



International Civil Aviation Organization

ICAO

**Thirtieth Meeting of the Regional Airspace Safety Monitoring
Advisory Group (RASMAG/30)**

Bangkok, Thailand, 14 – 17 July 2025

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

PARMO HORIZONTAL SAFETY MONITORING REPORT 2024

(Presented by United States/PARMO)

SUMMARY

This paper presents the horizontal safety monitoring report from the Pacific Approvals Registry and Monitoring Organization (PARMO) for the period January to December 2024. This report contains a summary of large longitudinal errors and large lateral deviations received by the PARMO for that period and the related performance monitoring activities for the Anchorage, Auckland, Nadi, Oakland, and Tahiti Flight Information Regions (FIRs).

1. INTRODUCTION

1.1 The Pacific Approvals Registry and Monitoring Organization (PARMO), serves as the En-route Monitoring Agency (EMA) for the Anchorage, Auckland, Nadi, Oakland, and Tahiti Flight Information Regions (FIRs). The report presented in this paper fulfills the ICAO emphasis on safety management systems; such reporting for international airspace is a component of safety management systems.

1.2 This working paper contains the PARMO horizontal safety monitoring report for the period January to December 2024. This paper contains a summary of large lateral deviation (LLD) and large longitudinal error (LLE) reports received by the PARMO during the reporting period.

2. DISCUSSION

2.1 **Attachment A** contains the PARMO Horizontal Safety Monitoring Report for January to December 2024.

Executive Summary

2.2 **Table 1** provides the Pacific airspace horizontal risk estimates. **Figure 1** presents the lateral and longitudinal collision risk estimate trends for Pacific airspace during the period January to December 2024.

Table 1: Pacific Airspace Horizontal Risk Estimates

Pacific Airspace – estimated annual flying hours = 1,933,809.4 hours (note: estimated hours based on Dec 2024 traffic sample data)			
Risk	Risk Estimation	TLS	Remarks
RASMAG 29 Lateral Risk	0.173×10^{-9}	5.0×10^{-9}	Below TLS
RASMAG 29 Longitudinal Risk	0.040×10^{-9}	5.0×10^{-9}	Below TLS
Lateral Risk	1.15×10^{-9}	5.0×10^{-9}	Below TLS
Longitudinal Risk	0.014×10^{-9}	5.0×10^{-9}	Below TLS

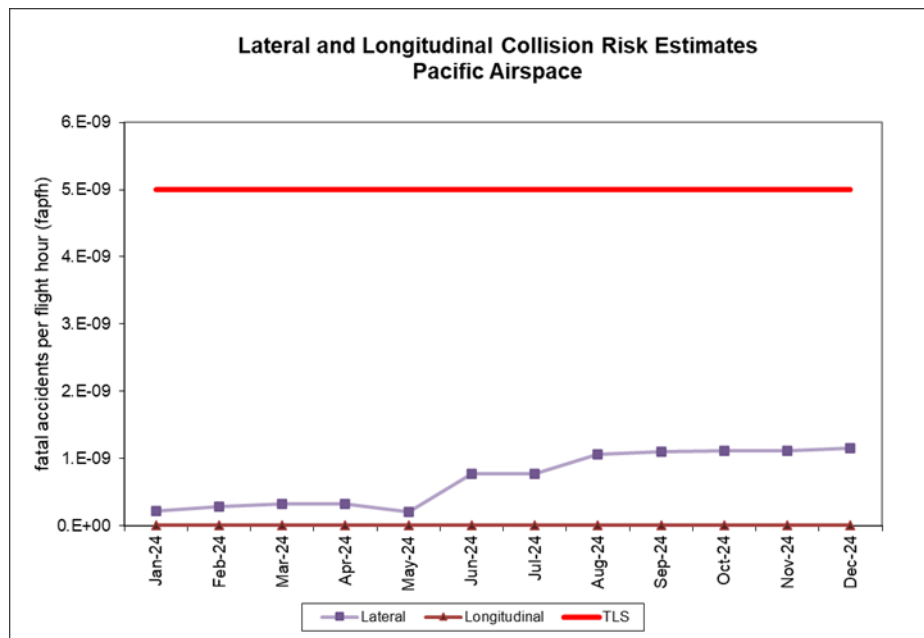


Figure 1: Pacific Airspace Horizontal Risk Estimates

2.3 **Table 2** contains a summary of Large Lateral Deviations (LLD) and Large Longitudinal Errors (LLE) received by PARMO for Pacific airspace.

Table 2: Summary of Pacific Airspace LLD and LLE Reports

Code	Deviation Description	No.
A	Flight crew deviates without ATC Clearance	25
B	Flight crew incorrect operation or interpretation of airborne equipment	4
C	Flight crew waypoint insertion error, due to correct entry of incorrect position or incorrect entry of correct position	4
D	ATC system loop error	4
E	Coordination errors in the ATC-unit-to-ATC-unit transfer of control responsibility due to human factor issues	105
F	Coordination errors in the ATC-unit-to-ATC-unit transfer of control responsibility due to technical issues	1
G	Navigation errors, including equipment failure of which notification was not received by ATC or notified too late for action	0

Code	Deviation Description	No.
H	Turbulence or other weather-related causes	1
I	An aircraft without PBN approval	0
J	Other	0
	Total	144

2.4 In calendar year 2024, the data show a trend in category A LLDs for aircrews deviating in the horizontal dimension without ATC clearance. In 2024, nineteen of the twenty-four reported category A LLDs indicate that weather (category H) was a secondary causal factor. In these cases, the published procedures for weather deviations and other contingencies in oceanic controller airspace were not applied correctly.

2.5 The increasing trend of coordination occurrences between Honolulu Control Facility (HCF) and Oakland ARTCC is observed to continue in calendar year 2024. These occurrences affect multiple traffic flows within Pacific airspace due to the centric geographic location of the HCF. However, the metrics for the central east pacific (CEP) traffic flow are the most significant due to the high traffic density. The related analysis is provided in a separate paper to RASMAG/30 as part of the Hot Spot N analysis.

3. ACTION BY THE MEETING

- 3.1 The meeting is invited to:
- note the information contained in this paper; and
 - discuss any relevant matters as appropriate.

SAFETY REVIEW OF THE APPLICATION OF REDUCED HORIZONTAL SEPARATION MINIMA IN PACIFIC AIRSPACE January to December 2024

Prepared by
Pacific Approvals and Registry Monitoring Organization (PARMO) – July 2025
(An ICAO APANPIRG approved Enroute Monitoring Agency)

1. Introduction

1.1 This report provides a safety review of the application of reduced horizontal separation minima in Pacific airspace. Specifically, this report utilizes data collected for the Anchorage, Auckland, Nadi, Oakland and Tahiti Flight Information Regions (FIRs).

2. Data Sources

2.1 **Traffic Sample Data (TSD).** A TSD covering the month of December 2024 for aircraft operations in the Anchorage, Auckland, Nadi, and Oakland FIRs was used as required by ICAO Regional agreement. **Table 1** indicates all FIRs have submitted a TSD to the PARMO.

Table 1: December 2024 TSD Submitted to PARMO

FIR	December 2024 TSD Submitted to PARMO
Anchorage	X
Auckland	X
Nadi	X
Oakland	X
Tahiti ¹	X

2.2 **Large Lateral Deviations (LLDs) and Large Longitudinal Errors (LLEs).** A cumulative 12-month data set of LLD and LLE reports was used, covering January to December 2024. **Table 2** indicates those FIRs which submitted LLD and LLE reports including nil reports.

Table 2: Summary of LLD and LLE Reports submitted by FIRs

	Anchorage	Auckland	Nadi	Oakland	Tahiti
Jan 2024	X	X	X	X	X
Feb 2024	X	X	X	X	X
Mar 2024	X	X	X	X	X
Apr 2024	X	X	X	X	X
May 2024	X	X	X	X	X
Jun 2024	X	X	X	X	X
Jul 2024	X	X	X	X	X
Aug 2024	X	X	X	X	X
Sep 2024	X	X	X	X	X
Oct 2024	X	X	X	X	X
Nov 2024	X	X	X	X	X

¹ Tahiti provided PARMO with four TSD; March, June, September and December 2024

	Anchorage	Auckland	Nadi	Oakland	Tahiti
Dec 2024	X	X	X	X	X

3. Summary of LLD and LLE Occurrences in Pacific Airspace

3.1 There were 42 LLDs and 102 LLEs reported to the PARMO during calendar year 2024. **Table 3** provides the number of reported LLDs and LLEs by month for all 144 reports.

Table 3: Summary of reported LLDs and LLEs for Pacific airspace – 2024

Month	No. of Reported LLDs and LLEs	Duration (min)	Number of tracks crossed w/o clearance
2024			
January	26	179	1
February	5	89	0
March	3	0	1
April	8	126	0
May	2	5	0
June	13	226	0
July	13	174	0
August	21	488	4
September	16	86	3
October	7	33	1
November	16	92	0
December	14	135	1
Total	144	1633	11

3.2 **Table 4** summarizes the number of reported LLDs and LLEs by category code from January to December 2024 inclusive for Pacific airspace.

3.3 **Table 5** summarizes all reported LLDs and LLEs by month and category. **Figure 1** shows relative proportion of all reported LLDs and LLEs by category code.

Table 4: Summary of reported LLDs and LLEs by category – 2024

Code	Deviation Description	No.
A	Flight crew deviates without ATC Clearance	25
B	Flight crew incorrect operation or interpretation of airborne equipment	4
C	Flight crew waypoint insertion error, due to correct entry of incorrect position or incorrect entry of correct position	4
D	ATC system loop error	4
E	Coordination errors in the ATC-unit-to-ATC-unit transfer of control responsibility due to human factor issues	105

Code	Deviation Description	No.
F	Coordination errors in the ATC-unit-to-ATC-unit transfer of control responsibility due to technical issues	1
G	Navigation errors, including equipment failure of which notification was not received by ATC or notified too late for action	0
H	Turbulence or other weather related causes	1
I	An aircraft without PBN approval	0
J	Other	0
	Total	144

3.4 **Figure 1** graphically shows the same data provided in Table 4, both the table and figure show the top LHD category in terms of count is category E. **Figure 2** provides a chart with the locations of the LLD and LLE reports. This graph also shows the LLD/LLE categories. The size of the plotted circle indicates the count of reported occurrences at that location compared to other plotted on the chart.

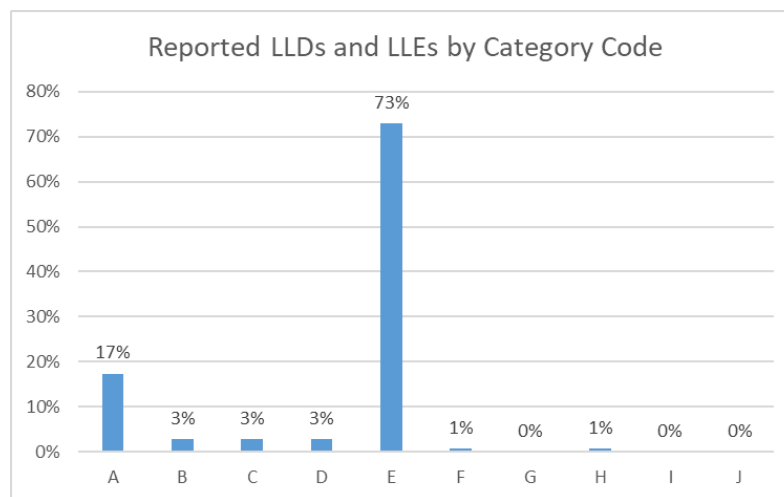


Figure 1: All Reported LLDs and LLEs by Category Code

3.5 Due to the variety of lateral separation standards available in Pacific airspace, it is necessary to examine each reported LLD to determine the eligible lateral separation standard(s) for the aircraft involved. It is not necessary that a lateral separation minimum been applied during the time of the occurrence. To determine eligibility for reduced separations, the filed required navigation performance (RNP), Required Communication Performance (RCP), and Required Surveillance Performance (RSP) specifications are examined. This practice, of analyzing reported LLD and LLE events by eligibility for reduced separation standards is a practice applied for risk estimates in other airspace such as the North Atlantic. This process is unique to horizontal risk estimation where there are a variety of performance-based separation minima available.

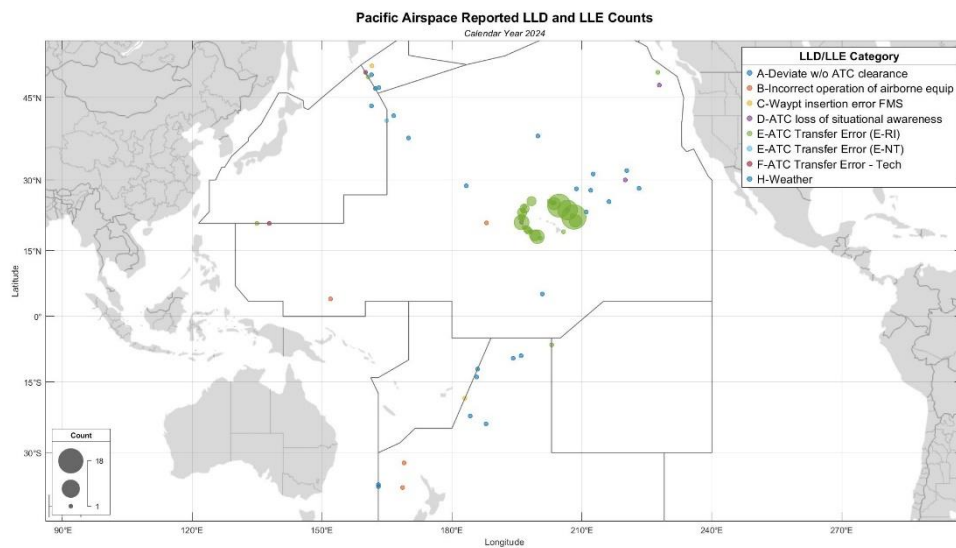


Figure 2: Locations of reported LLDs and LLEs – Calendar Year 2024

3.6 **Table 5** provides the number of reported LLDs and LLEs by month and category code. This table shows that category E is the top contributor to the number of reports. This result is similar to that observed in previous calendar years.

Table 5: Summary of reported LLDs and LLEs

LLD and LLE Category Codes							
	A	B	C	D	E	F	H
Jan-24	5	0	0	0	20	0	1
Feb-24	2	0	0	0	3	0	0
Mar-24	2	0	1	0	0	0	0
Apr-24	0	1	0	0	7	0	0
May-24	2	0	0	0	0	0	0
Jun-24	0	0	0	1	12	0	0
Jul-24	0	0	2	1	10	0	0
Aug-24	5	3	1	1	11	0	0
Sep-24	5	0	0	0	11	0	0
Oct-24	2	0	0	0	5	0	0
Nov-24	1	0	0	0	14	1	0
Dec-24	1	0	0	1	12	0	0
Totals	24	4	4	4	105	1	1

3.7 Trends Observed in Reported Large Lateral Deviations (LLDs)

3.8 **Figures 3 through 5** show the trends in the number of reported LLDs by category for 2018 through 2024. The LLD category descriptions are provided in Table 4. There were 42 reported LLDs for calendar year 2024. This is an increase in the overall number of reported LLDs received by

PARMO compared to calendar year 2023. **Figure 4** shows the trend data in chart format for the categories related to aircrews. **Figure 5** shows the trend data for the categories related to ATC.

3.9 The data in Figure 3 show a trend in category A LLDs for aircrews deviating in the horizontal dimension without ATC clearance. In 2024, nineteen of the twenty-four reported category A LLDs have indicated that weather (category H) was a secondary causal factor. In these cases, the published procedures for weather deviations and other contingencies in oceanic controller airspace were not applied correctly.

3.10 **Figure 6** shows the locations of all reported LLDs by category in Pacific airspace. The size of the circles reflects the relative individual risk estimates calculated at each occurrence location. The calculated lateral risk estimate reflects the duration/magnitude of the deviation as well as the location within the airspace. A higher estimate of lateral risk results from reported occurrences within an area with high traffic density.

3.11 The lateral risk estimate for calendar year 2024 is 1.15×10^{-9} fatal accidents per flight hour (fapfh), an estimate that is below the target level of safety. The largest contribution to the lateral risk estimate was a category E report. This was a long duration, 100 minutes, LLD within the CENPAC traffic flow. This occurrence involved an error in the transfer between adjacent ATC units and a flight plan that had timed out of the automation system. The LLD category assigned to this report was E with a sub-category of J (other). The note for category J is the ATC automation parameter that specifies the time to maintain flight plans in the system. As a result of this occurrence, changes were made to extend the time the ATC automation parameter maintains filed flight plans in the system.

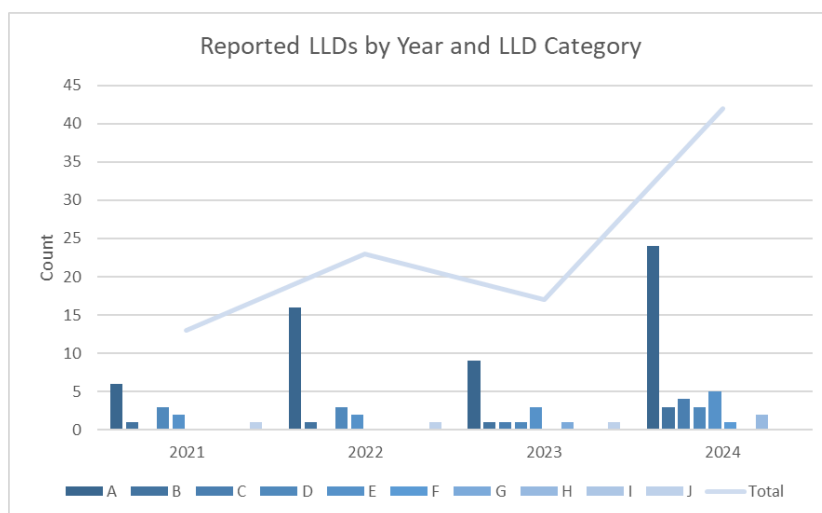


Figure 3: Trend in reported LLDs for all categories

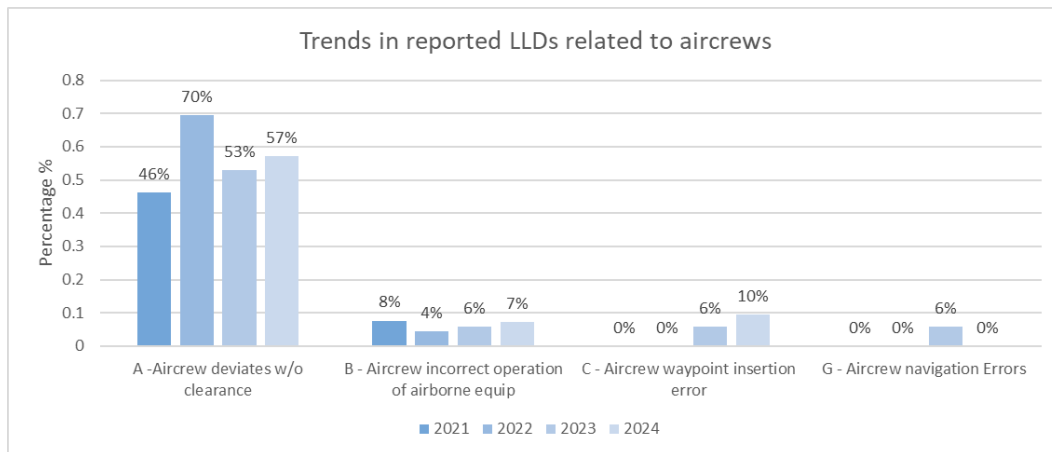


Figure 4: Trend in reported LLDs for categories related to aircrew (counts of LLD reports)

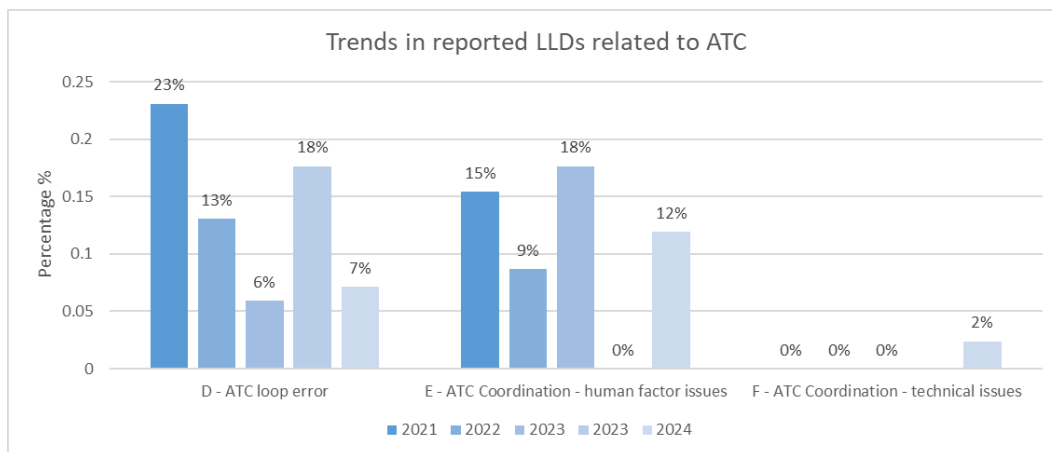


Figure 5: Trend in reported LLDs for categories related to ATC (counts of LLD reports)

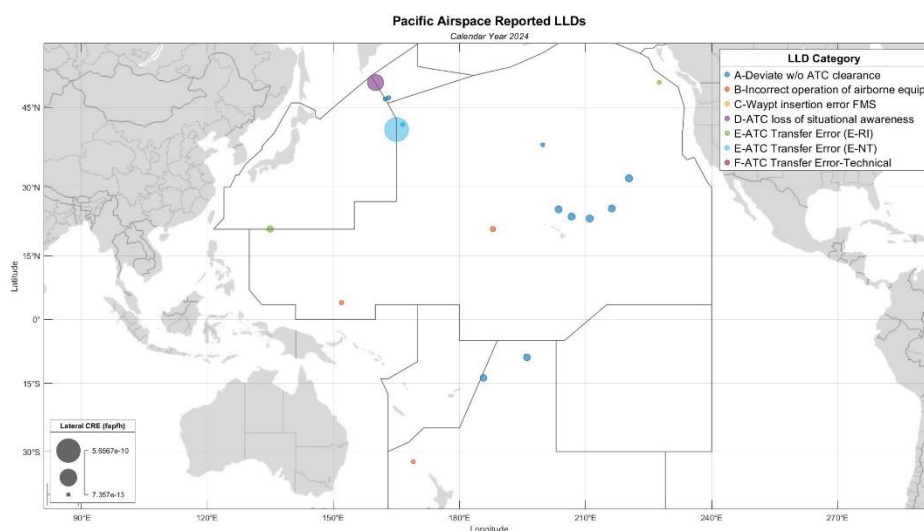


Figure 6: Locations of Reported LLDs – 2024

3.12 Trends Observed in Reported Large Longitudinal Errors (LLEs)

3.13 **Figure 7** shows the trends in the number of reported LLEs by category for calendar years 2020 through 2024. Table 4 provides a description of the categories. The high number of category E reported LLEs are due to reports for transfer errors between Honolulu Control Facility (HCF) and Oakland Oceanic FIR. There were 100 of these reported category E LLEs between HCF and Oakland Oceanic FIR in 2024. **Figure 8** shows the locations for the reported LLEs in 2024.

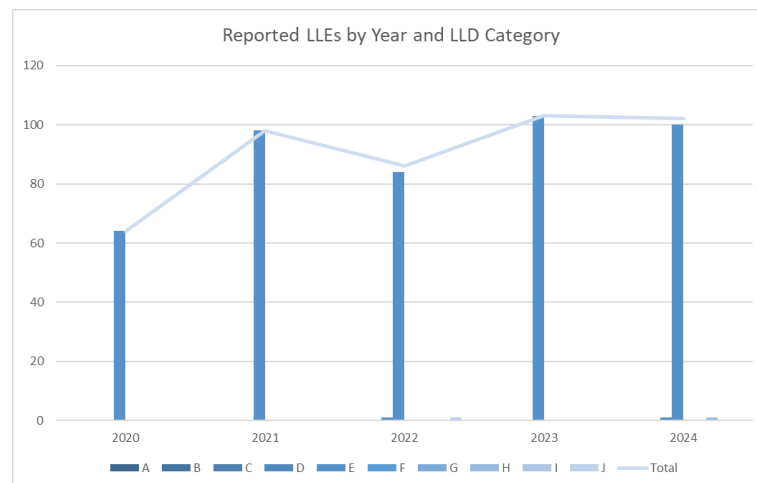


Figure 7. Trends in reported LLEs by category, 2020 through 2024

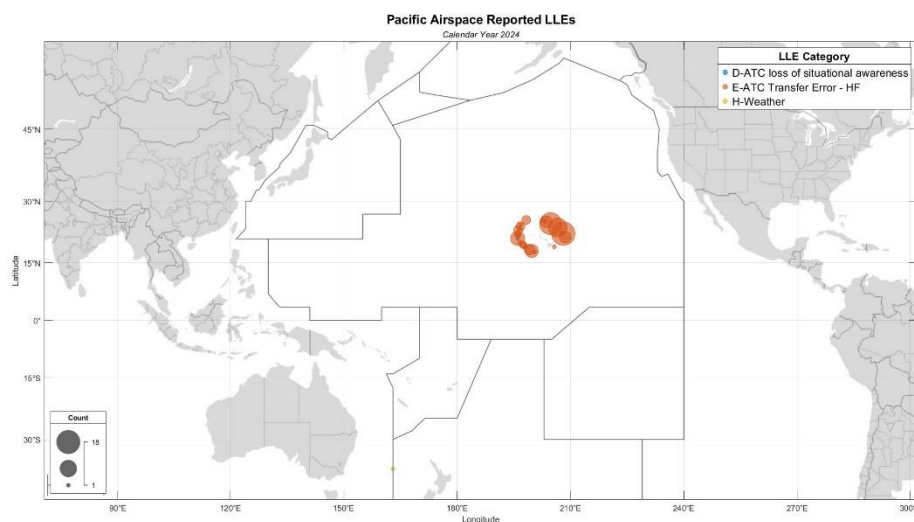


Figure 8: Locations of Reported LLEs – 2024

3.14 The scrutiny review group informed PARMO these LLE occurrences between HCF and Oakland ARTCC affect the User Preferred Routes (UPRs) crossing fixed airways within Oakland Oceanic FIR. These events occur frequently and require significant resources at the ATC facility to investigate underlying causes.

3.15 A task force was established to further investigate these occurrences and determine remedial actions, the task force met at the HCF in 2021. The task force reviewed the current systems and procedures at the HCF. It was determined that the HCF does not have the functionality to update the aircraft profile and transfer the updated information to the next facility. The current automation system includes the Surveillance Data Processing (SDP) Microprocessor En Route Automated Radar Tracking System (Micro-EARTS) and the Offshore Flight Data Processing System (OFDPS). The FAA's offshore modernization plan had been delayed for many years due to higher priorities. The current plan to implement the En Route Automation Modernization (ERAM) system at the HCF is now planned for implementation by 2027. Prior to that time, both facilities have implemented mitigation strategies:

3.15.1 A procedure that requires the controller to determine the remaining travel time to the boundary fix is in use by the HCF. During this procedure, ATC computes an estimated time of arrival (ETA) for the boundary fix and manually transfers the ETA to the next facility. It is noted that this is a manual procedure and is a short-term solution.

3.15.2 Oakland ARTCC has implemented refresher training for the oceanic controllers. This training instructs the controllers on how to update an aircraft's profile/fix times using the coordination window within the ATC automation system. All the reported occurrences of this type were validated by Oakland ARTCC using the radar information or ADS-C position information from the aircraft.

4. Horizontal Risk Assessment and Safety Oversight for Pacific Airspace

4.1 Collision Risk Model (CRM) Parameters

4.2 To calculate a lateral risk estimate for Pacific airspace, each reported large lateral deviation is examined to determine the time spent on an incorrect route and the number of tracks crossed without ATC clearance. This process is similar to that done for reported large height deviations (LHDs) except that the capabilities of the aircraft are considered due to the requirements for the different lateral separation minima. This methodology is used for lateral risk estimates in North Atlantic (NAT) airspace. This methodology provides a lateral risk estimate for the entire airspace rather than lateral risk estimates for specific portions of operations.

4.3 To determine whether time spent on an incorrect route and/or tracks crossed without clearance are appropriate, each reported occurrence is examined. The capabilities of the aircraft determine the appropriate Lateral Infringement Distance (LID). If the occurrence involves a lateral deviation from a cleared route, the magnitude of the deviation is compared to the appropriate LID. Based on the available lateral separation minima in Pacific airspace, the current LIDs are:

4.3.1 15 NM if the aircraft is eligible for a 23-NM lateral separation standard, therefore, is RNP4, RCP240 and RSP180 equipped (23 NM – 4 NM [RNP4] – 4 NM [2 × SLOP to account for opposite direction traffic])

4.3.2 36 NM if the aircraft is RNP10 (50 NM – 10 NM [RNP10] – 4 NM [2 × SLOP to account for opposite direction traffic])

4.4 The same risk-weighting method by traffic flows used in the calculation of the vertical risk is applied in the calculation of lateral risk. The values of the parameters in the CRM used to estimate risk in Pacific RVSM airspace, are summarized in **Table 6**. Other collision risk model parameters

that vary by traffic flow include aircraft size and flying hours. These parameters are shown in **Table 7** by traffic flow.

Table 6: Estimates of the parameters in the horizontal CRM for Pacific airspace

Parameter	Description	Value
$ \overline{\Delta V} $	Average relative same-direction speed	13 Knots
$ \overline{V} $	Average aircraft speed	480 knots
$ \overline{\dot{z}} $	Average relative vertical speed during loss of vertical separation	1.5 knots
$ \overline{y_o} $	Average absolute relative cross track speed for aircraft nominally on the same track.	5 knots
$ \overline{y_{60}} $	Average absolute relative cross track speed when one aircraft has committed a 1° waypoint insertion error.	80 knots
$P_z(0)$	Probability two aircraft at the same nominal level are in vertical overlap	0.42
T	ADS-C periodic report frequency	10 minutes

Table 7: Horizontal CRM Parameters that Vary by Traffic Flow

Traffic Flow	Annual Flying Hours	Percent	$E_y(\text{same})$	$E_y(\text{opp})$	Average Aircraft Length, λ_x (NM)	Average Aircraft Wingspan, λ_y (NM)	Average Aircraft Height, λ_z (NM)
NOPAC	387,123.9	20.0%	0.0424	0.0000	0.0368	0.0343	0.0098
CENPAC	490,374.1	25.4%	0.0424	0.0000	0.0368	0.0348	0.0097
CEP	481,227.3	24.9%	0.0653	0.0626	0.0258	0.0230	0.0074
JPHAWA	52,467.3	2.7%	0.0050	0.0000	0.0327	0.0309	0.0093
JPGUAM	14,221.8	0.7%	0.0050	0.0000	0.0255	0.0226	0.0076
OTHER	16,511.1	0.9%	0.0005	0.0000	0.0305	0.0274	0.0083
AUSNZSP	70,125.8	3.6%	0.0005	0.0000	0.0253	0.0232	0.0075
NADI	26,321.4	1.4%	0.0005	0.0000	0.0313	0.0302	0.0090
AUSNZJP	89,167.2	4.6%	0.0005	0.0000	0.0336	0.0331	0.0092
SOPAC	306,269.5	15.8%	0.0424	0.0000	0.0343	0.0329	0.0093
TOTAL	1,933,809.4	100.0%			0.033 NM	0.031 NM	0.009 NM
					<i>199.2 ft</i>	<i>186.2 ft</i>	<i>52.2 ft</i>

4.5 Risk Estimation Results. The results for the lateral and longitudinal risk for Pacific airspace are detailed in **Table 8**. **The risk estimates meet the specified TLS value of 5.0×10^{-9} fapfh.**

4.6 The estimate of overall lateral risk for 2024 increased from the estimate provided for calendar year 2023 but remains below the TLS.

Table 8: Pacific Airspace Horizontal Risk Estimates

Pacific Airspace – estimated annual flying hours = 1,933,809.4 hours (note: estimated hours based on Dec 2024 traffic sample data)			
Risk	Risk Estimation	TLS	Remarks
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Lateral Risk	1.15×10^{-9}	5.0×10^{-9}	Below TLS
Longitudinal Risk	0.014×10^{-9}	5.0×10^{-9}	Below TLS

4.7 **Figure 9** presents the lateral and longitudinal collision risk estimate trends during the period from January to December 2024.

4.8 The estimate of longitudinal collision risk examines the observed separation between aircraft pairs in terms of distance and time. The observed spacing between aircraft pairs is compared to the distribution of aircraft spacing assumed in the collision risk model. The ICAO Separation and Airspace Safety Panel (SASP) developed the monitoring methodology for reduced longitudinal separation standards for the second edition of the ICAO Doc 10063, *Manual on Monitoring the Application of Performance-based Horizontal Separation Minima*.

4.9 The methodology essentially compares the observed aircraft pair spacings to those assumed in the collision risk model. **Figure 10** shows the direct comparison of the modeled versus observed longitudinal spacing. The red line in Figure 10 represents the modeled aircraft spacing, the blue line represents the observed aircraft spacing. The monitoring methodology provides results that meet the TLS when the blue line is below the red line. **Figure 11** shows the same results as Figure 10, but with a closer view of the most important area of the chart, the area close to the minimum separation distances.

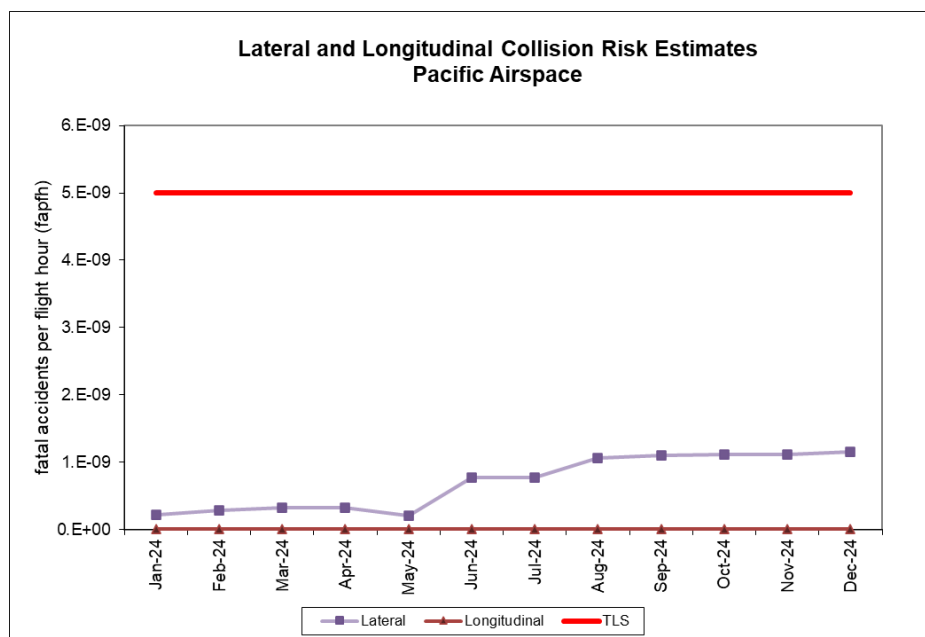


Figure 9: Trends of Horizontal Risk Estimates for Pacific Airspace

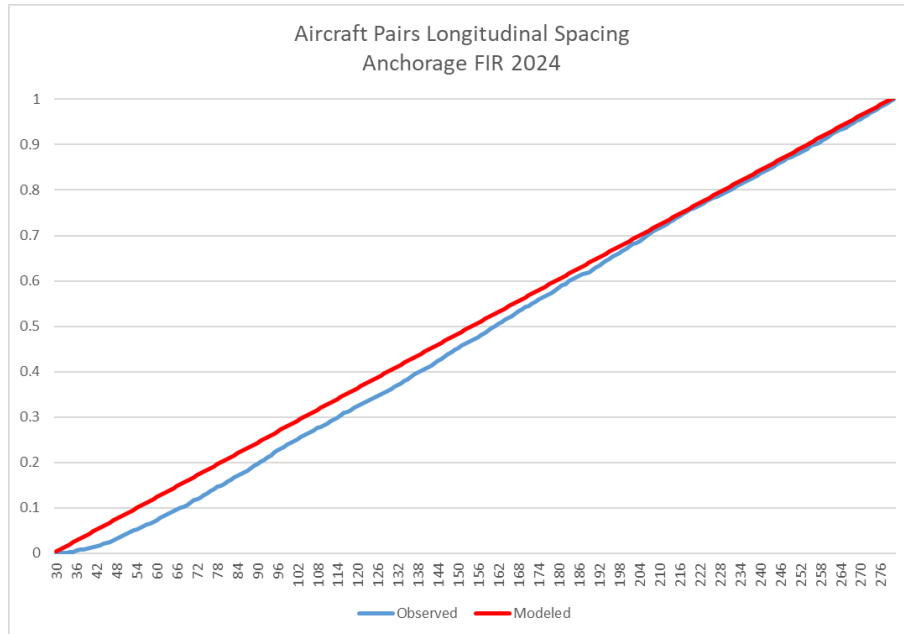


Figure 10: Longitudinal Aircraft Pair Spacing

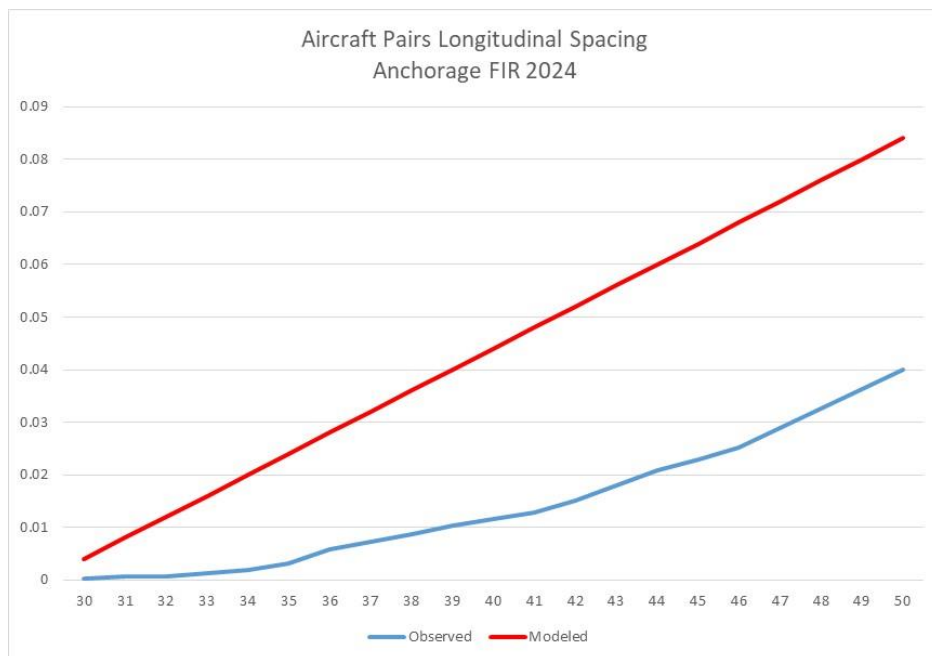


Figure 11: Longitudinal Aircraft Pair Spacing – closely spaced aircraft pairs