



International Civil Aviation Organization

**ICAO** Twenty-Seventh Meeting of the Regional Airspace Safety  
Monitoring Advisory Group (RASMAG/27)

Video Teleconference, 22 – 25 August 2022

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

**JASMA VERTICAL SAFETY REPORT**

(Presented by JASMA)

**SUMMARY**

This paper presents the results of the vertical safety assessment of the Reduced Vertical Separation Minimum (RVSM) airspace in the Fukuoka Flight Information Region (FIR) by the Japan Airspace Safety Monitoring Agency (JASMA) for the period from January to December 2021.

**1. INTRODUCTION**

1.1 This paper provides the executive summary of the airspace safety oversight assessment undertaken by the Japan Airspace Safety Monitoring Agency (JASMA) for the Reduced Vertical Separation Minimum (RVSM) implementations in the Fukuoka Flight Information Region (FIR) which is a part of the Pacific Ocean Airspace and North-East Asia Airspace. The report is detailed in **Attachment A**.

**2. DISCUSSION**

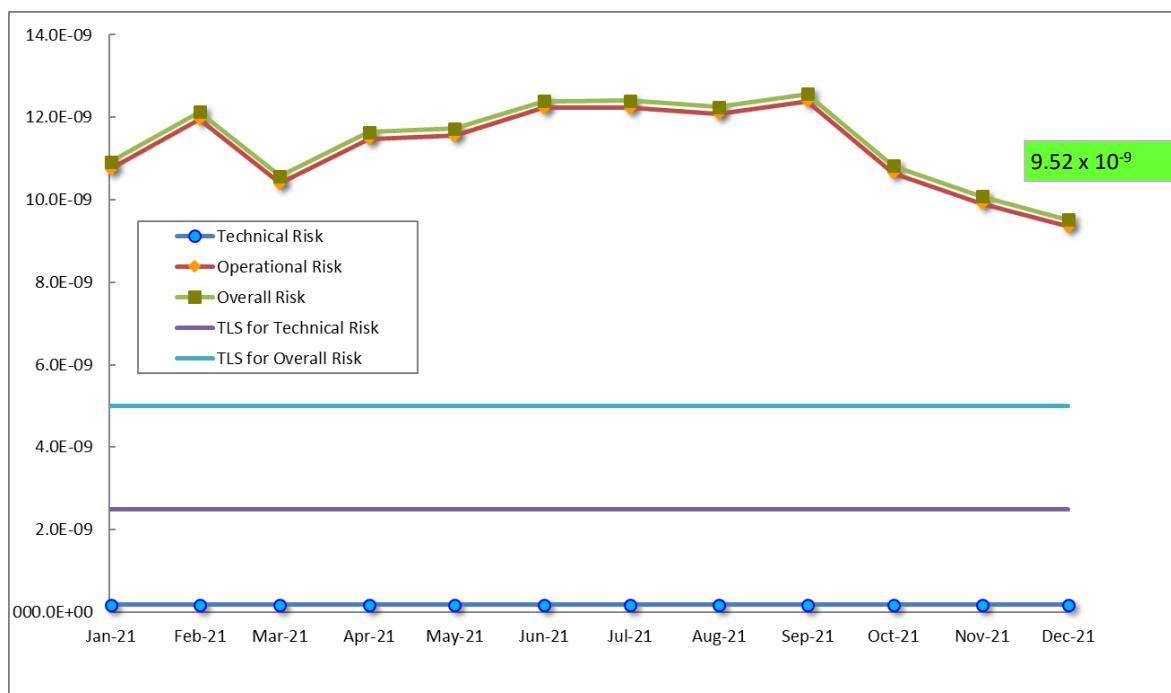
2.1 The report shows that for Fukuoka FIR, the level of risk for the reporting period from 1 January 2021 to 31 December 2021 was  $9.52 \times 10^{-9}$ , which exceeds the target level of Safety  $5.0 \times 10^{-9}$  (TLS).

Executive Summary

2.2 **Table 1** summarizes Japanese airspace RVSM technical, operational, and total risks. **Figure 1** presents collision risk estimate trends during the period from January 2021 to December 2021.

<b>Japanese Airspace – estimated annual flying hours = 991,428 hours</b> (note: estimated hours based on Dec 2021 traffic sample data)			
<b>Source of Risk</b>	<b>Risk Estimation</b>	<b>TLS</b>	<b>Remarks</b>
<i>RASMAG 26 Total Risk</i>	$11.57 \times 10^{-9}$	$5.0 \times 10^{-9}$	<i>Above TLS</i>
Technical Risk	$0.17 \times 10^{-9}$	$2.5 \times 10^{-9}$	Below Technical TLS
Operational Risk	$9.35 \times 10^{-9}$	-	-
Total Risk	<b><math>9.52 \times 10^{-9}</math></b>	$5.0 \times 10^{-9}$	<b>Above TLS</b>

**Table 1:** Japanese Airspace RVSM Risk Estimates



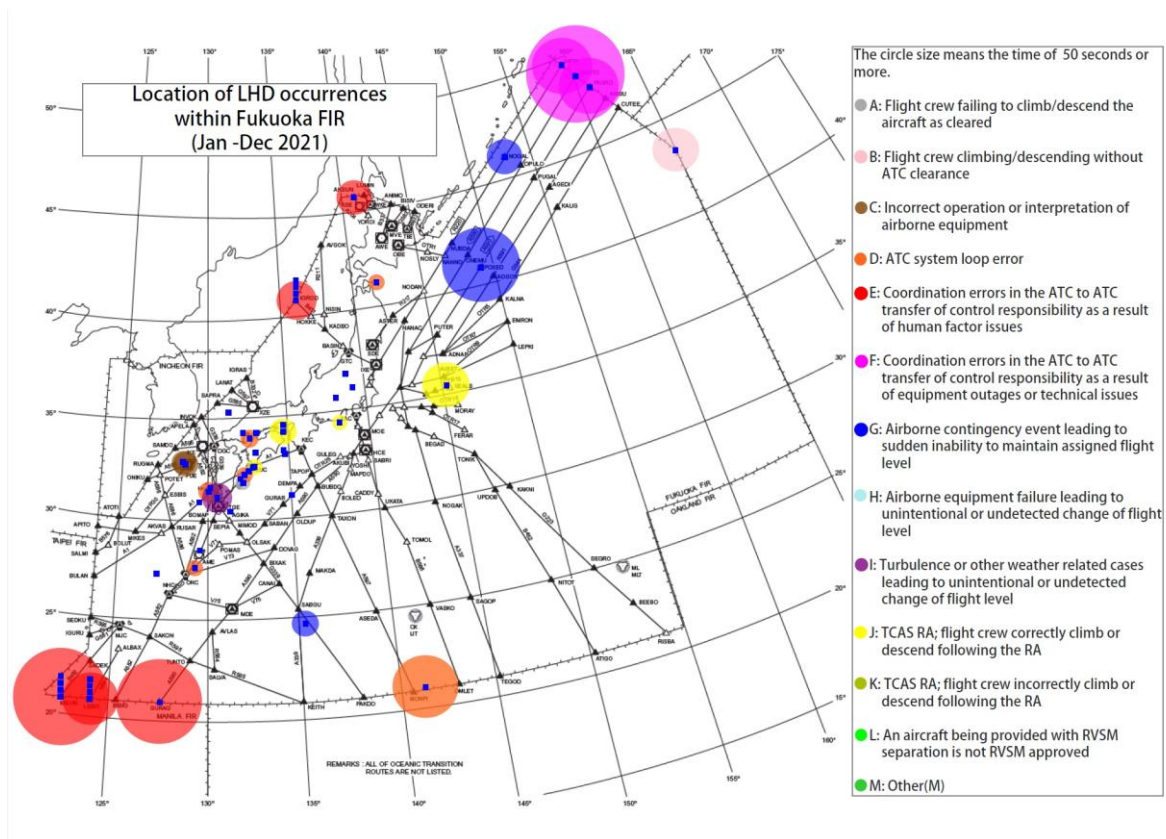
**Figure 1:** Japanese Airspace RVSM Risk Estimate Trends

2.3 **Table 2** presents a summary of the LHD causes within Japanese airspace from January 2021 until December 2021.

Code	LHD Category Description	No.
A	Flight crew fails to climb or descend the aircraft as cleared	3
B	Flight crew climbing or descending without ATC clearance	1
C	Incorrect operation or interpretation of airborne equipment	2
D	ATC system loop error	12
E	Coordination errors in the ATC -to-ATC transfer of control responsibility as a result of human factors issues	15
F	ATC transfer of control coordination errors due to technical issues	3
G	Aircraft contingency leading to sudden inability to maintain level	6
H	Airborne equipment failure and unintentional or undetected level change	0
I	Turbulence or other weather related cause leading to unintentional or undetected change of flight level	5
J	TCAS resolution advisory; flight crew correctly climb or descend following the resolution advisory	9
K	TCAS resolution advisory; flight crew incorrectly climb or descend following the resolution advisory	0
L	An aircraft being provided with RVSM separation is not RVSM approved	0
M	Others	0
Total		56

**Table 2:** Summary of LHD Causes within Japanese Airspace

2.4 **Figure 2** provides the geographic location of LHD reports occurred within Fukuoka FIR during the assessment period. The filled blue square symbols represent LHD location in the RVSM stratum of Fukuoka FIR. The circle size means an LHD duration of 50 seconds or more.



**Figure 2:** Geographical Location of LHDs within Fukuoka FIR

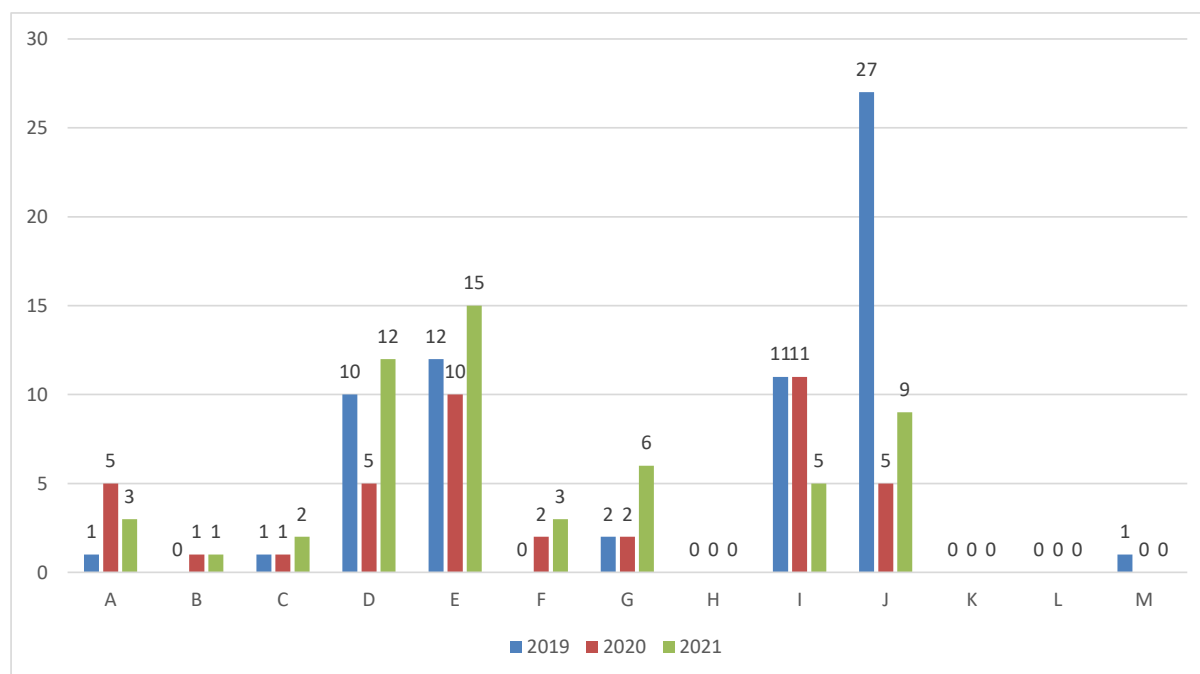
2.5 The estimated overall risk in 2021 exceeds the TLS. However, the risk value is lower than the previous year.

2.6 **Figure 3** presents the comparing the number of LHDs by category from the calendar year 2019 to 2021.

- In general, the number of LHDs in 2021 increased from in 2020. However, the number of LHDs in 2021 did not exceed in 2019.
- The number of category A LHDs, Flight crew fails to climb or descend the aircraft as cleared, slightly decreased to 3.
- The number of category D LHDs, ATC system loop error, soared to 12, which was more than twice the previous year and the highest number in the recent four years.
- The number of category E LHDs, Coordination errors in the ATC -to-ATC transfer of control responsibility as a result of human factors issues, increased to 15, which marked the top contender in the recent five years.
- The number of category J LHDs, TCAS resolution advisory and flight crew correctly responds, increased to 9.
- All nine category J LHDs were caused due to "nuisance TCAS RAs"<sup>\*1</sup>, so "genuine TCAS RAs"<sup>\*2</sup> were not reported in 2021.

\*1 TCAS RAs that occurred despite ATC instructed enough vertical separation for aircraft and the flight crew responded correctly.

\*2 TCAS RAs that occurred when ATC did not provide 1,000 ft or more vertical separation.



**Figure 3:** Comparing LHDs from 2019 to 2021

2.7 JASMA has been analyzing trends and changes of LHDs under the COVID-19 situation.

- Decreasing the number of category A LHDs might be due to the increasing opportunities that pilots could operate aircraft thanks to the relaxation of travel restrictions.
- The reason for jumping the number of category D LHDs might be supposed due to increased errors on both sides, air traffic controllers and pilots. One of the reasons is the increase and rebound of callsign confusion. Thus, the occurrence of callsign confusion seems to be in proportion to the traffic volume.
- It might be thought as one of the other reasons for soaring category D LHDs that less-experienced controllers and pilots who had obtained their license during the less traffic situation were on duty in the current situation that they have never experienced. In any case, continued and detailed analysis would be needed.
- The number of category E LHDs might not be in proportion to air traffic volumes and flight hours, so implementing technical mitigation measures (e.g. AIDC) might be most effective.
- The number of category J LHDs might be in proportion to air traffic volumes and flight hours.

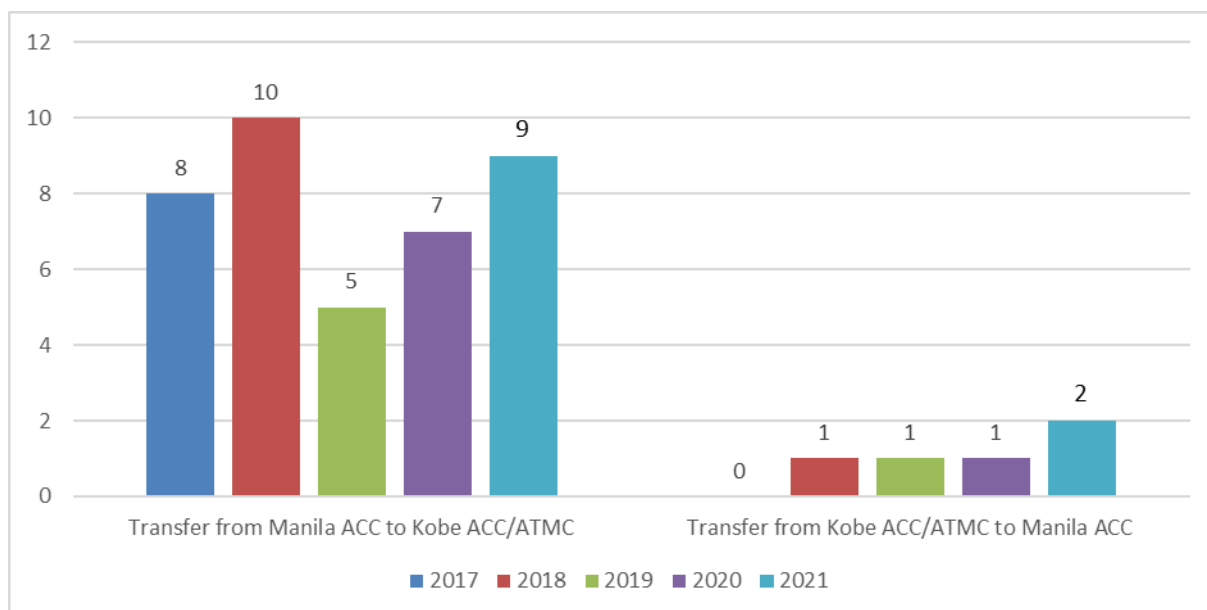
2.8 On the basis of the RASMAG Task List 26/3, the detailed analysis for category A and B LHDs in 2020 and 2021 would be presented by JASMA in a separated working paper.

2.9 **Figure 4** presents LHDs that occurred at the Hot spot D, the FIR boundary between Fukuoka FIR and Manila FIR. A total of 11 category E LHDs occurred at Hot spot D in 2021. Nine of these LHDs occurred on transfer from the Manila Area Control Center (ACC) to the Fukuoka Air Traffic Management Center (ATMC) or Kobe ACC, and the rest of the two LHDs occurred on transfer from Fukuoka ATMC or Kobe ACC to Manila ACC.

2.10 Four LHDs occurred due to no revised transfer information of altitude change from Manila ACC. Two LHDs occurred due to no revised transfer information of estimated time of over (ETO) at

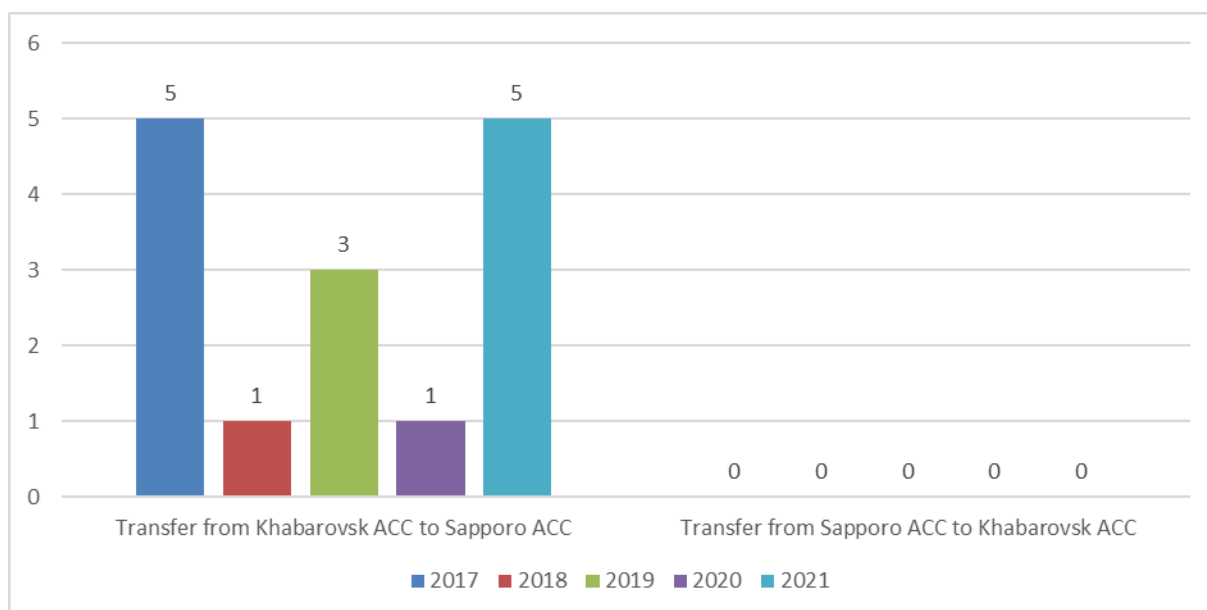
the FIR boundary from Manila ACC, and the aircraft passed at the FIR boundary more than 11 minutes prior to the ETO.

2.11 Two LHDs occurred due to verbal communication errors on transfer, read-back and hear-back mistakes between Kobe ACC and Manila ACC.



**Figure 4:** Number of LHDs at Hot spot D between Fukuoka and Manila FIR

2.12 **Figure 5** presents LHDs that occurred at the former Hot spot L, the FIR boundary between Fukuoka FIR and Khabarovsk FIR. A total of 5 category E LHDs occurred on transfer from Khabarovsk ACC to Sapporo ACC at the area in 2021. All of these LHDs occurred due to no revised transfer information of altitude change from Khabarovsk ACC.



**Figure 5:** Number of LHDs at former Hot spot L between Fukuoka FIR and Khabarovsk FIR

2.13 The area was identified as Hot Spot L for the first time at the RASMAG/23 meeting based on the number of LHDs occurred in 2017, and was removed from the hot spot list at the RASMAG/26 meeting due to small number of LHD occurrences from 2018 to 2020. In 2021, the number of LHDs in this area increased to 5 which was the same as the number of LHDs in 2017.

2.14 Thus, JASMA decided to consider and analyze whether the area, around FIR boundary between Fukuoka FIR and Khabarovsk FIR, should be identified and reclassified as Hot Spot L.

2.15 The JASMA's analysis was conducted on the basis of the process that the Monitoring Agency for Asia Region (MAAR) developed and presented at the ninth meeting of the RASMAG Monitoring Agency Working Group (RASMAG-MAWG/9) in February 2022. The result and process for JASMA's consideration and analysis are summarized and presented in another working paper.

**3. 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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## Attachment A

### AIRSPACE SAFETY REVIEW FOR THE RVSM IMPLEMENTATION IN FUKUOKA FLIGHT INFORMATION REGION

JAN 2021 to DEC 2021

(Presented by JASMA)

#### SUMMARY

The purpose of this report is to compare actual performance to safety goals related to the continued use of reduced vertical separation minimum (RVSM) in the Fukuoka Flight Information Region (FIR). This report contains a summary of large height deviation reports received by the Japan Airspace Safety Monitoring Agency (JASMA) and an update of the vertical collision risk for the period from January 2021 to December 2021. There are a total of 42 reported large height deviations that occurred during this period in Fukuoka FIR. The vertical collision risk estimate for the RVSM airspace in Fukuoka FIR was  $11.57 \times 10^{-9}$  that exceeds the target level of safety (TLS).

## 1. INTRODUCTION

1.1 This attachment presents a summary of large height deviation reports received by the JASMA and an update of the vertical collision risk for the period of 1 January 2021 to 31 December 2021.

## 2. DISCUSSION

### 2.1 Traffic Sample Data (TSD)

2.1.1 Traffic Sample data for December 2021 of aircraft operating in the Fukuoka FIR were used to assess the safety of RVSM airspace.

### 2.2 Large Height Deviation (LHD)

2.2.1 A series of cumulative 12-month LHD reports were used in this safety assessment starting from January 2021 to December 2021.

#### 2.2.2 Summary of LHD Occurrences in the Fukuoka FIR

2.2.3 **Table 1** summarizes the number of LHD occurrences and associated LHD duration (in minutes) by month in the RVSM airspace of the Fukuoka FIR.

Month-Year	No. of LHD Occurrences	LHD Duration (Minutes)
January 2021	3	28.3
February 2021	4	22.0
March 2021	4	9.8
April 2021	4	16.4
May 2021	4	13.2
June 2021	5	11.4
July 2021	5	3.5
August 2021	3	2.1
September 2021	5	13.5
October 2021	12	22.4
November 2021	4	51.3
December 2021	3	5.8
<b>Total</b>	<b>56</b>	<b>199.9</b>

**Table 1:** Summary of LHD Occurrences and Duration per Month in the Fukuoka FIR

2.2.4 The LHD reports are separated by categories based on the details provided for each deviation. **Table 2** presents a summary of the LHD causes within Fukuoka FIR in 2020 and 2021. The number of LHD reports in 2021 decreases what in 2020.

Code	LHD Category Description	2020	2021
A	Flight crew fails to climb or descend the aircraft as cleared	5	3
B	Flight crew climbing or descending without ATC clearance	1	1
C	Incorrect operation or interpretation of airborne equipment	1	2
D	ATC system loop error	5	12
E	ATC transfer of control coordination errors due to human factors	10	15
F	ATC transfer of control coordination errors due to technical issues	2	3
G	Aircraft contingency leading to sudden inability to maintain level	2	6
H	Airborne equipment failure and unintentional or undetected level change	0	0
I	Turbulence or other weather related cause	11	5
J	TCAS resolution advisory and flight crew correctly responds	5	9
K	TCAS resolution advisory and flight crew incorrectly responds	0	0
L	Non-approved aircraft is provided with RVSM separation	0	0
M	Other	0	0

Code	LHD Category Description	2020	2021
Total		42	56

**Table 2:** Summary of LHD Causes within Fukuoka FIR.

2.2.5 **Appendix A** contains the details of the 33 LHDs contributed to the operational risk, which were reported to the JASMA during the assessment period.

2.2.6 **Appendix B** contains the details of the 23 LHDs which were not involved in the operational risk and were reported to the JASMA during the assessment period.

2.2.7 **Appendix C** contains the details of the 4 LHDs which occurred outside of Fukuoka FIR and were not involved in the operational risk during the assessment period.

2.2.8 **Appendix D** provides the geographic location of all LHD reports in Fukuoka FIR during the assessment period. The filled blue square symbols represent LHD location in the RVSM stratum inside of Fukuoka FIR, and the hollow blue square symbols represent LHD location in the RVSM stratum outside of Fukuoka FIR. The circle size means an LHD duration of 50 seconds or more.

### 3. Risk Assessment and Safety Oversight

3.1 This section updates the results of safety oversight for the RVSM implementation in the Fukuoka FIR. Accordingly, the internationally accepted collision risk methodology is applied in assessing the safety of the airspace.

3.1.1 Estimate of the Collision Risk Model (CRM) Parameters shown in **Table 3**. The average sizes of aircraft based on the TSD of December 2021 are slightly smaller than that of aircraft based on the TSD of December 2020.

Parameter Symbol	Parameter Definition	Parameter Value	Source for Value
Pz(1000)	Probability that two aircraft nominally separated by the vertical separation minimum 1000 feet are in vertical overlap	$1.7 \times 10^{-8}$	Value specified in ICAO Doc. 9574
Pz(0)	Probability that two aircraft at the same nominal level are in vertical overlap	0.54	Value often used (shown in RVSM/TF-9-IP/2)
Py(0)	Probability that two aircraft on the same track are in lateral overlap	0.0711	Using the data of secondary surveillance radar obtained by the Hachinohe Air Route Surveillance Radar (domestic RNAV route, 2001-2002) and FDPS data (December 2012).
$\lambda_x$	Average aircraft length	0.0276 nm	JASMA(December 2021)
$\lambda_y$	Average aircraft width	0.0253 nm	
$\lambda_z$	Average aircraft height	0.0079 nm	
$ \Delta V $	Average along track speed of aircraft pairs	28.9 kt	Kushiro Air Route Surveillance Radar data (R220)

Parameter Symbol	Parameter Definition	Parameter Value	Source for Value
			route, NOPAC, Apr. 1994)
$ \bar{V} $	Individual-aircraft along track speed	480 kt	Value often used
$ \bar{y} $	Average cross track speed of aircraft pairs	11.6 kt	Kushiro Air Route Surveillance Radar data (R220 route, NOPAC, Apr. 1994)
$ \bar{z} $	Average vertical speed of aircraft pairs	1.5 kt	Value often used
$N_x(\text{same})$	The passing frequency of aircraft pair assigned to the adjacent flight levels under the same direction traffic	$1.49 \times 10^{-2}$	CCAW data (2021)
$N_x(\text{opp})$	The passing frequency of aircraft pair assigned to the adjacent flight levels under the opposite direction traffic	$5.02 \times 10^{-2}$	CCAW data (2021)
$N_{az}^{\text{technical}}$ (cross)	The collision risk for crossing routes (technical dimension)	$8.12 \times 10^{-11}$ [accidents/flight hour]	FO data (December 2021) is utilized for the calculation of $E_z(\theta)$ .
$N_{az}^{\text{operational}}$ (cross)	The collision risk for crossing routes (operational dimension)	$3.13 \times 10^{-9}$ [accidents/flight hour]	By eq. (12).
H	Total flight hours of aircraft flying on the route segments within airspace under consideration	82619 flight hours	Jan. 2021 to Dec. 2021
T(0)	LHD duration in hours	1.69 flight hours	Total duration hours of 37 operational LHD reports received from Jan 2021 to Dec 2021

**Table 3:** Summarizes the value of the parameters used for the vertical risk calculation.

### 3.2 Risk Calculation

3.2.1 Based on the TSD for one month of December 2021 extracted from the JCAB Flight Data Processing System (FDPS), the numbers of passing events,  $n_p(\text{same})$  and  $n_p(\text{opp})$ , were calculated for each route segment consisting of two fixes.

3.2.2 Using the CRM parameters, such as the average size of aircraft and average relative speed of the aircraft pair, contained in **Table 3**, kinematical coefficients of passing frequencies for the same and opposite direction traffic can be calculated by

$$K(\text{same}) = 1 + \frac{\lambda x}{v_{rx}(\text{same})} \left( \frac{v_{ry}}{\lambda y} + \frac{v_{rz}}{\lambda z} \right) \quad (1)$$

$$K(\text{opp}) = 1 + \frac{\lambda x}{v_{rx}(\text{opp})} \left( \frac{v_{ry}}{\lambda y} + \frac{v_{rz}}{\lambda z} \right) \quad (2)$$

Same-direction passing frequency  $N_x(\text{same})$ , opposite-direction passing frequency  $N_x(\text{opp})$ , and equivalent opposite-direction passing frequency  $N_x^z(e)$  are defined by

$$N_x^z(\text{same}) = \frac{2n_p(\text{same})}{H} \quad (3)$$

$$N_x^z(\text{opp}) = \frac{2n_p(\text{opp})}{H} \quad (4)$$

$$N_x^z(e) = N_x^z(\text{opp}) + \frac{K(\text{same})}{K(\text{opp})} N_x^z(\text{same}) \quad (5)$$

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respectively.

Technical Risk is estimated by

$$N_{az}^{\text{tec}\nabla\text{nical}} = N_{az}^{\text{tec}\nabla\text{nical}}(o + s) + N_{az}^{\text{tec}\nabla\text{nical}}(\text{cross}) \quad (6)$$

$$N_{az}(o + s)^{\text{tec}\nabla\text{nical}} = P_z(1000)P_y(0)N_x^z(e)K(o) \quad (7)$$

$$N_{az}^{\text{tec}\nabla\text{nical}}(\text{cross}) = P_z(1000) \sum_{\theta} P_{\nabla}(\theta) E_z^{\text{cross}}(\theta) \left[ \frac{2 \left| \dot{\nabla}(\theta) \right|}{\pi \lambda_{xy}} + \frac{\left| \dot{z} \right|}{2 \lambda_z} \right] \quad (8)$$

$P_h(\theta)$  was calculated assuming that the distributions of along-track positions and cross-track deviations follow normal distributions whose standard deviations are  $5/\sqrt{6}$  NM and 0.132, respectively. Remark that 5NM is the radar separation standard and  $5/\sqrt{6}$  NM is the standard deviation of the uniform distribution with the domain width = 5NM. The value 0.132 is calculated from the Hachinohe radar data collected from August 2001 till July 2002.  $P_h(\theta)$ ,  $E_z^{\text{cross}}(\theta)$  and  $\left| \dot{h}(\theta) \right|$  were calculated every ten degrees.

Operational Risk is given by

$$N_{az}^{\text{operational}} = N_{az}^{\text{operational}}(o + s) + N_{az}^{\text{operational}}(\text{cross}) \quad (9)$$

where,

$$N_{az}^{\text{operational}}(o + s) = \frac{\sum P_z(z)T(z)}{H} P_y(0)N_x^z(e)K(o) \quad (10)$$

$$N_{az}^{\text{operational}}(\text{cross}) = \frac{\sum P_z(z)T(z)}{H} \sum_{\theta} P_{\nabla}(\theta) E_z^{\text{cross}}(\theta) \left[ \frac{2 \left| \dot{\nabla}(\theta) \right|}{\pi \lambda_{xy}} + \frac{\left| \dot{z} \right|}{2 \lambda_z} \right] \quad (11)$$

$$N_{az}^{\text{operational}}(\text{cross}) = \frac{\sum P_z(z)T(z)}{H} \cdot \frac{N_{az}^{\text{tec}\nabla\text{nical}}(\text{cross})}{P_z(1000)} \quad (12)$$

Executive Summary

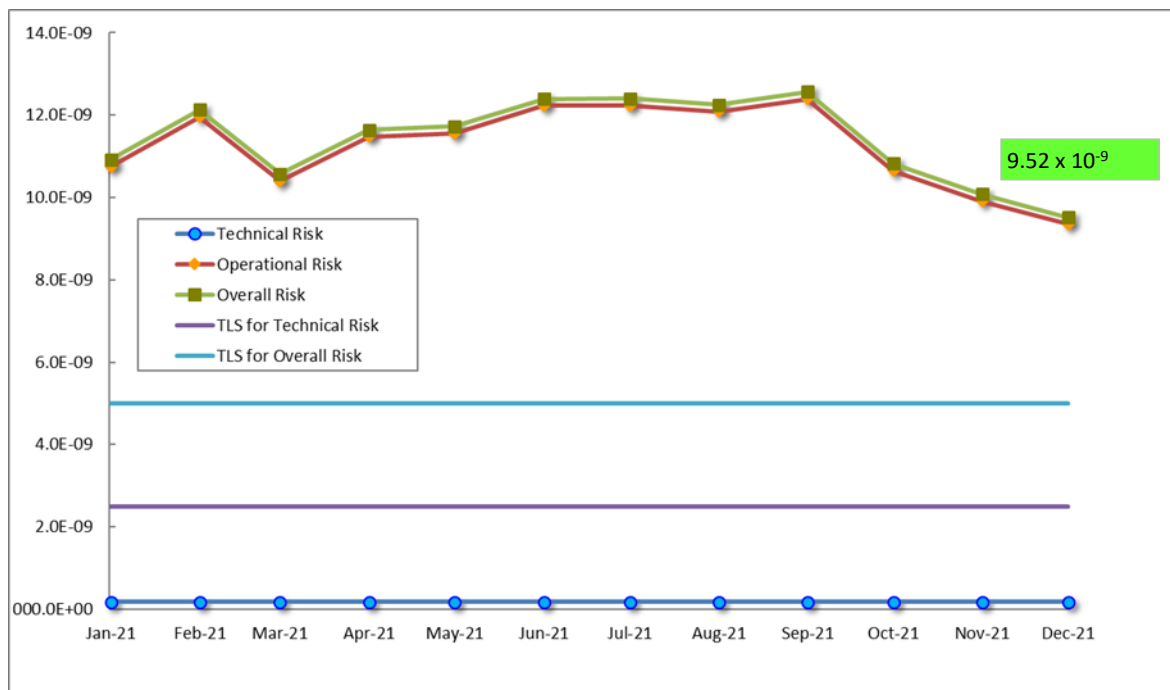
3.3 Safety Oversight for the RVSM implementation in the Fukuoka FIR

3.3.1 **Table 4** presents the estimates of vertical collision risk for the RVSM airspace of the Fukuoka FIR. The technical risk is estimated to be  $0.17 \times 10^{-9}$  fatal accidents per flight hour. The operational risk estimate is  $9.35 \times 10^{-9}$  fatal accidents per flight hour. The estimate of the overall vertical collision risk is  $9.52 \times 10^{-9}$  fatal accidents per flight hour, which exceeds the globally agreed TLS value of  $5.0 \times 10^{-9}$  fatal accidents per flight hour.

<b>Japanese Airspace – estimated annual flying hours = 991,428 hours</b>			
<i>(note: estimated hours based on Dec 2021 traffic sample data)</i>			
Source of Risk	Risk Estimation	TLS	Remarks
RASMAG 25 Total Risk	$11.57 \times 10^{-9}$	$5.0 \times 10^{-9}$	Above TLS
Technical Risk	$0.17 \times 10^{-9}$	$2.5 \times 10^{-9}$	Below Technical TLS
Operational Risk	$9.35 \times 10^{-9}$	-	-
Total Risk	<b><math>9.52 \times 10^{-9}</math></b>	$5.0 \times 10^{-9}$	<b>Above TLS</b>

**Table 4:** Fukuoka FIR RVSM Risk Estimates

3.3.2 **Figure 2** presents collision risk estimate trends by type (technical, operational, and total) for each month using the appropriate cumulative during the period from January 2021 to December 2021.



**Figure 2:** Fukuoka FIR RVSM Risk Estimate Trends

3.3.3 The estimated overall risk exceeded the TLS. The risk value is lower than the previous year.

**Appendix A**

LHDs contributed to Operational Risk within the RVSM airspace in Fukuoka FIR reported to the JASMA during the assessment period

	Occurrence Date	Reporter	Location	ACFT Type	Assigned FL	Observed/ Reported ALT (ft)	Duration of LHD (min.)	Cause	CAT code	Hot Spot
1	6 JAN 2021	Kobe ACC	MEVIN	K35R	330	33000	27	Coordination errors in the ATC-to-ATC transfer of control responsibility as a result of human factors issues	E	D
2	18 JAN 2021	Kobe ACC	LEBIX	A21N	350	37000	1	Coordination errors in the ATC-to-ATC transfer of control responsibility as a result of human factors issues	E	D
3	12 FEB 2021	Kobe ACC	MADOG	B738	350	33000	1	Flight crew failing to climb/descend the aircraft as cleared	A	-
4	18 FEB 2021	Fukuoka ATMC	GURAG	B789	390	41000	17	Coordination errors in the ATC-to-ATC transfer of control responsibility as a result of human factors issues	E	D
5	22 FEB 2021	Sapporo ACC	NAVER	A21N	350	34400	1	ATC system loop error	D	-
6	15 MAR 2021	Kobe ACC	LEBIX	B789	390	41000	1.5	Coordination errors in the ATC-to-ATC transfer of control responsibility as a result of human factors issues	E	D
7	17 MAR 2021	Fukuoka ATMC	43N165E	A332	350	37000	5	Flight crew climbing/descending without ATC clearance	B	-
8	1 APR 2021	Fukuoka ACC	SUC	B738	390	38400	0.9	ATC system loop error	D	-
9	11 APR 2021	Kobe ACC	MEVIN	K35R	360	36000	10	Coordination errors in the ATC-to-ATC transfer of control responsibility as a result of human factors issues	E	D

	Occurrence Date	Reporter	Location	ACFT Type	Assigned FL	Observed/ Reported ALT (ft)	Duration of LHD (min.)	Cause	CAT code	Hot Spot
10	22 APR 2021	Sapporo ACC	AKSUN	B789	390	41000	3	Coordination errors in the ATC-to-ATC transfer of control responsibility as a result of human factors issues	E	(L)
11	9 MAY 2021	Fukuoka ACC	HKC	A320	340	31500	0.5	ATC system loop error	D	
12	22 MAY 2021	Fukuoka ACC	MYE	B77L	340	33300	1.3	ATC system loop error	D	
13	21 JUN 2021	IJT	Fukuoka ATMC	C560	250	35000	10	ATC system loop error	D	-
14	27 JUN 2021	MUGUS	Fukuoka ACC	H25B	380	36000	0	Coordination errors in the ATC-to-ATC transfer of control responsibility as a result of human factors issues	E	-
15	28 JUN 2021	IGROD	Sapporo ACC	B77L	370	35000	1	Coordination errors in the ATC-to-ATC transfer of control responsibility as a result of human factors issues	E	(L)
16	2 JUL 2021	SUC	Kobe ACC	H25B	310	30300	0.7	ATC system loop error	D	-
17	8 JUL 2021	MYE	Fukuoka ACC	B738	380	36100	0.5	ATC system loop error	D	-
18	17 JUL 2021	TAMAK	Kobe ACC	A332	370	38000	1	ATC system loop error	D	-
19	15 AUG 2021	IGROD	Sapporo ACC	B77L	330	35000	1	Coordination errors in the ATC-to-ATC transfer of control responsibility as a result of human factors issues	E	(L)

	Occurrence Date	Reporter	Location	ACFT Type	Assigned FL	Observed/ Reported ALT (ft)	Duration of LHD (min.)	Cause	CAT code	Hot Spot
20	17 SEP 2021	LEBIX	Kobe ACC	B77W	350	37000	4	Coordination errors in the ATC-to-ATC transfer of control responsibility as a result of human factors issues	E	D
21	21 SEP 2021	HGE	Kobe ACC	B738	340	35600	0.3	Flight crew failing to climb/descend the aircraft as cleared	A	-
22	23 SEP 2021	LEBIX	Kobe ACC	B789	390	41000	0.2	Coordination errors in the ATC-to-ATC transfer of control responsibility as a result of human factors issues	E	D
23	4 OCT 2021	HKC	Fukuoka ACC	B738	340	29300	1.6	ATC system loop error	D	-
24	6 OCT 2021	FUE	Fukuoka ACC	B789	340	38700	1.8	Incorrect flight level provided due to incorrect operation or interpretation of airborne equipment	C	-
25	10 OCT 2021	FUE	Fukuoka ACC	B78X	300	35200	2.2	Incorrect flight level provided due to incorrect operation or interpretation of airborne equipment	C	-
26	16 OCT 2021	SUC	Fukuoka ACC	B748	360	37000	0.8	ATC system loop error	D	-
27	17 OCT 2021	MEVIN	Kobe ACC	K35R	360	35000-36000	2	Coordination errors in the ATC-to-ATC transfer of control responsibility as a result of human factors issues	E	D
28	17 OCT 2021	MEVIN	Kobe ACC	K35R		35000-36000	2	Coordination errors in the ATC-to-ATC transfer of control responsibility as a result of human factors issues	E	D
29	22 OCT 2021	IGROD	Sapporo ACC	B77W	350	37000	1	Coordination errors in the ATC-to-ATC transfer of control responsibility as a result of human factors issues	E	(L)

	Occurrence Date	Reporter	Location	ACFT Type	Assigned FL	Observed/ Reported ALT (ft)	Duration of LHD (min.)	Cause	CAT code	Hot Spot
30	23 OCT 2021	SUC	Fukuoka ACC	B763	330	35200	0.5	ATC system loop error	D	-
31	12 NOV 2021	IGROD	Sapporo ACC	B789	390	41000	1	Coordination errors in the ATC-to-ATC transfer of control responsibility as a result of human factors issues	E	(L)
32	17 DEC 2021	HKC	Fukuoka ACC	B738	400	39500	0.3	ATC system loop error	D	-
33	28 DEC 2021	KEC	Fukuoka ACC	A320	390	38000	0.5	Flight crew failing to climb/descend the aircraft as cleared	A	-

**Appendix B**

LHDs not contributed to Operational Risk in the Fukuoka FIR reported to the JASMA during the assessment period

	Occurrence Date	Reporter	Location	ACFT Type	Assigned FL	Observed/ Reported ALT (ft)	Duration of LHD (min.)	Cause	CAT code	Hot Spot
1	24 JAN 2021	Tokyo ACC	MBE	A320	340	34500	0.3	TCAS resolution advisory, flight crew correctly climb or descend following the resolution advisory	J	-
2	8 FEB 2021	Fukuoka ATMC	NOGAL	B748	300	28500	3	Aircraft contingency leading to sudden inability to maintain level	G	-
3	20 MAR 2021	Tokyo ACC	IKAHO	B763	300	30300	0.3	TCAS resolution advisory, flight crew correctly climb or descend following the resolution advisory	J	-
4	29 MAR 2021	Fukuoka ATMC	POXED	B744	330	29000	3	Aircraft contingency leading to sudden inability to maintain level	G	-
5	13 APR 2021	Fukuoka ACC	HKC	B748	350	33400	2.5	Turbulence or other weather related causes leading to unintentional or undetected change of flight level	I	-
6	14 MAY 2021	Fukuoka ATMC	POXED	C17	310	33000	11	Aircraft contingency leading to sudden inability to maintain level	G	-
7	17 MAY 2021	Tokyo ACC	DAIGO	E190	340	34300	0.3	TCAS resolution advisory, flight crew correctly climb or descend following the resolution advisory	J	-
8	6 JUN 2021	Kobe ACC	AMAMI	D328	310	30500	0.3	Aircraft contingency leading to sudden inability to maintain level	G	-

	Occurrence Date	Reporter	Location	ACFT Type	Assigned FL	Observed/ Reported ALT (ft)	Duration of LHD (min.)	Cause	CAT code	Hot Spot
9	14 JUN 2021	Operator	KXC	A320	380	37700	0.1	Turbulence or other weather related causes leading to unintentional or undetected change of flight level	I	-
10	15 JUL2021	Kobe ACC	SUC	CRJ7	320	32600	0.5	TCAS resolution advisory, flight crew correctly climb or descend following the resolution advisory	J	-
11	28 JUL 2021	Fukuoka/ Kobe ACC	SUC	B738	340	34900	0.8	TCAS resolution advisory, flight crew correctly climb or descend following the resolution advisory	J	-
12	6 AUG 2021	Fukuoka ACC	TGE	A320	370	36500	0.5	Turbulence or other weather related causes leading to unintentional or undetected change of flight level	I	-
13	16 AUG 2021	Fukuoka ACC	SAPRA	C560	410	40200	0.6	Aircraft contingency leading to sudden inability to maintain level	G	-
14	4 SEP 2021	Tokyo ACC	SZE	B738	290	30500	1.1	TCAS resolution advisory, flight crew correctly climb or descend following the resolution advisory	J	-
15	30 SEP 2021	Fukuoka ATMC	PASRO	B744	400	40000	8	Coordination errors in the ATC-to-ATC transfer of control responsibility as a result of equipment outage or technical issues	F	-
16	3 OCT 2021	Fukuoka ATMC	NIPPI	A306	340	34000	8	Coordination errors in the ATC-to-ATC transfer of control responsibility as a result of equipment outage or technical issues	F	-
17	19 OCT 2021	Kobe ACC	AWAJI	B744	310	31500	1	TCAS resolution advisory, flight crew correctly climb or descend following the resolution advisory	J	-

	Occurrence Date	Reporter	Location	ACFT Type	Assigned FL	Observed/ Reported ALT (ft)	Duration of LHD (min.)	Cause	CAT code	Hot Spot
18	19 OCT 2021	Kobe ACC	AWAJI	E190	300	29600	1	TCAS resolution advisory, flight crew correctly climb or descend following the resolution advisory	J	
19	25 OCT 2021	Tokyo ACC/ Operator	YULIA	B748	350	34600	0.5	Turbulence or other weather related causes leading to unintentional or undetected change of flight level	I	
20	6 NOV 2021	Fukuoka ATMC	2449N 13548E	C17	300	31000	2	Aircraft contingency leading to sudden inability to maintain level	G	
21	8 NOV 2021	Tokyo ACC	TURFY	B77L	330	33400	0.3	Turbulence or other weather related causes leading to unintentional or undetected change of flight level	I	
22	24 NOV 2021	Fukuoka ATMC	OMOTO	B789	390	40000	0.8	Coordination errors in the ATC-to-ATC transfer of control responsibility as a result of equipment outage or technical issues	F	
23	17 DEC 2021	Tokyo ACC	PUTER	B748	310	29200	5	TCAS resolution advisory, flight crew correctly climb or descend following the resolution advisory	J	

**Appendix C**

LHDs occurred outside of Fukuoka FIR

	<b>Occurrence Date</b>	<b>Relevant ATC Unit</b>	<b>Location</b>	<b>ACFT Type</b>	<b>Assigned FL</b>	<b>Observed/ Reported ALT (ft)</b>	<b>Duration of LHD (min.)</b>	<b>Cause</b>	<b>CAT code</b>	<b>Hot Spot</b>
1	7 JAN 2021	Shanghai ACC	SADLI	B748	300			Coordination errors in the ATC-to-ATC transfer of control responsibility as a result of human factors issues	E	B
2	7 JAN 2021	Incheon ATMC	INVOK	B748	380			Coordination errors in the ATC-to-ATC transfer of control responsibility as a result of human factors issues	E	-
3	20 MAR 2021	Manila ACC	GURAG	A20N	380			Coordination errors in the ATC-to-ATC transfer of control responsibility as a result of human factors issues	E	D
4	3 NOV 2021	Manila ACC	BISIG	B77W	360	38000		Coordination errors in the ATC-to-ATC transfer of control responsibility as a result of human factors issues	E	D

Note: Case 1 occurred before the AKARA Phase 1 implementation.

Appendix D

Geographical Location of all LHDs in Fukuoka FIR

