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

MAAR VERTICAL SAFETY REPORT

(Presented by Monitoring Agency for Asia Region)

SUMMARY

This paper presents the results of the 2024 airspace safety oversight for Reduced Vertical Separation Minimum (RVSM) operations in the South Asia/Indian Ocean airspace, Southeast Asia airspace, and Mongolian airspace.

1. INTRODUCTION

1.1 This paper provides the executive summary of airspace safety oversight for the RVSM operation in the South Asia/ Indian Ocean (SA/IO) airspace, Southeast Asia (SEA) airspace, and Mongolian airspace during calendar year 2024. The full reports of SA/IO, SEA, and Mongolian airspace are provided in the **Attachment 1, 2 and 3**. Each report contains:

- a) Traffic Sample Data (TSD) and Large Height Deviation (LHD) reports used in risk estimation;
- b) summary of LHD occurrences and their associated risk;
- c) risk estimation parameters and results; and
- d) further discussion including geographical location of LHDs, the identification of hot spots and the hot spot analysis

2. DISCUSSION

Executive Summary: SA/IO Airspace

2.1 **Table 1** summarizes the SA/IO airspace RVSM technical, operational, and total risks. The total risk decreased from 4.05×10^{-9} in 2023 to 2.21×10^{-9} FAPFH in 2024, which is also below the specified TLS of 5.0×10^{-9} FAPFH. **Figure 1** presents collision risk estimate trends during the period from January 2024 to December 2024. The operational and total risk in 2024 showed a downward trend below the TLS. The trend was steady from January to August 2024, followed by a sharp decrease in the last four months.

Table 1: SA/IO Airspace RVSM Risk Estimates

SA/IO Airspace – estimated annual flying hours = 3,386,302 hours (note: estimated hours based on Dec 2024 traffic sample data)			
Source of Risk	Risk Estimation	TLS	Remarks
RASMAG 29 Total Risk	4.05×10^{-9}	5.0×10^{-9}	Below TLS
Technical Risk	0.89×10^{-9}	2.5×10^{-9}	Below Technical TLS
Operational Risk	1.32×10^{-9}	-	-
Total Risk	2.21×10^{-9}	5.0×10^{-9}	Below TLS

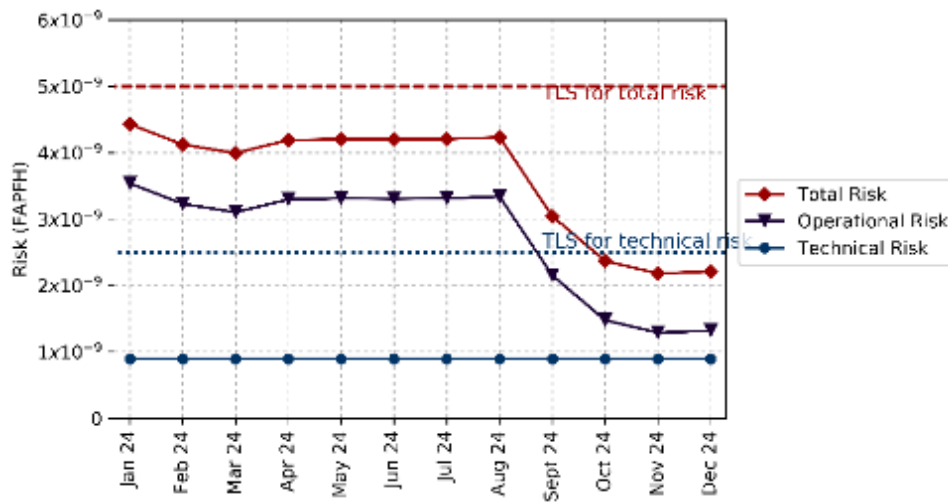


Figure 1: SA/IO Airspace RVSM Risk Estimate Trends

2.2 **Table 2** presents a summary of the LHD causes within SA/IO airspace from January 2024 until December 2024.

Table 2: Summary of LHD Causes within SA/IO Airspace

Code	LHD Category Description	No.
A	Flight crew fails to climb or descend the aircraft as cleared	1
B	Flight crew climbing or descending without ATC clearance	2
C	Incorrect operation or interpretation of airborne equipment	0
D	ATC system loop error	2
E	Coordination errors in the ATC-to-ATC transfer of control responsibility as a result of human factors issues	192
F	ATC transfer of control coordination errors due to technical issues	0
G	Aircraft contingency leading to sudden inability to maintain level	0
H	Airborne equipment failure and unintentional or undetected level change	0
I	Turbulence or other weather related cause leading to unintentional or undetected change of flight level	1
J	TCAS resolution advisory; flight crew correctly climb or descend following the resolution advisory	6
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		204

2.3 In 2024, 94% of the total number of LHDs in SA/IO airspace fell under Category E, which was further divided into sub-categories as shown in **Figure 2**. Category E LHDs in SA/IO airspace are dominated by two sub-categories. The largest portion, "E-RI: No or Late Revision of Transfer Information" accounts for 73%, while "E-NT: No Transfer or Negative Transfer Information" accounts for 26%.

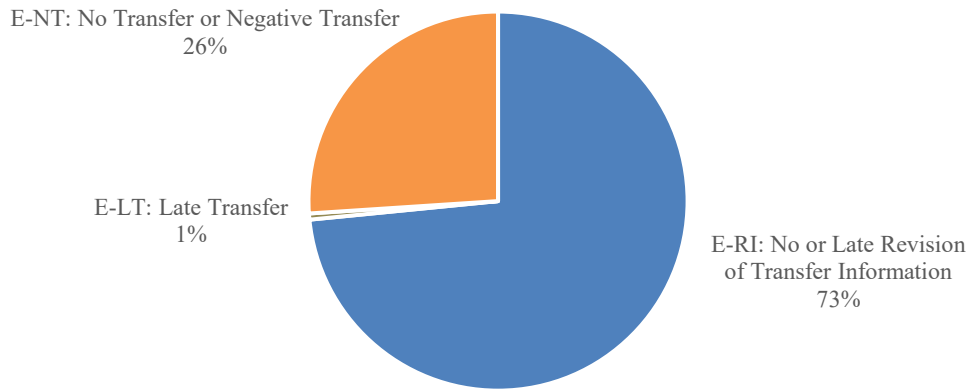


Figure 2: Sub-Categories of Category-E LHDs in SA/IO Airspace

2.4 **Figure 3** provides the geographic location of all LHD reports within SA/IO airspace during the assessment period.

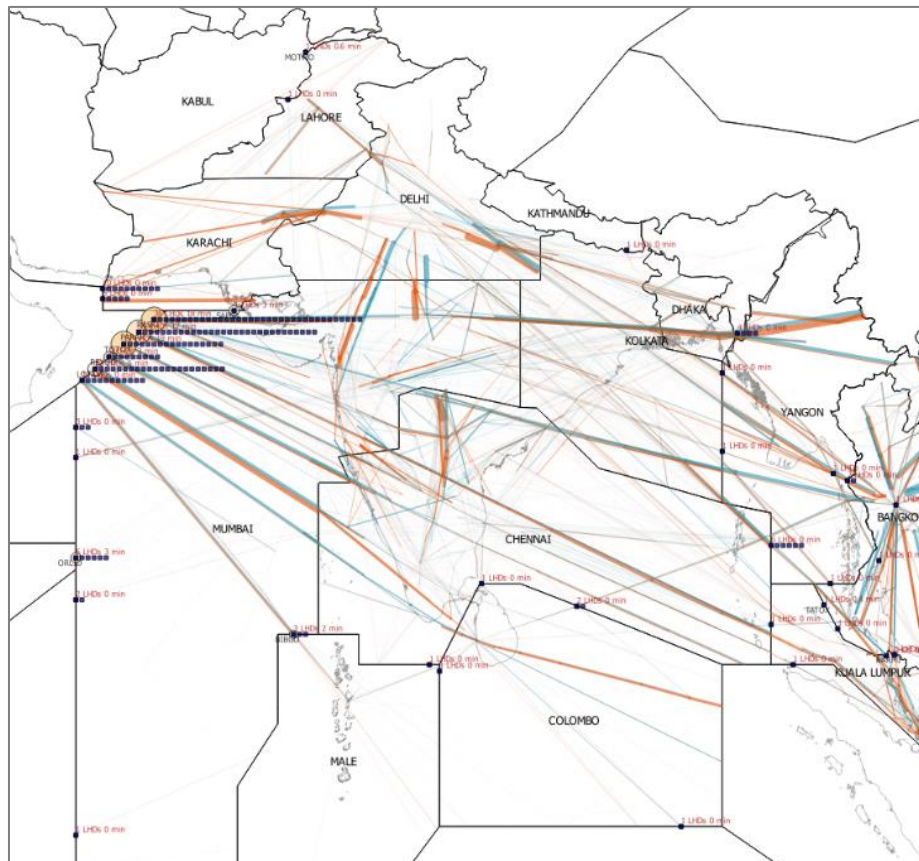


Figure 3: Geographic Location of All LHDs within SA/IO Airspace

2.5 **Figure 4** provides the geographic location of the non-zero-duration LHD reports within SA/IO airspace during the assessment period.

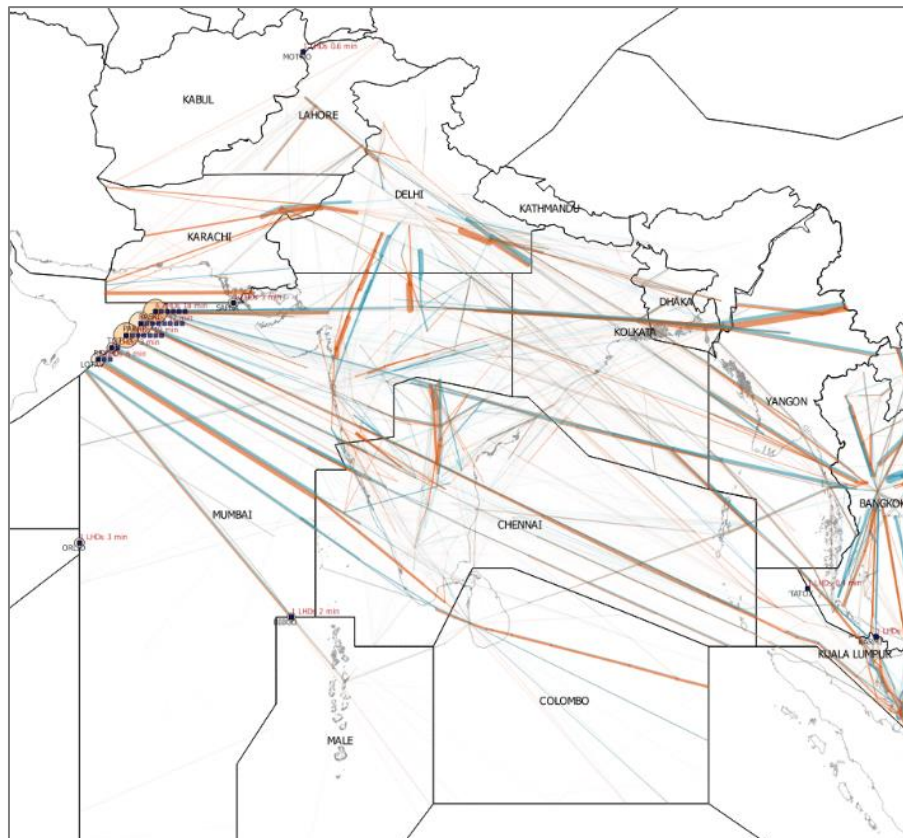


Figure 4: Geographic Location of Non-zero-duration LHDs within SA/IO Airspace

2.6 According to the process of identifying hot spots, **Table 3** shows the number of LHDs and operational risk for each cluster as well as the results of criteria check in SA/IO airspace. A 'Negative' result indicates that the cluster does not satisfy that particular criterion, while a 'Positive' result indicates that the cluster satisfies that particular criterion and can be identified as a hot spot.

Table 3: The Results of Identifying Hot Spots in SA/IO Airspace

2024 Clusters (SA/IO)	Mumbai/Muscat (Hot Spot G)	Mogadishu/Mumbai (Hot Spot F)	Chennai/Dhaka/Kolkata/ Yangon (Hot Spot A1)	Karachi/Muscat
Number of LHDs	132	6	12	15
Check Criteria: Number ≥ 40.8	Positive	Negative	Negative	Negative
Operational Risk ($\times 10^{-9}$ FAPFH)	1.09	0.05	0.00	0.00
Check Criteria: Risk $\geq 0.26 \times 10^{-9}$ FAPFH	Positive	Negative	Negative	Negative
Check Criteria: Operation Risk $\geq 5.00 \times 10^{-9}$ FAPFH	Negative	Negative	Negative	Negative

2.7 Regarding the results in **Table 3**, the Mumbai/Muscat FIR boundary (Hotspot G) is the only cluster that satisfies hot spot criteria in 2024.

LHD Hot Spot

LHD Hot Spot G (Mumbai/Muscat/Sanaa) and F (Mogadishu/Mumbai)

2.8 The western boundaries of Mumbai FIR were identified as LHD Hot Spots G and F in 2015, including the Mumbai/Muscat, Mumbai/Sanaa, and Mogadishu/Mumbai FIR boundaries. **Table 4** summarizes the number of LHDs, the number of non-zero-duration LHDs, and the operational risk at the western boundaries of the Mumbai FIR from 2022 to 2024. **Figure 5** shows the geographic locations of non-zero-duration LHDs and operation risk at these boundaries from 2022 to 2024.

Table 4: Comparison of the Number of LHDs, the Number of Non-Zero-Duration LHDs and Operational Risk at the Western Boundaries of Mumbai FIR from 2022 to 2024

Area	Number of LHDs			Number of non-zero-duration LHDs			Operational Risk (10^{-9} FAPFH)		
	2022	2023	2024	2022	2023	2024	2022	2023	2024
Mumbai/Muscat	43	138	132	10	32	27	0.79	2.79	1.09
Mumbai/Sanaa	2	3	2	0	0	0	0.00	0.00	0.00
Mogadishu/Mumbai	9	10	7	1	0	1	0.02	0.00	0.05
Total	54	151	141	11	32	28	0.81	2.79	1.14

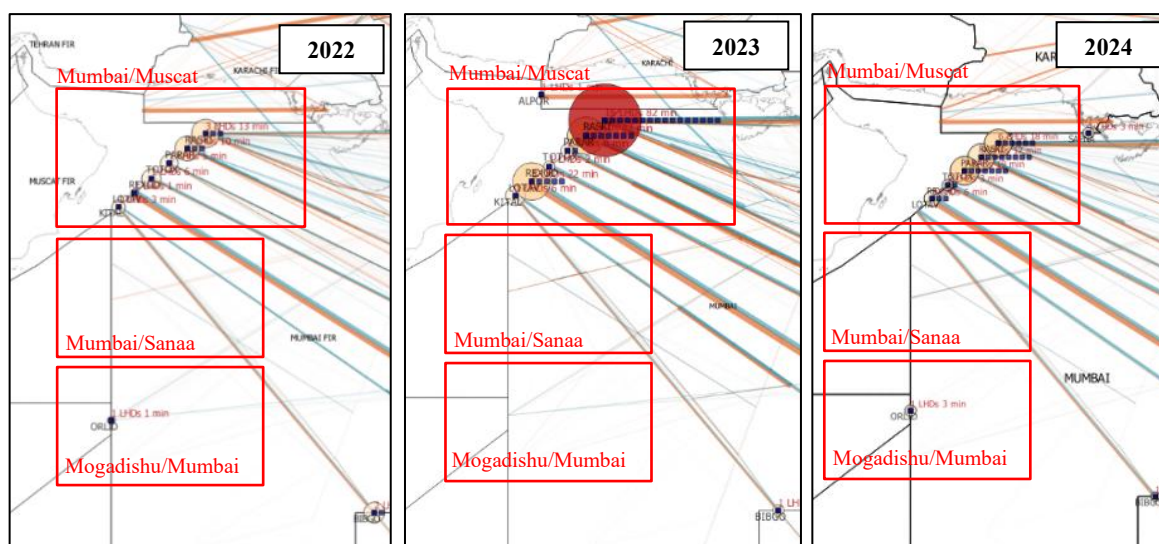


Figure 5: Geographic Locations of Non-Zero-Duration LHDs and Operation Risk at the Western Boundaries of Mumbai FIR from 2022 to 2024

2.9 Mumbai/Muscat FIR boundary has been a primary area of concern for SA/IO airspace for many years. However, the situation showed a slight improvement in 2024. According to **Table 4** and **Figure 5**, both the number of LHDs and the number of non-zero-duration LHD in 2024 slightly decreased compared to 2023. Additionally, the operation risk dramatically decreased from 2.79×10^{-9} FAPFH in 2023 to 1.09×10^{-9} FAPFH in 2024. This decrease was a result of the reduction in long-duration LHDs: In 2024, there were no LHDs with a duration longer than 10 minutes, whereas in 2023, there were four LHDs with a duration longer than 10 minutes, and one of them had a 30-minute duration. Despite the improvements observed in 2024, LHDs at the Mumbai/Muscat FIR boundary continued to be a major contributor to the overall LHDs in the SA/IO airspace, accounting for 65% of the total number of LHDs, and 83% of the total operational risk in SA/IO airspace.

2.10 At the Mumbai/Sanaa and Mogadishu/Mumbai FIR boundaries, the number of LHDs, the number of non-zero-duration LHDs and the operational risk were significantly lower compared to the values at Mumbai/Muscat FIR boundary.

2.11 With the differences in the working environment and risk profile at Hot Spot G which covers both the Mumbai/Muscat and Mumbai/Sanaa FIR boundaries, **MAAR proposes splitting Hot Spot G into Hot Spot G1 (Mumbai/Muscat) and Hot Spot G2 (Mumbai/Sanaa)**. This subdivision enables more efficient monitoring and reporting.

2.12 In the process of identifying hot spot, the Mumbai/Muscat FIR boundary (Hot Spot G1) continues to satisfy the hot spot criteria in terms of the number of LHDs and the operational risk as shown in **Table 4**. In contrast, the Mumbai/Sanaa FIR boundary (Hot Spot G2) and Mogadishu/Mumbai FIR boundary (Hot Spot F) have not satisfied any criteria since 2021. However, the AIDC implementation or other mitigation measures have not been completed yet.

2.13 Therefore, **Hot Spot G1, G2 and F should remain in the list of hot spots** and continue to be monitored until further safety improvement initiatives or prevention measures, such as AIDC, are completed and demonstrate their effectiveness.

LHD Hot Spot A1 (Chennai/Dhaka/Kolkata/Yangon)

2.14 Chennai/Dhaka/Kolkata/Yangon FIR boundaries were identified as LHD hot spot in 2015. **Table 5** summarizes the number of LHDs, the number of non-zero-duration LHDs, and the operational risk at Hot Spot A1 from 2022 to 2024. **Figure 6** shows the geographic locations of non-zero-duration LHDs and operation risk at these boundaries from 2022 to 2024.

Table 5: Comparison of the Number of LHDs, the Number of Non-zero-duration LHDs and Operational Risk at Hot Spot A1 from 2022 to 2024

Area	Number of LHDs			Number of non-zero-duration LHDs			Operational Risk (10 ⁻⁹ FAPFH)		
	2022	2023	2024	2022	2023	2024	2022	2023	2024
Kolkata/Yangon	17	11	6	0	0	0	0.00	0.00	0.00
Chennai/Yangon	23	15	6	1	1	0	0.02	0.06	0.00
Total	40	26	12	1	1	0	0.02	0.06	0.00

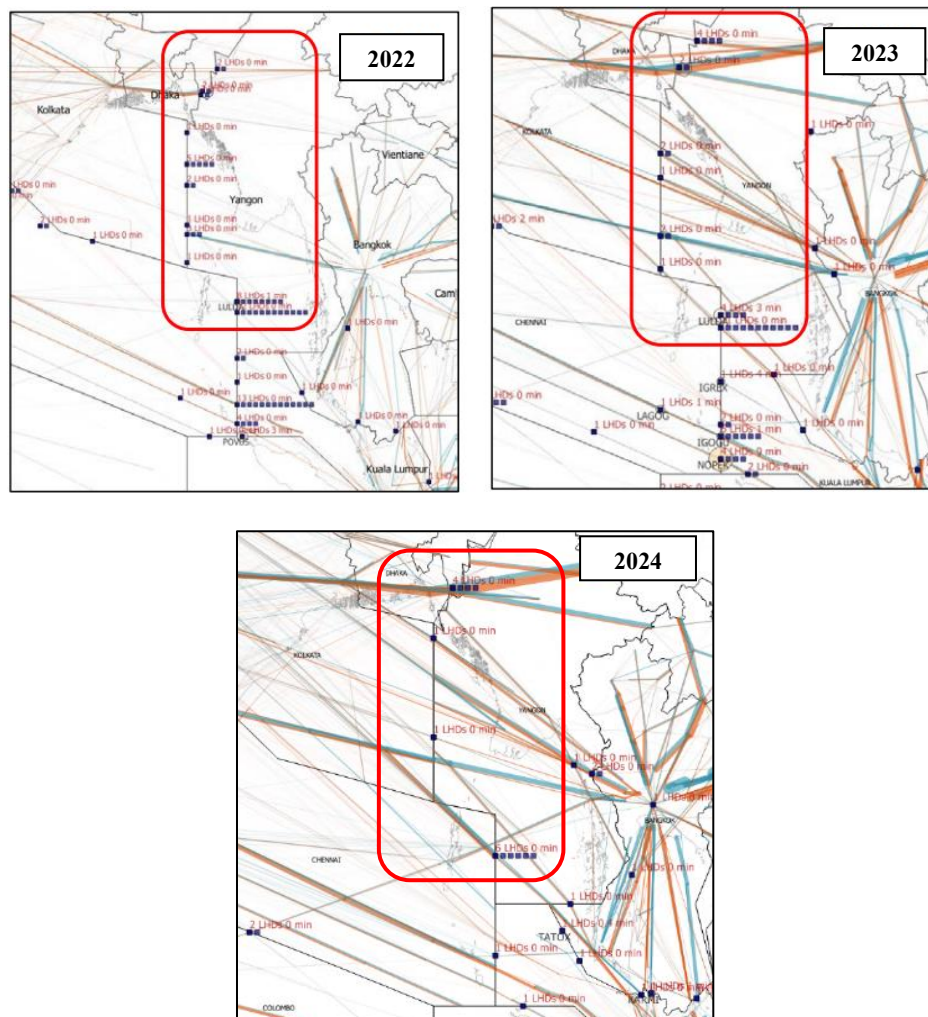


Figure 6: Geographic Locations of LHDs and Operation Risk at Hot Spot A1 from 2022 to 2024.

2.15 In **Table 5**, the number of LHDs decreased from 40 in 2022, 26 in 2023 to 12 in 2024. Additionally, there was no non-zero-duration LHDs, as well as operational risk in 2024.

2.16 Considering the results from the process of identifying hot spots, Hot Spot A1 did not satisfy any hot spot identification criteria in 2024. However, the AIDC implementation between Kolkata ACC and Yangon ACC, as well as between Chennai ACC and Yangon ACC, was initiated but remained in the testing phase and has not yet been operated. Therefore, **Hot Spot A1 should remain on the list of hot spots** and continue to be monitored until further safety improvement initiatives (specifically AIDC) are implemented and successfully reduce the number of LHDs.

Executive Summary: SEA Airspace

2.17 **Table 6** summarizes the SEA airspace RVSM technical, operational, and total risks. Compared to 2023, the total risk in 2024 reduced to 2.54×10^{-9} FAPFH, which is below the specified TLS of 5.0×10^{-9} FAPFH. **Figure 7** presents collision risk estimate trends during the period from January 2024 to December 2024. The operational and total risk in 2024 showed a slight downward trend below the TLS.

Table 6: SEA Airspace RVSM Risk Estimates

SEA Airspace – estimated annual flying hours = 3,054,228 hours (note: estimated hours based on Dec 2024 traffic sample data)			
Source of Risk	Risk Estimation	TLS	Remarks
RASMAG 29 Total Risk	2.91×10^{-9}	5.0×10^{-9}	Below TLS
Technical Risk	1.34×10^{-9}	2.5×10^{-9}	Below Technical TLS
Operational Risk	1.20×10^{-9}	-	-
Total Risk	2.54×10^{-9}	5.0×10^{-9}	Below TLS

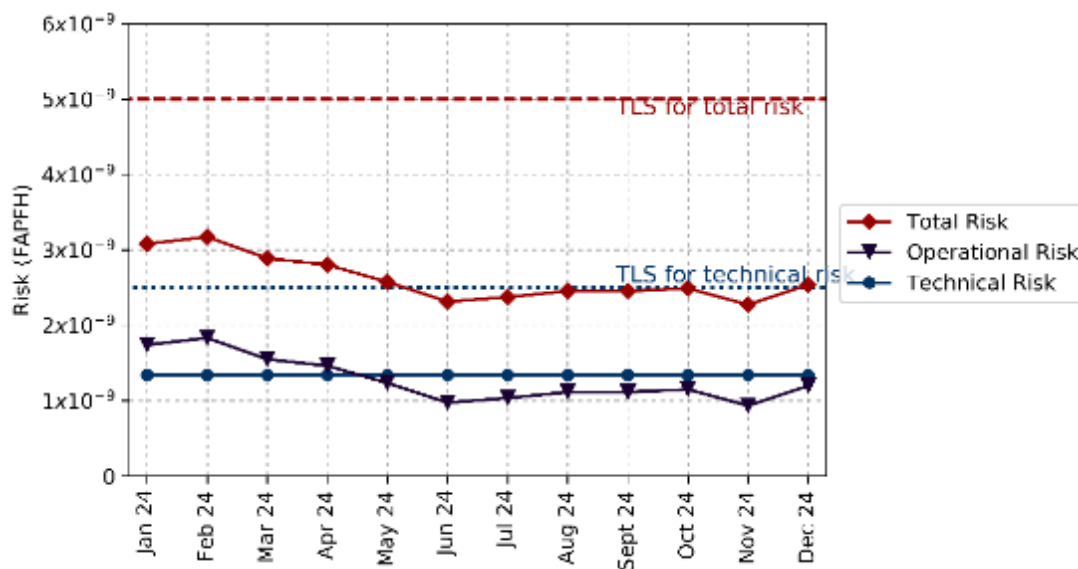


Figure 7: SEA Airspace RVSM Risk Estimate Trends

2.18 **Table 7** presents a summary of the LHD causes within SEA airspace from January 2024 until December 2024.

Table 7: Summary of LHD Causes within SEA Airspace

Code	LHD Category Description	No.
A	Flight crew fails to climb or descend the aircraft as cleared	1
B	Flight crew climbing or descending without ATC clearance	2
C	Incorrect operation or interpretation of airborne equipment	0
D	ATC system loop error	4
E	Coordination errors in the ATC-to-ATC transfer of control responsibility as a result of human factors issues	68
F	ATC transfer of control coordination errors due to technical issues	8
G	Aircraft contingency leading to sudden inability to maintain level	0
H	Airborne equipment failure and unintentional or undetected level change	0
I	Turbulence or other weather related cause leading to unintentional or undetected change of flight level	0
J	TCAS resolution advisory; flight crew correctly climb or descend following the resolution advisory	6
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		89

2.19 According to **Table 7**, the majority of LHDs in SEA airspace fell under Category E. The second-highest number of LHDs occurred in Category F, accounting for 9% of the total number of LHDs in the SEA airspace. To further analyze Category E LHDs, they can be broken down into sub-categories, as shown in **Figures 8**.

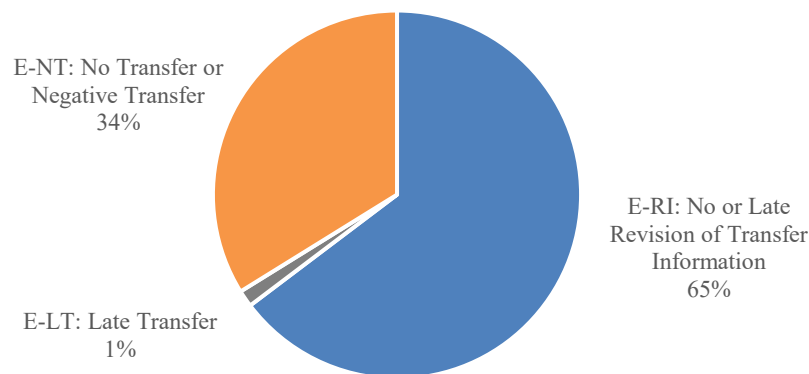


Figure 8: Sub-Categories of Category-E LHDs in SEA Airspace

2.20 In **Figure 8**, the largest portion, E-RI: No or Late Revision of Transfer Information, accounts for 65% of Category E LHDs. This is followed by E-NT: No Transfer or Negative Transfer, which accounts for 34%.

2.21 **Figure 9** provides the geographic location of all LHD reports within SEA airspace during the assessment period.

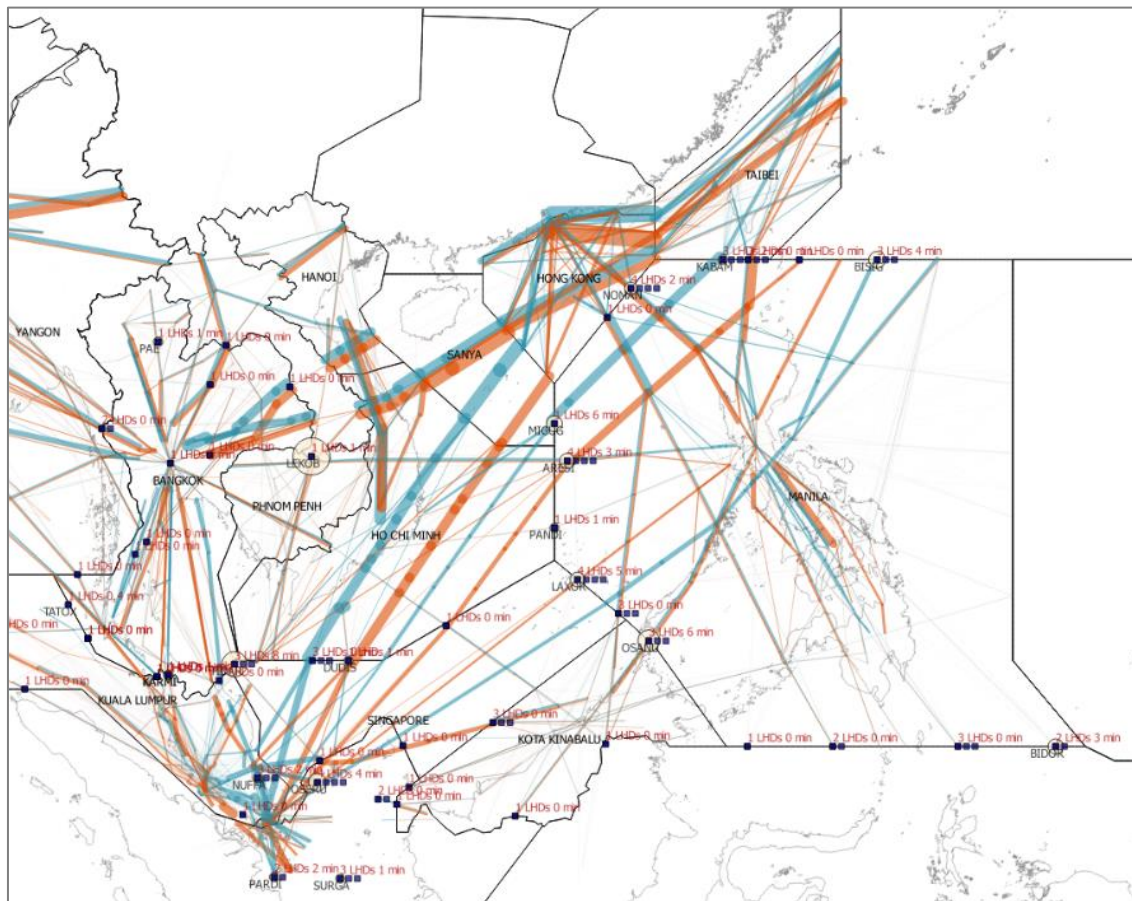


Figure 9: Geographic Location of All LHDs within SEA Airspace

2.22 **Figure 10** provides the geographic location of the non-zero-duration LHD reports within SEA airspace during the assessment period.

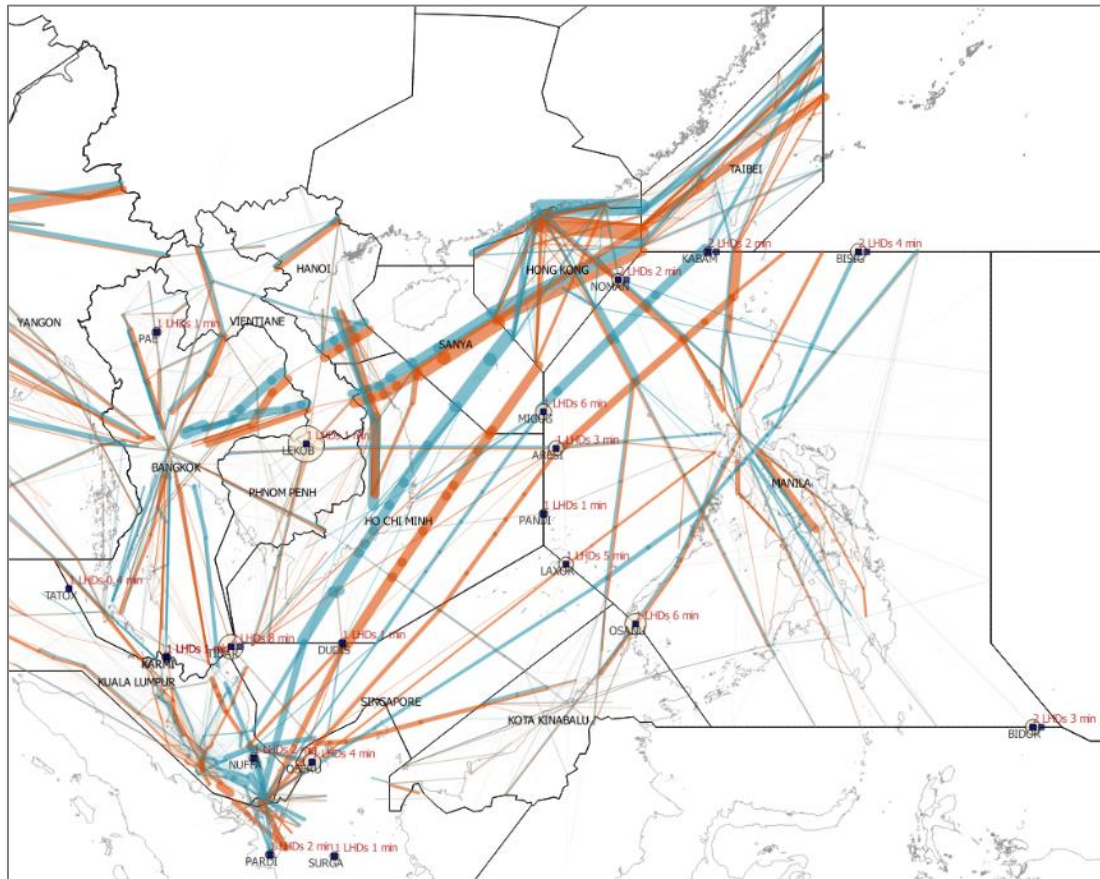


Figure 10: Geographic Location of Non-zero-duration LHDs Within SEA Airspace

2.23 According to the process of identifying hot spots, **Table 8** shows the number of LHDs and operational risk for each cluster, as well as the results of criteria check in SEA airspace. A ‘Negative’ result indicates that the cluster does not satisfy that particular criterion, while a ‘Positive’ result indicates that the cluster satisfies that particular criterion and can be identified as a hot spot.

Table 8: The Results of Identifying Hot Spots in SEA Airspace

2024 Clusters (SEA)	Bangkok/Ho Chi Minh/ Kuala Lumpur/Singapore (Hot Spot O)	Hong Kong/Manila	Ho Chi Minh/Manila (Hot Spot D5)	Jakarta/Singapore (Hot Spot J)	Kota Kinabalu/Manila (Hot Spot D7)	Manila/Taipei	Manila/Ujung Pandang (Hot Spot D8)
Number of LHDs	3	5	6	11	6	6	8
Check Criteria: Number ≥ 11.13	Negative	Negative	Negative	Negative	Negative	Negative	Negative
Operational Risk ($\times 10^{-9}$ FAPFH)	0.15	0.04	0.14	0.12	0.12	0.02	0.06
Check Criteria: Operational Risk $\geq 0.15 \times 10^{-9}$ FAPFH	Positive	Negative	Negative	Negative	Negative	Negative	Negative
Check Criteria: Operational Risk $\geq 5.00 \times 10^{-9}$ FAPFH	Negative	Negative	Negative	Negative	Negative	Negative	Negative

2.24 According to the results in **Table 8**, the Bangkok/Ho Chi Minh/Kuala Lumpur/Singapore FIR boundaries (Hot Spot O) satisfy the hot spot criteria in terms of the operational risk. On the other hand, other clusters and previously listed Hot Spots, including Hot Spot D1, D5, D7 and D8, did not satisfy any hot spot criteria in 2024.

LHD Hot Spot

2.25 This report focuses on updates for the listed Hot Spots D1, D5, D7, D8, J and O. For Hot Spot D1, D5, D7 and D8, **Table 9** summarizes the number of LHDs, non-zero-duration LHDs, and the operational risk from 2022 to 2024.

Table 9: Comparison of the Number of LHDs, Non-Zero-Duration LHDs and Operational Risk at Hot Spot D1, D5, D7, and D8 from 2022 to 2024

Area	Number of LHDs			Number of non-zero-duration LHDs			Operational Risk (10^{-9} FAPFH)		
	2022	2023	2024	2022	2023	2024	2022	2023	2024
Fukuoka/Manila (Hot Spot D1)	4	4	4	3	2	2	0.03	0.19	0.07
Ho Chi Minh/Manila (Hot Spot D5)	3	2	6	2	1	3	0.05	0.10	0.14
Kota Kinabalu/Manila (Hot Spot D7)	3	5	6	2	2	1	0.04	0.13	0.12
Manila/Ujung Pandang (Hot Spot D8)	2	15	8	1	6	2	0.11	0.41	0.06

2.26 **Figure 11** depicts the geographical locations of LHDs and operational risk at Hot Spot D1, D5, D7, and D8 from 2022 to 2024.

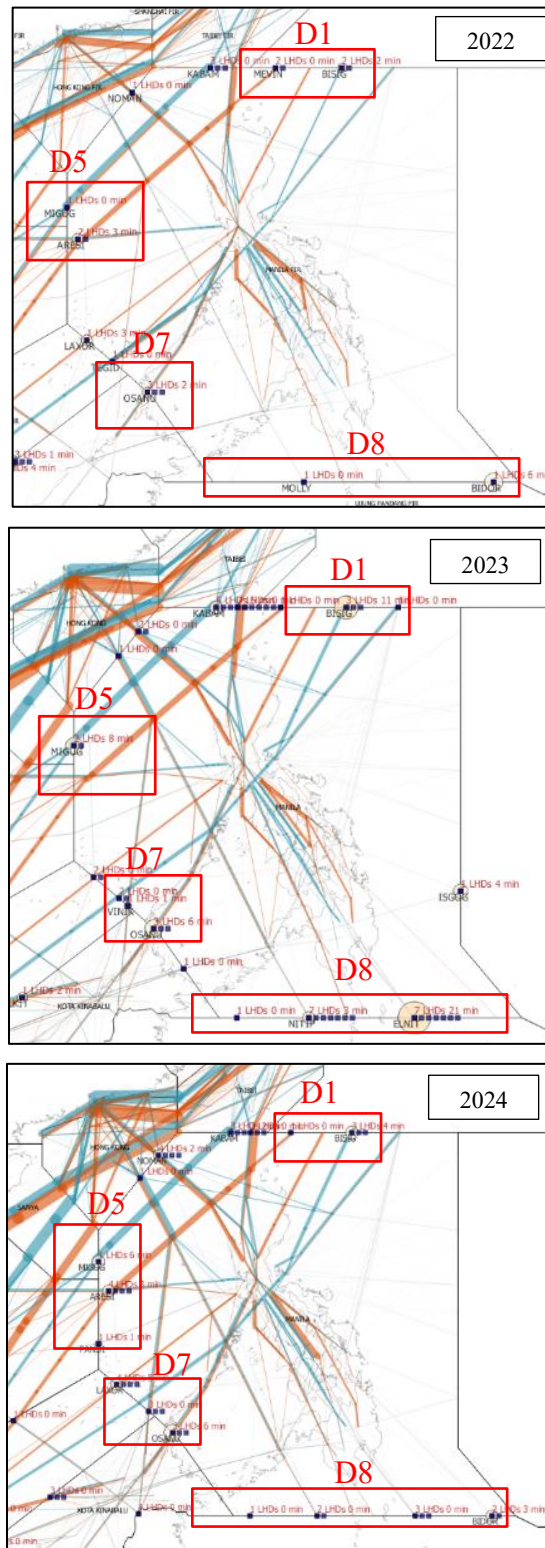


Figure 11: Geographic Locations of LHDs and Operational Risk at Hot Spot D1, D5, D7, and D8 from 2022 to 2024

LHD Hot Spot D1 (Fukuoka/Manila)

2.27 At Fukuoka/Manila FIR boundary, the number of LHDs and non-zero-duration LHDs in 2024 remained at the same number as those in 2022 and 2023. Additionally, the operational risk significantly decreased from 0.19×10^{-9} FAPFH in 2023 to 0.07×10^{-9} FAPFH in 2024.

2.28 To address the causes of LHDs at Hot Spot D1, Fukuoka and Manila ACCs have actively collaborated to investigate the causes and implement mitigations. Consequently, the coordination meetings were held to identify the root causes of transfer errors. As reported in IP/07 to the RASMAG/29 meeting, both ACCs agreed to adjust the timing for sending transfer information from Manila ACC to Fukuoka ACC: from 30 minutes to 20 minutes prior to the estimated time over the FIR boundary. This change reduces complexity by ensuring the transfer is coordinated within a single sector instead of over two sectors. A successful trial of this procedure led to an amendment of the Letter of Agreement (LOA), with full implementation beginning on 13 June 2024.

2.29 Additionally, Fukuoka and Manila ACCs will continue holding the coordination meetings to further enhance airspace safety, prevent transfer errors, and improve operational procedures.

2.30 Considering that Hot Spot D1 has not satisfied the hot spot criteria since 2023 and the mitigation has been successfully implemented, **Hot Spot D1 is proposed as a potential non-hotspot**. If this area does not satisfy the hot spot criteria again in 2025, Hot Spot D1 may be proposed for removal from the list of hot spots.

LHD Hot Spot D5 (Ho Chi Minh/Manila)

2.31 In 2024, the number of LHDs at Hot Spot D5 increased. The number of non-zero-duration LHDs and operational risk also increased in 2024. Even though Hot Spot D5 has not satisfied the hot spot criteria since 2022, the mitigation measures, such as the implementation of AIDC, have not been initiated. Therefore, **Hot Spot D5 should remain on the list of hot spots**.

LHD Hot Spot D7 (Kota Kinabalu/Manila)

2.32 In 2024, the number of LHDs at Hot Spot D7 slightly increased. However, the number of non-zero-duration LHDs and operational risk slightly decreased in 2024. In addition, the Hot Spot D7 has not satisfied the hot spot criteria since 2021. Nevertheless, AIDC implementation is currently in the operational trial phase, with full implementation expected in the fourth quarter of 2025. Thus, **Hot Spot D7 should remain on the list of hot spots**. Once the AIDC implementation is complete together with the decrease in LHDs, this area may be considered a potential non-hotspot in 2026.

LHD Hot Spot D8 (Manila/Ujung Pandang)

2.33 At Hot Spot D8, the number of LHDs, the number of non-zero-duration LHDs and the operation risk significantly decreased in 2024. In addition, the Hot Spot D8 has not satisfied the hot spot criteria in 2024 and the AIDC has been successfully operated since 2020 as a mitigation measure. Therefore, **Hot Spot D8 is proposed as a potential non-hotspot**. If this area does not satisfy the hot spot criteria in 2025, Hot Spot D8 may be proposed for removal from the list of hot spots.

LHD Hot Spot J (Jakarta/Singapore)

2.34 The FIR boundary between Jakarta and Singapore has been identified as Hot Spots J since 2018. In **Table 10**, the number of LHDs at Hot Spot J dramatically decreased from 27 in 2023 to 11 in 2024. Similarly, the operational risk decreased from 0.33×10^{-9} FAPFH in 2023 to 0.12×10^{-9} FAPFH in 2024.

Table 10: Comparison of the number of LHDs, the number of non-zero-duration LHDs and operational risk at Singapore/Jakarta FIR Boundary from 2022 to 2024

Area	Number of LHDs			Number of non-zero-duration LHDs			Operational Risk		
							(10 ⁻⁹ FAPFH)		
	2022	2023	2024	2022	2023	2024	2022	2023	2024
Jakarta/Singapore (Hot Spot J)	14	27	11	2	5	3	0.18	0.33	0.12

2.35 On 21 March 2024, the FIR boundary between Jakarta and Singapore was realigned to improve the traffic flow management. To support the transition and maintain safety, operational coordination meetings between Singapore ACC and Jakarta ACC were held in July, October, and December 2024, with further discussions planned for 2025. In addition, the results of the LHD analysis were shared with controllers to enhance safety awareness. These efforts of FIR realignment, ongoing coordination, and increased operational awareness had contributed to the significant reduction in both the number of LHDs and the level of operational risk in 2024.

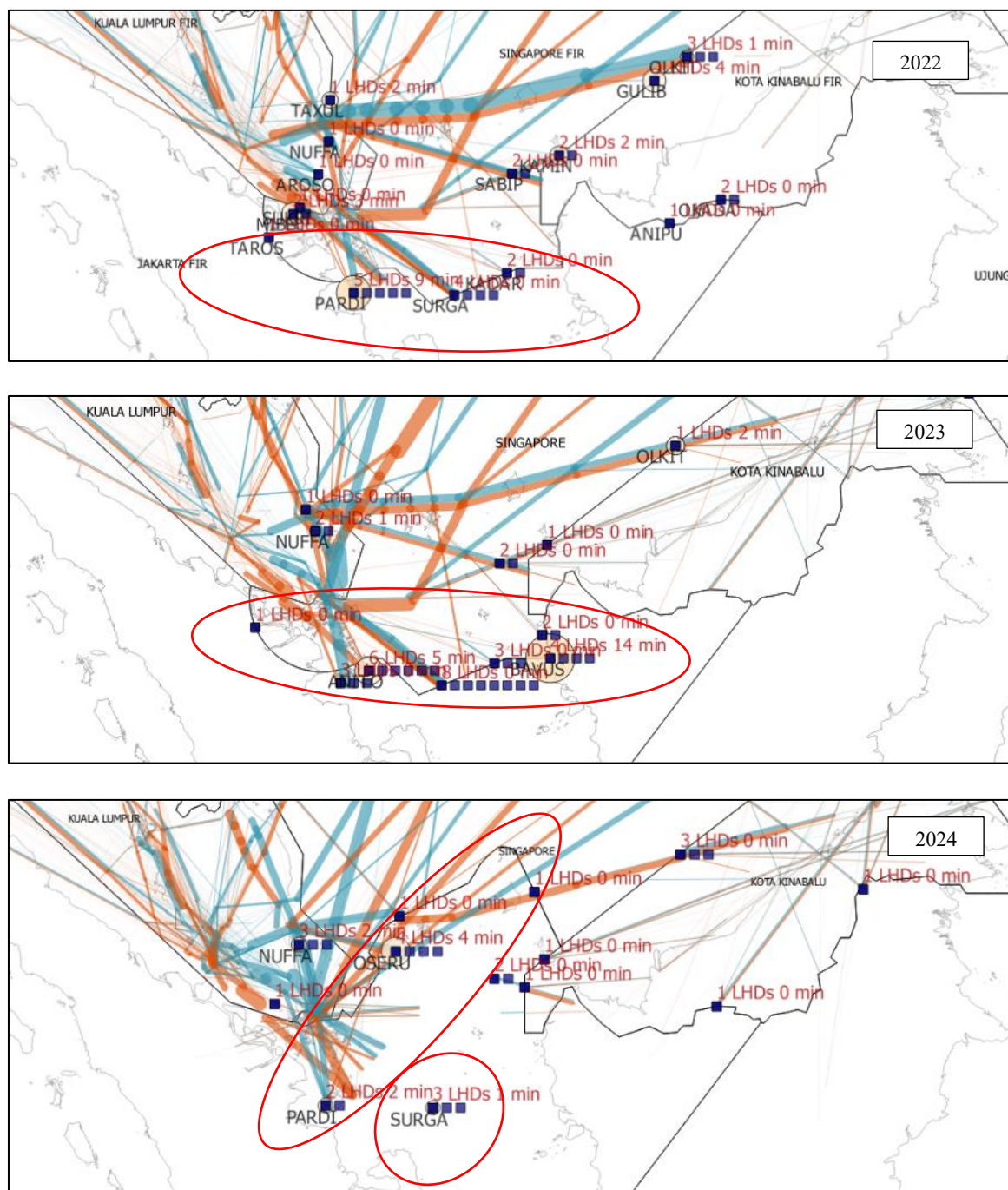


Figure 12: Geographic Location of LHDs and Operation Risk at Singapore/Jakarta FIR Boundary from 2022 to 2024.

2.36 Although this boundary was identified as an LHD cluster during the hot spot identification process, it did not satisfy the hot spot criteria in 2024. With the decreased number of LHDs, decreased operational risk, and successful implementation of mitigation measures, **Hot Spot J is proposed as a potential non-hot spot**. If this area does not satisfy the hot spot criteria again in 2025, Hot Spot J may be proposed for removal from the list of hot spots.

LHD Hot Spot O (Bangkok/Ho Chi Minh/Kuala Lumpur/Singapore)

2.37 This area was identified as Hot Spot O during RASMAG/28 meeting in 2023 due to the operational risk. As shown in **Table 11**, the number of LHDs, non-zero-duration LHDs, as well as operational risk in 2024 decreased from 2023. However, the operational risk accounted for 12 % of the total operational risk in SEA airspace.

Table 11: Comparison of the Number of LHDs, the Number of Non-Zero-Duration LHDs and Operational Risk at Hot Spot O from 2022 to 2024

Area	Number of LHDs			Number of non-zero-duration LHDs			Operational Risk (10 ⁻⁹ FAPFH)		
	2022	2023	2024	2022	2023	2024	2022	2023	2024
Hot Spot O	7	5	3	4	3	2	0.58	0.51	0.15

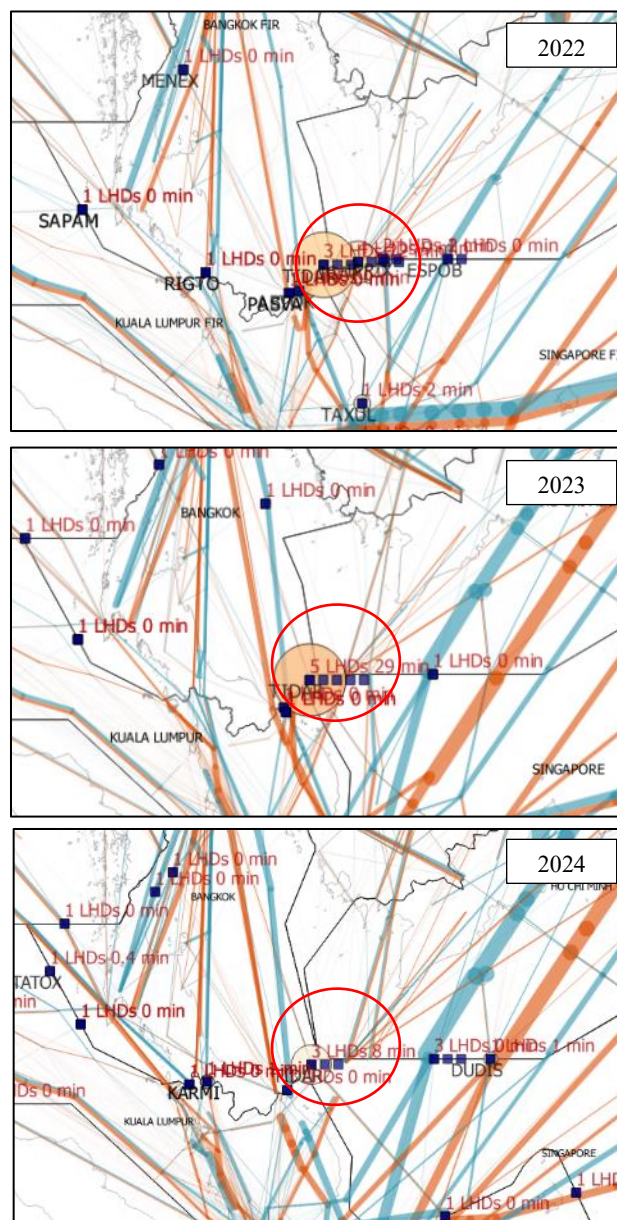


Figure 13: Geographic Location of LHDs and Operational Risk at Bangkok/Ho Chi Minh/Kuala Lumpur/Singapore FIR Boundary from 2022 to 2024.

2.38 When applying the hot spot identification process, the LHD cluster of Hot Spot O continues to satisfy the hot spot criteria in terms of the operational risk. No mitigation measures have been identified. Therefore, **Hot Spot O should remain on the list of hot spots.**

Executive Summary: Mongolian Airspace

2.39 **Table 12** summarizes the vertical collision technical, operational, and total risk estimates in the Mongolian airspace.

Mongolian Airspace – estimated annual flying hours = 103,477 hours (note: estimated hours based on Dec 2024 traffic sample data)			
Source of Risk	Risk Estimation	TLS	Remarks
<i>RASMAG 29 Total Risk</i>	0.58×10^{-9}	5.0×10^{-9}	<i>Below TLS</i>
Technical Risk	0.72×10^{-9}	2.5×10^{-9}	Below Technical TLS
Operational Risk	0.00×10^{-9}	-	-
Total Risk	0.72×10^{-9}	5.0×10^{-9}	Below TLS

Table 12: Mongolian Airspace RVSM Risk Estimates

2.40 In 2024, the total risk was estimated as 0.72×10^{-9} FAPFH. No LHD was reported within or at the boundary of the Mongolian airspace. Hence, the analysis of operational errors cannot be conducted.

APANPIRG List of Deficiencies

2.41 To facilitate the process of RVSM safety oversight, States are required to annually submit a December TSD (APANPIRG Conclusion 16/4) and ANSPs are responsible for submitting LHD data to their Regional Monitoring Agencies (RMAs) on a monthly basis.

2.42 MAAR has not received any data from Afghanistan since the political issue in August 2021. Additionally, MAAR has not received the TSD for 2024 from Nepal within the designated timeframe and in the correct format. Therefore, MAAR proposes to **maintain Afghanistan and include Nepal on the APANPIRG List of Deficiencies in the ATM and Airspace Safety, under “Non-Provision of Safety-related Data”.**

Reporting Culture

2.43 Over the past several years, MAAR has observed continuous improvement among the States and ANSPs under its jurisdiction. Almost all States now regularly submit their LHD reports to MAAR through the Online LHD Submission System and cooperate in addressing LHD-related matters. Only Nepal and Myanmar continue to use the LHD reporting template and submit their reports via email.

2.44 Furthermore, most reported LHDs in MAAR’s area of responsibility were located at the boundary of FIRs and classified as Category E LHD, which refers to coordination errors in the ATC-to-ATC transfer of control responsibility. There were a small number of other LHD categories observed. Additionally, MAAR has received a number of NIL reports, indicating that no LHDs occurred on that particular month, from Delhi, Dhaka, Vientiane and Ulaanbaatar FIRs for the past 3 years. On the other hand, the number of NIL reports may raise concerns whether all LHDs are being captured and reported, indicating the possibility of under-reporting.

2.45 Thus, MAAR would like to **encourage the LHD POCs of the States to expand their focus on other LHD occurrences in addition to category E, while promoting a positive safety reporting culture within their States/organizations.**

3. ACTION BY THE MEETING

3.1 The meeting is invited to:

- a) consider splitting LHD Hot Spot G into Hot Spot G1 (Mumbai/Muscat) and Hot Spot G2 (Mumbai/Sanaa) (paragraph 2.11);
- b) consider the results from the analysis and the hot spot identification process that;
 - i) LHD Hot Spot G1 (Mumbai/Muscat), G2 (Mumbai/Sanaa) and F (Mogadishu/Mumbai) should remain in the list of hot spots (paragraph 2.13);
 - ii) LHD Hot Spot A1 (Chennai/Dhaka/Kolkata/Yangon) should remain in the list of hot spots (paragraph 2.16);
 - iii) LHD Hot Spot D1 (Fukuoka/Manila) is proposed for a potential non-hotspot (paragraph 2.30);
 - iv) LHD Hot Spot D5 (Ho Chi Minh/Manila) should remain in the list of hot spots (paragraph 2.31);
 - v) LHD Hot Spot D7 (Kota Kinabalu/Manila) should remain in the list of hot spots (paragraph 2.32)
 - vi) LHD Hot Spot D8 (Manila/Ujung Pandang) is proposed for a potential non-hotspot (paragraph 2.33);
 - vii) LHD Hot Spot J (Singapore/Jakarta) is proposed for a potential non-hotspot (paragraph 2.36); and
 - viii) LHD Hot Spot O (Bangkok/Ho Chi Minh/Kuala Lumpur/Singapore) should remain in the list of hot spots (paragraph 2.38);
- c) consider maintaining Afghanistan and including Nepal on the List of Deficiencies in the ATM and Airspace Safety, under “Non-Provision of Safety-related Data” (paragraph 2.42);
- d) encourage the LHD POCs of the States to expand their focus on other LHD occurrences in addition to category E, while promoting a positive safety reporting culture within their States/organizations (paragraph 2.45); and
- e) discuss any relevant matters as appropriate.

MONITORING AGENCY FOR ASIA REGION (MAAR)



**Airspace Safety Oversight for RVSM Implementation
in South Asia/Indian Ocean (SA/IO) Airspace**

January 2024 to December 2024

**AIRSPACE SAFETY OVERSIGHT FOR THE RVSM OPERATION
IN THE SOUTH ASIA/INDIAN OCEAN (SA/IO) AIRSPACE
Assessment Period: January 2024 to December 2024**

**Prepared by
Monitoring Agency for Asia Region (MAAR)
(An ICAO APANPIRG approved Regional Monitoring Agency)**

1. Introduction

This report presents the results of airspace safety oversight for RVSM operations in the South Asia/Indian Ocean (SA/IO) airspace. The assessment is based on one month of Traffic Sample Data (TSD) collected in December 2024 and Large Height Deviation (LHD) reports submitted by States in the SA/IO airspace for occurrences between January and December 2024.

2. Data Sources

2.1. Traffic Sample Data (TSD). The TSD collected in December 2024, covering aircraft operations in SA/IO airspace, has been utilized in accordance with ICAO regional agreement. However, MAAR has not received any data from Afghanistan since the political issue in August 2021. Additionally, MAAR has not received the TSD for 2024 from Nepal within the designated timeframe and in the correct format.

2.2. Large Height Deviation (LHD). The cumulative 12-month dataset of LHD reports submitted by States in the SA/IO airspace for occurrences between January and December 2024. **Table 1** presents the FIRs that submitted LHD reports, including NIL reports. It is noted that no LHD reports or related responses have been received from Kabul ACC since 16 August 2021. Detailed information on each reported LHD, along with brief descriptions, is provided in **Appendix A**.

FIR/ Month	Dhaka	Chennai	Delhi	Kolkata	Mumbai	Kuala Lumpur	Male	Yangon	Katmandu	Karachi	Lahore	Kabul	Colombo	Bangkok
January	X	X	X	X	X	X	X	X	X	X	X		X	X
February	X	X	X	X	X	X	X	X	X	X	X		X	X
March	X	X	X	X	X	X	X	X	X	X	X		X	X
April	X	X	X	X	X	X	X	X	X	X	X		X	X
May	X	X	X	X	X	X	X	X	X	X	X		X	X
June	X	X	X	X	X	X	X	X	X	X	X		X	X
July	X	X	X	X	X	X	X	X	X	X	X		X	X
August	X	X	X	X	X	X	X	X	X	X	X		X	X
September	X	X	X	X	X	X	X	X	X	X	X		X	X
October	X	X	X	X	X	X	X	X	X	X	X		X	X
November	X	X	X	X	X	X	X	X	X	X	X		X	X
December	X	X	X	X	X	X	X	X	X	X	X		X	X

Table 1: Summary of LHD Reports Submitted by SA/IO FIRs in 2024. An ‘X’ indicates that LHD or NIL Reports are Submitted Each Month.

3. Summary of LHD Occurrences

3.1. **Table 2** and **Figure 1** summarize the number of LHDs, the duration (in minutes), the number of levels crossed, and their associated operational risk by month from January 2024 to December 2024.

Month (2024)	No. of LHDs	No. of Non-zero-duration LHDs	LHD Duration (Min)	No. of Levels Crossed	Operational Risk ($\times 10^{-9}$ FAPFH)
January	22	4	8	1	0.16
February	15	4	6	0	0.10
March	24	7	17	0	0.29
April	15	3	14	0	0.24
May	21	6	11	0	0.18
June	20	4	7	0	0.12
July	11	2	4	0	0.07
August	12	3	4	1	0.08
September	19	1	2	0	0.03
October	17	0	0	0	0.00
November	3	0	0	0	0.00
December	25	1	3	0	0.05
Total	204	35	76	2	1.32

Table 2: Monthly Summary of LHDs in SA/IO Airspace

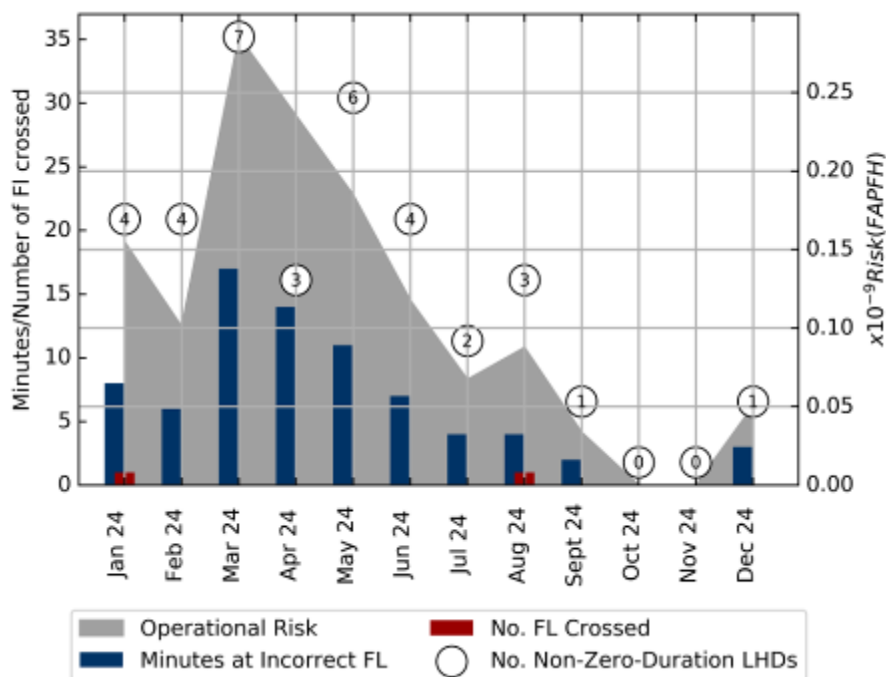


Figure 1: Monthly Summary of Non-Zero-Duration LHDs, Duration, FL crossed and Operational Risk in SA/IO Airspace

3.2. The number of LHDs decreased from 254 in 2023 to 204 in 2024. The highest monthly number of non-zero-duration LHDs was 7, in March 2024, contributing to 22% of the total operational risk in SA/IO airspace. In contrast, no non-zero-duration LHDs were in October and November 2024, indicating zero operational risk during those two months.

3.3. **Figure 2** and **Table 3** summarize the number of non-zero-duration LHDs, and the duration (in minutes), the number of levels crossed, and their associated operational risk, by LHD category from January 2024 to December 2024.

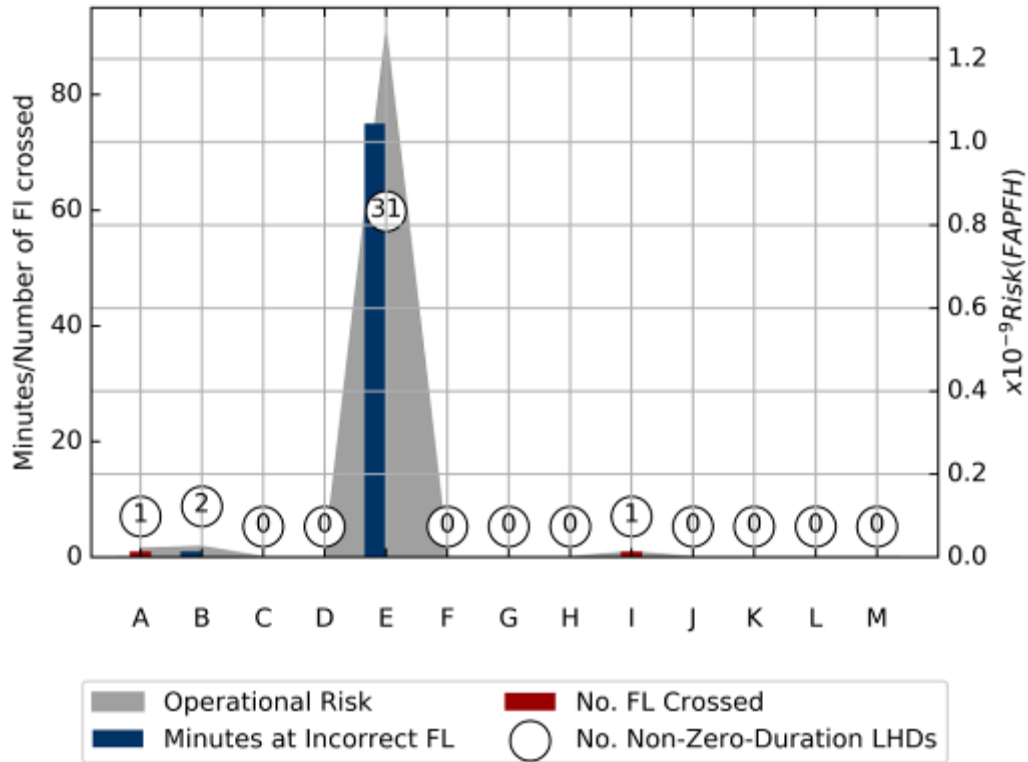


Figure 2: Summary of Non-Zero-Duration LHD Duration, FL crossed and Operational Risk by Category in SA/IO Airspace

LHD Category Code	LHD Category Description	No. of LHDs	No. of Non-zero-duration LHDs	LHD Duration (Min)	No. of levels Crossed	Operational Risk (x10⁻⁹ FAPFH)
A	Flight crew failing to climb/descend the aircraft as cleared	1	1	0	1	0.02
B	Flight crew climbing/descending without ATC Clearance	2	2	1	0	0.03
C	Incorrect flight level provided due to incorrect operation or interpretation of airborne equipment (e.g. incorrect operation of fully functional FMS, incorrect transcription of ATC clearance or re-clearance in FMS, flight plan followed rather than ATC clearance, original clearance followed instead of re-clearance etc.).	0	0	0	0	0
D	ATC system loop error; (e.g. ATC issues incorrect flight level clearance or flight crew misunderstands the flight level clearance message)	2	0	0	0	0
E	Coordination errors in the ATC-to-ATC transfer of control responsibility as a result of human factors issues (e.g. late or non-existent coordination of flight level).	192	31	75	0	1.26
F	Coordination errors in the ATC-to-ATC transfer of control responsibility as a result of equipment outage or technical issues (e.g. late or non-existent coordination of flight level).	0	0	0	0	0
G	Aircraft contingency event leading to sudden inability to maintain assigned flight level (e.g. pressurization failure, engine failure)	0	0	0	0	0
H	Airborne equipment failure leading to unintentional or undetected change of flight level.	0	0	0	0	0
I	Turbulence or other weather related causes leading to unintentional or undetected change of flight level	1	1	0	1	0.01
J	TCAS resolution advisory, flight crew correctly climb or descend following the resolution advisory	6	0	0	0	0

LHD Category Code	LHD Category Description	No. of LHDs	No. of Non-zero-duration LHDs	LHD Duration (Min)	No. of levels Crossed	Operational Risk (x10 ⁻⁹ FAPFH)
K	TCAS resolution advisory, flight crew incorrectly climb or descend following the resolution advisory.	0	0	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	0	0
M	Other	0	0	0	0	0
Total		204	35	76	2	1.32

Table 3: Summary of LHD by Category in SA/IO Airspace.

3.4. In 2024, 94% of the total number of LHDs and 96% of the operational risk in SA/IO airspace fell under Category E, which was further divided into sub-categories. **Figure 3** illustrates the contribution of each sub-category in terms of the number of LHDs, while **Figure 4** shows the contribution in terms of operational risk.

3.5. In **Figure 3**, Category E LHDs in SA/IO airspace are dominated by two sub-categories. The largest portion, "E-RI: No or Late Revision of Transfer Information" accounts for 73%, while "E-NT: No Transfer or Negative Transfer Information" accounts for 26%.

3.6. In terms of the operational risk, **Figure 4** shows that "E-RI: No or Late Revision of Transfer Information" accounts for 85%, with "E-NT: No Transfer or Negative Transfer Information" accounting for 15%. Other sub-categories do not account for any operational risk.

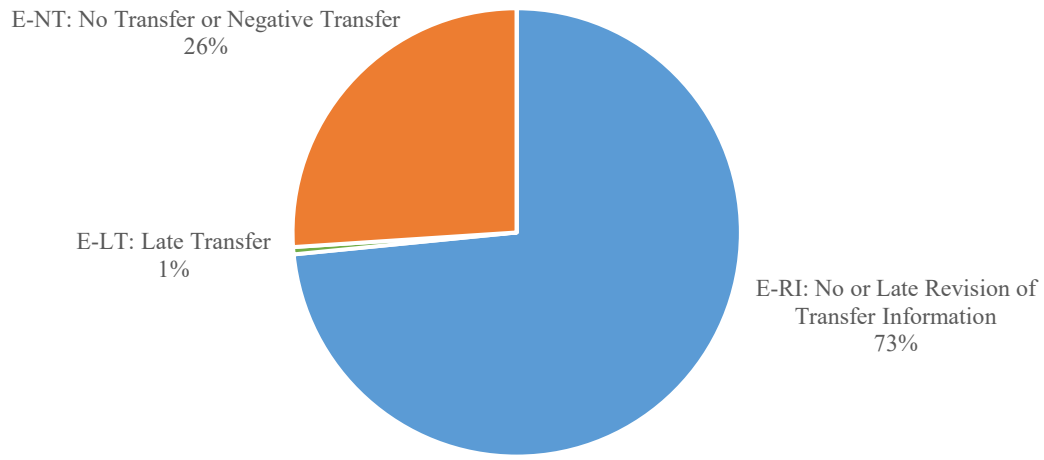


Figure 3: Sub-Categories of Category-E LHDs in SA/IO Airspace
(The Number of LHDs)

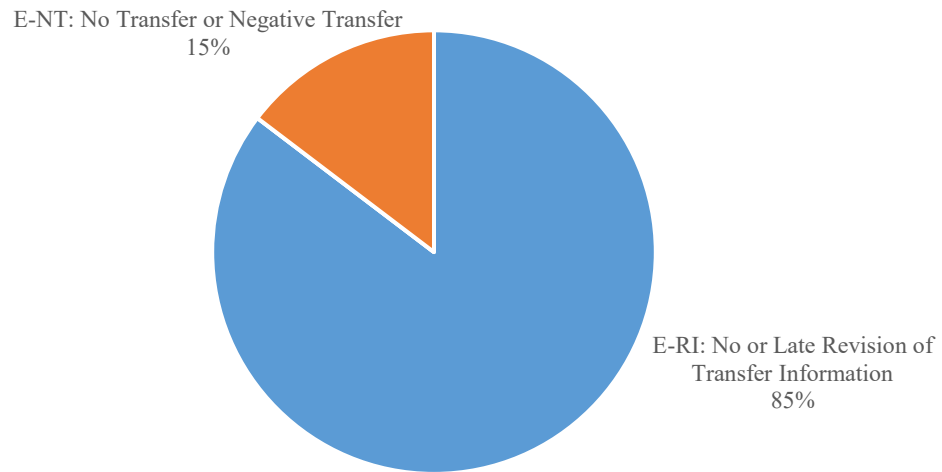


Figure 4: Sub-Categories of Category-E LHDs in SA/IO Airspace
(Operational Risk)

4. Risk Assessment and Safety Oversight

4.1. **Collision Risk Model (CRM) Parameters.** The value and the source of the parameters in the CRM used to estimate risk in the RVSM airspace are summarized in **Table 4**.

Parameter	Description	Value Bi-Dir	Value Uni-Dir	Unit	Based On
T	Annual flight hours	2,847,522	538,780	Hour	Dec 2024 TSD
$E_z(\text{same})$	Same-direction vertical occupancies	0.4326/ 0.0357	0.0639	-	
$E_z(\text{opposite})$	Opposite-direction vertical occupancies	0.1752	0.0638	-	
λ_x	Average aircraft length	0.02896	0.02506	NM	
λ_y	Average aircraft wingspan	0.02655	0.02307	NM	
λ_z	Average aircraft height	0.00817	0.00736	NM	
λ_h	Diameter of the disk representing the shape of an aircraft in the horizontal plane	0.02896	0.02506	NM	
$P_z(0)$	Probability of vertical overlap (with planned vertical separation equal to zero)	0.538	0.538	-	Conservative value used in previous assessments
$ \overline{\Delta V} $	Average relative along-track speed between aircraft on same direction routes	34.07	38.52	Knot	Dec 2024 TSD
$ \overline{V} $	Average absolute aircraft ground speed	480	480	Knot	Conservative value used in previous assessments

Table 4: Estimates of the Parameters in the CRM for SA/IO Airspace

4.2. **Risk Estimation Results.** The results for technical, operational, and total risk are detailed in **Table 5**. The technical risk is estimated at 0.89×10^{-9} FAPFH, which is below the target level of safety (TLS) of 2.5×10^{-9} FAPFH. The operational risk is estimated at 1.32×10^{-9} FAPFH. Consequently, the total risk decreased from 4.05×10^{-9} in 2023 to 2.21×10^{-9} FAPFH in 2024, which is also below the specified TLS of 5.0×10^{-9} FAPFH.

SA/IO Airspace – estimated annual flying hours = 3,386,302 hours (note: estimated hours based on Dec 2024 traffic sample data)			
Source of Risk	Risk Estimation	TLS	Remarks
RASMAG 29 Total Risk	4.05×10^{-9}	5.0×10^{-9}	Below TLS
Technical Risk	0.89×10^{-9}	2.5×10^{-9}	Below Technical TLS
Operational Risk	1.32×10^{-9}	-	-
Total Risk	2.21×10^{-9}	5.0×10^{-9}	Below TLS

Table 5: Vertical Collision Risk Estimates for SA/IO Airspace

4.3. **Figure 5** presents the trends in collision risk estimates for each month using the appropriate cumulative 12-month dataset of LHD. The operational and total risk in 2024 showed downward

trend below the TLS. The trend was steady from January to August 2024, followed by a sharp decrease in the last four months.

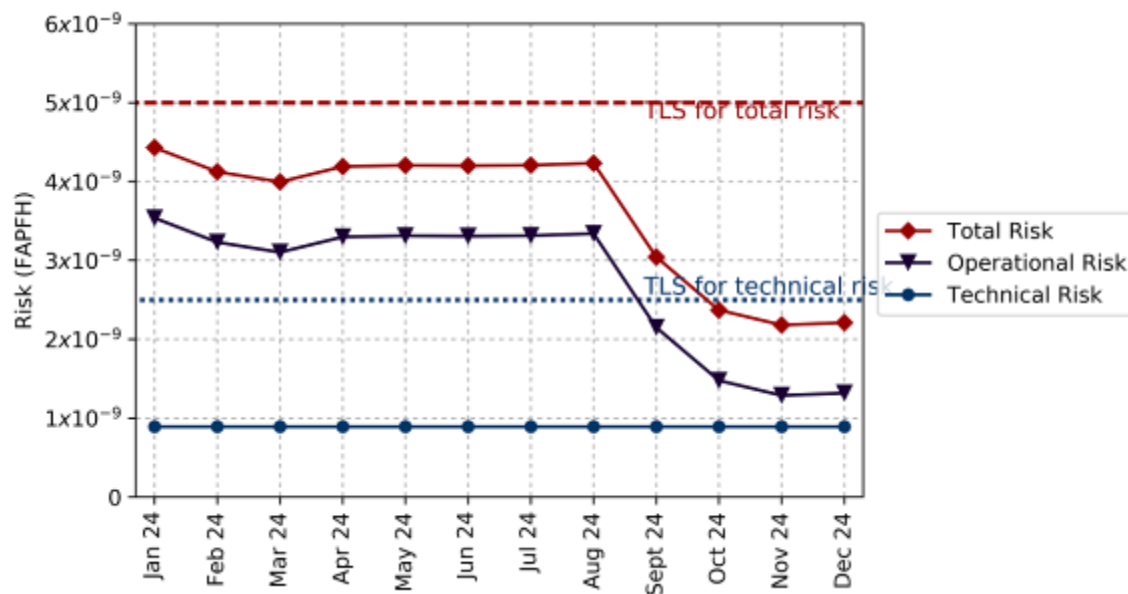


Figure 5: Trends of Risk Estimates for SA/IO Airspace

5. Analysis of Operational Errors

5.1 **Figure 6** depicts geographic locations of all reported LHDs in SA/IO airspace based on LHD reports from January to December 2024. **Figure 7** depicts only LHDs which are determined to be non-zero duration. The following are symbols and color codes used in the visualizations:

- the navy dotted line represents the frequency of occurrences at the labeled waypoint,
- the color of each circle represents the sum of minutes at incorrect flight level and the number of flight levels crossed without clearance (darker orange represents higher value) associated with LHDs occurring at or near the labeled waypoint,
- the area of the circle represents the sum of operational risk associated with LHDs occurring at or near the labeled waypoint, and
- the turquoise lines represent west-bound traffic movements while the orange lines represent east-bound traffic movements.

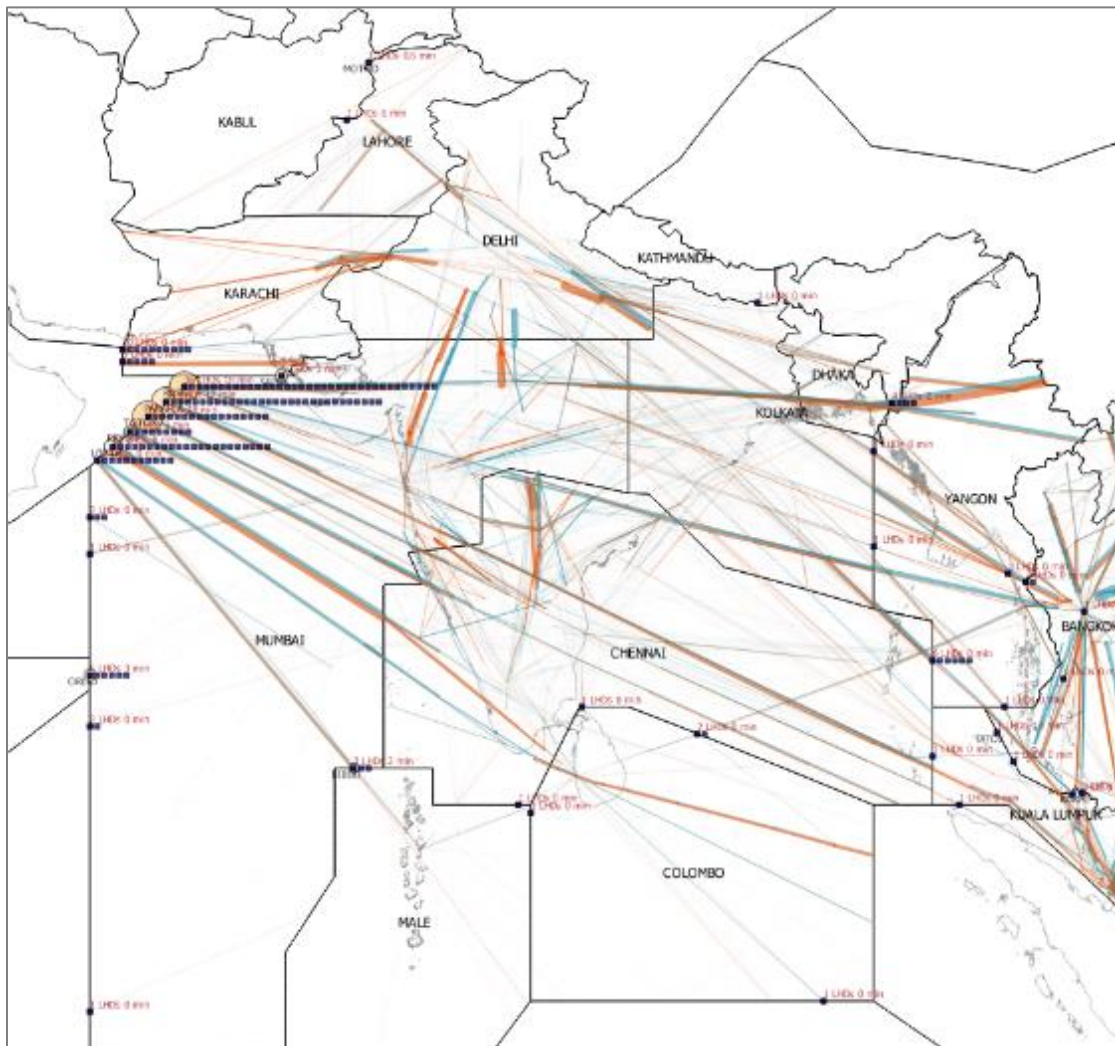


Figure 6: Geographic Locations of All LHDs in SA/IO Airspace

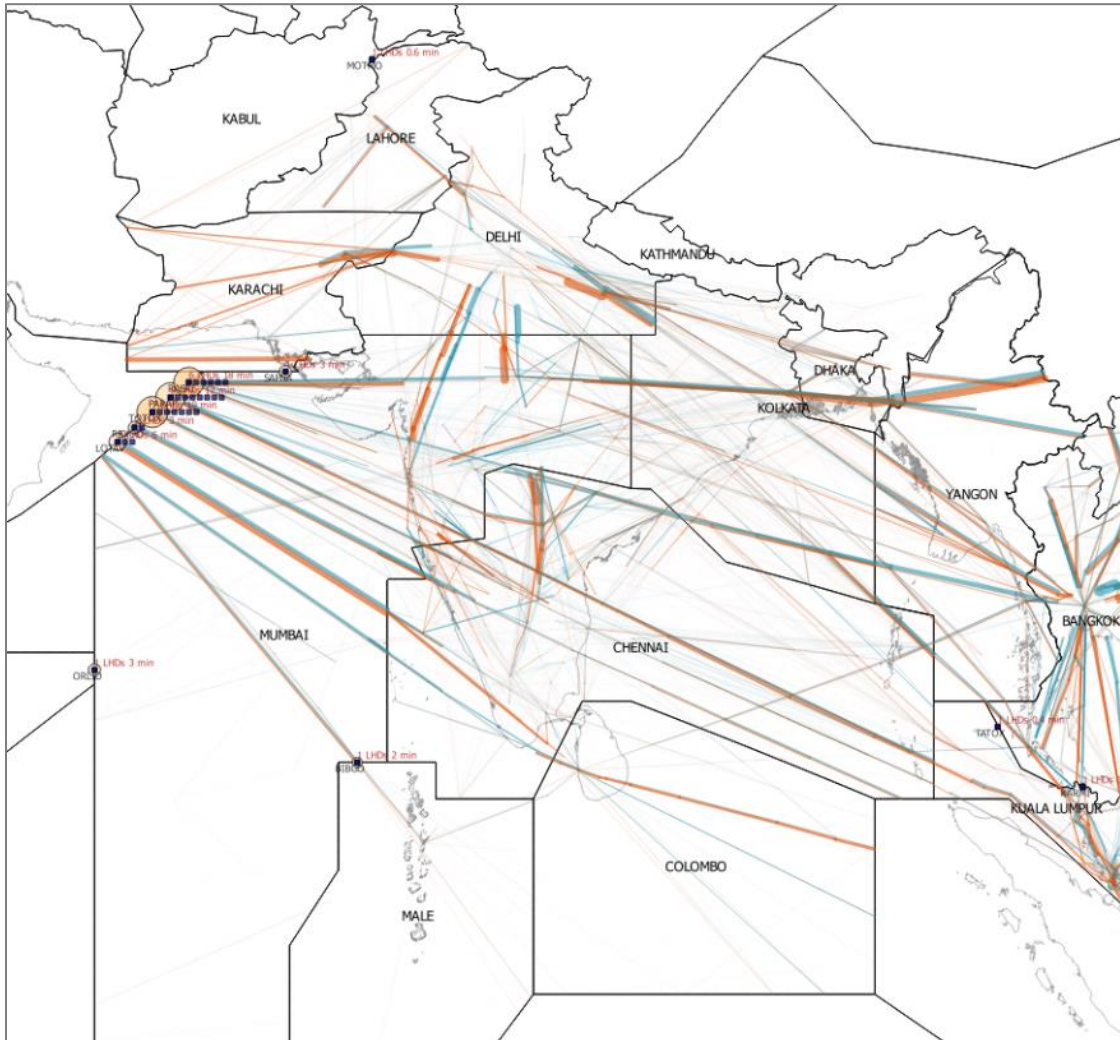


Figure 7: Geographic Locations of Non-Zero-Duration LHDs in SA/IO Airspace

LHD Hot Spot identification

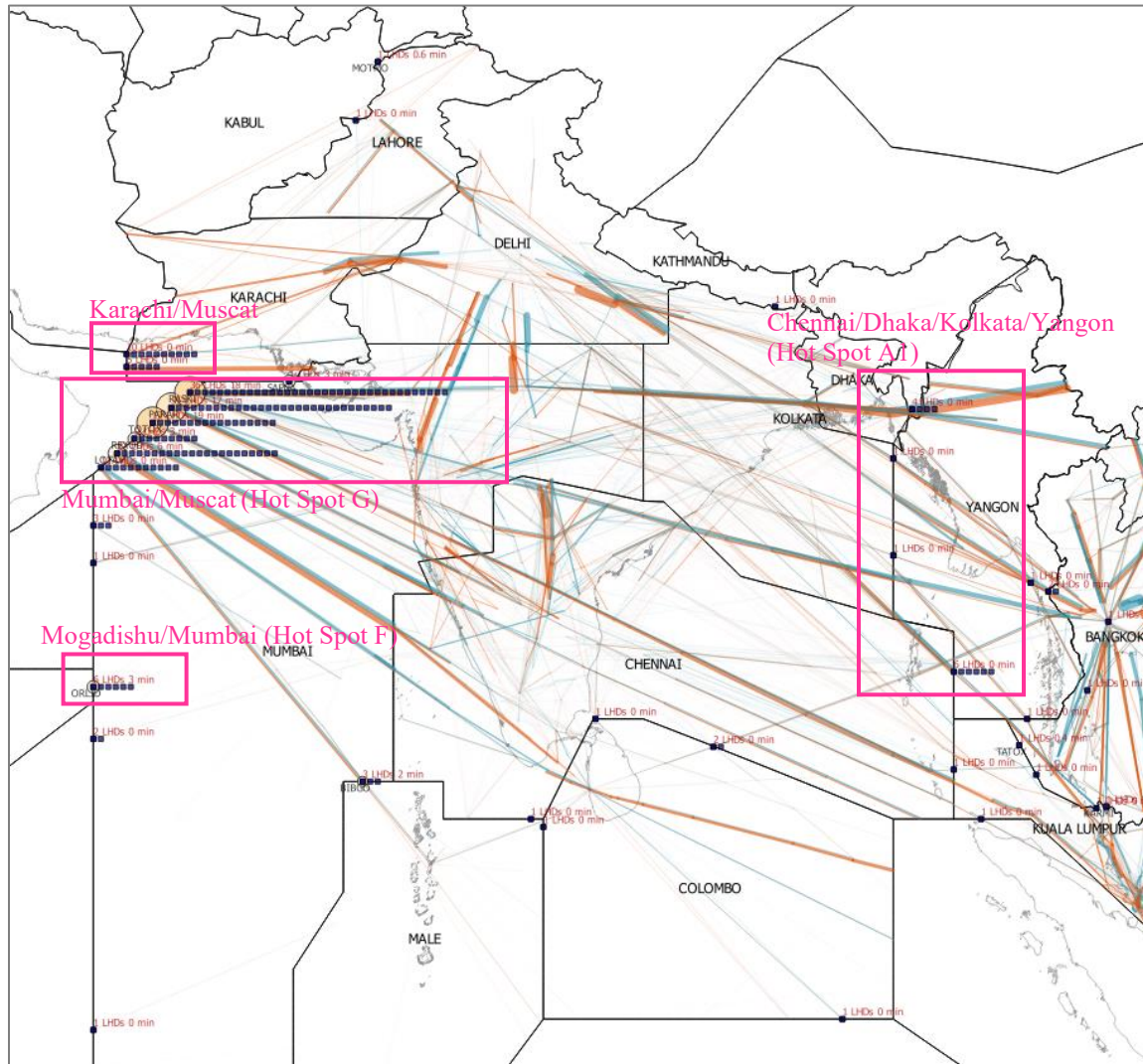


Figure 8: Geographic locations of LHD Clusters identified in SA/IO Airspace

5.2 In the process of identifying hot spots in SA/IO airspace, 4 LHD clusters are identified as shown in pink rectangles in **Figure 8**.

5.3 **Table 6** shows the profile of the LHD clusters in SA/IO airspace and the determining criteria in 2024.

SA/IO Airspace	2024
Number of Clusters	4
Number of LHDs	204
Operational Risk (x 10 ⁻⁹ FAPFH)	1.32
Criteria: Number of LHDs	40.80
Criteria: Risk (x 10 ⁻⁹ FAPFH)	0.26
Criteria: TLS (x 10 ⁻⁹ FAPFH)	5.00

Table 6: Profile of LHD Clusters and Determining Criteria for SA/IO Airspace in 2024

5.4 According to the decision in the process of identifying hot spots, a cluster will be identified as a LHD hot spot if the number of LHDs or the operational risk equals to or exceeds at least one of the three criteria. **Table 7** shows the number of LHD and operational risk of each cluster, as well as the results of checking against the criteria. A ‘Negative’ result indicates that the cluster does not satisfy that particular criterion, while a ‘Positive’ result indicates that the cluster satisfies that particular criterion and can be identified as a hot spot.

2024 Clusters (SA/IO)	Mumbai/Muscat (Hot Spot G)	Mogadishu/Mumbai (Hot Spot F)	Chennai/Dhaka/Kolkata/ Yangon (Hot Spot A1)	Karachi/Muscat
Number of LHDs	132	6	12	15
Check Criteria: Number >= 40.8	Positive	Negative	Negative	Negative
Operational Risk (x 10 ⁻⁹ FAPFH)	1.09	0.05	0.00	0.00
Check Criteria: Risk >= 0.26 x 10 ⁻⁹ FAPFH	Positive	Negative	Negative	Negative
Check Criteria: Operation Risk >= 5.00 x 10 ⁻⁹ FAPFH	Negative	Negative	Negative	Negative

Table 7: Results of Identifying Hot Spots in SA/IO Airspace

5.5 Regarding the results in **Table 7**, the Mumbai/Muscat FIR boundary (Hotspot G) is the only cluster that satisfies hot spot criteria in 2024.

LHD Hot Spot

LHD Hot Spot G (Mumbai/Muscat/Sanaa) and F (Mogadishu/Mumbai)

5.6 The western boundaries of Mumbai FIR were identified as LHD Hot Spots G and F in 2015, including the Mumbai/Muscat, Mumbai/Sanaa, and Mogadishu/Mumbai FIR boundaries. **Table 8** summarizes the number of LHDs, the number of non-zero-duration LHDs, and the operational risk at the western boundaries of the Mumbai FIR from 2022 to 2024. **Figure 9** shows the geographic locations of non-zero-duration LHDs and operation risk at these boundaries from 2022 to 2024.

Area	Number of LHDs			Number of non-zero-duration LHDs			Operational Risk (10 ⁻⁹ FAPFH)		
	2022	2023	2024	2022	2023	2024	2022	2023	2024
Mumbai/Muscat	43	138	132	10	32	27	0.79	2.79	1.09
Mumbai/Sanaa	2	3	2	0	0	0	0.00	0.00	0.00
Mogadishu/Mumbai	9	10	7	1	0	1	0.02	0.00	0.05
Total	54	151	141	11	32	28	0.81	2.79	1.14

Table 8: Comparison of the Number of LHDs, the Number of Non-Zero-Duration LHDs and Operational Risk at the Western Boundaries of Mumbai FIR from 2022 to 2024

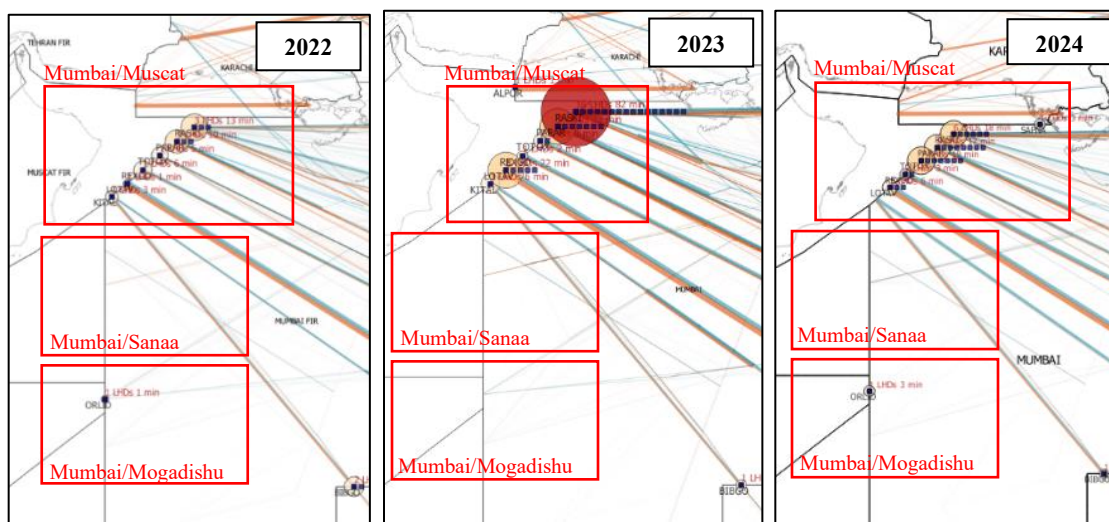


Figure 9: Geographic Locations of Non-Zero-Duration LHDs and Operation Risk at the Western Boundaries of Mumbai FIR from 2022 to 2024.

5.7 Mumbai-Muscat FIR boundary has been a primary area of concern for SA/IO airspace for many years. However, the situation showed slight improvement in 2024. According to **Table 8** and **Figure 9**, both the number of LHDs and the number of non-zero-duration LHD in 2024 slightly decreased compared to 2023. Additionally, the operation risk dramatically decreased from 2.79×10^{-9} FAPFH in 2023 to 1.09×10^{-9} FAPFH in 2024. This decrease was a result of the reduction in long-duration LHDs. In 2024, there were no LHDs with a duration longer than 10 minutes, whereas in 2023, there were four LHDs with a duration longer than 10 minutes, and one of them had a 30-minute duration. Despite the improvements observed in 2024, LHDs at the Mumbai/Muscat FIR boundary continued to be a major contributor to the overall LHDs in the

SA/IO airspace, accounting for 65% of the total number of LHDs, 77% of non-zero-duration LHDs, and 83% of the total operational risk in SA/IO airspace.

5.8 At the Mumbai/Sanaa and Mogadishu/Mumbai FIR boundaries, the number of LHDs, the number of non-zero-duration LHDs and the operational risk were significantly lower compared to the values at Mumbai/Muscat FIR boundary.

5.9 With the differences in the working environment and risk profile at Hot Spot G which covers both the Mumbai/Muscat and Mumbai/Sanaa FIR boundaries, MAAR proposes splitting Hot Spot G into Hot Spot G1 (Mumbai/Muscat) and Hot Spot G2 (Mumbai/Sanaa). This subdivision enables more efficient monitoring and reporting.

5.10 Considering the causes of LHDs at these three boundaries, the majority of LHDs were in Category E, similar to the overall picture in the SA/IO airspace. The most frequent sub-categories were E-RI: No or Late Revision of Transfer Information.

5.11 At these three boundaries, the coordination errors between the ATS units continue to occur, but these errors have been detected or solved in a short period of time. Since February 2020, the Space-Based ADS-B, which enhances the surveillance capability and allows controllers to detect LHDs beyond the Transfer of Control (TOC) point, has been operated over India. Consequently, the duration of LHDs and operational risk significantly decreased from 2020.

5.12 To address coordination issues underlying Category E LHDs, ATS Inter-Facility Data Communication (AIDC) has been actively promoted across the APAC region. The AIDC implementation efforts between Mumbai ACC and Muscat ACC, as well as Mumbai ACC and Mogadishu ACC, have been initiated. However, as of 2024, these efforts remain in the testing phase, as noted in the Appendix D of the Summary of Discussion (SOD) to the Twelfth Meeting of the Aeronautical Communication Services (ACS) Implementation Coordination Group (ACSICG/12) meeting.

5.13 In the process of identifying hot spot, the Mumbai/Muscat FIR boundary (Hot Spot G1) continues to satisfy the hot spot criteria in terms of the number of LHDs and the operational risk as shown in **Table 7**. In contrast, the Mumbai/Sanaa FIR boundary (Hot Spot G2) and Mogadishu/Mumbai FIR boundary (Hot Spot F) have not satisfied any criteria since 2021. However, the AIDC implementation or other mitigation measures have not been completed yet.

5.14 As a result, **Hot Spot G1, G2 and F remain in the list of hot spots** and continue to be monitored until further safety improvement initiatives or mitigation measures, such as AIDC, are completed and demonstrate their effectiveness.

LHD Hot Spot A1 (Chennai/Dhaka/Kolkata/Yangon)

5.15 Chennai/Dhaka/Kolkata/Yangon FIR boundaries were identified as LHD Hot Spot in 2015. **Table 9** summarizes the number of LHDs, the number of non-zero-duration LHDs, and the operational risk at Hot Spot A1 from 2022 to 2024. **Figure 10** shows the geographic locations of non-zero-duration LHDs and operation risk at these boundaries from 2022 to 2024.

Area	Number of LHDs			Number of non-zero-duration LHDs			Operational Risk (10 ⁻⁹ FAPFH)		
	2022	2023	2024	2022	2023	2024	2022	2023	2024
Kolkata/Yangon	17	11	6	0	0	0	0.00	0.00	0.00
Chennai/Yangon	23	15	6	1	1	0	0.02	0.06	0.00
Total	40	26	12	1	1	0	0.02	0.06	0.00

Table 9: Comparison of the number of LHDs, the number of non-zero-duration LHDs and operational risk at Hot Spot A1 from 2022 to 2024.

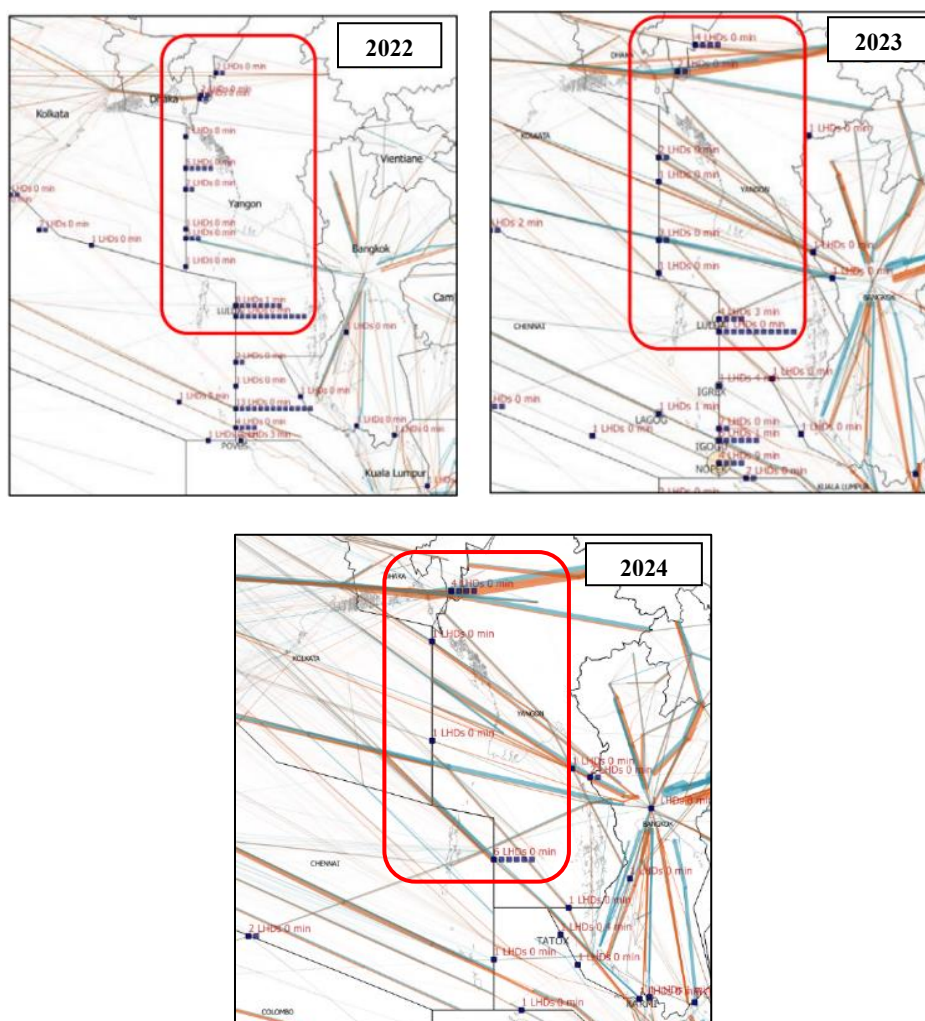


Figure 10: Geographic locations of LHDs and operation risk at Hot Spot A1 from 2022 to 2024.

5.16 In **Table 9**, the number of LHDs decreased from 40 in 2022, 26 in 2023 to 12 in 2024. All LHDs at these boundaries belonged to Category E. Additionally, there was no non-zero-duration LHDs, as well as operational risk in 2024.

5.17 Considering the results from the process of identifying hot spots, Hot Spot A1 did not satisfy any hot spot identification criteria in 2024. However, the AIDC between Kolkata ACC and Yangon ACC, as well as, between Chennai ACC and Yangon ACC, were initiated but remained in the testing phase and have not yet been operated, as mentioned in SOD of ACSICG/12. Therefore, **Hot Spot A1 remains on the list of hot spots** and continue to be monitored until further safety improvement initiatives (specifically AIDC) are implemented and successfully reduce the number of LHDs.

Appendix A: Details of the Reported LHD Occurrences in the SA/IO Airspace

Date	Source	Assigned FL	Observed/Reported FL	Minutes at Incorrect FL/No. FL crossed without clearance	Category	Cause
4/1/2024	JPR	FL310	FL306	0.4	B	PILOT MISUNDERSTANDS ATC CLEARANCE
28/1/2024	FZN		FL340	0	E	E-NT: NO TRANSFER OR NEGATIVE TRANSFER
1/1/2024	NHP	FL290	FL290	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
5/1/2024	NHP	FL350	FL370	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
6/1/2024	NHP	FL390	FL390	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
7/1/2024	NHP	FL410	FL410	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
7/1/2024	NHP		FL370	0	E	E-NT: NO TRANSFER OR NEGATIVE TRANSFER
7/1/2024	NHP	FL350	FL350	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
8/1/2024	NHP	FL330	FL370	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
9/1/2024	NHP	FL370	FL410	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
10/1/2024	NHP		FL370	0	E	E-NT: NO TRANSFER OR NEGATIVE TRANSFER
11/1/2024	NHP	FL310	FL330	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
13/1/2024	NHP	FL390	FL410	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
14/1/2024	NHP	FL330	FL350	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
16/1/2024	NHP		FL390	0	E	E-NT: NO TRANSFER OR NEGATIVE TRANSFER
19/1/2024	NHP		FL390	0	E	E-NT: NO TRANSFER OR NEGATIVE TRANSFER
20/1/2024	NHP	FL330	FL310	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION

Date	Source	Assigned FL	Observed/Reported FL	Minutes at Incorrect FL/No. FL crossed without clearance	Category	Cause
21/1/2024	NHP	FL330	FL350	5	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
29/1/2024	NHP	FL350	FL390	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
29/1/2024	NHP	FL370	FL350	3	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
20/1/2024	TBR	FL360	FL354	0.6	I	TURBULENCE OR WEATHER RELATED CAUSE
3/1/2024	OZX		FL360	0	E	E-NT: NO TRANSFER OR NEGATIVE TRANSFER
15/2/2024	FZN	FL300	FL360	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
21/2/2024	IQG	FL390	FL400	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
5/2/2024	NHP	FL310	FL310	1	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
8/2/2024	NHP	FL330	FL350	3	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
11/2/2024	NHP	FL310	FL290	1	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
12/2/2024	NHP	FL410	FL390	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
19/2/2024	NHP	FL330	FL350	1	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
22/2/2024	NHP	FL370	FL410	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
24/2/2024	NHP	FL350	FL370	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
24/2/2024	NHP	FL370	FL390	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
25/2/2024	NHP		FL370	0	E	E-NT: NO TRANSFER OR NEGATIVE TRANSFER
25/2/2024	NHP		FL350	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
26/2/2024	NHP	FL350	FL370	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION

Date	Source	Assigned FL	Observed/Reported FL	Minutes at Incorrect FL/No. FL crossed without clearance	Category	Cause
27/2/2024	NHP		FL410	0	E	E-NT: NO TRANSFER OR NEGATIVE TRANSFER
22/2/2024	NHP	FL390	FL370	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
5/3/2024	FZN	FL320	FL300	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
11/3/2024	FZN		FL300	0	E	E-NT: NO TRANSFER OR NEGATIVE TRANSFER
12/3/2024	FZN	FL360	FL340	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
14/3/2024	FZN	FL320	FL360	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
22/3/2024	FZN	FL340	FL400	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
12/3/2024	JPR	FL340	FL340	0	D	ATC SYTEM LOOP ERROR
27/3/2024	ONG		FL360	0	E	E-NT: NO TRANSFER OR NEGATIVE TRANSFER
1/4/2024	FZN	FL350	FL310	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
1/3/2024	NHP	FL370	FL350	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
6/3/2024	NHP		FL390	3	E	E-NT: NO TRANSFER OR NEGATIVE TRANSFER
9/3/2024	NHP	FL310	FL350	4	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
11/3/2024	NHP	FL370	FL390	2	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
12/3/2024	NHP	FL390	FL410	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
13/3/2024	NHP		FL410	3	E	E-NT: NO TRANSFER OR NEGATIVE TRANSFER
14/3/2024	NHP	FL370	FL350	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
14/3/2024	NHP	FL370	FL390	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION

Date	Source	Assigned FL	Observed/Reported FL	Minutes at Incorrect FL/No. FL crossed without clearance	Category	Cause
16/3/2024	NHP	FL350	FL330	1	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
17/3/2024	NHP	FL370	FL390	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
17/3/2024	NHP	FL390	FL410	3	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
20/3/2024	NHP	FL370	FL330	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
23/3/2024	NHP	FL350	FL370	1	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
23/3/2024	NHP	FL370	FL390	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
24/3/2024	NHP	FL370	FL350	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
25/3/2024	NHP	FL370	FL390	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
2/4/2024	JPR		FL315	0	E	E-NT: NO TRANSFER OR NEGATIVE TRANSFER
1/4/2024	NHP	FL390	FL410	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
2/4/2024	NHP	FL390	FL410	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
4/4/2024	NHP	FL390	FL370	1	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
4/4/2024	NHP	FL370	FL350	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
7/4/2024	NHP	FL310	FL370	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
10/4/2024	NHP		FL370	0	E	E-NT: NO TRANSFER OR NEGATIVE TRANSFER
10/4/2024	NHP	FL370	FL390	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
13/4/2024	NHP	FL390	FL410	9	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
14/4/2024	NHP		FL350	0	E	E-NT: NO TRANSFER OR NEGATIVE TRANSFER

Date	Source	Assigned FL	Observed/Reported FL	Minutes at Incorrect FL/No. FL crossed without clearance	Category	Cause
14/4/2024	NHP	FL370	FL390	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
15/4/2024	NHP	FL330	FL350	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
18/4/2024	NHP	FL370	FL350	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
27/4/2024	NHP	FL330	FL310	4	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
11/5/2024	ONG	FL330	FL310	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
1/5/2024	JPR	FL320	FL340	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
10/5/2024	JPR	FL340	FL340	0	J	TCAS
29/3/2024	IQG	FL360	FL360	0	E	E-NT: NO TRANSFER OR NEGATIVE TRANSFER
7/5/2024	JPR	FL360	FL380	1	B	FLIGHT CREW CLIMBING/DESCENDING WITHOUT ATC CLEARANCE
2/5/2024	NHP	FL370	FL390	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
5/5/2024	NHP		FL370	0	E	E-NT: NO TRANSFER OR NEGATIVE TRANSFER
7/5/2024	NHP	FL350	FL370	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
9/5/2024	NHP	FL370	FL390	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
11/5/2024	NHP		FL350	0	E	E-NT: NO TRANSFER OR NEGATIVE TRANSFER
15/5/2024	NHP	FL350	FL370	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
16/5/2024	NHP	FL310	FL370	2	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
19/5/2024	NHP	FL310	FL330	1	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
27/5/2024	NHP	FL350	FL330	1	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION

Date	Source	Assigned FL	Observed/Reported FL	Minutes at Incorrect FL/No. FL crossed without clearance	Category	Cause
27/5/2024	NHP		FL370	0	E	E-NT: NO TRANSFER OR NEGATIVE TRANSFER
28/5/2024	NHP		FL370	3	E	E-NT: NO TRANSFER OR NEGATIVE TRANSFER
30/5/2024	NHP	FL390	FL350	3	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
30/5/2024	NHP		FL290	0	E	E-NT: NO TRANSFER OR NEGATIVE TRANSFER
31/5/2024	NHP	FL350	FL330	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
5/5/2024	COS	FL310	FL350	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
19/5/2024	COS	FL330	FL350	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
22/5/2024	COS	FL330	FL370	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
4/6/2024	JPR	FL360	FL364	0	J	TCAS
8/6/2024	FZN	FL300	FL340	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
30/6/2024	TCK	FL300	FL360	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
1/6/2024	NHP	FL350	FL370	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
1/6/2024	NHP	FL310	FL370	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
3/6/2024	NHP	FL410	FL450	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
4/6/2024	NHP	FL330	FL370	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
8/6/2024	NHP		FL390	0	E	E-NT: NO TRANSFER OR NEGATIVE TRANSFER
8/6/2024	NHP		FL390	0	E	E-NT: NO TRANSFER OR NEGATIVE TRANSFER
8/6/2024	NHP	FL370	FL350	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION

Date	Source	Assigned FL	Observed/Reported FL	Minutes at Incorrect FL/No. FL crossed without clearance	Category	Cause
8/6/2024	NHP	FL310	FL350	3	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
9/6/2024	NHP	FL350	FL370	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
13/6/2024	NHP	FL330	FL310	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
18/6/2024	NHP	FL330	FL350	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
19/6/2024	NHP	FL330	FL370	2	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
20/6/2024	NHP	FL350	FL370	1	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
21/6/2024	NHP	FL370	FL390	1	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
28/6/2024	NHP		FL370	0	E	E-NT: NO TRANSFER OR NEGATIVE TRANSFER
30/6/2024	NHP		FL330	0	E	E-NT: NO TRANSFER OR NEGATIVE TRANSFER
30/6/2024	JPR	FL340	FL330	0	D	ATC ISSUES INCORRECT CLEARANCE TO PILOT
1/7/2024	NHP	FL310	FL350	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
2/7/2024	NHP	FL310	FL350	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
7/7/2024	NHP	FL390	FL350	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
9/7/2024	NHP	FL310	FL350	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
11/7/2024	NHP		FL330	0	E	E-NT: NO TRANSFER OR NEGATIVE TRANSFER
12/7/2024	NHP	FL350	FL370	2	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
13/7/2024	NHP		FL330	0	E	E-NT: NO TRANSFER OR NEGATIVE TRANSFER
13/7/2024	NHP		FL310	2	E	E-NT: NO TRANSFER OR NEGATIVE TRANSFER

Date	Source	Assigned FL	Observed/Reported FL	Minutes at Incorrect FL/No. FL crossed without clearance	Category	Cause
16/7/2024	NHP	FL310	FL350	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
19/7/2024	NHP	FL310	FL330	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
31/7/2024	NHP		FL310	0	E	E-NT: NO TRANSFER OR NEGATIVE TRANSFER
11/8/2024	JPR	FL340	FL335	1	A	FLIGHT CREW FAILING TO CLIMB/DESCEND THE AIRCRAFT AS CLEARED
1/8/2024	NHP	FL330	FL350	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
3/8/2024	NHP	FL310	FL390	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
5/8/2024	NHP	FL370	FL390	2	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
17/8/2024	NHP	FL310	FL410	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
20/8/2024	NHP	FL340	FL360	2	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
30/8/2024	NHP		FL330	0	E	E-NT: NO TRANSFER OR NEGATIVE TRANSFER
5/9/2024	JPR		FL310	0	E	E-LT: LATE TRANSFER
14/9/2024	IQG	FL370	FL390	2	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
11/9/2024	ONG	FL330	FL350	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
14/9/2024	IQG	FL310	FL370	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
21/9/2024	JPR	FL290	FL290	0	J	TCAS
2/8/2024	COS		FL390	0	E	E-NT: NO TRANSFER OR NEGATIVE TRANSFER
2/8/2024	COS		FL330	0	E	E-NT: NO TRANSFER OR NEGATIVE TRANSFER
3/8/2024	COS	FL330	FL350	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION

Date	Source	Assigned FL	Observed/Reported FL	Minutes at Incorrect FL/No. FL crossed without clearance	Category	Cause
7/8/2024	COS	FL330	FL370	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
22/8/2024	COS	FL330	FL370	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
25/10/2024	JPR		FL360	0	E	E-NT: NO TRANSFER OR NEGATIVE TRANSFER
23/10/2024	JPR	FL340	FL351	0	J	TCAS
2/9/2024	COS		FL330	0	E	E-NT: NO TRANSFER OR NEGATIVE TRANSFER
28/9/2024	COS		FL350	0	E	E-NT: NO TRANSFER OR NEGATIVE TRANSFER
2/10/2024	COS		FL410	0	E	E-NT: NO TRANSFER OR NEGATIVE TRANSFER
5/10/2024	COS	FL370	FL390	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
7/10/2024	COS	FL330	FL350	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
17/10/2024	COS	FL350	FL343	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
18/10/2024	COS	FL330	FL370	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
21/11/2024	JPR		FL380	0	E	E-NT: NO TRANSFER OR NEGATIVE TRANSFER
5/9/2024	NHP	FL350	FL390	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
6/9/2024	NHP	FL350	FL390	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
13/9/2024	NHP	FL330	FL310	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
14/9/2024	NHP	FL350	FL310	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
18/9/2024	NHP	FL350	FL370	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
14/9/2024	NHP	FL310	FL370	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
19/9/2024	NHP	FL310	FL370	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION

Date	Source	Assigned FL	Observed/Reported FL	Minutes at Incorrect FL/No. FL crossed without clearance	Category	Cause
20/9/2024	NHP	FL330	FL350	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
20/9/2024	NHP	FL390	FL370	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
21/9/2024	NHP	FL370	FL390	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
21/9/2024	NHP	FL350	FL330	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
22/9/2024	NHP	FL390	FL410	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
5/10/2024	NHP	FL350	FL370	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
7/10/2024	NHP	FL390	FL410	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
9/10/2024	NHP		FL390	0	E	E-NT: NO TRANSFER OR NEGATIVE TRANSFER
9/10/2024	NHP	FL370	FL390	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
9/10/2024	NHP	FL290	FL350	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
12/10/2024	NHP	FL370	FL390	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
15/10/2024	NHP	FL310	FL330	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
26/10/2024	NHP		FL330	0	E	E-NT: NO TRANSFER OR NEGATIVE TRANSFER
27/10/2024	NHP	FL350	FL390	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
2/11/2024	NHP		FL410	0	E	E-NT: NO TRANSFER OR NEGATIVE TRANSFER
17/11/2024	NHP	FL310	FL330	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
19/12/2024	JPR		FL370	0	E	E-NT: NO TRANSFER OR NEGATIVE TRANSFER
22/12/2024	JPR	FL350	FL350	0	J	TCAS
14/12/2024	JPR	FL320	FL320	0	J	TCAS

Date	Source	Assigned FL	Observed/Reported FL	Minutes at Incorrect FL/No. FL crossed without clearance	Category	Cause
11/12/2024	JPR	FL370	FL370	0	E	E-NT: NO TRANSFER OR NEGATIVE TRANSFER
13/12/2024	TBR	FL350	FL340	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
1/12/2024	NHP		FL390	0	E	E-NT: NO TRANSFER OR NEGATIVE TRANSFER
3/12/2024	NHP	FL370	FL310	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
5/12/2024	NHP	FL390	FL370	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
8/12/2024	NHP	FL350	FL370	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
9/12/2024	NHP	FL330	FL350	3	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
11/12/2024	NHP		FL320	0	E	E-NT: NO TRANSFER OR NEGATIVE TRANSFER
14/12/2024	NHP	FL290	FL310	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
15/12/2024	NHP	FL370	FL390	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
17/12/2024	NHP	FL350	FL390	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
24/12/2024	NHP	FL370	FL390	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
27/12/2024	NHP	FL310	FL370	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
27/12/2024	NHP	FL350	FL370	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
27/12/2024	NHP		FL310	0	E	E-NT: NO TRANSFER OR NEGATIVE TRANSFER
28/12/2024	NHP	FL370	FL350	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
28/12/2024	NHP	FL370	FL390	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
30/12/2024	NHP		FL390	0	E	E-NT: NO TRANSFER OR NEGATIVE TRANSFER

Date	Source	Assigned FL	Observed/Reported FL	Minutes at Incorrect FL/No. FL crossed without clearance	Category	Cause
2/10/2024	OZL	FL430	FL410	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
5/12/2024	OZL		FL390	0	E	E-NT: NO TRANSFER OR NEGATIVE TRANSFER
5/12/2024	OZL		FL390	0	E	E-NT: NO TRANSFER OR NEGATIVE TRANSFER
5/12/2024	OZL		FL390	0	E	E-NT: NO TRANSFER OR NEGATIVE TRANSFER
5/12/2024	OZL		FL410	0	E	E-NT: NO TRANSFER OR NEGATIVE TRANSFER

MONITORING AGENCY FOR ASIA REGION (MAAR)



**The Airspace Safety Oversight for the RVSM Operation
in Southeast Asia (SEA) Airspace**

January 2024 to December 2024

AIRSPACE SAFETY OVERSIGHT OF THE RVSM OPERATION IN SOUTHEAST ASIA AIRSPACE

Assessment Period: January 2024 to December 2024

Prepared by
Monitoring Agency for Asia Region (MAAR)
(An ICAO APANPIRG approved Regional Monitoring Agency)

1. Introduction

This report presents the results of airspace safety oversight for RVSM operations in Southeast Asia (SEA) airspace. The assessment is based on one month of Traffic Sample Data (TSD) collected in December 2024 and Large Height Deviation (LHD) reports submitted by States in the SEA airspace for occurrences between January and December 2024.

2. Data Sources

2.1. Traffic Sample Data (TSD). The TSD collected in December 2024, covering aircraft operations in SEA airspace, has been utilized in accordance with ICAO regional agreement.

2.2. Large Height Deviation (LHD). The cumulative 12-month dataset of LHD reports submitted by States in the SEA airspace for occurrences between January and December 2024. **Table 1** presents the FIRs that submitted LHD reports, including NIL reports. All FIRs in SEA airspace submitted LHD reports and NIL reports in a timely manner. Detailed information on each reported LHD, along with brief descriptions, is provided in **Appendix A**.

FIR/Month	Phnom Penh	Hong Kong	Vientiane	Kota Kinabalu	Kuala Lumpur	Manila	Singapore	Bangkok	Hanoi	Ho Chi Minh	Taipei
January	X	X	X	X	X	X	X	X	X	X	X
February	X	X	X	X	X	X	X	X	X	X	X
March	X	X	X	X	X	X	X	X	X	X	X
April	X	X	X	X	X	X	X	X	X	X	X
May	X	X	X	X	X	X	X	X	X	X	X
June	X	X	X	X	X	X	X	X	X	X	X
July	X	X	X	X	X	X	X	X	X	X	X
August	X	X	X	X	X	X	X	X	X	X	X
September	X	X	X	X	X	X	X	X	X	X	X
October	X	X	X	X	X	X	X	X	X	X	X
November	X	X	X	X	X	X	X	X	X	X	X
December	X	X	X	X	X	X	X	X	X	X	X

Table 1: Summary of LHD Reports Submitted by SEA FIRs in 2024. An ‘X’ indicates that the LHD or NIL Reports Submitted Each Month.

3. Summary of LHD Occurrences

3.1. **Table 2** and **Figure 1** summarize the number of LHDs, the duration (in minutes), the number of levels crossed, and their associated operational risk by month from January 2024 to December 2024.

Month (2024)	No. of LHD	No. of Non-zero-duration LHD	LHD Duration (Min)	No. of Levels Crossed	Operational Risk (x10 ⁻⁹ FAPFH)
January	9	2	1	0	0.03
February	5	2	7	0	0.09
March	2	0	0	0	0
April	5	1	1	0	0.02
May	6	1	1	0	0.02
June	7	2	2	0	0.03
July	6	3	11	0	0.16
August	7	2	3	1	0.08
September	8	2	7	0	0.13
October	10	3	6	0	0.11
November	13	2	8	0	0.14
December	11	4	4	1	0.39
Total	89	24	51	2	1.20

Table 2: Monthly Summary of LHD in SEA Airspace

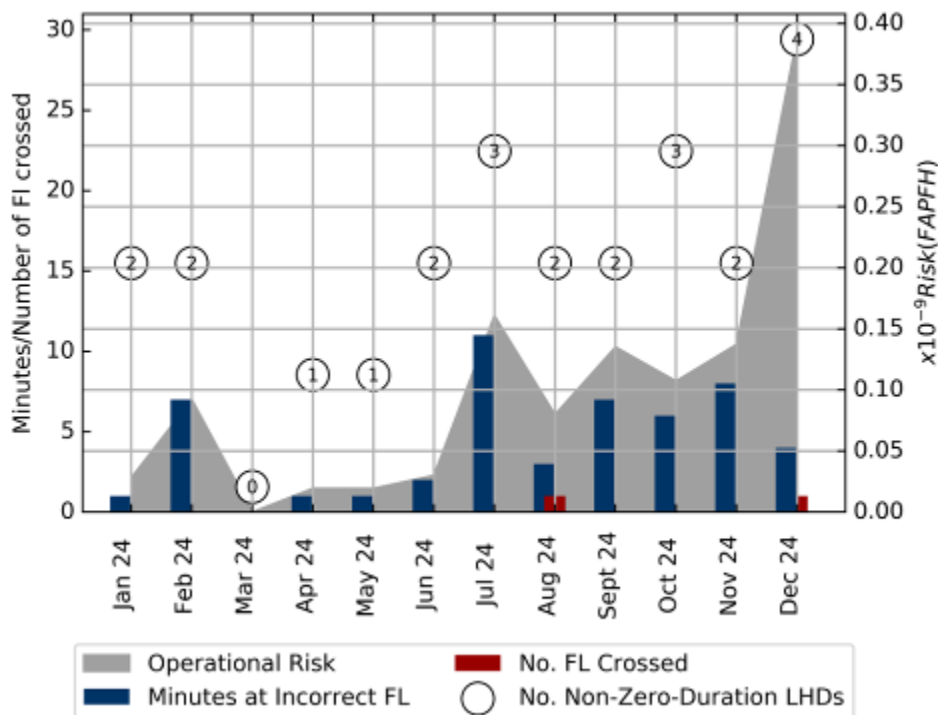


Figure 1: Monthly Summary of Non-Zero-Duration LHDs, Duration, FL Crossed and Operational Risk in SEA Airspace

3.2. In 2024, the number of LHDs slightly decreased from 95 in 2023 to 89 in 2024. Among the 89 LHDs, 24 were non-zero-duration LHDs, contributed to a low level of operational risk. Accordingly, the total operational risk also declined from 1.84×10^{-9} FAPFH in 2023 to 1.20×10^{-9} FAPFH in 2024.

3.3. **Figure 2** and **Table 3** summarize the number of LHDs, the duration (in minutes), the number of levels crossed, and their associated operational risk, by the LHD category from January 2024 to December 2024.

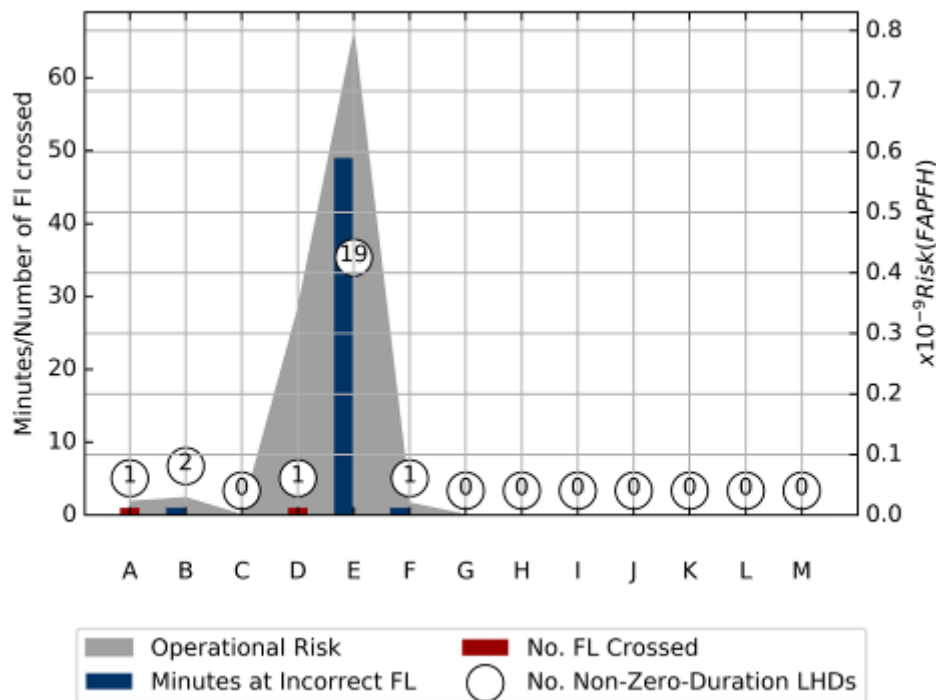


Figure 2: Summary of Non-Zero-Duration LHD by Category in SEA Airspace

LHD Category Code	LHD Category Description	No. of LHDs	No. of Non-zero-duration LHDs	LHD Duration (Min)	No. of levels Crossed	Operational Risk ($\times 10^{-9}$ FAPFH)
A	Flight crew failing to climb/descend the aircraft as cleared	1	1	0	1	0.02
B	Flight crew climbing/descending without ATC Clearance	2	2	1	0	0.03
	Incorrect flight level provided due to incorrect operation or interpretation of airborne equipment (e.g. incorrect operation of fully functional FMS, incorrect transcription of ATC clearance or re-clearance in FMS, flight plan followed rather than ATC clearance, original clearance followed instead of re-clearance etc.).	0	0	0	0	0

LHD Category Code	LHD Category Description	No. of LHDs	No. of Non-zero-duration LHDs	LHD Duration (Min)	No. of levels Crossed	Operational Risk (x10⁻⁹ FAPFH)
D	ATC system loop error; (e.g. ATC issues incorrect flight level clearance or flight crew misunderstands the flight level clearance message)	4	1	0	1	0.34
E	Coordination errors in the ATC-to-ATC transfer of control responsibility as a result of human factors issues (e.g. late or non-existent coordination of flight level).	68	19	49	0	0.79
F	Coordination errors in the ATC-to-ATC transfer of control responsibility as a result of equipment outage or technical issues (e.g. late or non-existent coordination of flight level).	8	1	1	0	0.02
G	Aircraft contingency event leading to sudden inability to maintain assigned flight level (e.g. pressurization failure, engine failure)	0	0	0	0	0
H	Airborne equipment failure leading to unintentional or undetected change of flight level.	0	0	0	0	0
I	Turbulence or other weather related causes leading to unintentional or undetected change of flight level	0	0	0	0	0
J	TCAS resolution advisory, flight crew correctly climb or descend following the resolution advisory	6	0	0	0	0
K	TCAS resolution advisory, flight crew incorrectly climb or descend following the resolution advisory.	0	0	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	0	0
M	Other	0	0	0	0	0
Total		89	24	51	2	1.20

Table 3: Summary of LHD by Category in SEA Airspace

3.4. According to **Table 3**, the majority of LHDs, non-zero-duration LHDs, total duration, and operational risk in SEA airspace fell under Category E. The second-highest number of LHDs occurred in Category F, accounting for 9% of the total number of LHDs in the SEA airspace. However, Category F LHDs contributed to a low level of operational risk, representing only 2%.

3.5. To further analyze Category E LHDs, they can be broken down into sub-categories, as shown in **Figures 3 and 4**. **Figure 3** illustrates the contribution of each sub-category in terms of the number of LHDs, while **Figure 4** shows their contribution in terms of operational risk. In **Figure 3**, the largest portion, E-RI: No or Late Revision of Transfer Information, accounts for 65% of Category E LHDs. This is followed by E-NT: No Transfer or Negative Transfer, which accounts for 34%.

3.6. Operational risk due to Category E LHDs results from only these two sub-categories. As shown in **Figure 4**, E-RI: No or Late Revision of Transfer Information is also the most significant contributor, accounting for 72% of the risk. Additionally, E-NT: No Transfer or Negative Transfer contributes the remaining 28%.

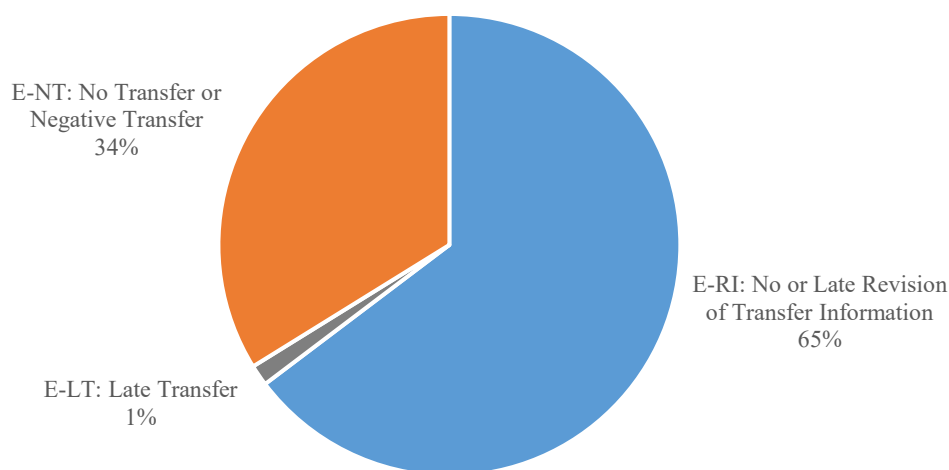


Figure 3: Sub-Categories of Category-E LHDs in SEA Airspace
(The Number of LHDs)

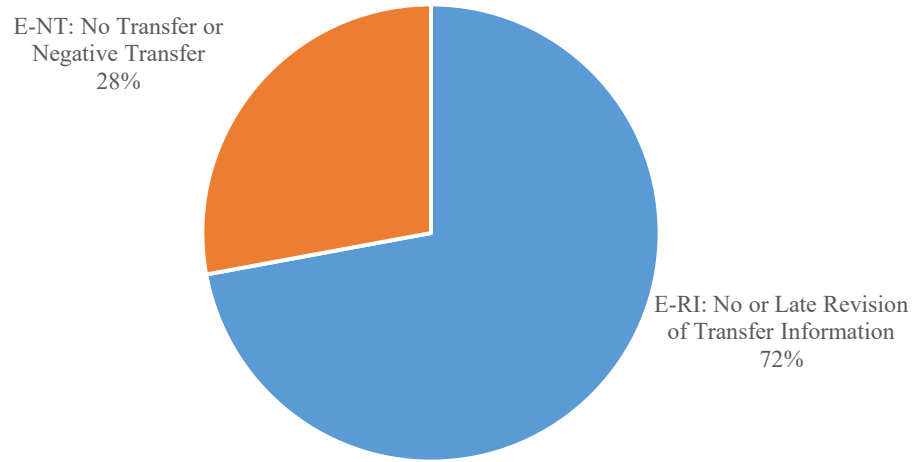


Figure 4: Sub-Categories of Category-E LHDs in SEA Airspace (Operational Risk)

4. Risk Assessment and Safety Oversight

4.1. **Collision Risk Model (CRM) Parameters.** The value and the source of the parameters in the CRM used to estimate risk in the RVSM airspace are summarized in **Table 4**.

Parameter	Description	Value Bi-Dir	Value Uni-Dir	Unit	Based On
T	Annual flight hours	2,118,721	935,507	Hour	Dec 2024 TSD
$E_z(\text{same})$	Same-direction vertical occupancies	0.44113/ 0.04502	0.26591	-	
$E_z(\text{opposite})$	Opposite-direction vertical occupancies	0.30726	0.06474	-	
λ_x	Average aircraft length	0.02669	0.02842	NM	
λ_y	Average aircraft wingspan	0.02444	0.02599	NM	
λ_z	Average aircraft height	0.00763	0.00792	NM	
λ_h	Diameter of the disk representing the shape of an aircraft in the horizontal plane	0.02669	0.02842	NM	
$P_z(0)$	Probability of vertical overlap (with planned vertical separation equal to zero)	0.538	0.538	-	Conservative value used in previous assessments
$ \overline{\Delta V} $	Average relative along-track speed between aircraft on same direction routes	34.79	31.14	Knot	Dec 2024 TSD
$ \overline{V} $	Average absolute aircraft ground speed	480	480	Knot	Conservative value used in previous assessments

Table 4: Estimates of the Parameters in the CRM for SEA Airspace

4.2. **Risk Estimation Results.** The results for technical, operational, and total risk are detailed in **Table 5**. The technical risk is estimated at 1.34×10^{-9} FAPFH, which is below the technical target level of safety (TLS) of 2.5×10^{-9} FAPFH. Additionally, the operational risk is estimated at 1.20×10^{-9} FAPFH. Thus, the total risk is estimated at 2.54×10^{-9} FAPFH, which is also below the specified TLS of 5.0×10^{-9} FAPFH.

SEA Airspace – estimated annual flying hours = 3,054,228 hours (note: estimated hours based on Dec 2024 traffic sample data)			
Source of Risk	Risk Estimation	TLS	Remarks
RASMAG 29 Total Risk	2.91×10^{-9}	5.0×10^{-9}	Below TLS
Technical Risk	1.34×10^{-9}	2.5×10^{-9}	Below Technical TLS
Operational Risk	1.20×10^{-9}	-	-
Total Risk	2.54×10^{-9}	5.0×10^{-9}	Below TLS

Table 5: Vertical Collision Risk Estimates for SEA Airspace

4.3. **Figure 5** presents the trends in collision risk estimates for each month using the appropriate cumulative 12-month dataset of LHD. The operational and total risk in 2024 showed a slightly downward trend below the TLS.

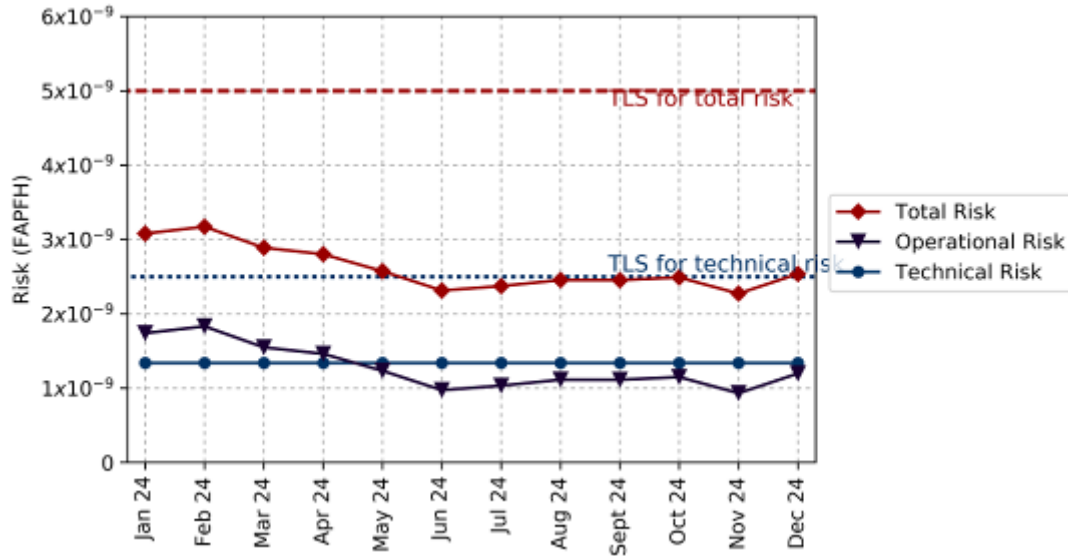


Figure 5: Trends of Risk Estimates for SEA Airspace

5. Analysis of Operational Errors

5.1 **Figure 6** depicts geographical locations of all reported LHDs in SEA airspace based on LHD reports from January to December 2024. **Figure 7** depicts only LHDs which are determined to be non-zero duration. The following are symbols and color used in the visualizations:

- the navy dotted line represents the frequency of occurrences at the labeled waypoint,
- the color of each circle represents the sum of minutes at incorrect flight level and the number of flight levels crossed without clearance (darker orange represents higher value) associated with LHDs occurring at or near the labeled waypoint,
- the area of the circle represents the sum of operational risk associated with LHDs occurring at or near the labeled waypoint, and
- the turquoise lines represent west-bound traffic movements while the orange lines represent east-bound traffic movements.

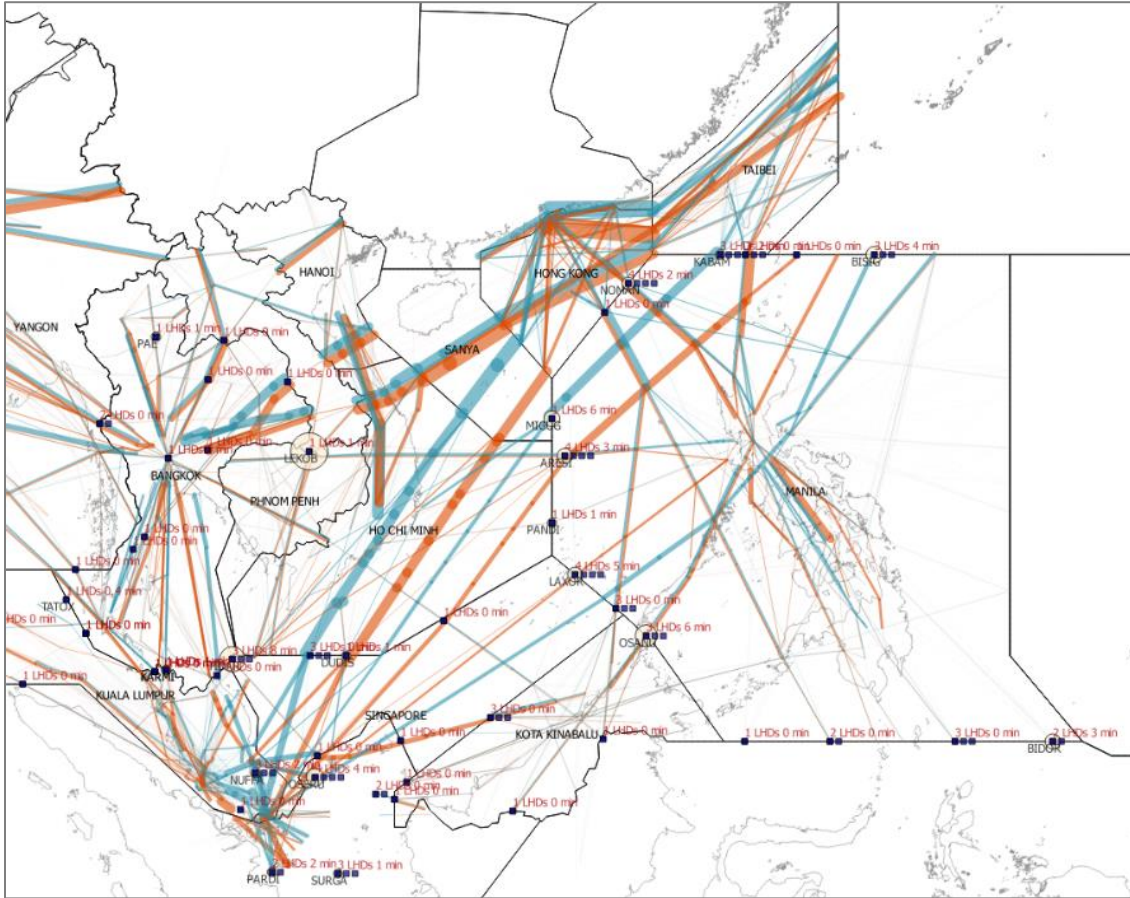


Figure 6: Geographic Locations of All LHDs in SEA Airspace

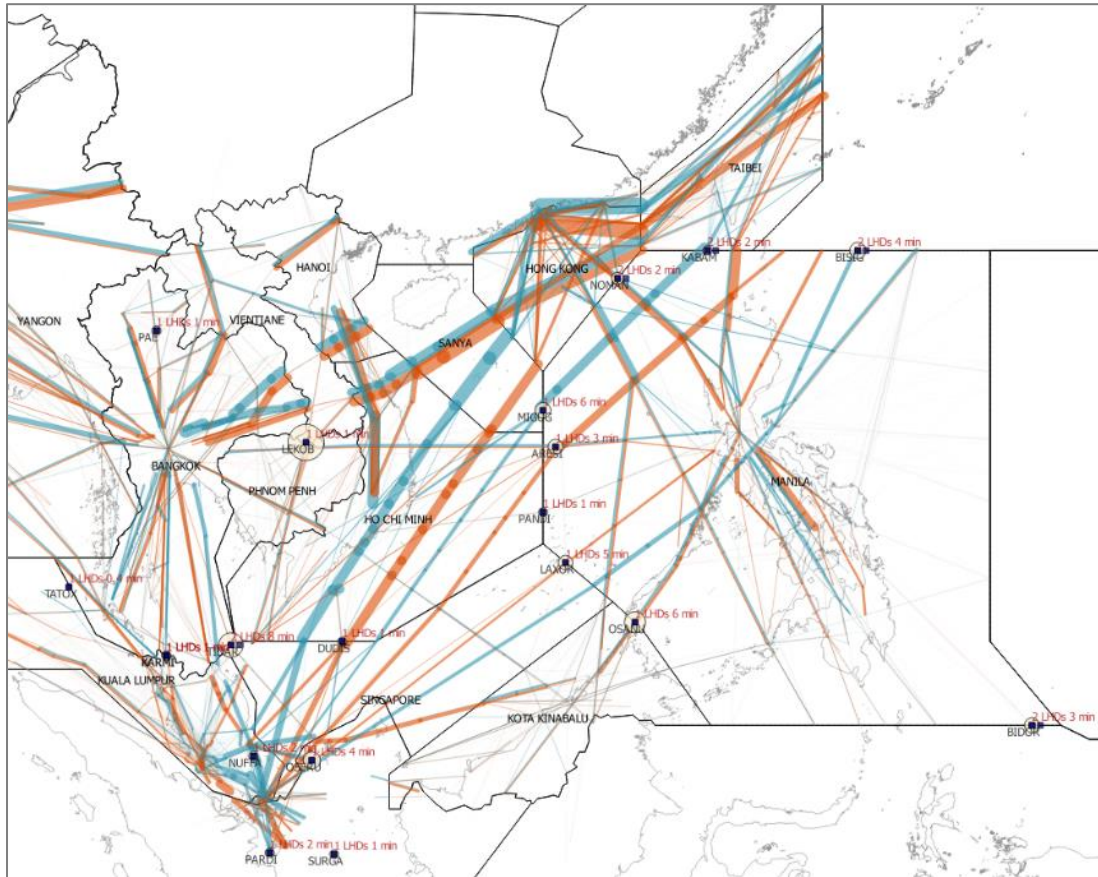


Figure 7: Geographic Locations of Non-Zero-Duration LHDs in SEA Airspace

LHD Hot Spot identification

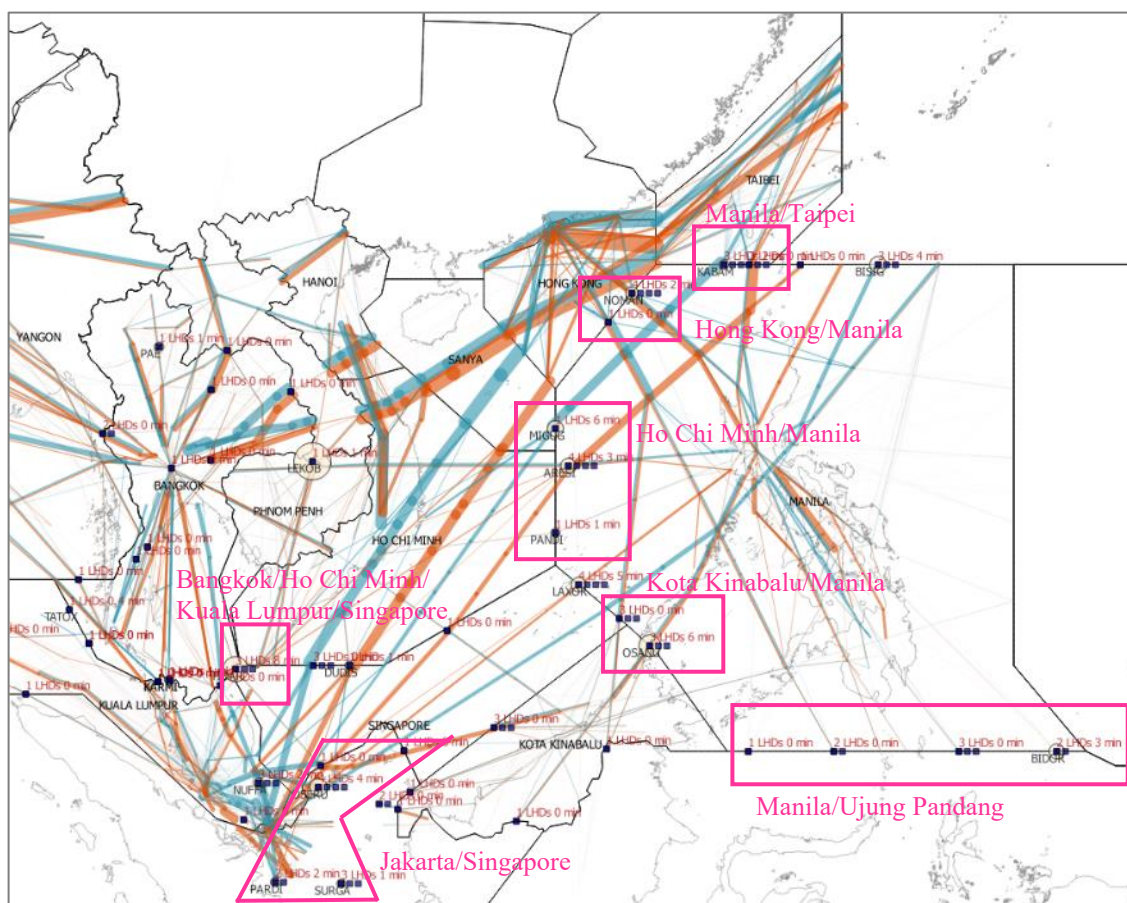


Figure 8: Geographical locations of **LHD clusters** identified for SEA Airspace

5.2 In identifying hot spots for SEA airspace, 7 LHD clusters are identified as shown in pink polygons in **Figure 8**. Additionally, **Table 6** shows the profile of the LHD clusters in SEA airspace and the determining criteria in 2024.

SEA Airspace	2024
Number of Clusters	7
Number of LHDs	89
Operational Risk (x 10 ⁻⁹ FAPFH)	1.20
Criteria: Number of LHDs	11.13
Criteria: Operational Risk (x 10 ⁻⁹ FAPFH)	0.15
Criteria: TLS (x 10 ⁻⁹ FAPFH)	5.00

Table 6: Profile of LHD Clusters and Determining Criteria for SEA Airspace in 2024

5.3 According to the decision in the process of identifying hot spots, a cluster will be identified as a LHD hot spot if the number of LHDs or the operational risk equals to or exceeds at least one of the three criteria. **Table 7** shows the number of LHD and operational risk of each cluster, as well as the results of checking against the criteria. A ‘Negative’ result indicates that the cluster does not satisfy the criteria, while a ‘Positive’ result indicates that the cluster satisfies the criteria and can be identified as a hot spot.

2024 Clusters (SEA)	Bangkok/Ho Chi Minh/ Kuala Lumpur/Singapore (Hot Spot O)	Hong Kong/Manila	Ho Chi Minh/Manila (Hot Spot D5)	Jakarta/Singapore (Hot Spot J)	Kota Kinabalu/Manila (Hot Spot D7)	Manila/Taipei	Manila/Ujung Pandang (Hot Spot D8)
Number of LHDs	3	5	6	11	6	6	8
Check Criteria: Number ≥ 11.13	Negative	Negative	Negative	Negative	Negative	Negative	Negative
Operational Risk ($\times 10^{-9}$ FAPFH)	0.15	0.04	0.14	0.12	0.12	0.02	0.06
Check Criteria: Operational Risk $\geq 0.15 \times 10^{-9}$ FAPFH	Positive	Negative	Negative	Negative	Negative	Negative	Negative
Check Criteria: Operational Risk $\geq 5.00 \times 10^{-9}$ FAPFH	Negative	Negative	Negative	Negative	Negative	Negative	Negative

Table 7: Results of Identifying Hot Spots in SEA Airspace

5.4 According to the results in **Table 7**, the Bangkok/Ho Chi Minh/Kuala Lumpur/Singapore FIR boundaries (Hot Spot O) satisfy the hot spot criteria in terms of the operational risk. On the other hand, other clusters and previously listed Hot Spots including Hot Spot D1, D5, D7 and D8 did not satisfy any hot spot criteria in 2024.

LHD Hot Spot

LHD Hot Spot D1 (Fukuoka/Manila), D5 (Ho Chi Minh/Manila), D7 (Kota Kinabalu/Manila) and D8 (Manila/Ujung Pandang)

5.5 During RASMAG/29 in 2024, Hot Spot D, which was identified as a hot spot since 2015 and represented the entire Manila FIR boundary, was subdivided into nine hot spots: D1 through D9 as shown in **Figure 9**. Each subdivision was re-analyzed with the hot spot identification process using the historical data up to 2023. As a result, Hot Spots D2, D3, D4, D6, and D9 were removed from the list of hot spots due to continuous improvements achieved through existing mitigations.

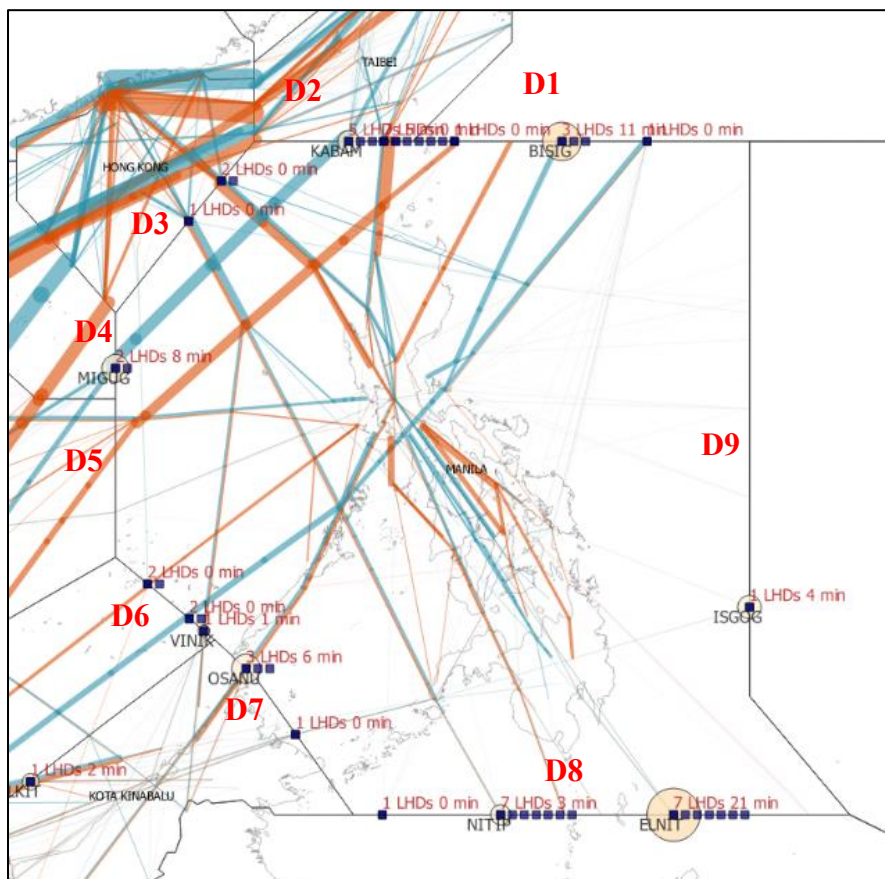


Figure 9: The Subdivision of Hot Spot D

5.6 In 2024, all of Hot Spot D subdivisions (including both those listed and those removed) did not satisfy any hot spot criteria. Therefore, this report focuses on updates for the remaining listed Hot Spots: D1, D5, D7, and D8.

5.7 **Figure 10** depicts the geographical locations of LHDs and operational risk at Hot Spot D1, D5, D7, and D8 from 2022 to 2024.

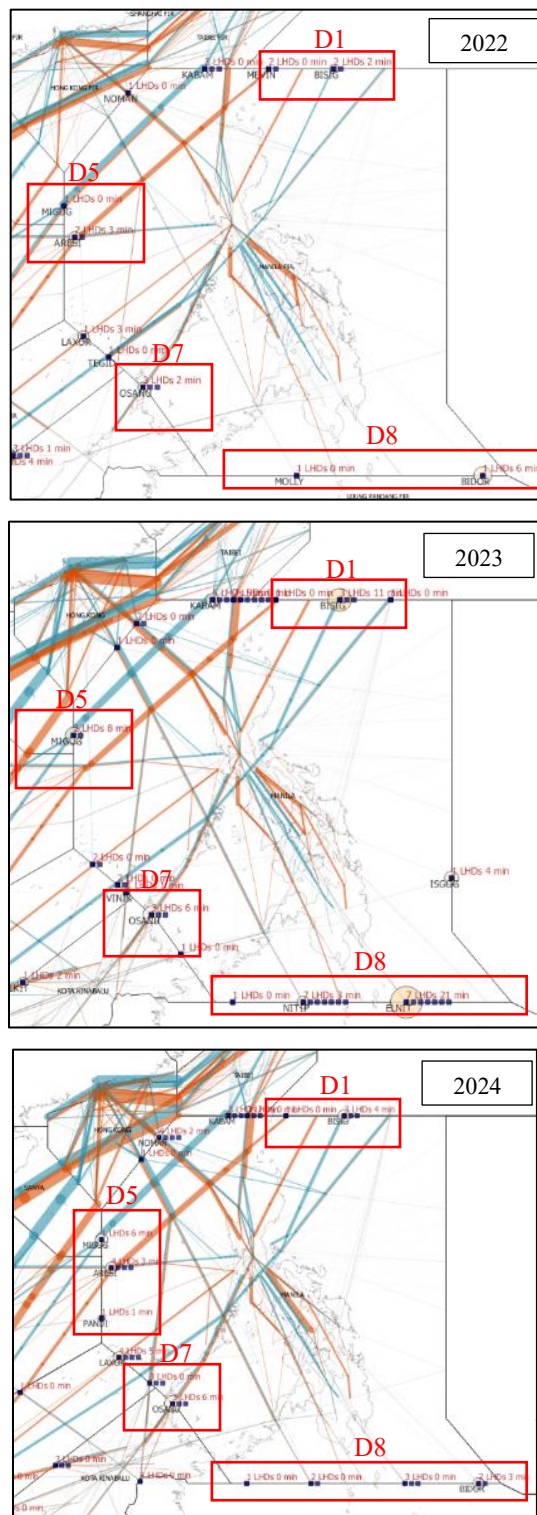


Figure 10: Geographic Locations of LHDs and Operational Risk at Hot Spot D1, D5, D7, and D8 from 2022 to 2024

5.8 **Table 8** summarizes the number of LHDs, non-zero-duration LHDs, and associated operational risk at Hot Spot D1, D5, D7, and D8 from 2022 to 2024.

Area	Number of LHDs			Number of non-zero-duration LHDs			Operational Risk (10 ⁻⁹ FAPFH)		
	2022	2023	2024	2022	2023	2024	2022	2023	2024
Fukuoka/Manila (Hot Spot D1)	4	4	4	3	2	2	0.03	0.19	0.07
Ho Chi Minh/Manila (Hot Spot D5)	3	2	6	2	1	3	0.05	0.10	0.14
Kota Kinabalu/Manila (Hot Spot D7)	3	5	6	2	2	1	0.04	0.13	0.12
Manila/Ujung Pandang (Hot Spot D8)	2	15	8	1	6	2	0.11	0.41	0.06

Table 8: Comparison of the Number of LHDs, Non-Zero-Duration LHDs and Operational Risk at Hot Spot D1, D5, D7, and D8 from 2022 to 2024

LHD Hot Spot D1 (Fukuoka/Manila)

5.9 At Hot Spot D1, the number of LHDs and non-zero-duration LHDs in 2024 remained at the same number to those in 2022 and 2023. Additionally, the operational risk significantly decreased from 0.19 x 10⁻⁹ FAPFH in 2023 to 0.07 x 10⁻⁹ FAPFH in 2024.

5.10 According to the results of the hot spot identification process for the subdivisions of Hot Spot D from 2016 to 2023, as presented in WP/10 to the RASMAG/29 meeting, Hot Spot D1 has not satisfied the hot spot criteria since 2023. However, mitigation measures, such as the implementation of AIDC, had not been completed. As a result, Hot Spot D1 remained on the hot spot list.

5.11 To address cause of LHDs at Hot Spot D1, Fukuoka and Manila ACCs have actively collaborated to investigate the causes and implement mitigations. Consequently, the coordination meetings were held to identify the root causes of transfer errors. As reported in IP/07 to the RASMAG/29 meeting, both ACCs agreed to adjust the timing for sending transfer information from Manila ACC to Fukuoka ACC: from 30 minutes to 20 minutes prior to the estimated time over the FIR boundary. This change reduces complexity by ensuring the transfer is coordinated within a single sector instead of over two sectors. A successful trial of this procedure led to an amendment of the Letter of Agreement (LOA), with full implementation beginning on 13 June 2024.

5.12 Additionally, Fukuoka and Manila ACCs will continue holding the coordination meetings to further enhance airspace safety, prevent transfer errors, and improve operational procedures.

5.13 Considering that Hot Spot D1 has not satisfied the hot spot criteria since 2023 and the mitigation has been successfully implemented, **Hot Spot D1 is proposed as a potential non-hotspot**. If this area does not satisfy the hot spot criteria again in 2025, Hot Spot D1 may be proposed for removal from the list of hot spots.

LHD Hot Spot D5 (Ho Chi Minh/Manila)

5.14 In 2024, the number of LHDs at Hot Spot D5 increased from 2 in 2023 to 6 in 2024. The number of non-zero-duration LHDs and operational risk also increased in 2024. Even though Hot Spot D5 has not satisfied the hot spot criteria since 2022, the mitigation measures, such as the implement of AIDC, have not been initiated. Therefore, **Hot Spot D5 should remain on the list of hot spots.**

LHD Hot Spot D7 (Kota Kinabalu/Manila)

5.15 In 2024, the number of LHDs at Hot Spot D7 slightly increased from 5 in 2023 to 6 in 2024. However, the number of non-zero-duration LHDs and operational risk slightly decreased in 2024. In addition, the Hot Spot D7 has not satisfied the hot spot criteria since 2021. Nevertheless, AIDC implementation is currently in the operational trial phase, with full implementation expected in the fourth quarter of 2025. Thus, **Hot Spot D7 should remain on the list of hot spots.** Once the AIDC implementation is completed together with the decrease in LHDs, this area may be considered a potential non-hotspot in 2026.

LHD Hot Spot D8 (Manila/Ujung Pandang)

5.16 At Hot Spot D8, the number of LHDs, the number of non-zero-duration LHDs and the operation risk significantly decreased from 15 in 2023 to 8 in 2024 as shown in **Table 8**. The number of non-zero-duration LHDs and operational risk also showed the significant decrease. In addition, the Hot Spot D8 has not satisfied the hot spot criteria in 2024 and the AIDC has been successfully operated since 2020 as a mitigation measure. Therefore, **Hot Spot D8 is proposed as a potential non-hotspot.** If this area does not satisfy the hot spot criteria in 2025, Hot Spot D8 may be proposed for removal from the list of hot spots.

LHD Hot Spot J (Jakarta/Singapore)

5.17 Since 2018, the FIR boundary between Jakarta and Singapore has been identified as Hot Spots J. In **Table 9**, the number of LHDs at Hot Spot J dramatically decreased from 27 in 2023 to 11 in 2024. Similarly, the operational risk decreased from 0.33×10^{-9} FAPFH in 2023 to 0.12×10^{-9} FAPFH in 2024.

Area	Number of LHDs			Number of non-zero-duration LHDs			Operational Risk (10^{-9} FAPFH)		
	2022	2023	2024	2022	2023	2024	2022	2023	2024
Jakarta/Singapore (Hot Spot J)	14	27	11	2	5	3	0.18	0.33	0.12

Table 9: Comparison of the number of LHDs, the number of non-zero-duration LHDs and operational risk at Singapore/Jakarta FIR Boundary from 2022 to 2024

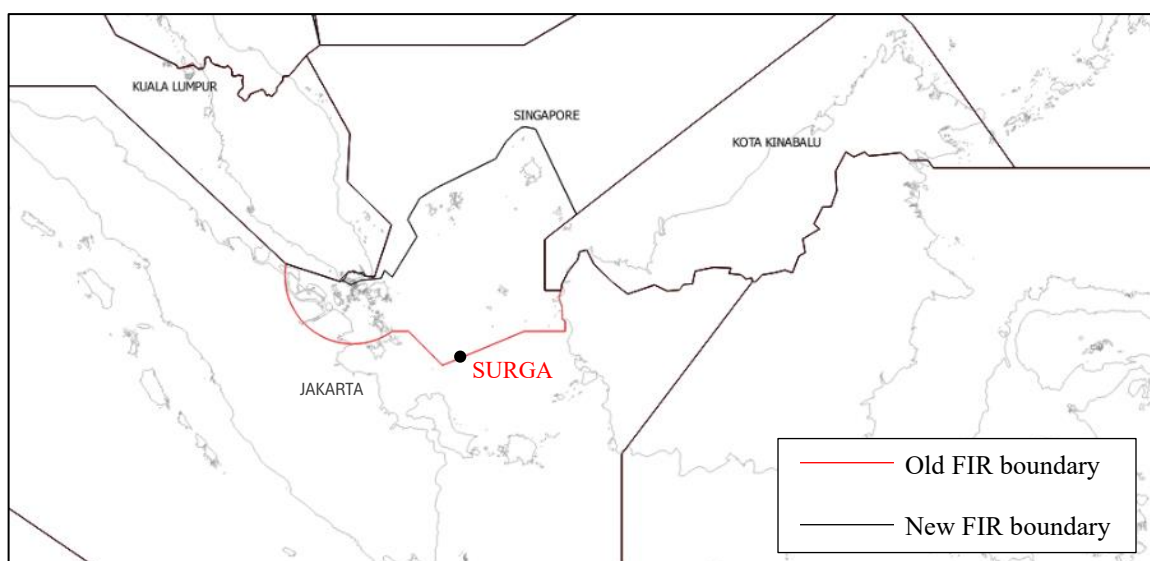


Figure 11: The Realignment of FIR Boundary between Jakarta and Singapore

5.18 After 21 March 2024, the FIR boundary between Jakarta and Singapore has been realigned to improve the traffic flow management as shown in **Figure 11**. Following the realignment, 3 of 11 LHDs occurred at SURGA, which is the former TOC point, as shown in **Figure 11**. To support the transition and maintain safety, operational coordination meetings between Singapore ACC and Jakarta ACC were held in July, October, and December 2024, with further discussions planned for 2025. In addition, the results of the LHD analysis were shared with controllers to enhance safety awareness. These efforts of FIR realignment, ongoing coordination, and increased operational awareness have contributed to the significant reduction in both the number of LHDs and the level of operational risk.

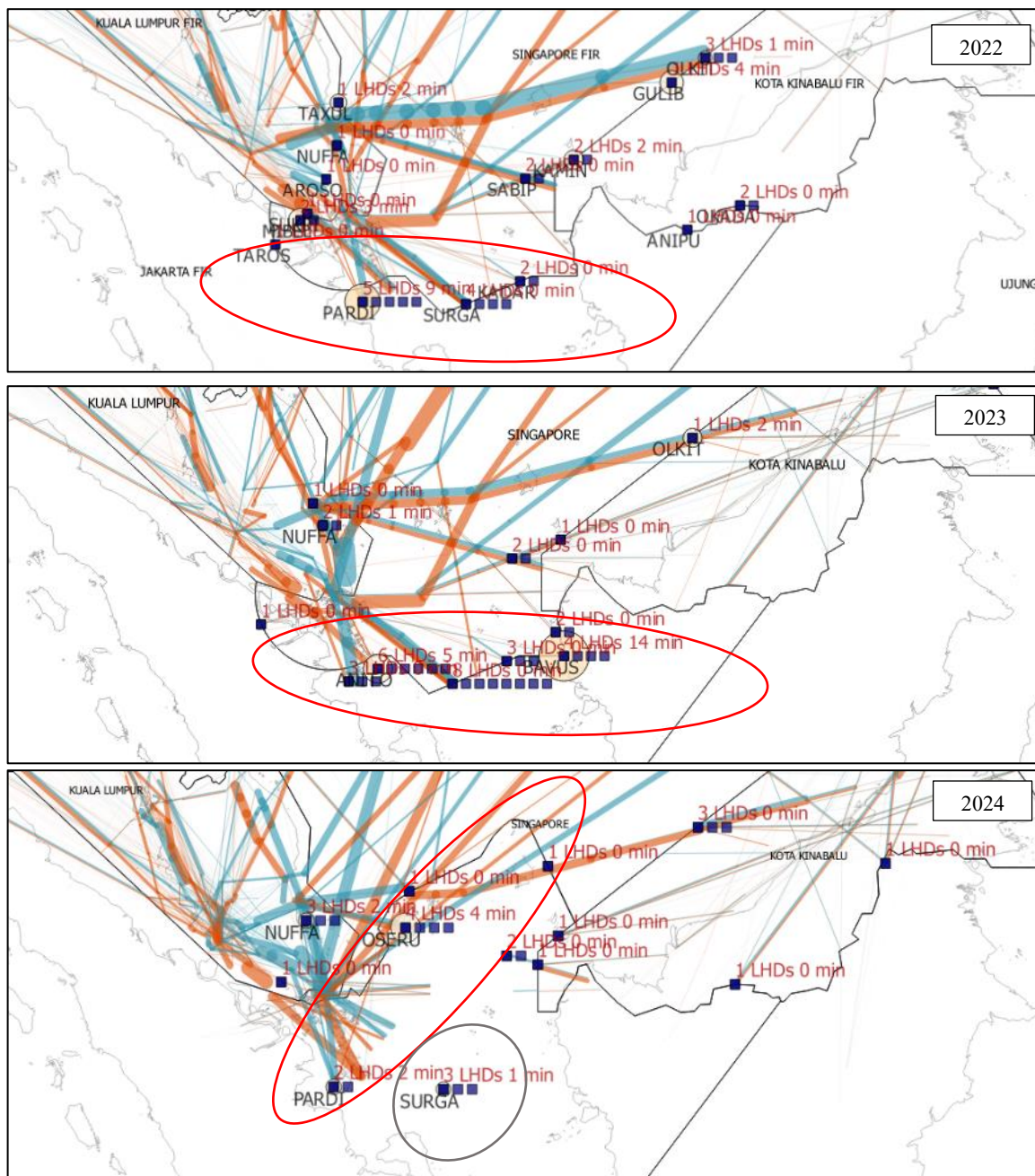


Figure 12: Geographic Location of LHDs and Operation Risk at Singapore/Jakarta FIR Boundary from 2022 to 2024.

5.19 Although this boundary was identified as a cluster during the hot spot identification process, it did not meet the hot spot criteria in 2024. With the improvements in the number of LHDs and operational risk, and successful implementation of mitigation measures, **Hot Spot J is proposed as a potential non-hot spot**. If this area does not satisfy the hot spot criteria again in 2025, Hot Spot J may be proposed for removal from the list of hot spots.

LHD Hot Spot O (Bangkok/Ho Chi Minh/Kuala Lumpur/Singapore)

5.20 This area was identified as Hot Spot O during RASMAG/28 meeting in 2023 due to the operational risk, which met the operational risk criteria in the process of identifying hot spots.

5.21 **Figure 13** demonstrates the area between Bangkok, Ho Chi Minh, Kuala Lumpur and Singapore FIR, which is considered as Hot Spot O. The route M904 between TIDAR and UPRON is in the Singapore FIR but the communication along this portion of route is with Kuala Lumpur ACC. In addition, the route M765 between VENLI and IGARI is delegated to Kuala Lumpur. Furthermore, the transfer of control at TIDAR relies on voice communication, despite the implementation of AIDC between Bangkok ACC and Kuala Lumpur ACC.

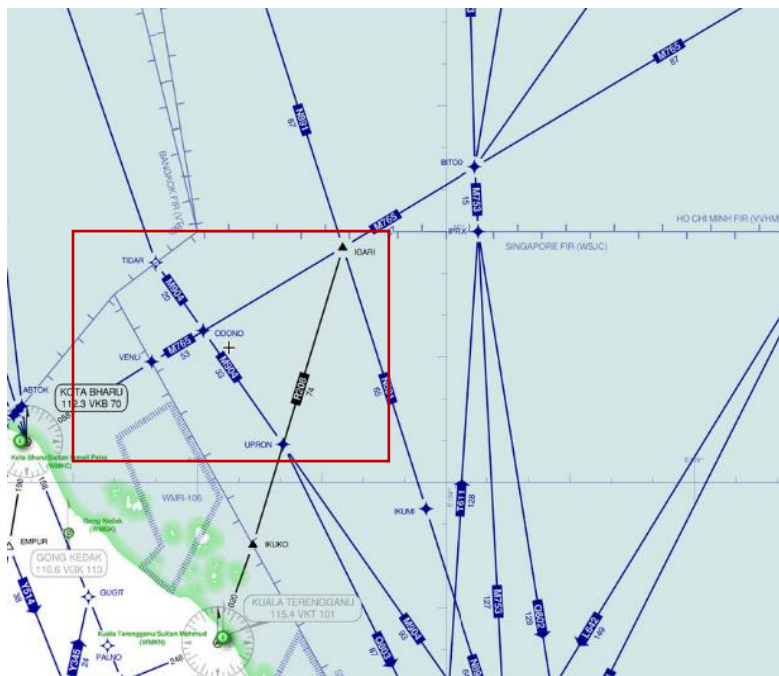


Figure 13: Location of Hot Spot O.

5.22 As shown in **Table 10**, the number of LHDs, non-zero-duration LHDs, as well as operational risk in 2024 decreased from 2023. However, the operational risk at Hot Spot O accounted for 12 % of the total operational risk in SEA airspace.

Area	Number of LHDs			Number of non-zero-duration LHDs			Operational Risk (10 ⁻⁹ FAPFH)		
	2022	2023	2024	2022	2023	2024	2022	2023	2024
Bangkok/Ho Chi Minh/Kuala Lumpur/Singapore (Hot Spot O)	7	5	3	4	3	2	0.58	0.51	0.15

Table 10: Comparison of the Number of LHDs, the Number of Non-Zero-Duration LHDs and Operational Risk at Hot Spot O from 2022 to 2024

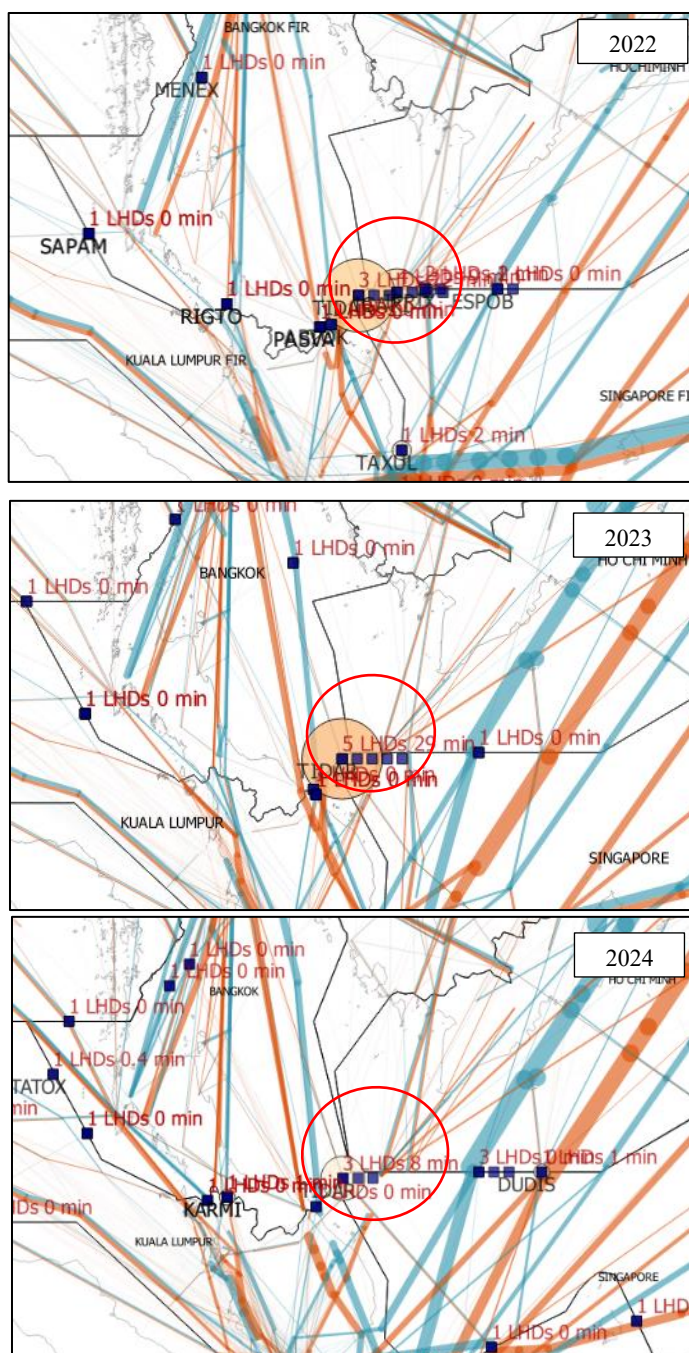


Figure 14: Geographic Location of LHDs and Operation Risk at Hot Spot O from 2022 to 2024.

5.23 Regarding the identifying hot spots process, the LHD cluster of Hot Spot O continue to satisfy the hot spot criteria in terms of the operational risk. No mitigation measure has been initiated. **Hot Spot O should remain on the list of hot spots.**

Appendix A: Details of the Reported LHD Occurrences in the SEA Airspace

Date	Source	Assigned FL	Observed/Reported FL	Minutes at Incorrect FL/No. FL crossed without clearance	Category	Cause
31/1/2024	IDD			0	D	ATC SYSTEM LOOP ERROR
4/1/2024	VDC	FL310	FL306	0.4	B	PILOT MISUNDERSTANDS ATC CLEARANCE
3/1/2024	MHZ	FL400	FL400	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
5/1/2024	MHZ	FL360	FL360	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
7/1/2024	MHZ		FL390	1	E	E-NT: NO TRANSFER OR NEGATIVE TRANSFER
22/1/2024	MHZ	FL360	FL380	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
12/3/2024	VDC	FL340	FL340	0	D	ATC SYSTEM LOOP ERROR
2/3/2024	QLX	FL280	FL280	0	E	E-NT: NO TRANSFER OR NEGATIVE TRANSFER
5/2/2024	MHZ		FL350	5	E	E-NT: NO TRANSFER OR NEGATIVE TRANSFER
21/2/2024	MHZ		FL310	0	E	E-NT: NO TRANSFER OR NEGATIVE TRANSFER
25/2/2024	MHZ	FL380	FL340	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
19/1/2024	IEX		FL340	0	E	E-NT: NO TRANSFER OR NEGATIVE TRANSFER
23/1/2024	IEX		FL380	0	E	E-NT: NO TRANSFER OR NEGATIVE TRANSFER
25/1/2024	IEX	FL350	FL390	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
5/2/2024	IEX		FL350	0	F	E-NT: NO TRANSFER OR NEGATIVE TRANSFER
7/2/2024	IEX	FL340	FL380	2	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
2/4/2024	VDC		FL315	0	E	E-NT: NO TRANSFER OR NEGATIVE TRANSFER
16/4/2024	QLX	FL340		0	E	E-NT: NO TRANSFER OR NEGATIVE TRANSFER

Date	Source	Assigned FL	Observed/Reported FL	Minutes at Incorrect FL/No. FL crossed without clearance	Category	Cause
1/5/2024	QLX			0	E	E-NT: NO TRANSFER OR NEGATIVE TRANSFER
1/5/2024	VDC	FL320	FL340	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
10/5/2024	VDC	FL340	FL340	0	J	TCAS
7/5/2024	VDC	FL360	FL380	1	B	FLIGHT CREW CLIMBING/DESCENDING WITHOUT ATC CLEARANCE
1/5/2024	MHZ		FL330	0	E	E-NT: NO TRANSFER OR NEGATIVE TRANSFER
12/5/2024	QLX		FL330	0	E	E-NT: NO TRANSFER OR NEGATIVE TRANSFER
5/4/2024	IEX	FL360	FL400	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
16/4/2024	IEX		FL340	0	E	E-NT: NO TRANSFER OR NEGATIVE TRANSFER
23/4/2024	IEX	FL370	FL390	1	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
4/6/2024	VDC	FL360	FL364	0	J	TCAS
4/6/2024	MHZ		FL330	0	E	E-NT: NO TRANSFER OR NEGATIVE TRANSFER
14/6/2024	EEZ	FL330	FL330	0	F	E-NT: NO TRANSFER OR NEGATIVE TRANSFER
30/6/2024	VDC	FL340	FL330	0	D	ATC ISSUES INCORRECT CLEARANCE TO PILOT
4/6/2024	IEX	FL360	FL320	1	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
14/6/2024	IEX		FL330	1	F	AIDC
21/6/2024	IEX		FL350	0	F	AIDC
23/7/2024	QLX		FL360	0	E	E-NT: NO TRANSFER OR NEGATIVE TRANSFER
6/7/2024	MHZ	FL310	FL320	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
12/7/2024	MHZ	FL370	FL370	2	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION

Date	Source	Assigned FL	Observed/Reported FL	Minutes at Incorrect FL/No. FL crossed without clearance	Category	Cause
23/8/2024	QLX	FL300	FL340	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
11/8/2024	VDC	FL340	FL335	1	A	FLIGHT CREW FAILING TO CLIMB/DESCEND THE AIRCRAFT AS CLEARED
5/9/2024	VDC		FL310	0	E	E-LT: LATE TRANSFER
19/8/2024	MHZ	FL370	FL330	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
26/8/2024	MHZ	FL340	FL320	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
21/9/2024	VDC	FL290	FL290	0	J	TCAS
12/9/2024	MHZ	FL290	FL310	1	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
12/9/2024	MHZ		FL330	6	E	E-NT: NO TRANSFER OR NEGATIVE TRANSFER
12/7/2024	IEX	FL360	FL400	6	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
25/10/2024	VDC		FL360	0	E	E-NT: NO TRANSFER OR NEGATIVE TRANSFER
23/10/2024	VDC	FL340	FL351	0	J	TCAS
26/10/2024	RCM	FL450	FL430	1	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
28/10/2024	RCM		FL330	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
17/7/2024	IEX	FL340	FL380	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
19/7/2024	IEX	FL340	FL360	3	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
13/8/2024	IEX	FL310	FL390	3	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
18/8/2024	IEX	FL370	FL350	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
30/8/2024	IEX		FL310	0	F	AIDC
3/10/2024	MHZ	FL380	FL340	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION

Date	Source	Assigned FL	Observed/Reported FL	Minutes at Incorrect FL/No. FL crossed without clearance	Category	Cause
5/10/2024	MHZ	FL320	FL360	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
4/10/2024	MHZ		FL310	0	E	E-NT: NO TRANSFER OR NEGATIVE TRANSFER
16/10/2024	MHZ	FL330	FL290	4	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
1/9/2024	IEX	FL340	FL360	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
3/9/2024	IEX	FL340	FL380	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
24/9/2024	IEX	FL350	FL390	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
20/9/2024	IDD	FL350	FL350	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
24/11/2024	QLX	FL310	FL390	6	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
4/11/2024	QLX	FL330	FL370	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
10/11/2024	QLX	FL350	FL370	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
21/11/2024	VDC		FL380	0	E	E-NT: NO TRANSFER OR NEGATIVE TRANSFER
18/11/2024	EEZ	FL290	FL290	0	F	E-NT: NO TRANSFER OR NEGATIVE TRANSFER
19/12/2024	VDC		FL370	0	E	E-NT: NO TRANSFER OR NEGATIVE TRANSFER
22/12/2024	VDC	FL350	FL350	0	J	TCAS
14/12/2024	VDC	FL320	FL320	0	J	TCAS
11/12/2024	VDC	FL370	FL370	0	E	E-NT: NO TRANSFER OR NEGATIVE TRANSFER
2/11/2024	MHZ	FL320	FL340	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
19/11/2024	MHZ	FL310	FL210	2	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION

Date	Source	Assigned FL	Observed/Reported FL	Minutes at Incorrect FL/No. FL crossed without clearance	Category	Cause
16/11/2024	MHZ	FL320	FL360	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
29/11/2024	MHZ		FL370	0	E	E-NT: NO TRANSFER OR NEGATIVE TRANSFER
8/12/2024	MHZ	FL350	FL370	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
11/12/2024	MHZ	FL340	FL340	2	E	E-NT: NO TRANSFER OR NEGATIVE TRANSFER
26/12/2024	MHZ	FL350	FL370	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
27/10/2024	IEX		FL320	1	E	E-NT: NO TRANSFER OR NEGATIVE TRANSFER
27/10/2024	IEX		FL380	0	F	AIDC
24/11/2024	IEX	FL310	FL390	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
30/11/2024	IEX	FL360	FL300	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
4/12/2024	IEX	FL340	FL380	1	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
6/12/2024	IEX		FL380	0	F	AIDC
28/12/2024	IEX	FL320	FL320	1	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
5/11/2024	IDD	FL410	FL430	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
19/11/2024	IDD	FL350	FL360	0	E	E-RI: NO OR LATE REVISION OF TRANSFER INFORMATION
16/12/2024	KFR	FL340	FL350	1	D	ATC ISSUES INCORRECT CLEARANCE TO PILOT

MONITORING AGENCY FOR ASIA REGION (MAAR)



**Airspace Safety Oversight of RVSM Implementation in
Mongolian Airspace**

January 2024 to December 2024

**AIRSPACE SAFETY OVERSIGHT OF THE RVSM IMPLEMENTATION IN
MONGOLIAN AIRSPACE**

Assessment Period: January 2024 to December 2024

Prepared by
Monitoring Agency for Asia Region (MAAR)
(An ICAO APANPIRG approved Regional Monitoring Agency)

1. Introduction

This report presents the results of airspace safety oversight for RVSM operations Mongolian airspace. The assessment is based on one month of Traffic Sample Data (TSD) collected in December 2024 and Large Height Deviation (LHD) reports submitted Mongolia for occurrences between January and December 2024.

2. Data Sources

2.1. Traffic Sample Data (TSD). The TSD collected in December 2024, covering aircraft operations in Mongolian airspace, has been utilized in accordance with ICAO regional agreement.

2.2. Large Height Deviation (LHD). The cumulative 12-month dataset of LHD reports submitted by Mongolia for occurrences in Mongolian airspace between January and December 2024. **Table 1** presents the FIRs that submitted LHD reports, including NIL reports. Notably, Mongolia submitted NIL reports every month throughout 2024, indicating no LHD occurrences in 2024.

FIR/ Month	Ulaanbaatar
January	X
February	X
March	X
April	X
May	X
June	X
July	X
August	X
September	X
October	X
November	X
December	X

Table 1: Summary of LHD Reports Submitted by Mongolia in 2024. An ‘X’ indicates that the LHD or NIL Reports are Submitted Each Month

3. Summary of LHD Occurrences

3.1. **Table 2** and **Table 3** summarize the number of LHDs and the duration (in minutes), the number of levels crossed, and their associated operational risk by month and by category respectively.

Month (2024)	No. of LHD	No. of Non-zero-duration LHD	LHD Duration (Min)	No. of Levels Crossed	Operational Risk (x10 ⁻⁹ FAPFH)
January	0	0	0	0	0
February	0	0	0	0	0
March	0	0	0	0	0
April	0	0	0	0	0
May	0	0	0	0	0
June	0	0	0	0	0
July	0	0	0	0	0
August	0	0	0	0	0
September	0	0	0	0	0
October	0	0	0	0	0
November	0	0	0	0	0
December	0	0	0	0	0
Total	0	0	0	0	0

Table 2: Monthly Summary of LHD in Mongolian Airspace

LHD Category Code	LHD Category Description	No. of LHDs	No. of Non-zero-duration LHDs	LHD Duration (Min)	No. of levels Crossed	Operational Risk (x10 ⁻⁹ FAPFH)
A	Flight crew failing to climb/descend the aircraft as cleared	0	0	0	0	0
B	Flight crew climbing/descending without ATC Clearance	0	0	0	0	0
C	Incorrect flight level provided due to incorrect operation or interpretation of airborne equipment (e.g. incorrect operation of fully functional FMS, incorrect transcription of ATC clearance or re-clearance in FMS, flight plan followed rather than ATC clearance, original clearance followed instead of re-clearance etc.).	0	0	0	0	0
D	ATC system loop error; (e.g. ATC issues incorrect flight level clearance or flight crew misunderstands the flight level clearance message)	0	0	0	0	0
E	Coordination errors in the ATC-to-ATC transfer of control responsibility as a result of human factors issues (e.g. late or non-existent coordination of flight level).	0	0	0	0	0

LHD Category Code	LHD Category Description	No. of LHDs	No. of Non-zero-duration LHDs	LHD Duration (Min)	No. of levels Crossed	Operational Risk (x10⁻⁹ FAPFH)
F	Coordination errors in the ATC-to-ATC transfer of control responsibility as a result of equipment outage or technical issues (e.g. late or non-existent coordination of flight level).	0	0	0	0	0
G	Aircraft contingency event leading to sudden inability to maintain assigned flight level (e.g. pressurization failure, engine failure)	0	0	0	0	0
H	Airborne equipment failure leading to unintentional or undetected change of flight level.	0	0	0	0	0
I	Turbulence or other weather related causes leading to unintentional or undetected change of flight level	0	0	0	0	0
J	TCAS resolution advisory, flight crew correctly climb or descend following the resolution advisory	0	0	0	0	0
K	TCAS resolution advisory, flight crew incorrectly climb or descend following the resolution advisory.	0	0	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	0	0
M	Other	0	0	0	0	0
Total		0	0	0	0	0

Table 3: Summary of LHD by Category in Mongolian Airspace

4. Risk Assessment and Safety Oversight

4.1. **Collision Risk Model (CRM) Parameters.** The value and the source of the parameters in the CRM used to estimate risk in the RVSM airspace are summarized in **Table 4**.

Parameter	Description	Value Bi-Dir	Value Uni-Dir	Unit	Based On
T	Annual flight hours	101,880	1597	Hour	Dec 2024 TSD
$E_z(\text{same})$	Same-direction vertical occupancies	0.36146/ 0.00786	0.00000	-	
$E_z(\text{opposite})$	Opposite-direction vertical occupancies	0.12807	0.08621	-	
λ_x	Average aircraft length	0.03278	0.03111	NM	
λ_y	Average aircraft wingspan	0.02998	0.02910	NM	
λ_z	Average aircraft height	0.00887	0.00858	NM	
λ_h	Diameter of the disk representing the shape of an aircraft in the horizontal plane	0.03278	0.03111	NM	
$P_z(0)$	Probability of vertical overlap (with planned vertical separation equal to zero)	0.538	0.538	-	More conservative value used in previous assessments
$ \overline{\Delta V} $	Average relative along-track speed between aircraft on same direction routes	19.62	0.00	Knot	Dec 2024 TSD NOTE: $ \overline{\Delta V} $ was calculated based on relative speed of proximate pair on each route type. For uni-dir route, there was no proximate pair.
$ \overline{V} $	Average absolute aircraft ground speed	480	480	Knot	More conservative value used in previous assessments

Table 4: Estimates of the Parameters in the CRM for Mongolian Airspace

4.2. **Risk Estimation Results.** The results for technical, operational, and total risk are detailed in **Table 5**. The technical risk is estimated at 0.72×10^{-9} FAPFH, which is below the technical target level of safety (TLS) value of 2.5×10^{-9} FAPFH. Additionally, the operational risk is zero. Thus, the total risk is equal to 0.72×10^{-9} FAPFH, which is also below the specified TLS value of 5.0×10^{-9} FAPFH.

Mongolian Airspace – estimated annual flying hours = 103,477 hours (note: estimated hours based on Dec 2024 traffic sample data)			
Source of Risk	Risk Estimation	TLS	Remarks
<i>RASMAG 29 Total Risk</i>	0.58×10^{-9}	5.0×10^{-9}	<i>Below TLS</i>
Technical Risk	0.72×10^{-9}	2.5×10^{-9}	Below Technical TLS
Operational Risk	0.00×10^{-9}	-	-
Total Risk	0.72×10^{-9}	5.0×10^{-9}	Below TLS

Table 5: Risk Estimates for Mongolian Airspace

5. Analysis of Operational Errors

In 2024, no LHD was reported within or at the boundary of the Mongolian airspace. Hence, the analysis of operational errors cannot be conducted.