



ICAO

International Civil Aviation Organization
**Twenty-Fifth Meeting of the Regional Airspace Safety
Monitoring Advisory Group (RASMAG/25)**
Video Teleconference, 27 – 30 October 2020

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

AAMA VERTICAL SAFETY REPORT

(Presented by AAMA)

SUMMARY

This paper presents an airspace Safety Review of RVSM airspace risk in the Brisbane, Honiara, Melbourne, Nauru and Port Moresby Flight Information Regions (FIRs), and Jakarta and Ujung Pandang FIRs for the period 1 January 2019 to 31 December 2019. The risk in the Brisbane, Honiara, Melbourne, Nauru and Port Moresby FIRs meets the Target Level of Safety (TLS), while the risk in the Jakarta and Ujung Pandang FIRs exceeds the TLS.

1. INTRODUCTION

1.1 This report provides an airspace Safety Review of RVSM airspace risk in the Brisbane, Honiara, Melbourne, Nauru and Port Moresby FIRs, and Jakarta and Ujung Pandang FIRs for the period 1 January 2019 to 31 December 2019.

1.2 The estimated risk is compared to the TLS of no more than 2.5×10^{-9} fatal accidents per flight hour for the technical component of the risk, and 5.0×10^{-9} for the total weighted risk.

1.3 The full reports are included in Attachments 1 and 2.

2. DATA SOURCES

2.1 *Traffic Sample Data (TSD)*: TSD covering four weeks of the month of December 2018 of aircraft operating in the Brisbane, Honiara, Melbourne, Nauru and Port Moresby FIRs, and separately for the Jakarta and Ujung Pandang FIRs, were used as required by ICAO Regional agreement.

2.2 For the Indonesian FIRs, the TSD quality is considered a large improvement over the sample used in previous assessments and has led to a more accurate indication of traffic within the FIRs. The following changes in the TSD were observed:

- Previously, flights from the Ujung Pandang FIR had been used in place of flights from the Jakarta FIR to over-estimate the total risk. In this report, a Jakarta FIR TSD was assessed.
- The calculated opposite direction occupancy has significantly decreased for the Ujung Pandang FIR.
- Estimated flight hours for both FIRs has increased. In the Ujung Pandang FIR this is due to additional data being provided to the AAMA, which allowed for points to be included in the sample that were previously not available.

2.3 *Large Height Deviations (LHDs)*: A cumulative 12 month data set of LHD reports was used, covering 1 January 2019 to 31 December 2019 for Brisbane, Honiara, Melbourne, Nauru and Port Moresby FIRs, and Jakarta and Ujung Pandang FIRs. All FIRs submitted LHD reports for all 12 months.

3. SUMMARY OF LHD OCCURRENCES

3.1 The number of non-zero-duration LHD occurrences, total LHD duration (in minutes), and total number of levels crossed for Brisbane, Honiara, Melbourne, Nauru and Port Moresby FIRs for the period 1 January 2019 to 31 December 2019 are shown by LHD category in **Table 1**.

Table 1: Summary of LHD occurrences by LHD category for Brisbane, Honiara, Melbourne, Nauru and Port Moresby FIRs for 1 January 2019 to 31 December 2019.

LHD category	LHD category description	Number of non-zero-duration LHDs	Duration of LHDs (minutes)	Number of levels crossed
A	Flight crew failing to climb/descend the aircraft as cleared	8	6.5	4
B	Flight crew climbing/descending without ATC clearance	14	4	8
C	Incorrect operation or interpretation of airborne equipment	0	0	0
D	ATC system loop error	4	3	1
E	Coordination errors in the ATC-to-ATC transfer or control responsibility as a result of human factors issues	5	3.5	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	2	0.5	1
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	2	1	1
J	Deviation due to TCAS resolution advisory; flight crew correctly following the resolution advisory	3	1	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	1	95	0
M	Other	0	0	0
Total		39	114.5	17

3.2 The number of non-zero-duration LHD occurrences, total LHD duration (in minutes), and total number of levels crossed for Jakarta and Ujung Pandang FIRs for the period 1 January 2019 to 31 December 2019 are shown by LHD category in **Table 2**.

Table 2: Summary of LHD occurrences by LHD category for Jakarta and Ujung Pandang FIRs for 1 January 2019 to 31 December 2019.

LHD category	LHD category description	Number of non-zero-duration LHDs	Duration of LHDs (minutes)	Number of levels crossed
A	Flight crew failing to climb/descend the aircraft as cleared	3	4	1
B	Flight crew climbing/descending without ATC clearance	3	1	7
C	Incorrect operation or interpretation of airborne equipment	0	0	0
D	ATC system loop error	3	4	0
E	Coordination errors in the ATC-to-ATC transfer or control responsibility as a result of human factors issues	24	31	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	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	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	0	0	0
M	Other	0	0	0
Total		33	40	8

4. COLLISION RISK ESTIMATE

4.1 The results for the technical, operational, and total risk for the RVSM implementation in Brisbane, Honiara, Melbourne, Nauru and Port Moresby FIRs for 1 January 2019 to 31 December 2019 are detailed in **Table 3**. The technical risk meets the agreed TLS value of no more than 2.5×10^{-9} fatal accidents per flight hour. The operational and weighted total risk meets the specified TLS value for these components of 5.0×10^{-9} .

Executive Summary

Table 3: RVSM Risk Estimates for Brisbane, Honiara, Melbourne, Nauru and Port Moresby FIRs for the period 1 January 2019 to 31 December 2019. The number of estimated annual flying hours is 942,831 based on December 2018 TSD.

Source of risk	Risk estimate	TLS	Comparison with TLS
Total risk reported at RASMAG/24	4.84×10^{-9}	5.0×10^{-9}	Below total TLS
Technical risk	0.283×10^{-9}	2.5×10^{-9}	Below technical TLS
Operational risk	1.08×10^{-9}	-	-
Total risk	1.37×10^{-9}	5.0×10^{-9}	Below total TLS

4.2 The trends of the technical risk, operational risk, and total risk for Brisbane, Honiara, Melbourne, Nauru and Port Moresby FIRs for the period 1 January 2019 to 31 December 2019 are shown in **Figure 1**.

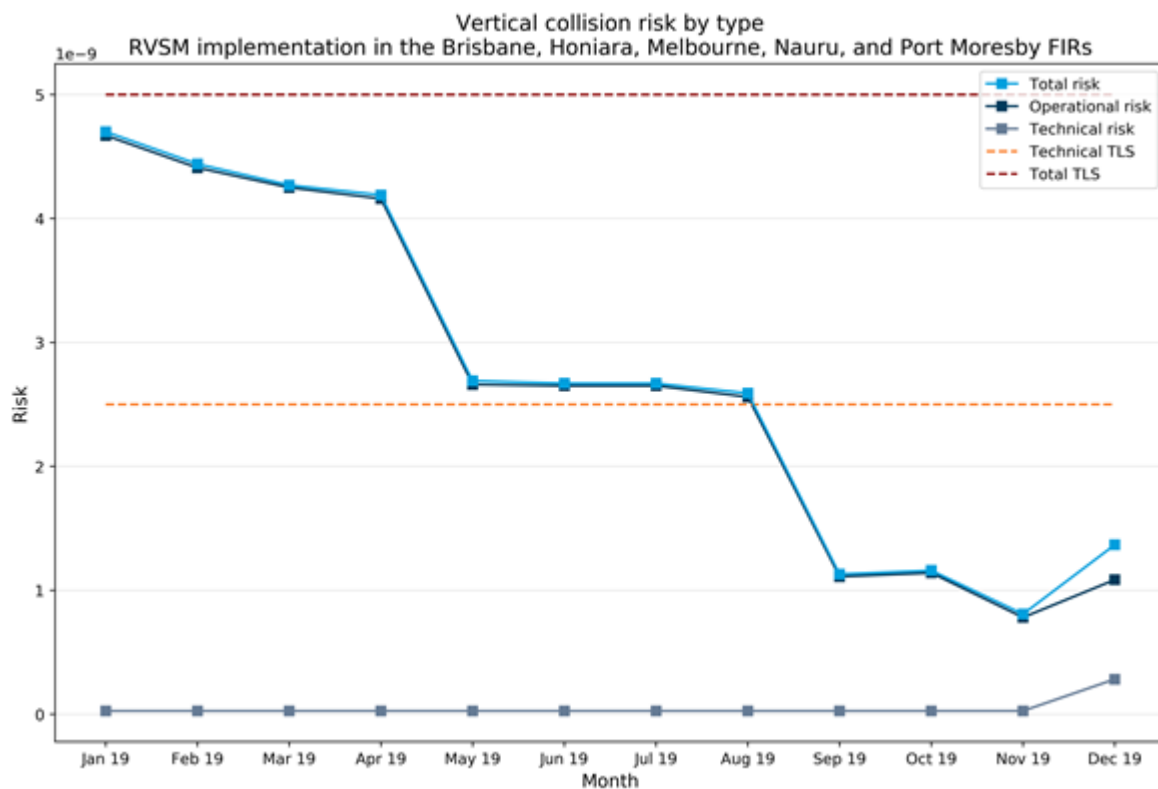


Figure 1: Trends of the technical risk, operational risk, and total risk for Brisbane, Honiara, Melbourne, Nauru and Port Moresby FIRs for the period 1 January 2019 to 31 December 2019.

4.3 The results for the technical, operational, and total risk for the RVSM implementation in Jakarta and Ujung Pandang FIRs for 1 January 2019 to 31 December 2019 are detailed in Table 4. The technical risk meets the agreed TLS value of no more than 2.5×10^{-9} fatal accidents per flight hour. The operational and weighted total risk exceeds the specified TLS value of 5.0×10^{-9} .

Table 4: RVSM Risk Estimates for Jakarta and Ujung Pandang FIRs for the period 1 January 2019 to 31 December 2019. The number of estimated annual flying hours is 1,232,871 based on December 2018 TSD.

Source of risk	Risk estimate	TLS	Comparison with TLS
Total risk reported at RASMAG/24	2.94×10^{-9}	5.0×10^{-9}	Below TLS
Technical risk	0.222×10^{-9}	2.5×10^{-9}	Below technical TLS
Operational risk	10.0×10^{-9}	-	-
Total risk	10.2×10^{-9}	5.0×10^{-9}	Above total TLS

4.4 The trends of the technical risk, operational risk, and total risk for Jakarta and Ujung Pandang FIRs for the period 1 January 2019 to 31 December 2019 are shown in **Figure 2**.

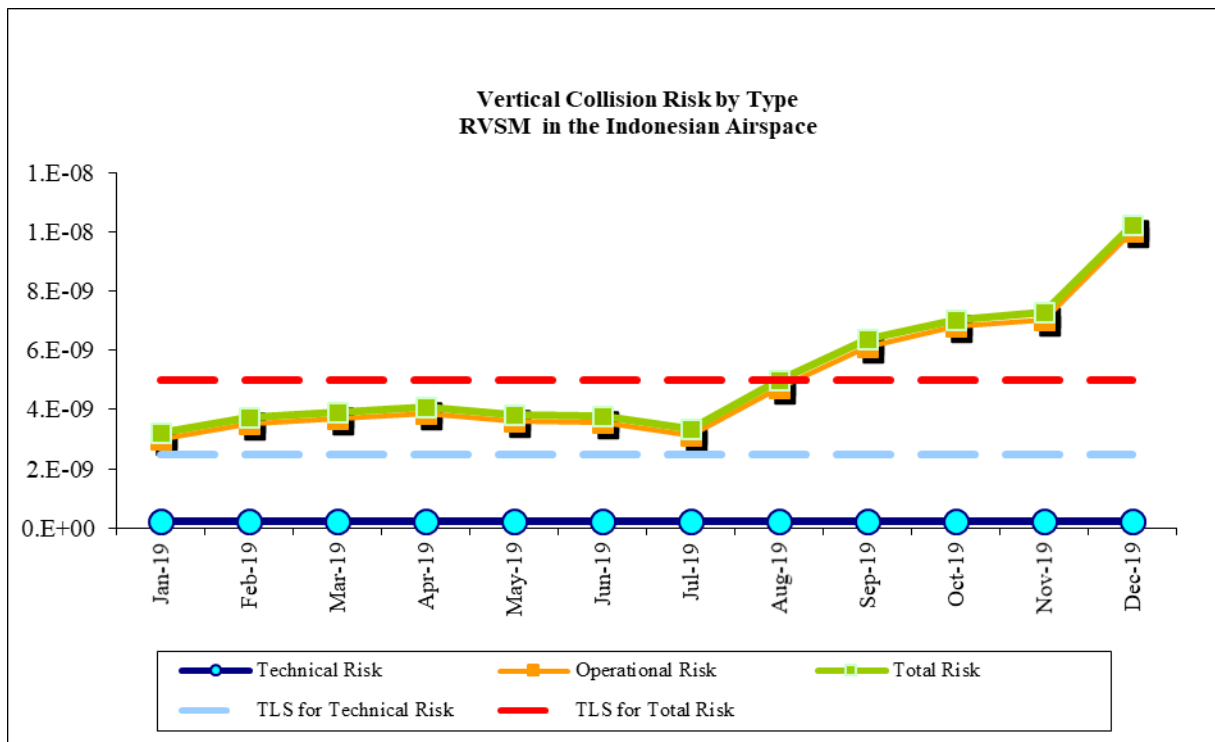


Figure 2: Trends of the technical risk, operational risk, and total risk for Jakarta and Ujung Pandang FIRs for the period 1 January 2019 to 31 December 2019.

5. MAPPING OF LHD HOTSPOTS

5.1 A map identifying the geographic location of LHD occurrences for Brisbane, Honiara, Melbourne, Nauru and Port Moresby FIRs for the period 1 January 2019 to 31 December 2019 is shown in **Figure 3**. Each occurrence is represented by a coloured circle, with the size of the circle proportional to the severity of the occurrence (duration + deviation). The occurrence in December 2019 involving a military formation being provided with RVSM separation while not RVSM approved is considered a high risk occurrence due to its long duration. The map is intended to provide a means to identify risk hot spots related to RVSM operations, and the updated style is in line with the mapping of LHD/LLD/LLE geolocations in the Consolidated Report presented at RASMAG/25.

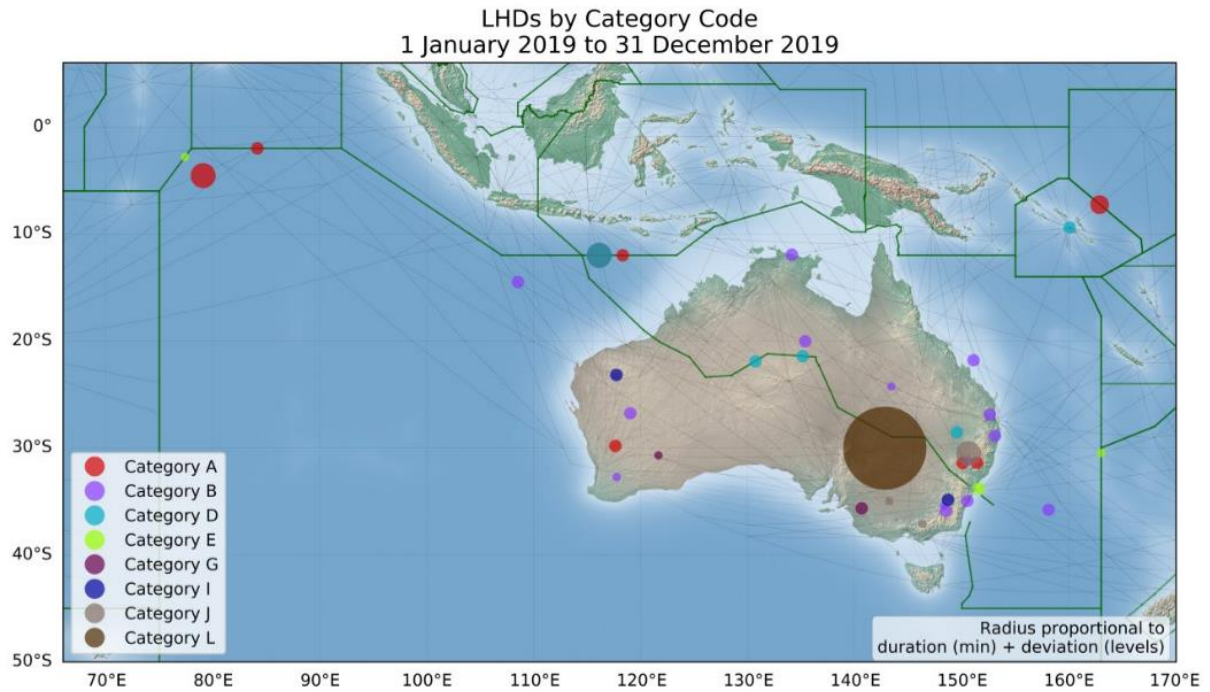


Figure 3: Location of all LHD occurrences for Brisbane, Honiara, Melbourne, Nauru and Port Moresby FIRs for the period 1 January 2019 to 31 December 2019.

5.2 A map identifying the geographic location of all LHD occurrences for Jakarta and Ujung Pandang FIRs for the period 1 January 2019 to 31 December 2019 is shown in **Figure 4**. There occurrences are dominated by Category E events (coordination errors due to human factors issues).

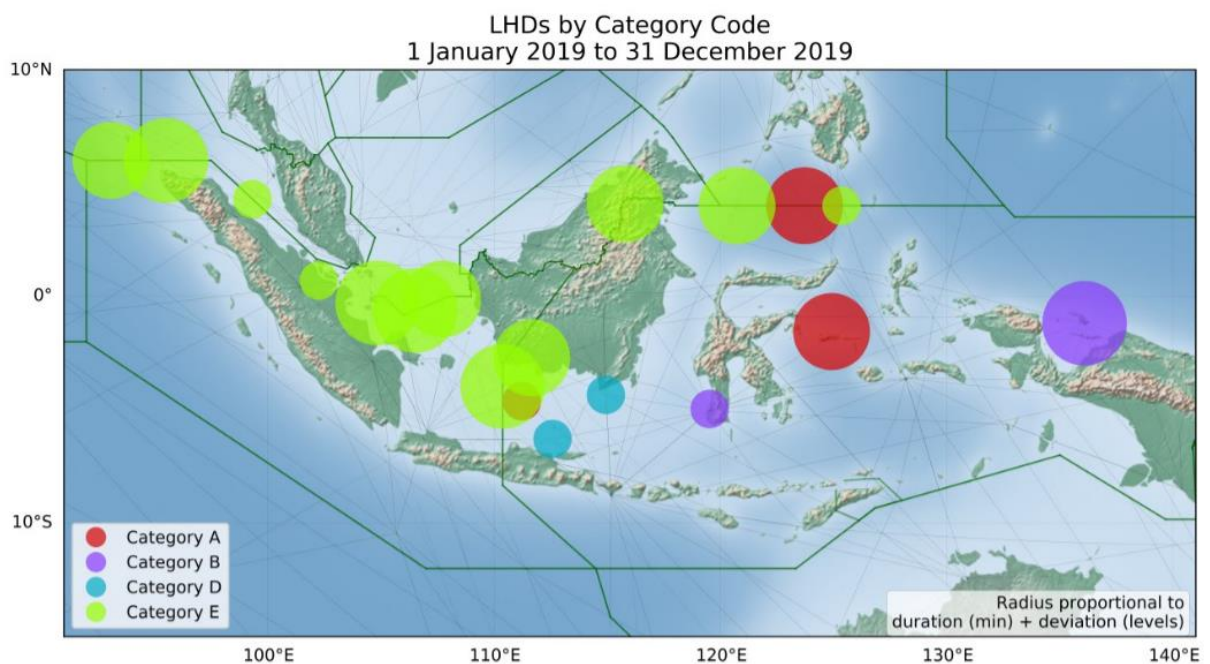


Figure 4: Location of all LHD occurrences for Jakarta and Ujung Pandang FIRs for the period 1 January 2019 to 31 December 2019.

6. DISCUSSION

6.1 For the Brisbane, Honiara, Melbourne, Nauru and Port Moresby FIRs, the risk is lower compared to that reported to RASMAG/24. This is because two high risk occurrences are no longer included in the 12 month sample.

6.2 For the Brisbane, Honiara, Melbourne, Nauru and Port Moresby FIRs, the majority of LHDs were category A (flight crew failing to climb/descend the aircraft as cleared) and B (Flight crew climbing/descending without ATC clearance).

6.3 In December 2019, there was one occurrence of long duration in the Melbourne FIR involving a military formation being provided with RVSM separation while RVSM separation was not approved. The event was assessed as duration 95 minutes. However, total risk remains below the total TLS because the risk associated with an individual occurrence involving RVSM separation being incorrectly applied is low, in comparison to occurrences in which an aircraft is at the incorrect level.

6.4 In the current report, the calculation for the technical risk in the Brisbane, Honiara, Melbourne, Nauru and Port Moresby FIRs was reviewed. Previously, in order to calculate the technical risk, RVSM airspace was split into Indian, Domestic, and Tasman regions. In the current report, the calculation is based on six separate regions: Indian Uni- and Bi-directional, Domestic Uni- and Bi-directional, and Tasman Uni- and Bi-directional. The calculation is more closely aligned with that for operational risk, which is also based on the six separate regions, and is a more accurate reflection of true risk.

6.5 For the Jakarta and Ujung Pandang FIRs, the risk is higher compared to that reported to RASMAG/24 and now exceeds the total TLS.

6.6 Since June 2019, there have been 21 non-zero-duration LHDs reported to AAMA from within the Jakarta and Ujung Pandang FIRs. The increased risk in RVSM airspace since RASMAG/24 could be due to an enhanced reporting culture.

6.7 The majority of LHDs (24 of 33) in the Jakarta and Ujung Pandang FIRs were category E (Coordination errors in the ATC-to-ATC transfer or control responsibility as a result of human factors issues).

6.8 The South East Asia Safety Monitoring Agency (SEASMA) have implemented air traffic services interfacility data communications (AIDC) and reported at the MAWG/7 meeting that this has mitigated Category E errors with neighbouring FIRs. Jakarta and Ujung Pandang ATC have reached out to SEASMA via AAMA to collaborate on developing additional mitigating measures to reduce coordination errors. This discussion has been put on hold as a result of the COVID-19 pandemic.

7. ACTION BY THE MEETING

3.1 The meeting is invited to:

- a) note the information contained in this paper; and
- b) 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
1 January 2019 to 31 December 2019**



Role	Name and Position	Signature
Prepared By	Amelia Gontar Risk Intelligence Specialist	<i>A. Gontar</i>
Reviewed By	Matthew Streat Senior ATM Safety Performance Lead	<i>M. Streat</i>
Endorsed By	Mu Yan Risk Intelligence Manager	<i>Mu Yan</i>

Executive Summary

For the period 1 January 2019 to 31 December 2019, the total risk meets the agreed Target Level of Safety (TLS) value of 5.0×10^{-9} . The RVSM technical, operational, and total risks are summarised in **Table A**. Trends of the technical, operational, and total risks are shown in **Figure A**.

In December 2019, there was one occurrence of long duration involving a military formation being provided with RVSM separation, while RVSM separation is not approved. The total risk remains below the total TLS because the risk associated with an individual occurrence involving RVSM separation being incorrectly applied is low.

In the current report, the calculation for the technical risk was reviewed. The result is a more accurate reflection of true risk.

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

Australian, Nauru, Papua New Guinea and Solomon Islands RVSM Airspace – estimated annual flying hours = 942,831 hours (note: estimated hours based on December 2018 traffic sample data)			
Source of Risk	Risk Estimation	TLS	Remarks
Technical Risk	0.283×10^{-9}	2.5×10^{-9}	Below Technical TLS
Operational Risk	1.08×10^{-9}	-	-
Total Risk	1.37×10^{-9}	5.0×10^{-9}	Below Overall TLS

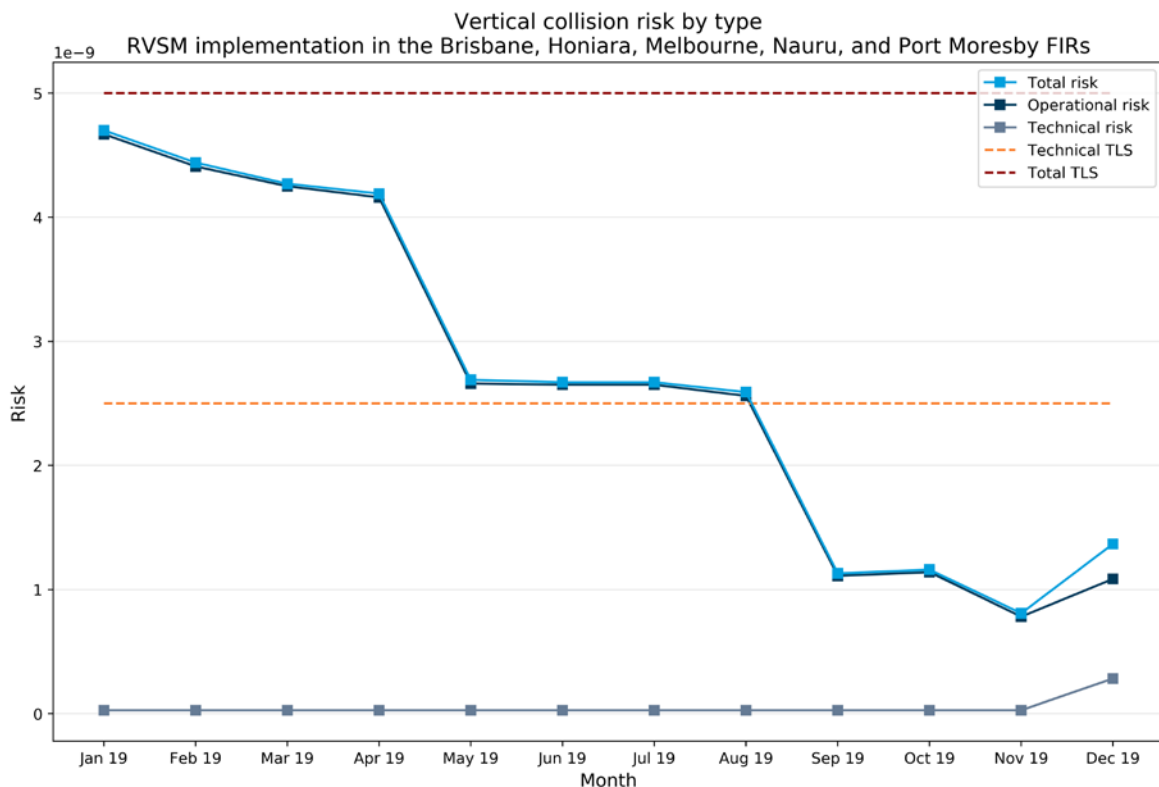


Figure A: RVSM Risk Estimate Trends for the period 1 January 2019 to 31 December 2019.

AIRSPACE SAFETY REVIEW OF THE RVSM IMPLEMENTATION IN AUSTRALIAN, NAURU, PAPUA NEW GUINEA AND SOLOMON ISLANDS AIRSPACE

1 JANUARY 2019 TO 31 DECEMBER 2019

Prepared by
Australian Airspace Monitoring Agency (AAMA) – January 2020
(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 12 month data sample period.

2. Data Sources

2.1 **Traffic Sample Data (TSD).** A TSD covering four weeks of the month of December 2018 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 1 January 2019 to 31 December 2019. The FIRs that submitted LHD reports, including nil returns, are shown in **Table 1**. Details of the LHD reports are provided in **Appendix A**.

Table 1: Summary of FIRs that submitted LHD reports.

FIR Name	Brisbane	Honiara	Melbourne	Nauru	Port Moresby
January 2019	✓	✓	✓	✓	✓
February 2019	✓	✓	✓	✓	✓
March 2019	✓	✓	✓	✓	✓
April 2019	✓	✓	✓	✓	✓
May 2019	✓	✓	✓	✓	✓
June 2019	✓	✓	✓	✓	✓
July 2019	✓	✓	✓	✓	✓
August 2019	✓	✓	✓	✓	✓
September 2019	✓	✓	✓	✓	✓
October 2019	✓	✓	✓	✓	✓
November 2019	✓	✓	✓	✓	✓
December 2019	✓	✓	✓	✓	✓

3. Summary of LHD Occurrences

3.1. The number of LHD occurrences assessed, number of non-nil LHD occurrences, total LHD duration (in minutes), and total number of levels crossed for the period 1 January 2019 to 31 December 2019 are shown by month in **Table 2** and **Figure 1**.

Table 2: Summary of LHD Occurrences. A ‘Non-nil LHD’ is any LHD for which there was a quantifiable risk of collision.

Month-Year	No. of Reported LHD	No. of Non-nil LHD	LHD Duration (Min)	No. Levels Crossed
2019				
January	11	1	0.5	0
February	5	1	1	0
March	12	4	0.5	4
April	7	4	1.5	2
May	7	2	1.5	0
June	6	3	0.5	2
July	9	6	5	2
August	8	3	1	1
September	6	1	0	1
October	6	4	2.5	1
November	11	3	0	3
December	13	7	100.5	1
Total	101	39	114.5	17

Summary of LHD occurrences in Australian, Nauru, Papua New Guinea, and Solomon Islands RVSM airspace
1 January 2019 to 31 December 2019

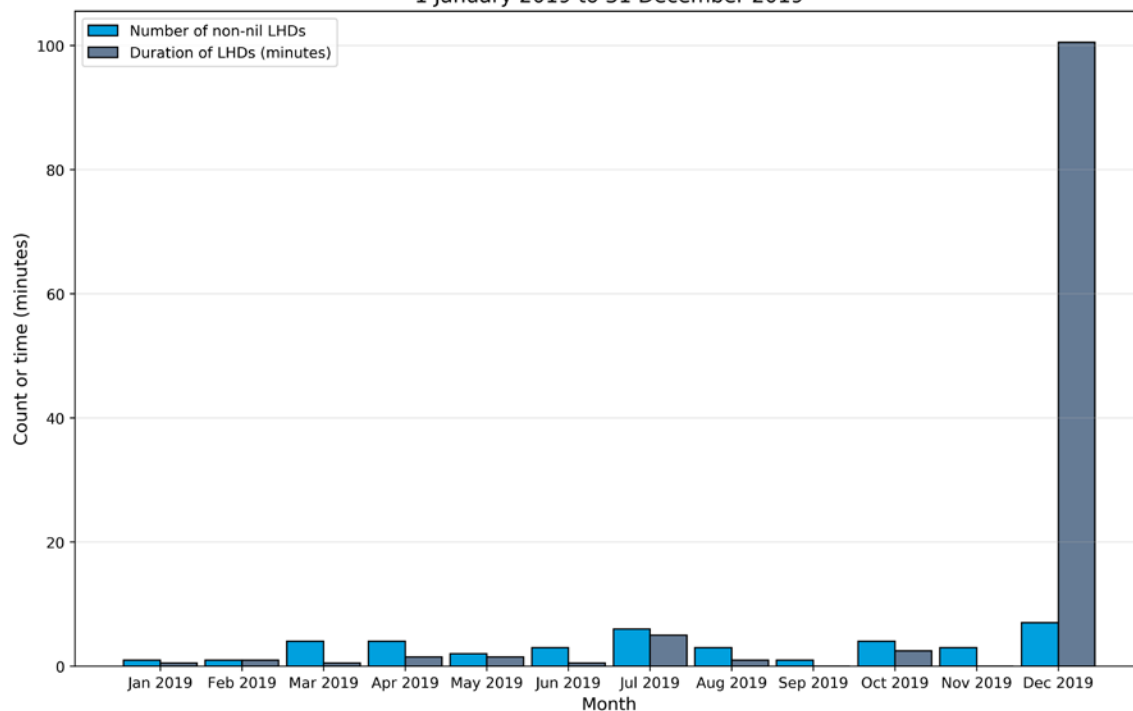


Figure 1: Number and duration of LHD Occurrences by month.

3.2. The number of non-nil LHD occurrences, total LHD duration (in minutes), and total number of levels crossed for the period 1 January 2019 to 31 December 2019 are shown by LHD category in **Table 3** and **Figure 2**.

Table 3: Summary of Non-nil LHD Occurrences, duration, and levels crossed by LHD Category.

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	8	6.5	4
B	Flight crew climbing/descending without ATC Clearance	14	4	8
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)	4	3	1
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)	5	3.5	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)	2	0.5	1
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	2	1	1

J	Deviation due to TCAS resolution advisory, flight crew correctly following the resolution advisory	3	1	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)	1	95	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	114.5	17

Summary of LHD causes in Australian, Nauru, Papua New Guinea, and Solomon Islands RVSM airspace
1 January 2019 to 31 December 2019

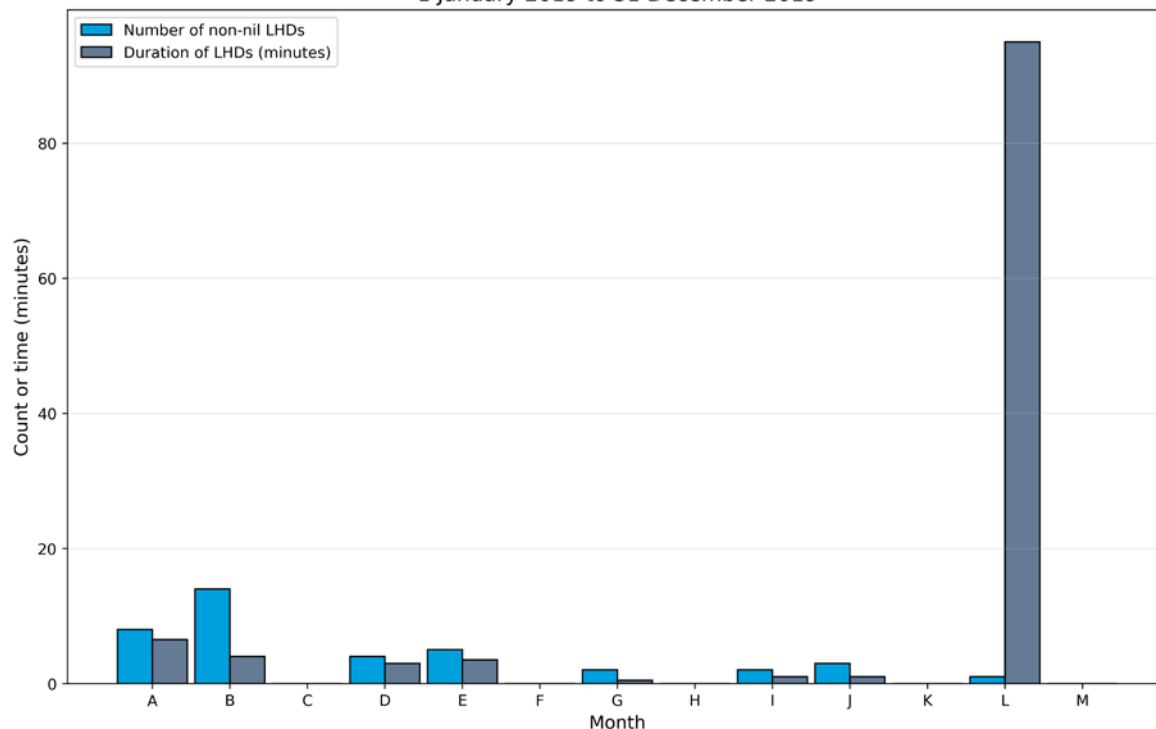


Figure 2: Summary of Non-nil LHDs and duration by LHD category.

- 3.3.1 One **Category A** (Flight crew failing to climb/descend the aircraft as cleared) report was assessed:
- **ATS-0174426** was filed by Southern Operations – West. The occurrence involved the flight crew being slow to climb, resulting in an ascent requirement not being met. The risk was assessed as time to assess and resolve (2 min).
- 3.3.2 One **Category B** (Flight crew climbing/descending without ATC clearance) report was assessed:
- **ATS-0174401** was filed by Northern Operations – Longreach. The occurrence involved the flight crew climbing without clearance following ATC enquiring when they could accept a level. The risk was assessed as time to assess and resolve (0.5 min).
- 3.3.3 Three **Category D** (ATC system loop error) reports were assessed:
- **ATS-0173865** was filed by Southern Operations – Central. The occurrence involved the flight crew mistakenly thinking the aircraft was cleared in a block after being advised that the block was available. The risk was assessed as time to assess and resolve (1 min).
 - **ATS-0173987** was filed by Northern Operations – East. The occurrence involved the flight crew failing to reach a height requirement by 10 minutes prior to estimated time of passing (ETOP). The risk was assessed as time to assess and resolve (1 min).
 - **ATS-0174528** was filed by Northern Operations – Gwydir. The occurrence involved a clearance to climb being issued to the incorrect aircraft, following callsign and frequency confusion. The risk was assessed as time to assess and resolve (1 min).
- 3.3.4 One **Category G** (Aircraft contingency event leading to sudden inability to maintain assigned flight level) report was assessed:
- **ATS-0173835** was filed by Southern Operations – Barossa. The occurrence involved immediate descent due to a shattered windshield. The risk was assessed as 1 level crossed.
- 3.3.5 One **Category L** (Aircraft being provided with RVSM separation is not RVSM approved) report was assessed:
- **ATS-0174073** was filed by Southern Operations – Central. The occurrence involved a military formation being provided with RVSM separation when RVSM separation standards do not apply for military formations. The flight plan indicated the aircraft in the formation were RVSM approved, which led to an ATC misunderstanding of a Flight Plan Safety Net Alert (FPSNA). The risk was assessed as time to assess and resolve (95 min).

3.4 A map identifying the geographic location of all risk bearing (non-nil) LHD occurrences for the period 1 January 2019 to 31 December 2019 is shown in **Appendix B**. Each occurrence is represented by a coloured point. The occurrence (ATS-0174073) in December 2019 involving a military formation being provided with RVSM separation when not RVSM approved has been identified as a high risk occurrence, and is identified by a red diamond. The map is intended to provide a means to identify risk hot spots related to RVSM operations.

4. Risk Assessment and Safety Oversight

4.1 **Estimate of the CRM Parameters.** The values of the parameters in the Collision Risk Model (CRM) used to estimate risk in the RVSM airspace are summarised in **Table 4**.

Table 4: Values of the parameters used in the CRM.

Parameter	Description	Value
λ_x	Average aircraft length	0.0233 NM DOM (Uni-directional) 0.0304 NM DOM (Bi-directional) 0.0333 NM IND (Uni-directional) 0.0357 NM IND (Bi-directional) 0.0289 NM TAS (Uni-directional) 0.0269 NM TAS (Bi-directional)
λ_y	Average aircraft wingspan	0.0208 NM DOM (Uni-directional) 0.0284 NM DOM (Bi-directional) 0.0318 NM IND (Uni-directional) 0.0346 NM IND (Bi-directional) 0.0267 NM TAS (Uni-directional) 0.0247 NM TAS (Bi-directional)
λ_z	Average aircraft height	0.0069 NM DOM (Uni-directional) 0.0085 NM DOM (Bi-directional) 0.0095 NM IND (Uni-directional) 0.0102 NM IND (Bi-directional) 0.0084 NM TAS (Uni-directional) 0.0078 NM TAS (Bi-directional)
$ \overline{\Delta V} $	Average relative same-direction speed	22.4 kt DOM (Uni-directional) 19.4 kt DOM (Bi-directional) 0.00 kt IND (Uni-directional) 18.1 kt IND (Bi-directional) 23.9 kt TAS (Uni-directional) 18.5 kt TAS (Bi-directional)
$ \overline{V} $	Average aircraft speed	448.2 kt DOM (Uni-directional) 472.7 kt DOM (Bi-directional) 466.5 kt IND (Uni-directional) 490.2 kt IND (Bi-directional) 465.0 kt TAS (Uni-directional) 464.0 kt TAS (Bi-directional)
$ \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 kt otherwise
$P_z(0)$	Probability two aircraft at the same nominal level are in vertical overlap	0.357 DOM (Uni-directional) 0.440 DOM (Bi-directional) 0.488 IND (Uni-directional) 0.527 IND (Bi-directional) 0.432 TAS (Uni-directional) 0.404 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) 0.084 DOM (Bi-directional) 0.094 IND (Uni-directional) 0.102 IND (Bi-directional) 0.079 TAS (Uni-directional) 0.073 TAS (Bi-directional)
$E_z(same)$	Same direction occupancy	0.088 DOM (Uni-directional) 0.273 DOM (Bi-directional) 0.000 IND (Uni-directional) 0.203 IND (Bi-directional) 0.074 TAS (Uni-directional) 0.203 TAS (Bi-directional)
$E_z(opp)$	Opposite direction occupancy	0.0042 DOM (Uni-directional) 0.0448 DOM (Bi-directional) 0.0000 IND (Uni-directional) 0.0160 IND (Bi-directional) 0.0000 TAS (Uni-directional) 0.02153 TAS (Bi-directional)
$E_z(cross)$	Crossing occupancy	0.014 DOM (Uni-directional) 0.036 DOM (Bi-directional) 0.000 IND (Uni-directional) 0.019 IND (Bi-directional) 0.026 TAS (Uni-directional) 0.015 TAS (Bi-directional)
T	Daily flight hours	830.4 DOM (Uni-directional) 1313.6 DOM (Bi-directional) 17.2 IND (Uni-directional) 166.0 IND (Bi-directional) 22.9 TAS (Uni-directional) 232.9 TAS (Bi-directional)

4.2 **Risk Estimation Results.** The results for the technical, operational, and total risk for the RVSM implementation are detailed in **Table 5**. The technical risk meets the agreed TLS value of no more than 2.5×10^{-9} fatal accidents per flight hour. The operational and weighted total risk meets the specified TLS value for these components of 5.0×10^{-9} .

Table 5: Australian, Nauru, Papua New Guinea, and Solomon Islands Airspace RVSM Risk Estimates.

Australian, Nauru, Papua New Guinea and Solomon Islands RVSM Airspace – estimated annual flying hours = 942,831 hours (note: estimated hours based on December 2018 traffic sample data)			
Source of Risk	Risk Estimation	TLS	Remarks
Technical Risk	0.283×10^{-9}	2.5×10^{-9}	Below Technical TLS
Operational Risk	1.08×10^{-9}	-	-
Total Risk	1.37×10^{-9}	5.0×10^{-9}	Below Overall TLS

4.3 The trends of collision risk estimates for each month for the period 1 January 2019 to 31 December 2019 are shown in **Figure 3**.

In December 2019, there was one occurrence of long duration involving a military formation being provided with RVSM separation while RVSM separation is not approved. The risk was assessed as 95 minutes to assess and resolve. However, total risk remains below the total TLS because the risk associated with an individual occurrence involving RVSM separation being incorrectly applied is low, in comparison to occurrences in which an aircraft is at the incorrect level.

In the current report, the calculation for the technical risk was reviewed. Previously, in order to calculate the technical risk, Australian, Nauru, Papua New Guinea, and Solomon Islands airspace was split into Indian, Domestic, and Tasman regions. In the current report, the calculation is based on six separate regions: Indian Uni- and Bi-directional, Domestic Uni- and Bi-directional, and Tasman Uni- and Bi-directional. The calculation is more closely aligned with that for operational risk, which is also based on the six separate regions, and is a more accurate reflection of true risk.

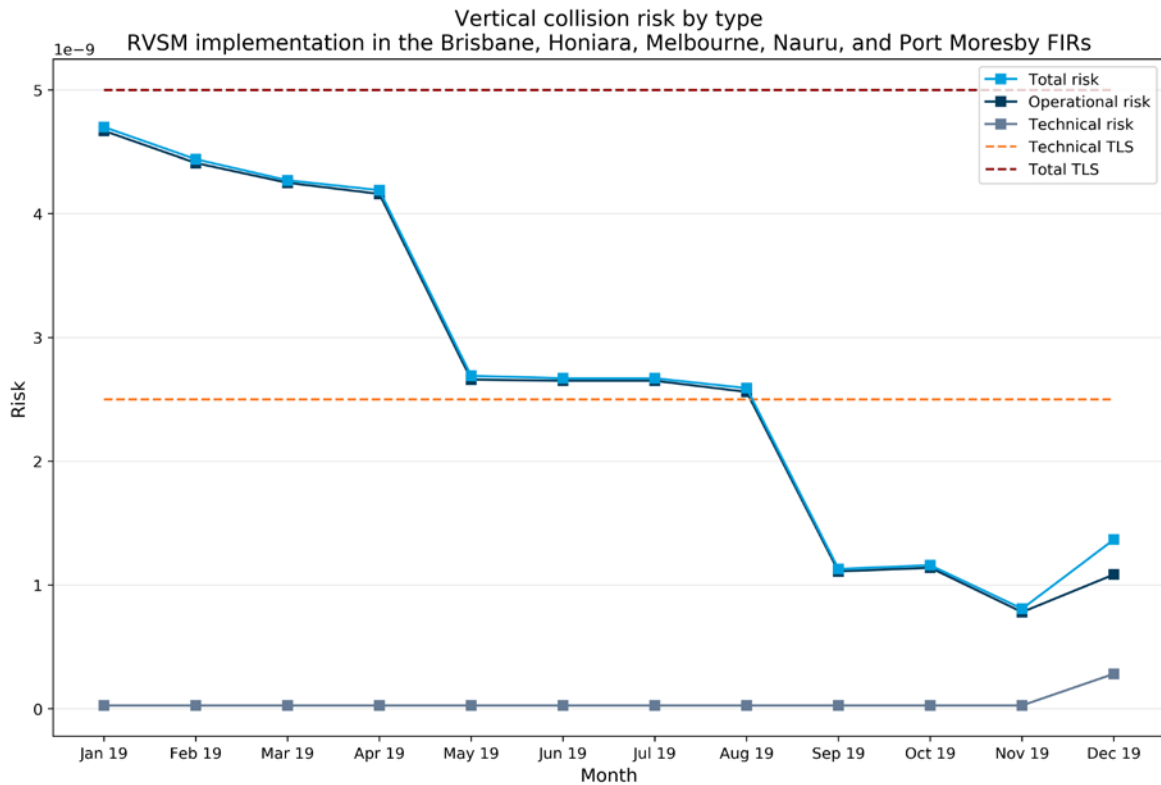


Figure 3: Trends of Risk Estimates for RVSM Airspace.

4.4 In addition to calculating the total risk across the entire 12 month sample, a risk value is calculated individually for each month, allowing the monthly risk to be evaluated without the influence of any historical high risk occurrences resident in the 12 month sample. The risk for every month in the 12 month sample was below the average monthly risk for an annual risk of 5.0×10^{-9} (Figure 4).

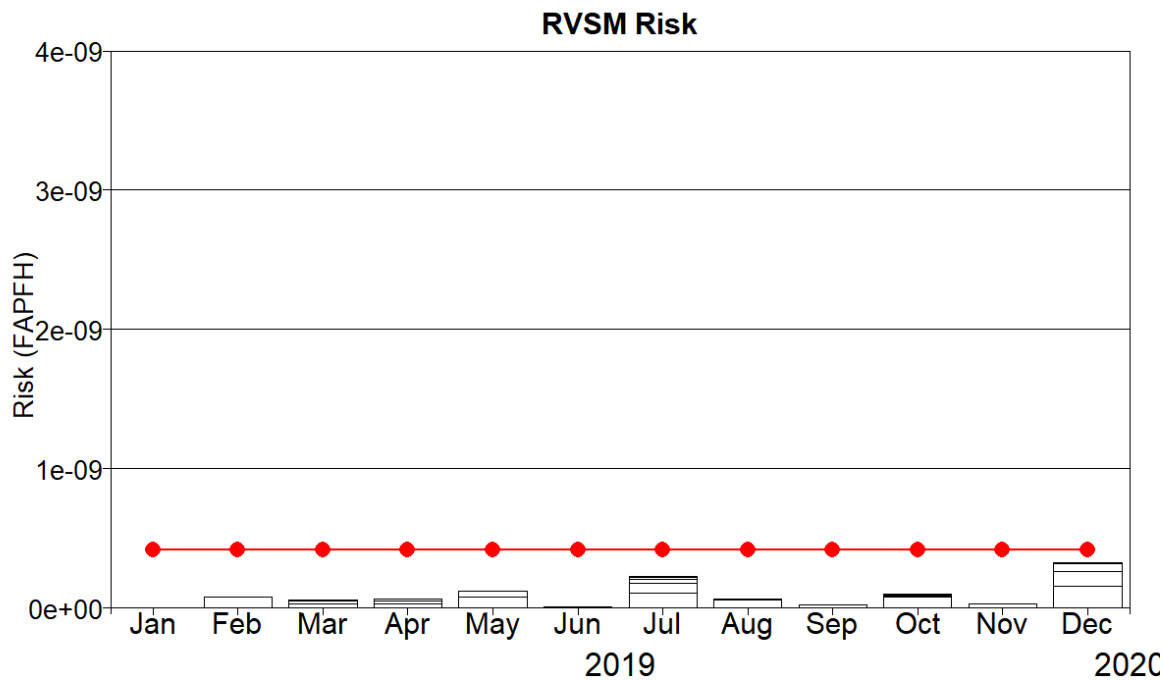


Figure 4: Monthly LHD Risk Estimates for the Australian, Nauru, Papua New Guinea and Solomon Islands RVSM Airspace. The red line is the average monthly value for an annual risk of 5.0×10^{-9} . Risk is measured in Fatal Accidents per Flight Hour (FAPFH).

5. Additional analysis

5.1 The graph shown in **Figure 5** indicates the risk contribution from each of the regions assessed by the AAMA for the Australian FIRs. The results show that Domestic Bi-directional airspace is the highest contributor to risk, with 46.4%.

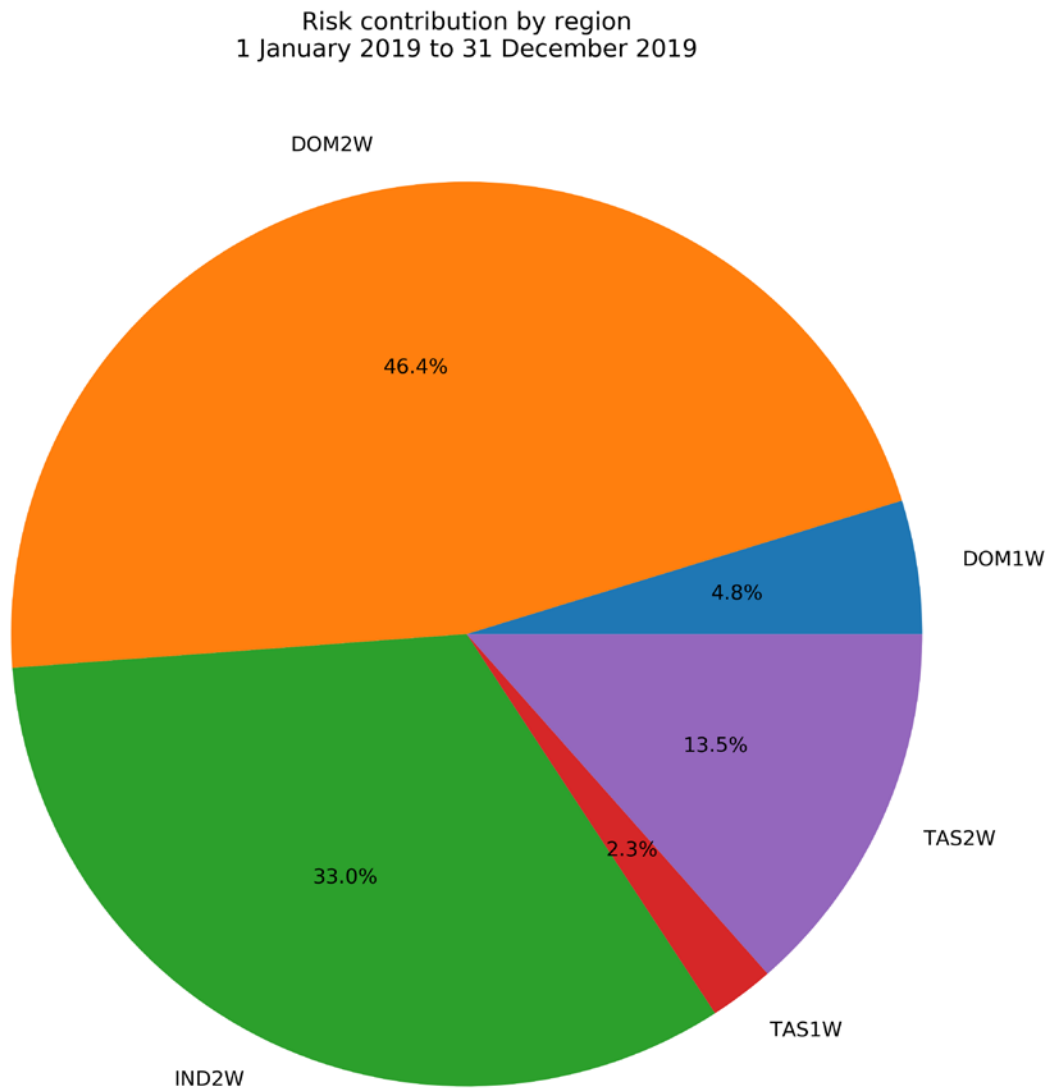


Figure 5: Percentage of risk contribution by region.

5.2 The risk contribution by attribution for the LHDs in the 12 month data sample is shown in **Figure 6**. The results show that foreign non-military pilot is the highest contributor to risk, with 39.5%.

Risk contribution by attribution
1 January 2019 to 31 December 2019

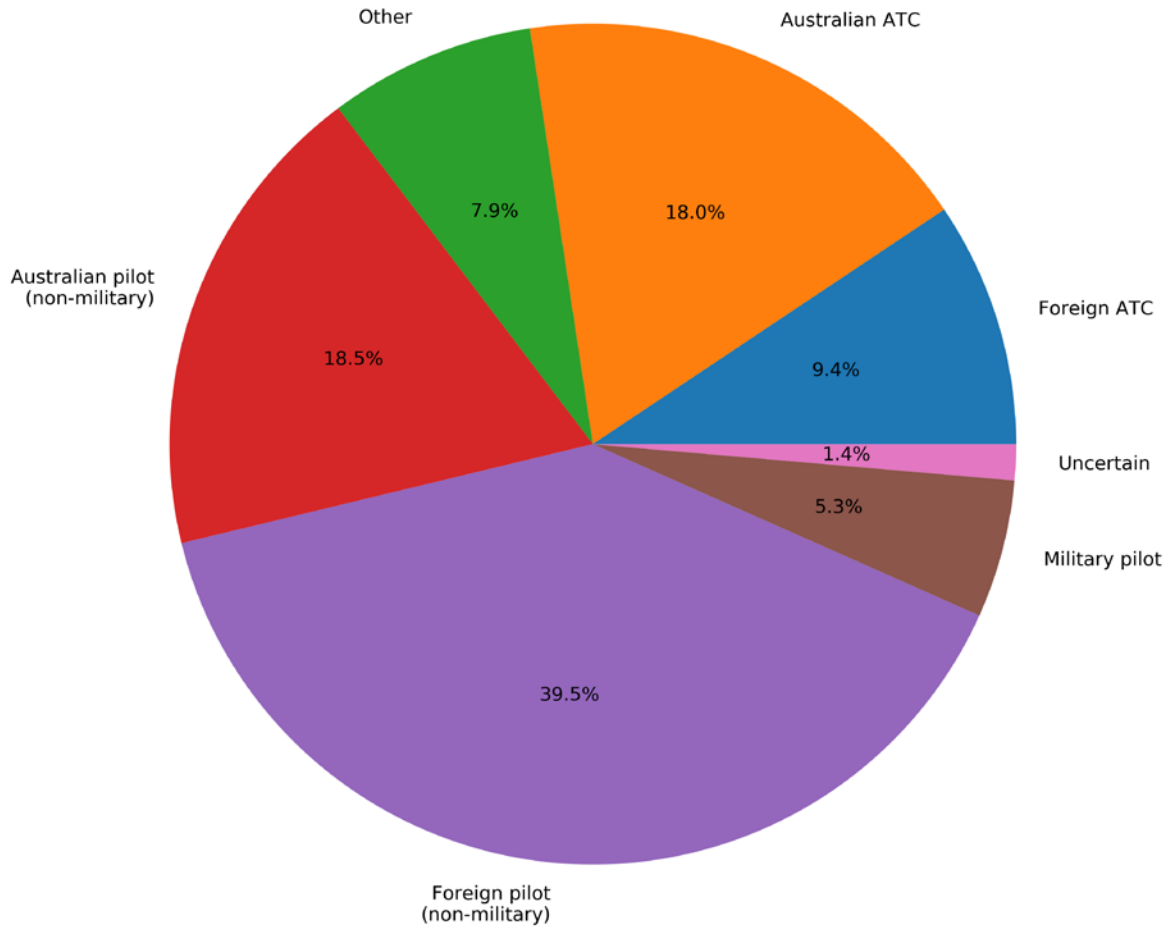


Figure 6: Percentage of Risk Contribution by Attribution.

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 6**.

Table 6: LTHM Burden as of 23 January 2020.

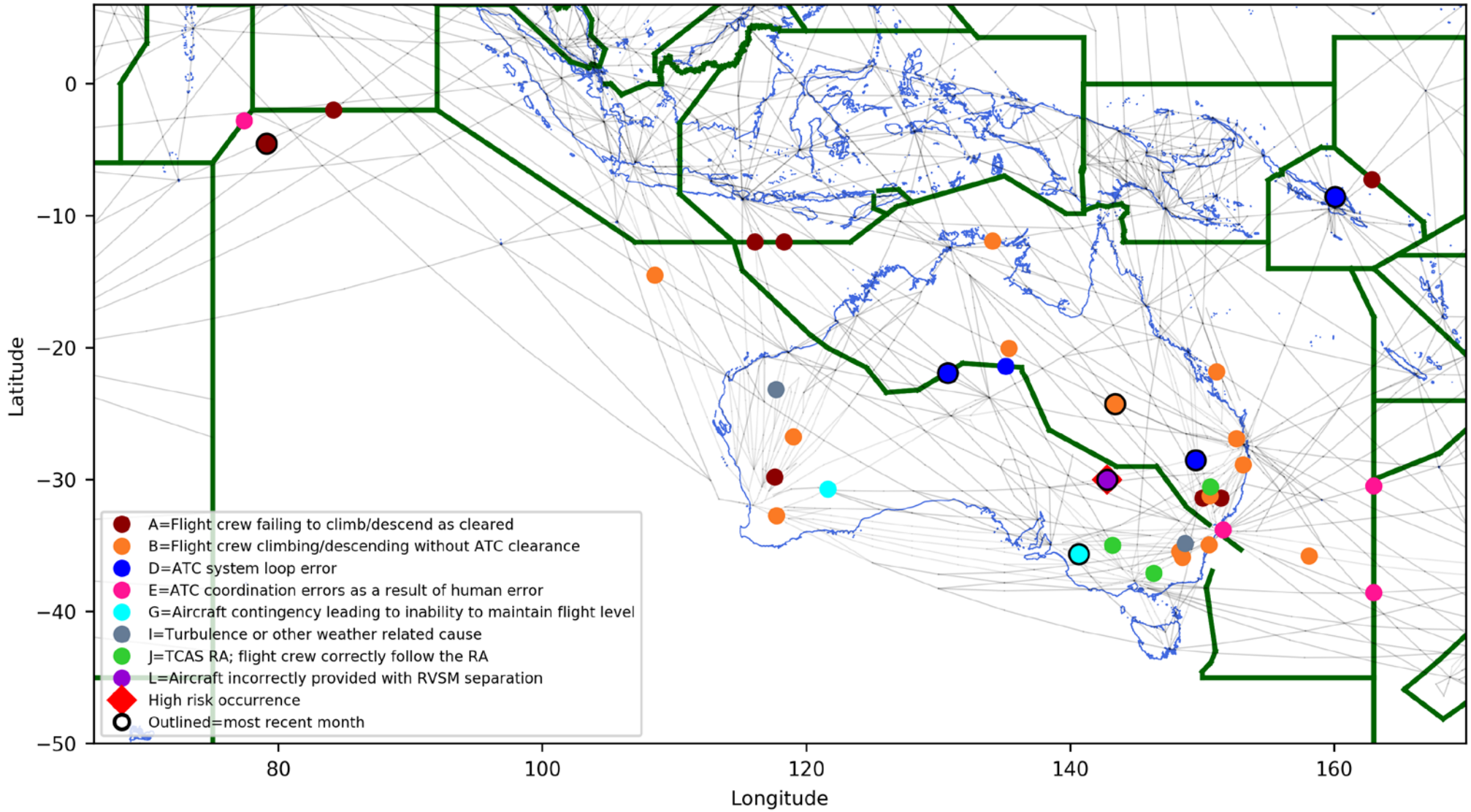
State	Total RVSM Approved Airframes	Resultant Monitoring Burden	Total Airframes Remaining to be Monitored
Australia	688	266	32
Papua New Guinea	21	13	1
Solomon Islands	1	1	0

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 2019	Airservices	FL330	Below FL330	0.5 min	Aircraft descended due to pressurisation issues.	G
February 2019	Airservices	FL280	FL380	1 min	McMurdo assigned the incorrect level to Melbourne ATC.	E
March 2019	Airservices	FL400	FL390	1 level crossed	Aircraft descent due to aircraft performance issue.	B
March 2019	Airservices	FL360	FL340	0.5 min	Auckland ATC did not coordinate a change in flight level to Brisbane ATC.	E
March 2019	Airservices	FL380 & FL370	FL384 & FL366	2 levels crossed	Two aircraft received TCAS RA after instruction to climb.	J
March 2019	Airservices	FL350	FL354	1 level crossed	Aircraft climbed above cleared flight level due to weather.	B
April 2019	Airservices	FL390	Below FL390	1 min	Aircraft descended without clearance due to medical issue.	B
April 2019	Airservices	FL380	FL384	1 level crossed	Aircraft climbed above cleared flight level without clearance.	B
April 2019	Airservices	FL390	Below FL390	0.5 min	Aircraft descended without clearance.	B
April 2019	Airservices	Up to FL330	FL337	1 level crossed	Military aircraft climbed outside of restricted airspace without clearance.	B
May 2019	Airservices	FL330	FL350	0.5 min	Male ATC did not coordinate a change in flight level to Melbourne ATC.	E
May 2019	Airservices	FL330	FL340	1 min	Aircraft issued with a descent instruction did not meet the requirement by the specified time.	B
June 2019	Airservices	FL370	Below FL370	1 level crossed	Aircraft descended without a clearance due to misunderstanding of ATC instruction.	A
June 2019	Airservices	FL370	Below FL370	0.5 min	Aircraft descended without clearance.	B
June 2019	Airservices	FL390	FL385	1 level crossed	Aircraft descended suddenly due to severe turbulence.	I
July 2019	Airservices	FL410	FL403	1 level crossed	Aircraft commenced descent without clearance into Brisbane.	B
July 2019	Airservices	Below FL300	FL308	1 level crossed	Military aircraft climbed above highest usable level for restricted airspace.	B
July 2019	Airservices	FL350	FL340	1.5 min	Aircraft failed to meet a height requirement on the Brisbane FIR boundary.	A
July 2019	Airservices	FL390	FL350	0.5 min	Aircraft descended after responding to a clearance for a different aircraft.	B
July 2019	Airservices	FL350	FL340	2 min	Aircraft failed to meet a height requirement on the Brisbane FIR boundary.	A
July 2019	Airservices	FL280	FL290	1 min	No coordination between sectors regarding a cleared flight level.	E

LHD date	Source	Assigned FL	Observed/ Reported FL	Duration at Incorrect FL	Cause	Category /Sub category
August 2019	Airservices	FL360	Below FL360	0.5 min	TCAS resolution advisory caused by crossing traffic at FL370, resulting in instructions for the aircraft to level off and then descend.	J
August 2019	Airservices	FL290	FL296	0.5 min	TCAS resolution advisory caused by the aircraft entering a holding pattern above an aircraft at FL280, resulting in instructions to climb.	J
August 2019	Airservices	FL360	FL364	1 level crossed	Aircraft climbed above cleared level due to pilot error.	A
September 2019	Airservices	FL400	Above FL400	1 level crossed	Aircraft climbed above assigned level as a result of delayed communications via CPDLC.	A
October 2019	Airservices	FL380	FL360	0.5 min	Incorrect level coordination between NZ ATC and Brisbane ATC.	E
October 2019	Airservices	FL380	FL370	1 min	Flight crew was slow to climb immediately after entering Melbourne FIR.	A
October 2019	Airservices	FL310	FL304	1 min	Flight crew descended without clearance while in a holding pattern, possibly due to turbulence.	I
October 2019	Airservices	Above FL370	FL370	1 level crossed	Flight crew descended without clearance due to misunderstood instruction.	B
November 2019	Airservices	FL350	FL340	1 level crossed	Aircraft was slow to climb and did not meet ascent requirement.	A
November 2019	Airservices	FL360	FL364	1 level crossed	Callsign confusion, resulting in the incorrect aircraft reading back an ascent instruction that was not heard by ATC.	D
November 2019	Airservices	FL360	FL360	1 level crossed	Callsign confusion, resulting in the flight crew descending without clearance after descent clearance was given to a different aircraft.	B
December 2019	Airservices	FL410	Below FL410	1 level crossed	Immediate descent due to shattered windshield.	G
December 2019	Airservices	FL350	Block FL350 to FL370	1 min	Flight crew mistakenly thought that the aircraft was cleared in a block after being advised that the block was available.	D
December 2019	Airservices	FL360	Below FL360	1 min	Aircraft did not reach height requirement by 10 minutes prior to estimated time of passing (ETOP).	D
December 2019	Airservices	FL330	FL330	95 min	A military formation was provided with RVSM separation, but RVSM separation standards cannot be applied for military formations. In the flight plan, the formation was filed as RVSM approved.	L
December 2019	Airservices	Below FL390	FL390	0.5 min	Flight crew climbed without clearance following ATC enquiring when they could accept a level.	B
December 2019	Airservices	FL380	FL370	2 min	Flight crew was slow to climb.	A
December 2019	Airservices	FL360	Above FL360	1 min	Clearance to climb was issued to the incorrect aircraft, following callsign and frequency confusion.	D

Appendix B to AIRSPACE SAFETY REVIEW
 Location of risk bearing LHDs in RVSM airspace
 1 January 2019 to 31 December 2019



AUSTRALIAN AIRSPACE MONITORING AGENCY (AAMA)

**Airspace Safety Review of RVSM in
Indonesian Airspace
1 January 2019 to 31 December 2019**

Role	Name and Position	Signature
Prepared By	Amelia Gontar Risk Intelligence Specialist	<i>A. Gontar</i>
Reviewed By	Matthew Streat ATM Safety Performance Lead	<i>M. Streat</i>
Endorsed By	Mu Yan Risk Intelligence Manager	<i>Mu Yan</i>

Executive Summary

For the period 1 January 2019 to 31 December 2019 inclusive, the total risk exceeds the agreed Target Level of Safety (TLS) value of 5.0×10^{-9} . The RVSM technical, operational and total risks are summarised in **Table A**. Collision risk estimate trends are presented in **Figure A**.

The number of occurrences related to large height deviations (LHDs) that are being reported from within the Indonesian FIRs is increasing, with 21 risk-bearing occurrences reported since 1 June 2019. The increase risk in RVSM airspace since July 2019 could be due to an enhanced reporting culture.

In addition, there are two reports of LHDs in October 2019 and November 2019 included in the rolling 12-month sample that had previously not been considered, since these were reported retrospectively by the Monitoring Agency for Asia Region (MAAR).

Table A: Indonesian Airspace RVSM Risk Estimates.

Indonesian RVSM Airspace – estimated annual flying hours = 1,232,871 hours (note: estimated hours based on Dec 2018 traffic sample data)			
Source of Risk	Risk Estimation	TLS	Remarks
Technical Risk	0.222×10^{-9}	2.5×10^{-9}	Below Technical TLS
Operational Risk	10.0×10^{-9}	-	-
Total Risk	10.2×10^{-9}	5.0×10^{-9}	Above TLS

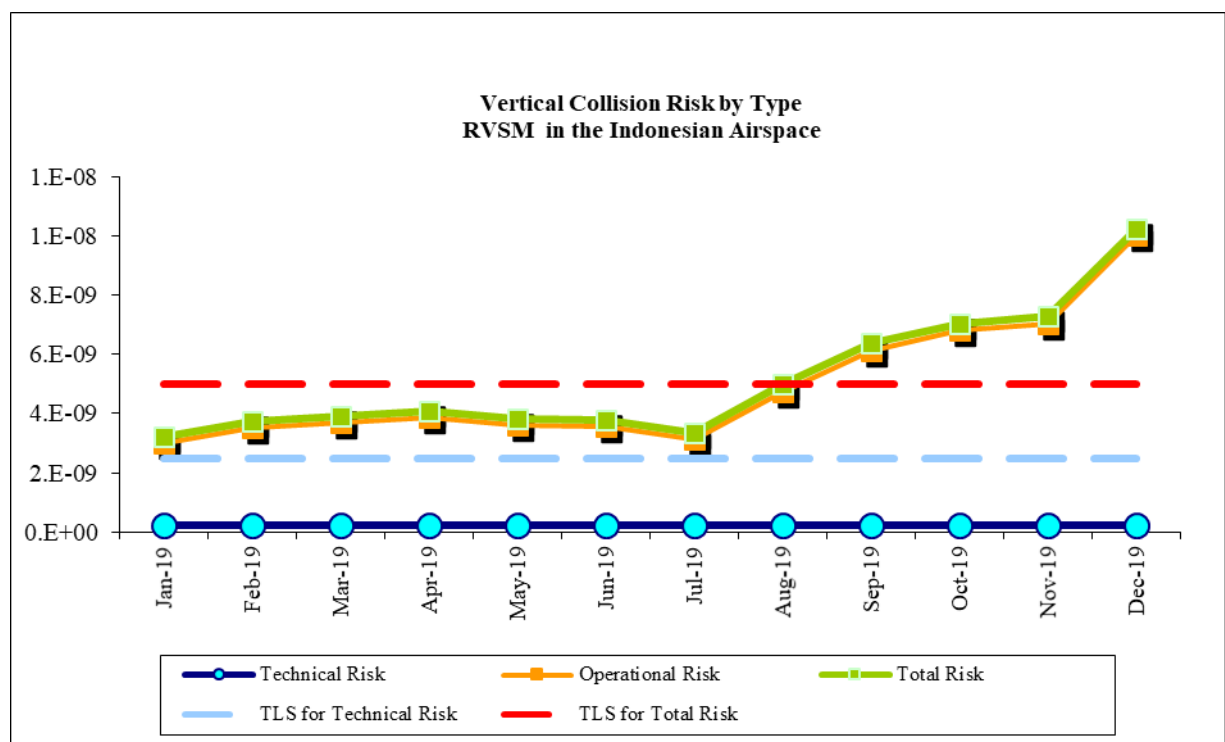


Figure A: RVSM Risk Estimate Trends.

**AIRSPACE SAFETY REVIEW OF THE RVSM IMPLEMENTATION IN
INDONESIAN AIRSPACE
1 JANUARY 2019 TO 31 DECEMBER 2019**

Prepared by

Australian Airspace Monitoring Agency (AAMA) – February 2020
(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 12 month data sample period.

2. Data Sources

2.1. **Traffic Sample Data (TSD).** A TSD covering four weeks of the month of December 2018 of aircraft operating in the Jakarta and Ujung Pandang FIRs was used as required by ICAO Regional agreement. The TSD quality is considered a large improvement over the sample used in previous assessments and has led to a more accurate indication of traffic within the FIRs. The following changes in the TSD were observed:

- Previously, flights from the Ujung Pandang FIR had been used in place of flights from the Jakarta FIR to over-estimate the total risk. In this report, a Jakarta FIR TSD was assessed.
- The calculated opposite direction occupancy time has significantly decreased for the Ujung Pandang FIR.
- Estimated flight hours for both FIRs has increased. In the Ujung Pandang FIR this is due to additional data being provided to the AAMA, which allowed for points to be included in the sample which were previously not available.

2.2. **Large Height Deviation (LHD).** A cumulative 12-month data set of LHD reports was used, covering 1 January 2019 to 31 December 2019. The FIRs that submitted LHD reports, including nil returns, are shown in **Table 1**. Details of the LHD reports are given in **Appendix A**.

Table 1: Summary of FIRs that submitted LHD reports.

FIR Name	Jakarta	Ujung
January 2019	✓	✓
February 2019	✓	✓
March 2019	✓	✓
April 2019	✓	✓
May 2019	✓	✓
June 2019	✓	✓
July 2019	✓	✓
August 2019	✓	✓
September 2019	✓	✓
October 2019	✓	✓
November 2019	✓	✓
December 2019	✓	✓

3. Summary of LHD Occurrences

3.1 The number of LHD occurrences assessed, number of non-nil LHD occurrences, total LHD duration (in minutes), and total number of levels crossed for the period 1 January 2019 to 31 December 2019 are shown by month in **Table 2** and **Figure 1**.

Table 2: Summary of LHD Occurrences. A 'Non-nil LHD' is any LHD for which there was a quantifiable risk of collision.

Month-Year	No. of Reported LHD Occurrences	No. of Non-NIL LHD Occurrences	LHD Duration (Min)	No. Levels Crossed
2019				
January	6	1	2	0
February	6	1	3	6
March	7	3	2	0
April	4	2	1	0
May	2	1	2	0
June	5	3	3	1
July	2	2	2	0
August	4	4	6	0
September	6	4	7	0
October	4	2	3	0
November	4	3	2	1
December	9	7	7	0
Total	60	33	40	8

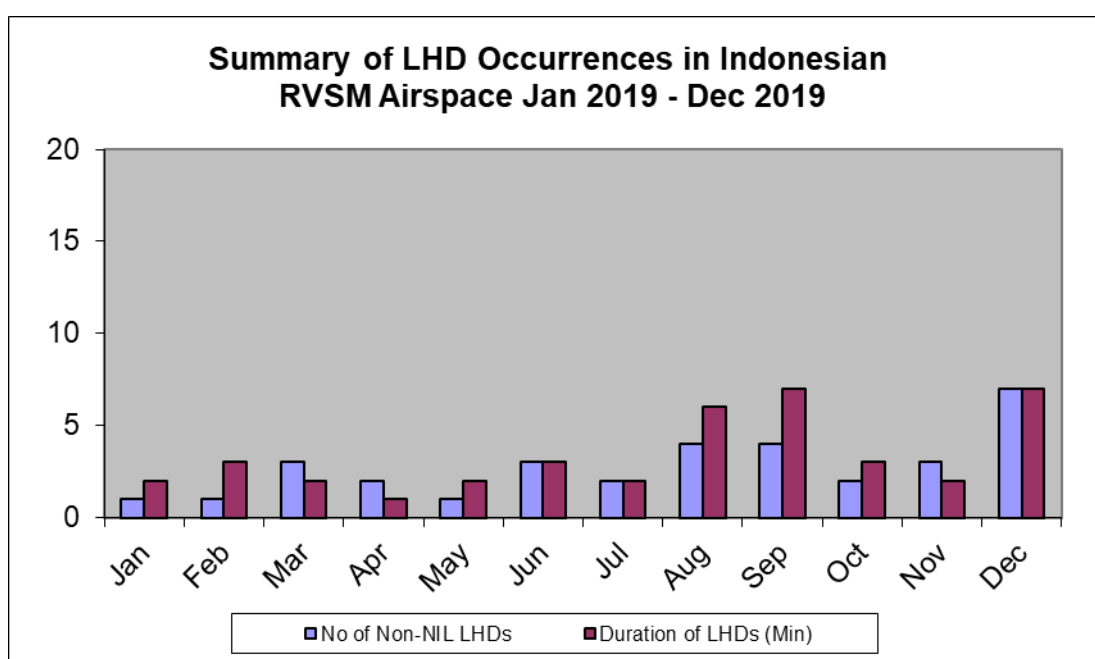


Figure 1: Number and duration of non-nil LHD Occurrences by month.

3.2 A total of 33 non-nil LHDs were reported in the period 1 January 2019 to 31 December 2019.

3.3 The number of non-nil LHD occurrences, total LHD duration (in minutes), and total number of levels crossed for the period 1 January 2019 to 31 December 2019 are shown by LHD category in **Table 3** and **Figure 2**.

Table 3: Summary of Non-nil LHD Occurrences, duration, and levels crossed by LHD Category.

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	3	4	1
B	Flight crew climbing/descending without ATC Clearance	3	1	7
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	4	0
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)	24	31	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	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.	0	0	0
	Total	33	40	8

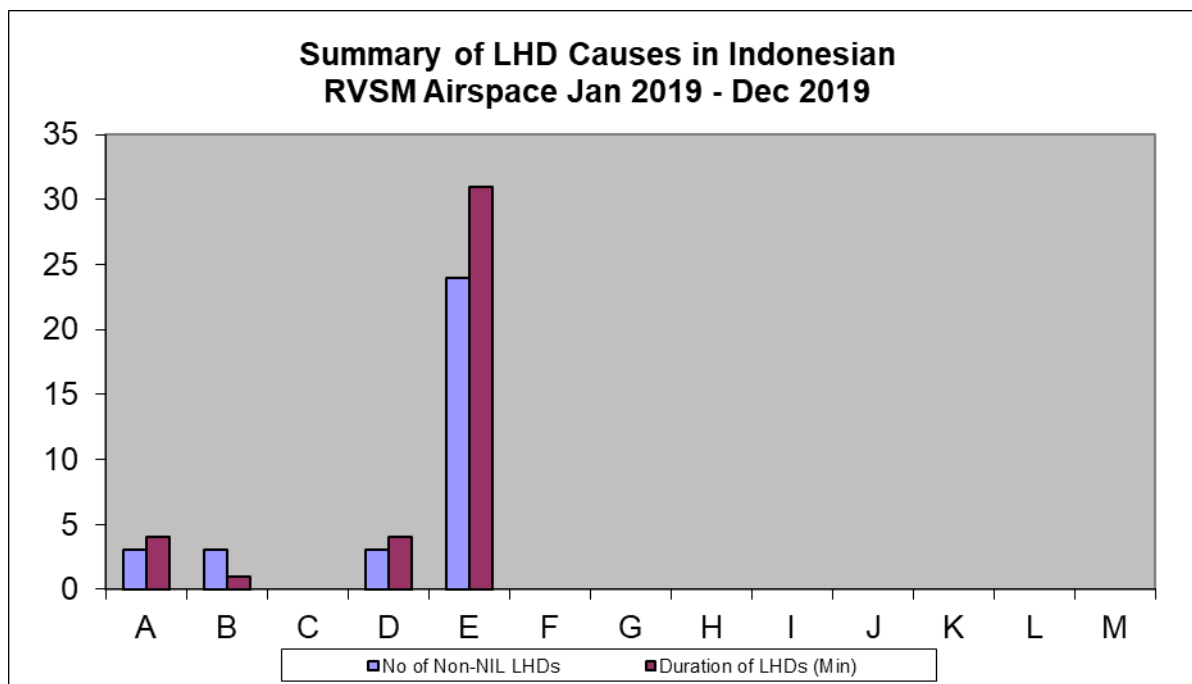


Figure 2: Summary of Non-nil LHDs and duration by LHD category.

3.4 Three non-nil Category A (Flight Crew Failing to climb/descend the aircraft as cleared) LHDs were reported in the 12 month sample. One of the occurrences was assessed as having crossed one level, and the other two occurrences were assessed as nominal time 2 minutes at the incorrect level. All three occurrences were reported by Ujung Pandang ATC.

3.5 Three non-nil Category B (Flight crew climbing/descending without ATC Clearance) LHDs were reported. One was assessed as 6 levels crossed, one was assessed as 1 level crossed, and one was assessed as nominal time 1 minute.

3.6 Three non-nil Category D (ATC loop error) LHDs were reported. One occurrence was reported by Brisbane ATC and involved Ujung ATC incorrectly instructing an aircraft to climb without prior coordination. Both of the remaining two occurrences were reported by Ujung Pandang ATC, and involved incorrect pilot readback that was not identified by the controller. Both occurrences were assessed as nominal time 1 minute.

3.7 Twenty four non-nil Category E (Coordination errors) LHDs were reported. In December 2019, five risk-bearing occurrences were reported. All were reported by Jakarta ATC. The transferring unit was Singapore in three of these occurrences, and Kuala Lumpur in the remaining two occurrences. All five occurrences were assessed as nominal time 1 minute. In addition, there was one non-nil Category E LHD reported retrospectively by MAAR in October 2019, and one in November 2019. These additional two occurrences had not been previously included in the rolling 12-month sample. Both were assessed as nominal time 1 minute.

3.8 A map identifying the geographic location of all risk bearing (non-nil) LHD occurrences for the period 1 January 2019 to 31 December 2019 is shown in **Appendix B**. Each occurrence is represented by a coloured point. Occurrences assessed as being high risk during the current period are identified by a red diamond (one in February 2019). The map is intended to provide a means to identify 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 4**.

Table 4: Estimates of the Parameters in the CRM derived from the Dec 2018 TSD.

Parameter	Description	Value
λ_x	Average aircraft length	0.025 NM (JAK) 0.027 NM (UJU)
λ_y	Average aircraft wingspan	0.023 NM (JAK) 0.025 NM (UJU)
λ_z	Average aircraft height	0.0074 (JAK) 0.0077 (UJU)
$ \overline{\Delta V} $	Average relative same-direction speed	20.3 KT (JAK) 28.7 KT (UJU)
$ \overline{V} $	Average aircraft speed	463 KT (JAK) 459 KT (UJU)
$ \overline{y} $	Average relative cross-track speed	13 KT
$ \overline{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	0.55 (JAK) 0.55 (UJU)
E_z same	Same direction occupancy	1.056 (JAK) 0.495 (UJU)
E_z opp	Opposite direction occupancy	0.207 (JAK) 0.078 (UJU)
	Annual RVSM flight hours	388704 HR (JAK) 844167 HR (UJU)

4.2 **Risk Estimation Results.** The results for the technical, operational, and total risk for the RVSM implementation are detailed in **Table 5**.

The technical risk meets the agreed TLS value of no more than 2.5×10^{-9} fatal accidents per flight hour. The operational and weighted total risk exceeds the specified TLS value for these components of 5.0×10^{-9} .

Table 5: Indonesian Airspace RVSM Risk Estimates.

Indonesian RVSM Airspace – estimated annual flying hours = 1,232,871 hours (note: estimated hours based on Dec 2018 traffic sample data)			
Source of Risk	Risk Estimation	TLS	Remarks
Technical Risk	0.222×10^{-9}	2.5×10^{-9}	Below Technical TLS
Operational Risk	10.0×10^{-9}	-	-
Total Risk	10.2×10^{-9}	5.0×10^{-9}	Above TLS

4.3 The trends of collision risk estimates for each month for the period 1 January 2019 to 31 December 2019 are shown in **Figure 3**.

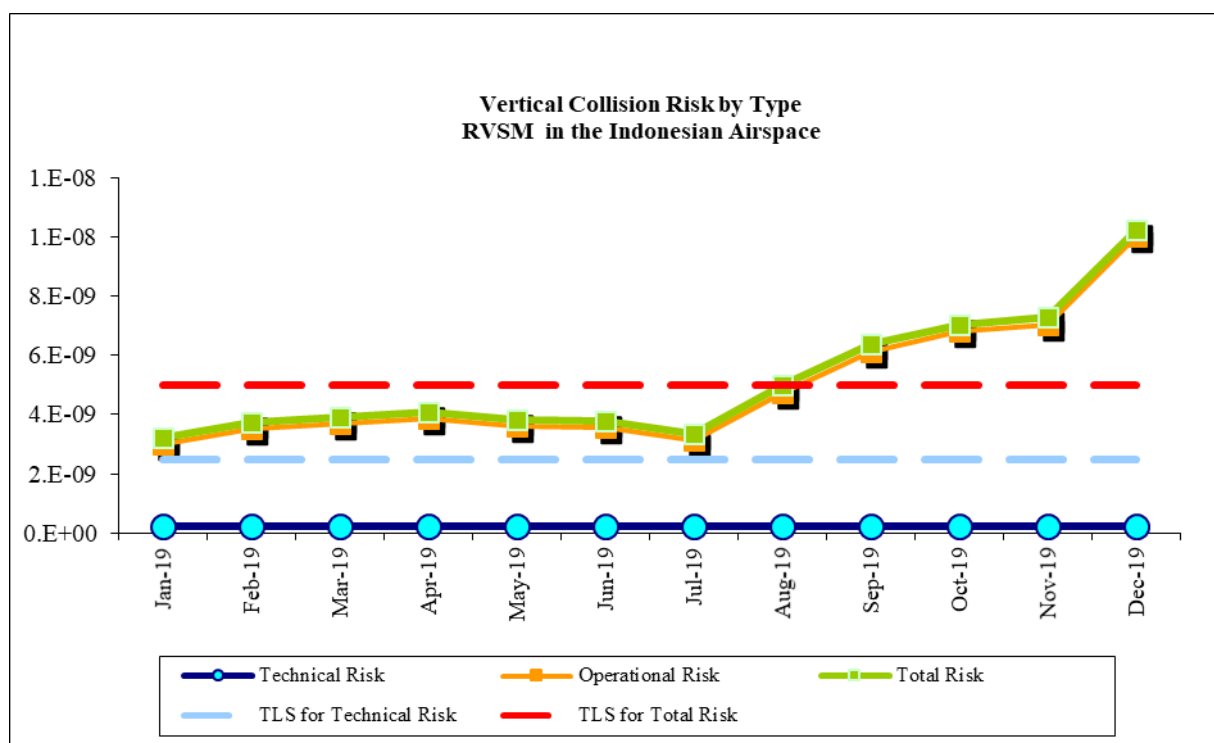


Figure 3: Trends of Risk Estimates for RVSM Airspace.

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 6** below.

Table 6: LTHM Burden as at 26 February 2020. Resultant Monitoring Burden is the total number of airframes that do not meet the required monitoring requirements. Total Airframes Remaining to be Monitored is the minimum number of airframes which require monitoring.

State	Total RVSM Approved Airframes	Resultant Monitoring Burden	Total Airframes Remaining to be Monitored
Indonesia	507	81	44

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 2019	Ujung Pandang	FL340	FL330	2 min	ATC coordinated an aircraft at the incorrect flight level	E
February 2019	Ujung Pandang	FL350	FL390	6 levels crossed	Aircraft descended without clearance	B
February 2019	Singapore	Unknown	Unknown	1 min	Singapore ATC did not include updated information in a transfer to Jakarta ATC	E
February 2019	Airservices	FL350	FL330	2 min	Ujung ATC incorrectly instructed an aircraft to climb without prior coordination.	D
March 2019	Singapore	Unknown	Unknown	1 min	Singapore ATC did not include updated information in a transfer to Jakarta ATC	E
March 2019	Singapore	Unknown	Unknown	1 min	Singapore ATC did not include updated information in a transfer to Jakarta ATC	E
April 2019	Singapore	Unknown	Unknown	1 min	Singapore ATC did not include updated information in a transfer to Jakarta ATC	E
May 2019	MAAR	FL330	FL310	2 min	Singapore ATC provided a revised flight level estimate to Jakarta ATC, but failed to climb aircraft to revised level due to workload.	E
June 2019	Ujung Pandang	FL340	FL330	1 min	Aircraft descended without clearance	B
June 2019	Ujung Pandang	FL320	FL330	1 level crossed	Aircraft climbed above their cleared flight level	A
June 2019	MAAR	FL320	FL360	2 min	Kinabalu ATC included incorrect level information in a transfer to Ujung ATC.	E
July 2019	Ujung Pandang	FL380	FL360	1 min	Ujung ATC included incorrect level information in a transfer to Jakarta ATC, and readback error.	E
July 2019	Ujung Pandang	FL350	FL290	1 min	Jakarta ATC included incorrect level information in a transfer to Ujung ATC.	E
August 2019	Manila	FL350	FL370	1 min	Manila ATC included incorrect level information in a transfer to Ujung ATC.	E
August 2019	Ujung Pandang	FL320	Above FL320	2 min	Aircraft climbed above cleared level on departure.	A
August 2019	Jakarta	FL320	FL340	2 min	Ujung ATC included incorrect level information in a transfer to Jakarta ATC.	E
August 2019	Jakarta	FL290	Above FL310	1 min	Singapore ATC included incorrect level information in a transfer to Jakarta ATC.	E
September 2019	Ujung Pandang	FL350	Below FL350	2 min	Flight crew continued descent past cleared level.	A
September 2019	Ujung Pandang	FL330	FL310	1 min	Jakarta ATC included incorrect level information in a transfer to Ujung ATC.	E
September 2019	Ujung Pandang	Unknown	FL400	2 min	Manila ATC did not provide transfer instructions to Ujung ATC.	E

September 2019	Ujung Pandang	FL390	FL410	2 min	Kinabalu ATC included incorrect level information in a transfer to Ujung ATC.	E
October 2019	Jakarta	Unknown	FL390	2 min	Chennai ATC did not provide transfer instructions to Jakarta ATC.	E
October 2019	MAAR	Unknown	Unknown	1 min	Singapore ATC did not make a level revision to Jakarta ATC due to lapse in workflow process.	E
November 2019	Ujung Pandang	FL330	FL320	1 level crossed	Flight crew descended without clearance as a result of callsign confusion.	B
November 2019	Jakarta	FL340	FL360	1 min	Ujung ATC included incorrect level information in a transfer to Jakarta ATC.	E
November 2019	MAAR	Unknown	Unknown	1 min	Singapore ATC did not provide transfer instructions to Jakarta ATC.	E
December 2019	Ujung Pandang	FL330	FL334	1 min	Incorrect pilot readback not identified by controller.	D
December 2019	Ujung Pandang	FL360	FL367	1 min	Incorrect pilot readback not identified by controller.	D
December 2019	Jakarta	Unknown	FL350	1 min	Aircraft entered Jakarta FIR without prior coordination from Kuala Lumpur following a route deviation.	E
December 2019	Jakarta	Unknown	FL340	1 min	Aircraft entered Jakarta FIR without prior coordination from Kuala Lumpur following a route deviation.	E
December 2019	Jakarta	Unknown	FL400	1 min	Aircraft entered Jakarta FIR without prior coordination from Singapore following a route deviation.	E
December 2019	Jakarta	Unknown	FL340	1 min	Aircraft entered Jakarta FIR without prior coordination from Singapore following a route deviation.	E
December 2019	Jakarta	Unknown	FL360	1 min	Aircraft entered Jakarta FIR without prior coordination from Singapore following a route deviation due to weather.	E

Appendix B to AIRSPACE SAFETY REVIEW
 Location of risk bearing LHDs in RVSM airspace
 1 January 2019 to 31 December 2019

