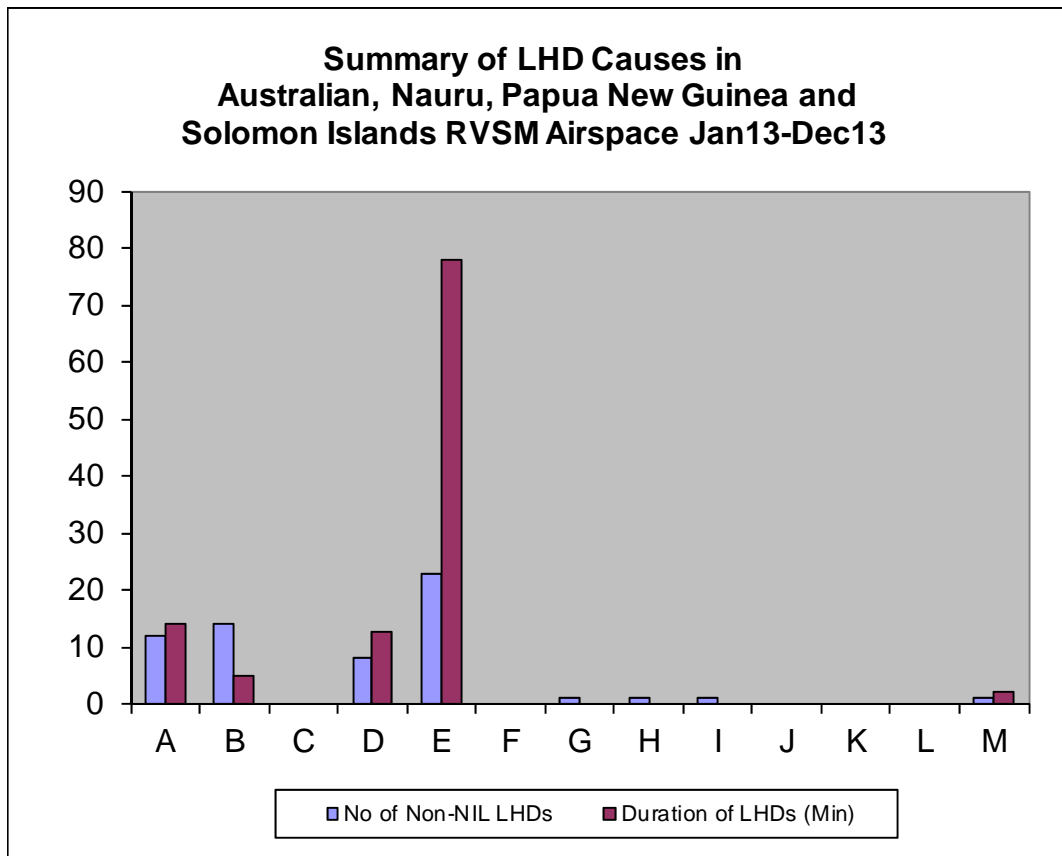


Figure 3: Summary of LHD Causes

3.4 One report was classified as Category A (Flight crew failing to climb/descend the aircraft as cleared). ATS-0125642 was filed by UAS South-Bight and involved an aircraft climbing through its cleared level by 300 feet. The risk was assessed as 0.5 minute duration.

3.5 Three reports were classified as Category B (Flight crew climbing/descending without ATC clearance). ATS-0125540 was filed by UAS North-UAS East and involved an aircraft climbing 600 feet above a block clearance. The risk was assessed in terms of 1 level crossed. ATS-0125649 was filed by UAS North – Tops and involved an aircraft climbing 600 feet above its cleared level. The risk was assessed as 0.5 minutes. ATS-0125817 was filed by ECSN Enroute – Byron and involved an aircraft descending without a clearance to do so. The aircraft descended 500 feet before returning to its assigned level. The risk was assessed as 1 level crossed.

3.6 One report, ATS-0126115, was classified as Category D (ATC system loop error) and was filed by UAS North – UAS East. The occurrence involved an incorrect readback of an assigned level by the flight crew, which was not corrected by the controller. The risk was assessed as 10 minutes duration.

3.7 Three Category E (Coordination errors) reports were assessed. ATS-0125538 was filed by UAS South - West and involved a level coordination error by a foreign ANSP. The risk was assessed as 3 minutes duration. ATS-0125554 was also filed by UAS South – West and involved an incorrect flight level coordination between sectors. The risk was assessed as 3 minutes duration. A third report, ATS-0125952 was filed by UAS North –

Tops and involved a crew not complying with an amended flight level as coordinated. The risk was assessed as 3 minutes duration.

3.8 One Category G (Contingency event leading to sudden inability to maintain assigned level) report was assessed. ATS-0125954 was filed by UAS South - West and involved an aircraft conducting an emergency descent from FL350 to A100. The risk was assessed in terms of 6 levels crossed.

3.9 **Appendix B** provides a visual picture of the geographic location of all risk bearing (non-NIL) LHD reports within the rolling 12 month data set. Each report is identified as a coloured dot. Reports assessed as being high risk during the current month of this report are identified as a red dot or a line showing approximate distance that equates to the assessed duration. The picture is intended to provide a means to identify specific risk hot spots related to RVSM operations.

4. Risk Assessment and Safety Oversight

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

Parameter	Description	Value
λ_x	Average aircraft length	0.0231 NM DOM (Uni-directional) 0.0280 NM DOM (Bi-directional) 0.0344 NM IND 0.0264 NM TAS (Uni-directional) 0.0253 NM TAS (Bi-directional)
λ_y	Average aircraft wingspan	0.0204 NM DOM (Uni-directional) 0.0255 NM DOM (Bi-directional) 0.0317 NM IND 0.0242 NM TAS (Uni-directional) 0.0226 NM TAS (Bi-directional)
λ_z	Average aircraft height	0.0069 NM DOM (Uni-directional) 0.0080 NM DOM (Bi-directional) 0.0094 NM IND 0.0079 NM TAS (Uni-directional) 0.0076 NM TAS (Bi-directional)
$ \Delta V $	Average relative same-direction speed	21.6 kt DOM (Uni-directional) 21.0 kt DOM (Bi-directional) 12.2 kt IND 15.3 kt TAS (Uni-directional) 22.1 kt TAS (Bi-directional)
$ \bar{V} $	Average aircraft speed	443.9 kt DOM (Uni-directional) 466.7 kt DOM (Bi-directional) 479.8 kt IND 453.4 kt TAS (Uni-directional) 457.8 kt TAS (Bi-directional)
$ \dot{y} $	Average relative cross-track speed	13 kt
$ \dot{z} $	Average relative vertical speed during loss of vertical separation	1.5 kt if aircraft in level flight, 10 kt otherwise

$P_z(0)$	Probability two aircraft at the same nominal level are in vertical overlap	0.358 DOM (Uni-directional) 0.412 DOM (Bi-directional) 0.484 IND 0.408 TAS (Uni-directional) 0.390 TAS (Bi-directional)
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Table 5: Estimates of the Parameters in the CRM

4.2 **Risk Estimation Results.** The results for the technical, operational, and total risk for the RVSM implementation are detailed in **Table 6**. The technical risk meets the agreed TLS value of no more than 2.5×10^{-9} fatal accidents per flight hour due to the loss of a correctly established vertical separation standard of 1,000 ft and to all causes. **The operational and weighted total risk meets the specified TLS value** for these components of 5.0×10^{-9} .

Australian, Nauru, Papua New Guinea and Solomon Islands RVSM Airspace – estimated annual flying hours = 599,990.50 hours (note: estimated hours based on December 2011 traffic sample data)			
Source of Risk	Risk Estimation	TLS	Remarks
Technical Risk	0.0255×10^{-9}	2.5×10^{-9}	Below Technical TLS
Operational Risk	3.40×10^{-9}	-	-
Total Risk	3.43×10^{-9}	5.0×10^{-9}	Below Overall TLS

Table 6: Australian, Nauru, Papua New Guinea and Solomon Islands Airspace RVSM Risk Estimates

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

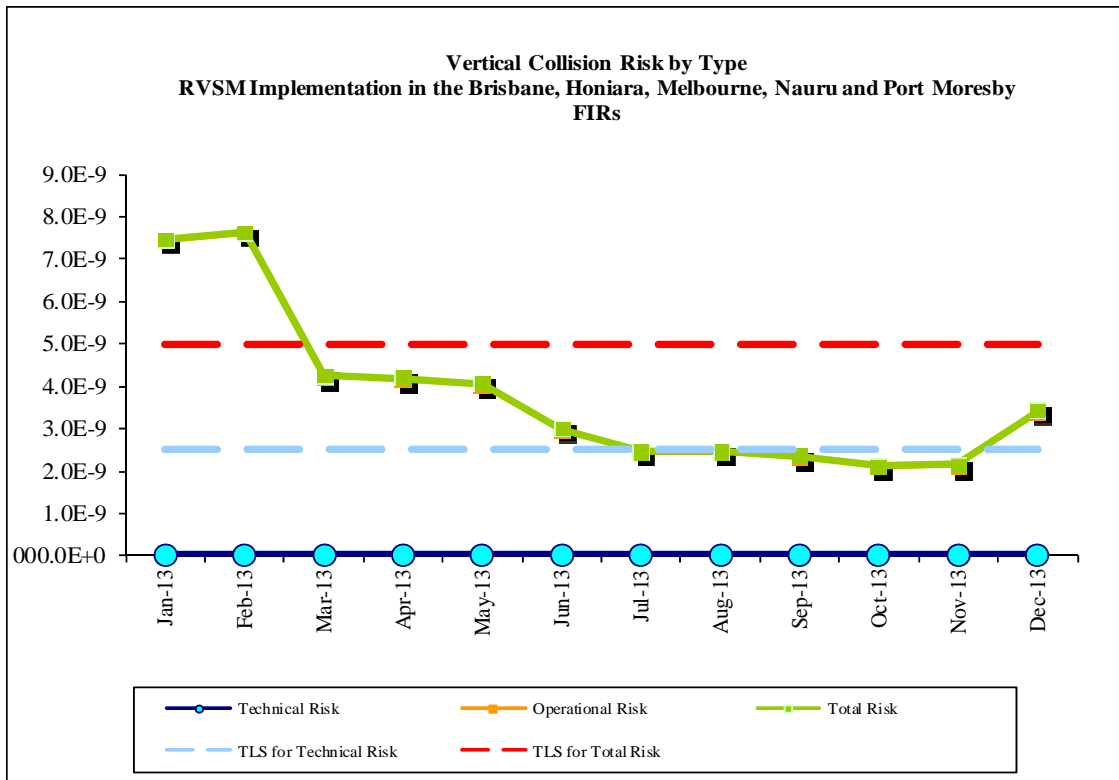


Figure 5: Trends of Risk Estimates for RVSM Airspace

4.3 A monthly LHD risk value is determined to provide real-time information on actual risk without reliance on historical high-time errors resident within the 12 month data sample. The data in **Figure 6** below shows the monthly risk for December 2013 as 1.51×10^{-9} which is above the average monthly risk of the annual risk of 5.0×10^{-9} (red line in Figure 6 below). The high risk occurrence involved a risk duration of 10 minutes.

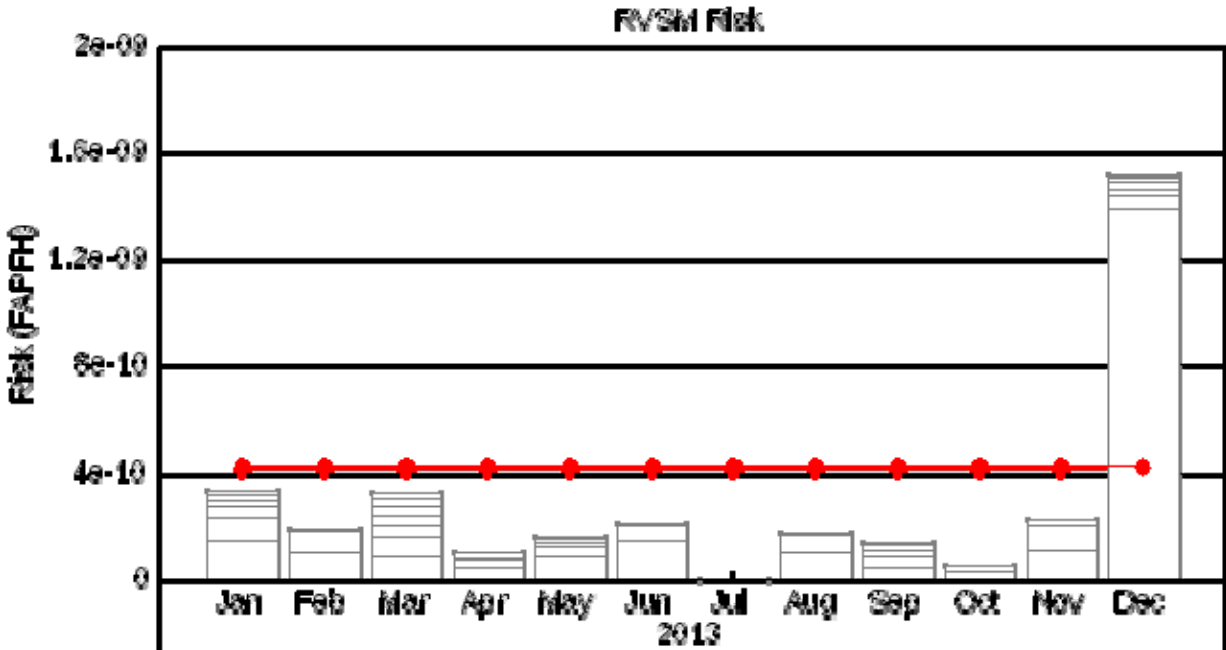


Figure 6: Monthly LHD Risk Estimates for the Australian, Nauru, Papua New Guinea and Solomon Islands RVSM Airspace.
(Red line is the average monthly value for an annual risk of 5.0×10^{-9} . Risk is measured in Fatal Accidents per Flight Hour (FAPFH).)

5. Additional analysis.

5.1 The graph shown at **Figure 7** below indicates the risk contribution from each of the areas assessed by the AAMA for the Australian FIRs. The percentage distribution remains stable.

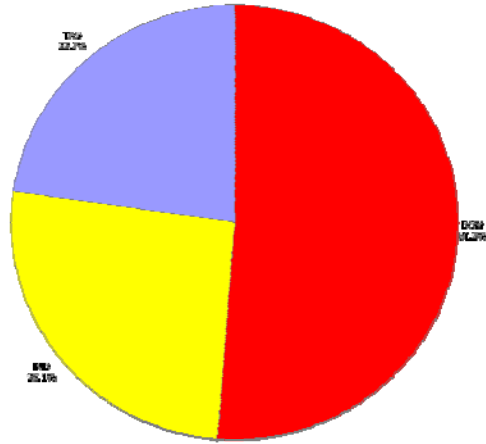


Figure 7: Risk Contribution by Traffic Region

5.2 **Figure 8** identifies the risk contribution by attribution for the operational errors and large height deviations in the twelve month data sample. The risk pattern shows Airservices ATC at 48% as the highest contributor to risk which is a significant change from the previous report where Foreign ATC was the highest contributor.

Risk Contribution by Attribution January 2013 to December 2013

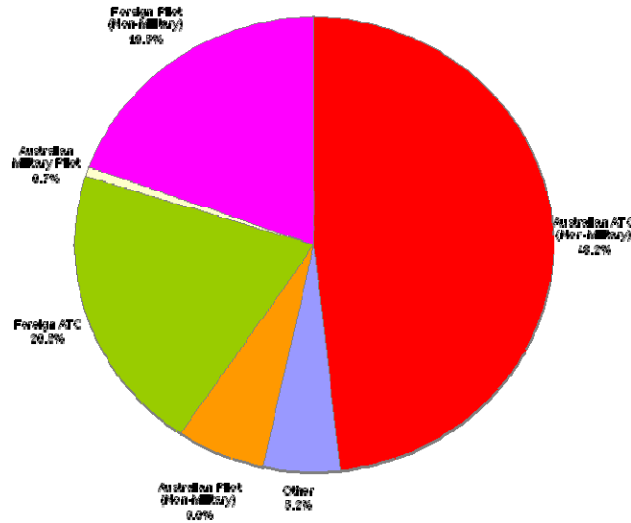


Figure 8: Risk Contribution by Attribution

6. Long Term Height-keeping Monitoring (LTHM)

6.1 To meet the ICAO Annex 6 LTHM requirements, the AAMA undertakes a monitoring program. The current monitoring burden data for Australia, Papua New Guinea and the Solomon Islands is detailed in **Table 7** below.

State	Total RVSM Approved Airframes	Resultant Monitoring Burden	Total Airframes Remaining to be Monitored
Australia	546	183	43
Papua New Guinea	7	6	2
Solomon Islands	1	1	1

Table 7: LTHM Burden

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Appendix A to AIRSPACE SAFETY REVIEW
Details of the Reported LHD Events

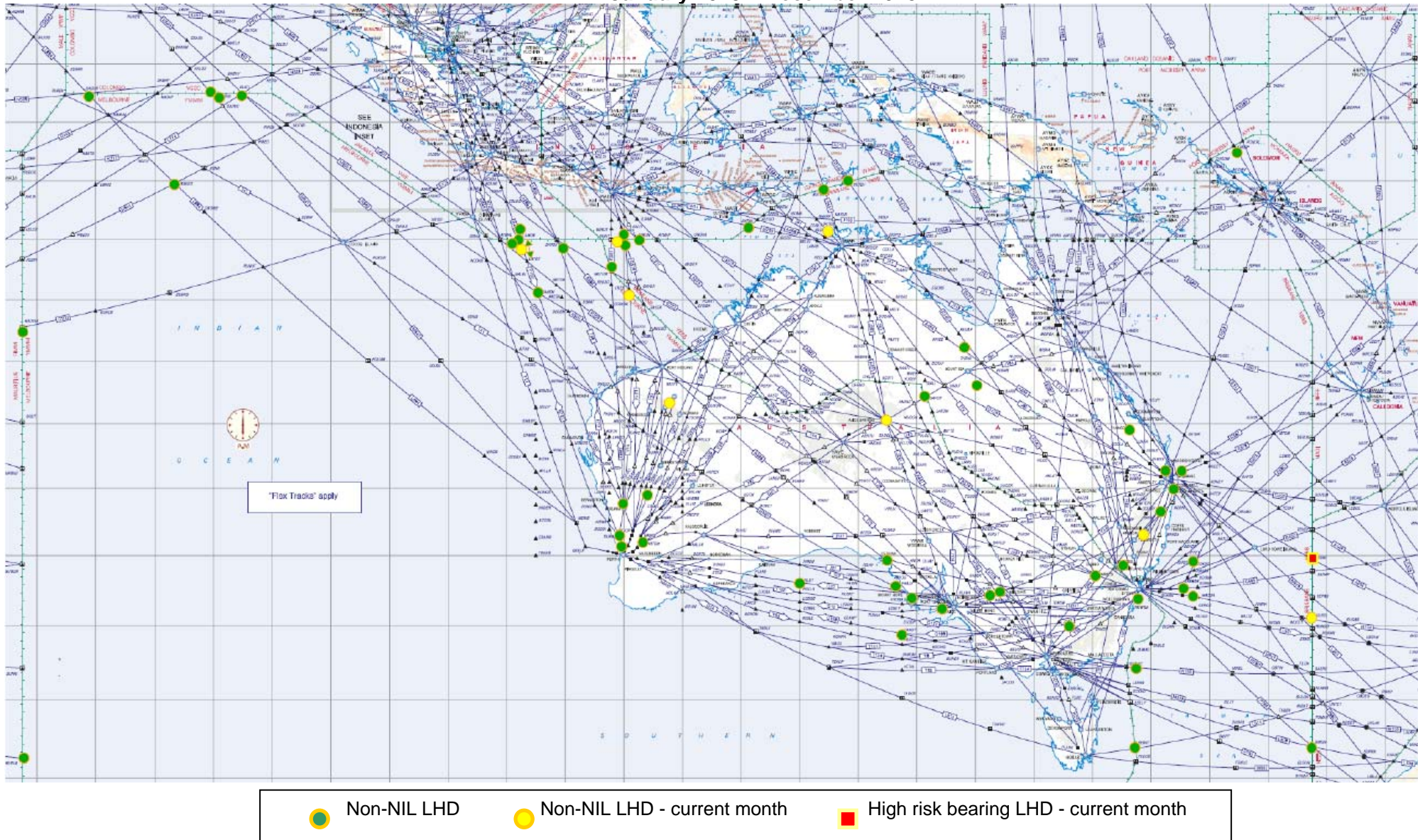
LHD date	Source	Assigned FL	Observed/ Reported FL	Duration at Incorrect FL	Cause	Category /Sub category
January 2013	Airservices	FL360	FL345	1 min	Aircraft failed to reach required level	A
January 2013	Airservices	FL340-FL350	FL356	1 level crossed	Aircraft operated outside block assigned	B
January 2013	Airservices	FL390	FL386	1 min	Aircraft failed to reach required level	B
January 2013	Airservices	FL350	FL340	1 level crossed	Loss of separation as aircraft climbed through level of other aircraft.	D
January 2013	Airservices	FL390	FL330	3 min	Coordination error by foreign ATS	E
January 2013	Airservices	FL390	FL307	1 min	Aircraft not maintaining level as required by coordination	E
February 2013	Airservices	FL320-FL340	FL300	11 min	Aircraft did not climb to operate in block as cleared	A
February 2013	Airservices	FL350	FL310	3 min	Failure by foreign ATS to correct incorrect level readback	E
February 2013	Airservices	FL390	FL400	1 level crossed	Autopilot failure	H
March 2013	Airservices	FL310	BLW FL310	1 level crossed	Aircraft descended below assigned level	A
March 2013	Airservices	FL370	FL350	2 levels crossed	Aircraft could not make level requirement by time	A
March 2013	Airservices	FL290	FL310	0.5 min	Incorrect CFL displayed which activated CLAM	E
March 2013	Airservices	FL320-FL340	FL320-FL360	3 min	Failure by foreign ATS to correct incorrect level readback	E
March 2013	Airservices	UNK	UNK	3 min	No coordination from foreign ATS	E
March 2013	Airservices	FL390	FL370	3 min	Coordination error by foreign ATS	E
March 2013	Airservices	FL310	FL370	2 min	Coordination error by foreign ATS	E
April 2013	Airservices	FL370	Descending	1 level crossed	Aircraft commenced descent without clearance	B
April 2013	Airservices	FL350	FL354	1 level crossed	Aircraft climbed without clearance	B
April 2013	Airservices	FL310	Descending	1 level crossed	Aircraft commenced descent without clearance	B
April 2013	Airservices	FL340	FL360	3 min	Coordination error by foreign ATS	E
April 2013	Airservices	FL330	FL310	29 min	Coordination error by foreign ATS	E
May 2013	Airservices	FL320	Climbing	1 level crossed	Aircraft climbed above cleared level	A
May 2013	Airservices	FL310	Descending	1 level crossed	Aircraft commenced descent without clearance	A
May 2013	Airservices	FL350	Descending	1 level	Aircraft descended through cleared level in holding pattern	A




				crossed		
May 2013	Airservices	FL360	FL365	1 level crossed	Aircraft climbed through level set in CFL although cleared to FL370	D
May 2013	Airservices	FL300	FL303	1 level crossed	Controller did not correct read back error	D
May 2013	Airservices	Descending	Descending	1 min	Loss of separation with aircraft outside holding pattern	D
May 2013	Airservices	FL340	FL320	3 min	Foreign ATS failed to climb aircraft as coordinated	E
May 2013	Airservices	FL340	FL350	0.5 min	Coordination error by foreign ATS	E
May 2013	Airservices	UNK	UNK	3 min	No coordination from foreign ATS	E
June 2013	Airservices	FL280	FL326	4 levels crossed	Incorrect CFL displayed	E
June 2013	Airservices	FL330	FL334	0.5 min	Pilot climbed to incorrect level. Hear back error by ATC.	A
June 2013	Airservices	FL380	FL385	1.5 min	Clearance confusion by crew due multiple level clearances issued	D
July 2013	Airservices	FL350	FL370	3 min	Coordination error by foreign ATS	E
August 2013	Airservices	FL350- FL390	FL395	2 min	Aircraft climbed above block level	B
August 2013	Airservices	FL400	On descent	0.5 min	Aircraft commenced descent without clearance	B
August 2013	Airservices	UNK	Descending	1 min	Aircraft descended without clearance	B
August 2013	Airservices	FL390	FL370	2 min	Coordination error by foreign ATS	E
September 2013	Airservices	FL350	FL355	1 level crossed	Aircraft climbed above cleared level	A
September 2013	Airservices	FL380	FL374	1 level crossed	Aircraft descended below cleared level	A
September 2013	Airservices	FL380	FL387	1 level crossed	Aircraft climbed without clearance	B
September 2013	Airservices	FL320	Above FL320	1 level crossed	Aircraft climbing to FL350 due to confusion by ATC as to cleared level	D
September 2013	Airservices	FL380	Above FL380	1 level crossed	Aircraft cleared to climb in error by ATC	D
September 2013	Airservices	FL370	FL360	0.5 min	CFL not updated to correct level. Wrong level coordinated.	E
September 2013	Airservices	FL370	FL360	0.5 min	Coordinated level requirement not passed to aircraft by foreign ATS.	E
October 2013	Airservices	FL330	Descending	1 level crossed	Aircraft commenced descent without clearance	B
October 2013	Airservices	FL360	FL360	2 min	Loss of separation between aircraft at same level due change in estimates	M
November 2013	Airservices	FL380	FL370	1 min	Loss of separation due aircraft not meeting level requirement	A
November 2013	Airservices	FL290	FL298	1 level crossed	Aircraft climbed through cleared level then descended below amended level	B
November 2013	Airservices	FL330	FL370	3 min	Coordination error by foreign ATS	E
November 2013	Airservices	FL350	FL370	3 min	Failure by foreign ATS to correct incorrect level readback	E
November 2013	Airservices	FL350-	FL344	1 level	Deviation due turbulence	I

		FL380		crossed		
December 2013	Airservices	FL300	FL303	0.5 min	Aircraft climbed above cleared level	A
December 2013	Airservices	FL340- FL360	FL366	1 level crossed	Aircraft climbed above block cleared level	B
December 2013	Airservices	FL380	FL386	0.5 min	Aircraft climbed above cleared level	B
December 2013	Airservices	FL370	FL365	1 level crossed	Aircraft descended without clearance	B
December 2013	Airservices	FL330	FL320	10 min	Pilot read back incorrect cleared level. Not corrected by ATC	D
December 2013	Airservices	FL350	FL370	3 min	Coordination error by foreign ATS	E
December 2013	Airservices	FL350	FL330	3 min	Coordination error by ATS	E
December 2013	Airservices	FL270	FL350	3 min	Non-ADSB exempt aircraft not adhering to amended clearance as coordinated and issued to foreign ATS	E
December 2013	Airservices	FL350	A100	6 levels crossed	Emergency descent	G

Appendix B to AIRSPACE SAFETY REVIEW

Brisbane, Honiara, Melbourne, Nauru and Port Moresby FIRs – Risk Bearing (Non-NIL) RVSM Large Height Deviations January 2013 – December 2013



Role	Name and Position	Signature and Date
Prepared By	Robert Butcher Operational Analysis Manager &	 5/5/14
	Dr Geoffrey Aldis Quantitative Modelling Specialist	 5/5/14
Reviewed By	Brian Dunlop Senior Safety Analyst	 5/5/14

Executive Summary

For the period 1 January 2013 to 31 December 2013 inclusive, the total risk meets the agreed Target Level of Safety (TLS) value of 5.0×10^{-9} . **Table A** summarises RVSM technical, operational and total risks. **Figure A** presents collision risk estimate trends.

Indonesian RVSM Airspace – estimated annual flying hours = 761390 hours (note: estimated hours based on Dec 2012 traffic sample data)			
Source of Risk	Risk Estimation	TLS	Remarks
Technical Risk	0.134×10^{-9}	2.5×10^{-9}	Below Technical TLS
Operational Risk	3.68×10^{-9}	-	-
Total Risk	3.82×10^{-9}	5.0×10^{-9}	Below TLS

Table A: Indonesian Airspace RVSM Risk Estimates

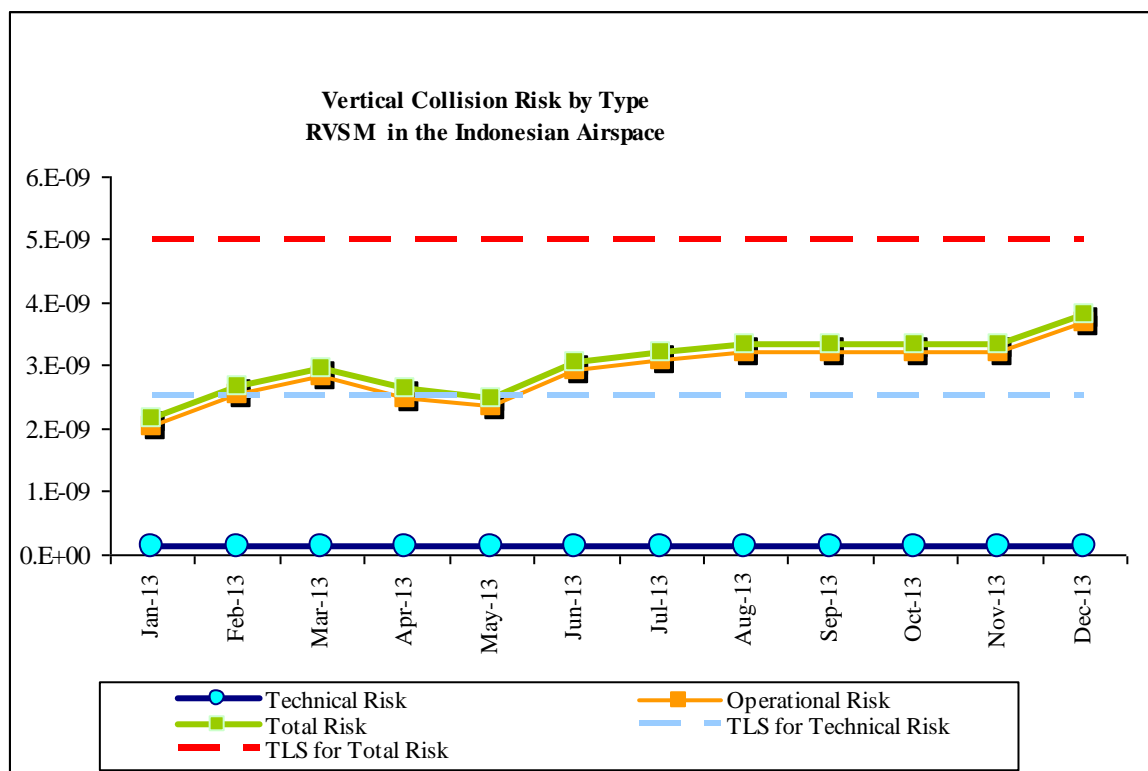


Figure A: RVSM Risk Estimate Trends

**AIRSPACE SAFETY REVIEW OF THE RVSM IMPLEMENTATION IN
INDONESIAN AIRSPACE
JANUARY 2013 TO DECEMBER 2013**

Prepared by

Australian Airspace Monitoring Agency (AAMA) - May 2014
(An ICAO APANPIRG approved Regional Monitoring Agency)

1. Introduction

This report provides an airspace safety review of RVSM airspace risk in the Jakarta and Ujung Pandang FIRs. The review is undertaken monthly using a twelve month data sample period.

2. Data Sources

2.1. Traffic Sample Data (TSD). A TSD covering four weeks of the month of December 2012 of aircraft operating in the Jakarta and Ujung Pandang FIRs was used as required by ICAO Regional agreement.

2.2. Large Height Deviation (LHD). A cumulative 12-month data set of LHD reports was used, covering January 2013 to December 2013. Additionally the AAMA has access to reports provided by other States or Regional Monitoring Agencies (RMAs) that included possible risk bearing LHDs relative to the Jakarta and Ujung Pandang FIRs. Assessment of these reports is made from the perspective of their impact within the Indonesian airspace. **Table 1** indicates those FIRs which submitted LHD reports including nil returns. **Appendix A** provides details of LHD reports.

FIR Name	Jakarta	Ujung
January 2013	✓	✓
February 2013	✓	✓
March 2013	✓	✓
April 2013	✓	✓
May 2013	✓	✓
June 2013	✓	✓
July 2013	✓	✓
August 2013	✓	✓
September 2013	X	✓
October 2013	X	✓
November 2013	X	✓
December 2013	X	✓

Table 1: Summary of LHD Reports submitted by FIRs

3. Summary of LHD Occurrences

3.1 **Table 2** and **Figure 2** summarise the number of LHD occurrences assessed and associated LHD duration (in minutes) or number of levels crossed, by month from 1 January 2013 – 31 December 2013 inclusive.

Month-Year	No. of Non-NIL LHD Occurrences	LHD Duration (Min)
2013		
January	3	4.5
February	6	12
March	6	7
April	2	10
May	4	9
June	4	11.5
July	6	1.5
August	4	1.5
September	0	0
October	0	0
November	1	0.5
December	0	0
Total	45	59.0

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

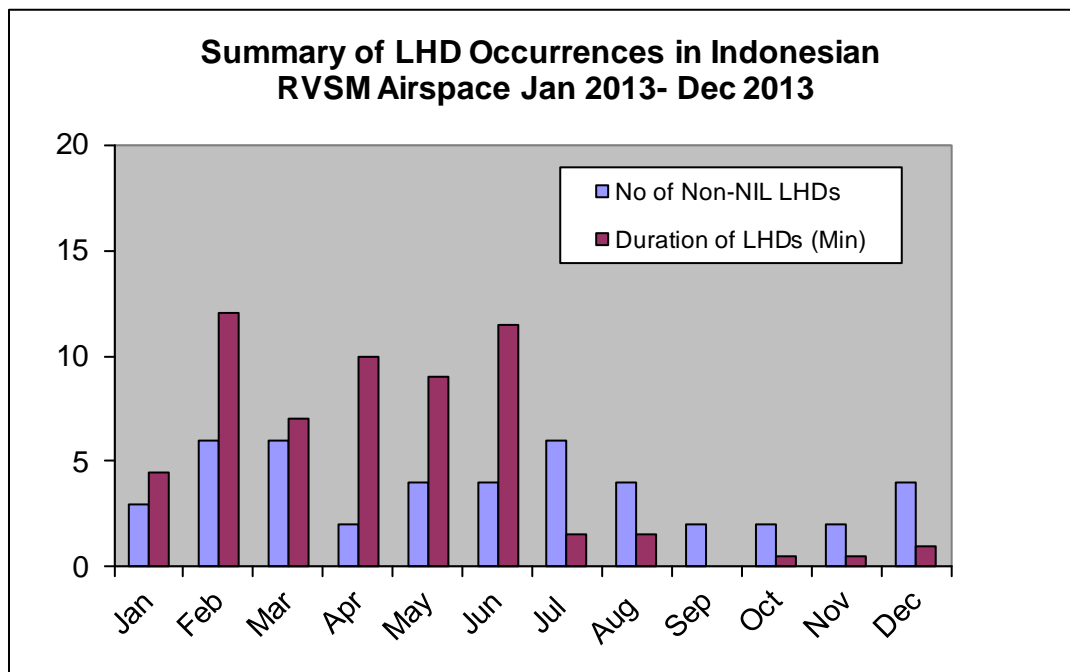


Figure 2: Summary of LHD Occurrences (by Month)

3.2 A total of 45 non-nil LHDs were reported during the 12 months period to end of December 2013. Notably 30 Category E (Coordination errors) were reported, the majority attributing errors to the Jakarta ACC.

3.3 **Table 3** and **Figure 3** summarise the number of LHD occurrences, the associated LHD duration (in minutes) and number of flight levels crossed without clearance, by LHD category from 1 January 2013 to 31 December 2013 inclusive.

LHD Category Code	LHD Category Description	No. of LHD Occurrences	LHD Duration (Min)	Levels Crossed
A	Flight crew failing to climb/descend the aircraft as cleared	8	0	13
B	Flight crew climbing/descending without ATC Clearance	1	0	1
C	Incorrect operation or interpretation of airborne equipment (e.g. incorrect operation of fully functional FMS, incorrect transcription of ATC clearance or re-clearance, flight plan followed rather than ATC clearance, original clearance followed instead of re-clearance etc)	0	0	0
D	ATC system loop error; (e.g. ATC issues incorrect clearance or flight crew misunderstands clearance message)	3	0	3
E	Coordination errors in the ATC to ATC transfer or control responsibility as a result of human factors issues (e.g. late or non-existent coordination, incorrect time estimate/actual, flight level, ATS route etc not in accordance with agreed parameters)	30	51	0
F	Coordination errors in the ATC to ATC transfer or control responsibility as a result of equipment outage or technical issues	0	0	0
G	Deviation due to aircraft contingency event leading to sudden inability to maintain assigned flight level (e.g. pressurization failure, engine failure)	0	0	0
H	Deviation due to airborne equipment failure leading to unintentional or undetected change of flight level	0	0	0
I	Deviation due to turbulence or other weather related cause	0	0	0
J	Deviation due to TCAS resolution advisory, flight crew correctly following the resolution advisory	1	0	2
K	Deviation due to TCAS resolution advisory, flight crew incorrectly following the resolution advisory	0	0	0
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)	0	0	0
M	Other – this includes situations of flights operating (including climbing/descending) in airspace where flight crews are unable to establish normal air-ground communications with the responsible ATS unit.	2	8	0
	Total	45	59	19

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

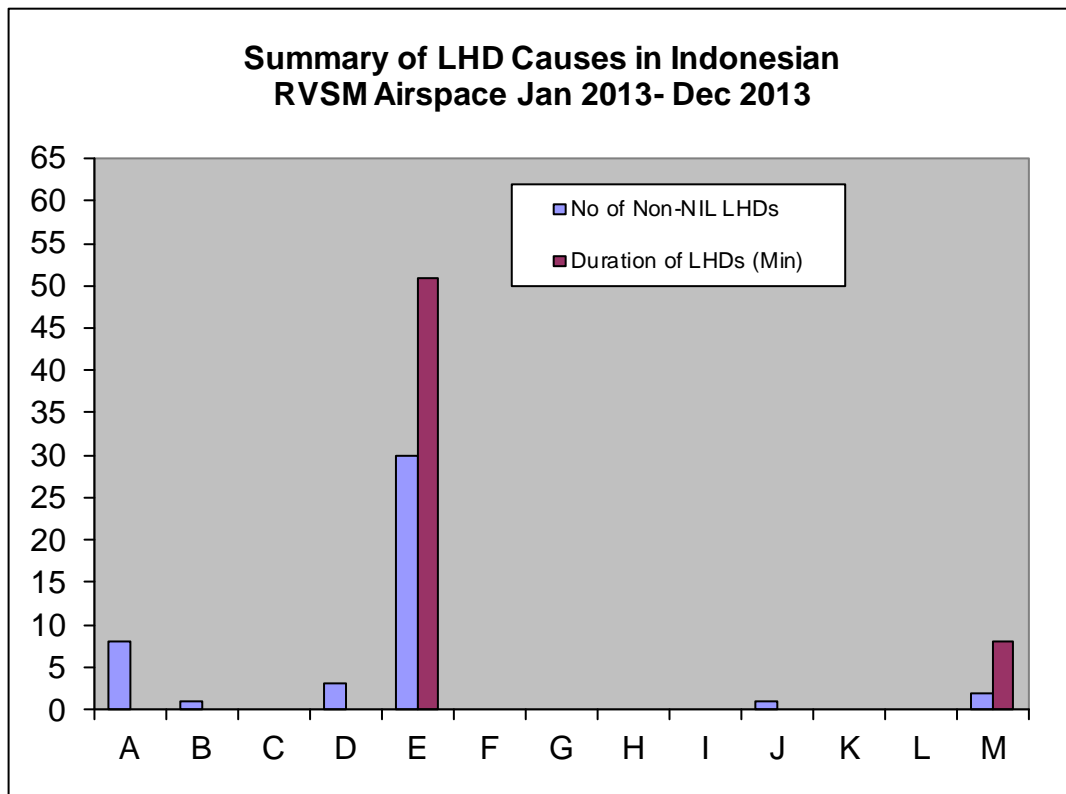


Figure 3: Summary of LHD Causes

3.4 Eight non-nil Category A (Flight Crew Failing to climb/descend the aircraft as cleared) LHDs were reported in the 12 month sample. All were assessed in terms of levels crossed with one having crossed 4 flight levels. The LHDs were distributed across a range of operators with two being foreign to the Indonesian airspace. One Category B (climbing/descending without clearance) LHD was reported.

3.5 Three non-nil Category D (ATC loop error) LHDs were reported with at least two of these resulting in a loss of separation and one of these triggering an TCAS RA. All three LHDs were reported by the Jakarta ACC however with the exception of one report, the AAMA was unable to clearly ascertain whether the two of the reports resulted from an ATC or pilot error.

3.6 Thirty non-nil Category E (Coordination errors) LHDs were reported over the 12 months ending December 2013. Of these 27 were the result of errors attributed to Jakarta ACC with the majority of these either no coordination being provided to the adjacent FIR or an incorrect level coordinated. Three reports were related variously to errors attributed to the ANSPs in the Manila, Colombo and Melbourne FIRs.

3.7 Appendix B provides a visual picture of the geographic location of all risk bearing (non-NIL) LHD reports within the rolling 12 month data set. Each report is identified as a coloured dot. Reports assessed as being high risk during the current month of this report are identified as a red dot or a line showing approximate distance that equates to the assessed duration. The picture is intended to provide a means to identify specific risk hot spots related to RVSM operations.

4. Risk Assessment and Safety Oversight

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

Parameter	Description	Value
λ_x	Average aircraft length	0.025 NM (JAK) 0.025 NM (UJU)
λ_y	Average aircraft wingspan	0.023 NM (JAK) 0.023 NM (UJU)
λ_z	Average aircraft height	0.0075 (JAK) 0.0075 (UJU)
$ \overline{\Delta V} $	Average relative same-direction speed	27.3 KT (JAK) 27.3 KT (UJU)
$ \overline{V} $	Average aircraft speed	458 KT (JAK) 458 KT (UJU)
$ \overline{\dot{y}} $	Average relative cross-track speed	13 KT
$ \overline{\dot{z}} $	Average relative vertical speed during loss of vertical separation	1.5 KT if aircraft in level flight, 10 knots otherwise
$P_z(0)$	Probability two aircraft at the same nominal level are in vertical overlap	0.423 (JAK) 0.423 (UJU)
E_z same	Same direction occupancy	0.395 (JAK) 0.395 (UJU)
E_z opp	Opposite direction occupancy	0.085 (JAK) 0.085 (UJU)
	Annual RVSM flight hours	380841 HR (JAK) 380841 HR (UJU)

Table 5: Estimates of the Parameters in the CRM

4.2 **Risk Estimation Results.** The results for the technical, operational, and total risk for the RVSM implementation are detailed in **Table 6**. The technical risk meets the agreed TLS value of no more than 2.5×10^{-9} fatal accidents per flight hour due to the loss of a correctly established vertical separation standard of 1,000 ft and to all causes. **The operational and weighted total risk meets the specified TLS value** for these components of 5.0×10^{-9} .

Indonesian RVSM Airspace – estimated annual flying hours = 761390 hours (note: estimated hours based on Dec 2012 traffic sample data)			
Source of Risk	Risk Estimation	TLS	Remarks
Technical Risk	0.134×10^{-9}	2.5×10^{-9}	Below Technical TLS
Operational Risk	3.68×10^{-9}	-	-
Total Risk	3.82×10^{-9}	5.0×10^{-9}	Below TLS

Table 6: Indonesian Airspace RVSM Risk Estimates

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

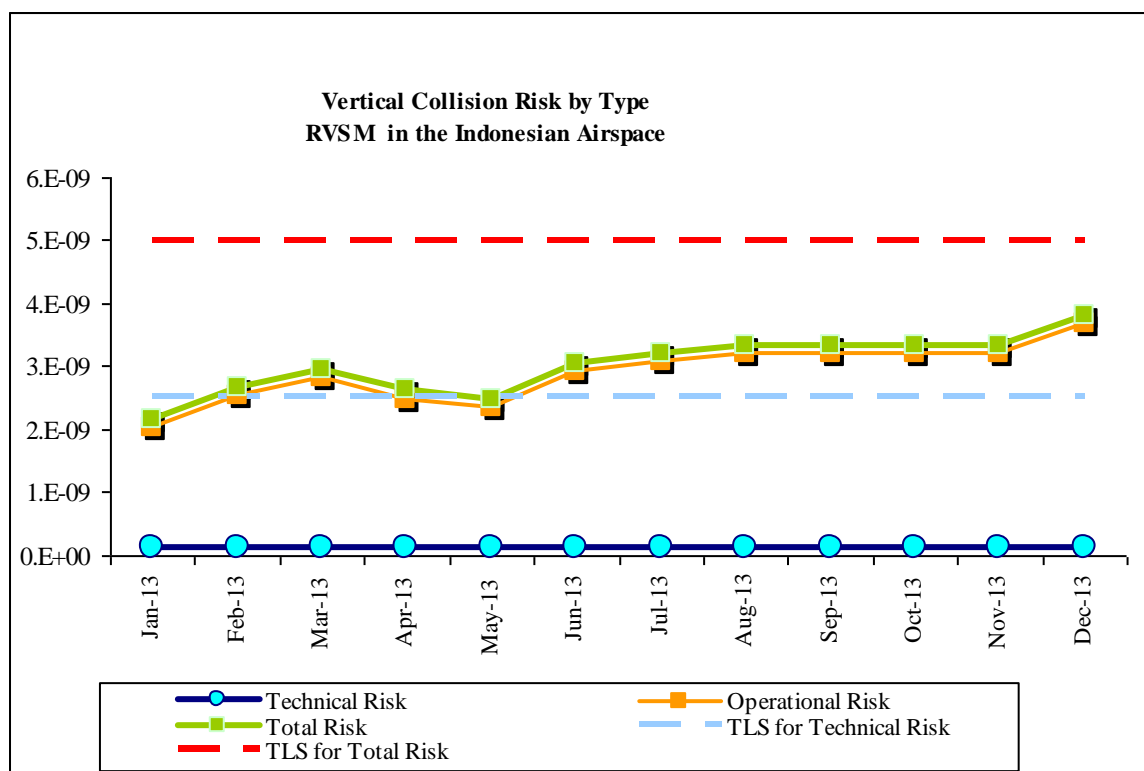


Figure 5: Trends of Risk Estimates for RVSM Airspace

5. Long Term Height-keeping Monitoring (LTHM)

5.1 To meet the ICAO Annex 6 LTHM requirements, the AAMA undertakes a monitoring program. The current monitoring burden data for Indonesia is detailed in **Table 7** below.

State	Total RVSM Approved Airframes	Resultant Monitoring Burden	Total Airframes Remaining to be Monitored
Indonesia	465	111	47

Table 7: LTHM Burden

Appendix A to AIRSPACE SAFETY REVIEW
Details of the Reported LHD Events

LHD date	Source	Assigned FL	Observed/ Reported FL	Duration at Incorrect FL	Cause	Category /Sub category
January 2013	Ujung Pandang	Unknown	FL347	1 level crossed	Aircraft climbed above cleared level.	A
January 2013	Ujung Pandang	Unknown	FL350	4 min	Coordination error by Jakarta ATS	E
January 2013	Ujung Pandang	Unknown	FL310	0.5 min	Coordination error by Jakarta ATS	E
February 2013	Ujung Pandang	Unknown	FL370	0.5 min	Coordination error by foreign ATS	E
February 2013	Ujung Pandang	FL350	FL390	0.5 min	Coordination error by Jakarta ATS	E
February 2013	Ujung Pandang	FL310	FL330	0.5 min	Coordination error by Jakarta ATS	E
February 2013	Ujung Pandang	FL370	FL330	0.5 min	Coordination error by Jakarta ATS	E
February 2013	Ujung Pandang	Unknown	FL380	5 min	Coordination error by Jakarta ATS	E
February 2013	Jakarta	FL350	Unknown	5 min	Aircraft not at cleared level	J
March 2013	Jakarta	FL320	FL340	5 min	Coordination error by foreign ATS	E
March 2013	Ujung Pandang	Unknown	FL370	0.5 min	Coordination error by Jakarta ATS	E
March 2013	Ujung Pandang	Unknown	FL310	0.5 min	Coordination error by Jakarta ATS	E
March 2013	Ujung Pandang	Unknown	FL330	0.5 min	Coordination error by Jakarta ATS	E
March 2013	Ujung Pandang	Unknown	FL350	0.5 min	Coordination error by Jakarta ATS	E
March 2013	Jakarta	FL310	Descending	2 levels crossed	Aircraft commenced descent due TCAS RA.	J
April 2013	Ujung Pandang	Unknown	FL310	5 min	Coordination error by Jakarta ATS	E
April 2013	Ujung Pandang	FL310	FL370	15 mins	Coordination error by Jakarta ATS	E
May 2013	Ujung Pandang	FL350	FL343 descending	1 level crossed	Aircraft descended below cleared level	A
May 2013	Ujung Pandang	Unknown	FL370	3 mins	Coordination error by Jakarta ATS	E
May 2013	Ujung Pandang	FL330	FL350	3 mins	Coordination error by Jakarta ATS	A
May 2013	Jakarta	Unknown	FL380	3 mins	Radar data failure resulted in loss of separation	M
June 2013	Ujung Pandang	Unknown	FL370	0.5 min	Coordination error by Jakarta ATS	E
June 2013	Ujung Pandang	Unknown	FL350	5 min	Coordination error by Jakarta ATS	E
June 2013	Ujung Pandang	Unknown	FL370	3 min	Coordination error by Jakarta ATS	E
June 2013	Ujung Pandang	FL360	FL370	3 min	Coordination error by Jakarta ATS. Loss of separation	E
July 2013	Ujung Pandang	FL350	FL353	1 level crossed	Aircraft climbed above cleared level	A
July 2013	Jakarta	FL340	FL320	1 level crossed	Aircraft conflicted with opposite direction aircraft at FL320	J
July 2013	Jakarta	FL330/FL320	FL334/FL324	1 level crossed	Aircraft climbed due TCAS RA following loss of separation	J

July 2013	Ujung Pandang	FL370	FL390	0.5 min	Coordination error by Jakarta ATS	E
July 2013	Ujung Pandang	FL330	FL350	0.5 min	Coordination error by Jakarta ATS	E
July 2013	Ujung Pandang	Unknown	FL330	0.5 min	Coordination error by Jakarta ATS	E
August 2013	Jakarta	Unknown	FL330	1 level crossed	Aircraft climbed above cleared level resulting in loss of separation	D
August 2013	Ujung Pandang	FL310	FL350	0.5 min	Coordination error by Jakarta ATS	E
August 2013	Ujung Pandang	Unknown	FL350	0.5 min	Coordination error by Jakarta ATS	E
August 2013	Ujung Pandang	Unknown	FL370	0.5 min	Coordination error by Jakarta ATS	E
September 2013	Ujung Pandang	FL350	FL370	2 levels crossed	Aircraft climbed above cleared level	A
September 2013	Ujung Pandang	FL340	FL360	2 levels crossed	Aircraft climbed above cleared level	A
October 2013	Ujung Pandang	FL360	FL368	1 level crossed	Aircraft climbed above cleared level	A
October 2013	Ujung Pandang	FL370	FL350	0.5 min	Coordination error by Jakarta ATS	E
November 2013	Ujung Pandang	FL380	FL376	1 level crossed	Aircraft descended below cleared level without clearance	B
November 2013	Airservices	FL380	FL400	0.5 min	Coordination error by Foreign ATS	A
December 2013	Ujung Pandang	FL310	FL318	1 level crossed	Aircraft climbed above cleared level	A
December 2013	Ujung Pandang	FL320	FL360	4 levels crossed	Aircraft climbed above cleared level	A
December 2013	Ujung Pandang	FL330	FL370	0.5 min	Coordination error by Jakarta ATS	E
December 2013	Ujung Pandang	Unknown	FL370	0.5 min	Coordination error by Jakarta ATS	E

Jakarta and Ujung Pandang FIRs – Risk Bearing (Non-NIL) RVSM Large Height Deviations
January 2013 – December 2013

