



International Civil Aviation Organization

**The Twentieth Meeting of the Regional Airspace Safety Monitoring
Advisory Group (RASMAG/20)**

Bangkok, Thailand, 26-29 May 2015

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

AAMA Safety 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 2014 for the Brisbane, Honiara, Melbourne, Nauru and Port Moresby FIRs. In addition results are provided for the Indonesian airspace of Jakarta 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, Indonesian, Nauru, Papua New Guinea and Solomon Islands airspace. The full report is detailed in **Attachment A**.

2. DISCUSSION

2.1 The report shows that for the Australian, Indonesia, Nauru, Papua New Guinea and Solomon Islands airspace, the target level of safety (TLS) was met.

2.2 The AAMA continues to receive a range of LHD reports from the Australian ANSP, however there have been difficulties in the receipt of reports from Papua New Guinea. This issue has now been resolved and the AAMA is now receiving monthly reporting from the Papua New Guinea.

2.3 The reporting of LHDs to the AAMA by Indonesia was problematic over the twelve month period, with significant delays being experienced in reports reaching the AAMA until early 2015. As a result the AAMA was unable to undertake validated monthly assessments during 2014 and this is reflected in the monthly risk estimate graph shown at Figure 1. Additionally the AAMA has been unable to resolve a number of data issues related to the 2014 TSD and as a result has had to use the 2012 TSD for risk calculations.

2.4 In the Australian, Honiara, Nauru and Papua New Guinea airspace, there have been a total of 28 occurrences of pilots climbing or descending an aircraft not in accordance with the clearance (n=11) or without a clearance (n=17). The occurrences involved a range of operators and locations and there does not appear to be any underlying common factor. The AAMA notes that almost the same number of Category A and B LHDs were reported for the 2013 year.

2.5 Five Category D (ATC System Loop Errors) were reported in the 12 month period. Of these 4 were attributed to ATC error and of these 2 related to a controller not confirming or correcting an incorrect flight level read-back by flight crew. Two of the occurrences resulted in a loss of separation.

2.6 Fifteen Category E (ATC Coordination error) reports were assessed. Of the 15 reports, 11 were the result of incorrect flight levels being coordinated; 2 related to no coordination being provided by a handing off sector; 1 related to incorrect time estimates; and 1 related to a controller providing an incorrect read-back of level coordination that was not picked up by the other sector controller.

2.7 One Category L (An aircraft being provided with RVSM separation is not RVSM approved) report was assessed. This report involved an aircraft operating in RVSM airspace without being RVSM approved. The pilot had advised ATC that the aircraft was RVSM approved but this was subsequently found to be incorrect information.

2.8 A review of the types of LHDs assessed for Indonesian airspace shows a number of Category E Coordination errors with significant grouping of these reports in two areas of the airspace at the boundary between Jakarta and Ujung Pandang FIRs. Twenty-five non-nil Category E (Coordination errors) LHDs were reported over the 12 months ending December 2014. Of these 13 were the result of errors attributed to Jakarta ACC with the majority of these either no coordination being provided to the adjacent FIR or incorrect information coordinated. Eleven reports were related variously to errors attributed to foreign ANSPs in the Kota Kinabalu, Manila, Melbourne and Singapore FIRs.

2.9 Four 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 2 flight levels. The LHDs were distributed across a range of Indonesian operators. Two Category B (climbing/descending without clearance) LHDs were reported, both associated with Indonesian operators.

2.10 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 a TCAS RA. All three LHDs were reported by the Jakarta ACC and the data appears to show that all the loss of separation occurrences could be attributed to ATC error.

2.11 Three Category J (TCAS resolution advisory) reports were received. All resulted in the pilots taking correct action.

Executive Summary

2.12 **Table 1** summarizes Australian, Nauru, Papua New Guinea and Solomon Islands airspace RVSM technical, operational, and total risks. **Figure 1** presents collision risk estimate trends during the period from 1January 2014 to 31December 2014.

Australian, Nauru, Papua New Guinea and Solomon Islands Airspace – estimated annual flying hours = 795,450 hours <i>(note: estimated hours based on Dec 2013 traffic sample data)</i>			
Source of Risk	Risk Estimation	TLS	Remarks
<i>RASMAG 19 Total Risk</i>	3.82×10^{-9}	5.0×10^{-9}	<i>Below TLS</i>
Technical Risk	0.0279×10^{-9}	2.5×10^{-9}	Below Technical TLS
Operational Risk	2.98×10^{-9}	-	-
Total Risk	3.01×10^{-9}	5.0×10^{-9}	Below TLS

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

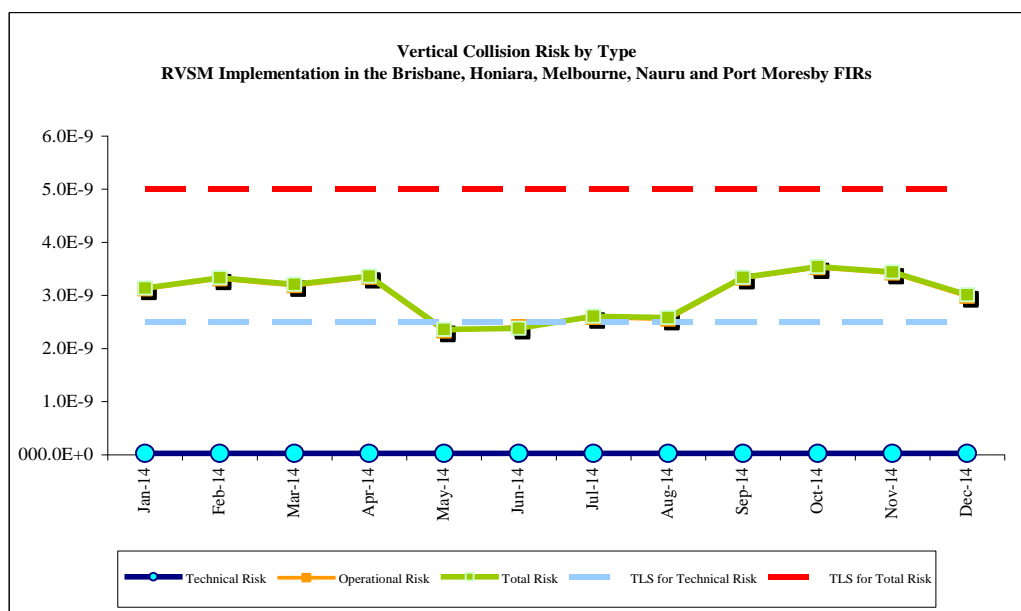


Figure 1: Australian, Nauru, Papua New Guinea and Solomon Islands Airspace RVSM Risk Estimate Trends

2.13 **Table 2** presents a summary of the LHD causes within Australian, Nauru, Papua New Guinea and Solomon Islands airspace from 1 January 2014 until 31 December 2014.

Code	LHD Category Description	No.
A	Flight crew fails to climb or descend the aircraft as cleared	11
B	Flight crew climbing or descending without ATC clearance	17
C	Incorrect operation or interpretation of airborne equipment	0
D	ATC system loop error	5
E	ATC transfer of control coordination errors due to human factors	15
F	ATC transfer of control coordination errors due to technical issues	0
G	Aircraft contingency leading to sudden inability to maintain level	7
H	Airborne equipment failure and unintentional or undetected level change	1
I	Turbulence or other weather related cause	8
J	TCAS resolution advisory and flight crew correctly responds	1
K	TCAS resolution advisory and flight crew incorrectly responds	0
L	Non-approved aircraft is provided with RVSM separation	1
M	Other	3
Total		69

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

2.14 **Figure 2** provides the geographic location of risk bearing LHD reports within Australian, Nauru, Papua New Guinea and Solomon Islands Airspace during the assessment period.

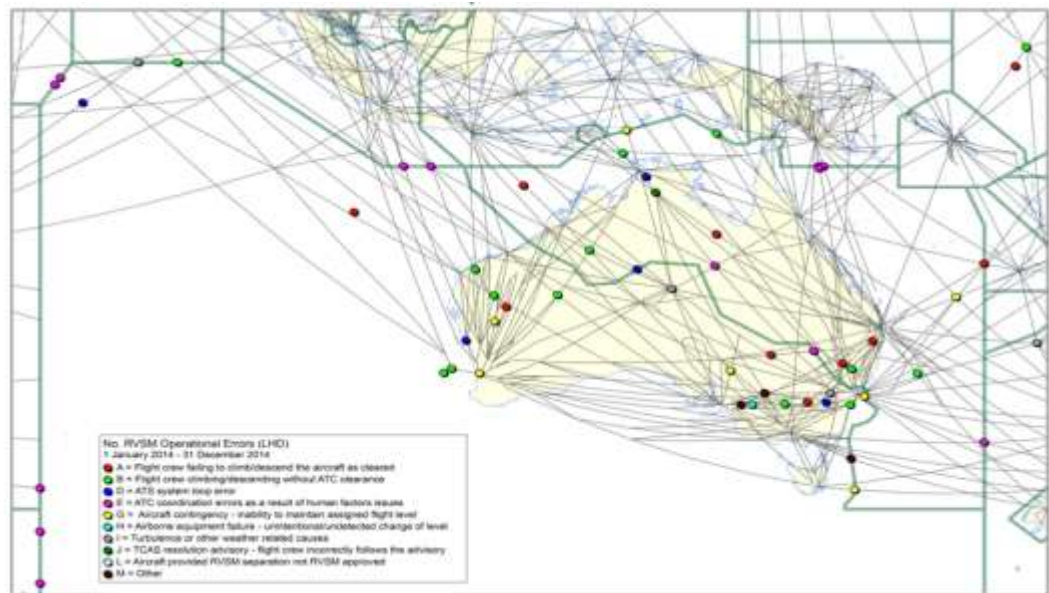


Figure 2: Australian, Nauru, Papua New Guinea and Solomon Islands Airspace – Risk Bearing LHD

2.15 **Table 1** summarizes Indonesian airspace RVSM technical, operational, and total risks. **Figure 1** presents collision risk estimate trends during the period from 1 January 2014 to 31 December 2014.

Indonesian Airspace – estimated annual flying hours = 761390 hours (note: estimated hours based on Dec 2012 traffic sample data)			
Source of Risk	Risk Estimation	TLS	Remarks
<i>RASMAG 19 Total Risk (PREVIOUS RASMAG)</i>	3.82×10^{-9}	5.0×10^{-9}	<i>Below TLS</i>
Technical Risk	0.134×10^{-9}	2.5×10^{-9}	Below Technical TLS
Operational Risk	2.05×10^{-9}	-	-
Total Risk	2.18×10^{-9}	5.0×10^{-9}	Below TLS

Table 1: Indonesian Airspace RVSM Risk Estimates

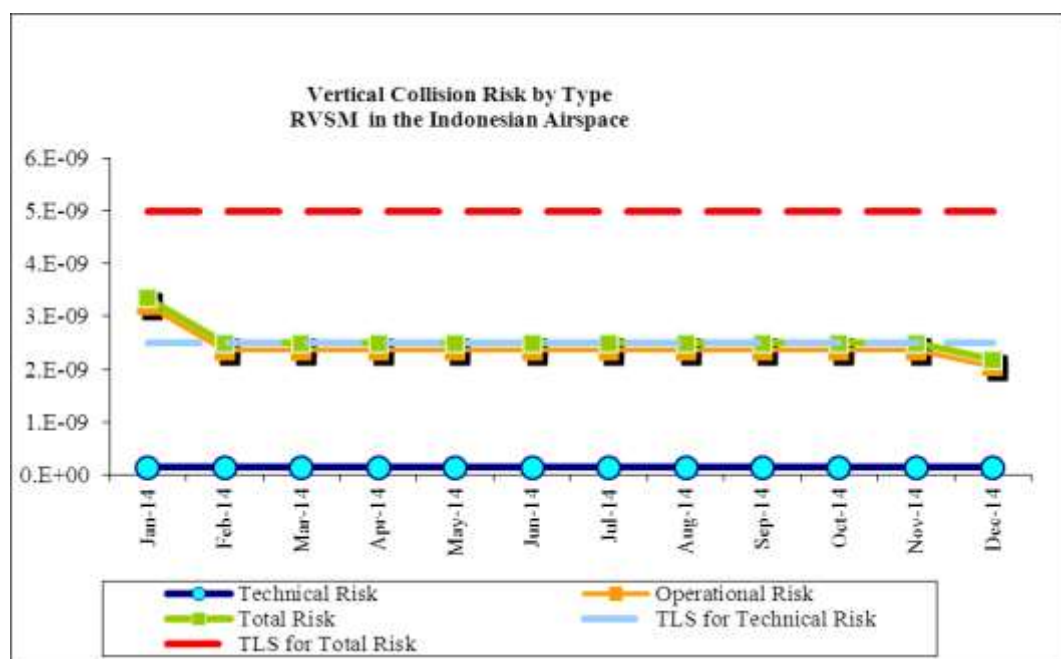


Figure 1: Indonesian Airspace RVSM Risk Estimate Trends

2.16 **Table 2** presents a summary of the LHD causes within Indonesian airspace from 1 January 2014 until 31 December 2014.

Code	LHD Category Description	No.
A	Flight crew fails to climb or descend the aircraft as cleared	4
B	Flight crew climbing or descending without ATC clearance	2
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	25
F	ATC transfer of control coordination errors due to technical issues	1
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	1
J	TCAS resolution advisory and flight crew correctly responds	3
K	TCAS resolution advisory and flight crew incorrectly responds	0
L	Non-approved aircraft is provided with RVSM separation	0
M	Other	0
Total		39

Table 2: Summary of LHD Causes within Indonesian Airspace

2.17 **Figure 2** provides the geographic location of risk bearing LHD reports within Indonesian Airspace during the assessment period.

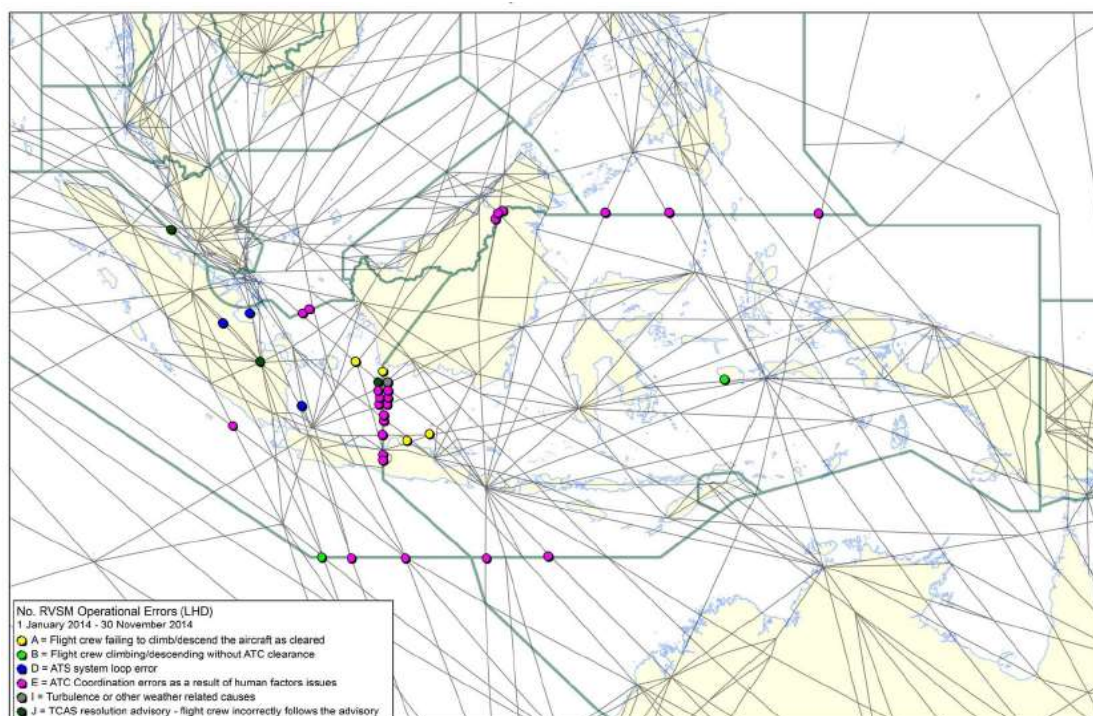


Figure 2: Indonesian Airspace – Risk Bearing LHD

3. ACTION BY THE MEETING

3.1 The meeting is invited to:

- note the information contained in this paper; and
- discuss any relevant matters as appropriate.



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AUSTRALIAN AIRSPACE MONITORING AGENCY (AAMA)



Airspace Safety Review of RVSM in Australian, Nauru, Papua New Guinea and Solomon Islands Airspace January 2014 to December 2014

Role	Name and Position	Signature and Date
Prepared By	Brian Dunlop Senior Safety Analyst & Dr Geoff Aldis Quantitative Modelling Specialist	19/1/15
		 12/1/15
Reviewed By	Robert Butcher Systemic Analysis, Monitoring and Review Manager	 19/1/15

Executive Summary

For the period 1 January 2014 to 31 December 2014 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 = 795,450 hours (note: estimated hours based on December 2013 traffic sample data)			
Source of Risk	Risk Estimation	TLS	Remarks
Technical Risk	0.0279×10^{-9}	2.5×10^{-9}	Below Technical TLS
Operational Risk	2.98×10^{-9}	-	-
Total Risk	3.01×10^{-9}	5.0×10^{-9}	Below Overall TLS

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

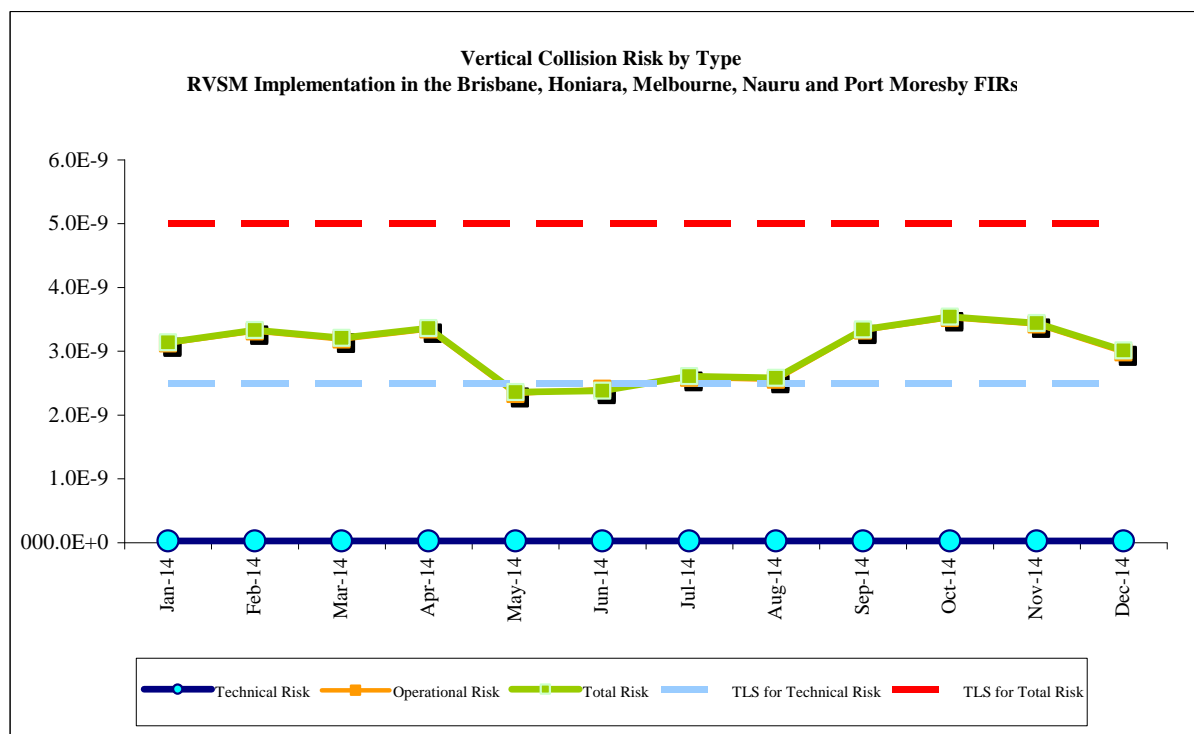


Figure A: RVSM Risk Estimate Trends

**AIRSPACE SAFETY REVIEW OF THE RVSM IMPLEMENTATION IN
AUSTRALIAN, NAURU, PAPUA NEW GUINEA AND SOLOMON ISLANDS
AIRSPACE
JANUARY 2014 TO DECEMBER 2014**

Prepared by
Australian Airspace Monitoring Agency (AAMA) – January 2015
(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 2013 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 2014 to December 2014. **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 2014	✓	✓	✓	✓	X
February 2014	✓	✓	✓	✓	X
March 2014	✓	✓	✓	✓	X
April 2014	✓	✓	✓	✓	X
May 2014	✓	✓	✓	✓	X
June 2014	✓	✓	✓	✓	X
July 2014	✓	✓	✓	✓	X
August 2014	✓	✓	✓	✓	X
September 2014	✓	✓	✓	✓	X
October 2014	✓	✓	✓	✓	X
November 2014	✓	✓	✓	✓	X
December 2014	✓	✓	✓	✓	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 2014 to 31 December 2014 inclusive.

Month-Year	No. of Non-NIL LHD	LHD Duration (Min)	No. Levels Crossed
2014			
January	4	3.0	3
February	6	4.5	3
March	9	2.5	4
April	7	4.5	10
May	1	0.0	1
June	7	7.0	4
July	6	7.5	4
August	5	4.5	6
September	4	18	1
October	7	2.5	7
November	6	4.0	9
December	7	105	10
Total	69	163	62

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

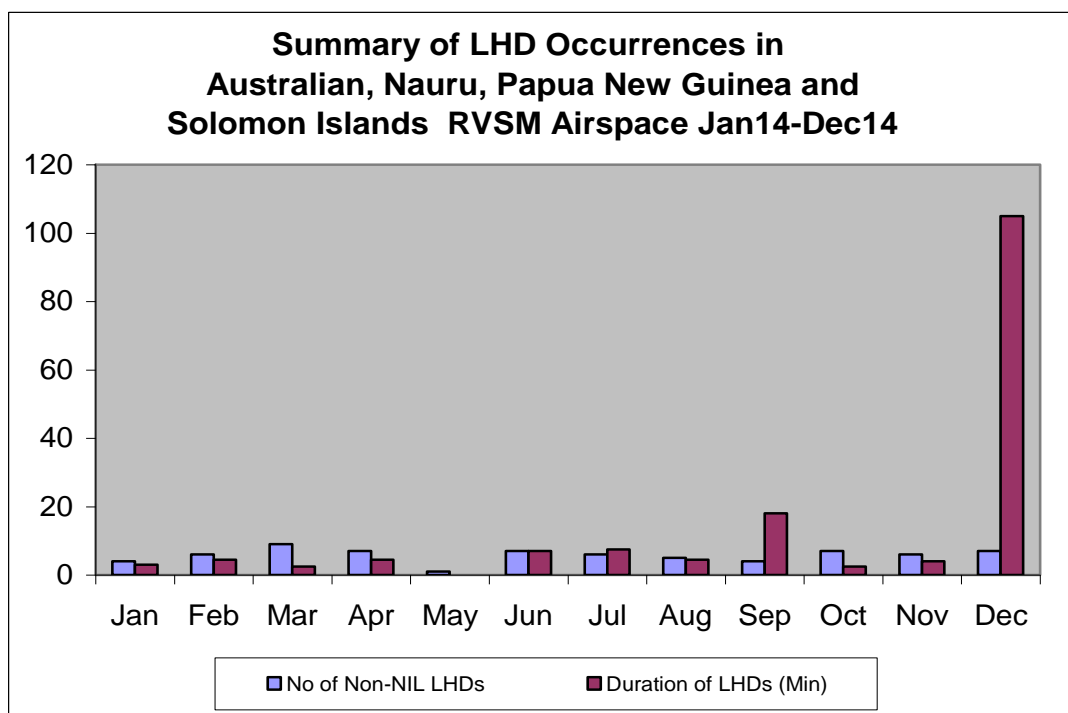


Figure 2: Summary of LHD Occurrences (by Month)

3.2 Seven non-Nil LHD were reported for the month of December which is an increase on the previous month. The total assessed risk duration increased 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 2014 to 31 December 2014 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	11	4.5	13
B	Flight crew climbing/descending without ATC Clearance	17	9	12
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)	5	1.5	2
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)	15	28.5	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)	7	0.5	22
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	8	3	10
J	Deviation due to TCAS resolution advisory, flight crew correctly following the resolution advisory	1	0	1

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)	1	100	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.	3	16	1
Total		69	163	62

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

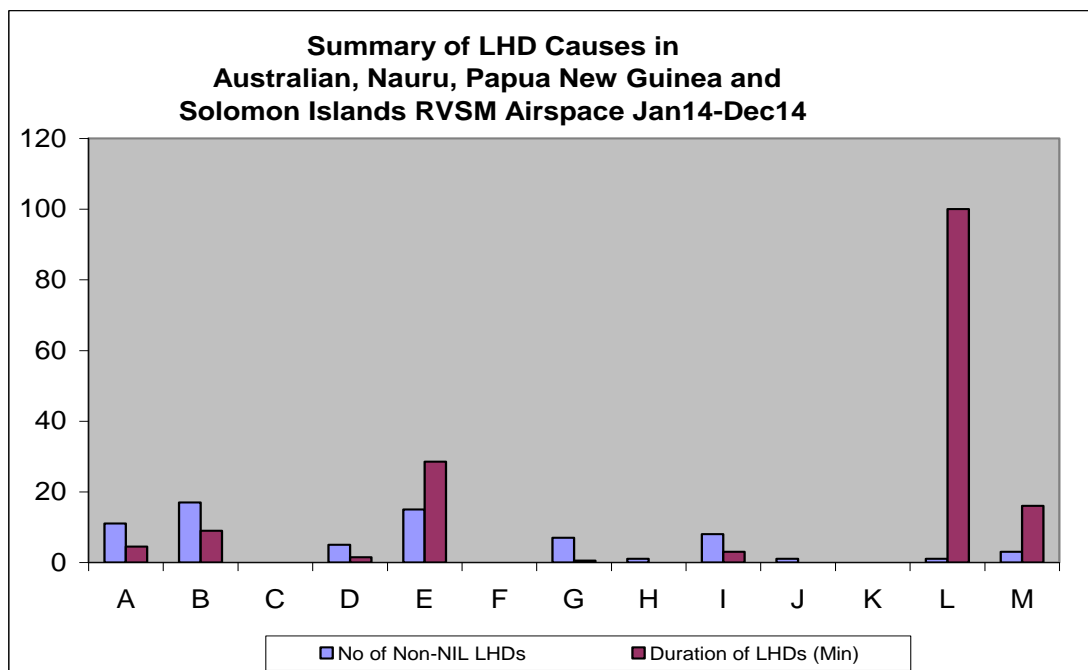


Figure 3: Summary of LHD Causes

3.4 There have been a total of 28 occurrences of pilots climbing or descending an aircraft not in accordance with the clearance (n=11) or without a clearance (n=17). The occurrences involved a range of operators and locations and there does not appear to be

any underlying common factor. The AAMA notes that almost the same number of Category A and B LHDs were reported for the 2013 year.

3.5 Five Category D (ATC System Loop Errors) were reported in the 12 month period. Of these 4 were attributed to ATC error and of these 2 related to a controller not confirming or correcting an incorrect flight level read-back by flight crew. Two of the occurrences resulted in a loss of separation.

3.6 Fifteen Category E (ATC Coordination error) reports were assessed. Of the 15 reports, 11 were the result of incorrect flight levels being coordinated; 2 related to no coordination being provided by a handing off sector; 1 related to incorrect time estimates; and 1 related to a controller providing an incorrect read-back of level coordination that was not picked up by the other sector controller.

3.7 One Category L (An aircraft being provided with RVSM separation is not RVSM approved) report was assessed. This report involved an aircraft operating in RVSM airspace without being RVSM approval. The pilot had advised ATC that the aircraft was RVSM approved but this was subsequently found to be incorrect information.

3.8 **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	0.0233 NM DOM (Uni-directional) 0.0293 NM DOM (Bi-directional) 0.0326 NM IND (Uni-directional) 0.0347 NM IND (Bi-directional) 0.0268 NM TAS (Uni-directional) 0.0254 NM TAS (Bi-directional)
λ_y	Average aircraft wingspan	0.0208 NM DOM (Uni-directional) 0.0272 NM DOM (Bi-directional) 0.0304 NM IND (Uni-directional) 0.0322 NM IND (Bi-directional) 0.0244 NM TAS (Uni-directional) 0.0232 NM TAS (Bi-directional)

λ_z	Average aircraft height	0.0069 NM DOM (Uni-directional) 0.0083 NM DOM (Bi-directional) 0.0091 NM IND (Uni-directional) 0.0096 NM IND (Bi-directional) 0.0080 NM TAS (Uni-directional) 0.0076 NM TAS (Bi-directional)
$ \Delta V $	Average relative same-direction speed	22.3 kt DOM (Uni-directional) 18.2 kt DOM (Bi-directional) 11.3 kt IND (Uni-directional) 13.7 kt IND (Bi-directional) 21.8 kt TAS (Uni-directional) 20.5 kt TAS (Bi-directional)
$ \bar{V} $	Average aircraft speed	449.4 kt DOM (Uni-directional) 467.4 kt DOM (Bi-directional) 461.5 kt IND (Uni-directional) 474.3 kt IND (Bi-directional) 470.5 kt TAS (Uni-directional) 460.9 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) 0.429 DOM (Bi-directional) 0.467 IND (Uni-directional) 0.496 IND (Bi-directional) 0.412 TAS (Uni-directional) 0.392 TAS (Bi-directional)
$P_z(1000)$	Probability two aircraft nominally separated vertically by 1000 feet are in vertical overlap	2.46E-8
$P_y(0)$	Probability two aircraft nominally on the route centreline are in lateral overlap	0.062 DOM (Uni-directional) 0.080 DOM (Bi-directional) 0.090 IND (Uni-directional) 0.095 IND (Bi-directional) 0.072 TAS (Uni-directional) 0.069 TAS (Bi-directional)
$E_z(same)$	Same direction occupancy	0.092 DOM (Uni-directional) 0.225 DOM (Bi-directional) 0.0084 IND (Uni-directional) 0.119 IND (Bi-directional) 0.124 TAS (Uni-directional) 0.201 TAS (Bi-directional)
$E_z(opp)$	Opposite direction occupancy	0.0095 DOM (Uni-directional) 0.0409 DOM (Bi-directional) 0 IND (Uni-directional) 0.0228 IND (Bi-directional) 0 TAS (Uni-directional) 0.0188 TAS (Bi-directional)

$E_z(\text{cross})$	Crossing occupancy	0.013 DOM (Uni-directional) 0.040 DOM (Bi-directional) 0 IND (Uni-directional) 0.026 IND (Bi-directional) 0.036 TAS (Uni-directional) 0.018 TAS (Bi-directional)
T	Daily flight hours	750.8 DOM (Uni-directional) 1100.6 DOM (Bi-directional) 27.9 IND (Uni-directional) 115.4 IND (Bi-directional) 24.6 TAS (Uni-directional) 161.3 TAS (Bi-directional)

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 = 795,450 hours (note: estimated hours based on December 2013 traffic sample data)			
Source of Risk	Risk Estimation	TLS	Remarks
Technical Risk	0.0279×10^{-9}	2.5×10^{-9}	Below Technical TLS
Operational Risk	2.98×10^{-9}	-	-
Total Risk	3.01×10^{-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.

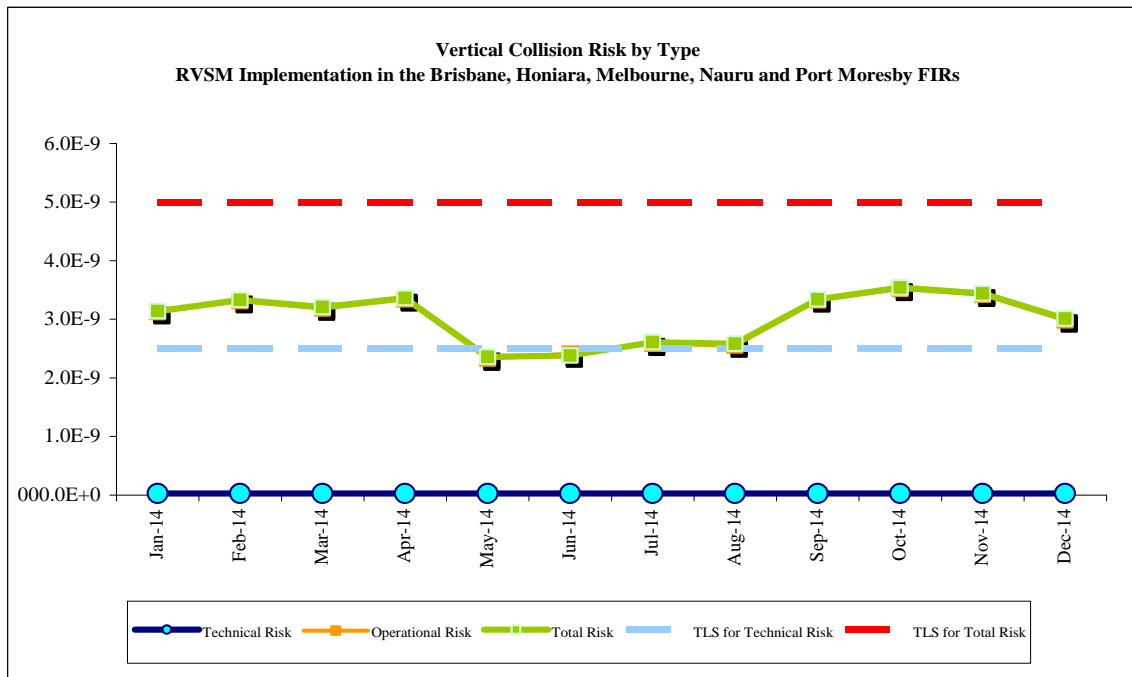


Figure 5: Trends of Risk Estimates for RVSM Airspace

4.4 A monthly LHD risk value is determined to provide real-time information on actual risk without reliance on historical high-time errors resident within the 12 month data sample. The data in **Figure 6** below shows the monthly risk for December 2014 as 0.189×10^{-9} which is below the average monthly risk of the annual risk of 5.0×10^{-9} (red line in Figure 6 below).

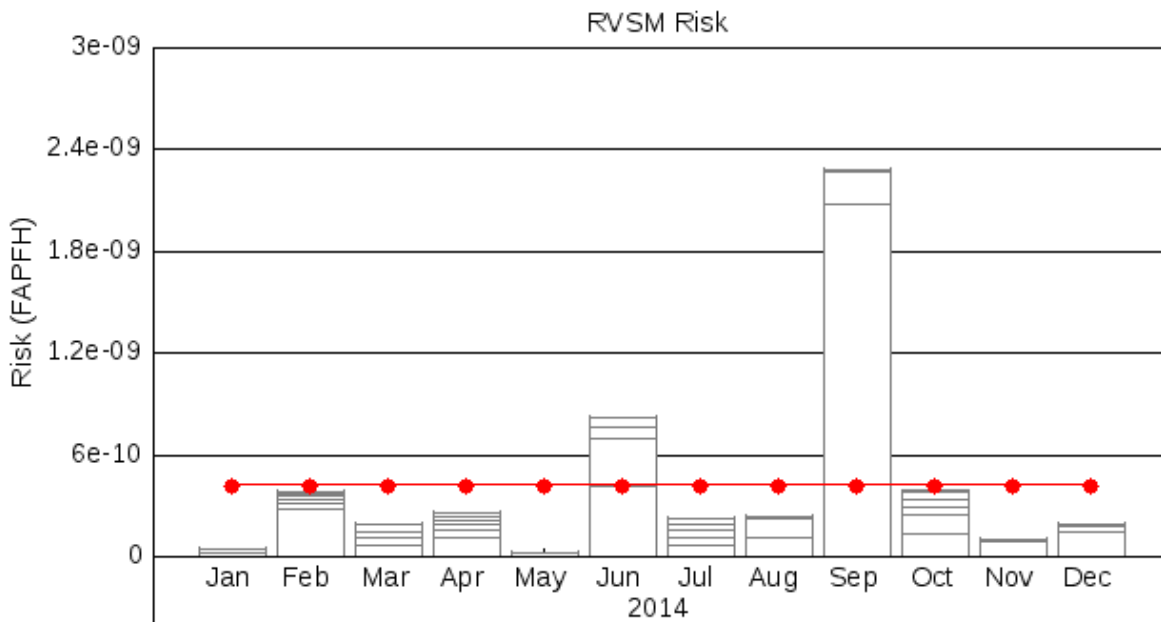


Figure 6: Monthly LHD Risk Estimates for the Australian, Nauru, Papua New Guinea and Solomon Islands RVSM Airspace.

(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.

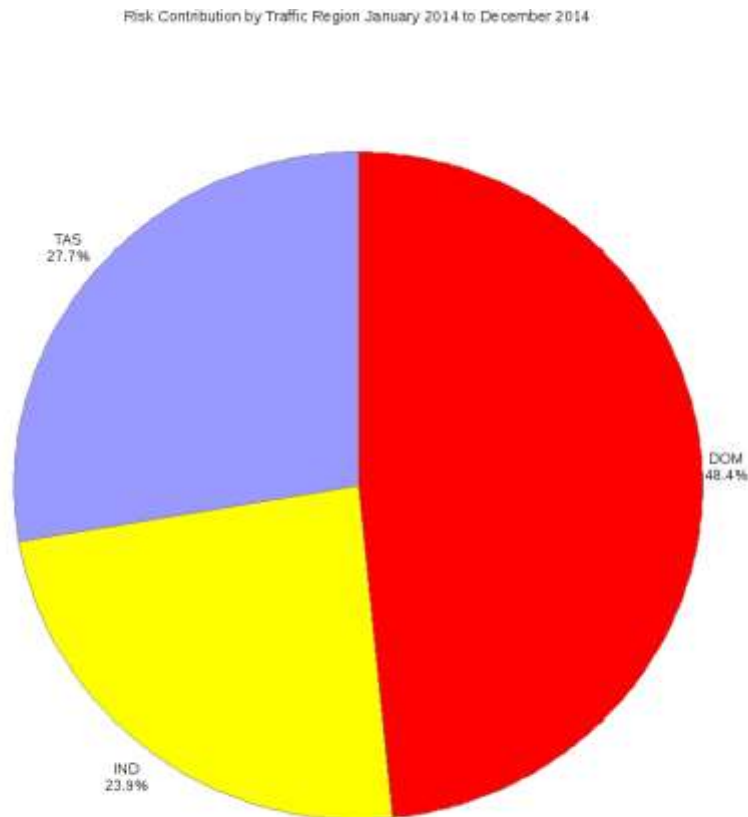


Figure 7: Risk Contribution by Traffic Region

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 45.6% as the highest contributor to risk.

Risk Contribution by Attribution January 2014 to December 2014

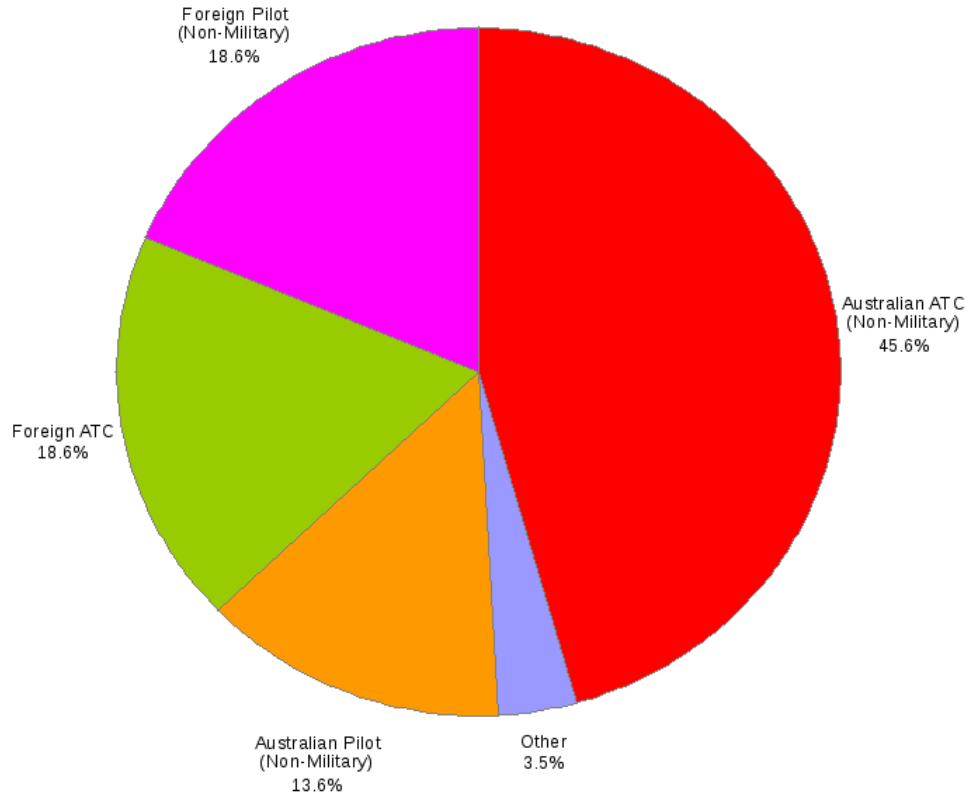


Figure 8: Risk Contribution by Attribution

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	585	196	50
Papua New Guinea	16	9	2
Solomon Islands	1	1	0

Table 7: LTHM Burden

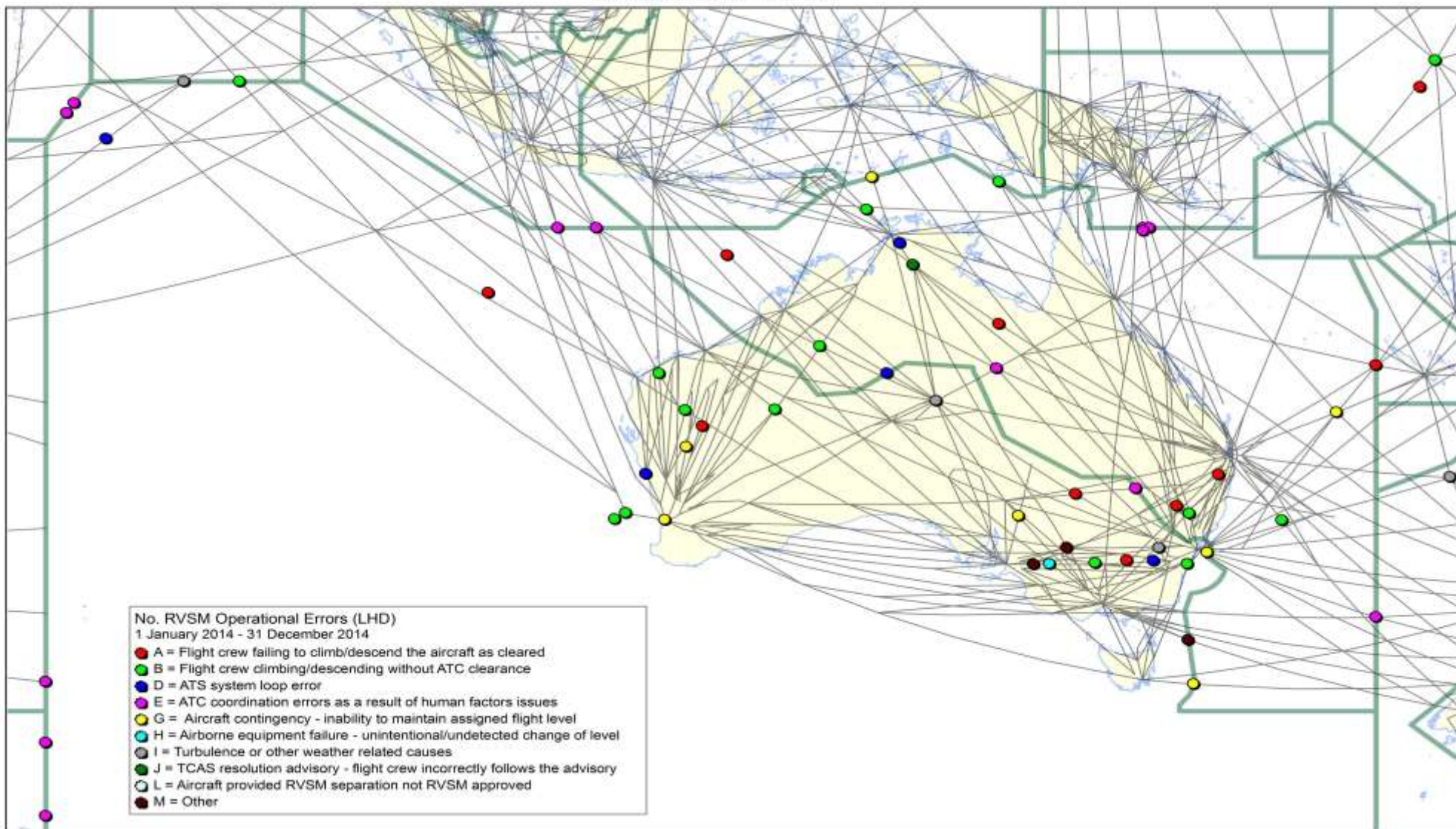
Appendix A to AIRSPACE SAFETY REVIEW
Details of the Reported LHD Events

LHD date	Source	Assigned FL	Observed/ Reported FL	Duration at Incorrect FL	Cause	Category /Sub category
January 2014	Airservices	FL340	UNK	1 level crossed	Aircraft commenced descent early	A
January 2014	Airservices	FL280	FL282+	1 level crossed	Aircraft climbed above cleared level while on climb	A
January 2014	Airservices	FL370	FL376	1 level crossed	Aircraft climbed without clearance	B
January 2014	Airservices	FL330	FL390	3 min	Coordination error by foreign ATS	E
February 2014	Airservices	FL340	FL343	1 level crossed	Aircraft climbed above cleared level following refuelling operation	A
February 2014	Airservices	FL350	FL347	1 level crossed	Aircraft descended when deviating around weather	B
February 2014	Airservices	FL370	Descending	1 min	Aircraft commenced descent without clearance	B
February 2014	Airservices	FL360	FL365	1 level crossed	Aircraft climbed to avoid weather without clearance	B
February 2014	Airservices	FL320	FL322+	0.5 min	Aircraft assigned incorrect level due to coordination error	D
February 2014	Airservices	FL370	< FL370	3 min	Aircraft met original level requirement while on climb when requirement time coordinated was incorrect. Resulted in loss of separation	E
March 2014	Airservices	FL380	FL387	2 levels crossed	Aircraft climbed without clearance	A
March 2014	Airservices	FL310	<FL310	0.5 min	Aircraft commenced descent without clearance	B
March 2014	Airservices	FL400	<FL400	0.5 min	Aircraft commenced descent without clearance	B
March 2014	Airservices	UKN	FL375	0.5 min	Pilot contacted ATC inside CTA A without a clearance	B
March 2014	Airservices	UKN	FL295	0.5 min	Pilot contacted ATC inside CTA A without a clearance	B
March 2014	Airservices	FL370	FL375	1 level crossed	Aircraft climbed without clearance	B
March 2014	Airservices	FL360	FL358	1 level crossed	ATC cleared aircraft to climb from FL340 to FL360 while a preceding conflicting aircraft was maintaining FL350.	D
March 2014	Airservices	UKN	Descending	0.5 min	Emergency descent	G
March 2014	Airservices	FL320	<FL320	1 level crossed	Vertical deviation below cleared level due to turbulence	I

April 2014	Airservices	FL360	Descending	7 levels crossed	Aircraft descended without a clearance. Aircraft was having communications difficulties with Brisbane ATC on HF radio.	B
April 2014	Airservices	UNK	UKN	1 level crossed	Aircraft commenced descent without clearance	B
April 2014	Airservices	FL410	<FL410	0.5 min	Pilot read back incorrect cleared level. Not corrected by ATC	D
April 2014	Airservices	FL310	FL330	3 min	Coordination error by foreign ATS	E
April 2014	Airservices	UNK	UNK	1 min	No coordination from ATS to Foreign ATS	E
April 2014	Airservices	FL350	FL354	1 level crossed	Vertical deviation above cleared level due to turbulence	I
April 2014	Airservices	FL360	>FL360	0.5 min	Aircraft climbed in response to a TCAS RA warning.	J
May 2014	Airservices	FL360 – FL380	FL385	1 level crossed	Vertical deviation above cleared level due to turbulence	I
June 2014	Airservices	FL430	FL400	3 min	Aircraft unable to climb to cleared flight level	A
June 2014	Airservices	FL380	UNK	0.5 min	Aircraft commenced a climb without a clearance	B
June 2014	Airservices	FL360	UNK	0.5 min	Aircraft commenced a climb without a clearance	B
June 2014	Airservices	FL390	FL387	2 min	Aircraft entered airspace below the cleared level	B
June 2014	Airservices	FL250	FL350	0.5 min	Aircraft cleared to descend through the level of a following aircraft. Resulted in a Loss of Separation.	D
June 2014	Airservices	FL330	FL350	1 min	Coordination error by foreign ATS	E
June 2014	Airservices	UKN	Descending	3 levels crossed	Emergency descent	G
July 2014	Airservices	FL360	FL370	2 levels crossed	Aircraft climbed through assigned level	A
July 2014	Airservices	FL320	FL340	0.5 min	No coordination from Foreign ATS to Airservices ATS	E
July 2014	Airservices	FL350	FL310	3 min	Coordination error by ATS	E
July 2014	Airservices	FL340	FL360	1 min	Coordination error by ATS	E
July 2014	Airservices	FL310	Descending	2 levels crossed	Emergency descent	G
July 2014	Airservices	FL370	FL350	0.5 min	Vertical deviation below cleared level due to turbulence	I
August 2014	Airservices	FL280	FL289	0.5 min	Aircraft climbed above cleared level while on climb	A
August 2014	Airservices	FL350	FL360	1 min	Coordination error by foreign ATS	E
August 2014	Airservices	FL330	FL350	3 min	Coordination error by foreign ATS	E
August 2014	Airservices	FL340	Descending	5 levels crossed	Emergency descent	G
August 2014	Airservices	FL390	Climbing	1 level crossed	Aircraft commenced a climb due to an autopilot failure	H
September 2014	Airservices	FL310	Climbing	1 level crossed	Aircraft climbed through assigned level	A
September 2014	Airservices	FL380	Descending	2 min	Aircraft commenced descent without a clearance	B
September 2014	Airservices	FL360	FL360	15 min	Controller lost situational awareness of actual CFL	M

September 2014	Airservices	FL370	Climbing	1 min	Aircraft was cleared to FL370 however CFL set to FL360. CLAM alerted when aircraft climbed above FL360	M
October 2014	Airservices	FL320	FL320	1 min	Aircraft was maintaining a level different to that coordinated	A
October 2014	Airservices	FL370	Descending	1 level crossed	Aircraft descended through cleared level	A
October 2014	Airservices	FL330	Descending	5 levels crossed	Aircraft descended through cleared level and reported maintaining a level different to cleared level	A
October 2014	Airservices	FL310	Descending	0.5 min	Aircraft commenced descent without a clearance	B
October 2014	Airservices	FL370	Climbing	0.5 min	Aircraft commenced climb without a clearance following the crew not recalling their block clearance was cancelled	B
October 2014	Airservices	FL350	Descending	0.5 min	Aircraft commenced descent without a clearance following callsign confusion and an ATC loop error	D
October 2014	Airservices	FL380	Climbing	1 level crossed	Aircraft climbed above cleared level while on climb due turbulence	I
November 2014	Airservices	FL280 - FL320	Climbing	1 min	Coordination error by ATS	E
November 2014	Airservices	FL350	FL390	3 min	Coordination error by ATS	E
November 2014	Airservices	FL300	Descending	1 level crossed	Emergency descent	G
November 2014	Airservices	FL350	Descending	3 levels crossed	Emergency descent	G
November 2014	Airservices	FL400	FL367	4 levels crossed	Vertical deviation below cleared level due to turbulence	I
November 2014	Airservices	FL320 - FL360	FL364	1 level crossed	Vertical deviation above cleared level due to turbulence	I
December 2014	Airservices	FL330	FL350	1 min	Coordination error by ATS	E
December 2014	Airservices	FL380	FL400	1 min	Coordination error by ATS	E
December 2014	Airservices	FL350	Climbing	1 min	Coordination error by ATS	E
December 2014	Airservices	FL370	Descending	8 levels crossed	Emergency descent	G
December 2014	Tiger Air	FL360	FL356	1 level crossed	Vertical deviation below cleared level due to turbulence	I
December 2014	Airservices	FL370	FL370	100 min	Non RVSM aircraft operating as RVSM approved	L
December 2014	Airservices	FL350	UNK	1 level crossed	Aircraft did not meet height requirement until 3NM past the required point	M

Appendix B to AIRSPACE SAFETY REVIEW
Brisbane, Honiara, Melbourne, Nauru and Port Moresby FIRs - Risk Bearing (Non-NIL) RVSM Large Height Deviations
January 2014 - December 2014







AUSTRALIAN AIRSPACE MONITORING AGENCY (AAMA)



Airspace Safety Review of RVSM in Indonesian Airspace January to December 2014

Role	Name and Position	Signature and Date
Prepared By	Brian Dunlop Senior Safety Analyst & Dr Geoff Aldis Quantitative Modelling Specialist	28/4/15
		 28/4/15
Reviewed By	Robert Butcher Systemic Analysis, Monitoring and Review Manager	 28/4/15

Executive Summary

For the period 1 January 2014 to 31 December 2014 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	2.05×10^{-9}	-	-
Total Risk	2.18×10^{-9}	5.0×10^{-9}	Below TLS

Table A: Indonesian Airspace RVSM Risk Estimates

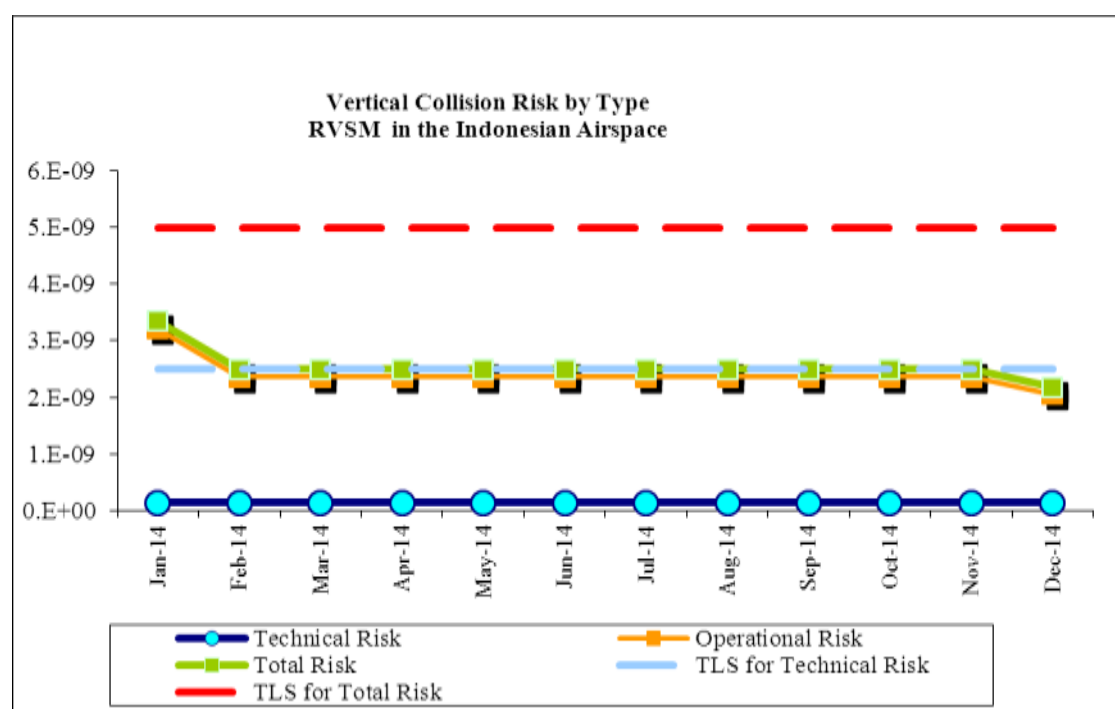


Figure A: RVSM Risk Estimate Trends

**AIRSPACE SAFETY REVIEW OF THE RVSM IMPLEMENTATION IN
INDONESIAN AIRSPACE
JANUARY 2014 TO DECEMBER 2014**

Prepared by

Australian Airspace Monitoring Agency (AAMA) - April 2015
(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 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 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 2014 to December 2014. **Table 1** indicates those FIRs which submitted LHD reports including nil returns. **Appendix A** provides details of LHD reports.

FIR Name	Jakarta	Ujung
January 2014	✓	✓
February 2014	✓	✓
March 2014	✓	✓
April 2014	✓	✓
May 2014	✓	✓
June 2014	✓	✓
July 2014	✓	✓
August 2014	✓	✓
September 2014	✓	✓
October 2014	✓	✓
November 2014	✓	✓
December 2014	✓	✓

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 2014 – 31 December 2014 inclusive.

Month-Year	No. of Non-NIL LHD Occurrences	LHD Duration (Min)	No. Levels Crossed
2014			
January	4	1	2
February	2	3	1
March	5	2.5	0
April	5	4.5	2
May	0	0	0
June	4	1	3
July	2	1	0
August	8	4.5	5
September	1	0.5	0
October	4	1	3
November	4	1.5	1
December	0	0	0
Total	39	20.50	17

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

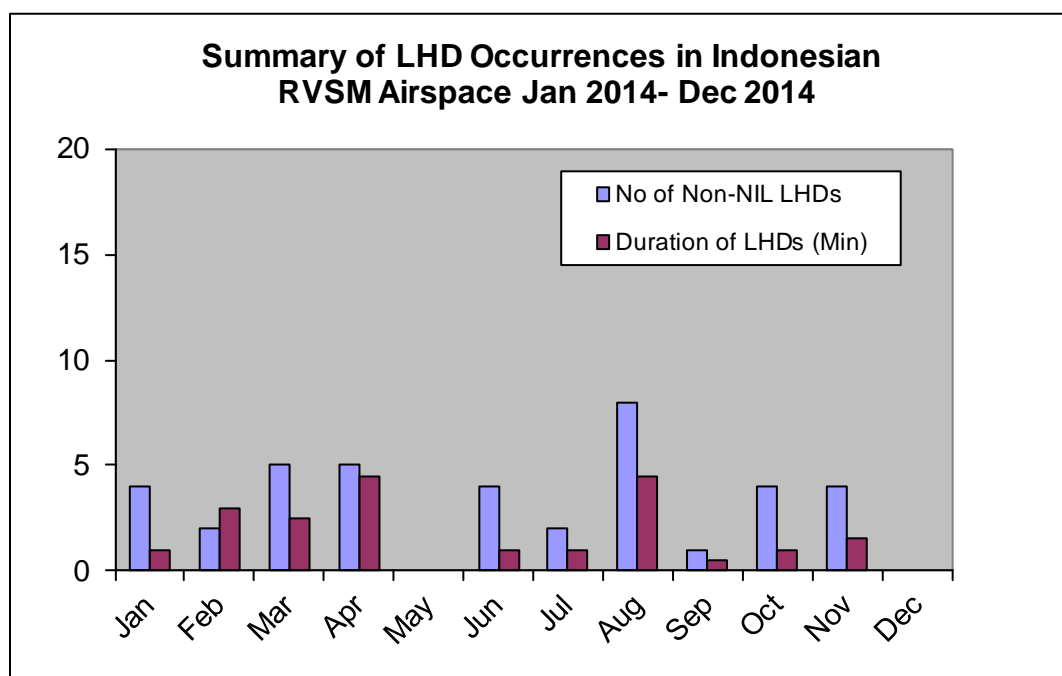


Figure 2: Summary of LHD Occurrences (by Month)

3.2 A total of 39 non-nil LHDs were reported during the 12 months period to end of December 2014. Notably 25 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 2014 to 31 December 2014 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	4	0	5
B	Flight crew climbing/descending without ATC Clearance	2	0	2
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	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)	25	17.5	0
F	Coordination errors in the ATC to ATC transfer or control responsibility as a result of equipment outage or technical issues	1	3	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	1	0	2
J	Deviation due to TCAS resolution advisory, flight crew correctly following the resolution advisory	3	0	3
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.	0	0	0
Total		39	20.5	17

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

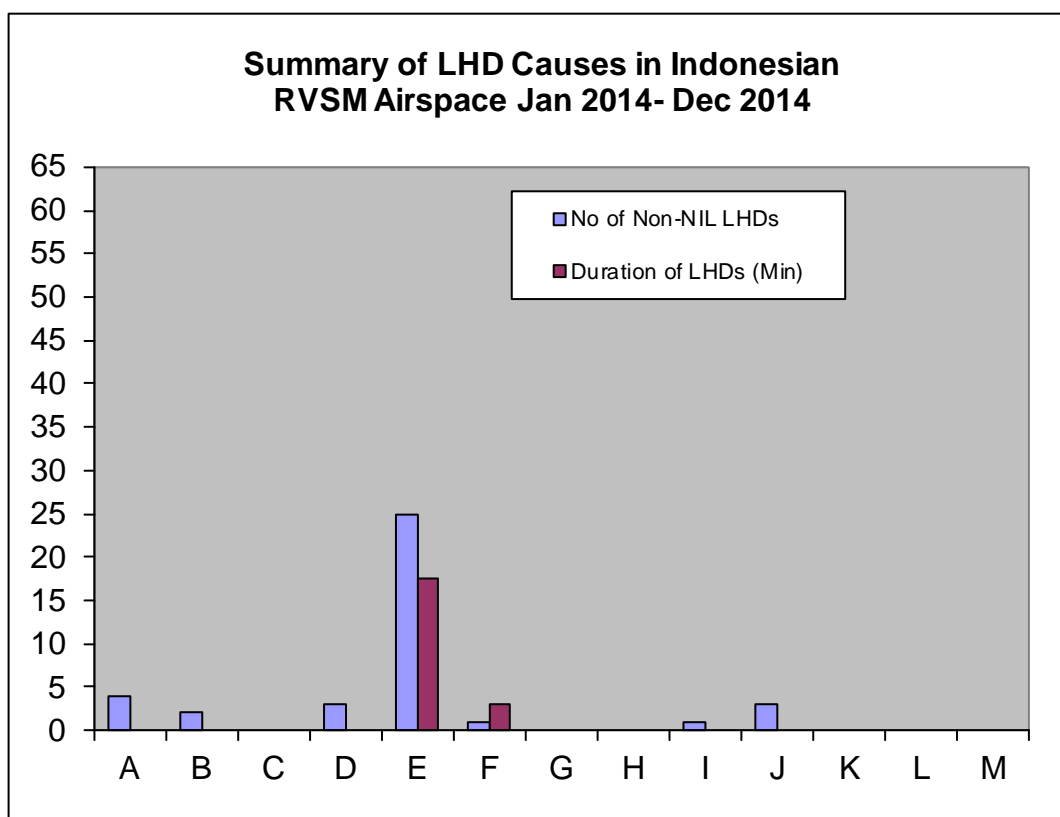


Figure 3: Summary of LHD Causes

3.4 Four 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 2 flight levels. The LHDs were distributed across a range of Indonesian operators. Two Category B (climbing/descending without clearance) LHDs were reported, both associated with Indonesian operators.

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 a TCAS RA. All three LHDs were reported by the Jakarta ACC and the data appears to show that all the loss of separation occurrences could be attributed to ATC error.

3.6 Twenty-five non-nil Category E (Coordination errors) LHDs were reported over the 12 months ending December 2014. Of these 13 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 information coordinated. Eleven reports were related variously to errors attributed to foreign ANSPs in the Kota Kinabalu, Manila, Melbourne and Singapore FIRs.

3.7 Three Category J (TCAS resolution advisory) reports were received. All resulted in the pilots taking correct action.

3.8 **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)
$ \Delta V $	Average relative same-direction speed	27.3 KT (JAK) 27.3 KT (UJU)
$ \bar{V} $	Average aircraft speed	458 KT (JAK) 458 KT (UJU)
$ \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 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	2.05×10^{-9}	-	-
Total Risk	2.18×10^{-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.

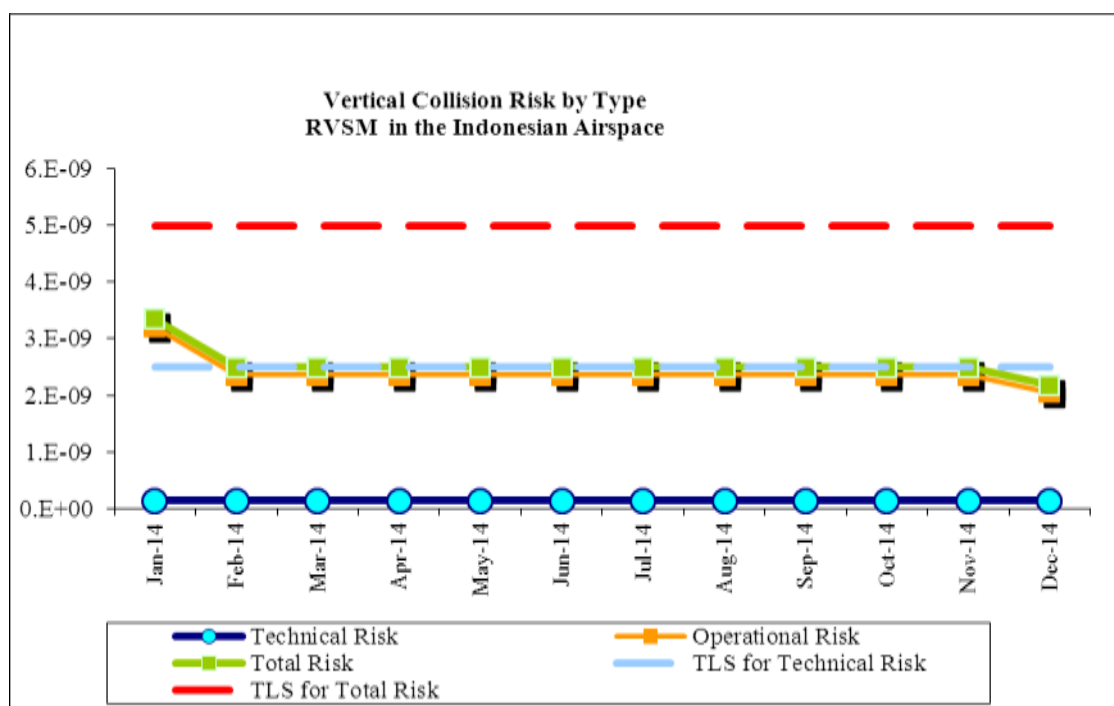


Figure 5: Trends of Risk Estimates for RVSM Airspace

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	514	119	72

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

APPENDIX B to AIRSPACE SAFETY REVIEW
Jakarta and Ujung Pandang FIRs - Risk Bearing (Non-NIL) RVSM Large Height Deviations
January 2014 - November 2014

