



International Civil Aviation Organization

**The Sixteenth Meeting of the Regional Airspace Safety Monitoring
Advisory Group (RASMAG/16)**

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

Airspace Safety Review for the RVSM Operation in the Mongolia Airspace

(Presented by Monitoring Agency for Asia Region)

Summary

This paper provides the results of the airspace safety oversight for the RVSM operation in the Mongolia airspace.

1. Introduction

- 1.1 This paper provides the results of safety assessments for the RVSM operation in the Mongolia airspace, which was implemented on 17 November 2011.

2. Content of Safety Assessment Report

- 2.1 The contents of the report include:

- Introduction
- Airspace and flight level allocation of Mongolia
- Traffic data analyses,
- Assessment of RVSM operation, and
- Results of RVSM safety assessment

3. Actions by the Meeting

- 3.1 The meeting is invited to note the results of the airspace safety assessment presented in this working paper and use the findings to consider the continuation of the RVSM operation in the airspace of Mongolia.

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**AIRSPACE SAFETY ASSESSMENT FOR THE RVSM
OPERATION IN THE MONGOLIA AIRSPACE**

December 2011



Monitoring Agency for Asia Region

**Aeronautical Radio of Thailand
(AEROTHAI)**

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1. INTRODUCTION

This report provides the summary of airspace safety assessments for the RVSM implementation in the airspace of Mongolia – Ulaanbaatar Flight Information Region (FIR).

These assessments are conducted based on:

- One month Traffic Sample Data (TSD) collected from 1 to 31 December 2011,
- Monthly Large Height Deviation (LHD) reports from January 2011 to December 2011, and
- RVSM approval records.

2. AIRSPACE AND FLIGHT LEVEL ALLOCATION OF MONGOLIA

2.1 Mongolia Airspace

Figure 1 provides a geographical representation of the airspace and route network of Mongolia.

2.2 Flight Level Allocation after RVSM Implementation

Based on the AIC series A 02/11 dated 3 Mar 2011, since 17 November 2011, the RVSM implemented in the airspace of Mongolia uses the RVSM-METER FLAS specified in Annex 2, Appendix 3 b) (see **Table 1**). It is important to note that ATC will issue flight level clearance in meters. In turn, pilots shall use the Mongolian RVSM FLAS Diagram to determine the corresponding flight level in feet. The aircraft shall be flown using the flight level in Feet.

180°-359°		000°-179°	
Flight Levels		Flight Levels	
M	FT	M	FT
ETC	ETC	ETC	ETC
↑	↑	↑	↑
15500	50900	14900	48900
14300	46900	13700	44900
13100	43000		
		12500	41100
12200	40100	11900	39100
11600	38100	11300	37100
11000	36100	10700	35100
10400	34100	10100	33100
9800	32100	9500	31100
9200	30100	8900	29100
8400	27600	8100	26600
7800	25600	7500	24600
7200	23600	6900	22600
6600	21700	6300	20700
6000	19700	5700	18700
5400	17700	5100	16700
4800	15700	4500	14800
4200	13800	3900	12800
3600	11800	3300	10800
3000	9800	2700	8900
2400	7900	2100	6900
1800	5900	1500	4900
1200	3900	900	3000
M	FT	M	FT

Table 1: Cruising RVSM levels in the Mongolia Airspace

3. TRAFFIC DATA ANALYSES

This section presents the summary of traffic data analyses based on the collected TSD. The results of the analysis are presented in the following contents:

- Number of flights per day,
- Top-10 operating airways
- Top-10 Aircraft types, and
- Flight level utilization.

3.1 Number of Flights per Day

Figure 2 provides numbers of flights per day operating within the airspace of Mongolia for the month of December 2011. The average daily flight for this data collection period is 213 flights per day.

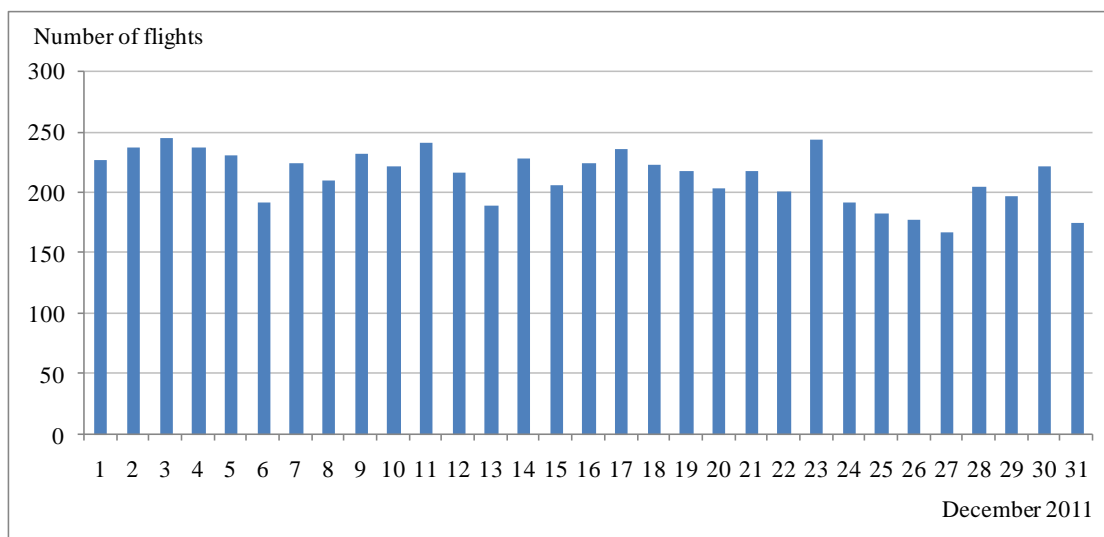


Figure 2: Numbers of Flights per Day Operating in the Mongolia Airspace

3.2 Top-10 operating airways

Figure 3 provides Top-10 operating airways within the airspace of Mongolia.

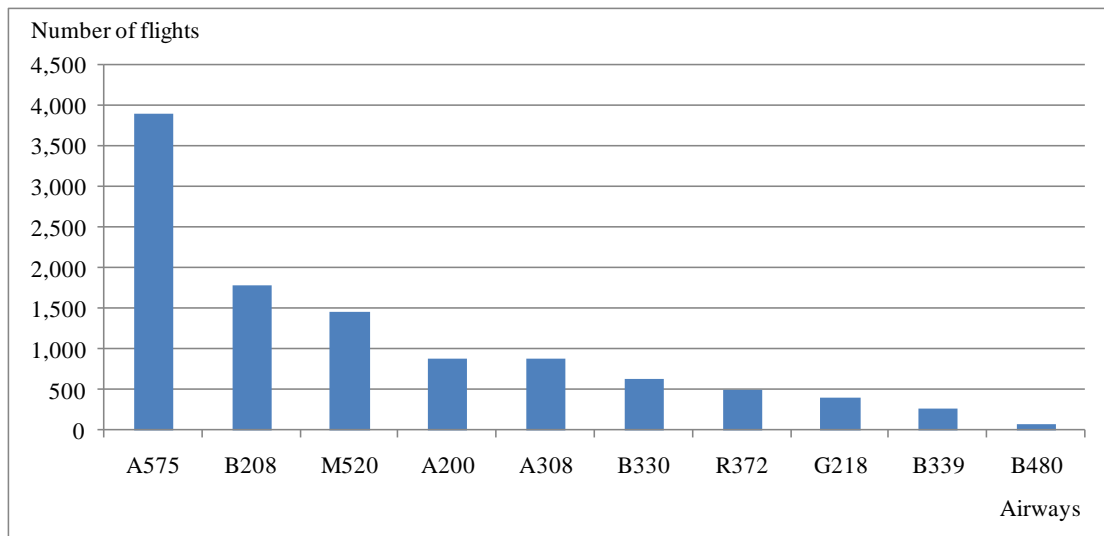


Figure 3: Top-10 Operating Airways

3.3 Top-15 aircraft types

Figure 4 provides Top-15 aircraft types operating within the Airspace of Mongolia.

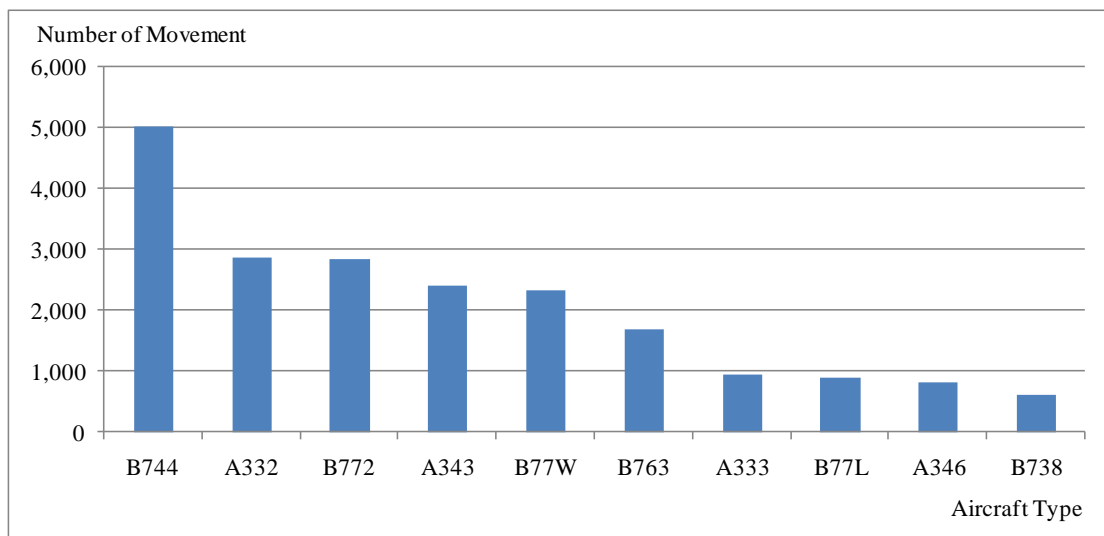


Figure 4: Top-10 Aircraft types

3.4 Flight Level Utilization

Figure 5 presents the utilization of flight levels in the airspace of Mongolia.

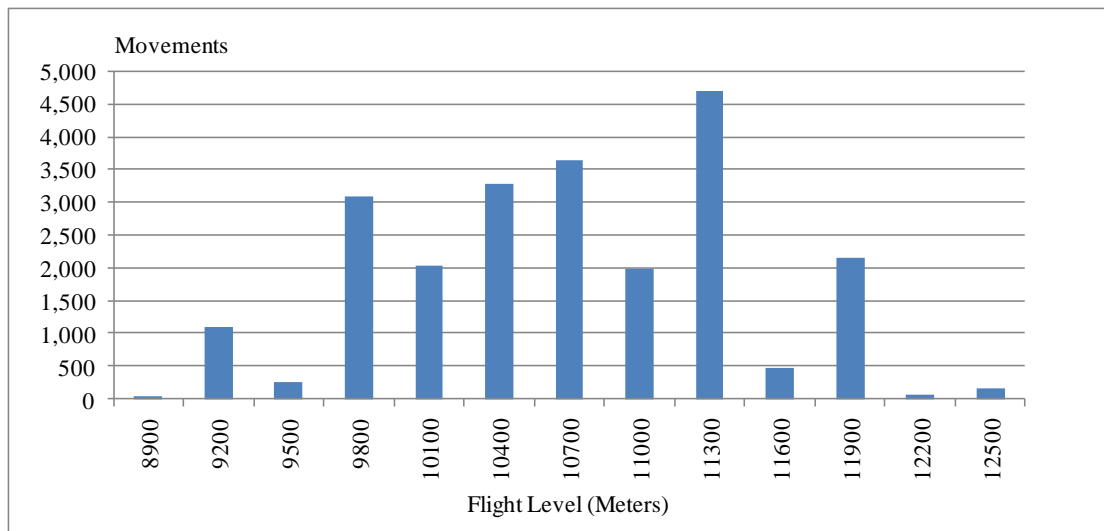


Figure 5: Flight Level Utilization

4. ASSESSMENT OF RVSM OPERATION

This section provides the results of the RVSM operation assessment using the December 2011 TSD and the RVSM approval information from the RMAs' databases (Table 2).

RMAs	Availability Period
AAMA	February 2012 update
AFIRMA	February 2012 update
CARSAAMA	February 2012 update
China RMA	February 2012 update
EURASIA	February 2012 update
EUROCONTROL	February 2012 update
Japan RMA	February 2012 update
MAAR	February 2012 update
MIDRMA	November 2011 update
NAARMO	January 2012 update
PARMO	January 2012 update
Combined	30 Jan 2012 update

Table 2: RVSM Approval Data Source

Table 3 provides list of aircraft registration operating in the Mongolia airspace without proof of RVSM approval from any RMAs' RVSM approval databases.

Aircraft Registration	Aircraft Type	Operator Code	State of Operator	State of Registry	Number of Flights
VQBEY	B752	UTA	Russia	Bermuda	26
VQBEZ	B752	UTA	Russia	Bermuda	17
VQBQY	A333	AFL	Russia	Bermuda	16
EIEJK	A332	AZA	Italy	Ireland	10
EIEJJ	A332	AZA	Italy	Ireland	8
EIEJI	A332	AZA	Italy	Ireland	6
HL8240	B738	KAL	Republic of Korea	Republic of Korea	4
EIISD	B772	AZA	Italy	Ireland	3
B3925	LJ60	ICU	China	China	2
HL8225	B738	KAL	Republic of Korea	Republic of Korea	2
HL8241	B738	KAL	Republic of Korea	Republic of Korea	2
VQBKU	A320	AFL	Russia	Bermuda	2
VQBJX	B738	ORB	Russia	Bermuda	1
B6833	A320	CSZ	China	China	1
OELGX	GLEX	VJS	Austria	Austria	1
HL8218	B77W	KAL	Republic of Korea	Republic of Korea	1
VPBPC	B738	ORB	Russia	Bermuda	1
B6137	A388	CSN	China	China	1

Table 3: Aircraft operating in Mongolia Airspace without RVSM Approvals

5. RVSM SAFETY ASSESSMENT

This section provides the results of safety assessment for the RVSM operation in the airspace of Mongolia, using the December 2011 TSD and monthly LHD occurrences between January 2011 and December 2011.

5.1 Estimate of the CRM Parameters

Table 4 summarizes the value and source material for estimating values for each of the inherent parameters.

Parameter Symbol	Parameter Definition	Parameter Value	Source for Value
T	Annual flight hours	98,679	Based on December 2011 TSD
$E_z(\text{same})$	Same-direction vertical occupancies	0.0004	
$E_z(\text{opposite})$	Opposite-direction vertical occupancies	0.0363	
λ_x	Average aircraft length	0.0341 NM	
λ_y	Average aircraft wingspan	0.0315 NM	
λ_z	Average aircraft height	0.0093 NM	
λ_h	Diameter of the disk representing the shape of an aircraft in the horizontal plane	0.0341 NM	
$P_y(0)$	Probability of lateral overlap	0.0752	Based on average aircraft wingspan
$P_z(0)$	Probability of vertical overlap (with planned vertical separation equal to zero)	0.5380	Conservative value used in Western Pacific/South China Sea and BOB RVSM safety assessments
$ \overline{\Delta V} $	Average relative along-track speed between aircraft on same direction routes	26.39 knots	Based on the pre-RVSM implementation safety assessment
$ \overline{V} $	Average absolute aircraft ground speed	480 knots	Value used in WPAC/SCS and BOB RVSM safety assessments
S_x	Longitudinal Separation	50 NM	

Table 4: Parameters Estimate in the CRM

5.2 LHD Summary

5.2.1 LHD Reports

Based on the received LHD reports, the LHD occurrences between January 2011 and December 2011 in the airspace of Mongolia are summarized in **Table 5** as follows.

Month-Year	No. of LHD Occurrences	Associated LHD Duration (Minutes)	12-month Cumulative Occurrences	12-month Cumulative Duration
January 2011	2	26	9	143
February 2011	0	0	9	143
March 2011	1	0	9	138
April 2011	1	1	10	139
May 2011	0	0	10	139
June 2011	1	1	10	120
July 2011	1	1	11	121
August 2011	2	2	12	89
September 2011	0	0	12	89
October 2011	1	1	13	90
November 2011	2	2	12	37
December 2011	3	3	14	37

Table 5: Summary of LHD Occurrences and Duration

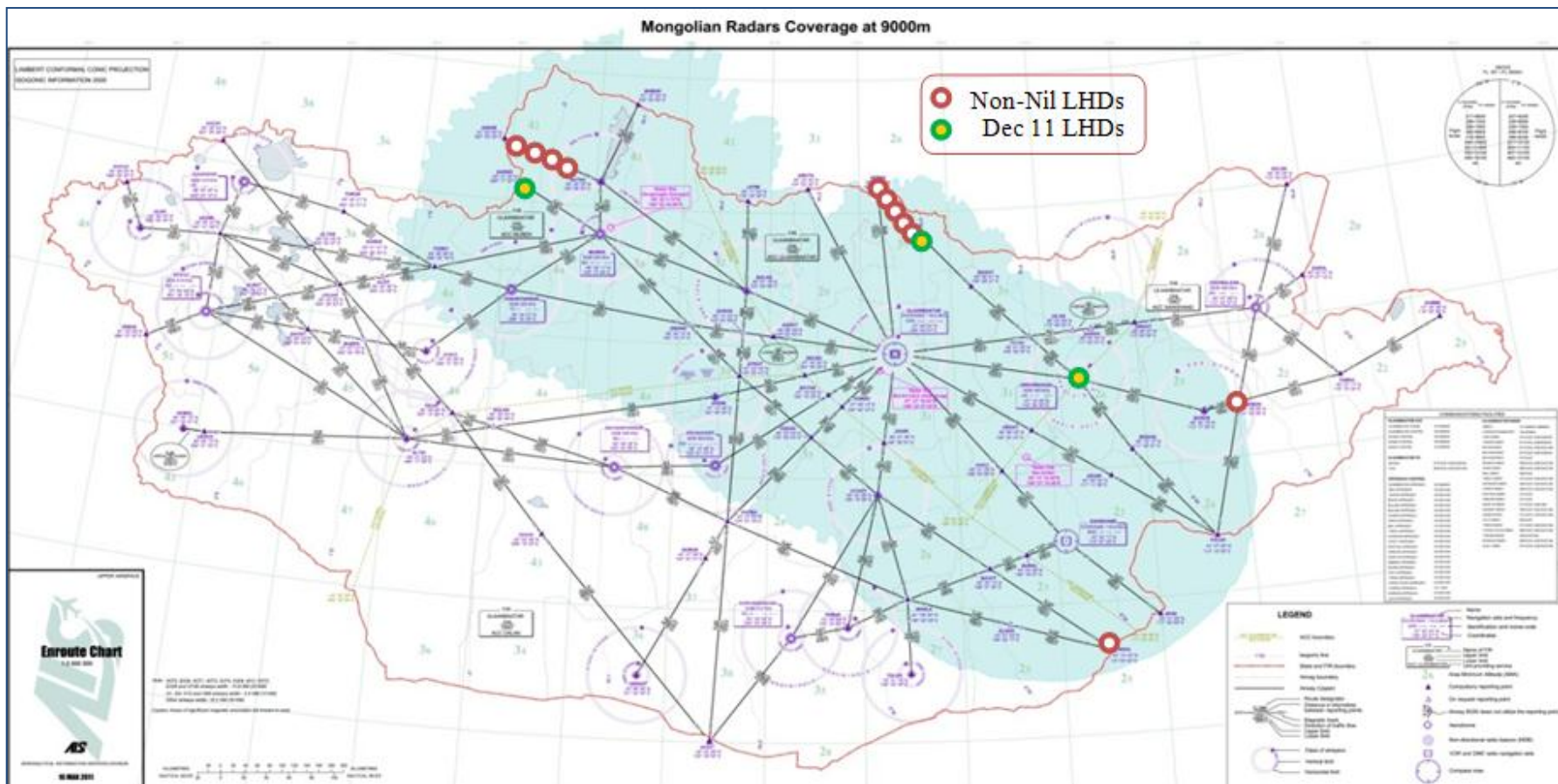
Table 6 summarizes the number of LHD occurrences and the associated LHD duration (in minutes) by cause of the deviation.

LHD Category Code	LHD Category Description	No. of LHD Occurrences	LHD Duration (Minutes)
D	ATC system loop error; (e.g. ATC issues incorrect clearance or flight crew misunderstands clearance message)	1	21
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)	12	11
M	Other – this includes situations of flights operating (including climbing/descending) in airspace where flight crews are unable to establish normal air-ground communications with the responsible ATS unit.	1	5
Total (January 2011 – December 2011)		14	37

Table 6: Summary of LHD Causes in the Mongolia Airspace

The LHD occurrences in the Mongolia airspace are summarized as follows:

- There were a total of 14 LHD occurrences accounting for 37-minute duration between January 2011 and December 2011.
- The number of 12-month cumulative LHD duration was reduced significantly from 139 minutes in May 2011 to 37 minutes in December 2011. The improvement is mainly as a result of the exclusion of a few LHD occurrences with long duration from this reporting period.
- Since March 2011, duration of all LHD occurrences was less than one minute.
- Most of the LHD occurrences (12 out of 14 occurrences) are contributable to Category E.
- The detailed information of the reported LHD occurrences is provided in the **Appendix A**.
- **Figure 6** presents the location of the LHD occurrences since January 2011



Note: Dec 11 LHDs are the LHDs that occurred after the RVSM implementation on 17 November 2011

Figure 6: LHD Locations and Radars Coverage at 9000 meter in Mongolia

5.3 Risk Assessment Results

Table 7 summarizes the results of the risk assessment in terms of technical, operational, and total risks for the RVSM implementation in the airspace of Mongolia.

The Airspace of Mongolia – estimated annual flying hours = 94,132 hours (note: estimated hours based on December 2011 traffic sample data)			
Source of Risk	Lower Bound Risk Estimation	TLS	Remarks
Technical Risk	0.45×10^{-9}	2.5×10^{-9}	Below Technical TLS
Operational Risk	3.02×10^{-9}	-	-
Total Risk	3.47×10^{-9}	5.0×10^{-9}	Below Overall TLS

Table 7: Risk Estimates for the RVSM Implementation in the Airspace of Mongolia

Figure 7 presents the trends of collision risk estimates for each month using the appropriate 12-month interval of LHD reports.

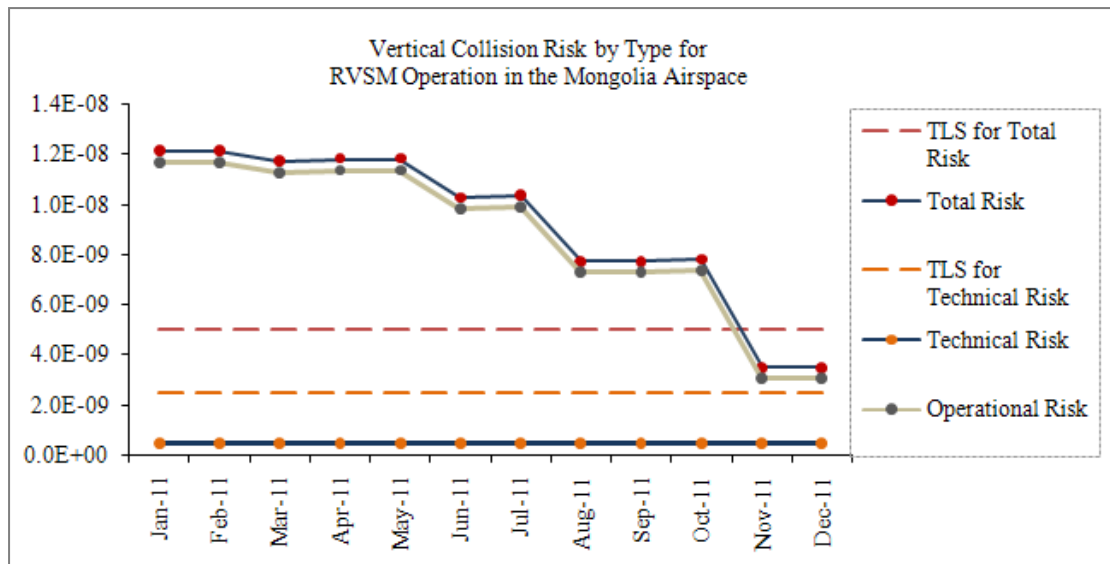


Figure 7: Trends of Risk Estimates for the RVSM Operation in the Airspace of Mongolia

Based on the collision risk estimate, **the technical risk satisfies** the agreed technical risk target level of safety value of no more than 2.5×10^{-9} fatal accidents per flight hour. **The overall risk estimate is below** the overall target level of safety of 5.0×10^{-9} fatal accidents per flight hour. This is mainly due to an improvement in LHDs duration in the recent period as there is no LHD occurrence with duration greater than one minute since March 2011.

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2. Aeronautical Information Publication Mongolia, 10 March 2011.
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4. Review of the General Concept of Separation Panel, Seventh Meeting, Montreal, 30 October – 20 November 1990, ICAO Doc 9572, RGCSP/7.
5. Review of the General Concept of Separation Panel, Sixth Meeting, Montreal, 28 November – 15 December 1988, ICAO Doc 9536, RGCSP/6, Volumes 1 and 2.

APPENDIX A: Detailed LHD Occurrences in the Airspace of Mongolia

No.	Date (dd-mm-yyyy)	Fix	Route	FL Assigned	FL Observed	Duration (Min)	Cause/Remarks
1	05-01-2011	MENOR	G218	10100	10400	21	Read back error. Controller didn't hear when pilot read back wrong level
2	21-01-2011	SERNA	M520	11100	10100	5	Incorrect marking of Assistant controller. Assistant Controller mixed coordination message with other message
3	04-03-2011	NIXAL	B208	9600	10600	0	Neighboring ACC sent revision late, flight data of receiving unit didn't make revision on flight progress strip
4	06-04-2011	GINOM	A308	10100	11100	1	Coordination error. Neighboring ACC didn't make revision
5	19-06-2011	GINOM	A308	10100	11100	1	Neighboring ACC didn't make revision
6	09-07-2011	SERNA	M520	10100	11100	1	Neighboring ACC didn't make revision
7	11-08-2011	GINOM	A308	10100	11100	1	Neighboring ACC didn't make revision
8	11-08-2011	GINOM	A308	11100	12100	1	Neighboring ACC didn't make revision
9	27-10-2011	SERNA	M520	11100	12100	1	Neighboring ACC didn't make revision
10	13-11-2011	SERNA	M520	11100	12100	1	Neighboring ACC didn't make revision
11	17-11-2011	SERNA	M520	11300	11900	1	Neighboring ACC didn't make revision
12	11-12-2011	DARNO	A575	10700	11300	1	Neighboring ACC didn't make revision
13	14-12-2011	UH	M520	11300	11900	1	Assistant controller didn't make revision
14	24-12-2011	SERNA	M520	10700	11300	1	Neighboring ACC didn't make revision